

UNIVERZA V LJUBLJANI
BIOTEHNIŠKA FAKULTETA

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**INTEGRALNO VREDNOTENJE VKLJUČITVE SISTEMA HACCP
PRI ZAGOTAVLJANJU VARNIH ŽIVIL**

DOKTORSKA DISERTACIJA

**INTEGRAL EVALUATION OF HACCP SYSTEM FOR FOOD
SAFETY MANAGEMENT**

DOCTORAL DISSERTATION

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Raziskovalno delo je bilo opravljeno na Oddelku za živilstvo, Biotehniške fakultete Univerze v Ljubljani, na Oddelku za sanitarno inženirstvo, Visoke šole za zdravstvo Univerze v Ljubljani, v izbranih živilskih in prehranskih objektih ter med potrošniki.

Na podlagi Statuta Univerze v Ljubljani ter po sklepu Senata Biotehniške fakultete in sklepa Senata Univerze z dne 14.02.2006, je bila sprejeta tema doktorske disertacije na podiplomskem študiju bioloških in biotehnoloških znanosti, s področja živilstva z naslovom Integralno vrednotenje vključitve sistema HACCP pri zagotavljanju varnih živil. Za mentorja je bil imenovan prof. dr. Peter Raspor, za somentorico pa izr. prof. dr. Valentina Hlebec.

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Naloga je rezultat lastnega raziskovalnega dela. Izjavljam, da so vsa vključena znanstvena dela identična objavljeni verziji.

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AI Skrb za zdravje ljudi je eden izmed glavnih ciljev razvitih dežel in je v neposredni povezavi z zagotavljanjem zdravstveno ustreznih živil. Iz dosedanjih raziskav je razbrati dvom o učinkovitosti sistema HACCP (Hazard Analysis and Critical Control Points System), vendar si avtorji niso povsem enotni o vzrokih neučinkovitosti. Z namenom ugotoviti dejansko stanje obvladovanja varnosti živil v živilsko/prehransko/oskrbovalni verigi so uporabljena različna kvantitativna in kvalitativna metodološka orodja (metoda meta-analize, anketne raziskave, metoda opazovanja, strukturirani in nestrukturirani intervjuji, objektivna metoda ocene higienskega stanja). Meta-analiza dokumentacijskih virov o vzrokih ovir pri implementaciji sistema HACCP kaže, da imata največji faktor vpliva na učinkovitost sistema HACCP oviri nezadostno usposabljanje zaposlenih in človeški viri. Na vseh analiziranih stopnjah verige so ugotovljene pomanjkljivosti pri razumevanju in obvladovanju mikrobioloških tveganj. Med elementi, ki vplivajo na učinkovitost sistema HACCP so ugotovljeni dejavniki, ki pomembno vplivajo na vedenje zaposlenih pri delu z živili in so povezani z organizacijsko klimo v podjetju, stopnjo zadovoljstva z delom, delovnimi pogoji ter z medosebnimi odnosi na delovnem mestu. Zaposleni pri delu z živili dela vedno ne izvajajo po zahtevah dobrih praks, kar nakazuje potrebo po reorganizaciji sedanjega načina usposabljanja in opozarja na pomanjkanje usposobljenih in kompetentnih strokovnjakov na obravnavanem področju. Delovno okolje in človeka, ki vstopa v živilsko/prehransko/oskrbovalno verigo je potrebno obravnavati enakovredno kot ostale dejavnike tveganj. Potrošniki so nezadostno informirani o načinih varne priprave hrane doma. Predlagana Dobra prehranska praksa združuje vse sisteme dobrih praks in postavi v enakovreden položaj potrošnika ter jasno opredeli novo dimenzijo tveganj pri zagotavljanju varnih živil, t.i. človeški faktor. Ugotovitve potrjujejo hipotezo: (A) Permanentno medsebojno nesodelovanje aktualnih proizvodnih praks in njihovih akterjev pripelje do nezaupanja, ki se odraža na (ne)učinkovitosti sistema HACCP; (B) Človeški faktor, na organizacijski in izvedbeni ravni je vzrok nedopustnih odstopanj v sistemu HACCP, ki se izrazijo v kritičnih razmerah. Na področju živilstva je potreben učinkovitejši sistem primarnega in vseživljenjskega izobraževanja. V cilju doseči celovito kakovost in varnost življenja je potreben multidisciplinaren in inovativen pristop, ki bo v živilsko/prehransko/oskrbovalni verigi sposoben učinkovitega in hitrega odzivanja na spremembe v okolju. Vključil in poudaril naj bi pomembnost subjektivnega načina dojemanja koncepta zdravja in varnosti, ki gradita kakovost življenja.

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AB Public health care is one of the main goals of developed countries and is directly connected with food assurance policies promoting consumer health and safety. Studies have questioned the efficiency of the Hazard Analysis and Critical Control Points (HACCP) system, but opinions differ concerning the reasons for this inefficiency. The aim of this study was to determine the actual state of food safety management at all stages of the food supply chain. Various quantitative and qualitative methodological tools were used, including meta-analysis, questionnaires, observations, structured and unstructured interviews, and the objective method of hygiene estimation. Meta-analysis of scientific and technical papers investigating barriers to HACCP implementation showed that human resources and insufficient training have the biggest impact on efficiency of the HACCP system. Deficiencies in understanding and the control of microbiological hazards were found at all analyzed stages of the food supply chain. Factors were determined that significantly influenced employee behaviour during food handling and which had an impact on HACCP efficiency. These factors are connected with organizational climate in a company, job satisfaction, working conditions, and relationships between co-workers. Food handlers do not always follow good food-handling practices. This indicates the need to modify current training techniques and highlights the lack of trained and competent experts. The necessity for discussion concerning the work environment and role of the individual in the food supply chain to address potential hazards is presented. Consumers are not sufficiently informed about food safety assurance at home. The proposed Good Nutritional Practice strategy combines all good practice systems, puts a consumer in an equal position and clearly defines a new hazard dimension, the so-called human factor, in food safety assurance. The findings of this study confirm that (A) permanent mutual non-cooperation of current good practices and their participants leads to mistrust, which is reflected by the inefficiency of the HACCP system, and (B) the human factor in organizational and execution levels is the reason for unacceptable deviations from the HACCP system, which appear in critical situations. A more effective system of primary education and lifelong learning of food-related topics is needed. A multi-disciplinary and innovative approach is required that provides quick and effective responses to maintain the safety of foods in the food supply chain. This would involve acknowledging the importance of the subjective comprehension of health and safety concepts, which is a component of well-being.

SEZNAM ZNANSTVENIH DEL

Objavljeni znanstveni članki in sestavek

Raspor P., Jevšnik M. 2008a. Good nutritional practice from producer to consumer. *Critical Reviews in Food Science and Nutrition*, 48: 276-292.

JCR IF (2006): 3.805, SE (1/96), food science & technology

Jevšnik M., Hlebec V., Raspor P. 2006. Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35, 3: 319-353.

JCR IF (2006): 0.253, SE (82/96), food science & technology, x: 1.025, SE (52/55), nutrition & dietetics, x: 2.138

Jevšnik M., Bauer M., Zore A., Raspor P. 2007a. Hygienic status of small and medium sized food enterprises during adoption of HACCP system. *International Journal of Food Science, Technology and Nutrition*, 1, 1: 95-113.

Jevšnik M., Hlebec V., Raspor P. 2008b. Food safety knowledge and practices among food handlers in Slovenia. *Food Control*, doi: 10.1016/j.foodcont.2007.11.010, sprejeto v tisk, on line december 2007.

JCR IF (2006): 1.579, SE (24/96), food science & technology, x: 1.025

Jevšnik M., Hlebec V., Raspor P. 2008c. Consumers' awareness of food safety from shopping to eating. *Food Control*, 19, 8: 737-745.

JCR IF (2006): 1.579, SE (24/96), food science & technology, x: 1.025

Jevšnik M., Hoyer S., Raspor P. 2008d. Food safety knowledge and practice among pregnant and non pregnant women in Slovenia. *Food Control*, 19, 5: 526-534.

JCR IF (2006): 1.579, SE (24/96), food science & technology, x: 1.025

Jevšnik M., Raspor P. 2007b. Tveganja na poti od polja do mize. V: *Varna in zdrava hrana na mizi potrošnika, zbornik z recenzijo. Posvetovanje*, Ljubljana, Visoka šola za zdravstvo, 7. december 2007. Rugelj D. (ur.). Ljubljana, Univerza v Ljubljani, Visoka šola za zdravstvo: 21-34.

Ostalo povezovalno znanstveno delo

Jevšnik M., Strah B., Hlebec V., Raspor P. 2007c. Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers. *Food Control*, v recenziji.

JCR IF (2006): 0.565, SE (63/96), food science & technology

Jevšnik M., Hlebec V., Raspor P. 2008e. Consumer interpretation of the term food safety. *Acta Alimentaria*, oddano po recenziji.

JCR IF (2006): 0.253, SE (82/96), food science & technology, x: 1.025, SE (52/55), nutrition & dietetics, x: 2.138

KAZALO VSEBINE

KLJUČNA DOKUMENTACIJSKA INFORMACIJA	III
KEY WORDS DOCUMENTATION	IV
SEZNAM ZNANSTVENIH DEL	V
KAZALO VSEBINE	VI
KAZALO PREGLEDNIC	VII
1 UVOD	1
1.1 OPREDELITEV RAZISKOVALNEGA PROBLEMA	1
1.2 NAMEN RAZISKAV IN HIPOTEZE	5
2 ZNANSTVENA DELA	6
2.1 OBJAVLJENI ZNANSTVENI ČLANKI IN SESTAVEK	6
2.1.1 Good nutritional practice from producer to consumer	6
2.1.2 Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety	24
2.1.3 Hygienic status of small and medium sized food enterprises during adoption of HACCP system	60
2.1.4 Food safety knowledge and practices among food handlers in Slovenia	80
2.1.5 Consumers' awareness of food safety from shopping to eating	93
2.1.6 Food safety knowledge and practice among pregnant and non-pregnant women in Slovenia	103
2.1.7 Tveganja na poti od polja do mize	113
2.2 OSTALO POVEZOVALNO ZNANSTVENO DELO	128
2.2.1 Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers	128
2.2.2 Consumer interpretation of the term food safety	146
3 POVEZOVALNA RAZPRAVA IN SKLEPI	159
3.1 POVEZOVALNA RAZPRAVA	160
3.1.1 HACCP kot dejavnik sodelovanja v živilski verigi	161
3.1.2 Človek kot dejavnik tveganja v sistemu HACCP	164
3.2 SKLEPI	170
4 POVZETEK (SUMMARY)	171
4.1 POVZETEK	171
4.2 SUMMARY	172
5 VIRI	173
ZAHVALA	

KAZALO PREGLEDNIC

Preglednica 1: Rezultati preverjanja delovne hipoteze: (A) Medsebojno nezaupanje in nesodelovanje vključenih v posamezno stopnjo živilske verige je vzrok neučinkovitosti sistema HACCP ter (B) Do nedopustnega odstopanja v sistemu HACCP pride v kritičnih razmerah zaradi človeškega faktorja in prikaz uporabljenih metodoloških pristopov ter merskih instrumentov v publiciranih znanstvenih delih.

160

1 UVOD

1.1 OPREDELITEV RAZISKOVALNEGA PROBLEMA

Do neolitske ali mlajše kamene dobe so ljudje le malo udomačevali rastline in živali. Poljedelstvo se je razvijalo v raznih časovnih obdobjih in na raznih krajih različno hitro in v raznovrstnih oblikah: od gojenja rastlin do pašništva in mešanega kmetovanja. Človek je bil sprva povsem odvisen od nabiranja sadežev, šele nato je začel sam pridelovati živež. Ta razvoj je potekal polagoma, njegovi dolgoročni učinki pa so pomenili pravo revolucijo. Vse za prehrano pomembne rastline in živali je človek kultiviral že v neolitiku (Krušič, 1983). Pridelana živila je človek izkustveno ohranjal z različnimi postopki konzerviranja, čeprav ni poznal dejavnikov, ki lahko pokvarijo živila. Z industrializacijo in centraliziranjem prebivalstva pa je potreba po pridelavi živil postala in ostala v domeni kmetijstva. S koncentriranjem živil na določenem mestu je rasla tudi potreba po industrijskem načinu dela in razmišljanja (Raspor, 2004a). Vendar je tradicija ostala in je utrla pot številnim novim tehnologijam in dobrim praksam, ki so se razvijale postopoma. V svetu so tradicija in praksa ter številna strokovna in znanstvena spoznanja sooblikovali principe in tehnike, kako doseči v danem okolju sprejemljivo varnost živila. Heterogenost v okoljskih danostih, bogastvo različnih surovin, raznolikost kultur in načinov dela so sooblikovali praktične principe dela, med katerimi so bili nekateri kasneje tudi vključeni v zakonodajo. Sistem HACCP (Hazard Analysis and Critical Control Points System) predstavlja najbolj jasen primer tovrstnega razvoja (Raspor, 2004b). Predhodni sistem kontrole kakovosti je temeljil na ustreznosti končnega izdelka. Nova filozofija varnosti živil pa temelji na ustreznosti tehnološkega procesa, v verigi skozi katero potuje živilo, kar bistveno zmanjša tveganje za zdravstveno neustrezen končni izdelek (Sperber, 2005a). Značilnosti sistema HACCP, kot predpisanega orodja za zagotavljanje varnosti živil, so transparentnost, preventivni mehanizmi nadzora na kritičnih mestih tehnološkega procesa in jasno definirane odgovornosti posameznika v sistemu (Likar in Jevšnik, 2004; Sperber, 2005a).

Potreba po celovitem obvladovanju posamezne stopnje in aktivnosti v proizvodni verigi je proizvajalce vodila k nastajanju dobre proizvodne prakse (DPP). Jasno postavljena načela in uspehi DPP so kmalu postavili osnovo za razvoj številnih dobrih praks (Raspor, 2004a). Dobre prakse oziroma spremljajoči (podporni) programi naraščajo in so specifični za posamezno branžo (Heggum, 2001). Zaskrbljujoče pa je dejstvo, da nekatere živilske panoge ne razumejo koncepta dobrih praks ali še huje, bojijo se, da bi le-te oslabile učinkovitost sistema HACCP (Panisello in Quantick, 2001). Ob tem se poraja vprašanje: »So dobre prakse pomoč ali ovira?« (Wallace in Williams, 2001) oziroma kako vzpostaviti učinkovite temelje za sklenjeno verigo varnosti, ki bo temeljila na obvladovanju dobre prakse v posameznih stopnjah verige in zaupanju med posameznimi členi verige.

Oskrba z varno hrano, ki ne ogroža zdravja potrošnikov preko fizikalnih, kemičnih, bioloških ali drugih vrst onesnaževal, je temelj zdrave prehrane in pomemben dejavnik varovanja zdravja kot javnega interesa. Preprečevanje bolezni povezanih z živilo oziroma hrano in varstvo potrošnikov, vključno z vprašanji prevar in zavajanja, sta dva bistvena elementa programov varnosti živil/hrane (Resolucija, 2005). Zagotavljanje varnih živil

potrošniku je v obdobju globalizacije, spremenjenega načina življenja in prehranjevanja odgovornost in stalna naloga tako razvitih kot nerazvitih držav. Razumevanje pojmovanja varnosti živil se razteza od tehnologije do zakonodaje in od prehrabenika do potrošnika živil (Raspor, 2004a). Prehranjevanje zunaj doma (Soriano in sod., 2002; Walker in sod., 2003) in uporaba (pol)pripravljene ali že pripravljene hrane narašča, kar po Wardovem (1999) mnenju ni posledica njene naraščajoče priljubljenosti med ljudmi, ampak je odziv na posebno konfiguracijo problemov pri časovni organizaciji vsakdanjega življenja (Tivadar, 2003). Zdravstveno ustrezna, varna hrana je temeljna pravica potrošnikov. Odgovornost za varnost živil/hrane si delijo nosilci dejavnosti proizvodnje in prometa živil, država in potrošniki. Krovni dokument, ki v Evropski uniji (EU) ureja področje varnosti živil, je Bela knjiga o varnosti živil iz leta 2000. Razvejana horizontalna in vertikalna zakonodaja s področja varnosti živil predstavlja obsežen del v evropskem pravnem redu. Strateški dokumenti v zvezi s prehransko politiko EU poudarjajo pomen zagotavljanja varne hrane vzdolž celotne živilske verige »od polja do krožnika« po načelu sledljivosti (Resolucija, 2005).

Po ugotovitvah številnih raziskav je zagotavljanje varnih živil najbolj problematično v enotah njene priprave in distribucije, še posebej v malih in srednje velikih podjetjih (Karalis in Gupta, 2001; Walker in Jones, 2002; Walker in sod., 2003; Walczak in Reuter, 2004; Sun in Ockerman, 2005; Jevšnik in sod., 2007). V zadnjem času je vse več raziskav usmerjenih v ugotavljanje učinkovitosti izobraževanja in usposabljanja zaposlenih, ki po ugotovitvah nekaterih avtorjev ne izpolnjuje svojega namena (Ehiri in Morris, 1997; Cotterchio in sod., 1998; Likar in Jevšnik, 2002; Nel in sod., 2004). Lahko je celo vzrok za neučinkovitost sistema HACCP. Pomembne, vendar v živilstvu preveč oddaljene, implicitne predstave ljudi so lahko vzrok zakritim dejavnikom visokega tveganja v proizvodnji in prometu živil (Jevšnik in sod., 2004; Taylor in Taylor, 2004a). Kot je znano, primernost in usposobljenost ljudi, ki sistem HACCP vzpostavijo, tistih, ki z njim upravljajo in tistih, ki ga nadzirajo, vpliva na učinkovitost le-tega v praksi (Khandke in Mayes, 1998; De Winter, 1998; Mortimore, 2001; Azanza in Zamora-Luna, 2005). Za obvladovanje sistema HACCP je potrebna reorganizacija načina usposabljanja zaposlenih pri delu z živilom in poudarek na ugotavljanju implicitnih predstav človeka (Jevšnik in sod., 2004).

Dosedanje raziskave so pokazale, da smo ob hkratnem poudarjanju učinkovitosti sistema HACCP (Ropkins in Beck, 2000; Konecka-Matyjek in sod., 2005), priča številnim medijsko odmevnim aferam o zastrupitvah s hrano doma in drugod po svetu (Walczak in Reuter, 2004; Aycicek in sod., 2004; Sun in Ockerman, 2005; IVZ, 2006). Podatki o zdravstveni ustreznosti živil, zbrani na osnovi rednega programiranega uradnega nadzora nad živilom v javnih ustanovah in na osnovi prijavljenih alimentarnih epidemij kažejo, da kot najpogostejši vzrok zdravstvene neustreznosti živil v Republiki Sloveniji prevladuje mikrobiološka onesnaženost živil, medtem ko prekomerna kemična onesnaženost zaenkrat še ne predstavlja večjega zdravstvenega problema (Resolucija, 2005). V zadnjih desetih letih je bilo v Sloveniji 10.000 do 20.000 primerov črevesnih nalezljivih bolezni letno, kar je primerljivo s pogostnostjo prijav v sosednjih državah (Smole Možina in Hočevar Grom, 2004). V ZDA poročajo, da vsako leto zboli 76 milijonov ljudi (Tauxe, 2002), v Angliji pa 9.4 milijone (Walker in sod., 2003) za boleznimi povzročenimi s hrano. Kolikšen pa je delež neprijavljenih obolenj? Med črevesnimi boleznimi znane etiologije so najpogostejše salmoneloze, kampilobakterioze in rotavirusni enteritisi (Smole Možina in Hočevar Grom,

2004; Sun in Ockerman, 2005). Vrstni red najpogostejših črevesnih nalezljivih bolezni v Sloveniji se je po podatkih IVZ (2006) v letu 2005 nekoliko spremenil. Po pogostosti prijave so bili za gastroenterokolitisi ponavadi salmonelni in kampilobakterski enteritisi, nato rotavirusni oziroma virusni enterokolitisi. V letu 2005 so bili na drugem mestu za gastroenterokolitisi rotavirusni enterokolitisi, nato drugi virusni enterokolitisi in nato salmonelni enteritisi.

Iz poročil o številu prijavljenih zastrupitev s hrano posledično izhaja potreba po iskanju vzrokov za neobvladovanje obstoječega sistema. Vprašanje je, ali je naraščanje bolezni povzročenih s hrano paradoks ali neuspeh sistema HACCP (Motarjemi in Käferstein, 1999)? Vse več je dokazov o njegovi nepravilni interpretaciji (Untermann, 1999), nepreglednosti (Sperber, 2005b) in prehitri vzpostavitvi v podjetjih, brez predhodno vzpostavljenih in delujočih podpornih sistemov dobrih praks, ki so temelj za njegovo učinkovitost. Varnost živil ni sinonim za sistem HACCP (Sperber, 2005a), zato so dileme živilskih strokovnjakov o učinkovitosti le-tega upravičene. Sam sistem brez ustrezne podpore ni »zdravilo« za preprečevanje okužb z živili (Motarjemi in Käferstein, 1999; Mortimore, 2001).

Avtorji z različnimi metodološkimi pristopi raziskujejo možne vzroke, ki ovirajo učinkovito implementacijo sistema v praksi, vendar si niso povsem enotni o vzrokih za njegovo neobvladovanje (Roberts in Sneed, 2003; Ramirez-Vela in Martin-Fernandez, 2003; Taylor in Taylor, 2004a; Taylor in Taylor, 2004b; Henroid in Sneed, 2004; Eves in Dervisi, 2005; Azanza in Zamora-Luna, 2005). Gilling in sod. (2001) so ovire za učinkovito uvedbo sistema analizirali skozi model »HACCP od zavedanja do privrženosti«, katerega so povzeli iz podobnih raziskav na področju medicine. Prvi so opozorili na dejavnike, ki vplivajo na vzorce obnašanja posameznika pri delu z živili. Izpostavili so tri ključne elemente, ki imajo vpliv na učinkovitost sistema HACCP, in sicer znanje, odnos do sistema in vedenje. Navedenim elementom so pripisali ovire, ki so jih ugotovili s pomočjo kvalitativne metodologije. Na podlagi analize intervjujev z zaposlenimi pri delu z živili so opozorili na pomembnost subjektivnih predstav posameznika o sistemu HACCP. Upoštevali so Ajznovo (1991) teorijo planiranega vedenja, ki spada med t.i. odločitvene motivacijske modele in je med bolj uveljavljenimi modeli ugotavljanja dejavnikov, ki vplivajo na motivacijo, so prvi razvili model, ki prikazuje ovire za neučinkovitost sistema HACCP. Azanza in Zamora-Luna (2005) sta preučevali ovire za privrženost smernicam sistema HACCP med člani HACCP timov. Ovire sta predstavili s pomočjo modela, ki združuje kognitivni in behavioristični koncept. Gre za nekoliko modificiran model od prvotno predstavljenega (Gilling in sod., 2001). Dopolnitev modela se kaže z notranjimi in zunanjimi dejavniki, ki kot ovire vplivajo na učinkovitost sistema v praksi. V obeh omenjenih študijah pa avtorji odpirajo možnosti nadaljnega raziskovanja ovir in dopolnitev obstoječih modelov.

Izbira primerne metodološkega pristopa in metodološkega orodja je pomembna za pridobitev relevantnih podatkov, ki nam omogočajo vpogled v problematiko raziskovane tematike. Dobra plat kvantitativnih raziskav je možnost uporabe njihovih izsledkov na širši populaciji, ob ustrezno izbranem vzorcu in načinu vzorčenja. Raziskovanje po načelu metodološke triangulacije se v zadnjem času vedno bolj uveljavlja. Smiselnost kombinacije je bila in je še predmet mnogih razprav tudi v Sloveniji. Doprinos uporabe kvalitativnih metod je v tem, da nam omogočajo poglobljen uvid v doživljanje in

pojmovanje preučevanega pojava. Omogočajo torej vključitev individualnih izkušenj (Domajnko in sod., 2006). Da bi si ustvarili čimbolj celovito sliko o proučevani problematiki, tako z zornega kota statistike kot analize tekstov, je potrebno uporabiti kombinacijo kvantitativnih in kvalitativnih pristopov. Pomembnost vključitve kvalitativnega pristopa preučevanja problematike je predvsem v njegovi sposobnosti prodreti v globino človekovega razumevanja, česar s kvantitativnimi metodami ne moremo zadovoljivo vrednotiti. Uporaba naravoslovne metodologije naj bi vodila k pozitivni, objektivni znanosti o družbi. Ta pristop se imenuje pozitivizem. Objektivnost, veljavnost in zanesljivost so trije osnovni principi pozitivistične metodologije. Kot radikalno nasprotje pozitivizmu se razvije fenomenološki pristop. Predstavniki fenomenološkega pristopa zagovarjajo stališče, da je družba drugačna kakovost, da naravoslovne znanosti raziskujejo materijo, družboslovne pa materijo in zavest. V družbi ni pomenov, ki bi obstajali neodvisno od zavesti. Kvantitativna metodologija se v svojih raziskavah odloča predvsem za zadovoljitev principa zanesljivosti, medtem ko se kvalitativna posveča predvsem principu veljavnosti. Jasno je, da človeške namere, cilji, razlogi, razmisleki, smisli in pomeni, s katerimi identificiramo situacije, ne obstajajo objektivno, tako kot stvari zunaj nas, ampak imajo drugačno dinamiko (Ule, 2000; Denzin in Lincoln, 2003). Zato jih samo s kvantitativnimi orodji ne moremo zadostno in celovito meriti.

Zagovorniki kvalitativnih pristopov poudarjajo, da so pozitivistični pristopi sami po sebi nezadostni za zbiranje, analizo in razlago podatkov ali pa so za vedo, ki se ukvarja s človeškim vedenjem, popolnoma neprimerni. Z vprašalniki, ki so tipično kvantitativno orodje, ne moremo celovito proučevati vrednostnega sistema in stališč (Haralambos in Holborn, 1999). Na področju varnosti živil sta že leta 1985 na to opozorila Foster in Käferstein. Izpostavila sta pomembnost socio-kulturnih raziskav na področju živilstva, ki bi se morale ukvarjati tako s prepričanji zaposlenih in delovnimi navadami zaposlenih pri delu z živili, kakor tudi s prepričanji in načinom dela, ki ni neposredno povezano z živili, pa lahko vseeno vpliva na njihovo varnost. Poudarila sta, da mora raziskovalec pred planiranjem intervencijske strategije, ki naj bi spremenila neustrezne navade, najprej določiti oziroma prepoznati prepričanja in oblike obnašanja zaposlenih, ki pozitivno vplivajo na zagotavljanje varnosti živil in tiste, ki jo lahko ogrožajo (Foster in Käferstein, 1985). Bliskovite socialne spremembe in posledično močna diverzifikacija načina življenja so dejstva, ki soočajo raziskovalce na področju družboslovja in živilstva z novimi konteksti in perspektivami (Flick, 2002). Zatorej je za doseg izboljšav na področju zagotavljanja varnosti živil v živilsko/prehransko/oskrbovalni verigi zelo pomembno upoštevati tudi socio-kulturne dejavnike. Za razliko od stvari imajo ljudje zavest. Vidijo, razlagajo in izkušajo svet glede na pomene. Ljudje se na zunanje dražljaje ne odzivajo avtomatično, temveč pomen dražljaja interpretirajo. Zato je pomembno s kvalitativnimi tehnikami ugotavljati način interpretacije signalov pri posameznih dejavnikih. Bryman (v Haralambos in Holborn, 1999) meni, da ima tako kvalitativno kot kvantitativno raziskovanje svoje prednosti. Nobeno od njiju ne more ustvariti popolnoma veljavnih in popolnoma zanesljivih podatkov, oba načina pa lahko nudita koristne vpoglede v družbeno življenje. Na splošno težijo kvantitativni podatki k ustvarjanju precej statičnih podob, omogočajo pa raziskovalcem, da preučujejo in odkrivajo splošne vzorce in strukture. Kvalitativni podatki so manj uporabni za odkrivanje splošnih vzorcev in struktur, omogočajo pa izdatnejše in globlje razumevanje procesov sprememb v družbenem življenju (Haralambos in Holborn, 1999). Glede na vedno prisotni socialni svet človekovega delovanja in pojasnjevanja sebe in drugih ljudi ima sklicevanje na namere, smotre, razmisleke in pomene svoj specifični, psiho-socialni vzorčni vpliv (Ule, 2000; Denzin in Lincoln, 2003).

Problematika zagotavljanja varnosti živil je obravnavana v številnih delih vzdolž živilsko/prehransko/oskrbovalne verige, vendar parcialno. Slednje odpira raziskovalno vprašanje o celoviti analizi vzrokov za nedoseganje želene stopnje varnosti v posameznih enotah verige z obstoječim konceptom.

1.2 NAMEN RAZISKAV IN HIPOTEZE

Z načrtovano raziskavo želimo pojasniti vzroke neobvladovanja in pretirane samozadostnosti izvajalcev posamezne prakse ter vzroke nezaupanja v obvladovanje varnosti na predhodnih in naslednjih stopnjah obdelave živil. Predvidevamo, da zaposleni pri svojem delu vedno ne upoštevajo pravil dobrih praks in se ne čutijo dovolj odgovorne za končni proizvod, ki ga dobi potrošnik.

Predpostavljamo, da je predpisano orodje za zagotavljanje varnosti živil, t.i. sistem HACCP, primerno, ker je napisano v obliki strategij in ne direktiv. S tem je omogočen individualni pristop izgradnje sistema HACCP v posameznih enotah živilsko/prehransko/oskrbovalne verige. Menimo, da znanje zaposlenih v kritičnih razmerah ne dosega nivoja obvladovanja vseh postopkov pri zagotavljanju varnega živila. Na osnovi omenjenega je postavljena naslednja delovna hipoteza, ki vključuje dva dela:

- (A) Medsebojno nezaupanje in nesodelovanje vključenih v posamezno stopnjo živilske verige je vzrok neučinkovitosti sistema HACCP.
- (B) Do nedopustnega odstopanja v sistemu HACCP pride v kritičnih razmerah zaradi človeškega faktorja.

2 ZNANSTVENA DELA

2.1 OBJAVLJENI ZNANSTVENI ČLANKI IN SESTAVEK

2.1.1 Good nutritional practice from producer to consumer

Dobra prehranska praksa od proizvajalca do potrošnika

Peter Raspor in Mojca Jevšnik

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Danes obvladujemo varnost živil skozi različne dobre prakse na različnih nivojih proizvodnje, transporta in potrošnje. V članku je predstavljena analiza sedanjih dobrih praks, ki vplivajo na varnost živil vzdolž živilsko/prehransko/oskrbovalne verige in dileme potrošnikov glede varnih živil. Z namenom uravnoteženja sistemov za zagotavljanje varnosti živil je kot rezultat obstoječega stanja predlagan nov pristop, imenovan Dobra prehranska praksa (DPP). Prikazana je pomembnost združevanja sedanjih načinov obvladovanja varnosti živil znotraj DPP, ki vključuje potrošnika. Tehnično je DPP predstavljena z modelom, ki jo označi kot krovni sistem s podsistemi, katere tvori devet sedanjih dobrih praks skozi živilsko/prehransko/oskrbovalno verigo. Sedanji način obvladovanja varnosti živil lahko hitro postane neučinkovit zaradi različnih ovir ali preprosto zaradi nesporazumov med vključenimi v verigo, vključno s potrošnikom.

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Good Nutritional Practice from Producer to Consumer

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Today we manage food safety through good practices at different levels of food production, distribution, and consumption. The paper analyses current good practices, parameters involved in the food safety circle along the food supply chain, and consumer dilemmas. As a result of the current situation the new approach called "Good Nutritional Practice" (GNP) is proposed to balance the food safety systems. It is shown how important it is to integrate actual the food safety solutions within GNP, which includes consumers, and is based on a model that covers subsystems from other relevant good practices (nine good practices along the food supply chain). It has been shown that present maintenance of food safety in the food supply chain can be easily broken down, because of the different kinds of barriers or a simple misunderstanding among stakeholders including consumers.

Keywords food safety, good practices, Good Nutrition Practice (GNP), HACCP, consumer

INTRODUCTION

Providing the consumer with safe food is linked with a different life style, food habits, or responsibility especially in the age of globalization and represents a constant task in developed and developing countries. Food safety understanding is a concept, which begins with technologies and goes all the way to the legislation, from the producer to the consumer (Raspor, 2004). Eating outside one's home (Soriano et al., 2002; Walker et al., 2003) and the usage of partly or fully cooked food is increasing. In Warde's (1999) opinion this is not the result of its increasing popularity, but it is a reaction to special configuration of time problems, and how to organize everyday life. People in the United States already spend 40–50% of their money for their nutrition in different eating out places, whereas people in Europe spend around 26%. The traditional understanding of foodstuffs supplying system is constantly changing. The incidence and type of foodborne diseases (FBD) are also changing. Analysis shows an increase of viral infections in comparison with classical bacterial infections (Raspor, 2004).

Suitable to human health, a safe food is a consumer's basic right. Assuring safe food is the most difficult task in preparation and distribution units, especially in small and medium-sized companies (Walker and Jones, 2002; Walker et al., 2003; Walczak and Reuter, 2004; Sun and Ockerman, 2005). It is commonly known that the number of FBD is increasing in both the developed and the developing countries. They represent an important public health problem in the contemporary world. Consumers have become very critical about food safety and food quality due to a number of food affairs, which have received a great deal of media attention. These events have globally resulted in increased government regulatory activities. Federal and international agencies are acting to encourage better public health protection. One of the principal actions has been the development of HACCP (Hazard Analysis and Critical Control Point) based regulations or recommendations by federal agencies and the United Nations Codex Alimentarius Commission (Sperber, 1998). To control and comprehend safety in the European Union (EU) the "White Paper on Food Safety" is an important document that was published in January 2000 (EC, 2000). After that regulation 178/2002/EC and decision 97/579/EC were published, which exactly define "European Food Safety Authority." The use of HACCP principles at all levels of the food chain is however compulsory under the EU Directive 93/43/EEC and Regulation 852/2004/EC (EU, 1993; EU, 2004). It is a responsibility of all included parties in the food chain to ensure food

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traceability and food safety by internal control in all production phases.

These safety assurance systems are based on the production process, the complexity of the product, and human resources. Interestingly enough, it is still unknown as to what extent these systems contribute to the real assurance of food safety. Previous research showed, that emphasizing success of the HACCP system (Ropkins and Beck, 2000; Konecka-Matyjek et al., 2005) to provide safe food, is reflected in several domestic and international affairs about food poisoning (Sun and Ockerman, 2005; Walczak and Reuter, 2004; Ayçiçek et al., 2004). From the reports about food poisoning, we can see the need to search for the cause for this uncontrolled part and other drawbacks of the system. Motarjemi and Käferstein (1999) asked: "Is the number of increasing food poisoning, paradox or failure of HACCP system?" We get more and more evidence about its incorrect interpretation (Untermann, 1999), complexity (Sperber, 2005b), and fast establishing, without preliminary establishing of support systems of good practice that work, and are a groundwork for its reinstatement. Food safety is not a synonym for the HACCP system (Sperber, 2005a), so the dilemma about the effectiveness of the existent system is justified. The system without adequate support is not a guarantee for food poisoning prevention (Motarjemi and Käferstein, 1999; Mortimore, 2001).

Definitions of Safety

The basic definition of safety, connected with our current knowledge about dangerous substances and exposure to them could be: "Security means that we are aware of all the possible risks that are connected with handling dangerous substances. We have to observe and have knowledge about all the mechanisms of exposure. We have to be aware of the safety recommendations and know how to use the safety techniques, which will reduce potential exposure because of the carelessness or negligence at work" (Raspor, 2004). Experts introduced some additional definitions of the term due to events of September 11th.

When we speak about the definition of safety, we could say that safety is a practical probability that injury will not happen, if we are exposed to the risk, under certain conditions. This means that we can potentially avoid injuries. But when we enter deeper into the connection between safety and foodstuffs and we try to use dictionaries, we get into trouble. Worldwide dictionaries distinguish between safety and security. Some interpret safety as an active form of safety and security is the passive form to assure safety. Connected to the foodstuffs, these two concepts have even more specific notation. The term "Food security" is regularly used in humanitarian actions, where we help the underdeveloped and those who need help. This explanation is not completely agreed upon, but usually means that people have the right to a constant food supply, so that hunger and starvation will not occur. This means that supplies will contain quality foodstuffs that are nutritious, safe, and acceptable culturally and ethnically and produced in an environmentally and legally ac-

cepted way (Raspor, 2004). In 1996, countries at the World Food Summit agreed that food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle (FAO, 2000). The term "Food safety" is broader and could be used in different areas such as agriculture, food technologies, and health care. In Codex Alimentarius "Food safety" is defined as an assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (CAC, 2003). According to EU food safety regulation food shall be deemed to be unsafe if it is considered to be injurious to health and unfit for human consumption (EC, 2002).

The correct understanding of safety and food security terms in food safety area needs clear co-ordination and education; not just the consumer but also the producer need to speak the same language when food safety is concerned. This means that we have to consider the regulation, connected scientific and technical principles to assure safety of raw materials, packaging, and other subsidiary materials that are used in a food production and trade. Carelessness, negligence, mistakes, or deliberate actions during work can be fatal for the consumer.

GOOD PRACTICES FROM PRODUCERS TO CONSUMERS

In ancient times when food safety was the sole responsibility of the hunter/gatherer, the chain of responsibility was a very short one. Today, with important changes in lifestyles and demography and with globalization in food trade, we see the food supply growing ever rapidly in size and diversity (Gorris, 2005). To ensure "Farm to Table Food Safety" it was necessary to establish a new concept of understanding the food safety completely (Sperber, 2005b). The HACCP system and its supporting programs (good practices) represent the most intelligent example of this development (Raspor, 2002).

The development of good practices in the last fifteen years enabled the integration of all activities in the food supply chain, specific for each individual branch (Heggum, 2001; Raspor, 2004). Manufacturers started to think about integrity control of the individual stage and activity in the food supply chain. Positive experiences have developed and today we call it Good Manufacturing Practice (GMP). From its first rules and principles in the year 1968, the World Health Organization (WHO) set the course about the meaning of enacting standard procedures dealing with personnel building, equipment, documentation, production, and quality control (Zschaler, 1989). GMP connects all factors that assure quality, safety, and effectiveness of food, according to its specification and purpose. Clearly set principles and success of GMP has soon set the foundation for developing many other good practices along the food supply chain, described in Table 1.

The main purpose of all good practices in the food safety circle is to provide consumers with safe, healthy, and quality

Table 1 Priority, common and other main issues of nine basic good practices in food supply chain

Good practices	Abbreviation	Description of good practices	Priority issues	Common issues	Other main issues
Good Agriculture Practice	GAP	GAP describes how to minimize the risk of pollution of water, air and soil. Broadly defined, a GAP approach applies recommendations and available knowledge to addressing environmental, economic, and social sustainability for on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products (FAO, 2003).	Environment	Communication, Control, Documentation, Education, Human resources, Training	Analyses, Applied chemicals, Food crop, Growth, Harvesting, Hygiene, Livestock, Plants, Rearing, Resources (irrigating water, air, soil, etc.), Sampling, Slaughter
Good Manufacturing Practice	GMP	GMP describes that part of quality assurance which ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use and as required by the marketing authorization (WHO, 1997).	Food processing		Equipment, Foodstuffs, Production, Product, Recall procedures, Regimes (temperature, time, sequence, handling, etc.), Resource management (raw materials, etc.), Supplying system, Working facilities
Good Laboratory Practice	GLP	Principles of GLP have been implemented into regulation under protection of Food and Drug Administration (FDA) 1978 and have direct elements that assure quality, integrity, and reliability of data testing for ensuring safety of tested products from pharmacy, cosmetics, and veterinary, pesticides, food supplements, and industrial chemical preparations (FAO, 1995).	Analyses		Impartiality, integrity, and reliability of data, Measurement uncertainty, Production, Quality, Traceability
Good Hygiene Practice	GHP	GHP connects and merges procedures of sanitary and technical work, so we could call this practice hygiene management. Comprehension of hygiene is in different professions connected with specific details and sub meanings. In principle it is dealing with physical, chemical, biological, geographical, and social factors of environment that affect health and induce diseases. Sanitary point of view is valid for devices and procedures, in short, technical contents. Both factors are closely included in environment that combine global and local environment (Dean, 1985).	Sanitary technical conditions		Cleaning, Disinfection, Environment (internal and external), Planning, Resource management (human, water, air, pest, etc.), Sanitation, Waste management
Good Transport Practice	GTP	Good transport practice (GTP) means settled system in procedures of foodstuffs transfer from producers to consumers (Berg et al., 1994; Raspor, 2004)	Logistics		Equipment, Marking, Monitoring, Recall procedures, Regimes (temperature, time, sequence, handling, etc.), Traceability, Vehicles
Good Storage Practice	GSP	GSP represents quality of management, control and regulation of storage (warehouse) procedures and regimes (temperature, time, handling, etc.) (Bucheli and Taniwaki, 2002).	Microclimatic conditions		Equipment, Marking, Monitoring, Maintenance (calibration, service, etc.), Regimes (temperature, time, FIFO, handling, etc.), Sanitary technical conditions, Traceability
Good Retail Practice	GRP	GRP consist of practical procedures and processes that ensure the right products are delivered to the right addressee within a satisfactory time period and at required conditions.	Supply and sale conditions		Equipment, Hygiene, Labelling, Monitoring, Recall procedures, Regimes (temperature, time, sequence, handling, etc.), Retail, Service, Traceability, Wholesale
Good Catering Practice	GCP	GCP includes procedures of preparation and distribution of meals from a producer to a consumer (Kydd, 2002; Larsen and Berry, 2003).	Foodstuffs		Equipment, Hygiene, Food preparation, Logistic, Marking, Monitoring, Regimes (temperature, time, sequence, handling, etc.), Resource management (raw materials, etc.), Service, Traceability
Good Housekeeping Practice	GKP	GKP represents all hygiene principles and techniques from purchase to home food preparation and consumption of home prepared food.	Family (personal) habits		Consumption, Food preparation, Hygiene, Motivation Media

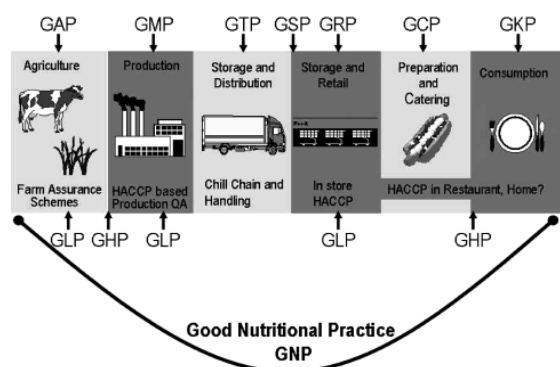


Figure 1 Novel approach of close link-up of all relevant good practices to Good Nutrition Practice (GNP).

food. In all good practices (Table 1) are the HACCP elements that compose the HACCP system as the main system in food practice today. All practices are partial and not connected in the comprehensive system. Good housekeeping practice (GKP) is of the least importance for connecting the food system chain into the food safety circle (Raspor, 2004). GKP is according to a considerable number of FBD occurring in domestic food preparation, still neglected. This paper offers a novel approach of close link-up of all the relevant good practices to Good Nutrition Practice (GNP), which could solve many issues since it involves the last step in the food chain namely the consumer. In classical food chain strategy all relevant activities are taken for the benefit of the human being but locating them outside the system as a consumer (Fig. 1).

Food safety is a result of several factors: legislation should lay down minimum hygiene requirements; official controls should be in place to check food business operators' compliance, and food business operators should establish and operate food safety programs and procedures based on the HACCP principles. Guides to good practice are a valuable instrument to aid food business operators at all levels of the food chain in compliance with food hygiene rules and with the application of the HACCP principles (EU, 2004).

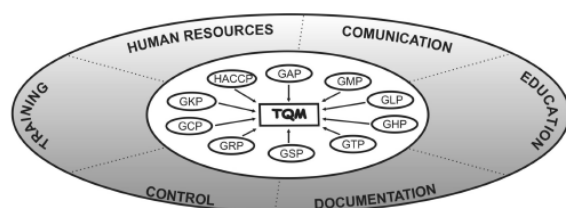


Figure 2 Analysis of factors contributing to food safety (GAP–Good Agriculture Practice; GMP–Good Manufacturing Practice; GLP–Good Laboratory Practice; GHP–Good Hygiene Practice; GTP–Good Transport Practice; GSP–Good Storage Practice; GRP–Good Retail Practice; GCP–Good Catering Practice; GKP–Good Housekeeping Practice; HACCP– Hazard Analysis Critical Control Point; TQM–Total Quality Management).

Some food industries do not understand the concept of good practices or even worse, they are afraid that they will weaken the effectiveness of HACCP system (Panisello and Quantick, 2001). At the same time a question appears: “Pre-requisites: a help or a hindrance to HACCP?” (Wallace and Williams, 2001) or how to restore effective foundations to link the food safety chain into the concluded circle, which will be based on trust between particular units. Raspor (2004) was the first one, who stressed the importance of restoring the system with GNP based on factor analysis contributing to food safety (Fig. 2).

Figure 2 presents a list of all the systems that become subsystems when we set a GNP and give a clear dimension to the control of food safety, required in every subsystem. Control in the sense of safety should get clear dimensions. Subsystems become controllable if we eliminate causes for uncontrollable food safety, described in chapter 3. It is interesting that in all of the practices we do not find GNP that includes all the procedures, important for growth, reproduction, and preparation of foodstuffs or meals for the final consumer. It shows that all mentioned practices are getting close to the consumer aspect, but do not get in touch with him. Although they are set to serve the consumer, they are leaving him outside their circle.

The problem is that all good practices today behave self-sufficiently and they do not understand their specific role in the food safety integrity–holistically insight is missing. Based on the fact that good practices do not appear to be an integral part of the food safety circle we established that it is necessary and urgent to set the GNP, as a way of providing the consumer with safe and quality food. Development of effective traceability systems is a possible solution to solve these problems. We can expect some solutions to these problems in the coming years.

How Effective is Food Safety Assurance?

Ensuring safe food for the consumer in the period of globalization, requires a great deal of responsibility and is a constant task in both the developed and the developing countries. EU countries have harmonized legislation and set control over food production and trade. There is still no shared definition and understanding of food safety globally due to good practices. The point is, that we do not treat food safety as a food safety cycle “from the farm to the table,” because we often focus on it partially (only individual segments of the food chain), and we neglect consumers. Each of us is a consumer, no matter at which stage of the food chain we enter the safety cycle. That is why GNP must be a link in the global vision of safety control, which begins and ends in the concern for the consumer. But a consumer is the one that is not informed enough on ensuring safe food (Reid et al., 1998; Marklinder et al., 2004). Foodborne diseases have emerged as an important and growing public health and economic problem in many countries during the last two decades. Redmond and Griffith (2003) assembled the annual data of foodborne diseases and food related illnesses in some countries. The results showed that 130 million Europeans, 2.1

million to 3.5 million Great Britons from England and Wales, 76 million Americans, and 4.7 million Australians have been affected. A direct comparison of incidence data is not possible because of the differences in the national surveillance systems; however, it has been suggested that Australia, the United Kingdom, and the United States appear to have similar incidences of FBD. Fielding and co-workers (2005) cited that food poisoning outbreaks usually occur from SMEs in the food manufacturing industry, which account for 99% of all food operations in the UK.

Countries with reporting systems have documented significant increases in the incidence of FBD outbreaks during the last two decades (Rocourt et al., 2003). It is estimated that each year FBD cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States (Mead et al., 2000) and 2,366,000 cases, 21,138 hospitalizations, 718 deaths in England and Wales (Rocourt et al., 2003). In the Netherlands there are an estimated 2 million FBD every year, of which 30 to 50% are supposed to find their origin in family homes (Oosterom, 1998). The burden of FBD is probably in the same order of magnitude in most countries (Rocourt et al., 2003) of the Organization for Economic Co-operation and Development (OECD). The cause can be found in a better way of life, better laboratory diagnostic, and an increasing number of infections with new or more virulent types. In the last ten years Slovenia, one of the smallest of the central European countries, registered from 10,000 to 20,000 cases of intestinal infectious diseases per year, which can be compared with the reported number of diseases in other countries (Smole Možina and Hočevar Grom, 2004). Foodborne disease is a public health problem, which comprises a broad group of illnesses (Tucker et al., 2006).

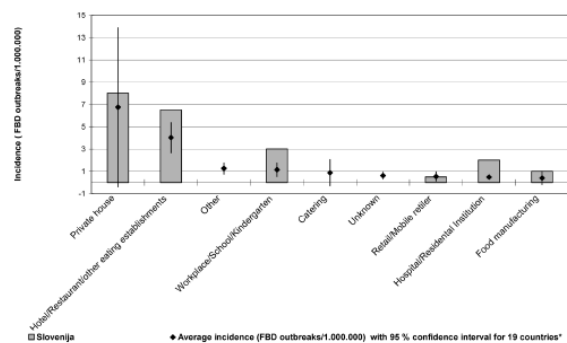
Analyzing various reports regarding annual incidences of diseases caused by foodborne pathogens in some of the European and non-European countries we acquired waste of data which is hard to compare. Some data from the period 1998 to 2003 were calculated from publications like WHO (Rocourt et al., 2003), FoodNet (CDC, 2002) and IVZRS (2005) respectively (Table 2). However, it should be emphasized that these data are based upon different monitoring systems and cannot be directly compared. Some countries distinguish between domestically acquired cases and cases acquired abroad; a large part of the observed variation might be accounted for by different diagnostic methods and differences in the surveillance systems and the ways of reporting.

Many studies focus on common mistakes made during food processing procedures leading to foodborne diseases (Worsfold, 2001). As far back as the Bryan (1988) highlighted review updates information about hazard operations that contributed to FBD in the US and assesses the risk of each factor. He noted that foods prepared in foodservice establishments account for most of the reported outbreaks of foodborne disease. Reflecting food habits and way of life, places where the implicated outbreak vehicle is prepared or eaten, vary between nineteen observed European and non-European countries. The evaluation and classification of a place where food was prepared or

eaten was done on the basis of data reported by the Food Safety Department, WHO (Rocourt et al., 2003) considering the latest year of data between 1998 to 2001 selected for countries with available data and compared with reported number of FBD outbreaks in Slovenia for 2003 (IVZ RS, 2005). The results show (Graph 1) an increase in incidences of family FBD outbreaks. Many other authors reported similar results (Scott, 1996; Sammarco et al., 1997; Johnson et al., 1998; Jones, 1998; Jay et al., 1999; Meer and Misner, 2000). For instance, Marklinder and co-workers (2004) mention the results from 102 households in Sweden, which presents the lack of data of consumer refrigeration temperatures and storage times. Consumers need to know which behaviors are most likely to result in illness in order to make decisions regarding food handling and consumption behaviors (Hillers et al., 2003).

Many authors agree that the weakest link is definitely incorrectness in the preparation of food in small and medium size food businesses (Ayçiçek et al., 2004; Baş et al., 2005; Bermúdez-Millán et al., 2004; Walczak and Reuter, 2004; Walker and Jones, 2002; Walket et al., 2003; Worsfold, 2001). The situation in Slovenia regarding consumers as well as food workers' knowledge of food preparation in comparison with available data of some EU and other countries is obviously worse (Graph 1).

Contributory factors associated with the foodservice establishment relate to time and temperature situations and, hence, their prevention and control are vital to food safety (e.g. cool/chill, cook/freeze). The question is: Does industry validate elements of HACCP plans at all?" (Scott, 2005). Problem arises because a lot of people do not differentiate between validation and verification. The International Organization for Standardization (ISO, 2005) gives us a clear definition of the term validation which means "Obtaining evidence that the control measures managed by the HACCP plan and by the operational PRPs are capable of being effective and verification, defined as



Graph 1 Comparison of the average incidence (FBD outbreaks/1.000.000) in 14 EU and 5 other countries with incidence (FBD outbreaks/1.000.000) in Slovenia regarding place of outbreak. Legend: * EU Countries (Denmark, Finland, France, Germany, Hungary, Ireland, The Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden, United Kingdom, Slovenia) and non - EU Countries (Iceland, Japan, New Zealand, Switzerland, United States).

Table 2 Annual incidence report by foodborne pathogens in some of the European and non-European countries from the period 1998 to 2003

Countries	Year ¹	Annual incidence ² /Bacterial agents		
Non-European countries				
Canada	1999	37.7	18.4	4.9
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>E. coli</i> VTEC
United States	2002	16.2	13.3	10.8
		<i>Salmonella</i> , non typhoidal	<i>Campylobacter</i> spp.	<i>Shigella</i> spp.
Japan	2001	3.9	2.4	1.8
		<i>Salmonella</i> , non typhoidal	<i>Vibrio</i> (excluding <i>cholerae</i> and <i>vulnificus</i>)	<i>E. coli</i> Non-VTEC
Australia	2000	107.1	32.1	3.8
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.
New Zealand	2001	271.5	64.7	45.8
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Staphylococcus aureus</i>
European countries				
Austria	1998	89.3	30.3	2.1
		<i>Salmonella</i> , non typhoida	<i>Campylobacter</i> spp.	<i>Shigella</i> spp.
Belgium	2000	137.0	73.0	5.0
		<i>Salmonella</i> , non typhoidal	<i>Campylobacter</i> spp.	<i>Yersinia enterocolitica</i>
Czech Republic	1998	476.2	4.9	1.2
		<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.	<i>E. coli</i> VTEC
Denmark	2001	86.4	54.5	5.3
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Yersinia enterocolitica</i>
Finland		76.4	52.6	14.0
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Yersinia enterocolitica</i>
France	1998/1999	23.1	1.6	0.9
		<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.	<i>E. coli</i> VTEC
Germany	1998	118.6	2.0	0.1
		<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.	0.1 <i>Campylobacter</i> spp. 0.1 <i>Staphylococcus aureus</i>
Greece	1998	8.8	4.2	1.3
		<i>Salmonella</i> , non typhoidal	<i>Brucella</i> spp.	<i>Campylobacter</i> spp.
Hungary	1998	179.3	6.4	2.0
		<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.	<i>Campylobacter</i> spp.
Iceland	2001	79.9	58.0	4.9
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Clostridium perfringens</i>
Ireland	2000	57.5	17.6	2.0
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.
Italy	1998	25.1	2.6	0.1
		<i>Salmonella</i> , non typhoidal	<i>Brucella</i> spp.	0.1 <i>Clostridium botulinum</i> 0.1 <i>Listeria monocytogenes</i>
Luxembourg	1998	12.6		
		<i>Salmonella</i> Typhi and <i>Salmonella</i> , non typhoida		
Netherlands	2001	30.6	0.3	0.1
		<i>Salmonella</i> , non typhoidal	<i>E. coli</i> VTEC	<i>Salmonella</i> Typhi
Norway	2001	64.2	42.0	4.2
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Shigella</i> spp.
Poland	1998	69.0	1.0	0.2
		<i>Salmonella</i> , non typhoidal	<i>Staphylococcus aureus</i>	<i>Clostridium botulinum</i>
Portugal	1998	7.9	6.2	0.2
		<i>Brucella</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Clostridium botulinum</i>
Slovak Republik	1998	398.3	26.1	19.9
		<i>Salmonella</i> , non typhoidal	<i>Campylobacter</i> spp.	<i>Shigella</i> spp.
Spain	1998	16.8	11.1	3.9
		<i>Salmonella</i> , non typhoidal	<i>Campylobacter</i> spp.	<i>Brucella</i> spp.
Slovenia	2003	33.5	14.4	4.6
		<i>Salmonella</i> Enteritidis	Unknown source	<i>Staphylococcus aureus</i>
Sweden	2001	96.3	52.9	6.5
		<i>Campylobacter</i> spp.	<i>Salmonella</i> , non typhoidal	<i>Yersinia enterocolitica</i>
Switzerland	1998	76.5	42.1	7.0
		<i>Campylobacter</i> spp.	<i>Salmonella</i> Typhi and <i>Salmonella</i> , non typhoida	<i>Shigella</i> spp.

(Continue on next page)

Table 2 Annual incidence report by foodborne pathogens in some of the European and non-European countries from the period 1998 to 2003

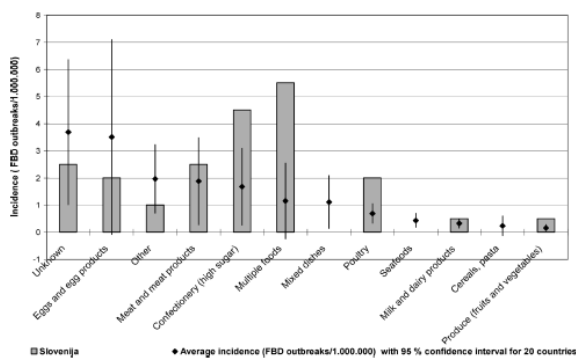
Countries	Year ¹	Annual incidence ² /Bacterial agents		
Turkey	1998	48.1	19.6	2.3
		<i>Salmonella Typhi</i>	<i>Brucella</i> spp.	<i>Shigella</i> spp.
United Kingdom	2000	95.0	25.2	1.6
		<i>Campylobacter</i> spp.	<i>Salmonella Typhi</i> and <i>Salmonella, non typhoida</i>	<i>Shigella</i> spp.

¹Latest available year of data from the period 1998 to 2003 selected for each country.

²Incidence rate per 100,000.

“Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled” (ISO, 2005). Validation is the element of verification focused on collecting and evaluating scientific and technical information to determine whether the HACCP plan, when properly implemented, will effectively control the hazards.

The source of FBD outbreaks is unknown in most of the reported cases. Foods most frequently involved in outbreaks are eggs and egg products, meat and meat products, and confectionery products, with the likely implication of these foods being associated with *Salmonella* and *Campylobacter*. According to the latest available data in Slovenia, home prepared foods, mostly confectionery products containing insufficient thermically treated egg cream (tiramisu, etc.) and products containing mayonnaise, are the main source of foodborne illnesses. Evaluation and classification of food groups was done on the basis of data reported by the Food Safety Department, WHO (Rocourt et al., 2003) considering the latest year of data between 1998 to 2001 selected for countries with available data and compared with the reported number of FBD outbreaks in Slovenia for 2003 (IVZ RS, 2005). Graph 2 shows results of the average incidence (FBD outbreaks/1.000.000) in 14 European and 6 other countries ($P < 0,05$) regarding the type of food.



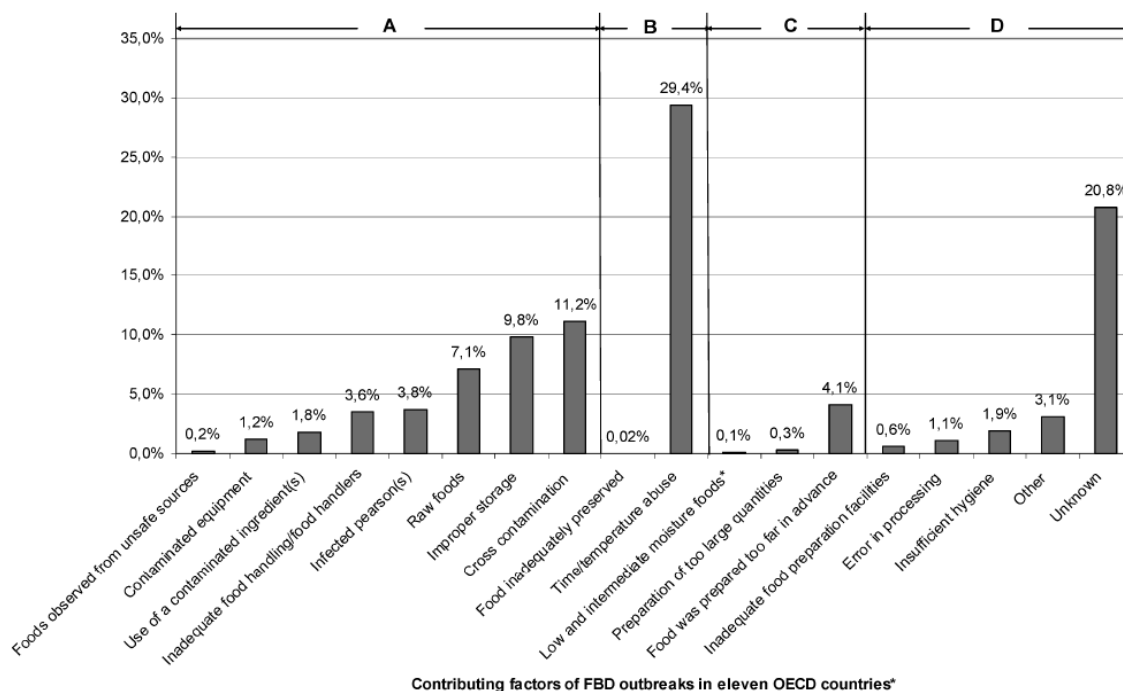
Graph 2 Comparison the average incidence (FBD outbreaks / 1.000.000) in 14 EU and 6 other countries with incidence (FBD outbreaks/1.000.000) in Slovenia regarding type of foods involved in outbreak. Legend: * EU countries (Czech Republic, France, Germany, Hungary, Ireland, Italy, The Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden, United Kingdom, Slovenia) and other countries (Iceland, Japan, New Zealand, Norway, Switzerland, United States).

FOOD SAFETY PARAMETERS

End-product testing alone is unable to assure safe food production and hence the HACCP approach has been adopted for the elimination or reduction of the identified hazard(s) to an acceptable level. HACCP is a systematic approach in identifying the hazards at any stage of the food chain, assessing the related risks, and determining the areas where control is needed. Monitoring and verification procedures form an integral part of the system in the maintenance of safe food. Prior to effectively implementing HACCP, food business should already have in place various practices including ingredient and product specifications, staff training, cleaning, and disinfectant regimes, hygienically designed facilities, and be engaged in GHP. These may be termed collectively as prerequisite programs (PRP) (Walker et al., 2003).

The most common causes of hazards along the food supply chain are connected with some biological, chemical, or physical parameters which have to be managed. From the available data reported by Food Safety Department, WHO (Rocourt et al., 2003) time/temperature abuse appears to be the most frequent contributing factor in eleven OECD countries. Factors involved in foodborne diseases represent four main groups (A, B, C, D) of contributing parameters, related to contamination (e.g. cross contamination, improper storage), to the survival of microorganisms (e.g. time/temperature abuse), to those related to microbial growth that can contribute to outbreaks (e.g. food prepared too far in advance), and other parameters, mostly unknown sources (Graph 3).

We could not neglect the contamination of foods, which may occur through environmental pollution of the air, water, soil, such as the case with toxic metals, polychlorinated biphenyls (PCBs), and dioxins. Other chemical hazards, such as naturally occurring toxicants, may arise at various points during food production, harvest, processing, and preparation. The contamination of food by chemical hazards is generally well-controlled in the OECD countries. The safe use of various chemicals such as food additives, pesticides, veterinary drugs, and other agrochemicals is also largely assured in OECD countries by proper regulation, enforcement, and monitoring. However, sporadic problems with chemical hazards continue to occur pointing to the need for constant vigilance. These topics were discussed in several works since they permit several comparisons and analysis (ICMSF, 1996; Garbutt, 1997; Hoomstra, 2001; Rocourt et al., 2003; Raspor, 2004).



Graph 3 Evaluation of FBD outbreaks showed eight parameters connected to contamination (A), two parameters with survival of microbes (B), three parameters with microbial growth (C) and five others (D) which represent 38.6%, 29.4%, 4.5% and 27.5%. Legend: * Denmark, Finland, France, Hungary, Iceland, Ireland, New Zealand, Slovak Republic, Spain, Sweden, United Kingdom.

Important Factors Influencing Food Safety

Food safety issues are triggered by various hazards, including microbiological hazards (*E. coli*, *Campylobacter*, *Salmonella*, *Listeria*, etc.), nutritional hazards (fat consumption, obesity levels), environmental hazards (pesticides, heavy metals, nitrates, etc.), natural hazards (chemicals naturally occurring in foods (ingredients); and food composition hazards (Barendsz, 1998).

Microbiological contamination is often perceived to be the main threat to human health from food. However, sometimes chemical residues are perceived to be the main health risk, especially when long-term effects are considered. When compared in terms of the producer's risk it must be realized that microbiological contamination (and physical contaminants) can be effectively controlled by many food processing operations. However, it is hardly possible to formulate an effective control system for chemical contamination (Barendsz, 1998) in particular when naturally or process added, degraded, and transformed compounds in food matrices are in question.

Analyzing foodstuffs with food safety in mind calls for segmentation according to its influence as follows:

Structure of Foodstuffs and their Physical, Chemical, and Structural Properties

The development of microorganisms is the most frequent in foodstuffs that contain lots of low-molecular substances (e.g. simple monosaccharide sugar), which are easily degraded and used for the further growth of microorganisms. Physical characteristics of foodstuffs that have proven to be especially important when analyzing the development of microorganisms include a_w value of foodstuffs, pH value, content, and proportion of organic acids, the presence of preservatives and their consistency. Foodstuffs can also contain chemical components such as allergens, micotoxins, veterinary drugs, pesticides, and other agro-chemicals. It is obvious that with new practices in food production also new foodborne pathogens could appear. For example:

In 1991, an outbreak of *E. coli* O157:H7 infection (23 cases) in Massachusetts was associated with consumption of an apple cider prepared from a cider mill. Ninety percent of the apples used in the cider were "drops" ± apples collected from the ground. Contamination may have occurred prior to harvest or at harvest. Low pH and temperature have been presumed to be barriers to survival and growth of *E. coli* O157:H7; however, prolonged survival has been documented at a

pH less than 4.0 and at refrigerator temperature (8°C) in experimentally contaminated apple cider. To prevent future similar outbreaks, the practice of using "drops" in cider and using unprocessed manure and manure composted under the current state of composting practices as fertilizer should be reviewed (De Roever, 1998).

Microflora of Foodstuffs and Environment

Microflora causes hazard when further procedures of processing do not assure their destruction or even enable further development of microorganisms. Three groups of microorganisms that have been proven to present microbiological hazards are: bacteria, viruses, and parasites (*protozoa, nematodes, trematodes, and cestodes*). Each of them represents a very specific group of microbes. However, all of them are specific in specific environments or environment and can be easily transported by traditional routes linked to the food chain. For instance the major contaminant, especially in high perishable food, are still bacteria and among them *Salmonella*. For example:

Salmonella Enteritidis and *Salmonella Typhimurium* have been reported most frequently as the major causative agents of human salmonellosis. In many EU countries the *Salmonellae* that most frequently cause human gastroenteritis are *S. Typhimurium* and, especially in more recent years, *S. Enteritidis*, particularly Phage Type 4 (PT4). The other serotypes involved in human illness vary geographically but frequently include *S. Agona*, *S. Hadar*, *S. Heidelberg*, *S. Infantis*, *S. Newport*, *S. Panama*, *S. Saint-paul*, *S. Thompson*, and *S. Virchow*. *Salmonellae* are capable of multiplying under aerobic or anaerobic conditions, and over a wide temperature range (5–46°C), with an optimum for growth of between 35°C and 43°C. At 8°C doubling times of salmonellae were reported to be between 22 and 35 h. Although the lowest temperature at which salmonellae may grow is approximately 5°C, most serotypes fail to grow in food stored below 7°C (EC, 2003).

The values of pH that are higher than 9 or lower than 4 inhibit the growth of *Salmonellae*. Free available water also controls growth; in the *Salmonella* case if the value is lower than 0.94, measured as water activity (a_w). Water activity is defined as relative availability of the water in a substance. Pure water has a_w of 1, and potential hazardous foods have a_w 0.85 or higher. Consequently it is sometimes difficult to distinguish bacteriostatic from bactericidal effects due to the combined influence of a variety of factors. In principle, the most reliable means of controlling growth of *salmonellae* are chill storage or heat. The primary production of food animals remains the most important reservoir of *Salmonellae* entering the human food chain, since a *salmonellae*-free production system cannot be achieved for all the animal species. Controls at slaughter and dressing are often not sufficient to prevent salmonellae entering the food chain. In foods, the main factors affecting microbial growth and survival are pH, a_w , and temperature. Other important factors include the competing microflora, the initial number of *salmonellae*, and their physiological state.

Nonetheless some other new foodborne pathogens are also entering the food chain, causing large difficulties to producer and

problems to consumers. For example *Campylobacter* is the leading cause of zoonotic enteric human infections in most developed countries. Most human campylobacteriosis are classified as sporadic single cases or part of small family related outbreaks (Rosenquist et al., 2003). For example:

Buzby (2001) stated that *Campylobacter* is the most commonly reported cause of FBD in United States (16). Each year it causes around 2 million cases of FBD, 10,000 hospitalizations, and 100 deaths. In the United States, infants (under 1 year old) have the highest reported incidence of *campylobacteriosis*; young adults age 20 to 29 are the illness's second highest risk group. High incidence of *Campylobacter* was reported also by Rosenquist et al. (2003) who stated that in Denmark, *Campylobacter* surpassed *Salmonella* in 1999, where more than 4000 human cases of *campylobacteriosis* (78 cases per 100,000 populations) were registered.

Food Preparation

Procedures are considered as causes of hazard when they do not ensure complete destruction/elimination of pathogenic microorganisms (vegetative shapes and spores) or are carried out in a way that enables contamination of foodstuffs during the process of preparation. They are also a risk factor when they do not reduce chemical and physical hazards to the acceptable level or exclude a material that cannot be processed into a safe food product. However, in current practices microbes still present a high risk to consumer, especially if fast food technology is applied. It is quite often the case that we face inconsistencies in technological process at the so-called critical points. For example:

An outbreak of *gastroenteritis* associated with *S. bredeney* (serovar O:4 H:Lv 1,7) occurred in Belfast, Northern Ireland in November 1997. In total, ten cases were confirmed, of which eight had consumed chicken cooked at local butcher's and retailed through one of two local bakeries. The person in one of the remaining cases was secondarily infected within her home and the person in the last case had eaten a product other than cooked chicken from one of the bakeries. Food preparation practices were inadequate in one of the bakeries in question and record keeping and possibly cooking procedures were inadequate at the butcher's. *S. bredeney* was isolated from an uncooked chicken supplied to the butcher's confirming that improperly cooked chicken was most likely the source of the outbreak. All outbreak clinical isolates were indistinguishable from each other and were similar to the isolate obtained from the uncooked poultry demonstrating that these DNA-based methods were valuable in the molecular characterization of *S. bredeney*. This report emphasizes the importance and maintenance of an effective hazard analysis critical control point (HACCP) approach to the processing and retailing of foodstuffs containing chicken in order to help eliminate hazards to public health (Moorea et al., 2003).

Materials, Instruments and Other Equipment

It is possible to produce safe foodstuffs when the equipment enables us to control the parameters of the process (e.g. temperature and time of specific stages of the process). Once the critical control points have been identified, appropriate control measures should be implemented. For all hazards, critical

limits must be established and meet the specified tolerances to ensure the safety of the food. For example critical limits may need to be set for temperature-time ratios and temperature during cooling. Adams (2001) highlighted the practicability of the Heisler model to predict the cooling effects of various types of equipment on different types of food. Another important fact in food establishments is the suitability of equipment, which comes into contact with food. Equipment that is required should be made of materials that are suitable for cleaning and are not easily breakable. Additional safety can be assured by adding filters, magnets, and metal detectors. Materials should be chemically stable, inert, and should not wear off in the determined period of time, regardless of the frequency of processes. They should have a smooth surface, which enables wet cleaning, and sterilization. They should also be worker safe without any danger to health. The materials and equipment are considered to be risk factors if they do not meet these criteria. For example:

Huss and co-workers (2000) reported the preventive measures include the formulation of a cleaning and sanitizing program specifically designed at reducing the presence of *L. monocytogenes* in the factory environment, the safe elimination of *L. monocytogenes* from heat treated products and prevention of growth in ready to eat (RTE) products within the normal shelf life and conditions started on the label. At least three outbreaks of listeriosis associated with seafood have been reported. Contamination or recontamination of seafood may also take place during processing and low levels (< 100cfu/g) of *L. monocytogenes* are frequently found on seafood including RTE products.

Characteristics of Workplace, where Production, Processing and Transport of Foodstuffs Takes Place

Contamination of food during processing happens more often if the paths of the material, the waste, the end product and the packing materials crossing points are not controlled. The situation can be even worse in acclimatized workplaces.

Interior microclimate (temperature, illumination, noise, ventilation) is in close relation with machinery, equipment, and technological processes that take place in the workplace. It also depends on the size of a workplace and the type of processes. Controlling the microclimate enables us to effectively prevent contamination hazards and health risks for employees (Likar, 2002).

Ventilation and constant supply of fresh air is important in assuring normal working conditions and preventing a stagnant atmosphere. Natural or artificial ventilation is therefore essential and should be capable of removing polluted air. Insufficient ventilation or inappropriate installation can be an epidemiological risk factors and serve as on-path for spreading microorganisms.

The temperature in the workplace and storage depends on a type of performed processes and should reflect the needs of the product, ensuring its stability.

Red meat samples collected from a deboning room of a high throughput abattoir shown enumerated aerobic and Enterobacteriaceae plate count. Sixty percent of the samples were positive for presumptive *Salmonella* spp. while 52% of the samples tested positive for the presence of *L. monocytogenes*. The extent of contamination is dependent upon the local environment, the throughput of meat, the temperature and the cleanliness of utensils such as the cutting tables, conveyor belt and knives (Nel et al., 2004).

Packing Material

European legislation regulates migration from food contact materials, such as packaging, into foods by an overall migration limit (OML) applicable to the total of the migrating material and specific migration limits (SMLs) referring to individual substances or groups of substances. The EU Directives on plastics in contact with food, presently Directive 2002/72/EC and its amendments, are the leading legislation, complimented by the directives regarding technical aspects (Grob et al., 2007). SMLs are a risk management tool derived from toxicological data, such as tolerable daily intakes (TDIs), or from a limited toxicological assessment ensuring safety only for a low migration. PVC cling films releasing plasticizers, such as di-(2-ethylhexyl) adipate (DEHA), into cheese or meat are used as examples to show that the high migrations tolerated by present legal limits are also exploited. In EU the legal limit for DEHA is 18 mg/kg (Directive 2002/72). Since films are not fillable, this limit applies as migration per surface area derived from the ratio of 6 dm²/kg food, i.e. as 3 mg/dm² (Grob et al., 2007).

Plastic food wraps, containers, and glass jars and bottles play an important role in protecting foods. Plastics of many kinds are widely used in the manufacture of a wide range of food wraps and containers.

The function of packing material is to control the food environment and to preserve the food. For example nisin is approved as a natural food preservative and knits together both functions. Nisin, a bacteriocin produced by strains of *Lactococcus lactis subsp. lactis*, is widely used as a preservative in pasteurized processed cheeses and cheese spreads (Delves-Broughton, 1990). It is the only bacteriocin which has been approved by the World Health Organization (WHO) to be used as a preservative in the food industry. Nisin displays inhibitory activity towards a broad range of Gram-positive organisms, including *L. monocytogenes* and *Bacillus cereus* (Jaquette and Beuchat, 1998). Gallo and co-workers (2006) pointed out the effectiveness of nisin in controlling the growth of *L. innocua* in liquid cheese whey (LCW) was more pronounced at 75°C than at 20°C and as the pH decreased from 6.5 to 5.5. As a consequence, this combined treatment may provide LCW with a degree of protection against this microorganism, particularly if employed in conjunction with low temperature.

Safety of foods packed in glass jars and bottles is questionable because of a substance called semicarbazide (EFSA, 2003). Packing material together with the process of packing can be a hazardous point and pose a threat if it fails to prevent

contamination of food. It has been proven that it can be a source of contamination by itself as well. Any potential threats originating from a package should be clearly written, informing customer about proper handling (Sperber, 2001). For example:

Semicarbazide has recently been detected in food contact materials made by using azodicarbonamide, a substance which has been used for over 20 years to make plastic seals for lids on glass jars. Semicarbazide (SEM) belongs to a family of chemicals (hydrazine's) which are known to cause cancer in laboratory animals. While semicarbazide has not been extensively tested for toxic effects, it may also be genotoxic. The foods that have been reported to contain SEM include baby foods, fruit juices, jams and conserves, honey, ketchups and mayonnaise, pickles and sterilized vegetables and sauces. The levels of SEM reported in these foods are variable, ranging from non detectable up to 25 ppb. Baby foods are reported to have highest concentrations, perhaps because of the higher ratio of gasket area to food mass given the small pack sizes for these foods. Given the present uncertainties in the science, and the fact that potential exposure to this substance on a body weight basis is likely to be the highest for infants, experts believe that it would be prudent to reduce the presence of SEM in baby foods (EFSA, 2003).

Storage and Transport

Improper storage can damage packing material and contaminate its content. Great care must be taken to prevent this until the product reaches a customer. Special attention should be practiced with fast perishable foodstuffs. The term food trade indicates all the postproduction procedures: storage, transport, distribution, and retail of final products, their export and import. The cold chain maintaining in retail represents the biggest problem to producers and retailers (Likar and Jevšnik, 2006). For highly perishable foodstuffs a cold chain below 5°C or at a temperature that is indicated on a label and required by the producer is essential. According to our regulations and EU regulations on the labelling of pre-packaged foodstuffs proper information should be labelled on the products. For foodstuffs with longer durability the appropriate microclimatic conditions are necessary and the products should be sold only until their expiration date. All foodstuffs have to be stored in original, undamaged packaging with a clear and complete labelling in domestic language.

Microbial contamination reduces the shelf life of foods and increases the foodborne diseases. Some of the traditional methods of preserving foods from the effect of microbial growth cannot be implied in products such as fresh meats and RTE products. Quintavalla and Vicini (2002) highlighted antimicrobial packaging as a promising form of active food packaging that is an innovative concept. Refrigeration is the only barrier for RTE products, and temperature abuse at any of the supply chain from the processing plants to the consumer's refrigerator, could accelerate the growth of *L. monocytogenes*. Most RTE foods received little or no final heat treatment before being consumed because such foods are assumed to be, and often labelled as, fully cooked. There have been reported illnesses resulting when supposedly RTE foods were not reheated before consumption (Mytle et al., 2004).

As a result of *L. monocytogenes* widespread distribution in the environment, its ability to survive long periods of time under adverse conditions, and its ability to grow at refrigeration temperatures, *Listeria* is now recognized as an important food-borne pathogen. One of the biggest challenges confronting the food industry is control of *L. monocytogenes* contamination and propagation in RTE meats. For example:

Mytle and co-workers (2004) highlighted the inhibitory effect of clove oil (1% and 2%, v/w) applied to the surface of RTE chicken frankfurters was determined on seven strains of *L. monocytogenes*. All strains of *L. monocytogenes* survived and grew on control frankfurters at 5°C and 15°C but growth was inhibited under both storage conditions in the presence of either 1% or 2% clove oil. Clove oil, an herbal extract, contains eugenol which when tested on various agar media has antimicrobial properties and has been shown to inhibit *L. monocytogenes*, *Campylobacter jejuni*, *Salmonella* sp., *Escherichia coli*, and *Staphylococcus aureus*.

Epidemics caused by contamination of food during transport have occurred periodically since 1956. Contaminated foodstuffs are usually powders, such as flour and sugar coming into contact with a toxic agent when the alimentary product is transported or stored together with the pesticide or in a place previously contaminated by the toxic agent (e.g. insecticide with a low LD₅₀). The population affected is usually large, involving at least a number of families usually living near the source of distribution of contaminated food, such as bakery. For example:

One of the most characteristic episodes happened in Saudi Arabia and Qatar in 1967 when 2 freight loads of flour were contaminated when they were transported beneath loads of endrin causing 4 outbreaks. Altogether 874 people were admitted to hospital and 26 died (Ferrer and Cabral, 1995).

Instructions for Consumer and Food Labelling

Certain types of food (containing allergens) or food intended for people who are more susceptible to infections (in hospitals, homes for elderly people, and children) should include additional instructions and information. Improper preparation and use by the customer can lead to contamination and increased incidence of infections. Labelling should include special storage conditions and instructions for use where needed.

Information about the foodstuffs that accompanies them should be clear and comprehensive and should not be misleading for the consumer in any way. EU has food labelling legislation which began with Council Directive 79/112/EEC. They added additional information by Council Directive 2000/13/EC and its amendment 2003/89/EC. An introductory statement stresses that prime consideration for any rules on the labelling of foodstuffs should be the need to inform and protect the consumer giving him the exact nature and characterization of the product thereby enabling him to make his choice in full knowledge of the facts (Przyrembel, 2004).

The members of an EU funded networking project, inform all, focusing on developing strategies for the provision of credible, reliable sources of information for food allergy sufferers, regulators and the food industry, have been considering these matters with respect to food labelling (Mills et al., 2004). Consumer perceptions thus show an increasing concern about food safety and about properties of the food they buy and eat. Although much information is available as a result of labelling conventions, this does not always translate into more confidence. It is of great importance to the food industry to protect brands in order to restore and maintain consumer confidence. It has been recognized that there is an increasing need for transparent information on the quality of the entire food chain, supported by modern tracking and tracing methods. High quality food, integrity, and associated services and information should be guaranteed. Consumers call for food that can be fully trusted, they ask for safety guarantees and information with integrity to confirm their trust (Beulens et al., 2005). Insufficient or improper labelling could cause serious illness or even death as was the case in accidental consumption of trigger foods, such as peanuts and other nuts. For example:

The recent tragic death of young athlete following consumption of nuts in a Coronation chicken sandwich, matches the reported pattern. Most peanut/nut allergy fatalities occur in the retail setting, where producers, retailers and environmental health officers may have insufficient knowledge of the actions and interventions necessary to protect sensitive consumers (Leitch et al., 2001).

Health, Hygiene and Education/Training of Workers

Workers coming in contact with food during its production and processing path are often a vector of contamination especially when they are not properly educated, trained, or ill.

A majority of FBD outbreaks result from faulty food handling practices in small and medium sized food businesses, and this applies even where an advanced safety control system is employed. Bare and gloved hands of food handlers can be vectors in the spread of food borne disease because of poor personal hygiene or cross-contamination (Ayçiçek et al., 2004). Food handlers who are symptomatically ill may present a real hazard and should be excluded from work. Educating food handlers is a crucial line of defence in the prevention of most types of food borne illnesses (Nel et al., 2004; Legnani et al., 2004).

To gain results it is necessary to develop a new viewpoint for educating and training specific groups of persons who manage with food (food handlers, managers). In this context we should not forget a specific group which verifies, the so-called food inspectors. Cotterchio et al. (1998) established that food manager training and certification programs may be an effective way to improve the sanitary conditions of restaurants and reduce the spread of foodborne illnesses. Food handlers play an important role in the transmission of FBD, because they may introduce pathogens into foods during production, processing, distribution, and preparation. For example:

Only 48.7% responding food handlers in the area of Catanzaro, Italy, knew the main foodborne pathogens and this knowledge was significantly greater among those with a higher education level, in practice from a longer period of time, and who had attended education courses. A vast majority correctly indicated those foods classified as common vehicles for FBD, and only 7.1% of food handlers were able to name five different food vehicles, each of which transmit one of the five pathogens (Angelillo et al., 2000). Baş and co-workers (2005) established that food handlers in Turkish food businesses often have lack of knowledge regarding the basic food hygiene (critical temperatures of hot or cold ready-to-eat foods, acceptable refrigerator temperature ranges, and cross-contamination etc.). There is an immediate need for education and increasing awareness among food handlers regarding safe food handling practices.

FOOD SAFETY DILEMMAS OF THE CONSUMER

Fast ways of living and constant lack of time is a global problem that dictates objective changes in the everyday environment. As the global food-marketing environment becomes more and more turbulent and competitive, marketers must "follow" and understand the changes in consumers' food-related attitudes and behaviors, and be willing to react and adapt to this information (Reid et al., 2005). There is a steady stream of conferences and lectures on the consumer of the future, on trends in food consumption, about the rapid changes in consumer demand, and about the need for innovation of food producers as a way to survive. Major topics mentioned in this context are usually health concern, the role of convenience, the importance of variety and new experiences, linking "stories" to food, ethical, and environmental issues (Grunert, 2006). Grunert and co-workers (2001) have documented the food-related lifestyle concept that are connected with food culture. Changing consumer needs have led to a rapid growth of convenience food sales in recent years. These changing consumer needs were a result of major macro-economic changes that occurred in developed countries in the last few decades (Jago, 2000). We experienced an explosion in the supply of new food products in most markets (Grunert et al., 2001). Prepared consumer foods (convenience foods) have an important role in developed countries (De Boer et al., 2004).

The literature on public perceptions of food related hazards is relatively recent (Sparks and Shepherd, 1994a,b; Fife-Schaw and Rowe, 1996; Grobe et al., 1999; Williams and Hammitt, 2001). Researchers have suggested that the public's reaction to risk is underpinned by quality hazards not taken into account by experts (Slovic, 1993). Public opinion on the evolution of food safety over the last ten years is divided: 38% consider that it has improved, 29% feel that it has stayed about the same and 28% believe that we are now worse off (Eurobarometer, 2005).

Rosati and Saba (2004) estimated that consumers were more worried about those food hazards that were well-known to them and, consequently, less worried about food hazards that were less known. Moreover, the study indicated that perceived personal risk and the individual's own knowledge of potential food risks were two distinct dimensions of food risk perception. It

was found that the reliability of knowledge held by agencies about risks associated with food-related hazards to human health and the trustworthiness of the sources of information were two important factors of consumer trust. One of the potential reasons for the lack of trust in institutions and institutional activities mentioned by Frewer and co-workers (2004) is that the public perceives that institutions have failed to take account of the actual concerns of the public as part of their risk management activities.

However, when consumers are reminded of the possible risks associated with food, concerns appear to be quite widespread. People do not differentiate greatly between the various types of risks although they are more likely to worry about risks caused by external factors over which they have no control (Eurobarometer, 2005). At the top end of the "worry" scale, consumers express concern regarding external factors that are clearly identified as dangerous (pesticides residues, new viruses such as avian influenza, residues in meats, contamination of food by bacteria, unhygienic conditions outside home). In the mid-range, one finds other external factors such as environmental pollutants (e.g. mercury), genetically modified organisms (GMOs), food additives, animal welfare, and bovine spongiform encephalopathy (BSE). Consumers appear to be less concerned about personal factors (such as individual susceptibility to food allergies) or other factors linked to their own behavior (e.g. food preparation, food hygiene at home, and putting on weight) (Eurobarometer, 2005).

Frewer and co-workers (2004) stated that in a demographic society where choice exists, people will not consume foods that they associate with some negative attribute. Various factors may contribute to concerns. A number of surveys and opinion polls have sought to identify consumer attitudes to food and its safety (O'Fallon et al., 2007; Eurobarometer, 2005; Frewer et al., 2004; Rosati and Saba, 2004; Banati and Lakner, 2003). Kuznesof and Brennan (2004) presented the results of an exploratory focus group where food concerns have been categorized according to hazard type. The results show a range of concerns varying from anxieties relating to each stage of the food chain (e.g. specific food issues, such as genetically modified foods and the use of additives and preservatives in processed foods, were frequently mentioned). O'Fallon and co-workers (2007) examined the data from the Eurobarometer 53 and they ascertained that many (roughly 73% of the sample) of the individuals residing in the 15 European countries are less likely to purchase a food product with a label indicating the existence of a genetically modified ingredient. Research by Plahuta and co-workers (2007) has shown that the opinion of Slovenian consumers, retail chain representatives, and professionals (oenologists) about GMO is refusal (e.g. the majority believe that GMO will be on the market within five years). Banati and Lakner (2003) pointed out that the level of knowledge on biotechnology is rather mixed, and that is why the Hungarian consumers do not yet have a well-defined opinion on genetically engineered products.

GOOD NUTRITIONAL PRACTICE FROM PRODUCERS TO CONSUMERS

The long, global evolution and use of HACCP in food processing plants provided overwhelming documentation that the HACCP system of food safety was very effective at controlling identified foodborne hazards (Sperber, 2005b). Food business operators shall ensure that all stages of production, processing, and distribution of food under their control satisfy the relevant hygiene requirements laid down in the Regulation (EC) No 852/2004. Successful implementation of the procedures based on the HACCP principles will require the full cooperation and commitment of food business employees. To this end, employees should undergo training.

The efficiency of the HACCP system, especially in small and medium sized enterprises (SMEs), is questionable. Lately the authors of technical and scientific articles (Sperber, 2005a,b; Azanza and Zamora-Luna, 2005; Taylor and Taylor, 2004a,b; Hennroid and Sneed, 2004; Vela and Fernández, 2003) are searching barriers for the system efficiency. Jevšnik and co-workers (2006) allocate seven elements (training, human resources, planning, knowledge and competence, management commitment) representing almost 50% (47,8%) of all the identified barriers using meta-analysis.

Practical experience and a review of food safety literature performed by Taylor and Kane (2005) indicates that success in developing, installing, monitoring, and verifying a successful HACCP system depends on overcoming a complex mix of managerial, organizational, and technical obstacles. Even the largest and well-equipped food companies with significant resources of money, technical expertise, and management skills face a difficult challenge; whilst the SMEs often feel that the difficulties of HACCP are potentially insurmountable (Taylor and Kane, 2005). The fact that a person is and will be responsible for HACCP implementation and further control calls for an in-depth analysis and understanding of the individual's reaction to received information (Jevšnik et al., 2006). This can be approached from different perspectives as was indicated already in 2001 for complex behavioral barriers in the food safety area (Gilling et al., 2001).

It is also important to research consumer knowledge, behavior and attitudes toward food safety. International studies indicated that a significant proportion of FBD arises from practices in the home kitchen (Scott et al., 1982; Bryan, 1988; Scott, 1996; Raspor et al., 2006). Domestic food preparation can negate much of the efforts of primary and secondary food producers to provide safe food (Oosterom, 1998; Jay et al., 1999). Several studies among different kinds of consumer groups (Sammarco et al., 1997; Johnson et al., 1998; Jay et al., 1999; Meer and Misner, 2000; Leitch et al., 2001; Bermúdez-Millán et al., 2004; Anderson et al., 2004; Marklinder et al., 2004) have identified food prepared in the family home as a major source of food poisoning and uncovered a lack of food safety knowledge and the need for promoting improved food safety behaviors aiming at

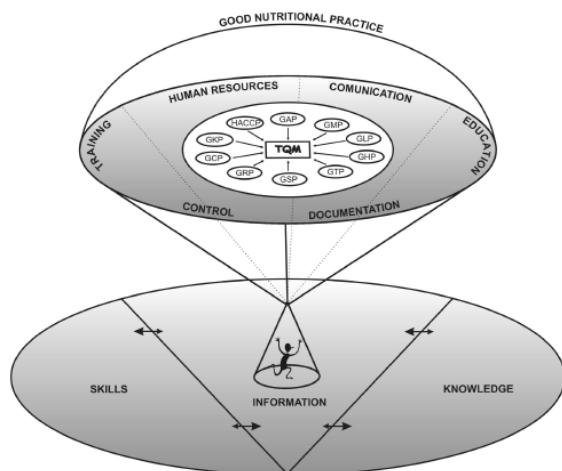


Figure 3 Food safety platform: balance model for ensuring food safety from good nutritional practices viewpoint.

particular target groups. The fact is that household food safety education is needed to minimize the risk of exposure to food-borne pathogens. The results of a number of previously mentioned consumer food safety research shows that the levels of understanding, motivation, and trust needs to be further cultivated and raised. It has been shown that the present maintenance of food safety in the food chain can be easily broken down, because of the different kinds of barriers or simple misunderstanding. So, the important perspective is to educate the public about safe food handling and preparation of foods throughout the system of good nutritional practice that emphasizes hazardous food handling techniques and the microbiological causes of FBD.

For solving the existing barriers in implementing and maintaining the food safety system in all the steps in the food supply chain it is necessarily to link-up of all relevant good practices from farm to table to the one, named Good Nutrition Practice (GNP), which could solve many issues since it involves the last step in the food chain—the consumer (Fig. 3).

In all of the mentioned practices there are HACCP elements there that comprise of the HACCP system as the main system in food practice today. All practices are partial and are not connected in a comprehensive system. Therefore a new approach called GNP should be adopted to balance food safety. It is important to restore the existing food safety system with GNP, based on a model (Fig. 3) that covers subsystems with other good practices. Clustering all the practices in a proper ratio under the shield of GNP has been shown to be an appropriate platform for achieving the final goal—safe and healthy food for consumers.

However, in daily practice most of the critical points are depending on a particular person in a particular place. If we do not perform adequate training, mainly appropriate education within human resources, we can not expect to have professionals with highly developed skills or high knowledge which makes relevant control and documentation. And now this is expressed with

adequate information of the particular process. This integration under GNP is based on the product of the professionals' activity, which is food. In that the particular food skills, knowledge, and information are integrated. If we enable these together, with our high quality personnel that the ratio of these activities is just proper, then we deliver a good, nutrient, and safe product to the consumer's table. And this is the global goal of GNP based on a comprehensive platform which includes all the needed instruments and all the partners but also respecting the consumer as a critical element in this philosophy.

CONCLUSIONS

Food safety is of crucial importance to the consumer, the food industry, and the economy. Despite of the significant investment, the incidence of food-derived diseases still increases what can be connected to better statistics or to real increase. Foodborne diseases caused by microbiological hazards are a public health problem in Europe and worldwide. But it is of serious concern that 50% to 87% of reported foodborne disease outbreaks in various countries throughout the world have been associated with the home (Clayton and Griffith, 2003). It is obvious that consumers are not provided with sufficient, processed, and easy-to-understand information (Banati and Lakner, 2006). And also it is indicative that we are losing some traditionally gained knowledge and skills about food preparation and consumption.

Our inability to effectively improve the situation is a matter of major concern in spite of the very significant resources allocated to the problem of foodborne diseases (Raspor, 2004). A closer look at the food field, which is spread from technical sciences to social sciences, is giving a broad spectrum of possibilities as to how to maintain food safety completely, with the consumer standing at the end of the chain.

Due to the measures taken by governments, public authorities, and food manufacturers, it is postulated that consumers, trust in food safety has increased within the last several years (Röhr et al., 2005). But it is still essential for risk managers to communicate that they are reducing or mitigating a particular risk and they also have to make sure that actions match their words. It is obvious that the consumer is the one that is not informed enough on ensuring safe food (Reid et al., 1998; Marklinder et al., 2004). It is necessary to define as to who is responsible to educate the consumers with food safety principals and which method of educating would be successful.

With the consumer outside the food safety circle we do not treat food safety "from farm to table." That is why Good Nutritional Practice (GNP) must become a link in the global vision of food safety control, which begins and ends in concern for the consumer.

The goal can be achieved only with global co-operation with all who are involved in different kinds of food activities: government, teachers and professors, controller's producers, food processors, transporters and trade, catering and ourselves—consumers who stand at the end of the chain.

It is obvious that the food represents one of major problems in the current world, beside health and environmental problems. We can expect this trend to continue in the future. Development of new techniques and methods will definitely help us to reduce (avoid) certain hazards and maintain the quality of life, but we should not forget the basic principles of nature.

We should create new knowledge with permanent education on all levels in the food supply chain. To achieve that strategy we have to:

- Develop new methods of food preservation;
- Improve methods for immediate identification of contaminants (e.g. pathogens, pesticides, veterinary drugs, etc.);
- Prepare new foodstuffs with improved nutritional profile for consumer's individual needs and wishes with respect to body requirements;
- Complete integration of good practices into a manageable system with the consumer as an integral part;
- Carefully plan nutrition and research policy with respect to cultural and regional diversity in diverse nutritional practice;
- Assure synchronized development of regulation and standardization procedures;
- Realization and control.

Global food safety will be achieved only, when every single link in the food chain entirely (in its indoor and outdoor environment) becomes master of its particular area and will trust in the activity of both the previous and the following link in the food safety circle "from farm to table," not ignoring the consumer as the one who should be aware of potential risks, proper handling, and preparation of food for a safe and balanced everyday meal.

REFERENCES

Adams, A. (2001). The use of models in the maintenance of the hygienic quality of foods. *Nutr. Food Sci.*, **31**(5):234–237.

Anderson, J. B., Shuster, T. A., Hansen, K. E., Levy, A. S., and Volk A. (2004). A camera's view of consumer food-handling behaviours. *J. Am. Diet. Assoc.*, **104**:186–191.

Angelillo, I. F., Viggiani, N. M. A., Rizzo, L., and Bianco A. (2000). Food handlers and foodborne diseases: knowledge, attitudes and reported behaviour in Italy. *J. Food Prot.*, **63**(3):381–385.

Ayçiçek, H., Aydoğan, H., Küçükkaaslan, A., Baysallar, M., and Başustaoğlu A. C. (2004). Assessment of the bacterial contamination on hands of hospital food handlers. *Food Control*, **15**:253–259.

Azanza, M. P. V., and Zamora-Luna, M. B. V. (2005). Barriers of HACCP team members to guideline adherence. *Food Control*, **16**(1):15–22.

Banati, D., and Lakner, Z. (2003). Modern biotechnology and the Hungarian consumers. *Acta Alimentaria* **32**:5–23.

Banati, D., and Lakner, Z. (2006). Knowledge and acceptance of genetically modified foodstuffs in Hungary. *J. Food Nutr. Res.*, **45**(2):62–68.

Barendsz, A. W. (1998). Food safety and total quality management. *Food Control*, **9**(2/3):163–170.

Baş, M., Ersun, A. Ş., and Kivanç, G. (2005). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control*, **17**(4):317–322.

Berg, C., Dahms, S., Hildebrandt, G., Klaschka, S., and Weiss, H. (1994). Microbiological collaborative studies for quality control in food laboratories:

reference material and evaluation of analyst's errors. *Int. J. Food Microbiol.*, **24**(1–2):41–52.

Bermúdez-Millán, A., Perez-Escamilla, R., Damio, G., Gonzalez, A., and Segura-Perez, S. (2004). Food safety knowledge, attitudes, and behaviours among Puerto Rican caretakers living in Hartford, Connecticut. *J. Food Prot.*, **67**(3):512–516.

Beulens, A. J. M., Broens, D. F., Folstar, P., and Hofstede, G. J. (2005). Food safety and transparency in food chains and networks; Relationships and challenges. *Food Control*, **16**:481–486.

Bryan, F. (1988). Risks of practices, procedures and processes that lead to outbreaks of foodborne diseases. *J. Food Prot.*, **51**:663–673.

Bucheli, P., and Taniwaki, M. H. (2002). Research on the origin, and on the impact of post-harvest handling and manufacturing on the presence of ochratoxin A in coffee. *Food Addit. Contam.*, **19**(7):655.

Buzby, J. C. (2001). Children and microbial foodborne illness. *Food Review*, **24**(2):32–37.

CAC (Codex Alimentarius Commission). (2003). Recommended international code of practice. General principles of food hygiene. FAO/WHO Food Standards; Codex Alimentarius Commission (CAC/RCP 1-1969), Rev. 4-2003, 31 pp.

CDC (Centers for Diseases Control and Prevention). (2002). Food Net Annual Reports. Available online: http://www.cdc.gov/foodnet/annual/2002/2002executive_summary.pdf (accessed: September 10, 2004).

Clayton, D. A., and Griffith, C. J. (2003). An investigation of the factors underlying consumers' implementation of specific food safety practices. *Br. Food J.*, **105**(7):434–453.

Cotterchio, M., Gunn, J., Coffill, T., Tormey, P., and Barry, A. (1998). Effect of a manager training program on sanitary conditions in restaurants. *ProQuest Social Science Journals, Public Health Reports*, Jul/Aug, **113**(4):353–358.

De Boer, M., McCarthy, M., Cowan, C., and Ryan, I., (2004). The influence of lifestyle characteristics and beliefs about convenience food on the demand for convenience foods in the Irish market. *Food Qual. & Pref.*, **15**:155–165.

De Roeer, C. (1998). Microbiological safety evaluations and recommendations on fresh produce. *Food Control*, **9**(6):321–347.

Dean, R. D. (1985). Training of Sanitary Engineers in Europe, p. 163–189. World Health Organization, Regional Office for Europe, Copenhagen.

Delves-Broughton, J. (1990). Nisin and its uses as a food preservative. *Food Technol.*, **44**(11):100–117.

EC (European Commission). 14–15 April (2003). Opinion of the Scientific Committee on Veterinary Measures relating to Public Health on Salmonellae in Foodstuffs. Available online: http://europa.eu.int/comm/food/fs/sc/scv/out66_en.pdf (accessed: November 18, 2004).

EC (European Commission). (2000). White Paper on Food Safety. Brussels, 12 January 2000. Available online: http://europa.eu.int/comm/dgs/health_consumer/library/pub/pub06_en.pdf (accessed: November 18, 2004).

EC (European Commission). Regulation No 178/2002 of the European parliament and of the council of 28 January (2002). Official Journal of the European Communities. L 31/24.

EFSA (European Food Safety Authority). 15 October (2003). Background information on semicarbazide found in foods packaged in glass jars and bottles. Available online: http://www.efsa.eu.int/press_room/questions_and_answers/44_en.html (accessed: November 20, 2004).

EU (European Union). (1993). Council Directive 93/43/EEC of 14 June 1993 on the hygiene of foodstuffs. *Off. Journal EU L* **175**, 19/07/1993, pp. 1–11.

EU (European Union). (2004). Corrigendum to Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (OJ L 139, 30.4.2004). *Off. Journal L226*, 25/06/2004, pp. 3–21.

Eurobarometer No 238. (2005). Risk issues. Opinion polls. European Commission, Directorate-General Press and Communication. Available online: http://ec.europa.eu/public_opinion/archives/eb/eb62/eb62_en.htm (accessed: November 20, 2006).

FAO (Food and Agriculture Organization). (2000). Twenty-sixth FAO regional conference for Latin America and the Caribbean Merida, Mexico, 10 to 14 April 2000. LARC/00/6. Available online: <http://www.fao.org/docrep/x4606e/x4606e00.htm> (accessed: November 20, 2004).

- FAO (Food and Agriculture Organization). (2003). Development of a good agricultural practice approach. Concept paper for the FAO Expert Consultation on Good Agricultural Practices, Rome, 10–12 November 2003. Available online: http://www.fao.org/prods/GAP/archive/GAPCONCEPT12_en.pdf (accessed: November 20, 2004).
- FAO (Food and Agriculture Organization). (1995). The Codex Alimentarius, General requirements (Food Hygiene), Vol. 1B. 2nd: 223p.
- Ferrer, A. and R. Cabral. (1995). Recent epidemics of poisoning by pesticides. *Toxicology Letters*, **82–83**:55–63.
- Fielding, L. M., Ellis, L., Beveridge, C., and Peters, A. C. (2005). An evaluation of HACCP implementation status in UK small and medium enterprises in food manufacturing. *Int. J. of Environ. Health Res.*, **15**(2):117–126.
- Fife-Schaw, C., and Rowe, G. (1996). Public perceptions of everyday food hazards: a psychometric study. *Risk Analysis*, **16**:487–500.
- Frewer, L., Lassen, J., Kettlitz, B., Scholderer, J., Beekman, V., and Berdal, K. G. (2004). Societal aspects of genetically modified foods. *Food & Chem. Toxicol.*, **42**:1181–1193.
- Gallo, L. L., Pilosof, A. M. R., and Jagus, R. J. (2006). Effective control of *Listeria innocua* by combination of nisin, pH and low temperature in liquid cheese whey. *Food Control*, doi:10.1016/j.foodcont.2006.07.009. Available online: <http://www.sciencedirect.com/> (accessed: October 15, 2006).
- Garbutt, J. (1997). Essentials of Food Microbiology. London, Arnold, 250 p.
- Gilling, S. J., Taylor, E. A., Kane, K., and Taylor, J. Z. (2001). Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioural adherence model. *J. Food Prot.*, **64**(5):710–715.
- Gorris, L. G. M. (2005). Food safety objective: An integral part of food chain management. *Food Control*, **16**:801–809.
- Grob, K., Pfenninger, S., Pohl, W., Laso, M., Imhof, D., and Rieger, K. (2007). European legal limits for migration from food packaging materials: 1. Food should prevail over simulants; 2. More realistic conversion from concentrations to limits per surface area. PVC cling films in contact with cheese as an example. *Food Control*, **18**(3):201–210.
- Grobe, D., Douthitt, R. and Zepeda, L. (1999). A model of consumers' risk perceptions toward recombinant bovine growth hormone (rgGH): the impact of risk characteristics. *Risk Anal.* **19**:661–673.
- Grunert, K. G. (2006). Future trends and consumer lifestyles with regard to meat consumption. *Meat Science*, **74**:149–160.
- Grunert, K. G., Brunso, K., Bredahl, L., and Bech, A. C. (2001). Food related lifestyle: A segmentation approach to European food consumers. In: *Food, People and Society: a European Perspective of Consumers' Food*, pp. 211–230. Frewer, L., Risvik, E., and Schifferstein, H. Eds., Springer, Berlin.
- Heggum, C. (2001). Trends in hygiene management – the dairy sector example. *Food Control*, **12**:241–246.
- Henroid, D., and Sneed, J. (2004). Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *J. Am. Diet. Assoc.*, **104**(2):180–185.
- Hillers, V. N., Medeiros, L., Kendall, P., Chen, G., and DiMascola, S. (2003). Consumer food-handling behaviours associated with prevention of 13 food-borne illnesses. *J. Food Prot.*, **66**(10):1893–1899.
- Hoomstra, E. (2001). The use of quantitative risk assessment in HACCP. *Food Control*, **12**:229–234.
- Huss, H. H., Jørgensen, L. V., and Vogel, B. F. (2000). Control options for *Listeria monocytogenes* in seafoods. *Int. J. Food Microbiol.*, **62**:267–274.
- ICMSF (International Commission on Microbiological Specifications for Foods). (1996). In: *Microorganisms in food: Microbiological Specifications of Food Pathogens*, Vol. 5. Blackie Academic and Professional, London.
- ISO (International Organization for Standardization). (2005). ISO 22000:2005. Food safety management systems—Requirements for any organization in the food chain. TC 34, ISO Standards, 32p.
- IVZ RS. (2005). Epidemiological tracing of infectious diseases in Slovenia in 2003. Institute of Public Health, Republic of Slovenia. Available online: http://www.ivz.si/javne_datoteke/datoteke/798-Epidemiolosko_spremljanje_nalezljivih_bolezni_2003.pdf (accessed: January 28, 2005).
- Jago, D. (2000). A healthy outlook. *Prepared foods*, **169**(4):29.
- Jaquette, C. B., and Beuchat, L. R. (1998). Combined effect of pH, nisin and temperature on growth and survival of psychrotrophic *Bacillus cereus*. *J. Food Prot.*, **61**:563–570.
- Jay, L. S., Comar, D., and Govenlock, L. D. (1999). A national Australian food safety telephone survey. *J. Food Prot.*, **62**:921–928.
- Jevšnik, M., Hlebec, V., and Raspor, P. (2006). Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, **35**(3), 319–353.
- Johnson, A. E., Donkin, A. J. M., Morgan, K., Lilley, J. M., Neale, R. J., Page, R. M., and Silburn, R. (1998). Food safety knowledge and practice among elderly people living at home. *J. Epidemiol. Comm. Health*, **52**:745–748.
- Jones, M. V. (1998). Application of HACCP to identify hygiene risks in the home. *Int. Biodeterior. Biodegrad.*, **41**:191–199.
- Konecka-Matyjek, E., Turlejska, H., Pelzner, U., and Szponar, L. (2005). Actual situation in the area of implementing quality assurance system GMP, GHP and HACCP in Polish food production and processing plants. *Food Control*, **16**:1–9.
- Kuznesof, S., and Brennan, M. (2004). Perceived risk and product safety in the food supply chain. In: *Food supply chain management*, pp. 32–48. Bourlakis, M. A., and Weightman, P. W. H., Eds., Blackwell Publishing, UK.
- Kydd, A. (2002). Focusing nursing care on the older person. *Nurs Times*, **13–19**(33):34–6.
- Larsen, L. L., and Berry, J. A. (2003). The regulation of dietary supplements. *J. Am. Acad. Nurse Pract.*, **15**(9):410–414.
- Legnani, P., Leoni, E., Berveglieri, M., Mirolo, G., and Alvaro, N. (2004). Hygienic control of mass catering establishments, microbiological monitoring of food and equipment. *Food Control*, **15**:205–211.
- Leitch, I., Blair, I. S., and McDowell, D. A. (2001). The role of environmental health officers in the protection of allergic consumers. *Int. J. Environ. Health Res.*, **11**:51–61.
- Likar, K. (2002). Sanitary technical conditions and spatial arrangement on the premises. In: *Handbook for establishment and conducting HACCP system*, pp. 37–49. Raspor, P., Ed., Slovenian Institute of Quality, Biotechnical faculty, Ljubljana.
- Likar, K., and Jevšnik, M. (2006). Cold chain maintaining in food chain. *Food Control*, **17**:108–113.
- Marklinder, I. M., Lindblad, M., Eriksson, L. M., Finnson, A. M., and Lindqvist, R. (2004). Home storage temperatures and consumer handling of refrigerated foods in Sweden. *J. Food Prot.*, **67**:2570–2577.
- Mead, P. S., Slutsker, L., Dietz, V., McCaig, L. F., Breesee, J. S., Shapiro, S., Griffin, P. M., and Tauxe, R. V. (2000). Food-related illness and death in the United States. *Emerg. Infect. Dis.*, **5**(5):1–34.
- Meer, R. R., and Misner, S. L. (2000). Food safety knowledge and behaviour of expanded food and nutrition education program participants in Arizona. *J. Food Prot.*, **63**:1725–1731.
- Mills, E. N. C., Valovirta, E., Madsen, C., Taylor, S. L., Vieths, S., Anklam, E., Baumgartner, S., Koch, P., Crevel, R. W. R., and Frewer, L. (2004). Information provision for allergic consumers - where are we going with food allergen labelling? *Allergy*, **59**(12):1262–1268.
- Moorea, J. E., Murrayb, L., Fanninge, S., Cormicane, D. M., Dalyc, M., Delapped, N., Morganb, B., and Murphya, P. G. (2003). Comparison of phenotypic and genotypic characteristics of *Salmonella* breedeney associated with a poultry-related outbreak of gastroenteritis in Northern Ireland. *J. Infect.*, **47**:33–39.
- Mortimore, S. (2001). How to make HACCP really work in practice. *Food Control*, **12**:209–215.
- Motarjemi, Y., and Käferstein, F. (1999). Food safety, Hazard Analysis and Critical Control Point and the increase in foodborne diseases: a paradox? *Food Control*, **10**:325–333.
- Mytle, N., Anderson, G. L., Doyle, M. P., and Smith, M. A. (2004). Antimicrobial activity of clove (*Syzygium aromaticum*) oil in inhibiting *Listeria monocytogenes* on chicken frankfurters. *Food Control*, **17**(2):102–107.
- Nel, S., Lues, J. F. R., Buys, E. M., and Venter, P. (2004). The personal and general hygiene practices in the deboning room of a high throughput red meat abattoir. *Food Control*, **15**:571–578.

- O'Fallon, M. J., Gursoy, D., and Swanger, N. (2007). To buy or not to buy: Impact of labelling on purchasing intentions of genetically modified foods. *Hosp. Manage.*, **26**:117–130.
- Oosterom, J. (1998). The importance of hygiene in modern society. *Int. biodeterior. Biodegrad.*, **41**:185–189.
- Panisello, P. J., and Quantick, P. C. (2001). Technical barriers to Hazard Analysis Critical Control Point (HACCP). *Food Control*, **12**:165–173.
- Plahuta, P., Tivadar, B., and Raspor, P. (2007). Slovenian public opinion regarding genetically modified organisms in winemaking. *Acta Alimentaria*, **36**(1):61–73.
- Przyrembel, H. (2004). Food labelling legislation in the EU and consumers information. *Trends Food Sci. Technol.*, **15**:360–365.
- Quintavalla, S., and Vicini, L. (2002). Antimicrobial food packaging in meat industry. *Meat Sci.*, **62**:373–380.
- Raspor, P. (2002). Handbook for establishment and conducting HACCP system. Slovenian Institute of Quality, Biotechnical faculty, Ljubljana, 598 pp.
- Raspor, P. (2004). Current viewpoint on food safety. In: Varnost živil, 22. Bitenčevi živilski dnevi, 18. in 19. marec 2004. pp. 1–14. Gašperlin, L., and Žlender, B., Eds., Radenci. Biotechnical Faculty, Ljubljana.
- Raspor, P., Jevšnik, M., and Hlebec, V. (2006). Consumers' awareness of food safety from shopping to eating. In: Nutrition and food safety. pp. 112. Bánáti, D., Ed., Brussels: Consortium International Congress on Food Safety, The Safe Consortium.
- Redmond, E. C., and Griffith, C. J. (2003). Consumer food handling in the home: a review of food safety studies. *J Food Prot.*, **66**(1):130–161.
- Reid, A., Wood, D., and Kinney, D. (1998). Food hygiene information: power to the people? *Nutr. Food Sci.*, **3**:138–144.
- Reid, M., Brunso, K., and Grunert, K. (2005). Food-Related Life Style Segments in Australia: What's the trend? Monash University, ANZMAC 2005 Conference: Consumer Behaviour.
- Rocourt, J., Moy, G., Vierk, K., and Schlundt, J. (2003). The present state of food-borne disease in OECD countries. World Health Organization, Food Safety Department, Geneva.
- Röhr, A., Lüddecke, K., Drusch, S., Müller, M. J., and Alvensleben, R. V. (2005). Food quality and safety - consumer perception and public health concern. *Food Control*, **16**(8):649–655.
- Ropkins, K., and Beck, A. J. (2000). Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends Food Sci. Technol.*, **11**:10–21.
- Rosati, S., and Saba, A. (2004). The perception of risks associated with food-related hazards and the perceived reliability of sources of information. *Int. J Food Sci. & Technol.*, **39**:491–500.
- Rosenquist, H., Nielsen, N. L., Sommer, H. M., Nørrung, B., and Christensen, B. B. (2003). Quantitative risk assessment of human campylobacteriosis associated with thermophilic *Campylobacter* species in chickens. *Int. J. Food Microbiol.*, **83**:87–103.
- Sammarco, M. L., Ripabelli, G., and Grasso, G. M. (1997). Consumer attitude and awareness towards food-related hygienic hazards. *J. Food Saf.*, **17**:215–221.
- Scott, E. (1996). Foodborne disease and other hygiene issues in the home. *J. Appl. Bacteriol.*, **80**:5–9.
- Scott, E., Bloomfield, S. F., and Barlow, C. G. (1982). An investigation of microbial contamination in the home. *J. Hyg.*, **89**:279–293.
- Scott, V. N. (2005). How does industry validate elements of HACCP plans? *Food Control*, **16**:497–503.
- Slovic, P. (1993). Perceived risk, trust and democracy. *Risk Anal.*, **13**:675–682.
- Smole Možina, S., and Hočevar Grom, A. (2004). Microbiological food safety. In: Varnost živil, 22. Bitenčevi živilski dnevi, 18. in 19. marec 2004. pp. 29–43. Gašperlin, L., and Žlender, B., Eds., Radenci. Biotechnical Faculty, Ljubljana.
- Soriano, J. M., Rico, H., Moltó, J. C., and Mañes, J. (2002). Effect of introduction of HACCP on the microbiological quality of some restaurants meals. *Food Control*, **13**:253–261.
- Sparks, P., and Shepherd, R. (1994a). Public perceptions of food-related hazards: individual and social dimension. *Food Qual. & Pref.*, **5**:185–193.
- Sparks, P., and Shepherd, R. (1994b). Public perceptions of the potential hazards associated with food production and food consumption. An empirical study. *Risk Anal.*, **14**:799–805.
- Sperber, W. H. (1998). Future developments in food safety and HACCP. *Food Control*, **9**(2–3):129–130.
- Sperber, W. H. (2001). Hazard identification: from a quantitative to a qualitative approach. *Food Control*, **12**:223–228.
- Sperber, W. H. (2005a). HACCP and transparency. *Food Control*, **16**:505–509.
- Sperber, W. H. (2005b). HACCP does not work from Farm to Table. *Food Control*, **16**:511–514.
- Sun, Y.-M., and Ockerman, H. W. (2005). A review of the needs and current applications of hazard analysis and critical control point (HACCP) system in foodservice areas. *Food Control*, **16**:325–332.
- Taylor, E., and Kane, K. (2005). Reducing the burden of HACCP in SMEs. *Food Control*, **16**(10), 833–839.
- Taylor, E. A., and Taylor, J. Z. (2004a). Perceptions of the "bureaucratic nightmare" of HACCP. A case study. *Br. Food J.*, **106**(1), 65–72.
- Taylor, E. A., and Taylor, J. Z. (2004b). Using qualitative psychology to investigate HACCP implementation barriers. *Int. J. Environ. Health Res.*, **14**(1), 53–63.
- Tucker, M., Whaley, S. R. and Sharp, J. S. (2006). Consumer perception of food-related risks. *Int. J Food Sci. & Technol.*, **41**:135–146.
- Untermann, F. (1999). Food safety management and misinterpretation of HACCP. *Food Control*, **10**:161–167.
- Vela, A. R., and Fernández, J. M. (2003). Barriers for the developing and implementation of HACCP plans: results from a Spanish regional survey. *Food Control*, **14**(5), 333–337.
- Walczak, D., and Reuter, M. (2004). Putting restaurant customers at risk: unsafe food handling as corporate violence. *Hosp. Manage.*, **23**:3–13.
- Walker, E., and Jones, N. (2002). An assessment of the value of documenting food safety in small and less developed catering businesses. *Food Control*, **13**:307–314.
- Walker, E., Pritchard, C., and Forsythe, S. (2003). Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control*, **14**:169–174.
- Wallace, C., and Williams, T. (2001). Pre-requisites: a help or a hindrance to HACCP? *Food Control*, **12**:235–240.
- Warde, A. (1999). Convenience Food: Space and Timing. *Br. Food J.*, **101**(7):518–527.
- WHO (World Health Organization). (1997). A WHO guide to good manufacturing practice (GMP) requirements. Part 2: Validation. Geneva. Available online: <http://www.who.int/vaccines-documents/DocsPDF/ww9666.pdf> (accessed: March 16, 2005).
- Williams, P. R. D., and Hammit, J. K. (2001). Perceived risks of conventional and organic produce: pesticides, pathogens, and natural toxins. *Risk Anal.*, **21**:319–330.
- Worsfold, D. (2001). Food safety behaviour in butchers' shops. *Nutr. Food Sci.*, **31**(1):13–18.
- Zschaler, R. (1989). Good Manufacturing Practice (GMP) in the food industry. *Zentralbl. Bakteriol. Mikrobiol. Hyg. [B]*, **87**(4–6):546–56.

2.1.2 Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety

Meta-analiza kot orodje za prepoznavanje ovir med vzpostavitvijo sistema HACCP z namenom izboljšanja varnosti živil

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V študiji je uporabljena metoda meta-analize z namenom ovrednotiti metodološke pristope v analiziranih delih in prepoznati, združiti in klasificirati ovire pri vzpostavitvi sistema HACCP. Sistem HACCP (Hazard Analysis and Critical Control Points System) je osnovan na znanstvenih temeljih z namenom prepoznavanja in obvladovanja tveganj v cilju zagotavljanja varnih živil. Vključuje sedem principov, ki služijo kot orodje za preprečevanje bolezni, povzročenih s hrano. Analizirana dela so bila prvotno izbrana preko specializirane podatkovne zbirke za področje živilstva Food Science and Technology Abstract (FSTA). V nadaljevanju iskanja dokumentacijskih virov je analizirana še baza podatkov Commonwealth Agricultural Bureau (CAB) ter baze, dostopne preko on-line informacijskega sistema COBISS. Kriteriji izbora so vključevali vsebinski in metodološki del. Vsebinski kriterij za vključitev enote analize je pogojeval delo, ki obravnava ovire za učinkovitost sistema HACCP. Metodološki kriterij pa tipologijo virov, in sicer, da ima delo značaj izvirnega raziskovalnega dela z definiranim metodološkim pristopom po shemi IMRAD (Introduction, Methods, Results, Discussion). Ključne besede za izbor znanstvenih in strokovnih del so bile: HACCP in ovire in vzpostavitev. Glavni rezultati metodološke analize izbranih znanstvenih del kažejo, da je najpogosteje izbrana metoda kvantitativna. Med kvalitativnimi metodami je najpogosteje uporabljen nestrukturiran intervju, med kvantitativnimi pa pregledne raziskovalne študije. Medtem ko nestrukturirani intervju omogoča poglobljeno analizo implicitnih predstav posameznika do sistema HACCP, ostale kvantitativne raziskovalne metode temeljijo na oceni frekvenčne porazdelitve določenega pojava ali vedenja v opazovani populaciji. Pri analizi implicitnih predstav posameznika na področju varnosti živil se v zadnjem obdobju uveljavlja psihološki pristop. Glavni namen metodološke analize je izpostaviti raziskovalna orodja, ki ponujajo nov vpogled v ovire pri vzpostavitvi sistema HACCP. Analiza ovir za učinkovitost sistema je omogočila identificirati elemente, ki so bili osnova za združevanje ovir v skupine ter v nadaljevanju določiti vpliv posameznega elementa na učinkovitost sistema HACCP. Predlagan je nov pristop k terminološki klasifikaciji prepoznanih ovir, ki bo v bodočnosti odprl nove dimenzije v zagotavljanju skupnega jezika med strokovnjaki na področju varnosti živil.

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META-ANALYSIS AS A TOOL FOR BARRIERS IDENTIFICATION DURING HACCP IMPLEMENTATION TO IMPROVE FOOD SAFETY

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The objectives of the study were twofold, i.e. to evaluate methodological approaches of analyzed papers and to identify, cluster, and classify barriers to HACCP system implementation using meta-analysis as methodological tool. Hazard Analysis and Critical Control Point (HACCP) is a science-based system of risk management designed to control food safety. HACCP is based on seven basic principles, which present an important tool in combating food borne disease. Articles for analysis were initially selected in the major on-line database for the field, namely "Food Science and Technology Abstract". Other databases were also used, including Commonwealth Agricultural Bureau and Co-operative Online Bibliographic System and Services. Selection was based on scientific excellence of the journal as well as on the method applied within the study. Main keywords to select appropriate scientific and technical articles were "HACCP", "barrier" and "implementation". Main results of methodological inquiry revealed that the most frequent methods used in scientific articles were quantitative ones. Among qualitative methods, the "narrative interview" was used most often, while among quantitative methods survey was used most frequently. Whereas narrative interview enables in-depth analysis of implicit role of individual actor in HACCP system, survey methods estimate frequency distributions of particular behaviours or attitudes in observed population. Lately, when analyzing implicit role of an individual in ensuring food safety, a psychological approach became important. The main goal of methodological analysis is to propose advances in research models that would tackle both qualitative and quantitative issues at the same time and offer new insights into barriers in HACCP system implementation. After analyzing the barriers to efficiency of the system, we identified elements that enabled us to cluster barriers into groups and identify the influence of specific elements on HACCP system efficiency. This paper is offering a novel approach to terminological classification of identified barriers, which will open new dimensions in assuring common language among food safety professionals in the future.

Keywords: meta-analysis, HACCP, efficiency, barriers, research

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Today, placing safe foodstuffs on the tables of consumers presents a problem, stretching from technology to legislation and from food manufacturer to consumer (RASPOR, 2004). It is of great importance to track and trace foodstuffs all the way from the animal's birth to the supermarket display case and at every step along the way (RASPOR, 2005). Ensuring safe foodstuffs in the age of globalization, changed lifestyles and nutrition patterns, is particularly problematic in the units of food chain, especially in small and medium size enterprises (SMEs) (WALKER & JONES, 2002; WALKER et al., 2003; WALCZAK & REUTER, 2004; SUN & OCKERMAN, 2005). HACCP is a system of quality control management placing clear responsibility for the result totally in the hands of those who handle the foodstuffs. System is appropriate, because it offers demands as strategies and do not act as directives. Thus it enables an individual approach in implementing HACCP to units of food chain. But the question is "Does HACCP really works in practice?" Lately, however, authors of technical and scientific articles started doubting the efficiency of HACCP, especially in SMEs (TAYLOR & TAYLOR, 2004b; VELA & FERNÁNDEZ, 2003; TAYLOR & TAYLOR, 2004a; HENROID & SNEED, 2004; AZANZA & ZAMORA-LUNA, 2005) and began searching for potential causes of the system's failed efficiency. Several studies have identified barriers to HACCP implementation in food service and retail (KIRBY, 1994; PANISELLO et al., 1999; MCSWANE & LINTON, 2000; GILLING, 2001; PANISELLO & QUANTICK, 2001; TAYLOR, 2001; ROBERTS & SNEED, 2003; VON HOLY, 2004; WAI, 2004; STROHBEHN et al., 2004). VON HOLY (2004) described that lack of financial and human resources are fundamental barriers to HACCP implementation in small food businesses. BAŞ and co-workers (2005) identified lack of understanding of HACCP as one of the main barriers, some of which are related to lack of knowledge about HACCP owing to lack of time, staff turnover, lack of employee motivation, complicated terminology and lack of personnel training. According to HIELM and co-workers (2006), most of the difficulties arose in devising the self-checking plan/HACCP plan. The most common answers about the crucial points in these plans were choosing the critical control points, committing the firm's entire workforce and organizing the documentation of monitored results. Data on risk factors for food borne diseases indicate that the majority of outbreaks result from faulty food handling practices (SORIANO et al., 2002a; 2002b; LEGNANI et al., 2004; BAŞ et al., 2005; LUES & VAN TONDER, 2005; SHOJAEI et al., 2006; HIELM et al., 2006; LUCCA & FERRAZ DA SILVA TORRES, 2006). Poor hygiene practice was also connected with improper or insufficient training in personal hygiene or employment of inexperienced personnel (HASAN et al., 2004; NEL et al., 2004; TENG et al., 2004; LUES & VAN TONDER, 2005; LUCCA & FERRAZ DA SILVA TORRES, 2006). Many authors emphasise the importance of training and qualifying people who set up the system, and those who execute and supervise it (DE WINTER, 1998; KHANDKE & MAYES, 1998; RASPOR, 2002; VANBAALE et al., 2003; STROHBEHN et al., 2004; AZANZA & ZAMORA-LUNA, 2005). Target training for food handlers is one of the key elements for decreasing food borne disease. When we consider the level of food borne diseases, it is difficult to ascertain an exact number of incidents as the cases of illness are significantly underreported (MCCARTHY et al., 2005; WINGSTRAND et al., 2006).

Problem is set in the non-uniform system of reporting food borne diseases as well. The burden of food borne disease is not well defined in many countries or regions or on a global level. The World Health Organization (WHO), in collaboration with other national public health agencies, is coordinating a number of international activities designed to assist countries in strengthening disease surveillance and in determining the burden of acute gastroenteritis. Although a number of countries have conducted studies to determine the burden of food borne disease, global estimates are lacking. The enormity of the problem is evident, through estimates of acute gastroenteritis incidence during childhood, for which an important proportion of cases are caused by food borne pathogens (FLINT et al., 2005).

Relevant literature offers different approaches and analyses of the causes for inefficiency, but they have not yet presented a final epilogue. Lately, the focus shifted to the implicit understandings of people that could be the cause of high risk in production, preparation and transport of foodstuffs (GILLING et al., 2001; TAYLOR & TAYLOR, 2004a; 2004b; JEVŠNIK et al., 2004; EVES & DERVISI, 2005). Reliable and valid scientific discoveries are a precondition for achieving the final goal of scientific research, namely discovering legality that enables explanation and subsequently prediction of observed phenomena (HLEBEC, 2001). It is understandable that complex behavioural barriers require detailed diagnostic tools and matching interventions to effectively overcome them. Behavioural research offers an innovative, yet logical approach to the problems existing within the field of food safety management, which has so far been mostly untouched (GILLING, 2001; GILLING et al., 2001). That is why further multidisciplinary research should be encouraged to seize the attention of a human being in units of food chain. Formal and informal organizational structures and relations should be taken into strong consideration. Due to a significant increase in information that scientists from different fields are facing today, a systematic approach to analysis of published discoveries has become essential. Meta-analysis became a popular method, whose purpose is to systematically analyze a number of significant discoveries of a specific field, which presents an essential element and answers the research questions. In 1976 the author Glass first invented the term meta-analysis to describe a systematic quantitative alternative to narrative literature reviews that enhances the scientific rigor of the review process (CORNELL & MULROW, 1999). The meta-analysis process of cleaning up and making sense of research literatures not only reveals the cumulative knowledge that is there, but also provides clearer directions about what the remaining research needs are (HUNTER & SCHMIDT, 2004).

1. Methods

1.1. Objective

We were motivated by doubts about the efficiency of HACCP tools for assuring safety of foodstuffs in the food chain units and consequently we conducted a methodological and content analysis of selected studies covering this particular topic from various

aspects. The objective of this article is a comparison and an analysis of methodological approaches used for recognizing barriers to HACCP implementation, as well as categorization of the barriers, as seen by authors of selected studies and determination of the influence factor on food safety of a single barrier. Meta-analysis as a methodological tool presents an introductory step of scientific work in determining levels of HACCP efficiency and is used to achieve this objective for the first time.

1.2. Methodology

A research method of meta-analysis was used to collect and analyze the selected scientific studies dealing with causes for inefficiency of HACCP implementation in food chain units. Documents were selected in two separated parts. First, keywords »HACCP« and »barrier« were used to get familiar with studies analyzing barriers to successful implementation of HACCP system. We used a specialized data collection in the field of foodstuffs: Food Science and Technology Abstract (FSTA) from the period from 1969 to April 2005. Second, we reviewed other relevant studies using Commonwealth Agricultural Bureau (CAB) from 1990 to April 2005 and other databases accessible through Co-operative Online Bibliographic System and Services (COBISS) from 1994 to April 2005. First part of the search proved to be too extensive; we obtained with these approach 62 articles and needed further selection. After screening all the articles, we narrowed the search pool by adding a key word »implementation« which gave us 16 articles. We selected six articles out of the first search and thirteen articles out of the second search. Then we structured them to the pool for meta-analyses.

Meta-analysis included content and methodological analysis. Criteria for selection of studies according to their content included their citation and analysis of barriers for successful implementation of HACCP. Methodologically, typology of sources was the main criteria. Every source had to be an original research with a defined methodological approach according to IMRAD (Introduction, Methods, Results, Discussion). Next, criteria of exclusion were defined to eliminate unsuitable documentation sources from further analysis. Studies not included in meta-analysis failed to address the issue of inefficiency of HACCP implementation and its application, unsuitable sources according to content and type of study, and popular literature (personal opinions, daily newspapers, popular publications, etc.). Technical articles were not included in meta-analysis, because they fulfilled only content criteria. We dealt with them separately with method of qualitative content analysis. After the screening all articles searching for relevant coverage of HACCP issues, it was decided that twelve scientific articles would be included in further qualitative meta-analysis and comparison according to chosen criteria. We numbered the studies and named them after the authors (No. 1: PANISELLO et al., 1999; No. 2: KARALIS & GUPTA, 2001; No. 3: GILLING et al., 2001; No. 4: CLAYTON et al., 2002; No. 5: ROBERTS & SNEED, 2003; No. 6: VELA & FERNÁNDEZ, 2003; No. 7: WALKER et al., 2003; No. 8: TAYLOR & TAYLOR, 2004a; No. 9: TAYLOR & TAYLOR, 2004b; No. 10: STROHBEHN et al., 2004; No. 11: AZANZA & ZAMORA-LUNA, 2005; No. 12: EVES & DERVISI, 2005).

Methodological approach of each study was deeply assessed and barriers to HACCP implementation were recognized. That enabled us to further develop methodological and content categories for comparison of chosen published studies.

2. Results

According to beforehand-defined criteria, we analysed seven technical and twelve scientific articles, which determine barriers to efficient implementation of the HACCP system. The group of seven technical articles was analyzed according to content criteria only. Meta-analysis included a selection of twelve scientific studies that were analyzed according to methodological and content criteria. The results of meta-analysis according to methodological and content categories are presented as follows. All studies were found in the following databases: FSTA, CAB and COBISS.

2.1. Methodological characteristics of scientific papers

Methodological characteristics were evaluated according to these categories: method, research instrument, research design, sampling, response rate, timing and duration of research (Tables 2, 3 and 4).

Method. Research papers were divided into three groups, i.e. quantitative, qualitative and mixed, combining quantitative and qualitative methods (Table 1). In six researches, the authors used exclusively quantitative method and in four researches exclusively qualitative ones. Combination of both methodological approaches was used in two researches. Quantitative methods were used in studies 1, 4, 5, 7, 10 and 11 in an attempt to recognize statistical characteristics of causes for HACCP inefficiency. Individual perceptions of persons integrated into the system were measured with qualitative methods in studies 3, 8, 9 and 12. Qualitative approach enables in-depth analysis of individual's perceptions in an attempt to grasp complexity of problems, especially in the phase of HACCP implementation. Researches 3 and 6 use a more complex approach, namely combination of quantitative and qualitative methods that enable the authors' to have an even greater insight into the problems in question. The study used both qualitative approach and method of sample selection. The latter could not be categorized into any methodological paradigm used in social sciences, as it is applicable only in natural sciences.

Research instrument. In accordance with chosen methods, authors decided on the use of methodological tools. Recognizing barriers to successful HACCP implementation strongly depends on the chosen methodological tools. Most authors decided to use questionnaires, which is consistent with their quantitative research approach. In studies 3, 8, 9 and 12, authors used a qualitative method of face-to-face semi-structured narrative interview. Other methodological tools, including non-participant observation, telephone interview and expert evaluation were used only once.

Table 1. Methodological approaches recognized in twelve selected scientific studies

Method	Research instrument	Study No.	Total No. of study
Quantitative study	Survey (questionnaire)	1, 4, 5, 7, 10, 11	6
Qualitative study	Face to face semi-structured narrative interview	8, 9	4
	Face to face semi-structured narrative interview and non-participant observation	12	
	Observation	2	
Mixed study (quantitative and qualitative method)	Telephone interview and face to face narrative interview	3	2
	Questionnaire and expert evaluation	6	

Research design. Insight into research process was significant for methodological part of meta-analysis. Authors' descriptions of the research process were used to recognize the way methodological tools were used. Authors of qualitative studies tend to describe their research design more in detail than authors of quantitative studies. In three out of six quantitative researches (studies 5, 7, 10), authors conducted pilot testing of questionnaire and further assessed appropriateness of the instrument. Other studies that used combination of methods do not offer information about pilot testing. Pilot testing is usually not suitable for case studies, while it is often conducted prior to extensive quantitative research.

Sampling. Consistent sampling is of great importance, especially in quantitative studies, whereas qualitative methodological approach allows authors more freedom in choosing the sample and as such is not a key element in research process description. According to 'Grounded theory approach' that is frequently used in qualitative research, the sampling of concrete individuals, groups or fields is not based on the usual criteria and techniques of statistical sampling. Samples of analyzed studies are either random, systematic random or expert ones. In most studies, sampling is presented quite consistently, although sampling frame is inadequately defined in studies 3, 5, 6, 7, 8, 12 and the process of sample selection is not clear in studies 1, 2, 5, 7, 8, 12. Sample is undefined in studies 1, 7 and 12. Sample sizes vary considerably. Smaller samples are justifiably used in qualitative studies, where only one person or a small group is considered. There are also two quantitative studies (6 and 11) that use small sample size, between 30 and 40 units, but as such do not assure representativeness and applicability to target population.

Response rate. All authors, using exclusively quantitative methods, stated response rate. The only study that failed to state response rate was study 3, which used both quantitative and qualitative methods. Qualitative studies do not state response rate, as this data is irrelevant.

Timing and duration. Authors of qualitative research do not state information about time and duration of research. This information is not given either in three qualitative researches (studies 4, 7, 11) and in study 6 that used combination of the

methods. Research results are strongly associated with time of observation, as old data often proves irrelevant in present situations.

2.2. Content analysis of scientific studies

Content of 12 selected scientific studies was evaluated according to five categories: publishing year, location of research, objectives, identified barriers and proposed measures (Tables 5, 6 and 7).

Publishing year. Scientific research studies that searched for barriers to successful HACCP implementation were published from 1999 to 2005. The number of published papers increased with the year of publishing. From 2003 to 2005, eight researches were published, whereas from 1999 to 2002 only four were published.

Location of research. Most of the researches were conducted in regions of developed countries (seven in UK, two in USA, one in Australia and one in Spain), which enable good comparison of research results. One research was conducted in the Philippines, but this is comparable with other research results as HACCP was recommended by CODEX ALIMENTARIUS COMMISSION (2003), as part of its revised guidelines on the General Principles of Food Hygiene in the Philippines as early as 1993.

Objectives. All the authors followed the same objective, namely to recognize barriers to successful HACCP implementation, although starting points for their researches were different. That could be ascribed to their different disciplinary backgrounds. Disciplinary background of researchers was explicitly stated in only two studies, so we searched for their employment information. Mostly, they are active in the field of food technology, management and public health. Authors of most studies (1, 6, 8, 9, 10 and 12) tried to recognize and present, with different methodological approaches, barriers that prevent successful HACCP implementation. PANISELLO and co-workers (1999) determined the level of HACCP implementation and ROBERTS and SNEED (2003) studied the level of implementation of prerequisite programs and HACCP system in small chain restaurants. KARALIS and GUPTA (2001) tried to establish risk levels concerning manufacture, distribution and sale of Asian perishable food and connection between microbiological status of foodstuffs and procedural deficiencies. Most of the studies do not mention implementation of HACCP in ethnic economies, with exception of study 2 that explicitly researched Asian perishable food businesses in inner western Sydney area. However, it would be sensible to compare Australian food businesses in the same area to reduce implicit stigmatization of the ethnic group in question. GILLING and co-workers (2001) tried to understand the barriers through the use of a Behavioural Adherence Model. Their report took a psychological approach to the problem by examining processes and factors that could obstruct adherence to the internationally accepted HACCP guidelines and subsequent successful implementation of HACCP. WALKER and co-workers (2003) wanted to assess the hygiene knowledge of food handlers from small businesses. In the study of AZANZA and ZAMORA-LUNA (2005), a cognitive-behaviour barrier model to HACCP guideline adherence for individuals comprising the HACCP team was developed. The model was established by consolidation of various concepts from similar models used in assessing physician

adherence to medical guidelines. Objectives of individual studies are presented in more detail in Tables 5, 6 and 7.

Identified barriers. Authors recognize HACCP implementation barriers with the use of different methodological approaches. They also present their findings in various ways, so comparison proved to be rather difficult. There is still no unified concept or terminological model that could be followed when categorizing and evaluating implementation barriers, which makes system categorization difficult and intricate. After an analysis of selected studies, we recognized barriers and presented them in Tables 5, 6 and 7. Next, we carefully analyzed each barrier and linked similar ones, according to their content, into groups. Twenty one new groups of barriers were created and named as »elements« that affect HACCP efficiency. Basic criteria for rating the influence of a particular element on HACCP efficiency was frequency of its citing in analyzed studies (Table 8). Barriers most frequently stated include lack of expertise, technical expertise, staff food hygiene training, understanding, cueing mechanism etc., which we linked together under the element »Training«; and lack of manpower, awareness, agreement, self-efficacy, outcome expectancy, motivation, staff, gender, educational level, etc., which are all included in the element »Human resources«. Most authors state lack of time for systems' implementation as an important barrier. We included it in an element »Planning«. Element »Knowledge« includes knowledge about principles of HACCP system and good hygiene practice. Clustering the barriers into elements is presented in detail in Table 8.

Proposed measures. The objective of analyzed studies was to recognize and understand various barriers for successful implementation of HACCP. Further solutions were only indicated and suggested for further research. Some authors, however, do suggest concrete guidelines or solutions for achieving better food safety, yet they fail to present a concrete strategy to achieve this objective. In studies 3, 6 and 11, the authors present barriers through a model, which stresses importance of researching implicit stance of individuals who are working with foodstuffs. Three qualitative researches (studies 4, 8 and 9) stress the importance of observing and analyzing human behaviour. Authors of these studies suggest the use of psychological theories (studies 8 and 9) in order to grasp problems regarding individual's acceptance and recognition of HACCP, and stress the importance of observing employees when handling foodstuffs (study 4).

2.2.1. Barrier clustering. When recognizing barriers to successful implementation of HACCP in the food industry units we realized there is still no unified concept available for their categorization. There is also no terminological model that would unify content related barriers. In the first part of content analysis, we presented barriers as seen, understood and stated by authors of the studies (Table 5, 6 and 7). Next, we clustered content related barriers into 21 new categories, named »elements« (Table 8).

To test suitability of new classification that would enable more systematic insight into barriers to HACCP efficiency, we carefully examined definitions for the elements, stated in analyzed studies, EC REGULATION (2002), recommendations of CODEX ALIMENTARIUS COMMISSION (2003), international standards ISO (2001), ISO (2005), BRC (2002) and other expert literature (VILA, 1994; ANON. (2004) (Table 9).

Table 2. Analysis of methodological characteristics of published papers (first part)

Characteristics		Published papers			
		1	2	3	4
Method	Quantitative study	PANISELLO et al. (1999)	KARALIS & GUPTA (2001)	GILLING et al. (2001)	CLAYTON et al. (2002)
Research instrument	Mail questionnaire		Qualitative study a) Qualitative: observation (using standardized inspection checklist) b) Food sampling and product packaging sampling (the method of sample selection cannot be categorized in either quantitative or qualitative methodological approach).	Mixed study a) Quantitative: telephone interviews b) Qualitative: face to face, discovery-focused narrative interview	Quantitative study Questionnaire, respondents visited by interviewers, questionnaires filled out and returned during the visit.
Research design	The final version of the questionnaire contained 24 questions, which was reviewed by a panel of food science and technology consultants for accuracy, proper wording and overall format.		a) The visual inspection of manufacturing premises and prerequisite programs using inspection checklist and recording comments relating to deficiencies observed. b) Perishable foods sampled (MB, CE analysis) from each manufacturer were obtained from cold storage (sample description). Product packaging was sampled to check for breaches in labelling.	a) Telephone interviews conducted with owners or managers of small businesses and technical managers of larger companies (sample description in abstract does not comply with the one stated in <i>Procedure</i> (article page 711); authors do not state the total number of conducted telephone calls; response rate not known). b) Face-to-face narrative interviews with food business proprietors.	– Questionnaire design: first part open-ended questions, second part closed questions. – Questionnaire developed around the constructs of the Theory of Planned Behaviour and The Health Belief Model.

Table 2. (cont.)

Characteristics	Published papers			
	1	2	3	4
	PANISELLO et al. (1999)	KARALIS & GUPTA (2001)	GILLING et al. (2001)	CLAYTON et al. (2002)
Sampling	<p>Undefined sample</p> <p>– A mailing list of 1000 food companies selected from a chosen and relevant database based on number of employees (<250) and area of location.</p> <p>– 175 completed and returned surveys</p>	<p>Expert (a) and random (b) sample</p> <p>a) 15 manufacturers of Asian perishable food.</p> <p>b) Perishable foods and product packaging randomly sampled from each manufacture.</p>	<p>Random (a) and expert (b) sample</p> <p>a) Telephone interviews involved 200 businesses, categorized by size: micro (<10), small (10–50), medium (51–250), and large (>250) and random sample was taken from each category; All groups of the food industry are represented within this sample.</p> <p>b) 5 face-to-face narrative interviews (farmer, baker, Asian-cuisine, egg packing co., meat cutting co.)</p>	<p>Systematic random sample</p> <p>– Every tenth SME of 2616 listed in the Cardiff register.</p> <p>– 260 selected food premises telephoned to determine whether they fit the selection criteria (SME: <250 employees; prepare or handle high risk foods).</p> <p>– Questionnaires completed by all available food handlers (managers and part-time workers): 55 out of the 149.</p>
Response rate	17.5%	100%	/	37%
Timing and duration	March – May 1998	June – September 1998	/	/

Table 3. Analysis of methodological characteristics of published papers (second part)

		Published papers			
		5	6	7	8
		ROBERTS & SNEED (2003)	VELA & FERNANDEZ (2003)	WALKER et al. (2003)	TAYLOR & TAYLOR (2004a)
Characteristics					
Method		Quantitative study	Mixed study	Quantitative study	Qualitative study
Research instrument		Mail questionnaire (in four parts)	a) Qualitative: expert evaluation of HACCP plans b) Quantitative: questionnaire	Questionnaire, using face-to-face interview technique (questions read aloud during the interview).	Non-prescriptive narrative in-depth interview
Research design		– Pilot study conducted. – A total of 800 questionnaires were mailed to a sample of restaurant managers. 110 returned (wrong address or no longer in business). – Out of the 690 usable questionnaires 131 were returned.	a) First stage: Expert evaluation of HACCP plans of selected companies; Meeting with business representatives and food assessors (if any) to inform about irregularities and gaps found in the plan; b) Second stage: Invitation of business representatives and their food assessors to dialogue about self control system and filling a questionnaire (two models)	– Pilot study conducted. – Questions, each with 4 or 5 possible answers and a series of open questions. – Each business visited by personnel trained in conducting face-to-face interviews and administering questionnaires. – Food handlers asked individually about their background details; remaining of the questionnaire was completed individually without discussion with other personnel. – Review of answers to determine eventual misinterpretation of questions.	– Four questions designed merely as a starting point for the stories, memories and associations of the interviewee. – Transcription of an interview text, including words with all remarks of both interviewer and interviewee.
Sampling		Random sample The sample (131 restaurant managers) consisted only of restaurants that are independently owned and operated or small chains (less than 10 units).	Expert sample a) 29 food industries; 22 of meat sector, 5 of fish products, 2 of dairy products. b) 29 business representatives and 12 food assessors (speculation*)	Undefined sample (two different terms, namely: external consultants and food assessors were probably used as synonyms, which cause the reader some confusion. The description of materials and methods in the study is rather unclear due to, we believe, a poor translation from Spanish). – 159 small independent food businesses with the average no. of employees (<10) contacted/104 participated. – 444 food handlers completed the questionnaire	A pen-portrait of one small farm owner

Table 3. (cont.)

Characteristics	Published papers		
	5	6	7
	ROBERTS & SNEED (2003)	VELA & FERNANDEZ (2003)	WALKER et al. (2003)
Response rate	19%	a) 100% b) 16 completed surveys from companies (55.2%) and 11 out of 12 (91.6%) from consultants were obtained.	65%
Timing and duration	– Initial mailing done in January 2002. – A follow up postcard sent two weeks after the initial mailing – A second questionnaire mailed after two weeks for those who did not reply after the postcard		TAYLOR & TAYLOR (2004a)

Table 4. Analysis of methodological characteristics of published papers (third part)

Characteristics	Published papers		
	9	10	11
	TAYLOR & TAYLOR (2004b)	STROHBEHN et al. (2004)	AZANZA & ZAMORA-LUNA (2005)
Method	Qualitative study	Quantitative study	Qualitative study
Research instrument	Non-prescriptive narrative interview with open-ended questions	Mail questionnaire	Questionnaire, using face-to-face narrative interview technique (questions read aloud during the interview).
Research design	<ul style="list-style-type: none"> - Four small business owners - Four questions designed as a starting point for the stories, memories and associations. - The interview transcribed with both the interviewer and the interviewee's words with all remarks. - Analysis: per-portrait of the four interviewees. 	<ul style="list-style-type: none"> - Pilot study conducted. - A four-structure questionnaire developed and mailed to the sample of health care professionals: registered dieticians (RDs) and dietary managers (DMs). 	<ul style="list-style-type: none"> - A questionnaire designed, based on the developed cognitive-behaviour barrier model to HACCP principle adherence. - questions with multiple choices for the answers and other open-ended queries - The modes of communications used to recruit participants: electronic and ordinary mail, field visits, or telephone calls.
Sampling	<ul style="list-style-type: none"> Random sample: 4 managers of SMEs (from 30 currently receiving support from the University). 	<ul style="list-style-type: none"> - Random sample: 1181 RDs of 20% of the total population of members of this dietetic practice group. - Expert sample; 274 DMs, who listed assisted-living facilities as place of employment (2% of the total membership). 	<ul style="list-style-type: none"> - Tape recorded interviews (post partum transcribed verbatim) and hand-written notes. - Content analysis - Observing practices in the establishments during routine visits by the enforcement officers. Undefined sample - Managers of seven foodservice outlets (responsible for the operation of the production area) - Ethnic restaurants excluded
Response rate		Total sample: 1455, response rate 38% (441)	27 respondents from 4 processors: 18 from meat industry (10+8); 9 from beverage industry (5+4)
Timing and duration		February, March 2003	

Table 5. Content analysis of published papers (first part)

Characteristics	Published papers			
	1	2	3	4
Location of research	PANISELLO et al. (1999)	KARALIS & GUPTA (2001)	GILLING et al. (2001)	CLAYTON et al. (2002)
Objectives	Yorkshire and Humberside region, UK a) Establishment of the level of implementation of HACCP systems. b) Gathering information of industry's knowledge and hazards awareness. c) Establishment of barriers to HACCP implementation.	Inner western Sydney area a) Identification of potential hazards associated with the manufacture of Asian perishable foods, their distribution and sale. b) Assessment of the relationship between procedural deficiencies and microbiological status of these foods.	Northwest of England, UK Understanding the barriers through the use of a Behavioural Adherence Model.	Cardiff, UK Utilization of elements of social cognitive theory in order to begin to examine the factors underlying food handlers' hygiene behaviour.
Identified barriers	a) Implementation of HACCP (especially smaller businesses): Lack of knowledge and expertise in HACCP; Lack of adequate resources such as time, manpower and management commitment to obtain this knowledge) b) Incomplete hazard identification c) Factors which may threaten the HACCP philosophy (size of the company, accessibility of information, technical expertise); the HACCP tool (lack of knowledge and expertise)	a) Staff hygiene (hygiene practice), food handling (temperature control), transport - Lack of operating HACCP plans - Poor food handling and hygiene practices - Poor handling or improper sanitation procedures - Insufficient staff food hygiene training b) Inadequacies in the current and proposed Food Standards Codes regarding <i>B. cereus</i> and many food products	- Lack of awareness - Lack of understanding - Lack of agreement - Lack of self-efficacy - Lack of outcome expectancy - Lack of motivation - Lack of cueing mechanism - Lack of competence - Lack of environmental factors - Resources - Lack of guideline factors (Lack of model HACCP program) - Negative external/customer factor	- Lack of time - Lack of staff - Lack of resources (poorly designed workspaces, insufficient work equipment) - Poor management perception of the problems that existed within the context of food safety

Table 5. (cont.)

		Published papers			
		1	2	3	4
Characteristics		PANISELLO et al. (1999)	KARALIS & GUPTA (2001)	GILLING et al. (2001)	CLAYTON et al. (2002)
Ascertainment and proposed measures		The barriers, which interfere in the implementation of HACCP, can be divided into those which threaten the HACCP philosophy and those which threaten the HACCP tool. Allocate direct action and effort to those involved, food industry, enforcement and regulatory authorities to improve hazard identification across all sectors involved in the handling of foodstuffs.	– Future research, development of multilingual educational material; microbiological guidelines, which are not legally enforceable. – Emphasizes the requirement for more effort in education, promoting HACCP and research to identify cultural barriers to implementing appropriate HACCP procedures at manufacturing and government levels.	The proposed model acts as a diagnostic tool, identifying progressive stages to successful HACCP guideline adherence. The current model requires further testing and review to ensure completely successful transference and validation of the newly established barriers. More work is needed to establish: – comparative weighting of each barrier; the sequence in which they occur, and the emergence of additional barriers requiring inclusion within the model; – different problems encountered by large, medium, and small businesses; – different perspective of food operatives compared to supervisors or managers; – variation of problems in different types of food businesses	Behavioural change will not occur merely as a result of training. Future research is needed to observe the behaviour of food handlers in their natural work setting. Food hygiene training needs to embody the concept of risk in order to emphasize to food handlers, especially those in a managerial role, the level of risk associated with their business.

Table 6. Content analysis of published papers (second part)

		Published papers			
		5	6	7	8
Characteristics		ROBERTS & SNEED (2003)	VELA & FERNANDEZ (2003)	WALKER et al. (2003)	TAYLOR & TAYLOR (2004a)
Location of research		Iowa, USA	District of Alcorcon and the VII Health Area of Community of Madrid	East Midlands region, UK	Avon, UK
Objectives		Determine the extent to which PRP and HACCP programs are implemented in independent and small chain restaurants.	– Identification of main difficulties and barriers in developing and implementing HACCP plans in food industries. – Overcoming those barriers and achieving good implementation of HACCP plans.	Assessment of hygiene knowledge of food handlers from small businesses*.	Uncover the range and interplay of barriers involved in small farm owner failure to implement HACCP, and to demonstrate how these can operate at knowledge, attitude and behavioural levels.
Identified barriers		– Non-defined primary responsibility for implementing and monitoring food safety practices to specific employees. – Restaurant managers' perceptions of HACCP depend on gender and educational level. – Implementation of food safety practices. – Resources (training programs must be cost effective). – Many restaurants do not have written policies and procedures.	– Lack of specific hazard analysis (negative guideline factors, lack of understanding) – Negative external/customer factor – Lack of outcome expectancy – Lack of agreement – Negative environmental factors (time, money)	– Lack of continuous training – Knowledge of hygienic practice was poor – Lack of temperature understanding – Poor knowledge of keeping work-surfaces hygienically clean	– Thoughts and experiences – Limited understanding (a knowledge barrier) – Lack of agreement and motivation (an attitude barrier) – Lack of credibility and oppression of HACCP officials and authorities – Misunderstandings and negative attitudes toward HACCP guidelines – Time and money spent on HACCP

Table 6. Content analysis of published papers (second part)

Characteristics	Published papers		
	5	6	7
	ROBERTS & SNEED (2003)	VELA & FERNANDEZ (2003)	WALKER et al. (2003)
Ascertainment and proposed measures	<p>Restaurant managers could use these survey questions as a self-assessment tool to evaluate current practices and identify areas where improvement is needed.</p> <p>Assigning responsibility for food safety to specific employees increases the number of food safety practices implemented in restaurants.</p> <p>More opportunities are needed for basic food safety training of employees at the restaurant level.</p> <p>Extension or state restaurants associations could develop a model HACCP program that would aid restaurant owners and managers in implementing such programs.</p>	<p>Administration should play actions in order to develop clear and detailed guides in Spanish for HACCP system with specific attention to hazard analysis and PRP and their relation to HACCP plan.</p> <p>Successfulness of HACCP system depends on the education, training and motivation of both managing and working personnel.</p> <p>Plan activities targeted at consultants, managers and owners with the aim of improving knowledge and understanding, and to improve the attitude to achieve that business management includes food safety.</p>	<p>Food handlers may be aware of the need for personal hygiene, but they do not comprehend crucial aspects of hygiene such as cleaning of work surfaces and cannot link temperature values with the role of cooking and low temperature storage for the control of MB hazards.</p>
			TAYLOR & TAYLOR (2004a)
			<p>The way people understand and formulate attitudes toward HACCP will be based initially on their first introduction to it, and work needs to be done on making such introductions accessible, relevant and positive.</p> <p>The emphasis on documentation needs to be lessened, both in presentation and actual practice. Paperwork should be at its minimum to ensure food safety, and valued as such.</p> <p>Further research is clearly a must, just like increased acceptance and use of new methods such as qualitative psychological techniques.</p>

Table 7. Content analysis of published papers (third part)

		Published papers			
		9	10	11	12
		TAYLOR & TAYLOR (2004b)	STROHBEHN et al. (2004)	AZANZA & ZAMORA-LUNA (2005)	EVES & DERVISI (2005)
		North West of England, UK	USA	National Capital Region and Region 4 in Philippines	South East of England, UK
Characteristics					
Location of research					
Objectives	Addressing the issue of HACCP implementation barriers by analyzing qualitative psychological interplay of factors.	Elicit opinions and views of food service practitioners and experts about HACCP implementation in assisted-living facilities for the elderly.	Development of the cognitive-behaviour barrier model to comprehensively present the sequence of barriers that must be overcome by HACCP team members.	Exploration of experiences of the implementation and operation of the HACCP system in the food service sector, and identification of barriers faced to its successful use.	
Identified barriers	<ul style="list-style-type: none"> - The difficulty of HACCP (the lack of help, lack of technical knowledge, difficult to remember to do everything that you should) - The burden of HACCP (they did not have the staff or time to deal with it) - HACCP as unnecessary (documentation only, concern should go back to the farms) - Staff problems with HACCP (staff motivation and understanding: lack of training, level of practical experience) - External problems with HACCP (credibility of consultants, lack of reinforcement for their attempts) 	<ul style="list-style-type: none"> - Inexperienced employees - Lack of knowledge about hand washing - Lack of hand washing practices - Written policies and procedures for the foodservice department such as storage and cooking - Need for policies about food production area access by other facility employees and employee uniforms - Factors of employees (knowledge, training, turnover) - Time issues (expense of training, time to develop HACCP, time to train employees, time to implement HACCP) - Commitment to HACCP (by managers and by employees, perception of value of HACCP, monitoring of HACCP) 	<ul style="list-style-type: none"> - Non-awareness of HACCP principles and tasks - Knowledge (awareness, familiarity, comprehension) - Inadequate and inappropriate information dissemination systems - Limited time and accessibility of HACCP information - Insufficient or lack of evaluation of the efficacy of HACCP education 	<ul style="list-style-type: none"> - Inaccurate identification of hazards - Lack of understanding of hazards - Conflict of interests - Lack of expertise in key areas - Inadequate knowledge - Lack of skills - Time-related issues relating to monitoring and recording - Excessive documentation - Convincing staff of the importance of the system - Increased costs - Not realistic and helpful recommendations by enforcement officers on some occasions 	

Table 7. (cont.)

Characteristics	Published papers		
	9	10	11
Ascertainment and proposed measures	<p>TAYLOR & TAYLOR (2004b)</p> <p>More research needs to be done, and new methods such as the qualitative psychological approach need to be given greater acceptance and put to greater use.</p>	<p>STROIBBEHN et al. (2004)</p> <p>– The need to increase training on proper hand washing for staff members – The specific need for written policies to address the issue of access to food production areas by other facility employees and others (vendors, visitors) – Future research: Investigate ownership structure; analyse input from facility executive staff to assess commitment levels and willingness to allocate resources to ensure safety of food served in their facilities.</p>	<p>AZANZA & ZAMORA-LUNA (2005)</p> <p>More intensive knowledge-based intervention strategies specifically designed for HACCP team members must be formulated and implemented as an initial step to achieve HACCP guideline adherence. More accessible HACCP information. The usefulness of the developed HACCP guideline cognitive-behaviour barrier model could still be further studied. Better educate HACCP instructors and industry implementers.</p>
			<p>EVES & DERSIVI (2005)</p> <p>The particular issues around language ability and training HACCP could usefully form the basis of further study. HACCP per se does not make food safe, but it is its correct application that can make a difference. The barriers to HACCP should be assessed and their impact evaluated.</p>

Table 8. Type of barriers identified in analysed research papers, integrated into 21 elements of food safety system

Elements	Type of barriers by No. of study	Total No. of identified barriers
Communication	Accessibility of information (1); Information system; HACCP information accessibility (11)	2
Customer	Negative external / customer factor (3, 6)	2
Credibility	Credibility and oppression of HACCP officials and authorities (8); Credibility of consultants (9); Credibility of enforcement officials (12)	3
Documentation	Documented procedures (2); Guideline factors (3); Written procedures (5); Guideline factors (6); Written procedures; Record keeping (10); Excessive documentation (12)	6
Food handling	Food handling and hygiene practice (2); Food handling area (10)	2
Food legislation, food standards	Inadequacies in food standards (2)	1
Food safety policy	Written policy (5, 10)	2
Hazard analysis	Incomplete hazard identification (1); Inaccurate identification of hazards (12)	2
Human resources	Manpower (1); Awareness, agreement, self-efficacy, outcome expectancy, motivation (3); Staff (4); Gender, educational level (5); Agreement, outcome expectancy (6); Thoughts and experiences; Agreement, motivation (8); Staff, Negative attitude; Motivation (9); Inexperienced employees; Turnover; Employee commitment (10); Awareness, familiarity, comprehension (11); Conflict of interests; Awareness; Lack of expertise in key areas (12)	10
Infrastructure	Workspaces, work equipment (4)	1
Knowledge and competence	Knowledge (1); Knowledge of hygienic and cleaning practice (7); Misunderstandings and negative attitudes toward HACCP guidelines (8); Technical knowledge; Practical experience (9); Knowledge of employees (about hand washing), HACCP perception (10); Inefficient HACCP education (11); Understanding of hazards; Inadequate knowledge (12)	7
Maintenance and sanitation	Handling of improper sanitation procedures (2)	1
Management commitment	Management commitment (1, 10, 11); Management perceptions (4)	4
Operation control	Temperature control (2)	1
Organizational design	Company size (1); Organizational structure (3)	2
Personal hygiene	Staff hygiene (2); Hand washing practices; Protective clothing (10)	2
Planning	Time (1, 3, 4, 6, 8, 9, 10, 11); Time to performing (12)	9
Resources	Resources (3); Money (6, 8); Expense of training (10); Costs (12)	5
Responsibility and authority	Non-defined primary responsibility (5); Help; External support (9)	2
Training	Expertise; Technical expertise (1); Staff food hygiene training (2); Understanding, cueing mechanism, competence (3); Training efficiency (5); Understanding (6); Continuous training; Temperature understanding (7); Limited understanding (8); Difficult to remember; Understanding (9); Training of employees (10); Skills (12)	10
Transportation	Transport (2)	1

Table 9. Elements of food safety and their explanations

Elements	Definition by authors	Explanation in literature	
		Explanation	Sources
Communication	Communication is the process of effective exchanging of information inside or outside the company.	The organization shall establish, implement and maintain effective arrangements for communicating with personnel on issues having an impact on food safety. To ensure that sufficient information on issues concerning food safety are available throughout the food chain, the organization shall establish, implement and maintain effective arrangements for communicating with suppliers and contractors, customers, food authorities and other organizations that have an impact on or will be affected by the effectiveness or updating of the food safety management system.	ISO (2005)
Customer	The word customer is meant as concentration of attention or action on customer's desire.	The company's senior management shall ensure that processes are in place to determine their customer's needs and expectations clearly, and define their requirements and ensure that these requirements are fulfilled.	BRC (2002)
Credibility	Credibility is food producers' ability to demonstrate that the object (food or service) is accurately identified and described on the way in which it was conducted.	Credibility is the believability of a statement, action, or source, and the ability of the observer to believe the above.	http://en.wikipedia.org/wiki/Credibility
Documentation	All writings that provide information: documents and records in any form that describe or record the methods, conduct, results of trials, the actions taken or omitted.	The food safety management system documentation shall include: documented statements of a food safety policy and objectives; documented procedures and records; documents, including records needed by the organization to ensure the effective development, implementation and updating of the food safety management system. These issues can be done by any means (e.g. paper, electronic or screen).	ISO (2005)
Food legislation, food standards	A law is a rule of conduct established and enforced by the authority of a given community, state, or nation. A standard is a definition that has been approved by a recognized standards organization or is accepted as a <i>de facto</i> standard by the industry.	Food law means the laws, regulations and administrative provisions governing food in general, and food safety in particular, whether at Community or national level; it covers any stage of production, processing and distribution of food, and also of feed produced for, or fed to food producing animals. Standard specifies the requirements for a food safety system and combines the generally recognized key elements to ensure food safety along the food chain.	EC REGULATION (2002); ISO (2005)

Table 9. (cont.)

Elements	Definition by authors	Explanation in literature	Sources
Food safety policy	A food safety policy is a written plan of action adopted by management.	Top management of the organization shall define, document and communicate its food safety policy. Top management shall ensure that the food safety policy is related to the organization's role in the food chain; that the food safety policy is in compliance with both the mutually agreed food safety requirements of customers and with regulatory requirements; that the food safety policy is communicated, implemented and maintained at all levels of the organization and is reviewed for continued suitability, and ensure that communication is adequately addressed by the food safety policy. The food safety policy shall be supported by measurable objectives.	ISO 22000 (31)
Food handling	Food handling means every operation during handling or preparing of food. It is a part of HACCP approach, which starts with the purchase and continues in the food business.	The 5 Keys strategy is complemented by a manual, which helps individuals to adopt good food-handling practices: they show how people around the world, no matter where and how they live, can protect themselves from food borne illness.	ANON. (2004)
Hazard analysis	Identifying and controlling the hazards in each food preparation process listed above achieves the same control of risk factors as preparing a HACCP plan for each individual product.	The food safety team shall conduct a hazard analysis to determine which hazards need to be controlled, the degree of control required to ensure food safety, and which combination of control measures is required. All food safety hazards that are reasonably expected to occur in relation to the type of product, type of process and actual processing facilities shall be identified and recorded.	ISO (2005)
Human resources	The expression, human resources, unites health, strength, talents, education and skills that humans can use to produce goods and services.	The food safety team and other personnel carrying out activities affecting food safety shall be competent and have the appropriate education, training, skills and experience. Where the assistance of external experts is required for the development, implementation, or operation of the food safety management system, records of agreement shall be made defining the responsibility and authority of such experts.	ISO (2005)
Infrastructure	The basic facilities, services, and installations needed for the functioning of a plant, such as transportation, buildings, equipment and communication systems, water and power lines, etc.	The organization shall determine, provide and maintain the infrastructure needed to achieve conformity to product requirements. Infrastructure includes, as applicable: buildings, workspace and associated utilities; process equipment (both hardware and software) and supporting services (such as transport or communication).	ISO (2001)
Knowledge and competence	Knowledge is the awareness and understanding of facts, truths or information gained in the form of experience or learning. Competence is a demonstrated ability to apply knowledge and skills.	The food safety team and other personnel carrying out activities affecting food safety shall be competent and have the appropriate education, training, skills and experience. Where the assistance of external experts is required for the development, implementation, or operation of the food safety management system, records of agreement shall be made defining the responsibility and authority of such experts.	ISO (2005)

Table 9. (cont.)

Elements	Definition by authors	Explanation in literature	
		Explanation	Sources
Maintenance and sanitation	Cleaning and disinfection programmes should ensure that all parts of the establishment are appropriately clean. Food premises and facilities should be kept clean and maintained in good repair and condition.	Food premises are to be kept clean and maintained in good repair and condition. The layout, design, construction, siting and size of food premises should: (a) permit adequate maintenance, cleaning and/or disinfection, avoid or minimise air-borne contamination, and provide adequate working space to allow for the hygienic performance of all operations; (b) be such, so as to protect against the accumulation of dirt, contact with toxic materials, the shedding of particles into food and the formation of condensation or undesirable mould on surfaces; (c) permit good food hygiene practices, including protection against contamination and, in particular, pest control.	EC REGULATION (2004)
Management commitment	A promise, usually in writing of management binding to a course of action that will ensure food safety.	Top management shall provide evidence of its commitment to the development and implementation of the food safety management system. The business objectives of the organization shall support food safety.	ISO (2005)
Operational control	The purpose of this procedure is to control key activities and operations in line with food safety objectives and targets.	Operational prerequisite programme identified by the hazard analysis as essential in order to control the likelihood of introducing food safety hazards to and/or the contamination or proliferation of food safety hazards in the product(s) or in the processing environment.	ISO (2005)
Organizational design	Organizational design takes into account four crucial performance factors: strategy, structure, system and culture, which enable organization to fulfil its purpose and objectives.	Organizational design is a selection of such kind of organizational structure, which is harmonized with its own company strategy and demands of the environment in such a manner that the company is able to attain its objectives.	VILA (1994)
Personal hygiene	Personal hygiene includes cleanliness, clothing (clean and protective clothing including suitable head coverings), food safety habits, first aid equipment, appropriate and sufficient hand wash basins, staff facilities (staff toilet facilities, staff changing area).	Every person working in a food-handling area is to maintain a high degree of personal cleanliness and is to wear suitable, clean and, where necessary, protective clothing. No person suffering from, or being a carrier of a disease likely to be transmitted through food or afflicted, is to be permitted to handle food or enter any food-handling area.	EC REGULATION (2004)
Planning	The process of anticipating future occurrences and problems, exploring their probable impact, and detailing policies, goals, objectives, and strategies to solve the problems. This often includes preparing options documents, considering alternatives, time needed, financial and human resources and issuing final plans.	The organization shall plan and develop the processes needed for the realization of safe products. This is achieved through effective development, implementation, monitoring or planned activities, maintenance and verification of control measures in the food process and process environment and through appropriate actions in the event of nonconformities.	ISO (2005)

Table 9. (cont.)

Elements	Definition by authors	Explanation in literature	
		Explanation	Sources
Resources	The raw materials, supplies, equipment, buildings, offices, labour, management, and skills that are used for producing goods and services.	Top management shall provide adequate resources for the establishment, implementation, maintenance and updating of the food safety management system. This includes human resources, infrastructure, and work environment.	ISO (2005)
Responsibility and authority	Responsibility is an obligation to carry forward an assigned task to a successful conclusion. With responsibility goes authority to direct and take the necessary action to ensure success. Authority means the power or right to give orders or make decisions.	Top management shall ensure that responsibilities and authorization are defined and communicated within the organization to ensure effective operation and maintenance of the food safety management system. Personnel shall have responsibility to report problems with the food safety management system. Designated personnel shall have defined responsibility and authority to initiate and record appropriate actions.	ISO (2005)
Training	Food hygiene training enables those engaged in food operations knowledge and skills to perform in accordance with food safety rules.	Those engaged in food operations that come directly or indirectly into contact with food should be trained, and/or instructed in food hygiene to a level appropriate to the operations they are to perform. Food hygiene training is fundamentally important. All personnel should be aware of their role and responsibility in protecting food from contamination or deterioration. Food handlers should have the necessary knowledge and skills to enable them to handle food hygienically. Those who handle strong cleaning chemicals or other potentially hazardous chemicals should be instructed in safe handling techniques.	CODEX ALIMENTARIUS COMMISSION (2003)
Transportation	Food must be adequately protected during transport. The type of transportation vehicle or packaging required depends on the nature of the food and the conditions under which it has to be transported.	Conveyances and/or containers used for transporting foodstuffs are to be kept clean and maintained in good repair and condition to protect foodstuffs from contamination and are, where necessary, to be designed and constructed to permit adequate cleaning and/or disinfection.	EC REGULATION (2004)

Fig. 1. Classification of elements and ranking the influence of a specific element on HACCP efficiency

No.	Elements of food safety system	Frequency		Total No. of barriers
		Scientific studies	Technical studies	
1	Training	10	3	13
2	Human resources	10	5	15
3	Planning	9	1	9
4	Knowledge and competence	7	4	11
5	Documentation	6	5	11
6	Resources	5	6	11
7	Management commitment	4	2	6
8	Credibility	3	1	4
9	Hazard analysis	2	1	2
10	Organizational design	2	2	4
11	Personal hygiene	2	1	2
12	Food handling	2	1	2
13	Customer	2	1	3
14	Food safety policy	2	1	2
15	Communication	2	1	2
16	Responsibility and authority	2	1	2
17	Operation control	1	5	6
18	Transportation	1	2	3
19	Maintenance and sanitation	1	1	1
20	Food legislation, food standards	1	1	2
21	Infrastructure	1	1	2

The influence of each element on HACCP efficiency was ranked according to frequency of their citation in analyzed studies (Fig. 1).

2.3. Content analysis of technical studies

Qualitative content analysis of seven technical studies was based on the recognition of barriers to HACCP implementation as stated by the authors that try to find the solutions for mentioned problems. Content of seven selected texts were evaluated according to four categories: publishing year, objectives, identified barriers and proposed measures.

Publishing year. Papers were published during 1994 and 2004. Four papers were published in year 2001, two in 2004 and one in 1994, 1998, 1999 and 2000.

Objectives. In six studies the authors had the same objective, namely to discuss the barriers, which arise mainly in small enterprises with up to 10 employees and medium-sized businesses in implementing the HACCP system. PANISELLO and QUANTICK (2001) discuss the potential technical barriers in the food and catering industry that may obstruct the use of HACCP before it has been implemented, during the process of implementation and after it has been implemented. TAYLOR (2001) discusses general problems, proposes solutions and identifies opportunities for small companies in their attempt to develop systems, which are technically sound, appropriate and manageable. MCSWANE and LINTON (2000) discuss about issues and concerns in HACCP development and implementation for retail food establishments. In two separate parts, the authors (VON HOLY, 2004; WAI, 2004) discuss the difficulties, which turn up in implementation in small and less developed food businesses. GILLING (2001) takes a psychological approach to the problem by examining processes and factors that could impede adherence to the internationally accepted Codex Guidelines and subsequent successful implementation of HACCP (GILLING, 2001).

Identified barriers. In technical articles, the authors comment in their own manner the difficulties in implementation of HACCP system and they do not rank them with regard to their importance. Some of them, besides the difficulties discuss the benefits, which small businesses derive from implementation of the HACCP system. Extensive overview and dealing as a whole with the causes of the barriers together with suggestions for solutions, from preparing for the implementation to work performance in accordance with HACCP system, were recognized in two papers (PANISELLO & QUANTICK, 2001; TAYLOR, 2001). Their practical experience and a review in food safety literature indicate the greatest obstacles to success in developing, installing, monitoring and verifying a successful HACCP system. Some of those are available through appropriate training in HACCP methodology, access to technical expertise, management commitment, excess or erroneous documentation and the general resource problems such as time and money. In the two separate parts, the authors (VON HOLY, 2004; WAI, 2004) briefly present the difficulties, which, according to their experiences, are present in HACCP implementation in small and less developed food businesses. They are low skill base, lack of knowledge, lack of management commitment and financial constraints, lack of perception of immediate benefits and difficulties in documentation control (lack of appropriate food safety documentation, lack of formal

cleaning schedules and procedures, cleaning checklists). MCSWANE and LINTON (2000) discuss the barriers in HACCP implementation for retail food establishments. Some examples of the barriers are the unique aspects of retail food operations, which may require a HACCP program, unlike those traditionally used by food processors, failure to make a HACCP program simple and user friendly, disagreement about the role of regulatory personnel in HACCP programs, the need for complex record keeping, language and cultural variations, high employee turnover, and the need for product-specific versus process specific HACCP methods. They expose the difficulties in HACCP terminology and like PANISELLO and QUANTICK (2001) expose the importance of tailored food safety programs. Each HACCP food safety program must be tailored to the needs of the individual retail food operation. GILLING (2001) tried to understand the barriers through the use of HACCP "Awareness to Adherence" Model. She illustrates eleven key barriers to HACCP adherence, which can be organized into a model around the knowledge, attitude and behaviour structure. These barriers may not be exhaustive and could be categorized or subdivided differently.

The barriers that are mentioned by the authors were ranked into one of the 21 elements (which were determined in content analysis of the scientific articles) based on the content and their presence in proper context.

Proposed measures. In all the examined articles, the authors discuss the concrete solutions for mentioned barriers. At the end of the text, suggestions for possible solutions are presented as conclusion, overcoming obstacles or solving the problems. They all have in common that the education of SMEs is vital for improving the understanding of hazards and raising awareness of the benefits of having a HACCP system in place. First of all, the food managers and supervisors must know how to develop, implement, and maintain the HACCP program. Then it is necessary to be capable to measure the effectiveness of HACCP plan and established equivalence between two similar plans (PANISELLO et al., 1999). Instead of providing general, untargeted information that requires extensive filtering and application, the information provided to SMEs to encourage them in implementing a HACCP plan should be such information, which would be helpful in their self-assessing and self-regulating process (WAI, 2004). GILLING (2001) stressed the need to investigate the problems through psychological approach. The traditional approach when HACCP goes wrong is to throw more resources at the problem, send staff to basic HACCP training or even to give up. But we must understand that HACCP problems are a complex mixture of managerial, technical and behavioural issues requiring specific remedies (TAYLOR, 2001).

3. Discussion

When determining levels of HACCP efficiency, authors of scientific and technical studies state barriers that arise with implementation, maintaining and updating HACCP programs in food chain units. That is why we searched for documentation sources with combination of key-words: »HACCP and barrier and implementation«. For the

following criteria for exclusion we chose twelve published scientific and seven technical studies. We included only scientific studies in meta-analysis, because they fulfil both methodological and content criteria. They were carefully analyzed and compared according to chosen criteria. The scientific studies that we examined are not the most cited studies from the field, but we can ascribe that to rather recent raise of awareness and interest in causes for rising number of food related diseases. Causes are sought by many in revision of functioning of HACCP, the system that was introduced for assuring food safety. Studies that scientifically approach the problem are new in character and thus have a lower citation index.

The first part of meta-analysis included a comparison of methodological research approaches for determining HACCP implementation barriers and an evaluation of appropriateness of each methodological approach for grasping the problem. To achieve this objective, advantages and disadvantages of both quantitative and qualitative methodological approaches needed to be scrutinized. Choosing and following principles of appropriate methodological approach and methodological tools are keys for obtaining relevant data that enables insight into researched problems. However, analysis showed that in selected studies, basic principles of chosen methodological approach were not followed consistently. In quantitative studies, for example, sampling is not presented thoroughly. And although one of the advantages of quantitative studies, when carefully choosing the sample, is a potential applicability of sample characteristic to the target population, none of the studies made the comparison.

Authors of studies 2, 3 and 6 supplemented their quantitative studies with qualitative approach. Method triangulation is recently becoming increasingly accepted in the field of food safety control and therefore also in discovering barriers to HACCP implementation. It is becoming apparent that only combination of both quantitative and qualitative approaches can provide needed answers.

Authors who use qualitative approach help to illuminate researched issues from a different perspective and thus try to fill the gap that quantitative approach could not fill. Qualitative analysis is searching for answers in individual's in-depth understanding of HACCP system and extensively in food safety, which could not be adequately measured with qualitative methods. Although extensive quantitative research has been done in determining barriers to HACCP inefficiency, concrete solutions for its successful implementation and consequently better food safety have not been offered, yet. Qualitative approach might prove to be a step in the right direction. Defenders of qualitative approach stress that positivistic approaches are not appropriate for use in science that is researching human behaviour. Questionnaires that are a standard quantitative methodological tool cannot grasp values and standpoints of individuals entirely (HARALAMBOS & HOLBORN, 1999). In the field of food safety, FOSTER and KÄFERSTEIN (1985) wrote about this problem. They claim that socio-cultural research in food chain is concerned both with beliefs and practices that are specific to food, and with those that affect its safety, although they are not specific to food. Before planning intervention strategies to modify harmful habits, the researcher must first determine the beliefs and forms of behaviour that promote food safety and those that threaten it. Rapid

social change and the resulting diversification of life around the world are increasingly confronting social, as well as food safety researchers with new social contexts and perspectives (FLICK, 2002). Therefore, it became essential to promote improvements in food safety with strong consideration of socio-cultural factors. The main actor in food safety circle is a person, who plays a crucial role in food safety control. That is why we believe that causes for HACCP inefficiency should be sought in organisational and communicational climate of a company or organisation as well as in the complexity of perception and functioning of each individual person. Those phenomena are studied by social sciences. Multidisciplinary approach is thus both inevitable and necessary and methodological tools used in social sciences should also be introduced to the field of food safety.

The second part of meta-analysis included qualitative content analysis that would enable systematic and thorough understanding of selected twelve texts. Unit of research was an individual study, which we analyzed systematically and in-depth. Next, comparison of the studies was conducted by following our own criteria and categories, namely objectives, barriers to successful HACCP implementation and suggested solutions. Objective of all selected studies was to recognize barriers to successful HACCP implementation, although starting points for their researches were different. Studies deal with problems in general, which can be ascribed to relatively short period of time spent on recommendations of directives for HACCP implementation in the western world. We assume that further research will focus on more complex definition of each individual barrier and provide concrete solutions. WALKER and co-workers (2003) made a step in that direction by assessing hygiene knowledge only among employees in small businesses. In-depth analysis of this potential barrier provides good insight into evaluation of food handlers' knowledge, but does not provide concrete solutions.

CLAYTON and co-workers (2002) and TAYLOR and TAYLOR (2004a; 2004b) also significantly contributed to understanding the importance of human behaviour. A new trend of researching implicit understandings of individuals in the system and taking into strong consideration their psychosocial nature are evident in models presented by GILLING and co-workers (2001b), VELA and FERNANDEZ (2003) and AZANZA and ZAMORA-LUNA (2005). In contrast to objects, human beings possess conscience. They observe and experience the world according to meanings. People do not react to outside signals automatically, instead they individually interpret their meaning. That is why it is important to learn in detail about various ways of signal interpretation, which can be done with qualitative research techniques. Quantitative as well as qualitative methodology has its advantages and disadvantages. None of the two methodological techniques can assure completely valid and reliable data, but if combined, they can provide important insights into dynamics of a society. In general, quantitative data offer more static insights, but enables the research of basic patterns and structures. Qualitative data, on the other hand, is less appropriate for determining patterns and structures in general, but enables more thorough and in-depth understanding of the process of changes in social life (HARALAMBOS & HOLBORN, 1999).

The papers with a description of the technical topics were excluded from the meta-analysis and were discussed separately, because they suited to the content criteria only. In studying the HACCP system's efficiency, the authors of technical papers discuss the barriers, which weaken the basic purpose of the system, namely to assure the food safety in food chain units and thus maintain the unbroken circle of safety "from stable to table". Their practical experiences and literature review of discussed issues reflect their critical view on the barriers, which burdens mainly SMEs. In all the analyzed papers more or less accurate proposals for the solutions were found. In two of the works (PANISELLO & QUANTICK, 2001; TAYLOR, 2001), the authors significantly contribute to the whole and extensive overview of mentioned issues together with concrete proposals for the solutions to abolition of mentioned barriers. PANISELLO and QUANTICK (2001) discussed the barriers in the groups, i.e. in the group of the barriers, which appears prior to HACCP implementation, group of barriers during the process of implementation and group of barriers after HACCP system have been implemented in the food and catering industry. The authors quote that the reasons for not implementing, maintaining and updating HACCP programs cannot be explained solely in terms of unwillingness by manufacturers but rather by the presence of technical barriers that may impede the application of the system. Technical barriers represent all those practices, attitudes and perceptions that negatively affect the understanding of the HACCP concept and hence the proper and affective implementation and maintenance of the HACCP principles. They discuss management commitment, education and training, availability of the resources and external pressures as four basic pillars to successful HACCP programme. In their opinion, the key to successful HACCP implementation will depend on how these pillars are prioritized. TAYLOR (2001) discusses general problems, proposes solutions and identifies the opportunities for small companies in their attempt to develop systems, which are technically sound, appropriate and manageable. She notes that each local area could develop a "HACCP Resource centre", which would provide some of the essential requirements for successful implementation. WAI (2004) and VON HOLY (2004) express their personal critical views on the difficulties that are present in SMEs and less developed food businesses. They quote the un-adaptability of the HACCP system for SMEs as a problem, because they may not have the necessary skill base to implement and maintain a HACCP plan. They see a solution in the guidelines as a helping tool, which could give a concrete example and ready to use control sheets and tables to the users. They emphasize the necessity of education and training of food workers as well the improvement in understanding hazards and raising awareness of the benefits of having a HACCP system in place. MCSWANE and LINTON (2000) discuss the issues and concerns in HACCP development and implementation for retail food establishments. They note that those managers who anticipate the obstacles and take steps to address them are most likely to succeed. They specially stress that HACCP plan must be compatible with the menu, personnel, production, methods and facilities. Regardless of the size and complexity of the operation, food managers are encouraged to "Keep it simple". Where personal responsibility of those involved is a basis of the system, it is necessary to motivate and to train the employees in order to understand

their personal role in food safety and customer satisfaction. Every single employee must be aware of his own responsibility and must perform the work in compliance with good hygiene and production instructions and keep the records about the work of the system on critical control points. Entering of insufficiently trained and educated person into the system is a focus of the problem. GILLING (2001) offers a new psychological approach through HACCP "Awareness to adherence" model to provide the food industry a cost effective and appropriate method to overcome barriers to HACCP, which may be managerial, psychological, technical or a combination of these. A model has been already tested in practice (GILLING et al., 2001) and based on the findings in research already modified (AZANZA & ZAMORA-LUNA, 2005).

In the papers of JOUVE (1998), BLAHA (1999) and BOCCAS and co-workers (2001) the chosen problem or area in HACCP system is discussed specifically. For example, BOCCAS and co-workers (2001) describe HACCP training program in the Lithuanian dairy industry, organized in two main phases with different and complementary training approaches. BLAHA (1999) describes the impact of the farm to table concept and the implementation of HACCP plans throughout the food production chain on animal production and veterinary profession, using the example of the pork production chain. In the paper he explores the benefits of an efficiently implemented system, which will protect the exporting country against the unfair or unjustified use of food safety concerns as non-tariff trade barriers. JOUVE (1998) briefly comments on the most obvious limitations of food safety legislation and suggests principles that should govern a more rational approach favourable to international harmonization and to consider HACCP in perspective with such principles.

The most substantial part of qualitative content analysis included recognizing and clustering barriers to successful HACCP implementation. After in-depth analysis, we discovered that authors of both scientific and technical papers use different terms for similar barriers, which complicates their ranking and further systematic handling. It is of great importance to set up one, accepted scientific model that would enable consistent barrier clustering and weighting of each barrier. By introducing a new concept of terminological classification of twenty-one elements, which is based upon in-depth content analysis of selected papers, we hope to contribute to this objective.

A comparison of the barriers in implementing the system, as quoted by the authors in the technical and scientific papers, is not possible as the authors of the technical articles discuss the barriers and do not rank them with regard to their importance. Whilst the authors of the scientific articles research the types of the barriers and their causes by using different methodological tools and present them according to their importance with regard to findings in research. The technical papers significantly contribute to shed light upon the researched issues. The positive straight of the authors, who besides the barriers discuss the benefits of the implemented system mainly for SMEs as well, is noted. In all the analyzed papers, we found out that the authors offer solutions for mentioned barriers and they discuss the improvements of the existing situation. On the contrary, in the scientific articles the authors only indicate the possible solutions or propose only rough guidelines for further researches.

Content analysis of the scientific articles showed that major barriers detected during implementation of HACCP system were twofold: insufficient training and human resources. The latter includes the broad area of human treatment, where barriers such as awareness, agreement, self-efficacy, outcome expectancy, motivation; staff (gender, educational level, thoughts and experiences, inexperienced employees, turnover, employee commitment, etc.) are included. The barriers such as planning, knowledge and competence, documentation and resources are then discussed. The authors of technical articles discuss the barriers on the basis of reviewed literature and their own practical experiences. The content analysis of selected technical articles has showed that the authors consider resources, such as human resources as well as time, money, costs (i.e. expense of training), to be the largest barrier in implementation of the system. By studying and classifying the elements, it is evident that the biggest problems for HACCP efficiency are human resources and training.

Impact of a particular factor as specified for relevant barrier (Table 9) will establish the possibility for novel approach for efficient design of projects and actions, which will be able to trace weakness of the analysed system (in the context of size and diversity food activity). This will also open the opportunity for novel approaches in education and training of food personal, which will be tailor made on the basis of relevant needs to achieve "food safety from farm to table around the world". We carefully defined and explained each element with relevant expert literature to present and illustrate relevancy of such classification and enable better understanding. Thus we contributed to a new dimension of qualitative content analysis in the field of food safety.

In comparison with HACCP, seven principles showed that there are grey areas in the system, which should be further analysed and developed to the state of clear understanding that food safety system needs.

4. Conclusion

When we are speaking about implementation of new approaches we refer to new discoveries and new methods, but more commonly we consult actual standards from the field. It seems that the problem of standard implementation does not always face relevant issues (if HACCP is concerned). Consequently, our approach can be applied for systematic analyzing of relevant standards to indicate their weaknesses prior to implementation. This can help even earlier during the standard development to test standard capacity and approaches for designated area of application.

As we demonstrated in our paper, quantitative and qualitative methods for analyzing HACCP system efficiency are of prime importance. Namely, these two approaches digest scientific and technical literature via pre-selected criteria and resulted outcome, illustrate weak and strong points very efficiently.

Field of food science and technology is a part of natural sciences and thus researched mainly with quantitative methodology. Nevertheless, it is encouraging that lately some food safety researchers have decided to use qualitative methods also. The

fact that a person is and will be responsible for HACCP implementation and further control calls for an in-depth analysis and understanding of individual's reaction to received information. GILLING and co-workers (2001) first investigated complex behavioural barriers. This kind of research offers an innovative, yet logical approach to the problems existing within the field of food safety management. Multidisciplinary approach, including experts for food safety, food technology, psychology, sociology and public health, is thus of great importance.

Unified terminology for assessing barriers to HACCP efficiency, namely elements that we offer in this paper, should be used as a starting point for further development of a common terminological model. The influence of each element on HACCP efficiency was ranked according to frequency of their citation in analyzed studies. Findings contribute to systematic planning of further research, directed towards appropriate strategies for elimination of barriers and to development of a common language among food safety professionals.

The theory and practice showed weakness in food safety management systems. Due to the fast development and in many cases also improvisation, particularly in SMEs', we face difficulties that have to be structured and overcome. It is no doubt that system, which will comprehensively assess soft and hard parameters of food systems, will become more powerful and finally more user friendly. It can be expected that such an approach will bring new level of safety and consequently trust to the food arena.

References

- ANON. (2004): News. Who launches new "5 keys" strategy to reduce the global incidence of foodborne disease. *Indian J. med. Sci.*, 58 (10), 450–451.
- AZANZA, M.P.V. & ZAMORA-LUNA, M.B.V. (2005): Barriers of HACCP team members to guideline adherence. *Fd Control*, 16, 15–22.
- BAŞ, M., YÜKSEL, M. & ÇAVUŞOĞYLU, T. (2005): Difficulties and barriers for the implementing of HACCP and food safety systems in food businesses in Turkey. *Fd Control*, (in press, corrected proof, available online: <http://www.sciencedirect.com>).
- BLAHA, T. (1999): Epidemiology and quality assurance application to food safety. *Prev. Vet. Med.*, 39, 81–92.
- BOCCAS, F., RAMANAUSKAS, A., BOUTRIF, E., CAVAILLE, P., LACAZE, J.M. & PILIPIENE, I. (2001): HACCP "train-in-action" program in the Lithuanian dairy industry. *Fd Control*, 12, 149–156.
- BRC (2002): *Technical Standard and Protocol for Companies Supplying Retailer Branded Food Products*. Issue 3, British Retail Consortium; April, 51 pp.
- CLAYTON, D.A., GRIFFITH, D.J., PRICE, P. & PETERS, A.C. (2002): Food handlers' beliefs and self-reported practices. *Int. J. Environ. Health Res.*, 12, 25–39.
- CODEX ALIMENTARIUS COMMISSION (2003): *Recommended international code of practice. General principles of food hygiene*. FAO/WHO Food Standards; CAC/RCP 1-1969, Rev. 4-2003, 31 pp.
- CORNELL, J. & MULROW, C. (1999): Meta-Analysis. -in: ADÈR, H.J. & MELLENBERGH, G.J.(Eds) *Research methodology in the life, behavioural and social sciences*. Sage Publication; London, 393 pp.
- DE WINTER, R.F.J. (1998): The role of interactive workshops in HACCP training in a multinational environment. *Fd Control*, 9, 147–149.
- EC REGULATION (2002): No 178/2002 of the European Parliament and of the council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. *Off. J. Europ. Comm.*, 24 pp.

- EVES, A. & DERVISI, P. (2005): Experiences of the implementation and operation of hazard analysis critical control points in the food service sector. *Hosp. Manage.*, *24*, 3–19.
- FLICK, U. (2002): *An introduction to qualitative research*. 2nd ed., Sage Publications; London, pp. 165–238.
- FLINT, J.A., VAN DUYNHOVEN, Y.T., ANGULO, F.J., DELONG, S.M., BRAUN, P., KIRK, M., SCALLAN, E., FITZGERALD, M., ADAK, G.K., SOCKETT, P., ELLIS, A., HALL, G., GARGOURI, N., WALKE, H. & BRAAM, P. (2005): Estimating the burden of acute gastroenteritis, foodborne disease, and pathogens commonly transmitted by food: an international review. *Clin. Infect. Dis.*, *41*, 698–704.
- FOSTER, G.M. & KÄFERSTEIN, F.K. (1985): Food safety and the behavioural sciences. *Soc. Sci. Med.*, *21*, 1273–1277.
- GILLING, S. (2001): Is your HACCP dragging you down? A psychological perspective. *Fd Sci. & Technol. Today*, *15* (3), 44–47.
- GILLING, S.J., TAYLOR, E.A., KANE, K. & TAYLOR, J.Z. (2001): Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioural adherence model. *J. Fd Prot.*, *64*, 710–715.
- HARALAMBOS, M. & HOLBORN, M. (1999): *Sociology: themes and perspectives*. 2nd ed., Unwin Hyman; London, 594 pp.
- HASAN, A., AYDOĞAN, H., KÜÇÜKKARAASLAN, A., BAYSALLAR, M. & BAŞUSTAOĞLU, A.C. (2004): Assessment of the bacterial contamination on hands of hospital food handlers. *Fd Control*, *15*, 253–259.
- HENROID, D. & SNEED, J. (2004): Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *J. Am. Diet. Assoc.*, *104*, 180–185.
- HIELM, S., TUOMINEN, P., AARNISALO, K., RAASKA, L. & MAIJALA, R. (2006): Attitudes towards own-checking and HACCP plans among Finnish food industry employees. *Fd Control*, *17*, 402–407.
- HLEBEC, V. (2001): Meta-analiza zanesljivosti anketnega merjenja socialne opore v populnih omrežjih. (Meta-analysis of reliability of network measurement instruments for measuring social support in complete networks.) *Teor. praksa*, *38* (1), 63–76.
- HUNTER, J.E. & SCHMIDT, F.L. (2004): *Methods of meta-analysis. Correcting error and bias in research findings*. 2nd ed., Sage Publication, California, 582 pp.
- ISO (2001): *Guidelines on the application of ISO 9001:2000 for the food and drink industry*. ISO 15161:2001. Int. Org. Standard; Geneva, 35 pp.
- ISO (2005): *Food safety management systems – Requirements for any organization in the food chain*. ISO 22000:2005. Int. Org. Standard; Geneva, 32 pp.
- JEVŠNIK, M., TIVADAR, B. & HLEBEC, V. (2004): Hidden factors of high hazard in food industry. -in: *CEFood congress programme and book of abstracts, 2nd Central European Congress on Food*. Budapest, Apr 26–28, Central Food Research Institute: Complex Committee on Food Science of the Hungarian Academy of Sciences; Budapest, p. 214.
- JOUBE, J.L. (1998): Principles of food safety legislation. *Fd Control*, *9*, 75–81.
- KARALIS, T. & GUPTA, L. (2001): Microbiological status of Asian style perishable foods and the relation with procedural deficiencies in manufacture. *Fd Technol. Aust.*, *53* (5), 184–188.
- KHANDKE, S.S. & MAYES T. (1998): HACCP implementation: a practical guide to the HACCP plan. *Fd Control*, *9*, 103–109.
- KIRBY, R. (1994): HACCP in practice. *Fd Control*, *5*, 230–236.
- LEGNANI, P., LEONI, E., BERVEGLIERI, M., MIROLO, G. & ALVARO, N. (2004): Hygienic control of mass catering establishments, microbiological monitoring of food and equipment. *Fd Control*, *15*, 205–211.
- LUCCA, A. & FERRAZ DA SILVA TORRES, E.A. (2006): Street-food: The hygiene conditions of hot-dogs sold in São Paulo, Brazil. *Fd Control*, *17*, 312–316.
- LUES, J.F.R. & VAN TONDER, I. (2005): The occurrence of indicator bacteria on hands and aprons of food handlers in the delicatessen sections of a retail group. *Fd Control*, (in press, corrected proof, available on-line: <http://www.sciencedirect.com>).
- MCCARTHY, M., BRENNAN, M., KELLY, A.L., RITSON, C., DE BOER, M. & THOMPSON, N. (2005): Who is at risk and what do they know? Segmenting a population on their food safety knowledge. *Food Qual. & Pref.*, (in press, corrected proof, available on-line: <http://www.sciencedirect.com>).

- MCSWANE, D. & LINTON, R. (2000): Issues and concerns in HACCP development and implementation for retail food operations. *Environ. Health*, January/February, 15–18.
- NEL, S., LUES, J.F.R., BUYS, E.M. & VENTER, P. (2004): The personal and general hygiene practices in the deboning room of a high throughput red meat abattoir. *Fd Control*, 15, 571–578.
- PANISELLO, P.J. & QUANTICK, P.C. (2001): Technical barriers to Hazard analysis critical control point (HACCP). *Fd Control*, 12, 165–173.
- PANISELLO, P.J., QUANTICK, P.C. & KNOWLES, M.J. (1999): Towards the implementation of HACCP: results of a UK regional survey. *Fd Control*, 10, 87–98.
- RASPOR, P. (2004): Sedanji pogled na varnost živil. (Current viewpoint on food safety). -in: GAŠPERLIN, L. & ŽLENDER, B. (Eds) *Food safety*, 22. Bitenčevi živilski dnevi, Radenci, 18. in 19. marec, 2004; Biotehniška fakulteta, Oddelek za živilstvo, Ljubljana, pp. 1–14.
- RASPOR, P. (2005): Bio-markers: traceability in food safety issues. *Acta biochim. Polonica*, 52, 659–664.
- RASPOR, P. (Ed.) (2002): Priročnik za vzpostavljanje in vodenje sistema HACCP. (Handbook for establishing and managing HACCP system.) Slovenski inštitut za kakovost in meroslovje, Biotehniška fakulteta, Oddelek za živilstvo; Ljubljana, 598 pp.
- ROBERTS, K.R. & SNEED, J. (2003): Status of prerequisite and HACCP program implementation in Iowa restaurants. *Fd Prot. Trends*, 23, 808–816.
- SHOJAEI, H., SHOOSHTARIPOR, J. & AMIRI, M. (2006): Efficacy of simple hand-washing in reduction of microbial hand contamination of Iranian food handlers. *Fd Res. int.*, 39, 525–529.
- SORIANO, J.M., FONT, G., MOLTÓ, J.C. & MAÑES, J. (2002a): Enterotoxigenic staphylococci and their toxins in restaurant foods. *Trends Fd Sci. Nutr.*, 13, 60–67.
- SORIANO, J.M., RICO, H., MOLTÓ, J.C. & MAÑES, J. (2002b): Effect of introduction of HACCP on the microbiological quality of some restaurant meals. *Fd Control*, 13, 253–261.
- STROHBEBN, C.H., GILMORE, S.A. & SNEED, J. (2004): Food safety practices and HACCP implementation: perceptions of registered dieticians and dietary managers. *J. Am. Diet. Assoc.*, 104, 1692–1699.
- SUN, Y-M. & OCKERMAN, H.W. (2005): A review of the needs and current applications of hazard analysis and critical control point (HACCP) system in foodservice areas. *Fd Control*, 16, 325–332.
- TAYLOR, E. (2001): HACCP in small companies: benefit or burden? *Fd Control*, 12, 217–222.
- TAYLOR, E.A. & TAYLOR, J.Z. (2004a): Perceptions of the »bureaucratic nightmare« of HACCP. A case study. *Br. Fd J.*, 106, 65–72.
- TAYLOR, E.A. & TAYLOR, J.Z. (2004b): Using qualitative psychology to investigate HACCP implementation barriers. *Int. J. Environ. Health Res.*, 14, 53–63.
- TENG, D., WILCOCK, A. & AUNG, M. (2004): Cheese quality at farmers markets: observations of vendor practices and survey of consumer perceptions. *Fd Control*, 15, 579–587.
- VANBAALE, M.J., GALLAND, J.C., HYATT, D.R. & MILLIKEN, G.A. (2003): A survey of dairy producer practices and attitudes pertaining to dairy market beef food safety. *Fd Prot. Trends*, 23, 466–473.
- VELA, A.R. & FERNÁNDEZ, J.M. (2003): Barriers for the developing and implementation of HACCP plans: results from a Spanish regional survey. *Fd Control*, 14, 333–337.
- VILA, A. (1994): *Organizacija in organiziranje*. (Organisation and organising.) Univerza v Mariboru. Fakulteta za organizacijske vede Kranj, Moderna organizacija; Kranj, 388 pp.
- VON HOLY, A. (2004): HACCP hassles for small businesses. *Fd Review*, 31 (6), 33–34.
- WAI, L.Y. (2004): HACCP for SMEs. *Asia Pacific Fd Ind.*, 16 (5), 56–58.
- WALCZAK, D. & REUTER, M. (2004): Putting restaurant customers at risk: unsafe food handling as corporate violence. *Hosp. Mgmt.*, 23, 3–13.
- WALKER, E. & JONES, N. (2002): An assessment of the value of documenting food safety in small and less developed catering businesses. *Fd Control*, 13, 307–314.
- WALKER, E., PRITCHARD, C. & FORSYTHE, S. (2003): Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Fd Control*, 14, 169–174.
- WINGSTRAND, A., NEIMANN, J., ENGBERG, J., MÖLLER-NIELSEN, E., GERNER-SMIDT, P., WEGENER, H.C. & MØLBAK, K. (2006): Fresh chicken as main risk factor for Campylobacteriosis, Denmark. *Emerg. Infect. Dis.*, 12, 280–284.

2.1.3 Hygienic status of small and medium sized food enterprises during adoption of HACCP system

Higiensko stanje v malih in srednje velikih prehranskih obratih po uvedbi sistema HACCP

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Glavni namen raziskave je bil preučiti način vključevanja zaposlenih v delovni proces priprave živil. V raziskavo je bilo vključenih sto naključno izbranih malih in srednje velikih prehranskih obratov. Analizirano je higienško in tehnično stanje prehranskih obratov ter higienška praksa zaposlenih, s poudarkom na opazovanju tehnike in pogostosti umivanja rok. V ta namen je bila izdelana opazovalna lista. Kriteriji ocenjevanja so sledili zahtevam zakonodaje in higienške doktrine. Rezultati kažejo tehnične pomanjkljivosti v obeh skupinah obratov in higienške nepravilnosti zaposlenih pri delu z živili. Higienška praksa zaposlenih ni vedno v skladu s predpisanimi zahtevami. Rezultati mikrobiološke ocene snažnosti obratov so bili v sprejemljivih mejah za živilsko prakso. Priprava mesa je iz higienško tehničnega vidika ocenjena kot kritična faza. V prihodnje bo potrebno planirati dodatne aktivnosti za doseganje zahtev sistema HACCP. V izogib šibkosti na higienškem področju, s poudarkom na higienški zavesti posameznika, je predlagan nov pristop, imenovanem »Model analize štirih elementov«. Izpostavljena je pomembnost človeškega faktorja pri zagotavljanju varnih živil, ki je v modelu obravnavan enakovredno kot ostali higienški, tehnični in tehnološki dejavniki tveganj.

HYGIENIC STATUS OF SMALL AND MEDIUM SIZED FOOD ENTERPRISES DURING ADOPTION OF HACCP SYSTEM

M. Jevšnik, M. Bauer, A. Zore and P. Raspor

ABSTRACT

The main area of assessment was food-handlers involvement in the working process. We assessed state of the art of technical environment and frequency of hand washing with employees. The study was performed in one hundred randomly selected small and medium size food enterprises. Estimation criteria were in accordance with legislation requirements and hygiene doctrine. The results showed non-compliance on technical level in small and also in medium sized enterprises. The hygiene awareness of food-handlers was not found on very high level; however the results of microbiological counts are still within the level acceptable for food practice. Critical area is meat preparation and it is obvious that some additional activities shall be planned in a future to achieve HACCP system requirements. The purpose of the solution to avoid hygiene problems is based on a new approach called "Four elements analysis", which exposes individual person who is entering the food area as risk factor.

Key words: Food Safety, Food Enterprises, HACCP, Prerequisite Programs, Good Hygiene Practice, Employees

INTRODUCTION

Ensuring safe food in the age of globalization, changed lifestyles and nutrition patterns, is particularly problematic in the units of food preparation and distribution, especially in small and medium sized food enterprises (SMEs) (Walker & Jones 2002; Raspor 2002; Walker & others 2003; Walczak & Reuter 2004; Raspor 2004a; Raspor 2004b; Sun & Ockerman 2005; Raspor 2006a; Ba^o & others 2007). Taylor (2001a) stated that Hazard Analysis and Critical Control Point (HACCP) system is widespread in large food enterprises, while its use is limited within SMEs¹. This is reflected in recent studies in the UK and Europe which have found that SMEs are less likely to invest in hygiene and food safety than large companies and are less likely to have HACCP in place (Mortimore 2001; Taylor 2001a; Konecka-Matyjek & others 2005; Conter & others 2007). SMEs differ between themselves on knowledge level, employees' responsibility, motivation and awareness of individuals and finally on available financial means (Taylor 2001b). Because small enterprises have lower level of previously mentioned elements, it is more difficult to assure an optimal food safety there than in medium sized plants (Ropkins & Beck 2000; Yapp & Fairman 2006).

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Meta-analysis of barriers during HACCP implementation has shown that among twenty one elements we can allocate seven elements (training, human resources, planning, knowledge and competence, management commitment) representing 47,8% of all identified barriers. The influence of each element on HACCP efficiency was ranked according to frequency of their citation in analyzed studies (Jevšnik & others 2006). Practical experience and a review of food safety literature performed by Taylor & Kane (2005) indicates that success in developing, installing, monitoring and verifying a successful HACCP system depends on overcoming a complex mix of managerial, organisational and technical hurdles. Even the largest and well equipped food companies with significant resources of money, technical expertise and management skills face a difficult challenge; whilst the SMEs often feel that the difficulties of HACCP are potentially insurmountable (Untermann 1999; Motarjemi & Käferstein 1999; Sperber 2005a; Sperber 2005b; Taylor & Kane 2005). The fact that a person is and will be responsible for HACCP implementation and further control calls for an in-depth analysis and understanding of individual's reaction to received information (Jevšnik & others 2006). This can be approached from different perspectives as was indicated already in 2001 for complex behavioural barriers in food safety area (Gilling & others 2001).

Recent survey studies conducted in Turkey, South Africa and the United Kingdom pinpointing the need for training and education of food handlers in public hygiene measures and revealed a general lack of knowledge of microbiologic food hazards, refrigerator temperature ranges, cross contamination and personal hygiene (Walker & others 2003; Nel & others 2004; Ayçiçek & others 2004; Ba° & others 2005; Ba° & others 2007). Data on risk factors for food-borne diseases indicate that the majority of outbreaks result from faulty food handling practices (Clayton & others 2002). Consuming and/or handling poultry meat is the most consistent risk factor, linked to the high prevalence of campylobacters in retail poultry meat (Zorman & others 2006). The risk of food-borne illness due to contact with hands or surfaces depends on both the level of contamination as well as probability of transfer and importance of contaminated surfaces in relation to potential transmission of pathogens to food is apparent in food processing (Den Aantrekker & others 2003, Kusumaningrum & others 2003; Raspor 2005). Proper sanitation practices provide the foundation that food safety assurance systems are built upon. Poor hygienic and sanitary practices can contribute to outbreaks of foodborne illnesses and cause injury. In the last several years, there have been some major food safety incidents that have made headlines and focused attention on poor sanitary practices in all sector of the food system (Heggum 2001; Marriot & Gravani 2006; Raspor & others 2006b). Fielding & others (2005) cited that food poisoning outbreaks usually occur from SMEs in the food manufacturing industry, which account for 99% of all food operations in the UK. In last ten years Slovenia registered from 10,000 to 20,000 cases of intestinal infectious diseases per year, which can be compared with reported number of diseases in other countries. *Salmonella* Enteritidis was the cause for 73% of epidemics in 2003 and was therefore characteristic for that year. Mentioned incidence rate are almost 10 times higher compared to United Kingdom. In Slovenia the most frequent are salmonellosis, campylobacteriosis, and rotavirus enteritis. The most frequent cause for infection was insufficient personal hygiene, cross contamination, inadequate storage temperature, inadequate transport and insufficient employee's knowledge (Smole Mo•ina & Hoèevvar Grom 2004).

The aim of the research is to determine hygiene-technical situations in selected food establishments, to estimate hygiene knowledge and awareness of employees by stressing the employees' observation during working process (hand washing technique and its frequency) and to objectively estimate sanitation of some beforehand defined spots.

MATERIALS AND METHODS

The research lasted from April to July 2006 and was performed in one hundred randomly selected small and medium size enterprises (SMEs). Data regarding a number of registered SMEs in Ljubljana the capital of Slovenia was gained from Health Inspectorate of the Republic of Slovenia. The food-processing establishments were divided according to a number of employees, namely to the small ones, which employ up to ten workers and represent 66.5% of all food enterprises in Ljubljana and into medium sized ones, which employ from ten to fifty workers and represent 28.4% share in Ljubljana.

The research was methodically and terminally divided in two parts. In the first part one hundred randomly selected food enterprises in Ljubljana (fifty small ones and fifty medium sized ones) took part. In the selected plants hygiene-technical situation of areas, which influenced the hygiene status of a plant, was estimated by using an observation list. The observation list was made on the basis of valid legislation, professional doctrine, food safety literature and frequent observation of researched surroundings. Prior to the research the observation list was tested with the intention of finding its eventual defects.

In the second part of the research wet swabs for sanitation testing from beforehand defined working surfaces were taken in the fifty food plants, which took part in the first part of the research (twenty-five small and twenty-five medium sized ones) and which have agreed to take part in the second half of the research as well.

Hygiene-Technical Criteria

For determination of hygiene-technical conditions in the selected plants an observation list, which included criteria for estimation of hygiene-technical suitability, was made. Among prerequisite hygiene programs for HACCP only the elements of good manufacturing practice, relating to hygiene-technical requirements for areas meant for employees (wash-hand basins, sanitary facilities, areas for cleansers and cleaning equipment) and the elements of good manufacturing practice, relating to employees, who handle food (knowledge, health, involvement in the working process) were estimated.

Hygiene-technical criteria for hand washing area:

- Number (is it suitable with regard to the activity and the size of a plant)
- Installation (preventing cross-contamination between high and low risk area)
- Purpose (separation from food / dish basins)
- Equipment with all the additional instruments (cold and hot running water, soap dispenser (for liquid soap), paper towels, wastebasket)

98 M. Jevšnik, M. Bauer, A. Zore And P. Raspor

- Maintenance (in good condition, detergents and cleaning equipment: separated regarding usage intention, designated place for storage, documentation: cleaning and disinfection schedule, records of realization and control)
- Wash-hand basin surroundings (maintenance, material characteristics, inclination and outflow of floor surfaces, warnings for employees, round joints between walls and floors)

Storage for cleansers and cleaning equipment:

- Storage (construction, micro-climate conditions)
- Cleansers and cleaning equipment (separation regarding usage, use intention, colour marks)

Hygiene-technical criteria for sanitation:

- Number (adequate regarding a plant size and activity performed in a plant)
- Construction (entrance must be separated from food area with a "pre-room"-washing station, hygiene-technical equipment in washing station, which can be a bathroom as well)
- Purpose (separated from sanitary facilities for "other" persons, sex-separated sanitary facilities)
- Floor (made from un-permeable, un-absorptive, un-slippery, washable and non-toxic materials, with suitable incline and outflow)
- Walls (un-permeable, washable, un-absorptive, non-toxic, smooth and without joints and shelves)
- Maintenance (in good condition, cleansers and cleaning equipment: separated regarding use intention, designated storage area; documentation: cleaning and disinfection schedule, records of realization and control)

Food-handlers:

- Personal hygiene (hand washing, overalls and working footwear, head-coverings)
- Health (conformity for obligatory illness report, which can be transmitted by working, signed by personnel and declaration regarding illness's symptoms)
- Knowledge and training (prerequisite hygiene programs for HACCP, HACCP system)
- Involvement in the working process (working procedures, rules)

Data collected from observation lists were analyzed regarding above presented items and regarding a size of plants (SE and ME).

Microbiological Estimation Of Sanitation In Food Establishments

Six spots for taking wet swabs, which show sanitation efficiency in the plant and hygiene awareness of employees, have been designated. In all the plants swabs were taken from left and right hands and from taps. Remaining three swabs were designated separate for each individual plant regarding individual researcher's opinion. Spots from low risk area have been selected, namely cutting boards for vegetables, for cooked meat, for bread, meat slicer, working surface, cutlery tray and refrigerator's interior.

Swabs were inoculated on growth medium containing mammalian blood (blood agar plates). Culture mediums were incubated at 37°C for 24 hours. After the incubation colonies were counted, described according to morphology and wiped across new culture media. From pure culture a microscopic preparation was made. Bacteria, for which we assumed that were not allowed by the legislation, were differentiating by Gram stain process. Criteria for estimation were in accordance of Slovenian national Act of special measure in case of food poisoning and infection and their preventive measures. Criteria for sanitation efficiency are the following:

- Working surface (20 cm²) is clean if number of aerobic mesophile bacteria is not higher than 200,
- A swab is not considered clean if it contains *Escherichio coli*, coagulase-positive staphylococci, faecal streptococci *Proteus sp.*, *Pseudomonas aeruginoza* (Anonymous 1981, 1982).

In the legislation there is no criteria for sanitation estimation of tap handle on wash-hand basin in the kitchen, walls in the cooling appliances and workers' hands (Anonymous 1981, 1982), that is why for those spots the same criteria as for work surfaces stated in the legislation was considered.

RESULTS

Areas

Areas for employees' hand washing

In the kitchens of the majority of food-processing plants (78%) only one wash-hand basin is installed and in even seven kitchens (14%) there is no wash-hand basin at all. All of the MEs have been equipped with wash-hand basins and in 44% of ME there were more than one wash-hand basin, there. Table 1 shows criteria, which were used for hygiene-technical estimation of wash-hand basins in the kitchens and belonging SHP documentation.

Locations of wash-hand basins in five SEs and in eight MEs do not enable hand washing in crosspoints between high and low risk areas. In 14% of SEs there is no wash-hand basin, that is why workers wash their hands in dish basins. In two MEs basins are used for food washing as well. Basins were inadequately equipped in 39% of SEs (in 14% without liquid soap, in 18% without paper towels, in 4% without liquid soap and paper towels). A number of inadequate hand-wash basins were significantly lower in MEs. Only in the two plants there were no wastebaskets there. Basins were inadequately maintained more frequently in SEs than

100 M. Jevšnik, M. Bauer, A. Zore And P. Raspor

in MEs. Among causes for tatter are unsuitable or timeworn floors, timeworn ceramic wall tiles near basins, roughcast falling off walls and presence of empty packaging and cleaning equipment. In the majority of plants there were hand washing instructions hanging on the walls.

Table 1. Criteria for hygiene-technical estimation of wash-hand basins and verification of belonging Legend: documentation.

Hygiene-technical criteria	ESTIMATION (%)						Documentation	ESTIMATION (%)					
	S		PS		NS			S		PS		NS	
	ME	SE	ME	SE	ME	SE		ME	SE	ME	SE	ME	SE
Installation	88	84	0	0	12	16	Cleaning and disinfection schedules						
Separation from food washing basins	86	96	0	0	14	4		8	18	16	58	76	24
Equipment	12	24	49	72	39	4	Records of cleaning and disinfection	12	26	0	48	88	26

S – Suitable: In accordance with Directive EC, 2004 requirements (EU 2004).

PS – Partly Suitable: Partly in accordance with Directive EC, 2004 requirements. Deficiency: equipment of the basin is partly suitable if wastebasket is covered, but no opening by foot is possible, or if it is open – with no covering; if basin tap can not be turned by using only one hand; if soap dispenser is not handle operated or if liquid soap dispenser is opened. Documentation is partly suitable if there are not all the required records there (EU 2004).

NS – Not Suitable: Not in accordance with Directive EC, 2004 requirements (EU 2004).

In small enterprises documentation is not managed well; in 76% of plants there are no cleaning and disinfection schedules, in 88% of plants there is no records of cleaning and disinfection. In the enterprises, in which there are cleaning and disinfection schedules, only 2/3 of those are suitable (columns for records of control and cleaning type are missing). In 76% of MEs there are cleaning and disinfection schedules, but 58% of those are only partly suitable (in the majority of cases columns for cleaning performance and control records are missing). Records of cleaning and disinfection are kept in 74% of plants, but in 48% of them there is no cleaning frequency stated, therefore the records are estimated as partly suitable.

Storage for cleansers and cleaning equipment for basin cleaning

Storages for cleansers and cleaning equipment for basin cleaning in 36% of SEs and in 36% of MEs were estimated as unsuitable, because the cleansers and cleaning equipment were stored directly on the floors. In five small sized plants and three MEs there is no designated cleanser/disinfector for basins, so they are cleaned by using dish detergent. In 86% of SEs and in 38% of MEs cloths for cleaning were not marked with different colour or in any other way.

Sanitary facilities

In 16% of SEs the sanitary facilities for staff and for guests were not separated. In 22% of MEs teachers and kitchen staff used the same toilets. In one of ME a toilet washroom was not suitable, because there was no soap dispenser and in other 22% of MEs hand washing stations in toilets were not suitable, because there were not enough of liquid soap, there were no paper towels or both of latter were missing.

Food-handlers

Personal hygiene

Personnel in the two thirds of small and medium sized plants do not wash their hands after dirty work or they do not wash them properly. Hand care cream was available in two small sized plants and in fourteen MEs. Table 2 shows criteria for personnel's for good hygiene practice estimation.

There were more employees wearing dirty and unsuitable overalls in SEs (36%) than in MEs (4%). In small sized plants more than half of workers (52%) didn't wear any head-covering during work in contrast to MEs, where 12% of workers did not wear any head-covering. Workers' hair is only partly covered by head-covering. Some of female workers had long nails and nail polish applied to the nails. Only small percentage (12%) of workers had injuries on their hands. One person in ME did not cover an injured hand.

In the majority of plants there is enough overalls for workers there, except in ten small sized plants (20%) and in one ME (2%), where only 2 overalls were available. In the majority of SEs working clothes were estimated as unsuitable, since 40% of workers worked in their own personal shoes, 26% wore dirty working clothes, 28% wore overalls of unsuitable colour (dark). In MEs only one person wore dark, unsuitable overall.

Only in 32% of SEs and in 48% of MEs there are designated and marked containers for dirty working clothes collecting. In 24% of SEs and in 20% of MEs dirty working clothes are collected in bags. In 44% of SEs and in 32% MEs areas for dirty and clean working clothes were not separated. Dirty working clothes were found in lockers together with clean clothes or were laid off on the floor. In the majority of MEs (78%) clothes are washed in own laundry, in 16% of MEs clothes are washed by workers themselves (in their homes), in 6% of MEs clothes were washed in laundries, which had no signed contract with plants. In the majority of SEs (72%) clothes are washed by workers themselves, in their homes.

In spite of the fact that in SEs all rules are placed on visible spots, in contrast to MEs, in practice they are less followed as in MEs. In the majority of MEs (90%) workers followed the rule of not to wear jewellery while working. In 38% of SEs workers did not follow that rule. Five workers in MEs and three of them in SEs ate during work time. While supervising working process two workers in SE chewed and two of them smoked.

Table 2. Criteria for estimation of staff good hygiene practice during work and verification of belonging documentation.

Staff good hygiene practice criteria	ESTIMATION (%)						Documentation	ESTIMATION (%)					
	S		PS		NS			S		PS		NS	
	ME	SE	ME	SE	ME	SE		ME	SE	ME	SE	ME	SE
Suitable, clean and if necessary protective working clothes	64	96	0	0	36	4	Working procedure regarding personal hygiene	60	66	0	0	40	34
Protective head-covering	22	36	26	52	52	12	Working procedure regarding hand washing	56	68	6	4	36	28
Hand nails	84	92	0	0	16	8							
Suitable covered hand injuries	4	4	2	0	0	2	Working procedure regarding injuries	34	34	0	0	66	66

Legend:

S – Suitable: In accordance with Directive EC, 2004 requirements (EU 2004).

PS – Partly Suitable: Partly in accordance with Directive EC, 2004 requirements. Deficiency: protective head-coverings are partly suitable if do not cover hair completely. Hand injuries coverings are partly suitable if plasters are not coloured. Working procedure regarding hand washing is partly suitable if hand washing is described up to wrist only (EU 2004).

NS – Not Suitable: Not in accordance with Directive EC, 2004 requirements (EU 2004).

Health

During the research there were no ill people in both small and medium sized plants, there. In 14% of SEs and in 18% of MEs workers have not signed conformity for obligatory illness report, which can be transmitted by working. In 38% of SEs and in 20% of MEs the declaration regarding illnesses symptoms have not been signed by personnel. Certificate of examination of person working with foodstuffs was present in 22% of SEs and 28% of MEs.

Knowledge And Training

By asking: "How do you measure a core temperature of heat treated food?" worker's qualification for a specific job was determined. Results showed that in four of SEs and in one ME workers were not suitably trained for specific jobs, because in three small sized plants a core temperature of heat treated food was measured with infra red thermometer; in one small sized plant and in one ME temperatures were not measured at all.

Knowledge regarding HACCP system principles was measured by asking three questions, namely: "Is HACCP system established in you plant?", "How do you record temperature in cooling appliances and during heat treatment of food?" and "What does a critical control point (CCP) mean and how many CCPs are determined in the HACCP plan in your plant?" Knowledge of work performance according to HACCP system was not suitable in 32% of SEs and in 34% of MEs. In four of SEs workers did not know that there is HACCP system established in the plant. In 12% of SEs and in 20% of MEs temperature is recorded for several days in advanced of for the past. In 12% of SEs and in one ME workers stated that there is no CCP in the HACCP plan. In 12% of MEs workers stated that a CCP mean cross-contamination between high and low risk working process.

There is no training plan in 74% of SEs and in 48% of MEs. Records of trainings are not kept in 70% of SEs and in 52% of MEs. Training certificates are not kept in 42% of SEs and in 46% of MEs.

Microbiological Estimation Of Sanitation In The Plants

In the tables from 3 to 5 the laboratory results of swab analyses, taken from work surfaces, equipment and workers' hands in small and medium sized enterprises are collected. Microbiological estimation of sanitation in SEs and MEs by separate checked spots (clean surfaces that were not used at the time of taking) is shown in the Table 3. Those spots were designated as critical beforehand.

From the results of microbiological estimation of work surface sanitation it was concluded that hygiene situation in MEs is much better as in SEs. In MEs there was, in spite of prior hand washing, the higher number of unsuitable swab results of left hands (68%) than in SEs (60%). The number of grown bacterial species was higher in SEs in comparison with MEs. From approximately half of the swabs taken from work surfaces (work surface, cutting board for heat treated vegetables, cutting board for heat treated meat, and cutting board for bread) in MEs no micro-organism has grown (Table 3). In SEs a hygiene situation was worse, because approximately half of results of swabs taken from work surfaces (work surface, cutting board for heat treated vegetables, cutting board for heat treated meat, and cutting board for bread) and from equipment (meat slicer) did not meet the required criteria.

Table 3. Microbiological estimation of sanitation of work surfaces, machines and equipment in the kitchens of small and medium sized enterprises.

A spot, a swab was taken from	Type and No. of enterprises		Sanitation estimation (%)					
	ME (n)	SE (n)	Suitable ¹		Suitable ²		Not suitable ³	
			M	SE	M	SE	ME	SE
Tap handle on wash-hand basin in the kitchen ⁴	25	24	20	0	76	67	4	33
Work surface	18	22	50	0	44	50	6	50
Cutting board for heat treated vegetable	12	25	50	12	42	40	8	48
Cutting board for heat treated meat	12	12	58	0	42	33	0	67
Cutting board for bread	6	/	50	/	50	/	0	/
Meat slicer	/	10	/	0	/	55	/	45
Cutlery tray	15	/	27	/	67	/	6	/
Wall in the refrigerator ⁴	13	7	54	29	38	57	8	14
Worker's left hand ⁴	25	25	0	0	32	40	68	60
Worker's right hand ⁴	25	25	0	0	48	48	52	52

Legend:

SE: small sized food-processing plants

ME: medium sized food-processing plants

Suitable¹: microorganisms have not grown on blood agar plates.

Suitable²: if aerobic mesophile bacteria count is not higher than 200 (Anonymous 1981, 1982).

Not suitable³: if aerobic mesophile bacteria count is higher than 200 (Anonymous 1981, 1982).

⁴In the legislation there is no criteria for sanitation estimation of tap handle on wash-hand basin in the kitchen; Wall in the refrigerator and workers' hands (Anonymous 1981, 1982), that is why for those spots the same criteria as for work surfaces stated in the legislation was considered.

Table 4. A number of isolated bacterial species, isolated from 25 swabs of left hands and from 25 right hands of workers in medium sized food enterprises.

Bacterial specie	Estimation ¹	Left hand (n=25)	Right hand (n=25)
<i>Bacillus</i> sp.	Suitable	1/25	1/25
<i>Bacillus cereus</i>	Suitable	1/25	3/25
<i>Staphylococcus</i> sp.	Suitable	21/25	18/25
<i>Staphylococcus aureus</i>	Not suitable	2/25	1/25
<i>Staphylococcus warneri</i>	Suitable	2/25	2/25
<i>Micrococcus</i> sp.	Suitable	11/25	8/25
á- Hemolytic Streptococci	Suitable	19/25	16/25
<i>Pseudomonas aeruginosa</i>	Not suitable	1/25	0/25

Legend:

¹ Estimation: suitable if *Escherichia coli*, coagulase-positive staphylococci, fecal streptococci, *Proteus* sp. and *Pseudomonas aeruginosa* have not been isolated (Anonymous 1981, 1982); not suitable not suitable if *Escherichia coli*, coagulase-positive staphylococci, fecal streptococci, *Proteus* sp. and *Pseudomonas aeruginosa* have been isolated (Anonymous 1981, 1982).

Table 5. The number of swabs taken from cheked spots in 25 medium sized plants and determined bacterial species on blood agar plates.

A spot, a swab was taken from	No. of swabs taken	Microorganism species, grown on blood agar plates (n)				
		<i>Bacillus species</i>	<i>Bacillus cereus</i>	<i>Staphylococcus species</i>	<i>Micrococcus species</i>	á-hemolytic Streptococci
Cutting board for heat treated meat	12	0	1	3	1	2
Cutting board for bread	6	0	1	1	0	1
Cutting board for vegetables	12	0	0	3	0	5
Work surface	18	0	0	6	2	8
Cutlery tray	15	2	1	6	1	4
Tap handle	25	2	0	13	5	7
Wall in the refrigerator	13	0	0	3	0	1

Table 5 shows that from defined spots there were isolated different bacterial species, but no pathogenic bacteria among them. A number of isolated bacteria did not exceed the total count standard in any of the swabs taken.

DISCUSSION

In most SEs there are area limitations and they are not constructive-technical suitable for performing food related activities. This finding was consistent with the findings of Ba^o & others (2007). In small plants technical and hygiene conditions for hand washing were estimated as inadequate and worrying. Un-negligible share of (14%) small plants does not meet even minimal hygiene-technical requirements for food handling (e.g. wash-hand basin is missing or is not installed properly – enables cross contamination between high and low risk area; unsuitable and worn out materials do not enable efficient sanitation and maintenance etc.). In some of MEs kitchen equipment is worn out, so efficient hygienic maintenance is not possible. Aarnisalo & others (2006) summarize the results of many studies which have shown that food processing equipment could be a source of contamination, e.g. *Listeria Monocytogenes*. Hygiene problems in equipment are caused when microorganisms become attached to the surfaces and survive on them and later become detached from them contaminating the product (Aarnisalo & others 2006). Therefore, kitchen design and the food handling processes themselves must be such that the »hygienic flow« of food is adequate and uninterrupted (Martínez-Tomé & others 2000).

In some of MEs as well as in some of small sized ones the wash-hand basins installation does not prevent cross contamination between high and low risk areas. Hygienic equipment of basins is inadequate mainly in SEs, since in more than a third of (39%) plants necessary hygienic equipment by the basins was missing (e.g. liquid soap, paper towels). In regulation (EC) No 852/2004 it is stated that an adequate number of hand-wash basins is to be available, suitably located and designated for cleaning hands. Washbasins for cleaning hands are to be provided with hot and cold running water, materials for cleaning hands and for hygienic drying. Where necessary, the facilities for washing food are to be separated from the hand-washing facility (EU 2004).

Due to area limitations the usage of sanitary facilities in some of SEs and MEs is unsuitable. In some of SEs the same sanitary facility is used by guests as well as by employees and in MEs by kitchen employees as well as by teachers. The fact that in 24% of examined plants hand-wash basins were not adequately hygienic equipped is alarming as well. The latter increases the possibility of faecal contamination transmission.

By observing employees during their work the fact, that most of workers in both groups do not wash their hands after performing any dirty work (e.g. when changing between high and low risk phase of work, after packaging handling etc.) or do not wash hands properly (e.g. they do not use liquid soap, negligent hand washing technique etc.), was determined. It was concluded that employees do not understand the meaning of proper hand washing and are not aware of microbiological hazards that can occur due to dirty hands respectively. The causes for the latter can be found among insufficient hygiene training, negligent, insufficient employees' knowledge and/or inefficient control by supervisors. Henroid and Sneed (2004)

state that 33% of employees in school kitchens in the USA do not always when necessary wash their hands. The hands of food handlers can be pivotal as vector in the spread of food-borne disease due to poor personal hygiene or cross-contamination (Setiabudhi & others 1997). According to Taylor & others (2000) there is evidence from the food industry to show that microorganisms are transferred to the hands in the process of handling food through poor personal hygiene after visiting lavatory, resulting in the hands being heavily contaminated with enteric pathogens.

Results of microbiological estimation of sanitation of working surfaces, equipment employees' hands show that comparing to SEs in MEs a hygiene conditions are poorer. A number of grown bacteria is higher in SEs than in MEs. It is surprising that from the swabs taken from tap (in ME) no microorganism has grown, which shows that workers have been prepared for our visit and it made a difference to them what hygiene situation would be recorded. Similar results have been determined on swabs taken from working surfaces in MEs, where from half of swabs grew no micro-organisms. On the contrary in SEs a poor hygiene situation was determined, since half of the swabs did not meet required criteria. Poor hygiene situation, which is connected with improper cleaning as well (food cutting boards), is reflected in SEs, where two thirds of swabs taken from heat treated meat cutting board were not suitable. In SEs 90% of the swabs taken from meat slicers did not meet required criteria as well. In MEs the rules for proper cleaning were followed, which is reflected in swabs taken from cutting boards, since results of laboratory analyses were mainly suitable and meet requirements of the legislation (Anonymous 1981, 1985) respectively. Species of isolated bacteria was determined only in MEs, where total bacteria count is significantly lower than in SEs.

Microorganisms are always present on hands, because they are a part of normal microflora, but nevertheless in food production and trade the presence of some of bacteria is not allowed. In the research for bacteriological analyses of hands a blood agar plates were used, which enable quick estimation of hygiene condition in the selected plants. In further analyses selective growth medium would be used only for not allowed bacteria, which show hygienic status of food-processing plants. Bacteria from employees' hands have grown from some to 100 and more (on an individual hand). It was determined that on right hands there were less microorganisms than on left hands. If studying an individual person in the most of the cases can be seen that in the same person has either low or high bacteria count on both hands. Therefore it may be wise to take swabs from workers hands more frequently and communicate the results. That could be a motivation for better hand hygiene at work. However, as shown in previous studies of food handlers' beliefs and self-reported practices (Clayton & others 2002), food handlers were aware of the food safety behaviours they should be carrying out, but 63% of respondents admitted that they did not always carry out these behaviours. Food handlers also reported carrying out food safety practices, particularly hand washing, much more frequently than they actually implemented them (Manning & Snider 1993). This suggests that food handlers could be carrying out food safety practices less frequently than the self-reported data implies (Clayton & others 2002). Shojaei & others (2006) cited that many authors emphasized that hands of food handlers are an important

vehicle of food cross-contamination and that improved personal hygiene and scrupulous hand washing would lead to the basic control of faeces-to-hand-to-mouth spread of potentially pathogenic transient micro-organisms. Lues & Van Tonder (2007) summarize results of several studies where it was established that various bacteria, among others *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* sp., survive on hands and surfaces for hours or even days after initial contact with the micro-organisms.

Every person working in a food-handling area is to maintain a high degree of personal cleanliness and is to wear suitable, clean and, where necessary, protective clothing (EU 2004). It was determined that personal hygiene is significantly poorer in SEs than in MEs. More than a third (36%) of workers in SEs did not wear clean and suitable overalls, more than half (52%) performed work with no head-covering. The cause of the problem contributing to the stated results in SEs is lack of control by trained and responsible persons. Workers are to a large extent left on their own, beside that the owners do not provide necessary means for the safe food handling. In MEs situation regarding personal hygiene is better. In most of MEs there is responsible person authorized by management, who is responsible for hygiene and has required professional education. A periodical training for workers is performed in accordance with a plan and work performance is checked daily. The main problem identified among food handlers in SEs is related to the fact that they receive no specific or insufficient knowledge about food hygiene.

Knowledge and training for working according to HACCP system were estimated by prior designed questions. By asking a question: "How do you record temperatures in cooling appliances and during heat treatment?" it was determined that in 12% of SEs and in 20% of MEs temperatures were registered in advance and for the past. From the results it is concluded that the majority of workers follow work instructions, but are not familiar with or do not understand why that is necessary and are not aware of hazards in case of hygiene violations and un-fulfillment of the requirements. This finding was consistent with the findings of Panisello & others 1999, Ramirez Vela & Martin Fernández 2003, Yapp & Fairman 2006 where they established that smaller companies may lack knowledge and expertise in HACCP and appropriate resources to obtain knowledge, both resulting in insufficient understanding of functions of HACCP principles. It was established that education and training is not efficient mainly in SEs, since it is carried out by incompetent persons without suitable professional and pedagogical knowledge. Yapp & Fairman (2006) pointed out that in some cases SMEs do not realize that they are breaking the law and often do not understand what is required of them. It is particularly evident when recording parameters according to HACCP plan. It was determined that documentation regarding prerequisite programs in both types of food enterprises incomplete, but in SEs the situation is worse. Mitchell (1998) stated that the HACCP plan is sometimes a »paper exercise« that overburdens the need of SMEs and it is not implemented in practice.

With regulation (EC) No 853/2004 the responsibilities for food safety lays entirely on food business operators, which means that operators are responsible for education and training of their employees as well (EU 2004). The former legislation in the Republic of Slovenia required regular periodical training and food handlers' knowledge checking every 5 years

and for newly employed respectively. It is still a question which training type will prove to be more effective in the future. Irrespective of that the most important fact according to Seaman & Eves (2007) is that the training will only lead to an improvement in food safety if the knowledge imparted leads to desired changes in behaviour in the workplace. For conscientious hygiene it is not important in which enterprise people work, but depends upon hygiene awareness and education of an individual person.

CONCLUSIONS

The hygiene assessment in small and medium sized food establishments in the capital city of Slovenia has brought to light unsatisfactory hygiene conditions. Fully compliance with prerequisite programs and HACCP system is far from complete, especially in small food enterprises. In order for these systems to work, Ramirez Vela & Martin Fernández (2003) stated that senior management has to assume the responsibility of educating employees for their specific tasks in keeping with the companies' goals.

For efficient food safety management it is suggested that food business operators follow the model of "Four elements analysis" for efficient hygiene-technical situation management in food-processing plants. The model includes equally important elements, where every individual element requires competent and trained person's involvement. Model's benefit is exposure of human factor in food safety assurance.

The first element includes current hygiene-technical estimation in food-processing plant. Hygiene-technical deficiencies and/or irregularities have to be analyzed and plan of improvements has to be made. The second element includes establishing of hygiene basics, so called prerequisite programs, which are the basic for HACCP system establishment – a tool for food safety management. The third element includes planning and execution of periodical training and education, adapted to specific work tasks, for employees of all the food hygiene levels. The fourth element rests on employees' knowledge during food handling checking and on responsible person's opinion regarding involvement of individual worker in specific work task. This demands professionally trained, competent person, who possess adequate technical and pedagogical knowledge, practical experiences and knowledge from human resource management. The various techniques and methods of training involvement and control of work process performance are required as well. By the last, fourth, element a human factor as risk for food safety assurance has been pointed out. In the future an equal discussion for human risk factor as for the other risk factors in production processes (biological, chemical and physical) is suggested.

Based on the results of the research it is determined that hygiene education and individual awareness are the most important tools for food safety assurance, that's why every food handler requires a complex and individual dealing. The human factor must be discussed equally like all the other risk factors such as hygiene, technical and technological factors.

For food safety it is essential that every link in food supply chain understands and fulfils his responsibilities and relies upon the previous and the next step in a chain.

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REFERENCES

- Aarnisalo, K., Tallavaara, K., Wirtanen, G., Maijala, R., Raaska, L. (2006): The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. *Food Control*, 17, 1001-1011.
- Anonymous. (1981, 1982): Act of special measure in case of food poisoning and infection and their preventive measures. Official Gazette of Republic of Slovenia No 24/1981, 35/1982.
- Ayçiçek, H., Aydoğan, H., Küçükkaraaslan, A., Baysallar, M., Başustaoglu A.C. (2004): Assessment of the bacterial contamination on hands of hospital food handlers. *Food Control*, 15, 253-259.
- Baş, M., Ersun, S.A., Kivanç, G. (2005): The evaluation of food hygiene knowledge, attitudes, and practices of food handlers in food businesses in Turkey. *Food Control*, 17, 4, 317-322.
- Baş, M., Yuksel, M., Cavusoglyu, T. (2007): Difficulties and barriers for the implementation of HACCP and food safety systems in food businesses in Turkey. *Food Control*, 18, 2, 124-130.
- Clayton, D. A., Griffith, C. J., Price, P., Peters, A. C. (2002): Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12, 1, 25-39.
- Conter, M., Zanardi, E., Ghidini, S., Pennis, L., Vergara, A., Campanini, G., Ianieri, A. (2007): Survey on typology, PRPs and HACCP plan in dry fermented sausage sector of Northern Italy. *Food Control*, 18, 6, 650-655.
- Den Aantrekker, E.D., Boom, R.M., Zweitering, M.H., Van Schothorst, M. (2003): Quantifying recontamination through factory environments – A review. *International Journal of Food Microbiology*, 80, 2, 117-130.
- EU (European Union). (2004): Corrigendum to Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (OJL 139, 30.4.2004). Official Journal of the European Union L226, 25/06/2004, 3-21.
- Fielding, L.M., Ellis, L., Beveridge, C., Peters, A.C. (2005): An evaluation of HACCP implementation status in UK small and medium enterprises in food manufacturing. *International Journal of Environmental Health Research*, 15, 2, 117-126.
- Gilling, S.J., Taylor, E.A., Kane, K., Taylor, J.Z. (2001): Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioural adherence model. *Journal of Food Protection*, 64, 710-715.
- Heggum, C. (2001): Trends in hygiene management – the dairy sector example. *Food Control*, 12, 241-246.
- Henroid, D., Sneed, J. (2004): Readiness to implement Hazard Analysis Critical Control Point (HACCP) system in Iowa school. *Journal of the American Dietetic Association*, 104, 2, 180-185.

- Jevšnik, M., Hlebec, V., Raspor, P. (2006): Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35, 3, 319-353.
- Konecka-Matyjek, E., Turlejska, H., Pelzner, U., Szponar, L. (2005): Actual situation in the area of implementing quality assurance system GMP, GHP and HACCP in Polish food production and processing plants. *Food Control*, 16, 1-9.
- Kusumaningrum, H.D., Riboldi, G., Hazeleger, W.C., Beumer, R.R. (2003): Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. *International Journal of Food Microbiology*, 85, 227-236.
- Lues, J. F. R., Van Tonder, I. (2007): The occurrence of indicator bacteria on hands and aprons of food handlers in the delicatessen sections of a retail group. *Food Control*, 18(4), 326-332.
- Manning, C. K., Snider, S. (1993): Temporary public eating places: food safety knowledge, attitudes and practices. *Journal of Environmental Health*, 56, 24-28.
- Marriot, N.G., Gravani, R.B. (2006): Foodservice Sanitation. In: Principles of food sanitation. Fifth Edition, Marriot, N.G. & Gravani, R.B. (Eds.). Springer, New York, 371-391.
- Martínez-Tomé, M., Vera, A.M., Murchia, M.A. (2000): improving the control of food production in catering establishments with particular reference to the safety of salads. *Food Control*, 11, 437-445.
- Mitchell, R.T. (1998): Why HACCP fails. *Food Control*, 9, 101.
- Mortimore, S. (2001): How to make HACCP really work in practice. *Food Control*, 12, 209-215.
- Motarjemi, Y., Käferstein, F. (1999): Food safety, Hazard Analysis and Critical Control Point and the increase in foodborne diseases: a paradox? *Food Control*, 10, 325-333.
- Nel, S., Lues, J.F.R., Buys, E.M., Venter, P. (2004): Bacterial population associated with meat from the deboning room of a high throughput red meat abattoir. *Meat Science*, 66, 667-674.
- Panisello, P.J., Quantic, P.C., Knowles, J.M. (1999): Towards the implementation of HACCP: the results of a UK regional survey. *Food Control*, 10, 87-98.
- Ramírez Vela, A., Martín Fernández, J. (2003): Barriers for the developing and implementation of HACCP plans: results from a Spanish regional survey. *Food Control*, 14, 333-337.
- Raspor, P. (2002): Handbook for establishment and conducting HACCP system. Slovenian Institute of Quality, Biotechnical faculty, Ljubljana, 598 pp.
- Raspor, P. (2004a): Opening ceremony. In Book of abstract. New tools for improving microbial food safety and quality. Biotechnology and molecular biology approaches, 12-16 September 2004, Portorož, Slovenia, 3-4.
- Raspor, P. (2004b). How much safety we can expect from microbiology and biotechnology in coming years? In: Raspor, P. (Ed.), Microbiology and biotechnology in food safety. Biotechnical Faculty, Ljubljana, 87-193.
- Raspor, P. (2005). Bio-markers: traceability in food safety issues. *Acta Biochimica Polonica* 52, 3, 659-664.

112 M. Jevšnik, M. Bauer, A. Zore and P. Raspor

- Raspor, P. (2006a): Faces of foods on the world of food systems (Editorial). *Acta Alimentaria*, 35, 3, 247-249.
- Raspor, P., Jevšnik, M., Hlebec, V. (2006b): Consumers' awareness of food safety from shopping to eating. In: *Nutrition and food safety*. Bánáti, D. (Ed.). Brussels: Consortium International Congress on Food Safety, The Safe Consortium, 112.
- Ropkins, K., Beck, A.J. (2000): Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends in Food Science and Technology*, 11, 10-21.
- Seaman, P., Eves, A. (2007): The management of food safety - the role of food hygiene training in the UK service sector. *International Journal of Hospitality Management*, 25, 278-296.
- Setiabudhi, M., Theis, M., Norback, J. (1997): Integrating hazard analysis and critical control point (HACCP) and sanitation for verifiable food safety. *Journal of the American Dietetic Association*, 97, 8, 889-891.
- Shojaei, H., Shooshtaripour, J., Amiri, M. (2006): Efficacy of simple hand-washing in reduction of microbial hand contamination of Iranian food handlers. *Food Research International*, 39, 5, 525-529.
- Smole Možina, S., Hočevar Grom, A. (2004): Microbiological food safety. In: *Food Safety*, 22. Food technology days, 18 and 19 March 2004, Radenci. Gašperlin, L., Žlender, B. (Eds.). Biotechnical Faculty, Ljubljana 29-43.
- Sperber, W.H. (2005a): HACCP and transparency. *Food Control*, 16, 505-509.
- Sperber, W.H. (2005b). HACCP does not work from Farm to Table. *Food Control*, 16, 511-514.
- Sun, Y-M., Ockerman, H.W. (2005): A review of the needs and current applications of hazard analysis and critical control point (HACCP) system in foodservice areas. *Food Control*, 16, 325-332.
- Taylor, E. (2001a): HACCP and SMEs. In: *Making the most of HACCP. Learning from other's experience*. Mayes, T.M. & Mortimore, S. (Eds.). Woodhead publishing limited, Cambridge, 13-31.
- Taylor, E. (2001b): HACCP in small companies: benefit or burden? *Food Control*, 12, 4, 217-222.
- Taylor, E., Kane, K. (2005): Reducing the burden of HACCP in SMEs. *Food Control*, 16, 10, 833-839.
- Taylor, J. H., Brown, K.L., Toivonen, J., Holah, J.T. (2000): A micro-biological evaluation of warm air hand driers with respect to hand hygiene and the washroom environment. *Journal of Applied Micro-biology*, 89, 910-919.
- Untermann, F. (1999): Food safety management and misinterpretation of HACCP. *Food Control*, 10, 161-167.
- Walczak, D., Reuter, M. (2004): Putting restaurant customers at risk: unsafe food handling as corporate violence. *Hospitality Management*, 23, 3-13.
- Walker, E., Jones, N. (2002): An assessment of the value of documenting food safety in small and less developed catering businesses. *Food Control*, 13, 307-314.
- Walker, E., Pritchard, C., Forsythe, S. (2003): Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control*, 14, 169-174.

Hygienic Status of Small and Medium Sized Food Enterprises During Adoption of Haccp System 113

- Yapp, C., Fairman, R. (2006): Factors affecting food safety compliance within small and medium-sized enterprises: implications for regulatory and enforcement strategies. *Food Control*, 17, 42-51.
- Zorman, T., Heyndrickx, M., Uzunović-Kamberović, S., Smole Možina, S. (2006): Genotyping of *Campylobacter coli* and *C. jejuni* from retail chicken meat and humans with campylobacteriosis in Slovenia and Bosnia and Herzegovina. *International Journal of Food Microbiology*, 110, 1, 24-33.

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2.1.4 Food safety knowledge and practices among food handlers in Slovenia

Poznavanje in upoštevanje načel za varnost živil med živilskimi delavci v Sloveniji

Mojca Jevšnik, Valentina Hlebec in Peter Raspor

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V delu so predstavljeni rezultati kvantitativne raziskave o dejavnikih, ki vplivajo na varnost živil med zaposlenimi pri delu z živili v Sloveniji. Podatki so bili zbrani v letu 2005 s pomočjo anonimnih anketnih vprašalnikov. V analizo je bilo vključenih 386 vprašalnikov, ki so jih izpolnili zaposleni v živilski industriji, gostinstvu in v trgovinah z živili. V uvodu je obravnavana pomembnost izobraževanja o higieni živil in področje ravnanja s človeškimi viri. Izpostavljeno je področje zadovoljstva z delom, ki je v živilstvu dostikrat zanemarjeno. Znanje zaposlenih o higieni živil je nezadostno, še posebej na področju poznavanja in obvladovanja mikrobioloških tveganj pri delu z živili; predvsem pri gostincih in trgovcih. Analiza mnenj o dejavnikih, ki vplivajo na varnost živil je osvetlila področja, katerim anketirani namenjajo več poudarka. Štirje elementi zadovoljstva zaposlenih na delovnem mestu pomembno vplivajo na zagotavljanje varnih živil v živilsko/prehransko/oskrbovalni verigi. Področje ravnanja s človeškimi viri bi moralo postati integralni del sistema HACCP.

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Food Control xxx (2008) xxx–xxx

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Food safety knowledge and practices among food handlers in Slovenia

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Abstract

The authors present and discuss the results of quantitative research on factors that have impact on food safety in three groups of food handlers in Slovenia. Data were collected via anonymous questionnaire in 2005. Altogether 386 respondents from food production, catering and retail units completed the questionnaire. First the importance of food safety training is shortly discussed. Further the importance of human resource management as well as employees' work satisfaction that is mostly neglected in the units of food supply chain is outlined. Some gaps of food handlers' knowledge on microbiological hazards were found, especially for those working in catering and retail. Analysis of employees' opinion toward food safety requirements has shown which hazards were ascribed as more important regard food safety. Analysis of four foundational pillars of employees' work satisfaction highlighted the importance of them in the units of food supply chain. The field of human resource management should have to become an integral part of HACCP system.

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Keywords: Food safety; HACCP; Food handlers; Human resource management; Knowledge; Work satisfaction

1. Introduction

In April 2004 the European Parliament adopted regulation (EU) No. 852/2004 on the hygiene of foodstuffs. This has to apply all EU food businesses from 1st of January 2006. The main change to the law relates to food safety management systems i.e. risk based methodologies to ensure the safety of food. Food business operators shall ensure that all stages of production, processing and distribution of food under their control satisfy the relevant hygiene requirements laid down in the Regulation (EC) No. 852/2004. The demand of application of HACCP principles became a law in Slovene in the beginning of 2003. Successful implementation of the procedures based on the

HACCP principles will require the full cooperation and commitment of food business employees. To this end, employees should undergo training.

A major problem that still remains is the employees' fully acceptance of prerequisite programs (PRP) and HACCP system especially in small and medium-sized (SMEs) food businesses. Many authors discuss about barriers or hindrances which have impact to the effective implementation of HACCP in SMEs (Azanza & Zamora-Luna, 2005; Baš, Šafak, & Kıvanç, 2006; Henroid & Sneed, 2004; Hielm, Tuominen, Aarnisalo, Raaska, & Majjala, 2006; Taylor & Taylor, 2004a; Taylor & Taylor, 2004b; Vela & Fernández, 2003; Walker, Pritchard, & Forsythe, 2003a). Among the key ones Walker et al. (2003a) mentioned lack of expertise and perception of benefits, absence of legal requirements, various attitude barriers and financial constrains. According to Hielm et al. (2006) most difficulties were established in devising the own-checking plan/HACCP plan the most common answers were choosing the critical control points, committing the firm's entire

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2

M. Jevšnik et al. / *Food Control* xxx (2008) xxx–xxx

workforce and organizing the documentation of monitored results. One of the major problems is that the food workers often lack interest and they often have a negative attitude toward food safety programs (Griffith, 2000).

The acceptance of food safety systems has put employee training under the microscope (Collis & Winnips, 2002). Under the personnel program of HACCP, employees must be trained in such areas as food safety, manufacturing controls and personnel hygiene. Once HACCP plans have been established, employees must be trained to manage any critical control points (CCPs). Though numerous companies have developed, documented and implemented training programs, few understand why employee training is important, what their training requirements are, or how to assess the effectiveness of in-house training programs. So far most publications about HACCP training have described what should be done, but little has been written about effectiveness of such training and how to motivate employees to follow all food safety requirements. Food business operators have to engage with these issues in their own way, as every company has its own specific ways of ensuring safety. HACCP has been described as a philosophy in theory and a tool in practice (Gilling, Taylor, Kane, & Taylor, 2001) and cited by Bryan (1981) "It should therefore come as no surprise that there can be different opinions on how it should be applied" HACCP problems are a complex mix of managerial, technical and behavioral issues requiring specific remedies (Gilling, 2001). By taking a psychological approach and utilizing practical experience and a theoretical knowledge of HACCP, Gilling et al. (2001) identified 11 key barriers and organised them around knowledge, attitude and behavior framework. The proposed behavioral adherence model therefore acts as a diagnostic tool, identifying progressive stages to successful HACCP guideline adherence. They emphasized that the model should be of significant help to those offering advice and guidance to food operators undertaking HACCP implementation. A problem which has considerable influence on acceptance of introduced "new" food safety system especially when it was begun were the way of presenting HACCP and qualification of trainers. Mortimore and Smith (1998) mentioned that many trainers had been willing to provide HACCP training without considering the scope (what had to be taught and what need not) and the depth of coverage. They also described that there was a wide disparity in content and quality between courses. Moreover, several authors suggested that most managers in food industry have limited understanding of the global food safety strategy (Ehiri, Morris, & McEwen, 1995; Mortimore & Smith, 1998; Khandke & Mayes, 1998; Williams et al., 2003). MacAuslan (2003) wrote that the majority of food businesses do not have satisfactory training policies for all their staff. He emphasized that too much reliance is being placed upon attaining a certificate rather than attention is paid to achieving competency in food hygiene practice. He suggested that more emphasis and resources need to be diverted towards assisting managers to become highly

motivated food hygiene managers who develop and maintain a food safety culture within their business. A small business owner may be tempted to place the burden of training responsibility on an external employer, and not shoulder any responsibility themselves. Upon MacAuslan (2003) the problem can have two sides; firstly the employer lacks key management skills in leadership, motivation, training and evaluation and secondly going for a certificate course as it is the "done think".

Factors, which have a significant impact on employers' behavior, are correlated with organizational climate in the company, level of job satisfaction and labour conditions and with relations between employees and their supervisors. Marolt and Gomišček (2005) described a new management approach to employees, which stimulates employees to be initiative, to learn, to devotion to company, to self-confidence, to higher efficiency and better team-work that all contribute to higher successfulness and effectiveness of the organisation. They emphasized a function of leadership, which plays a key role in realization of the new principles into practical work and thus can significantly contribute to better usage of existent resources. A leader should with leadership function persuade the employees to fulfil their needs and desires by effective working and should enable them to use their potentials and by doing so to contribute to achieve the goals of a team and an organisation. It would be ideal if people would be motivated to such level so they would not work just because they have to, but would work with eagerness and with trust. As skills of a successful leader motivation, communication, improvement and introduction of modifications are mentioned (Černetič, 2001; Marolt & Gomišček, 2005). In review on history of motivational research and theory Latham and Ernst (2006) summarized that psychologists now knew the importance of (1) taking into account a person's needs (Maslow's need hierarchy theory, Hackman and Oldham's job characteristics theory), (2) creating a job environment that is likely to facilitate self-motivation (Herzberg's job enrichment theory, Hackman and Oldham's job characteristics theory), and (3) ways to directly modify, that is, to directly increase or decrease another person's behavior by administering environmental reinforcers and punishers contingent upon a person's response (Skinner's contingency theory). They also stress the importance on attaining employees' goals, then they not only feel satisfied, they generalize their positive affect to the task (Locke & Latham, 1990). Jannadi (1995) emphasized that workers are the ones who carry out the work in a company, and they can be an important factor in making the company profitable or bankrupt. Human behavior is very important, and it is difficult to control, so handling people requires situational leadership. Hazards can not be solved and eliminated just through engineering control. They also need to be recognised by employees who will minimize their effects (Jannadi, 1995). Human resource management and education of food safety managers in food premises has not captured the strong attention of researchers.

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M. Jevšnik et al. / *Food Control* xxx (2008) xxx–xxx

3

The aim of this study was to evaluate and compare the three food safety issues: food safety knowledge and practice, employee attitude toward food safety, and employee work satisfaction among three groups of food handlers (employees in food production, retail and catering) in Slovenia.

2. Materials and methods

2.1. Questionnaire design

A self-administrable questionnaire was developed for this study with 20 multiple choice questions with four, five or six possible answers, including “do not know” and “other”, for the purpose of minimizing the possibility of selecting the correct answer by chance. In addition, six questions were related with demographic characteristics of respondents (education level, personal income, type of settlement, gender, age, and number of years in a food business). The questions were designed and structured in three groups. The first group named “Knowledge and practices” (12 questions) was designed to assess knowledge and practice habits focused on microbiologic food hazards, temperature control, food storage, cross-contamination, health requirements and working utensils cleaning. One of the questions was related to respondents’ opinion to additional education and training. The second group of four questions was designated “Employees’ opinion of food safety”. Through correct and incorrect answers an employees’ relation to safe food assurance and their opinion if working conditions are in accordance with food safety principles were determined. With the next question the hygiene violations, which influence food safety the most and the ones, which do not influence food safety were found out. And with the last question of this topic an employees’ opinion regarding carrying out food safety requirements by their co-workers was determined.

The last part of the questionnaire “Employees’ work satisfaction” (four questions) was designed to determine employees’ work satisfaction (their satisfaction with co-workers, managers’ relationships and their opinion on work motivational factors). To measure employees’ work satisfaction a group of experts (content and methodology) adopted several well known scales¹ and arranged them to better suit the specific problems and situation in Slovenia. To balance the scales an equal number of positive and negative items was selected.

The respondents completing the questionnaire remained anonymous and were identified by job description. The

questionnaire was pilot tested by 30 participants during February and March of 2005, resulting in minor modifications of questions’ wording. Each questionnaire took approximately 15 min to complete. A study was conducted from April to November of 2006.

2.2. Participating businesses and questionnaire delivery

For analyzing an employees’ knowledge about general food safety principles, their opinion of their work according to food safety requirements and general employees’ feeling in working environment a questionnaire for employees in three different food dealing work units was designed. The basic guidance for participating units selection was production flow of the selected food item (sauerkraut), namely only units dealing with the sauerkraut were selected. For those purpose three food companies, which produce the sauerkraut, tourist farms, which have the sauerkraut or sauerkraut dishes on their menus and retails, which sell sauerkraut in bulk or in the original packaging were selected.

2.2.1. Food production (P)

The questionnaire was delivered in all three food businesses, which manufacture sauerkraut in Slovenia. In each food business the questionnaire was delivered to the food technologist (who is responsible for the production). The purpose of the survey and instruction for completing the questionnaire were explained to a technologist in person or by phone. The number of respondents was determined with regard to a number of workers, working in the sauerkraut production and with regard to the number of workers present on the day of investigation. Questionnaires were distributed among the workers and their content explained to them by food technologist during the lunch time. Completed questionnaires from three plants ($N=50$) were mailed the same day by responsible technologists.

2.2.2. Catering (C)

Among catering businesses all tourist farms in Slovenia were chosen. The questionnaires were sent to all the registered tourist farms in Slovenia ($N=368$). Information regarding the number of tourist farms and their addresses were collected by data base of the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES). Questionnaires together with survey explanation and a short guidance for questionnaire fulfilment were sent by mail to tourist farms. Each envelope included an empty letter with a post stamp and an address of the recipient, so that completed questionnaires could be sent back. After the first dispatch 51 (13.8%) completed questionnaires were received back. With the second letter we thanked to all the participants and we kindly asked again all of those, who had not completed the questionnaire yet, to complete it and send it back. After the second dispatch we received

¹ Job in general scale (Ironson, Smith, Brannick, Gibson and Paul, 1989); Industrial salesperson Job satisfaction: Indsales/Fellow workers, Indsales/Pay, Indsales/Supervision, Indsales/Promotion and advancement (Churchill, Ford and Walker, 1974); Job induced tension (House and Rizzo, 1972); Employee motivation (Stone, 1998; Bearden, Netemeyer, & Mobley, 1993).

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4

M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

25 (6.8%) completed questionnaires more. Total of 76 (20.6%) completed questionnaires were received.

2.2.3. Retail (R)

Among larger retail chains in Slovenia one of them, which sells not only food, but assorted goods as well, was selected (variety of goods depends upon a size of a store located in particular place). Criteria for the sample selection were a site of a store (defined as a store sales area) and a number of employees in a shop. 385 (6.7%) employees from 100 shops were included in the survey. Shops were divided regarding sales area to the small ones ($N = 57$), the middle ones ($N = 35$) and the large ones ($N = 8$).

Questionnaires, together with their instructions, were handed to the company's responsible person for food safety in the company's headquarters. The questionnaires were distributed then by the responsible person of the company to the responsible ones in the separate units (mainly team supervisors). The questionnaires were then during the lunch time distributed among defined number of employees by the responsible persons. Completed questionnaires were then sent back to the responsible person of the whole company. Completed questionnaires were collected by the researchers in the headquarters of the company.

2.3. Statistical analysis

Scores for each test category (i.e., food safety knowledge and practices and opinion of food safety) were calculated by assigning correct responses. Cross tabulations and chi-square tests (5% significance) were used to compare results among three groups of food handlers. Pearson correlation coefficient was used to assess some associations depending on the measurement level of variables. Independent sample *t*-test and ANOVA (confidence interval 95%) were used to compare selected test parameters within three groups of food handlers. The SPSS 13.0 statistical package was used for all analyses.

3. Results and discussion

3.1. Sample characteristics

Of the 386 employees taking part in the research, 76 (19.7%) classified themselves as catering, 260 (67.4%) as retail and 50 (12.9%) as manufacturing. Most of the respondents (88.8%) are female. Average age of respondents are 40.3 (SD = 8.98). Education level of almost half of the respondents (46.1%) are finished vocational school or unfinished high school (1.6%), 8.6% have unfinished vocational school or less, 43.8% have finished high school and more. Personal income 46% of respondents are in the range between 416 and 625 Eur, 44.3% lower than 416 and 9.7% above 625. Types of settlement at half of the respondents are rural, 30.5% lives in suburbia and 19.3% in town. Respondents worked in food business in average 17.3 years (SD = 9.9; max = 38 years).

3.2. Comparative analysis of responses to "Knowledge and practices" questions

With the first set of questions (Tables 1 and 2) we were trying to establish the most effective education and training strategy according to employees. In addition, we were testing the knowledge of employees with emphasis on potential microbiological hazards (preventing cross-contamination, following principles of cold and hot chain, health condition, etc.). Majority (78%) of the respondents is familiar with the basic principle of HACCP system ("maintaining food safety"); while 15% of respondents think that HACCP refers to maintaining food quality. Comparison of the results among three groups of employees working in catering (C), retail (R) and food production (P) has shown no significant differences. Education, provided by experts in a company (82.9%) and education, provided by supervisors during work (73.1%) is most effective according to most respondents. Both ways of education are more effective for employees in production ($p = 0.000$), than for those employed in retail and catering. In a study of Cohen, Reichel, and Schwartz (2001) they established food's microbiological quality improvement after the in-house sanitation training program. Because not all departments benefited equally they suggested that it might be useful to tailor the program to the unique circumstances in each department to maximize the benefits of an in-house sanitation programs. Baş et al. (2006) pointed out that a number of studies have indicated that although training may bring about an increased knowledge of food safety this does not always result in a positive change in food handling behavior. This finding corroborates with the results in a study of Clayton, Griffith, Price, and Peters (2002) in which majority of food handlers operating in a food premises in UK admitted that they did not always carried out all the food safety practices they know they should be implementing. Food safety knowledge and practise questions (Table 1) show inadequate knowledge of employees concerning microbiological hazard protection. A quarter of employees would store a bean salad in the wrong place if a large piece of fresh meat is stored on the middle rack. In a study by Walker, Pritchard, and Forsythe (2003b), 97% of food handlers knew that raw and cooked foods should be separated in order to prevent bacterial transfer. A quarter also chose the wrong temperature value (63 °C) for storing thermally processed meals (among which 16% believe that 37 °C would be adequate). However, there are statistically significant differences between groups ($\chi^2 = 18.684$; $p < 0.005$; $N = 347$). Less catering personnel (C) think that 37 °C is adequate for maintaining food warm than retail personnel (R) and production personnel (P). Poor knowledge of correct temperature for holding hot food was also indicated in a study by Baş et al. (2006) and Walker et al. (2003b). Panisello and Quantick (2001) indicated that small businesses may lack the in-house knowledge and resources to identify foodborne microbial hazards and therefore correctly implement HACCP.

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M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

5

Table 1
Food safety knowledge and practice questions

Questions	%
1	
<i>Where in the cooling unit would you store a bean salad, if there is a large piece of fresh meat stored on the middle rack? N = 381</i>	
On the highest rack in the refrigerator	49.9
Next to the meat	1.0
On the rack under the meat	2.4
On the bottom of the refrigerator	20.7
In another refrigerator as fresh meat and prepared food do not belong together	23.4
I do not know	2.6
2	
<i>What is the lowest allowed temperature for maintaining thermically processed food warm? N = 369</i>	
37 °C	16.0
53 °C	6.8
63 °C	56.9
83 °C	15.2
I do not know	5.1
3	
<i>When would you be certain that food is contaminated with bacteria causing foodborne disease? N = 369</i>	
If it would smell bad	42.5
If it had soury taste	4.9
If it would become mouldy	5.1
That can not be established solely by appearance	48.0
I do not know	0.5
4	
<i>The knife used for cutting raw meat I later ... N = 378</i>	
... wipe with a kitchen cloth	1.3
... thoroughly wash and occasionally disinfect	63.8
... thoroughly wash with boiling water	23.5
... thoroughly wash under running water	9.8
... wipe with a paper towel	0.3
Other	1.1
I do not know	0.3
5	
<i>How would you react if your measurement would show a wrong temperature value (e.g. to low temperature of food during cooking)? N = 377</i>	
I would not do anything	0.3
I would carefully consider what to do and find the best possible solution in peace	11.1
I would consult with my supervisor	18.3
I would call maintenance to repair the measuring device	18.3
I would immediately carry out necessary measures to correct the situation	49.9
I would consult with my co-workers	0.5
I do not know	1.6
6	
<i>When fruit and crops are delivered, the most important thing to do is ... N = 378</i>	
... check the hygiene condition of delivery vehicle	0.0
... check the temperature of fruit and crops	8.5
... check whether the driver is respecting personal hygiene principles	0.3
... check consideration of good agricultural practice requirements	3.7
... check the quality of fruit and crops	86.0
Other	1.6
I do not know	0.0
7	
<i>When thermically processing food, measuring internal food temperature is ...? N = 373</i>	
... not important	0.3
... not important, as the procedure is standardised and time is measured	1.1
... important, so that time of cooking can be adjusted and thus energy can be saved	0.3
... important, so that foodstuffs do not loose nutritional value (e.g. are not overcooked)	15.5
... important, so that we know when harmful microorganisms are destroyed	81.8
I do not know	1.1
8	
<i>In cooling units microorganisms that are on/in a foodstuffs ... N = 381</i>	
... grow very slow	63.4
... grow quite fast	6.0
... grow very fast	4.4
... do not grow	23.4
... all die	2.1
Other	0.5
I do not know	0.3

Majority of respondents (64%) believe that microorganisms (MO) grow very slow in cooling units. Among them there are less of those working in sales than those working

in production ($\chi^2 = 24.295$; $p < 0.002$; $N = 381$). Respondents (23.4%) believe that MO dies in cooling units. Among them there are more R than C and P. In a previous

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6

M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

Table 2
Food handling and health problems

May I handle food when ...	N ^a	Yes	No	I do not know
... having a diarrhoea	384	0.3	99.7	0.0
... having hypertension	371	85.7	11.1	3.2
... having a cold	381	3.1	96.6	0.3
... having a toothache	371	82.7	13.5	3.8
... coughing and wearing protective mask	381	22.3	76.9	0.8
... having raised temperature	374	14.2	84.5	1.3
... vomiting	384	0.8	99.2	0.0
... I had cut myself	378	9.0	89.7	1.3
... wearing nail polish	378	4.8	94.7	0.5
... I am upset	366	79.8	14.2	6.0
... having wounds on my hands	382	0.0	99.7	0.3

^a Number of respondents.

study (Walker et al., 2003b) 21% thought that freezing killed all bacteria; 63% correctly answered that the temperature of the food in a refrigerator should be at or below 8 °C.

Half of employees believe that bad smell, taste or appearance are a certain manifestation of bacterial infection, causing food borne disease. Among groups of employees there were no significant differences. Similar result (57%) was obtained in survey by Walker et al. (2003b). Tauxe (2002) alleged that foods can be contaminated with microbes, and the number of microbes present may be amplified at many points from growing or rearing on the farm to processing to final preparation. After his words understanding those mechanisms of contamination is critical to interrupting them, and thus preventing the infection from reaching the consumer.

Only a half of the respondents would immediately carry out corrective action when the results of internal measured temperature of foods were too low. Others would carefully think how to react (11.1%) or consult they supervisors (18.3%) or co-workers (0.5%) for advice, or call maintenance to repair the thermometer. Among groups there are statistically significant differences ($\chi^2 = 67.253$; $p = 0.000$; $N = 368$). Namely, among R are less of those that would carefully think how to react than among P, and more of those that would call maintenance to repair the thermometer than among C. Among C there are less of those that would consult their supervisor than among P and more of those that would immediately carry out necessary measures than among P. Most respondents (81.8%) are aware of the importance of measuring internal temperature to check the doneness of cooked foods, in order to establish when harmful MO are destroyed. However, among them there are more C than R and P. In the study by Greene et al. (2005) more than half of the respondents indicated that a thermometer was not the method they used most often to check the doneness of cooked foods. Their results suggest, that workers use a variety of methods, other than a thermometer (e.g. checking the doneness of

cooked foods by the length of time the food cooked or by the appearance and feel of the food), to determine when food is sufficiently cooked. Since temperature treatment is frequently the critical control point in a production process, the issue of poor temperature understanding could be a major hindrance of effective HACCP implementation (Walker et al., 2003b).

More than half (63.4%) of respondents believe that cooling process slows down the growth of MO in/on foodstuffs. Among them there are statistically less R than P, as among R there are more of those that believe that MO are not growing during cooling ($\chi^2 = 24.295$; $p < 0.002$; $N = 381$). Baş et al. (2006) reported the lack of knowledge about the critical temperatures of hot or cold ready-to-eat foods, acceptable refrigerator temperature ranges, and cross-contamination among food handlers. Most of employees (77.1%) in our study would reject frozen meat if its temperature at delivery would be too high (e.g. -9 °C). Among them there are statistically more R than P ($\chi^2 = 74.628$; $p = 0.000$; $N = 364$). The rest of employees (12%) would immediately put the meat in the freezer (among them there are more P and less R) and the remaining 5.6% would consult their supervisors.

Most employees believe they should not handle food when dealing with health problems (Table 2). However, there are statistically significant differences between groups. In comparison with P and C, more R ($\chi^2 = 30.384$; $p = 0.000$; $N = 375$) believe they should not work with food when they are coughing and wearing mouth masks for protection; when they have a cut ($\chi^2 = 19.017$; $p = 0.000$; $N = 370$); and when they are wearing nail polish ($\chi^2 = 7.505$; $p = 0.023$; $N = 373$). It is obvious that employees do not fully understand individual hazards, their risks and methods of managing such hazards, since food handling while coughing is allowed if protective mask is worn. Certainly rules for stricter hygiene regime must be followed in cases of weak health problems (e.g. employees should not handle high-risk foods, protective mask should be changed more frequently, hands should be washed more frequently, etc.). In the study by Greene et al. (2005) almost 5% of the workers reported working while sick with vomiting or diarrhea. They argue that this could be cause for concern, as ill workers can potentially expose large numbers of costumers for their illnesses. Such ascertainment was also confirmed by Bryan (1988). Evans et al. (1998) reported that only 12% of food handlers identified the need to report illnesses which may be significant given that an infected food handler has been described as a contributing factor in 12% of outbreaks in England and Wales.

Meta-analysis of barriers during HACCP implementation has shown that among twenty one elements we can allocate seven elements (training, human resources, planning, knowledge and competence, management commitment) representing almost 50% (47.8%) of all identified barriers. The influence of each element on HACCP efficiency was ranked according to frequency of their citation in analyzed studies (Jevšnik, Hlebec, & Raspor, 2006).

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M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

7

From the available data reported by Food Safety Department, WHO (Rocourt, Moy, Vierk, & Schlundt, 2003) time/temperature abuse appears to be the most frequent contributing factor in eleven OECD (the Organization for Economic Co-operation and Development) countries. In Slovenia it is estimated that outbreaks related to microbial contamination represent the highest number of foodborne disease outbreaks and are the consequences of unsuitable hygiene and technological conditions in production and trade as well as low hygiene level and poor knowledge of food workers (Pollak, 2005).

3.3. Comparative analysis of responses to ‘‘Employees’ opinion of food safety’’ questions

Employees’ relation about food safety is high, confirmed by relatively high average values (Table 3). Among groups there are statistically significant differences in average values regarding statements No. 4 ‘‘It is important that I constantly educate myself about food safety’’ ($p = 0.02$), No. 5 ‘‘Foodborne disease are more dangerous for vulnerable groups of people (e.g. children, older people, pregnant women)’’ ($p = 0.003$) and No. 9 ‘‘All conditions that enable me to do my job according to food safety principles, are ensured’’ ($p = 0.000$). With statement No. 4 agree significantly more P than C; with statement No. 5 more P than R and with statement No. 9 more C than R and P. Food handlers in catering are more satisfied with work conditions than those in retail and food production. Insufficient or bad work conditions could be one of main barriers to carrying out proper food safety actions. Clayton et al. (2002) pointed out that food handlers may be aware of

the need to carry out certain practices but without the provision of adequate resources these practices become difficult, if not possible to implement. In the study of Mortlock, Peters, and Griffith (2000) they found a generally negative attitude towards the applicability of HACCP in retail and catering premises in UK. The findings in the study of Toh and Birchenough (2000) affirmed education as an important link to the two variables (knowledge and attitudes; culture and environment). Their results showed strong relationships between knowledge and attitudes. According to the results of Shojaei, Shooshtaripoor, and Amiri (2006) a dramatic reduction in hand contamination was observed after a simple intervention which included a face-to-face health education on strict hand-washing after toilet. They suggested that much emphasis should be put on meticulous hand-washing by health inspectors.

Among violations of hygiene principles (Table 4) forgetting to wash hands after using a toilet is, according to most employees (93.2%), the biggest risk factor for food safety. Food safety can also be compromised by using inappropriate utensils (67.5%) and by inconsistent temperature control in cooling units (57.6%). According to Lues and Van Tonder (2007) coliforms were present on 40% of food handler’s hands and on 26% of aprons (of those 32% exceeded the target value of $<2.5 \text{ cfu cm}^{-2}$ with regard to hands and 8% with regard to aprons). However, as shown in previous studies of food handlers’ beliefs and self-reported practices (Clayton et al., 2002), food handlers were aware of the food safety behaviors they should be carrying out, but 63% of respondents admitted that they did not always carry out these behaviors. Food handlers also reported carrying out food safety practices, particularly hand-washing, much more frequently than they actually implemented them (Manning & Snider, 1993). This suggest that food handlers could be carrying out food safety practices less frequently than the self-reported data implies (Clayton et al., 2002). Shojaei et al. (2006) cited that many authors emphasized that hands of food handlers are an important vehicle of food cross-contamination and that improved personal hygiene and scrupulous hand-washing would lead to the basic control of faeces-to-hand-to-mouth spread of potentially pathogenic transient microorganisms.

Table 3
Employees’ opinion toward food safety

Statements	N ^a	Mean ^b	SD
1. I have to make sure that prepared food is safe for customers/consumers	389	4.93	0.347
2. My important responsibility is following all food safety principles	384	4.95	0.314
3. My handling with foodstuffs does not affect food safety	372	3.38	1.867
4. It is important that I constantly educate myself about food safety	381	4.82	0.569
5. Foodborne disease is more dangerous for vulnerable groups of people (e.g. children, older people, and pregnant women)	375	4.31	1.325
6. HACCP system certificate enables me to get a promotion at work	351	2.38	1.688
7. If conditions prohibit me from following food safety principles, I’m obliged to notify my supervisors	374	4.75	0.731
8. I believe that other employees, dealing with food, respect good hygiene practise principles	370	4.48	0.837
9. All conditions that enable me to do my job according to food safety principles are ensured	376	4.26	0.967

^a Number of respondents.

^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

Table 4
Violations of hygiene principles that would compromise food safety according to employees

Choose 3 inappropriate hygienic principles that would, in your opinion, compromise food safety the most, N = 389	Select (%)	Not select (%)
1. Not checking the quantity of delivered foodstuffs	6.5	93.5
2. Wearing jewellery when handling foodstuffs	38.4	61.6
3. Washing the working clothes at home	8.3	91.7
4. Forgetting to check baits for rodents	16.4	83.6
5. Using inappropriate utensils	67.5	32.5
6. Chewing at work	9.1	90.9
7. Forgetting to wash hands after using a toilet	93.2	6.8
8. Forgetting to check temperature in cooling units	57.6	42.4

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8

M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

Among eight offered answers to the question: “What is least important for food safety?” more than a half of respondents (55.1%) chose “Checking the quantity of delivered foodstuffs”. Other answers were chosen less frequently (checking the date of expiration (12.4%), checking the concentration of cleaning detergents (12.1%), ensuring all work conditions (7.0%), record keeping (5.4%), following personal hygiene principles (4.6%); measuring internal temperature to check doneness of cooked foods (3.2%), measuring air temperature in cooling units (0.3%). Results pointed out those spheres, which are usually neglected. Employees understand a food safety in a restricted sense. This ascertainment could be a good starting-point for a preparation of educational programs, which should comprise rich, picturesque and detailed explanation of those previously mentioned areas that are obviously not so important to employees. Walker and Jones (2002) established that the main ineffectiveness of utilizing hazards and problems of monitoring temperatures (especially at cooking) and cross-contamination resulted from poor cleaning practices. The survey conducted by Walker et al. (2003b) indicated that poor results (60%) for the implementation of HACCP in SMEs in UK centered on temperature control and record keeping.

How employees grade attitudes of their co-workers regarding food safety principles, is shown in Table 5. High average values (Table 5) show, that employees consider their co-workers attitude towards food hygiene requirements very positive (all average values are higher than 4). However, average values according to groups of employees differ ($p < 0.05$) regarding all task, except tasks No. 6 and 7 (Table 5). C grade their co-workers more positive than P in

tasks No. 1, 4, 5, 8, 9, 10, 11 and more negative than R in tasks No. 2, 3. P grades their co-workers less positive than R and C regarding tasks No. 4, 8, 9.

The results of previous study (Jevšnik, Tivadar, & Hlebec, 2004) also attest to the fact that the quality of the relationship that workers have with their superiors and co-workers is a highly important factor of their job satisfaction. Thus, each company must find its own mechanisms for creating a positive and encouraging working atmosphere.

3.4. Comparative analysis of responses to “Employees work satisfaction” questions

With a question in Table 6 we tried to measure general mood of employees in a company. Between groups there are statistically significant differences in average values of statements No. 1 ($p = 0.42$), 5 ($p = 0.000$), 6 ($p = 0.000$), 9 ($p = 0.005$) and 10 ($p = 0.007$). Significantly more R ($p = 0.49$) than P agree with statement 1. Significantly less C than R ($p = 0.013$) and P ($p = 0.000$) would leave the company if offered a better pay and more interesting work. With statement No. 5 and 6 agreed significantly less R ($p = 0.001$) than P and C. Significantly more C would again choose the same profession than R ($p = 0.033$) and P (0.007).

The main barriers to carrying out food safety actions, identified by Clayton et al. (2002) were time constraints and lack of staff; in addition respondents also expressed the need for better design of the workspace, more resources and a recognition of problems by management. Barriers identified by school foodservice directors include employee acceptance, attitude and motivation of employees, training

Table 5
Opinion of employees regarding attitude towards hygiene of their co-workers, when dealing with foodstuffs

With numbers from 1–5 grade attitude f your co-workers	N ^a	Mean ^b	SD
1. They do their job according to food safety requirements	359	4.52	0.739
2. They fill out the required forms carefully and regularly	360	4.59	0.674
3. They frequently carry out required temperature measurements	351	4.72	0.597
4. They always thoroughly wash their hands after using the toilet	358	4.82	0.515
5. They frequently clean their working space	362	4.68	0.628
6. They always use clean utensils	360	4.75	0.509
7. They check the dates of expiration regularly	359	4.74	0.573
8. They are careful not to cause cross-contamination	355	4.63	0.675
9. They report all health problems to their superiors	339	4.36	1.038
10. They follow good hygiene practice principles	355	4.70	0.590
11. All conditions are fulfilled in order for them to follow good hygiene practise principles	355	4.39	0.890

^a Number of respondents.

^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (most likely).

Table 6
General mood of employees in a company

With numbers from 1 to 5 evaluate whether you find these statements true or not true	N ^a	Mean ^b	SD
1. If I chose the same profession again, I would definitely choose to work in the same company that I'm employed in now	325	4.09	1.221
2. When I have a personal problem that is upsetting me, I talk to my co-workers about it	360	2.74	1.468
3. When I have a personal problem that is upsetting me, I talk to my supervisors about it	356	2.71	1.580
4. I always do my job according to written or agreed rules	361	4.61	0.645
5. I would leave the company if offered a better pay elsewhere	330	3.09	1.660
6. I would leave the company if offered a more interesting job elsewhere	326	2.91	1.613
7. I will work in the same company until I retire	301	4.11	1.273
8. I often compete with co-workers	352	1.75	1.232
9. If I had a chance to choose my profession again, I would choose the same	311	3.29	1.620
10. I find work that I do at the present interesting	360	2.56	1.648

^a Number of respondents.

^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

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M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

9

and education of employees about food safety and HACCP, comfort level of employees with food safety issues, and time constraints among food service directors to implement HACCP (Giampaoli, Sneed, Cluskey, & Koenig, 2002). Roberts and Sneed (2003) suggests that assigning responsibility for food safety to specific employees increases the number of food safety practices implemented in restaurants. Success in implementing and maintaining a HACCP program depends on how its four basic pillars (commitment, education and training, availability of resources and external pressure) are prioritised and organised in a company (Panisello & Quantick, 2001).

Opinion of employees about co-workers (Table 7) differs according to groups of employees ($p < 0.05$) in all statements, except statements 1 and 5. Comparison of average values of different groups showed that C have the most positive opinion about their co-workers, regarding all statements in Table 7. They are followed by R, while P have the most negative opinion of co-workers.

Comparison of differences in average values between groups showed that P do not have worse relationship with their co-workers ($p = 0.001$), that they are in their way ($p = 0.014$) and that they receive less help from them ($p = 0.001$) than C. P also believe that co-workers ignore them more ($p < 0.02$), are more selfish ($p < 0.01$) and stand up for them less often ($p < 0.05$) that employees in groups C and R. However, R are in worse relations with their co-workers ($p = 0.003$) and receive less help from them ($p = 0.002$) than C.

It was established that workers which performed better hygiene practice are more satisfied with interpersonal relationship in the workplace in general, which includes relations with supervisors as well as relations with co-workers (Jevšnik et al., 2004).

Average opinion of employees about their supervisors (Table 8) differs according to groups of employees ($p = 0.000$) in statements 1–7 and 9 and ($p < 0.05$) in statements 8, 10 and 11. Average value comparison between different groups showed, that C think better of their supervisors in statements from 1 to 4, 7 and 12, than other

Table 7
Respondents opinion about co-workers

With numbers 1–5 evaluates your relationship with co-workers	N ^a	Mean ^b	SD
1. Co-workers obstruct me while I'm working	347	1.42	0.972
2. I'm in a friendly relationship with my co-workers	345	4.37	0.857
3. Co-workers ignore me	344	1.42	0.941
4. I get along with my co-workers well	347	4.48	0.765
5. I do not have any contacts with my co-workers	338	2.22	1.614
6. Co-workers are selfish	340	1.74	1.175
7. Co-workers stand up for me	321	3.85	1.143
8. I do not care about my co-workers	327	2.14	1.563
9. Co-workers help me	356	4.26	0.958

^a Number of respondents.
^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

Table 8
Respondents opinion about their supervisors

With numbers from 1 to 5 evaluate your relationship with the supervisor	N ^a	Mean ^b	SD
1. Supervisor awards me for a well done job	322	3.20	1.484
2. I learn a lot from my supervisor	338	3.96	1.148
3. Supervisor is good at organising work	332	4.05	1.125
4. Supervisor is fair	327	4.02	1.102
5. Supervisor follows developments in our profession	329	4.36	0.900
6. Supervisor fulfils all his promises	319	4.11	1.033
7. Supervisor takes my suggestions and opinions into consideration	324	3.96	1.046
8. Supervisor is familiar with what I do	328	4.39	0.867
9. Supervisor encourages me at work	329	4.13	1.072
10. Supervisor is making an effort so that I can do my work well	327	4.39	0.878
11. I have no contact with my supervisor	332	2.66	1.709
12. Supervisor does not notice me	319	2.56	1.694

^a Number of respondents.
^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

two groups. In statements 5, 6, 8, 9, 10 and 11 R have a better opinion than C and P. In comparison to average differences between groups, P have worse opinion ($p < 0.05$) about supervisors (statements 1–9). In comparison to P, R expressed better opinion ($p < 0.05$) about their supervisors in statements 10 and 11.

The senior management team clearly needs to be fully supportive of a HACCP program if it is to be successful. Senior managers need to grasp both the importance of HACCP to the organization and the immediate and long-term resource issues involved in implementing a HACCP

Table 9
Employees' evaluation of work satisfaction and motivation

With numbers 1–5 evaluate how strongly you are personally satisfied with ...	N ^a	Mean ^b	SD
1. ... your job	353	4.05	0.929
2. ... promotion possibilities	315	3.33	1.316
3. ... supervisor's appreciation of your work	320	3.64	1.200
4. ... benefits provided by the company	324	3.64	1.139
5. ... interpersonal relations at work	340	4.11	0.906
6. ... your position at work	334	4.01	1.003
7. ... relations between you and your supervisor	325	4.10	0.924
8. ... working conditions	337	3.74	1.015
9. ... taken measures for health and safety at work	336	3.88	1.068
10. ... education and training organised in the company	335	4.01	1.051
11. ... evaluation of your work by supervisors	306	3.73	1.178
12. ... the pay	328	3.01	1.292

^a Number of respondents.
^b Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

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10

M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

program. This is not always a straightforward task. Motivation can be a problem in small and larger food companies. Wallace (2001) stressed that particularly in SMEs HACCP can initially be viewed as bureaucratic burden imposed from outside, rather than as an essential tool in the management of product safety.

Employees' evaluation of work satisfaction and motivation (Table 9) is on average statistically different ($p < 0.01$) in all groups, regarding all statements. Comparison of average values in groups showed, that C rank all elements of satisfaction and motivation higher (with exception of statement 10, where a higher average is contributed to R) than the rest two groups. The lowest average values were evident in P, who are most unsatisfied with their pay and promotion possibilities. On average, R are most satisfied with education and training, organised in the company. When comparing differences between groups, P expressed less satisfaction ($p < 0.01$) in statements 1, 2, 3, 4, 6, 7, 8, 11 and 12, that C and R. C expressed more satisfaction than P and R in statements 5, 6, 9 and 12. R are significantly more satisfied in statements 1, 2, 3, 4, 6, 7, 8, 10, 11 and 12, than P.

In implementing the HACCP system, managers or owners should take care not to give workers the mistaken impression that this would add meaningless chores to their work-load. As many authors have established, workers believe that they will now have to deal excessively with paper work and with an increasing amount of documentation. Admittedly, they do need precise and clear instructions on what to do. These, however, should be kept to a minimum amount necessary and written in such a way that workers would understand them. Also, they should be able to comment upon them and their opinion would have to be taken into consideration by their superiors which would in turn also strengthen their affiliation to the company. The superiors must therefore develop strategies for measuring work efficiency, assessing employees' comments and the system of rewarding. Financial reward on its own does not guarantee higher work satisfaction and affiliation to the company in the long run. To a worker, an important motivational force might be the mere fact that he or she is being noticed. The prevailing attitude in food companies is often prioritising the fulfilment of the production norm. Therefore, looking for factors that might have contributed to the production norm not being fulfilled is frequently avoided. Mortimore (2001) mentioned that is harder to develop a HACCP system in the absence of management commitment. Prerequisite hygiene programs are an essential partner to the HACCP system and management commitment is needed for these to be embedded in the heart of the business. McAloon (2001) suggested that continuing commitment to food safety need incentives. He also recommended assign responsibility for HACCP implementation to a senior company person to get food safety into the culture of the company. MacAuslan (2005) cited that the hospitality training foundation and learn purple identified that motivation, evaluation, leadership and training were key

management skills missing in small businesses. It is important to introduce a basic management module to supervisors and managers, especially in small businesses.

To achieve the final goals that meet the safety, quality, quantity and price expectations of costumers, food companies need to set three output criteria: productivity, satisfaction and revitalisation. Satisfaction refers to the overall positive feelings people have about an organisation, whether as an employee, customer, supplier or regulator. Revitalisation refers to the ability to take care of tomorrow's problems as well as those of today by renewing the strategies, resources, technology and skills required for future success (Coffey, Cook, & Hunsaker, 1994).

4. Conclusion

Strict performance of working procedures in accordance with HACCP system principles and food hygiene is essential for food related diseases prevention and efficient safe food assurance. To achieve this purpose two basic conditions: (1) suitable working environment from the hygienic-technical point of view and (2) motivated, satisfied and qualified personnel must be assured. It is interesting that many understand HACCP system as a novelty, when in fact it is about more complete approach to food safety assurance as stated by Ehiri et al. (1995). HACCP system assures more structured surveillance over determined hazards as was the case with the usual classic type of surveillance. Hazards and corrective actions are not something new. What is new is how separate activities and procedures are logically ranged. The approach is multidisciplinary. It requires personal responsibility, document and record control and rapid action when non-conformities are discovered. It enables traceability as well. Its greatest ability lies in responding to changes as well as in enabling continuous checking and efficiency confirmation. It brings changes in thinking, organizing, managing, education and training at all levels, from employers to employees (Likar & Jevšnik, 2004; Likar, Bauer, & Jevšnik, 2001). The system becomes efficient when understandable to employees and when the responsible ones perform their duties. Then the requirements of the system are not considered as irrational, unnecessary and additional burden, but as desire for continuous improvement of one's own work. That is why the training from top management to all employees is crucial for food safety. The fact that a person is and will be responsible for HACCP implementation and further control calls for an in-depth analysis and understanding of individual's reaction to received information (Jevšnik et al., 2006). Bryan (1988) predicted that in the future the number of HACCP principles would increase from seven to ten or more. The ninth HACCP principle, according to him, would be education and training, which is now being incorporated into the existing principles or other related guidelines. If routine-work employees do not understand the significance of hazards associated with food safety well

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M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

11

enough, this may hinder a successful implementation of preventive and control actions.

Legislative changes in 2004 demand that now all food premises must provide food hygiene training appropriate for the work activities of their staff (Regulation, 2004). The results of our study showed as well that training carried out by company experts and by supervisors directly in working place is the most efficient one. Mortlock et al. (2000) suggested that it is also important to recognise that while formal training might ensure greater consistency and quality (Manning, 1994), improper training could present a greater risk to food safety than no training at all. In a study by Cohen et al. (2001) they analyzed the impact of an in-house food sanitation training program on the performance of a catering company. They concluded that for fully effective sanitation program, it must be taken into consideration the different environments and circumstances in which the departments operate. It is very important that those performing a training have suitable food safety knowledge as well as skills in pedagogical-andragogical field. Those people have to be competent experts in their field so that adequate knowledge and skills can be passed on to the employees. A problem lies in SMEs, where owners of a company are usually at the same time responsible persons for food safety programs, which includes training as well. Because lack of time or poor knowledge such trainings are not carried out as intended by the law. The results of our study show poor knowledge about microbiological hazards and their control among employees in retail, catering and food production units. MacAuslan (2003) stressed the importance on helping managers to understand what is expected of them, and giving them a support in managing effective food hygiene. He pointed out that too much reliance has been placed upon certificates and not enough on the competence. According to his opinion this is defined as the ability of an individual to demonstrate the activities within their workplace, or to function to the standards expected in a food business.

The purpose of internal surveillance is to identify specific hazards in particular company and then to establish a strategy of efficient control or successive elimination of hazards. Owners or managers must besides equal economic growth of a company take care of human resource management as well. A positive motivational atmosphere in working environment significantly contributes to higher productivity, employees' loyalty and to general good feeling in workplace. The results of work satisfaction elements carry important messages for companies' management. In the three studied food units food production employees are the least satisfied in workplace and the most satisfied ones are employees in catering. A low score of employees in food production units regarding their opinion and suggestion consideration, rewarding for good work, wages, work conditions and promotion possibility must be stressed out. All that weakens motivation and satisfaction in workplace as well as reduce a number of those, who perform their work well. Food safety assurance stands

between two strong poles, which have to be balanced to achieve global food safety. The first pole is system requirements, namely flexible, faultless, which requires in forms of strategies, not directives. The second pole is work performance and a person in all his uniqueness; his knowledge, qualification, working in a group and consciousness. A company's management should be aware that a quality and safe products is a result of an immediate performer, who should be paid full of many-sided attention to.

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References

- Azanza, M. P. V., & Zamora-Luna, M. B. V. (2005). Barriers of HACCP team members to guideline adherence. *Food Control*, 16(1), 15–22.
- Baş, M., Şafak, A., & Kivanç, G. (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control*, 17(4), 317–322.
- Bearden, W. O., Netemeyer, R. G., & Mobley, M. F. (1993). *Handbook of marketing scales. Multi-item measures for marketing and consumer behavior research*. Newbury Park, London, New Delhi: Sage Publications, Inc., pp. 266–300.
- Bryan, F. L. (1981). Hazard analysis critical control point approach: Epidemiological rationale and application to food service occupations. *Journal of Environmental Health*, 44, 7–14.
- Bryan, F. (1988). Risks of practices, procedures, and processes that lead to outbreaks of foodborne diseases. *Journal of Food Protection*, 51, 663–673.
- Čermetič, M. (2001). Evaluation of work and motivation – Human resource management. Kranj, 2001.
- Clayton, D. A., Griffith, C. J., Price, P., & Peters, A. C. (2002). Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12(1), 25–39.
- Coffey, R. E., Cook, C. W., & Hunsaker, P. L. (1994). *Management and organizational behavior* (1st ed.). Burr Ridge (Ill.), Boston (Mass.), Sydney, Irwin: Austen Press.
- Cohen, E., Reichel, A., & Schwartz, Z. (2001). On the efficacy of an in-house food sanitation training program: Statistical measurements and practical conclusions. *Journal of Hospitality & Tourism Research*, 25(1), 5–16.
- Collis, B., & Winnips, K. (2002). Two scenarios for productive learning environments in the workplace. *British Journal of Educational Technology*, 33(2), 133–148.
- Ehiri, J. E., Morris, G. P., & McEwen, J. (1995). Implementation of HACCP in food businesses: The way ahead. *Food Control*, 6(6), 341–345.
- Evans, H. S., Madden, P., Doudlas, C., Adak, G. K., O'Brien, S. J., Djuretic, T., et al. (1998). General outbreaks of infectious intestinal disease in England and Wales: 1995 and 1996. *Communicable Disease and Public Health*, 1, 165–171.
- Giampaoli, J., Sneed, J., Cluskey, M., & Koenig, H.F. (2002). School foodservice directors' attitudes and perceived challenges to implementing food safety and HACCP programs. *Journal of Child Nutrition, Mgt.* P. 26.
- Gilling, S. (2001). *Food Science & Technology Today*, 15(3), 44–47.
- Gilling, S. J., Taylor, E. A., Kane, K., & Taylor, J. Z. (2001). Successful hazard analysis critical control point implementation in the United

ARTICLE IN PRESS

12

M. Jevšnik et al. / Food Control xxx (2008) xxx–xxx

- Kingdom: Understanding the barriers through the use of a behavioral adherence model. *Journal of Food Protection*, 64(5), 710–715.
- Greene, L., Selman, C., Banerjee, A., Marcus, R., Medus, C., Angulo, F. J., et al. (2005). Food service workers' self-reported food preparation practices: An EHS-Net study. *International Journal of Hygiene and Environmental Health*, 208, 27–35.
- Griffith, C. J. (2000). *Food safety in catering establishments – Safe handling of foods*. New York: Marcel Dekker.
- Henroid, D., & Sneed, J. (2004). Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *Journal of the American Dietetic Association*, 104(2), 180–185.
- Hielm, S., Tuominen, P., Aarmisalo, K., Raaska, L., & Maijjala, R. (2006). Attitudes towards own-checking and HACCP plans among Finnish food industry employees. *Food Control*, 17(5), 402–407.
- Jannadi, M. O. (1995). Impact of human relations on the safety of construction workers. *International Journal of Project Management*, 13(6), 383–386.
- Jevšnik, M., Tivadar, B., & Hlebec, V. (2004). Hidden factors of high hazard in food industry. In CEFood Congress Programme and book of abstracts/2nd Central European Congress on Food, 26–28 April 2004, Budapest. Budapest: Central Food Research Institute: Complex Committee on Food Science of the Hungarian Academy of Sciences, 214 p.
- Jevšnik, M., Hlebec, V., & Raspor, P. (2006). Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35(3), 319–353.
- Khandke, S. S., & Mayes, T. (1998). HACCP implementation: A practical guide to the HACCP plan. *Food Control*, 9(2-3), 103–109.
- Latham, G. P., & Ernst, C. T. (2006). Keys to motivating tomorrow's workforce. *Human Resource Management Review*, 16, 181–198.
- Likar, K., Bauer, M., & Jevšnik, M. (2001). Sanitary control methods after enforcement of HACCP system. In B. Juteršek & A. Krulec (Eds.), *Practical approach for implementing HACCP system in food businesses* (pp. 14–20). Ljubljana: Institute of Sanitary Engineering.
- Likar, K., & Jevšnik, M. (2004). Pogoji za vzpostavitev učinkovitega notranjega nadzora. In N. Ferfila & M. Jevšnik (Eds.), *Hygiene management in kindergartens and old people's home* (pp. 69–78). Ljubljana: Institute of Sanitary Engineering.
- Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Englewood Cliffs: NJ Prentice-Hall.
- Lues, J. F. R., & Van Tonder, I. (2007). The occurrence of indicator bacteria on hands and aprons of food handlers in the delicatessen sections of a retail group. *Food Control*, 18(4), 326–332.
- MacAuslan, E. (2003). The boss, the owner, the proprietor...the food hygiene manager? *The Journal of the Royal Society for the Promotion of Health*, 123(4), 229–232.
- MacAuslan, E. (2005). Think laterally on training. *Environmental Health Journal*, July, 20–21. Available on <http://www.ehj-online.com/archive/2000/july2005/july5.html>.
- Manning, C. K. (1994). Food safety knowledge and attitudes of worker's from institutional and temporary food service operations. *Journal of the American Dietetic Association*, 94(8), 895–897.
- Manning, C. K., & Snider, S. (1993). Temporary public eating places: Food safety knowledge, attitudes and practices. *Journal of Environmental Health*, 56, 24–28.
- Marolt, J., & Gomišček, B. (2005). *Quality management*. Kranj: Modern Organization, 574 p.
- McAloon, T. R. (2001). HACCP implementation in the United States. In T. Mayes & S. Mortimore (Eds.), *Making the most of HACCP. Learning from others' experience* (pp. 61–78). Cambridge, Boca Raton: CRC Press, Woodhead (etc.).
- Mortimore, S. (2001). Conclusions. In T. Mayes & S. Mortimore (Eds.), *Making the most of HACCP. Learning from others' experience* (pp. 235–264). Cambridge, Boca Raton (etc.): CRC Press, Woodhead.
- Mortimore, S., & Smith, R. A. (1998). Standardized HACCP training: assurance for food authorities. *Food Control*, 9(2), 141–145.
- Mortlock, M. P., Peters, A. C., & Griffith, C. J. (2000). A national survey of food hygiene training and qualification levels in the UK food industry. *International Journal of Environmental Health Research*, 10, 111–123.
- Panisello, P. J., & Quantick, P. C. (2001). Technical barriers to hazard analysis critical control point (HACCP). *Food Control*, 12, 165–173.
- Pollak, P. (2005). *Epidemiological surveillance of infectious diseases in Slovenia in 2004*. Ljubljana: Institute of Public Health of the Republic of Slovenia, pp. 20–29.
- Regulation EC (2004). No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the Hygiene of Foodstuffs. Official Journal of the European Communities, 18 p.
- Roberts, K. R., & Sneed, J. (2003). Status of prerequisite and HACCP program implementation in Iowa restaurants. *Food Protection Trends*, 23(10), 808–816.
- Rocourt, J., Moy, G., Vierk, K., & Schlundt, J. (2003). The present state of foodborne disease in OECD countries. World Health Organization, Food Safety Department, Geneva.
- Shojaei, H., Shooshtaripour, J., & Amiri, M. (2006). Efficacy of simple hand-washing in reduction of microbial hand contamination of Iranian food handlers. *Food Research International*, 39(5), 525–529.
- Tauxe, R. V. (2002). Surveillance and investigation of foodborne diseases; roles for public health in meeting objectives for food safety. *Food Control*, 13, 363–369.
- Taylor, E. A., & Taylor, J. Z. (2004a). Perceptions of the “bureaucratic nightmare” of HACCP. A case study. *British Food Journal*, 106(1), 65–72.
- Taylor, E. A., & Taylor, J. Z. (2004b). Using qualitative psychology to investigate HACCP implementation barriers. *International Journal of Environmental Health Research*, 14(1), 53–63.
- Toh, P. S., & Birchenough, A. (2000). Food safety knowledge and attitudes: culture and environment impact on hawkers in Malaysia. Knowledge and attitudes are key attributes of concern in hawker foodhandling practices and outbreaks of food poisoning and their prevention. *Food Control*, 11, 447–452.
- Vela, A. R., & Fernández, J. M. (2003). Barriers for the developing and implementation of HACCP plans: Results from a Spanish regional survey. *Food Control*, 14(5), 333–337.
- Walker, E., & Jones, N. (2002). An assessment of the value of documenting food safety in small and less developed catering businesses. *Food Control*, 13, 307–314.
- Walker, E., Pritchard, C., & Forsythe, S. (2003a). Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control*, 14, 169–174.
- Walker, E., Pritchard, C., & Forsythe, S. (2003b). Food handlers' hygiene knowledge in small food businesses. *Food Control*, 14(5), 339–343.
- Wallace, C. (2001). Effective HACCP training. In T. Mayes & S. Mortimore (Eds.), *Making the most of HACCP. Learning from others' experience* (pp. 213–230). Cambridge: Woodhead Publishing Limited.
- Williams, A. P., Smith, R. A., Gaze, R., Mortimore, S. E., Motarjemi, Y., & Wallace, C. A. (2003). An international future for standards of HACCP training. *Food Control*, 14, 111–121.

2.1.5 Consumers' awareness of food safety from shopping to eating

Zavedanje potrošnikov o načinih zagotavljanja varnih živil od nakupa do zaužitja hrane

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Znanje potrošnikov o varnosti živil zajema več dimenzij. Zaradi afer povezanih z živili in številnimi izbruhi bolezni povzročenimi s hrano po svetu in doma, je zaupanje potrošnikov o varnost hrane začelo upadati. Namen kvantitativne raziskave med 1030 potrošniki je bil ugotoviti njihovo znanje o načinih zagotavljanja varnih živil, njihovih navadah med nakupovanjem in transportom ter hrambo živil in ravnanjem z živili doma. Rezultati osvetlijo področja pomanjkljivega znanja o varnosti živil ter napake pri ravnanju z živili doma. Polovica anketiranih ni nikoli razmišljala o uporabi hladilne vreče/torbe za transport zamrznjenih in/ali hitropokvarljivih živil. Približno polovica jih odtaja zamrznjeno meso na delovni površini, le tretjina pomiva nože in rezalne deske z vročo vodo in detergentom. Skoraj polovica (44%) jih ne pozna temperature za shranjevanje hitro pokvarljivih živil v hladilniku. Med pripravo živil si le 57,1% anketiranih umije roke ustrezno; s toplo vodo in milom. Drugi rezultati glede znanja in ravnanja z živili doma so podrobneje opisani v članku. Izobraževanje potrošnikov o zagotavljanju varnih živil bi vplivalo na zmanjšanje bolezni povzročenih s hrano v domačem okolju. Publikacije o dobri gospodinjski praksi bi morale biti javno dostopne vsem skupinam prebivalstva, kajti le osveščen potrošnik je lahko aktiven člen v verigi zagotavljanja varnosti živil.



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Consumers' awareness of food safety from shopping to eating

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Abstract

Knowledge of food safety among consumers has various dimensions. Due to a number of food-related incidents and reported outbreaks worldwide, consumer confidence has begun to vacillate. The objective of this quantitative survey ($n = 1030$) was to determine Slovenian consumers' food safety knowledge and practices during purchase, transportation and storage of food, as well as food handling practices at home. The study highlighted gaps in food safety knowledge and some critical safety violations regarding food handling at home. Half of the respondents never thought of using a cooling bag for the transport of refrigerated or frozen foods. Approximately half of the respondents defrost meat on working surfaces and only one-third wash knives and cutting boards with hot water and detergent before re-use or use clean implements. Forty-four percent of respondents did not know the correct refrigerator temperature for the storage of perishable food. All other determinations concerning food safety knowledge and practices are presented and discussed. Consumer education should be the focus in order to reduce foodborne diseases. Educational material regarding Good Housekeeping Practice should be available to the general public from many sources. Only safety-conscious consumers can become active partners within the food safety circle.

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Keywords: Food safety; Consumer; Food handling; Education; Good housekeeping practice

1. Introduction

Food safety is of crucial importance to the consumer, food industry and economy. Calculation of annual cases of salmonellosis and campylobacteriosis shows that the yearly number of cases in Europe is likely to exceed five million, demonstrating that economic losses and human distress resulting from foodborne diseases can no longer be neglected (Raspor, 2004). Food contamination creates an enormous social and economic burden on communities and their health systems. Korel, Ergönül, and Gökgöz (2003) reported that in the last 20 years these economic losses amounted to nearly 1.0–1.2 billion dollars, indicating

the importance of food safety and the HACCP system (Ergönül & Günç, 2004).

The incidence of foodborne diseases is rising in developing countries, as well as in the developed world (Redmond & Griffith, 2003). The cause can be found in a better way of life, improved laboratory diagnostics, and an increasing number of infections involving new or more virulent types (Smole Možina & Hočevar Grom, 2004; Tauxe, 2002). Rocourt, Moy, Vierk, and Schlundt (2003) reported that foods most frequently involved in outbreaks in OECD countries (The Organisation for Economic Co-operation and Development) are meat and meat-related products, poultry, eggs and egg-related products, and that these foods are associated with *Salmonella* and *Campylobacter*. In Slovenia, the most common infection is caused by *Salmonella enteritidis* (IVZ, 2006). To obtain a diverse profile of pathogens it is important to study and follow bacteria,

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yeast and mycotoxins produced by filamentous fungi, viruses and prions because new foodborne pathogens are still being discovered (Raspor, 2004). According to epidemiologists, the recent emergence of infectious diseases can be considered a third epidemiological transition, characterised by a globalisation of human disease ecology and the evolution of considerable technological and social-economic changes. The changing epidemiology of foodborne illnesses and the increase in knowledge concerning emerging foodborne pathogens requires a re-examination of food safety educational messages to ensure that the guidance given to consumers is appropriate for controlling pathogens that are prevalent in the food supply chain (Hillers, Medeiros, Kendall, Chen, & DiMascola, 2003).

What do consumers know about food safety principles and what do they do to protect themselves from foodborne diseases? The results of consumer studies concerning food safety knowledge and practices have shown that consumers are aware of and are thinking about food safety, although there are also many gaps in food safety knowledge and practices that may result in foodborne diseases (Badrie, Gobin, Dookeran, & Duncan, 2006; Medeiros et al., 2004; Patil, Morales, Cates, Anderson, & Kendal, 2004; Raspor, Jevšnik, & Hlebec, 2006). Epidemiologic surveillance summaries of foodborne diseases clearly indicate that consumer behaviours such as ingestion of raw/undercooked foods and poor hygienic practices are important contributors to outbreaks of foodborne diseases (Patil et al., 2004). Unusan (2007) reported that people of all ages seem to think they know how to handle food safely, but their self-reported food-handling behaviours do not support this confidence. A review of the consumer food safety literature indicates many gaps that have an impact on foodborne diseases at home (Garayoa, Cordoba, Garcia-Jalon, Sanchez-Villegas, & Vitas, 2005; Hillers et al., 2003; Jay, Comar, & Govenlock, 1999a; Jay, Comar, & Govenlock, 1999b; Kendall et al., 2004; Kennedy et al., 2005; Li-Cohen & Bruhn, 2002; Redmond & Griffith, 2003; Unusan, 2007; Yang, Angulo, & Altekruze, 2000). Consumers need to know which behaviours are most likely to result in illness in order to make decisions about food handling and consumption behaviours (Hillers et al., 2003), and then need to be motivated to act on that knowledge as a precondition for behavioural change (Medeiros et al., 2004).

The aim of this study was to investigate the actual level of food safety knowledge and relevant practices in food handling that are responsible for shaping the food safety mindset of consumers at home.

2. Materials and methods

2.1. Sampling plan

A cross-sectional study of consumer food safety knowledge and practices was conducted from January to March 2006 in different parts of Slovenia. A food safety and nutri-

tion questionnaire was designed, which consisted of demographic questions (gender, age, education, marital status) and 48 questions covering issues related to food safety and nutrition habits. The first part of the study is presented in this paper.

The revised questionnaire was divided into four sections: (1) a demographic section, (2) food safety knowledge, (3) food safety practices from purchase to home, and (4) food handling practices at home. Each questionnaire took approximately 20 min to complete. Data were collected on weekends and weekday afternoons when a member of the particular target group would most likely be at home or in the shopping centres. A quota sample of 1030 consumers was obtained. Gender and age distribution were controlled (to assure a balanced structure of the sample) by 35 interviewers, each of whom distributed 30 questionnaires. Interviewers were trained, final-year university students, who visited selected households or interviewed consumers in larger shopping centres. Interviewers briefly explained the purpose and nature of the study to the potential adult respondent (over 18 years of age), and sought permission for inclusion of their views in the survey. To guarantee anonymity of respondents and enable easier identification of questionnaires, identity numbers were assigned to each questionnaire when collected at the College of Health Studies. As students conducted interviews in their home cities, a considerable geographical distribution of data was obtained.

2.2. Pilot survey

The questionnaire was pilot tested by 20 participants during October and November 2005 to confirm question clarity, identify response options, and gauge likely interview duration. The questionnaire was revised on the basis of pre-test results and other recommendations.

2.3. Data analysis

The questionnaire responses were analyzed using SPSS version 13.0 software. Mean responses with standard deviation and percentages of responses in each category were calculated and presented in tabular form. To examine the relationship among and between the variables, cross-tabulations and the χ^2 test, Pearson correlation coefficient, independent sample *t*-test and ANOVA were used.

3. Results and discussion

3.1. Profile of respondents

A total of 1030 questionnaires were obtained. Characteristics of survey participants are listed in Table 1. The majority of respondents were female (60.1%). Most of the respondents were married with an average age of 38 (SD: 14.1) and had a secondary school education.

Table 1
Demographic characteristics of respondents

Demographic characteristics	n ^a	%
<i>Gender (n = 1028)</i>		
Male	410	39.9
Female	618	60.1
<i>Age group (n = 1023)</i>		
≤30	417	40.8
31–49	380	37.1
≥50	226	22.1
<i>Education (n = 988)</i>		
Primary school or less	344	34.8
Secondary school	426	43.1
Higher education	218	22.1
<i>Marital status (n = 985)</i>		
Married or living together as married	612	62.1
Single	203	20.6
Separated or divorced	170	17.3

^a Number of respondents.

3.2. Food safety knowledge

The place of purchase (possible answers were: shop, market, farm, self-produced, and not buying) depended on the foodstuffs they wished to buy. Milk products (97.6%), milk (85.4%), meat products (86.2%), raw meat (71%), poultry (81.8%), eggs (56.5%), fresh fish (68.6%), fruit (78.3%) and tofu (20.3%) are mainly bought in shops. Foodstuffs that are most commonly self-grown or self-produced include vegetables (19.9%), eggs (16.5%), raw meat (12.8%), milk (7.8%), poultry (6.8%) and fruit (6.5%). From farmers, respondents tended to buy predominantly eggs (21%) and less of other products, e.g. raw meat (11.6%), poultry (6.7%) and milk (5.3%). Respondents who believe that home food production provides the best assurance for food safety were also more likely to claim that food produced by farmers and sold in food markets was safer than food sold in shops ($r = 0.424$, $p < 0.01$). The results showed a positive impact regarding the type of home-produced food (for milk ($F = 3,308$, $p = 0.011$), milk products ($F = 9,945$, $p < 0.001$) and meat ($F = 12,386$, $p < 0.001$)) and the confidence that food bought in a market or from a farm is safer.

Table 2
Consumers' opinion concerning responsibility for food safety

Food safety participants	n ^a	M ^b	SD
Consumers	990	3.37	1.365
Farmers	993	4.22	0.934
Food industry	1007	4.69	0.653
Retail	1004	4.56	0.729
Catering	1004	4.64	0.702
Food safety inspectors	985	4.50	0.917
Ministry of Health	960	4.17	1.120
Slovene Consumers' Association	945	3.89	1.239

^a Number of respondents.

^b Average of the ranking given to the opinion by respondents. Opinions were ranked from 1 (not at all) to 5 (very much).

Consumers believe that they are not responsible for food safety to the same degree as food handlers (farmers, food industry, retail, catering), whose ascribed mean value rating was above 4.17. They also believe that the Slovene Consumers' Association is not as strongly responsible as food handlers and other food safety institutions, such as the Inspection and Ministry of Health (Table 2). Demographic characteristics have no association with attitude toward consumers' responsibility for food safety, with the exception of gender. More women are aware of the responsibility of consumers for food safety than men ($\chi^2 = 12.248$, $p = 0.002$, $n = 988$).

3.3. Food safety practice from purchase to home

When shopping, the respondents most often checked the date of durability and the state of packaging (Table 3). Most respondents always checked the date of durability (54.2%) or often (29.7%), which can be compared to the study of Surujal and Badrie (2004) in which it was estimated that 61.9% of consumers always checked food labels for date of durability, while 33.3% checked sometimes. In our study, the state of packaging is always checked by 48.6% and often by 25.5% of respondents. These results are comparable to those of Surujal and Badrie (2004) who estimated that 82.1% of consumers always checked

Table 3
Respondents' opinions toward food safety and food quality elements during purchase

Query	Response	n ^a	M ^b	SD
How often do you checkin which country a foodstuff has been grown/produced	1027	2.22	0.929
	...if a foodstuff is organic	1025	1.86	0.829
	...the name of the grower/manufacturer	1022	2.42	0.936
	...date of durability	1025	3.35	0.827
	...if the package is damaged	1008	3.15	0.973
	...the refrigerator temperature in a store, where yoghurts, cheese, fresh meat, etc. are kept	1019	1.45	0.764
	...presence of artificial additives	1025	2.12	0.928
	...presence of vitamins, minerals, fibres, etc.	1025	2.17	0.910
	...energy value	1026	2.03	0.935
	In your opinion, how often have sale assistants, who are serving you delicacies, bread or raw meatclean hands	918	2.86
...a protective hair net		973	2.75	0.999
...clean working clothes		953	2.94	0.826
...clean utensils (knife, cutting board, etc.)		872	2.79	0.893

^a Number of respondents.

^b To evaluate the importance of certain food safety elements when shopping, respondents used a four-point scale (1 – never, 2 – sometimes, 3 – often, 4 – always).

for damaged food packages, foul odours and discoloured meat prior to purchase, while 16.7% checked sometimes. The results show a positive impact of gender and age group on purchasing behaviour. Women ($F = 21,003$, $p < 0.001$) significantly more often checked the date of durability than men, and younger respondents (<30 years of age) ($F = 2,872$, $p < 0.001$) significantly more often checked the date of durability than older respondents. Respondents who were familiar with the HACCP system ($n = 1023$, 51.3%) checked the date of durability and state of package significantly more often ($p < 0.05$) than other groups shown in Table 3. HACCP as a philosophy and technique does have applications to domestic food preparation (Griffith & Worsfold, 1994).

The least important parameter for consumers was the temperature in a retail cold chain unit. The majority of respondents (67.8%) never checked the temperature. However, we must consider whether consumers trust shop managers or simply assume that they cannot influence the temperature settings. More than half of the respondents (55.1%) were aware of the correct temperature range (1–5 °C) for retail refrigerator units (Table 3). This is a significantly higher proportion than that recorded in the study of Kennedy et al. (2005), in which 22% were aware of the temperature range. Redmond and Griffith (2003) remarked that a large proportion of consumers lack knowledge concerning adequate refrigeration temperatures: 46–60% of US consumers and 50–93% of UK consumers do not know the ideal refrigeration temperature.

Most of the respondents evaluated the hygiene practices of sale assistants pretty positively in relation to their handling of delicatessen products, bread and raw meat. All characteristics were graded on average above 2.7 (Table 3).

We wanted to discover whether consumers maintain a cold chain from the point of purchase to the home. Raw meat and tofu were chosen as the perishable foodstuffs in order not to exclude vegetarians. However, since the percentage of respondents not eating meat proved to be very low (3.4%), we will restrict further discussion to results concerning raw meat. Most consumers took raw meat sometimes during their shopping (36.4%) or depending (36.1%) on when they came across it, while 14.4% took it as soon as they entered the shop. Only 10% of respondents collected raw meat at the end of their shopping (Table 4). These results are worse than those presented by Jay et al. (1999b), which revealed that 58.3% of respondents bought their raw meat at the end of their shopping trip. The potential for temperature abuse would be reduced if they purchased meat at the end of their shopping. The average time between buying raw meat and transporting it home was 25 min (SD = 18.4). Similar studies have shown that some potential for temperature abuse exists because 7% of respondents allow more than 90 min (Kennedy et al., 2005) and 5.8% more than 60 min (Jay et al., 1999) to lapse between shopping and subsequent chilled or frozen storage.

The use of an isolated bag or cooling box can help to ensure that perishable foodstuffs remains at a safe temperature after purchase and during transportation home. The results showed that more than half (51.7%) of the respondents never thought of using a cooling bag, while 33% believed that a cooling bag is not even necessary (Table 4). These results were similar to a study by Jay et al. (1999b) in which 32% of sampled individuals responded with “not important” when questioned in relation to this matter. In our study, those who collected raw meat at the end of shopping more frequently used cooling bags when purchasing foodstuffs and had a shorter transportation time (21 min), although the differences were not statistically significant. The majority of respondents (58.1%) were convinced that a short transportation time is important for the safety of raw meat, and this belief is expressed to a greater degree by respondents (67.2%) who claimed that the consumer is responsible for food safety ($\chi^2 = 37.552$, $p < 0.001$, $n = 952$). Among all respondents, only 15.5% had ever taken a freezing bag to the store when buying highly perishable foodstuffs; however, this percentage is significantly higher among respondents (19.4%) who believe that the consumer is responsible for food safety ($\chi^2 = 12.003$, $p = 0.017$, $n = 985$). Badrie et al. (2006) found that the practice when purchasing seafood was to refrigerate the food immediately on arrival at home ($p > 0.05$). Worsfold and Griffith (1997) indicated that chilled or fresh foods represented up to 60% of the contents of the food basket of the European consumer, and several surveys reported that the majority of people do not use a

Table 4
Respondents' food safety practices from purchase to home

Query	Response	%
During the shopping, at what stage do you purchase raw meat/tofu? ($n = 1026$)	Straight away when I enter the shop	14.4
	Sometime during the shopping	36.4
	At the end, when I have already purchased all other items	9.9
	Depends	36.1
	I do not know	3.2
Do you ever use an isolated bag or cooling box to carry your frozen or refrigerated foodstuffs home (e.g. ice cream or raw meat)? ($n = 1030$)	Yes	15.3
	No, I did not think of that	51.7
	No, I do not think it is necessary	33.0
At what temperature should raw meat/tofu in a retail refrigerator unit be stored? ($n = 1029$)	Less than 1 °C	5.4
	1–5 °C	55.1
	6–10 °C	26.5
	More than 11 °C	2.7
	Do not know	10.2
How important is the duration of transport of raw meat/tofu from the time of purchase to the home? ($n = 1028$)	Not important	5.3
	Quite important	33.0
	Very important	58.1
	Do not know	3.7

cool bag or a cool box for the transport of chilled or frozen food from the shop to the home.

3.4. Food handling practices at home

Respondents were asked about their food handling practices at home (Table 5). More than half (53.8%) of the respondents learned cooking practices from their parents and 21.7% learned by themselves. When preparing lunch, 45.1% of respondents use an established preparation sequence for meat or salad (i.e. in a sink, washing salad first, followed by meat). Over half of the respondents (54.4%) refrigerate raw meat intended for immediate use, while they freeze the rest. Over a quarter of respondents (27.8%) mostly freeze raw meat. This study revealed that the majority of respondents thawed meat improperly, i.e. on a kitchen counter (50.4%) or in hot water (12.8%). This critical violation is comparable to the proportion of respondents of other studies who thawed foods at room temperature: 41.6% in Badrie et al. (2006), 56% in Kennedy et al. (2005), 45.2% in Surujlal and Badrie (2004), 21% in Meer and Misner (2000), and 40.1% in Jay et al. (1999b). We established that among those who defrosted meat on the kitchen counter, the greatest proportion was represented by those who learned cooking practices by themselves (57.1%).

We asked consumers if they knew the temperature of their refrigerator to establish whether they find storage conditions important. Almost forty-four percent of respondents did not know the temperature in their refrigerator (Table 5). This result is lower than that recorded in a study by Badrie et al. (2006), in which 65.3% of respondents from Trinidad did not know or have never measured the temperature in their refrigerator, or the 76% of the respondents recorded by Marklinder, Lindblad, Eriksson, Finnson, and Lindqvist (2004), although it is higher than the 15.5% of respondents recorded in the study of Jay et al. (1999b).

Over half (53.5%) of the respondents in our study cool leftovers to room temperature and then put them in the refrigerator (58% in the study of Badrie et al. (2006) and 84.5% in the study of Jay et al. (1999b)), but 12.5% leave leftovers on the kitchen-range until they are eaten (Table 5). The result was higher than that recorded by the study of Badrie et al. (2006), in which 4.5% of respondents left them at room temperature overnight or longer, and considerably higher than the 1.6% of respondents recorded by Jay et al. (1999b). Beumer (2003) summarized findings concerning the microbiological quality of leftovers by Brinkman et al. (1999), which concluded that leftovers should be handled hygienically, kept in clean trays, cooled as quickly as possible, covered and then stored in a refrigerator at 4–7 °C for no longer than three days (if longer, the leftovers should be frozen). The proportion of respondents that leave a meal that is not immediately consumed on the stove, until eaten sometime later, was 12.5%. Two procedures stand out when respondents re-heated a meal: re-

heating occurs in a frying pan, wok or saucepan (46.1%), or in a microwave (36.5%). Close to one-tenth of respondents (9.1%) reported that they did not re-heat leftovers. In an Australian food safety telephone survey, the majority (67.2%) of respondents use a microwave for re-heating leftovers (Jay et al., 1999b). 42.2% of respondents heat a meal so that it becomes warm and suitable for immediate consumption, while only 18.2% leave the meal to boil for some time (Table 5). Our survey demonstrated that a significant percentage of respondents cool food after cooking and re-heat it in a potentially unsafe manner, and it is for this reason that increased awareness is needed of the risks associated with these practices.

Respondents were asked how they washed their hands and the length of time taken to perform this action (Table 5). The proportion of respondents who wash their hands prior to food preparation was 86%, and includes individuals who will only wash their hands depending on what they were doing previously (7.9%) or what kind of food they are going to prepare (5.8%). Worsfold and Griffith (1997) reported poor food handling practices after observing 108 consumers during all stages of the purchase, preparation, cooking and storage of one of four recipes. Such practices may lead to the great danger of cross-contamination and subsequent food poisoning. It has been estimated that 66% of consumers do not wash their hands before work, 41% do not wash vegetables, and 60% use a single board for all cutting tasks (Worsfold & Griffith, 1997).

After handling raw meat, poultry or fish during food preparation, 57.1% of respondents wash their hands properly with soap and hot water, although a significant number (33.9%) washed their hands with water only or did not wash at all (1.6%). The number of respondents who wash their hands properly was lower than that recorded for other similar studies; better scores were obtained for consumers of Ireland (64.6% in Kennedy et al., 2005), Trinidad (78.3% in Badrie et al., 2006), and Australia (82.3% in Jay et al., 1999b). One of the worrying discoveries of this study was that 52% of respondents wash their hands for only 10 s or less. Similar results (82.3%) were reported by Jay et al. (1999b). The results showed that among those respondents who use warm water and soap (or detergent) for hand washing, more wash their hands for 11–20 s or more than 20 s, rather than for 10 s or less ($\chi^2 = 25.535$, $p < 0.001$, $n = 992$). A hygienic hand wash for food handling purposes could be defined as one requiring warm water, soap or detergent and a scrubbing or rubbing action for at least 20 s (Jay et al., 1999b). Results regarding the effectiveness of three types¹ of hand soaps in reducing bacteria on hands by Montville, Yuhuan, and Schaffner (2002) showed that all three types were effective when using a 20-s wash procedure. Most respondents (87.5%) wash their hands in the kitchen, while some use the bathroom

¹ Plain hand soaps, antimicrobial hand soaps, E2-rated hand soaps (a USDA Classification requiring equivalency to 50 parts per million chlorine).

742

M. Jevšnik et al. / Food Control 19 (2008) 737–745

Table 5
Respondents' food handling practices at home

Query	Response	%
How did you learn your cooking practices? (<i>n</i> = 1025)	By myself	21.7
	From cookery books	11.7
	From parents	53.8
	From my partner	4.4
	Cooking is my profession	2.8
	Other	5.6
When preparing a meal, do you follow a sequence of preparing meat and salad (i.e. to wash salad in a sink first, followed by meat)? (<i>n</i> = 1011)	Yes	45.1
	No	54.9
How do you store raw meat at home after purchase? (<i>n</i> = 1020)	I do not preserve raw meat because I use it at once	7.6
	I refrigerate raw meat intended for immediate use, and freeze the rest	54.4
	Mostly in a freezer	27.8
	Mostly in a refrigerator	10.1
Do you know the temperature in your refrigerator? (<i>n</i> = 1020)	Yes	56.3
	No	43.7
How do you defrost meat? (<i>n</i> = 1020)	On a kitchen counter	50.4
	In a refrigerator	16.6
	In hot water	12.8
	In a microwave	11.4
	I do not defrost, I start to cook meat while it is still frozen	5.5
	I do not defrost	3.3
What do you do with leftovers from your meal? (<i>n</i> = 1028)	I leave them on the stove until they are eaten	12.5
	I store them in the refrigerator while still warm	1.2
	I cool leftovers to room temperature and then put them in the refrigerator	53.5
	I freeze them	1.4
	I throw them out	11.2
	I use them to feed animals	20.3
How do you re-heat leftovers from your meal? (<i>n</i> = 1019)	In a microwave	36.5
	In an oven	6.3
	In a frying pan, wok or saucepan	46.1
	I do not re-heat them	9.1
	Other method	2.0
How long are you re-heating a meal? (<i>n</i> = 1020)	I do not re-heat it	9.3
	For as long as it takes to become warm and ready for consumption	42.2
	Until it boils	29.4
	I leave it to boil for a while	18.2
	Other	0.9
Do you wash your hands before food preparation? (<i>n</i> = 1026)	It is not necessary to do so	0.4
	Depends on what I was previously doing	7.9
	Depends on the food I am going to prepare	5.8
	I always wash my hands	86.0
How do you wash your hands after handling raw meat, poultry or fish? (<i>n</i> = 1023)	I do not wash my hands, I dry them with a paper towel	2.2
	I do not wash my hands, I dry them with a kitchen cloth	5.2
	With cold or hot water	33.9
	With warm water and soap (or detergent)	57.1
	I do not wash my hands during food preparation	1.6
How long do you wash your hands? (<i>n</i> = 996)	10 s or less	52.0
	11–20 s	29.9
	More than 20 s	8.2
	I do not know	9.8
How do you dry your hands after washing? (<i>n</i> = 993)	I do not dry my hands	1.4
	With an apron	4.0
	With a kitchen cloth used for wiping the dishes	19.7
	With a disposable paper kitchen towel	27.5
	With a kitchen cloth, intended for drying hands	41.9
	With a bathroom hand towel	5.4

Table 5 (continued)

Query	Response	%
What do you usually do when cutting raw vegetables and later use the same knife for cutting food not intended for cooking? (<i>n</i> = 1082)	I use the same knife	6.6
	I wipe the knife with a damp cloth	13.3
	I wash the knife with cold water without a detergent	16.8
	I wash the knife with hot water without a detergent	29.4
	I wash the knife with hot water and a detergent	23.7
	I use another knife	10.1
What do you usually do when cutting raw vegetables and later use the same cutting board for cutting food not intended for cooking? (<i>n</i> = 1026)	I use the same cutting board	8.9
	I wipe the cutting board with a damp cloth	11.4
	I wash the cutting board with cold water without a detergent	13.6
	I wash the cutting board with hot water without a detergent	29.3
	I wash the cutting board with hot water and a detergent	26.3
	I use another cutting board	10.4
If you use the same knife for cutting raw and then cooked meat, there is a ... (<i>n</i> = 1009)	... strong possibility for food poisoning	42.3
	... slight possibility for food poisoning	39.8
	This does not affect the potential for food poisoning	17.8
How often do you clean your kitchen sink and kitchen counter? (<i>n</i> = 1026)	After every use	59.7
	After every meal	23.2
	Once a day	13.0
	When they are dirty	4.1

(12.5%). After washing, 41.9% of respondents dry their hands with a kitchen cloth intended for the drying of hands, while 27.5% use a disposable paper kitchen towel. Almost 20% of respondents dry their hands with a kitchen cloth used for wiping the dishes. Effective hand washing was therefore not practised by a significant proportion of respondents during food preparation.

We investigated whether respondents thought that some food handling practices could lead to cross-contamination. A considerable percentage of respondents do not use effective means to properly clean cutting boards (20.3%) and knives (19.9%) after cutting raw vegetables before using that utensil/surface again for something that is not intended to be cooked (Table 5). The respondents are therefore performing an unsafe food handling practice that could lead to cross-contamination of finished food with microorganisms from the raw food. More than one-third of respondents engage in an improper practice by re-using without effective cleaning the same cutting board/knife for food that is not intended for cooking. Only one-third of respondents answered correctly “with hot water and a detergent” (23.7% for cleaning knife, 26.3% for cutting board) and “use another knife/cutting board” (10.1% for cleaning knife, 10.4% for cutting board). Similar findings have also been reported by Kennedy et al. (2005) and Jay et al. (1999b). Hillers et al. (2003) suggested that knives, cutting boards and food preparation surfaces should be washed with hot water and soap after contact with raw poultry, meat and seafood. They summarized behaviour related to cross-contamination as the second most important behaviour leading to outbreaks of *Campylobacter jejuni*, *Salmonella* serotypes other than Enteritidis, and *Yersinia enterocolitica*. Even when food is thoroughly cooked, it can be re-contaminated by coming into contact with raw food or food preparation surfaces, serving uten-

sils, or even the preparer’s hands if they were not properly cleaned. Proper refrigeration of cold foods and leftovers is essential to prevent any pathogens in food from multiplying to dangerous levels (USDA, 2006). Numerous microbiological surveys have found the presence of pathogenic bacteria in many foods consumed and prepared in consumers’ homes on a daily basis (Redmond & Griffith, 2003).

Less than half of the respondents (42%) believe there is a strong possibility of poisoning when using the same knife for cutting cooked and raw meat, 39.8% believe that the possibility is slight, and 17.8% believe that this does not affect potential poisoning. Those respondents who believe that there is a high possibility of poisoning when using the same knife or cutting board for cutting cooked and raw meat are less likely to use the same knife, wipe it with a damp cloth or wash it with hot water without a detergent, and more likely to wash the knife and cutting board with hot water and a detergent or use another knife ($\chi^2 = 90.512$, $p < 0.001$, $n = 1009$). When respondents were asked how often they cleaned their kitchen sink and kitchen counter, most (59.7%) indicated that these kitchen areas were cleaned after every use or after every meal (23.2%). According to Yeung and Morris (2001), a consumer’s perception of food safety is not strongly linked to objective risk, but more to sociological and psychological characteristics. There is a vast gap between objectively and scientifically proven risks and perception of risks among consumers. Consumers react to subjective risks that can be recognised and evaluated by themselves.

4. Conclusion

It follows that consumers are one of the important components in the food safety chain when considering a ‘From Farm to Table’ approach. According to Sammarco, Ripa-

belli, and Grasso (1997), it is essential to understand consumers' awareness regarding home food safety and home food preparation practices in order to plan proper education programs.

This study highlighted some gaps in food safety knowledge and practices that occur from shopping to eating. We can conclude on the basis of these results that respondents are not familiar with their role in the food safety chain or with the importance of maintaining a cold chain, and that they allow numerous opportunities for microbiological contamination of food. The most important issues were incorrect defrosting practices, poor cooling of cooked food, re-heating of cooked food, lack of knowledge regarding refrigeration temperatures, lack of knowledge concerning cross-contamination and its control, and a lack of knowledge with respect to hand hygiene. If one reflects on our findings and the most important foodborne pathogens appearing regularly in the area of foodborne diseases, it becomes obvious that there is significant commonality between factors causing foodborne diseases and food handling deficiencies reported in this survey. The results indicated that women adhered to safer food handling practices to a greater degree than men.

The results obtained from our survey revealed the need for consumer education regarding safe food handling practices from the point of purchase to the home, as well as within the home. We have to educate consumers so that they can cope with all novelties (Raspor, 2006) in the field of food safety on a daily basis. The attitudes of consumers towards food safety and their practices concerning food are themes of interest to food producers and retailers, public authorities and health educators (Wilcocky, Pun, Khanonax, & Aung, 2004). Food safety agencies around the globe should play an important role in the education of consumers. Educational material about Good Housekeeping Practice should be available to the general public from many sources. Food safety messages should focus on the younger members of a population with educational programs, but more importantly, with relevant training. It is also of vital importance to properly educate educators and teachers in order to transmit food hygiene principles to children, and through them, to their parents. Only safety-conscious consumers can become active partners within the food safety circle.

References

- Badrie, N., Gobin, A., Dookeran, S., & Duncan, R. (2006). Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control*, 17, 370–377.
- Beumer, R. R. (2003). Kitchen hygiene in daily life. *International Biodeterioration & Biodegradation*, 51, 299–302.
- Ergönül, B., & Günc, P. (2004). Application of HACCP system in catering sector in Turkey. *Internet Journal of Food Safety*, 3, 20–24. Available from <http://www.internetjfs.org/articles/ijfsv3-5.pdf>.
- Garayoa, R., Cordoba, M., Garcia-Jalon, I., Sanchez-Villegas, A., & Vitas, A. I. (2005). Relationship between consumer food safety knowledge and reported behavior among students from health sciences in one region of Spain. *Journal of Food Protection*, 68(12), 2631–2636.
- Griffith, C. J., & Worsfold, D. (1994). Application of HACCP to food preparation practices in domestic kitchens. *Food Control*, 5(3), 200–204.
- Hillers, V. N., Medeiros, L., Kendall, P., Chen, G., & DiMascola, S. (2003). Consumer food-handling behaviours associated with prevention of 13 foodborne illnesses. *Journal of Food Protection*, 66(10), 1893–1899.
- IVZ. (2006). Epidemiološko spremljanje nalezljivih bolezni v Sloveniji v letu 2005. Ljubljana, Institut of Public Health of the Republic of Slovenia, 20–29. http://www.ivz.si/javne_datoteke/datoteke/798-Epidemiolosko_spremljanje_NB_2005.pdf.
- Jay, L. S., Comar, D., & Govenlock, L. D. (1999a). A video study of Australian domestic food-handling practices. *Journal of Food Protection*, 62(11), 1285–1296.
- Jay, L. S., Comar, D., & Govenlock, L. D. (1999b). A national Australian food safety telephone survey. *Journal of Food Protection*, 62(8), 921–928.
- Kendall, P. A., Elsbernd, A., Sinclair, K., Schroeder, M., Chen, G., Bergmann, V., et al. (2004). Observation versus self-report: Validation of a consumer food behavior questionnaire. *Journal of Food Protection*, 67(11), 2578–2586.
- Kennedy, J., Jackson, V., Blair, I. S., McDowell, D. A., Cowan, C., & Bolton, D. J. (2005). Food safety knowledge of consumers and the microbiological and temperature status of their refrigerators. *Journal of Food Protection*, 68(7), 1421–1430.
- Korel, F., Ergönül, B., & Gökğöz, E. (2003). Economic impacts of HACCP system applications in food industry. *Food(2003/01)*, 80–82.
- Li-Cohen, A. E., & Bruhn, C. M. (2002). Safety of consumer handling of fresh produce from the time of purchase to the plate: A comprehensive consumer survey. *Journal of Food Protection*, 65(8), 1287–1296.
- Marklinder, I. M., Lindblad, M., Eriksson, L. M., Finnson, A. M., & Lindqvist, R. (2004). Home storage temperatures and consumer handling of refrigerated foods in Sweden. *Journal of Food Protection*, 67(11), 2570–2577.
- Meer, R. R., & Misner, S. L. (2000). Food safety knowledge and behavior of expanded food and nutrition education program participants in Arizona. *Journal of Food Protection*, 63(12), 1725–1731.
- Medeiros, L. C., Hillers, V. N., Chen, G., Bergmann, V., Kendall, P., & Schroeder, M. (2004). Design and development of food safety knowledge and attitude scales for consumer food safety education. *Journal of the American Dietetic Association*, 104, 1671–1677.
- Montville, R., Yuhuan, C., & Schaffner, D. W. (2002). Risk assessment of hand washing efficacy using literature and experimental data. *International Journal of Food Microbiology*, 73, 305–313.
- Patil, S. R., Morales, R., Cates, S., Anderson, D., & Kendal, D. (2004). An application of meta-analysis in food safety consumer research to evaluate consumer behaviours and practices. *Journal of Food Protection*, 67(11), 2587–2595.
- Raspor, P. (2004). Opening ceremony. In *Book of abstracts. New tools for improving microbial food safety and quality. Biotechnology and molecular biology approaches* (pp. 3–4). 12–16 September 2004, Portorož, Slovenia.
- Raspor, P. (2006). Faces of foods on the world of food systems (Editorial). *Acta Alimentaria*, 35(3), 247–249.
- Raspor, P., Jevšnik, M., & Hlebec, V. (2006). Consumers awareness of food safety from shopping to eating. In D. Bánáti (Ed.), *Nutrition and food safety* (pp. 112). Brussels: Consortium International Congress on Food Safety, The Safe Consortium.
- Redmond, E. C., & Griffith, C. J. (2003). Consumer food handling in the home: A review of food safety studies. *Journal of Food Protection*, 66(1), 130–161.
- Rocourt, J., Moy, G., Vierk, K., & Schlundt, J. (2003). The present state of foodborne disease in OECD countries. World Health Organization, Food Safety Department, Geneva, p. 7.
- Sammarco, M. L., Ripabelli, G., & Grasso, G. M. (1997). Consumer attitude and awareness towards food-related hygienic hazards. *Journal of Food Safety*, 17, 215–221.

- Smole Možina, S., Hočevar Grom, A. (2004). Microbiological food safety. In L. Gasperlin, & B. Zlender (Eds.), *Food Safety, 22. Bitencbitencjevi živilski dnevi, 18.-19.3.2004* (pp. 29–43). Ljubljana, Biotehniška fakulteta, Oddelek za živilstvo.
- Surujal, M., & Badrie, N. (2004). Household consumer food safety study in Trinidad, West Indies. *Internet Journal of Food Safety*, 3, 8–14. Available from <http://www.foodhaccp.com/internetjournal/ijfsv3-3.pdf>.
- Tauxe, R. V. (2002). Emerging foodborne pathogens. *International Journal of Food Microbiology*, 78, 31–41.
- Unusan, N. (2007). Consumer food safety knowledge and practices in the home in Turkey. *Food control*, 18(1), 45–51.
- USDA. (2006). Consumer food safety behaviour: Preparation and risk. United States Department of Agriculture, Economic Research Service. Available from <http://www.ers.usda.gov/briefing/consumerfoodsafety/preparation.htm>.
- Wilcocks, A., Pun, M., Khanonax, J., & Aung, M. (2004). Consumer attitudes, knowledge and behaviour: A review of food safety issues. *Trends in Food Science & Technology*, 15, 56–66.
- Worsfold, D., & Griffith, C. J. (1997). Food safety behaviour in the home. *British Food Journal*, 99, 97–104.
- Yang, S., Angulo, F. J., & Altekruze, S. F. (2000). Evaluation of safe food-handling instructions on raw meat and poultry products. *Journal of Food Protection*, 63(10), 1321–1325.
- Yeung, R. M. W., & Morris, J. (2001). Food safety risk: Consumer perception and purchase behaviour. *British Food Journal*, 103(3), 170–186.

2.1.6 Food safety knowledge and practice among pregnant and non-pregnant women in Slovenia

Poznavanje načinov zagotavljanja varnih živil in izvajanje le-teh med nosečimi in nenosečimi ženskami v Sloveniji

Mojca Jevšnik, Silvestra Hoyer in Peter Raspor

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S kvantitativno raziskavo med nosečimi in nenosečimi ženskami smo ugotovili znanje o varnosti živil in načinih priprave živil doma. Raziskava je bila izvedena v skupini nosečih žensk (n=291), ki so v času raziskave obiskovale materinsko šolo in skupini nenosečih žensk (n=200), ki so se v času raziskave udeležile roditeljskih sestankov v osnovnih šolah. V raziskavi je sodelovalo deset naključno izbranih osnovnih šol. Rezultati kažejo visoko stopnjo zavedanja o varnosti živil pri obeh proučevanih skupinah. Vendar so med skupinama značilne razlike, v glavnem med mlajšimi ženskami pod 25 let. Napake se kažejo predvsem v postopkih priprave živil, ki so lahko vzrok navzkrižnih onesnaženj pri pripravi živil doma. Skupina nosečih žensk pogosteje poje glavni obrok pri ponudnikih hitre prehrane in odmrzuje živila na sobni temperaturi v kuhinji. Med nakupovanjem je skupina nosečnic bolj pozorna na rok uporabe živil, higienske pogoje v trgovini in nadzor nad živilom, kupljenimi pri kmetih doma. Značilen vpliv na višjo stopnjo znanja o varnosti živil imata kraj bivanja (v mestu) in starost (nad 25 let). V izobraževalne programe materinskih šol je potrebno vključiti vsebine o zagotavljanju varnosti živil. Za doseg celovite varnosti živil je nujno delovati v smeri neprestanega informiranja potrošnikov, še posebej rizičnih skupin, o načinih zagotavljanja varnih živil doma.



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Food safety knowledge and practices among pregnant and non-pregnant women in Slovenia

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Abstract

Food safety knowledge and practices among pregnant and non-pregnant women in Slovenia were systematically assessed through an inquiry-based investigation. The study was conducted with 291 pregnant women, who attended antenatal classes at the time of the investigation, and 200 non-pregnant women, all of whom participated during consultation hours for parents in ten, randomly selected primary schools in the country. Results showed that a high level of food safety awareness was possessed by both groups of respondents. However, some food safety differences were recorded (e.g., kitchen practices that can lead to cross-contamination), mainly in younger women under 25 years of age. Pregnant women more frequently had the main meal at fast-food restaurants and de-frosted frozen food at room temperature in the kitchen. However, when purchasing food they paid more attention to food safety assurance elements such as checking 'best before' date, paying attention to hygienic conditions in stores, and assessing the veterinary control of meat. The results showed that the living location (in town) and age group (above 25 years of age) had a significant impact on food safety knowledge. Educational programs in antenatal classes need to be supplemented with information concerning the principles of food safety at home in order to encourage desired food safety patterns. To achieve global food safety it is necessary to inform consumers, especially vulnerable groups, about fundamental principles of food safety assurance at home, since food safety begins and ends in the home of a consumer.

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Keywords: Food safety; Pregnant woman; Consumer; Education; Good housekeeping practice

1. Introduction

The principal objective of the new general and specific hygiene rules is to ensure a high level of consumer protection with regard to food safety (EU, 2004). Foodstuffs can become a risk factor for consumers if they are not handled and treated along the food supply chain in accordance with principles of good practices and the HACCP system. The

food supply chain does not exclude consumers. But the question is whether consumers are sufficiently informed to assure food safety at the end of the food chain. A review of consumer food safety studies highlights many gaps that have an impact on foodborne diseases at home (Garayoa, Cordoba, Garcia-Jalon, Sanchez-Villegas, & Vitas, 2005; Hillers, Medeiros, Kendall, Chen, & DiMascola, 2003; Jay, Comar, & Govenlock, 1999; Kendall et al., 2004; Kennedy et al., 2005; Li-Cohen & Bruhn, 2002; Raspor, Jevšnik, & Hlebec, 2006; Unusan, 2007; Yang, Angulo, & Altekruze, 2000). Epidemiologic surveillance summaries of foodborne diseases clearly indicate that consumer behaviours such as ingestion of raw/undercooked foods

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and poor hygienic practices are important contributors to outbreaks of foodborne diseases (Patil, Morales, Cates, Anderson, & Kendal, 2004). Epidemiological data from Europe, North America, Australia and New Zealand indicate that a substantial proportion of foodborne disease is attributable to improper food preparation practices in the homes of consumers (Redmond & Griffith, 2003). Most of the consumer food safety research conducted to date has consisted of surveys examining consumers' attitudes, knowledge and behaviour regarding food safety. Few investigations have focussed on vulnerable groups of a population. The most vulnerable to foodborne diseases are the elderly, pregnant women, immune-compromised individuals, and children (McCabe-Sellers & Beattie, 2004). To achieve an adequate level of food safety, a coordinated plan is needed for all involved in the food supply chain (Garayoa et al., 2005), including a consideration of vulnerable groups in a population.

International studies have shown that a significant proportion of foodborne diseases arise from practices in the kitchen of a home (Bryan, 1988; Raspor et al., 2006; Scott, 1996; Scott, Bloomfield, & Barlowk, 1982). Domestic food preparation can negate most of the efforts of primary and secondary food producers to provide safe food (Jay et al., 1999; Oosterom, 1998). Several studies assessing different kinds of consumer groups identified food prepared in the family home as a major source of food poisoning (Anderson, Shuster, Hansen, Levy, & Volk, 2004; Bermúdez-Millán, Perez-Escamilla, Damio, Gonzalez, & Segura-Perez, 2004; Jay et al., 1999; Johnson et al., 1998; Leitch, Blair, & McDowell, 2001; Marklinder, Lindblad, Eriksson, Finnson, & Lindqvist, 2004; Meer & Misner, 2000; Sammarco, Ripabelli, & Grasso, 1997). These studies have also uncovered a lack of food safety knowledge and the need to promote improved food safety behaviours for particular target groups. It is very important to investigate a consumer's knowledge, behaviour and attitudes toward food safety. Redmond and Griffith (2004) noted that target social marketing of food safety strategies is required because they found differences in perceived responsibility between males and females and consumers from different age groups. They also emphasised that consumers need to perceive interventions as personally relevant for there to be effective food safety education.

Smith (1999) described foodborne infections during pregnancy. Intracellular pathogens such as *Listeria monocytogenes*, *Toxoplasma gondii*, hepatitis E virus and *Coxiella burnetii* have a predilection for the maternal-fetal unit and may induce serious diseases in a mother and/or fetus. Athearn et al. (2004) showed that *L. monocytogenes* and *T. gondii* are most likely to cause issues for pregnant women in the United States. Approximately 2500 individuals contract listeriosis annually in the US and become seriously ill, resulting in approximately 500 deaths per year (Cates, Heather, Carter-Young, Conley, & O'Brien, 2004). Thirty-five cases of listeriosis were

reported in Slovenia during the period 1990–2005, of which six resulted in death (IVZ, 2005). Pregnant women are approximately 20 times more at risk than healthy people (Athearn et al., 2004; Gilbert, 2002). Voelker (2002) noted that safe food handling is an important aspect of good nutritional practices to prevent food-related diseases during pregnancy such as listeriosis and toxoplasmosis. Pregnant women are advised to avoid raw or undercooked fresh meat and chilled ready-to-eat food that is not freshly prepared in order to reduce the risk of listeriosis and toxoplasmosis (Gilbert, 2002). It is considered very difficult to effectively change the food choices and dietary behaviour of consumers (Glasgow, Lichtenstein, & Marcus, 2003). Specific events or changes in life (e.g., when individuals become part of a couple or experience pregnancy) can have a major impact on these habits (Verbeke & De Bourdeaudhuij, 2007). Pregnancy is a period during which a woman is more motivated to acquire health-related knowledge because of concerns she has for her health and that of her child. Athearn et al. (2004) reported that a group of pregnant women partly changed their nutrition habits and acknowledged 7 out of 12 recommendations. Educational programs for pregnant woman in Slovenia are well organized. 2001 statistics show that 73% of pregnant women attended antenatal classes (IVZ, 2005). The educational program includes classes concerning nutrition education and healthy food preparation (Anonymous, 1998), though the time spent on topics regarding food safety assurance remains inadequate.

The results of a number of the previously mentioned investigations on consumer food safety showed that the levels of understanding, motivation and trust need to be further cultivated and enhanced in order to maintain an acceptable level of food safety for the whole food chain. Most of the work during the last few years has centred on hazard control in the production sector, but an equal effort was not dedicated to improving the food safety education of consumers (Garayoa et al., 2005). Therefore, an important objective is to educate the public about safe food handling and the preparation of foods using a system of good nutritional practices that emphasizes hazardous food handling techniques and the microbiological causes of foodborne diseases (Raspor, 2004). An effective risk communication to inform consumers of the possible health risks of foodborne diseases and encourage safer food handling practices at home is probably the best way to ensure food safety at the consumer end of the food chain (Patil, Cates, & Morales, 2005).

The awareness of pregnant women in Slovenia regarding the importance of food safety assurance and their knowledge and practices associated with this aspect of their daily life have not been researched. Thus, the objective of this study was to use quantitative research approaches to ascertain current food safety knowledge and practices in pregnant women and compare the results with a group of non-pregnant women.

2. Methodology

2.1. Research design

The survey examining food safety knowledge and practices of Slovenian pregnant women (Group B) was conducted from April to June, 2005. The sample of 291 pregnant women was restricted to pregnant women who at the time of the investigation attended antenatal classes, organized in different Slovenian cities. On the average, there are approximately 17,000 pregnant women in Slovenia per year.

In order to compare results concerning food safety knowledge and practices of Slovenian pregnant women with a group of non-pregnant women (Group A), 200 non-pregnant women were interviewed during the period January to March, 2007. Random sampling and local dispersion were assured by involvement of 10 randomly selected Slovenian primary schools, which organize monthly consultation hours for parents and present informative lectures. A detailed explanation of the research was sent to the school principals with a request to participate in the survey. Participants in the non-pregnant group were selected by distributing questionnaires to all non-pregnant mothers present at a school parental meeting and asking them to complete the questionnaire in the presence of a class teacher.

2.2. Instrumentation

The questionnaire was specially designed for this survey by the authors of this article because no such research had been conducted in Slovenia. The questions were designed to assess food safety knowledge and practices between pregnant and non-pregnant women. The questionnaire was pilot tested using 30 pregnant women between January and March 2005 for clarity and validity, and adjustments were made where necessary. The revised questionnaire was divided into three sections, with a demographic section at the end. Areas of inquiry included (1) purchasing behaviour, (2) food safety knowledge, and (3) food safety practices at home. Some questions included multi-item scales. Answers were given on a 5-point scale, where 1 indicated the weakest and 5 the strongest agreement. Each questionnaire took an average of 20 min to complete. The same questionnaire was given to the group of non-pregnant women to allow a comparison of results between both groups.

2.3. Data collection

The group comprising pregnant women completed the questionnaire under the supervision of registered nurses and an investigator. Women of the non-pregnant group were given the questionnaire by a teacher and an investigator before the parental meeting started and then asked to complete the questionnaire. In the presence of a class teacher the investigator explained briefly to both groups

the purpose of the survey and explained how to complete the questionnaire. All the mothers that were at the meeting gladly participated in the survey.

The completed surveys were collected for analysis by researchers at the Slovenian College of Health Studies. Identity numbers were assigned to each questionnaire when collected at the university to guarantee anonymity of respondents and enable easier identification of questionnaires. The research was approved by the Medical Ethics Commission of the Republic of Slovenia.

2.4. Data analysis

The SPSS 13.0 statistical package was used for all analyses. Scores for each test category (i.e., food safety habits towards a purchase, transportation and storage of food, food handling practices at home) were calculated by assigning correct responses. Mean responses and percentages of responses in each category were computed. Cross tabulations and chi-square tests (5% significance) were used to compare indicators across demographic characteristics (age, educational level, marital status). The independent sample *t*-test and ANOVA (confidence interval 95%) were used to compare average values of selected test parameters (e.g., food safety habits towards a purchase, transportation and storage of food, food handling practices at home) across demographic data (age, educational level, marital status).

3. Results and discussion

3.1. Profile of respondents

Analyzable questionnaires were obtained from 291 pregnant women and 200 non-pregnant women. Demographic characteristics of survey participants are listed in Table 1. 81.9% of pregnant women who participated in this survey were experiencing their first pregnancy. The majority of pregnant women lived in towns (40.7%) or suburbs (30.2%), whereas the majority of participants in the non-pregnant group lived in suburbs (35%) or villages (47%). Approximately half of the respondents of both groups had completed secondary school. The majority were married or lived together as a *de facto* married couple. 69.5% of pregnant women were between 26 and 35 years of age, whereas most (68.3%) women of the non-pregnant group were older than 35 years of age.

3.2. Purchasing behaviour

Respondents mostly purchased food in supermarkets. Harris, Knight, and Worosz (2006) suggested that supermarkets may be preferred because of their shopping choices, ambiance, and the easier personal inspection they allow. Therefore, public health agencies should place food safety messages in places that are most frequently visited by consumers.

Table 1
Descriptive characteristic of the surveyed pregnant women

Demographic characteristic	Number (%)	
	Pregnant women	Non-pregnant women
Age of the group ($n = 285^a$, $n = 199^b$)		
≤25	13 (4.6)	17 (8.5)
26–35	237 (81.4)	46 (23.1)
>35	35 (12.0)	136 (68.3)
Marital status ($n = 289^a$, 199^b)		
Married or living together as married	279 (95.9)	173 (86.5)
Single	10 (3.4)	26 (13.0)
Place of living ($n = 290^a$, 199^b)		
Town	118 (40.7)	36 (18.0)
Suburb	88 (30.2)	70 (35.0)
Village	84 (28.9)	94 (47.0)
Education ($n = 289^a$, 200^b)		
Secondary school or less	152 (52.2)	84 (42.0)
More than secondary school	137 (47.1)	116 (58.0)

^{a,b} The numbers of participants (a – pregnant women; b – non-pregnant women) who responded to the questions are indicated in parentheses.

Pregnant women were more careful when purchasing food than non-pregnant women (Table 2) since they more frequently checked the 'best before' date and inspected food packages for possible damage ($p < 0.001$). They were also more particular regarding how the food was served, as results showed that it was much more important to pregnant women whether the food was served in a hygienic way ($p < 0.001$). Pregnant women were also more concerned that the person preparing the food had clean hands while handling foodstuffs ($p < 0.001$), and that the food handler separated clean items (tableware and working instruments) from those that were unclean ($p < 0.05$). Least attention was paid to conditions of storage of highly perishable food in stores. Likar and Jevšnik (2006) established that the majority of consumers believe that sellers respect all food safety requirements. As a consequence, they do not check storage conditions and the date of durability when purchasing foodstuffs.

Table 2
Elements to which women pay attention during food purchasing

	Group ^a	N ^b	Mean ^c	SD	F ^d	Sig.
Best before date	A	200	4.61	0.826	11.562	0.001
	B	291	4.71	0.604		
Food storing conditions	A	200	3.95	1.076	2.327	0.128
	B	291	3.99	0.986		
Hygienic way of serving food	A	200	4.41	0.914	13.121	0.000
	B	290	4.58	0.726		
Package damages	A	200	4.57	0.787	12.202	0.001
	B	290	4.69	0.640		

^a Groups of respondents: A – non-pregnant women; B – pregnant women.

^b Number of respondents.

^c Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very often).

^d Levene's test for equality of variances.

Answers to the question 'Do you buy home-made products, for which you are not sure of any veterinary inspection control?' showed that women in the non-pregnant group were more likely to buy such products than pregnant women. Pregnant women were statistically less likely ($p < 0.05$) to buy meat, dried meat products, black puddings or grilled sausages that were not controlled by veterinary inspection. Among all the questioned women, dried meat products were bought more frequently ($p < 0.05$) by women who had no more than a high school education and were under 25 years of age.

Respondents sometimes purchased food from farmers (i.e. raw meat, meat products, raw milk, dairy products) without knowing if the food had been tested, but among such women those who lived in villages and were under 35 years of age purchased such food items more frequently. Home food production in Slovenia is still a family tradition passed from one generation to the next, and that is why consumers still mainly trust domestically known producers despite not knowing if they are being controlled by veterinary inspections.

3.3. Food safety knowledge

Lunch is the main meal for the majority of respondents of both groups (68.2%), but results showed statistically significant differences in eating habits between the groups ($\chi^2 = 14.291$; $p < 0.01$; $N = 487$). Among women who believe breakfast is the main meal (15%), 10.7% were pregnant and only 4.3% belonged to the non-pregnant group. During pregnancy women are more motivated and likely to follow dietary guidelines and to take care of their own health and that of their baby, which is reflected by a more regular breakfast eating habit. It is interesting that pregnant women were statistically less likely ($F = 3.798$; $p < 0.05$) to prepare their main meal in their homes and had this meal more frequently in fast food restaurants ($F = 7.403$; $p < 0.01$) or at the home of their parents ($F = 6.192$; $p < 0.05$), and less frequently ($F = 14.900$; $p < 0.001$) at the home of a friend. Low mean values for

both groups show that fast food home delivery is an unpopular eating style.

Results revealed that pregnant women less frequently prepared food belonging to a high-risk group for microbiological infection (Table 3), such as pastries and cakes containing raw eggs (e.g., tiramisu), raw meat (beef tartare, carpaccio) and raw fish (sushi). While eggs with soft yolks (fried or boiled) were prepared occasionally by women of both groups, sweets made from raw eggs and dishes made from raw meat were more frequently ($p < 0.05$) prepared by women who live in villages, have no more than a secondary school education and were above 35 years of age. Pregnant women are at high risk for foodborne illness due to food or water-borne pathogens (i.e. *Salmonella* species, *Helicobacter pylori*, *Shigella*, *Escherichia coli* O157:H7, *L. monocytogenes*, *Cryptosporidium*, etc.) (Kaiser & Lindsay, 2002), and need to ensure that their food is heat treated to an appropriate degree. Kaiser and Lindsay (2002) presented some dietary guidelines for pregnant women and recommended that pregnant women should not consume unpasteurized juices, raw sprouts or raw (unpasteurized) milk products. It was also suggested that they avoid raw or undercooked meat, poultry, eggs, fish and shellfish. Athearn et al. (2004) reported that pregnant women consume raw and inadequately processed yolks in regard to heat treatment, despite a warning that running yolk presents a potential risk factor for poisoning with *Salmonella*. A short thermal processing time for the boiling or frying of eggs that produces a running yolk does not guarantee that pathogenic microorganisms have been destroyed. This is the reason why women are advised against these two kinds of egg preparation whilst pregnant. Our study showed that women who have more than a secondary school education believe it is significantly more important ($p < 0.01$) not to eat boiled or fried eggs with a running yolk during pregnancy. *Salmonella* was the pathogen involved in most outbreaks of foodborne illness in Slovenia in the past few years, especially with food prepared at home (IVZ, 2005). Garayoa et al. (2005) indicated that more than 85% of the identified cases of foodborne illness associated with

the consumption of egg and egg products in Spain from 1999 to 2003 were due to *Salmonella* infection.

The frequency of poisoning by foodstuffs prepared at home or outside the home was low according to our study. 11.5% ($A = 3.9\%$; $B = 7.6\%$) of the respondents ($N = 489$) reported minor digestion problems caused by inadequate food preparation at home. Poisoning by food prepared at home was reported by 1.8% ($A = 1.2\%$; $B = 0.6\%$) of the respondents ($N = 490$). Interestingly, women who have experienced at least one previous pregnancy reported significantly more ($p < 0.05$) gastrointestinal problems with food prepared at home than women who were pregnant for the first time. We can conclude that younger women and those who are pregnant for the first time are more concerned about the dangers of bacterial infection and its effects on a foetus when preparing and consuming foodstuffs.

Both groups of women selected high values for all stated answers to questions concerning responsibility for food safety in the food supply chain (every individual, farmers, producers, retailers, catering personnel and inspectors). But there were differences between the groups; pregnant woman believed that the responsibility of every individual (consumer) ($p < 0.05$) and food retailers ($p < 0.01$) was greater than that believed by non-pregnant women. Badrie, Gobin, Dookeran, and Duncan (2006) showed that respondents believed the primary responsibility was with government and food manufacturers in particular. The results of our study showed that a significantly larger responsibility was ascribed to each individual by respondents living in villages than those living in suburbs.

The majority of respondents (75.4%) received information on food safety recommendations during shopping, and advice for the preparation of food at home from mass media. A small proportion (14.2%) received such information at antenatal classes or from health specialists (8.9%). Other sources of information include retailers (20.4%) and the Slovenian Consumer Association (19.2%). 5.2% of respondents reported they were not familiar with any information regarding food safety assurance at home.

Table 3

Frequency of preparing of dishes with higher risk levels for microbiological infection between pregnant and non-pregnant women

How often do you prepare the following dishes ...	Group ^a	N ^b	Mean ^c	SD	F ^d	Sig.
Pastries and cakes containing raw eggs (e.g., tiramisu)	A	198	2.32	1.147	6.703	0.010
	B	291	1.77	0.982		
Dishes containing raw meat (e.g., dried meat products, beef tartare, carpaccio)	A	199	1.63	0.949	69.213	0.000
	B	290	1.29	0.551		
Raw fish (e.g., sushi)	A	200	1.32	0.749	56.296	0.000
	B	290	1.10	0.483		
Eggs with running yolk (soft boiled or fried)	A	200	2.65	1.210	1.062	0.303
	B	291	2.39	1.216		

^a Groups of respondents: A – non-pregnant women; B – pregnant women.

^b Number of respondents.

^c Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very often).

^d Levene's test for equality of variances.

Woodburn and Raab (1997) indicated that the popular media was responsible for increased awareness of foods associated with *E. coli*- and *Salmonella*-related foodborne illness. The differences in mean values of both groups show that pregnant women were slightly more familiar with guidelines for food safety assurance during purchasing, preparing, storing, de-frosting, heat treatment, re-heating and freezing of foodstuffs, and that they more frequently followed such guidelines on a daily basis, though the differences between the groups were not statistically significant.

3.4. Food handling practices

The majority of the respondents always put foodstuffs that required the maintenance of a cold chain (e.g., fresh meat, dairy products) into the home refrigerator as soon as possible after purchase, but this task was more frequently performed by pregnant women ($p < 0.001$). Pregnant women more frequently ($p < 0.001$) checked the 'best before' date in refrigerators at homes. In contrast, non-pregnant women more frequently ($p < 0.01$) checked the temperature in home refrigerators. The temperature

in home refrigerators and freezers was never or rarely checked by 32.7% of pregnant women. Similar results were also found by Jay et al. (1999).

Most of the respondents always paid attention to hygienic principles of food preparation at home. But there were significant differences ($p < 0.001$) between the groups; pregnant women more frequently washed their hands after performing dirty work, more frequently used clean kitchenware and tableware, but less frequently separated used dishcloths from clean ones. The results showed that respondents with no more than a secondary school education more frequently separated clean and dirty dishcloths. Bloomfield and Scott (1997) warned against the possibilities of cross-contamination at home due to incorrect housework procedures, such as those involved in cleaning, the hygiene of food preparation, and the care of a baby or the sick. Table 4 shows the evaluations of respondents regarding the importance of selected food safety requirements during food preparation at home.

Differences in mean values show that pregnant women believed more strongly than non-pregnant women that it is better to store poultry in an area separated from other

Table 4
Evaluation of selected food safety requirements during home food preparation

Estimate with numbers from 1 to 5 how important it is to ...	Group ^a	N ^b	Mean ^c	SD	F ^d	Sig.																																																																																																																																	
Store raw poultry separated (protected) from other raw types of meat	A	200	4.40	3.764	0.862	0.354																																																																																																																																	
	B	286	4.09	1.136			Separate cutting boards for raw foodstuffs and boards for cooked food	A	200	4.20	1.169	2.260	0.133	B	288	3.90	1.281	Wash all the dishes and tableware with detergent and hot water or in a dishwasher after preparing the food and before new usage	A	200	4.84	0.506	5.683	0.018	B	289	4.89	0.440	Wash a cutting board after cutting raw meat and before cutting cooked meat	A	200	4.72	0.708	0.125	0.724	B	287	4.73	0.676	In a sink wash lettuce first and poultry afterwards	A	200	4.28	1.161	0.216	0.643	B	281	4.13	1.164	Separate clean and dirty dishcloths	A	200	4.69	0.629	2.929	0.088	B	288	4.63	0.697	Rinse well and dry with sponges after usage	A	200	4.55	0.742	1.529	0.217	B	287	4.47	0.788	Food reaches sufficiently high temperature during heat treatment	A	200	4.74	0.597	2.183	0.140	B	285	4.77	0.531	Store raw eggs separately (protected) from other foodstuffs in a refrigerator	A	200	4.16	1.121	0.146	0.703	B	286	4.02	1.180	Use kitchen cloth only there and not for other housework	A	200	4.82	0.538	3.469	0.063	B	288	4.86	0.464	Wash hands well after handling eggs	A	200	4.28	0.993	0.140	0.708	B	285	4.22	0.981	When peeling to wash hands first and eat the fruit afterwards	A	200	4.25	0.995	0.004	0.951	B	287	4.27	1.038	During pregnancy not to eat fried or boiled eggs with running yolks	A	198	3.90	1.171	0.023	0.879	B
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	B	287	4.47	0.788			Food reaches sufficiently high temperature during heat treatment	A	200	4.74	0.597	2.183	0.140	B	285	4.77	0.531	Store raw eggs separately (protected) from other foodstuffs in a refrigerator	A	200	4.16	1.121	0.146	0.703	B	286	4.02	1.180	Use kitchen cloth only there and not for other housework	A	200	4.82	0.538	3.469	0.063	B	288	4.86	0.464	Wash hands well after handling eggs	A	200	4.28	0.993	0.140	0.708	B	285	4.22	0.981	When peeling to wash hands first and eat the fruit afterwards	A	200	4.25	0.995	0.004	0.951	B	287	4.27	1.038	During pregnancy not to eat fried or boiled eggs with running yolks	A	198	3.90	1.171	0.023	0.879	B	283	3.95	1.183																																																															
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	B	285	4.77	0.531			Store raw eggs separately (protected) from other foodstuffs in a refrigerator	A	200	4.16	1.121	0.146	0.703	B	286	4.02	1.180	Use kitchen cloth only there and not for other housework	A	200	4.82	0.538	3.469	0.063	B	288	4.86	0.464	Wash hands well after handling eggs	A	200	4.28	0.993	0.140	0.708	B	285	4.22	0.981	When peeling to wash hands first and eat the fruit afterwards	A	200	4.25	0.995	0.004	0.951	B	287	4.27	1.038	During pregnancy not to eat fried or boiled eggs with running yolks	A	198	3.90	1.171	0.023	0.879	B	283	3.95	1.183																																																																										
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^a Groups of respondents: A – non-pregnant women; B – pregnant women.

^b Number of respondents.

^c Average of the rankings given to the opinion by the respondents. Opinions were ranked from 1 (not at all) to 5 (very often).

^d Levene's test for equality of variances.

types of meat, to separate cutting boards used for raw foodstuffs from those used for heat-treated foods, to first wash lettuce in a sink and poultry afterwards, to separate clean and dirty dishcloths, to store raw eggs in an area of a refrigerator separated (protected) from other food, and to wash hands thoroughly after handling eggs (Table 4). Such behaviour can substantially reduce the possibility of cross-contamination. Anderson et al. (2004) reported that cross-contamination (due to badly washed hands, inappropriate procedures used for the preparation of raw and thermally processed foodstuffs, badly cleaned vegetables) represented the biggest problem during the preparation of food at home. Jones (1998) found that most coliform bacteria were found in the kitchen sink, at the outpouring opening, and in kitchen cloths. Most respondents believed that foodstuffs should reach an appropriate temperature level when being processed thermally. Pregnant woman believed more strongly ($p < 0.05$) than non-pregnant woman that it is important to wash all the dishes with detergent and hot water after food preparation. They also believed it is less important to separate clean and dirty dishcloths. The results showed that respondents under 25 years of age believe it is less important ($p < 0.05$) to wash dishes and tableware with detergent and hot water after food preparation, to wash cutting boards thoroughly after cutting raw meat and before use for cooked meat, and to reach a sufficient temperature during heat treatment than those who were 26–34 years of age. Respondents with no more than a secondary school education believed it is more important ($p < 0.05$) to separate clean and dirty dishcloths and to rinse scourers well after use.

The use of the same cutting boards for raw and thermally processed foodstuffs of animal and vegetable origin without thorough washing can be one of the causes of infections with *Listeria*. Cates et al. (2004) investigated 63 pregnant women and stressed the need for education regarding the dangers of listeriosis and preventive measures to avoid possible infections. Respondents were anxious and surprised not to have been educated about listeriosis by health professionals as part of their antenatal education. Schuchat (1997) lists foodstuffs that caused outbursts and sporadic cases of listeriosis. He highlighted the danger of cabbage salad and foodstuffs of animal origin that cause major outbursts like soft cheeses, improperly pasteurized milk, pate, pork tongue in jelly, and minced pork meat. Inappropriately or insufficiently cleaned vegetables like cabbage, Brussels sprouts and lettuce can present a potential source of contamination due to the presence of microorganisms between the layers of leaves as a result of watering with liquid manure. Similar findings were reported by Athearn et al. (2004).

The majority of respondents (90.7%) included frozen food in their nutrition, but they did not defrost these items in accordance with food safety principles; almost two-thirds of the women defrosted items at room temperature. Defrosting food on a kitchen counter was the most frequent way of defrosting food for both groups, but there

were statistically significant differences between the groups ($p < 0.001$). Pregnant women less frequently defrosted food in refrigerators, in hot water or in microwave ovens. But they more frequently defrosted items at room temperature than non-pregnant women. Respondents under 25 years of age more frequently ($p < 0.05$) thawed food at room temperature than those above 35 years of age.

4. Conclusion

The results show a high level of food safety awareness in both groups of respondents. However, there are food safety gaps in both groups (e.g., certain kitchen practices that can cause cross-contamination), mainly among respondents who are less than 25 years of age. For example, pregnant women more frequently had their main meal in fast food restaurants and defrosted food at room temperature. However, they paid more attention to food safety assurance elements (e.g., 'best before' date, hygienic weighing, meat control by veterinary inspection) when purchasing food, which was expected because pregnant women are more receptive to information regarding health, food safety and quality of life, and are willing to do much more during a pregnancy. The majority of respondents received food safety information from mass media, but the reliability of such information is questionable. The recommendations in popular television shows and the traditional advice of "our grandmothers" can create many inconveniences and may even lead to fatal consequences. Only a small proportion (14.2%) of respondents received food safety information during antenatal classes or from health specialists. It is obvious that food safety topics are inadequately represented in antenatal programmes for future mothers, and are sometimes only briefly mentioned or totally ignored. Athearn et al. (2004) stressed that it is necessary to prepare informative material concerning food safety assurance at home to provide choice for pregnant women in regard to food safety principles. The question is whether health-trained specialists possess sufficient education and competence to lecture on the relevant topics. An example is the change in nutritional doctrine regarding the recommended frequency of consumption and manner of preparation of eggs by women during pregnancy. Approximately 20 years ago health professionals encouraged the consumption of raw yolks due to their high biological value. The recommendation took root and was passed from one generation to the next to form a tradition in modern times (Athearn et al., 2004). The quantitative analysis identified fields of weaker knowledge, so it would be sensible to broaden the research using a qualitative analysis of interviews with pregnant women.

To achieve global food safety all groups of consumers should be informed about basic principles of food safety assurance at home (Good Housekeeping Practice) because food safety begins and ends with the daily practices of a consumer. Jones (1998) stressed that it is important to pay attention to hygienic measures that can decrease

numerous potential risk factors, and highlighted the importance of acknowledging HACCP principles at home.

When a consumer is outside the food safety circle we do not treat food safety "From Farm to Fork". That is why Good Nutritional Practice (GNP) must become a link in the global vision of food safety control, which begins and ends with a concern for the consumer (Raspor, 2004).

Acknowledgments

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References

- Anderson, J. B., Shuster, T. A., Hansen, K. E., Levy, A. S., & Volk, A. (2004). A camera's view of consumer food-handling behaviors. *Journal of the American Dietetic Association*, 104(2), 186–191.
- Anonymous. (1998). Instruction for performing preventive health care on primary level. *Official Gazette of Republic of Slovenia*, 1253.
- Athearn, P. N., Kendall, P. A., Val Hillers, V., Schroeder, M., Bergmann, V., Chen, G., et al. (2004). Awareness and acceptance of current food safety recommendations during pregnancy. *Maternal and Child Health Journal*, 8(3), 149–162.
- Badrie, N., Gobin, A., Dookeran, S., & Duncan, R. (2006). Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control*, 17, 370–377.
- Bermúdez-Millán, A., Perez-Escamilla, R., Damio, G., Gonzalez, A., & Segura-Perez, S. (2004). Food safety knowledge, attitudes, and behaviours among Puerto Rican caretakers living in Hartford, Connecticut. *Journal of Food Protection*, 67(3), 512–516.
- Bloomfield, S. F., & Scott, E. (1997). Cross-contamination and infection in the domestic environment and the role of chemical disinfectants. *Journal of Applied Microbiology*, 83(1), 1–9.
- Bryan, F. (1988). Risks of practices, procedures and processes that lead to outbreaks of foodborne diseases. *Journal of Food Protection*, 51, 663–673.
- Cates, S. C., Heather, L., Carter-Young, H. L., Conley, S., & O'Brien, B. (2004). Pregnant women and listeriosis: Preferred educational messages and delivery mechanisms. *Journal of Nutrition Education and Behavior*, 36, 121–127.
- EU (European Union). 2004. Corrigendum to Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (OJ L 139, 30.4.2004). *Off. Journal L226*, 25/06/2004, pp. 3–21.
- Garayoa, R., Cordoba, M., Garcia-Jalon, I., Sanchez-Villegas, A., & Vitas, A. I. (2005). Relationship between consumer food safety knowledge and reported behavior among students from health sciences in one region of Spain. *Journal of Food Protection*, 68(12), 2631–2636.
- Gilbert, G. L. (2002). Infections in pregnant women. *The Medical Journal of Australia*, 176, 229–236.
- Glasgow, R. E., Lichtenstein, E., & Marcus, A. C. (2003). Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American Journal of Public Health*, 93, 1261–1267.
- Harris, C. A., Knight, & Worosz, M. R. (2006). Shopping for food safety and the public trust: What supply chain stakeholders need to know about consumer attitudes. *Food Safety Magazine*(June/July), 52–59.
- Hillers, V. N., Medeiros, L., Kendall, P., Chen, G., & DiMascola, S. (2003). Consumer food-handling behaviours associated with prevention of 13 foodborne illnesses. *Journal of Food Protection*, 66(10), 1893–1899.
- IVZ. (2005). Epidemiological tracing of infectious diseases in Slovenia in 2003. *Institute of Public Health, Republic of Slovenia*. Available from: <http://www.ivz.si/javne_datoteke/datoteke/798-Epidemiološko_spremljanje_nalezljivih_bolezni_2003.pdf> Accessed 28.01.07.
- Jay, L. S., Comar, D., & Govenlock, L. D. (1999). A national Australian food safety telephone survey. *Journal of Food Protection*, 62, 921–928.
- Johnson, A. E., Donkin, A. J. M., Morgan, K., Lilley, J. M., Neale, R. J., Page, R. M., et al. (1998). Food safety knowledge and practice among elderly people living at home. *Journal of Epidemiology and Community Health*, 52(11), 745–748.
- Jones, M. V. (1998). Application of HACCP to identify hygiene risks in the home. *International Biodeterioration & Biodegradation*, 41, 191–199.
- Kaiser, L. L., & Lindsay, A. (2002). Position of the American Dietetic Association: Nutrition and lifestyle for a healthy pregnancy outcome. *Journal of the American Dietetic Association*, 102(10), 1479–1490.
- Kendall, P. A., Elsbernd, A., Sinclair, K., Schroeder, M., Chen, G., Bergmann, V., et al. (2004). Observation versus self-report: validation of a consumer food behavior questionnaire. *Journal of Food Protection*, 67(11), 2578–2586.
- Kennedy, J., Jackson, V., Blair, I. S., McDowell, D. A., Cowan, C., & Bolton, D. J. (2005). Food safety knowledge of consumers and the microbiological and temperature status of their refrigerators. *Journal of Food Protection*, 68(7), 1421–1430.
- Leitch, I., Blair, I. S., & McDowell, D. A. (2001). The role of environmental health officers in the protection of allergic consumers. *International Journal of Environmental Health Research*, 11, 51–61.
- Li-Cohen, A. E., & Bruhn, C. M. (2002). Safety of consumer handling of fresh produce from the time of purchase to the plate: a comprehensive consumer survey. *Journal of Food Protection*, 65(8), 1287–1296.
- Likar, K., & Jevšnik, M. (2006). Cold chain maintaining in food trade. *Food Control*, 17, 108–113.
- Marklinder, I. M., Lindblad, M., Eriksson, L. M., Finnson, A. M., & Lindqvist, R. (2004). Home storage temperatures and consumer handling of refrigerated foods in Sweden. *Journal of Food Protection*, 67, 2570–2577.
- McCabe-Sellers, B. J., & Beattie, S. E. (2004). Food safety: Emerging trends in foodborne illness surveillance and prevention. *Journal of the American Dietetic Association*, 104(11), 1708–1717.
- Meer, R. R., & Misner, S. L. (2000). Food safety knowledge and behaviour of expanded food and nutrition education program participants in Arizona. *Journal of Food Protection*, 63, 1725–1731.
- Oosterom, J. (1998). The importance of hygiene in modern society. *International Biodeterioration and Biodegradation*, 41(3), 185–189.
- Patil, S. R., Cates, S., & Morales, R. (2005). Consumer food safety knowledge, practices, and demographic differences: Findings from a meta-analysis. *Journal of Food Protection*, 68(9), 1884–1894.
- Patil, S. R., Morales, R., Cates, S., Anderson, D., & Kendal, D. (2004). An application of meta-analysis in food safety consumer research to evaluate consumer behaviours and practices. *Journal of Food Protection*, 67(11), 2587–2595.
- Raspor, P. (2004). Current viewpoint on food safety. In L. Gašperlin, & B. Zlender (Eds.), *Food safety, 22nd Food technology days 2004 dedicated to Prof. F. Bitenc, 18 and 19 of March 2004, Radenci, Biotechnical Faculty, Ljubljana* (pp. 1–14).
- Raspor, P., Jevšnik, M., & Hlebec, V. (2006). Consumers' awareness of food safety from shopping to eating. In Bánáti, D. (Ed.), *Nutrition and Food Safety* (pp. 112). Brussels, Consortium International Congress on Food Safety, The Safe Consortium.
- Redmond, E. C., & Griffith, C. J. (2003). Consumer food handling in the home: a review of food safety studies. *Journal of Food Protection*, 66(1), 130–161.
- Redmond, E. C., & Griffith, C. J. (2004). Consumer perceptions of food safety risk, control and responsibility. *Appetite*, 43, 309–313.

- Sammarco, M. L., Ripabelli, G., & Grasso, G. M. (1997). Consumer attitude and awareness towards food-related hygienic hazards. *Journal of Food Safety*, 17, 215–221.
- Schuchat, A. (1997). Listeriosis and pregnancy: Food for thought (A Guest Editorial). *Obstetrical and Gynecological Survey*, 52(12), 721–722.
- Scott, E. (1996). Foodborne disease and other hygiene issues in the home. *Journal of Applied Bacteriology*, 80, 5–9.
- Scott, E., Bloomfield, S. F., & Barlow, C. G. (1982). An investigation of microbial contamination in the home. *The Journal of Hygiene*, 89, 279–293.
- Smith, J. L. (1999). Foodborne Infections during pregnancy. *Journal of Food Protection*, 62(7), 818–829.
- Unusan, N. (2007). Consumer food safety knowledge and practices in the home in Turkey. *Food Control*, 18(1), 45–51.
- Verbeke, W., & De Bourdeaudhuij, I. (2007). Dietary behaviour of pregnant versus non-pregnant women. *Appetite*, 48, 78–86.
- Voelker, R. (2002). Listeriosis outbreak prompts action—finally. *JAMA*, 288(21), 2675–2676.
- Woodburn, M. J., & Raab, C. A. (1997). Household food preparers' food-safety knowledge and practices following widely publicized outbreaks of foodborne illness. *Journal of Food Protection*, 60(9), 1105–1109.
- Yang, S., Angulo, F. J., & Altekruze, S. F. (2000). Evaluation of safe food-handling instructions on raw meat and poultry products. *Journal of Food Protection*, 63(10), 1321–1325.

2.1.7 Tveganja na poti od polja do mize

Food safety hazards from field to fork

Mojca Jevšnik, Peter Raspor

Posvetovanje Varna in zdrava hrana na mizi potrošnika, zbornik z recenzijo (2007).
Ljubljana, Visoka šola za zdravstvo: 21-34.

Health care is one of the most important goals in the developed countries. It is tightly linked to healthy and safe foods and nutrition. The aim of the article is to present barriers, which weaken HACCP system efficiency and to determine the actual state of food safety management in all stages of the food supply chain. To obtain required data different quantitative and qualitative methodological approaches were used. The results of meta-analysis of the selected scientific papers have shown that almost half of the barriers to HACCP system efficiency are connected with the human factor. In different stages of the food supply chain, structured and unstructured interviews, questionnaires, observation of the working environments and objective method of hygiene estimation were used to determine the factors that influence the behaviour of food handlers. Barriers are connected to organisational climate in a company, job satisfaction, working conditions and relationships between co-workers and their supervisors. Deficiencies in understanding and controlling microbiological hazards were found out in all the analyzed stages of the chain. Food handlers do not always follow good food-handling practices. This indicates the need to change current training techniques and points out the lack of trained and competent experts in the discussed field. Consumers are not sufficiently informed about food safety assurance at home. Reliable information, information method and continuity of the latter is essential for better awareness off all included in the food supply chain. Holistic mastering of food safety needs to integrate all the good practices in a unified system. The proposed Good Nutritional Practice strategy combines all good practice systems, puts a consumer in an equal position and clearly defines a new hazard dimension, the so-called human factor, in food safety assurance.

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

Tveganja na poti od polja do mize

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IZVLEČEK

Skrb za zdravje ljudi je danes eden izmed glavnih ciljev razvitih dežel in je v neposredni povezavi z zagotavljanjem zdravih in varnih živil in prehrane. Namen dela je iz dokumentacijskih virov analizirati ovire, ki slabijo učinkovitost sistema HACCP in ugotoviti dejansko stanje obvladovanja varnosti živil na posameznih stopnjah živilsko/prehransko/oskrbovalne verige. V ta namen so bili uporabljeni različni metodološki pristopi, tako kvantitativni kot kvalitativni. Z metodo meta-analize smo ugotovili, da je skoraj polovica ovir za učinkovitost sistema HACCP vezanih na človeški faktor. V posameznih stopnjah verige smo z anketno raziskavo, strukturiranimi in ne strukturiranimi intervjuji, opazovanjem delovnega procesa in objektivno metodo preverjanja higienskega stanja ugotovili dejavnike, ki pomembno vplivajo na vedenje zaposlenih pri delu z živili in so povezani z organizacijsko klimo, ki vlada v podjetju, stopnjo zadovoljstva z delom in delovnimi pogoji ter z medosebnimi odnosi zaposlenih na delovnem mestu. Ugotovljene so bile pomanjkljivosti pri razumevanju predvsem mikrobioloških tveganj tako med zaposlenimi pri delu z živili kot pri potrošnikih. Zaposleni pri delu z živili ne delajo vedno skladno z zahtevami dobrih praks, kar nakazuje potrebo po reorganizaciji sedanjega načina usposabljanja in opozarja na pomanjkanje usposobljenih, kompetentnih strokovnjakov na obravnavanem področju. Potrošniki so nezadostno informirani o načelih varne priprave hrane doma. Verodostojnost informacij, način informiranja ter kontinuiteta le-tega je temeljnega pomena za dvig osveščenosti vseh, ki smo v živilsko/prehransko/oskrbovalni verigi. Za celovito obvladovanje varnosti živil je zato potrebno integrirati vse dobre prakse v obvladljiv sistem. Predlagana Dobra Prehranska Praksa, ki vključuje in obravnava potrošnika kot enakopravnega partnerja v živilsko/prehransko/oskrbovalni verigi, je dobra rešitev.

Ključne besede: varnost živil, sistem HACCP, dobre prakse, tveganja, potrošnik

IZHODIŠČA

Zagotavljanje varnih živil potrošniku je v obdobju globalizacije, spremenjenega načina življenja in prehranjevanja odgovornost in stalna naloga tako razvitih kot nerazvitih držav. Razumevanje pojma varnost živil se razteza od tehnologije do zakonodaje in od prehranbenika do potrošnika živil (Raspor, 2004). Odgovornost za varnost živil si delijo nosilci živilske dejavnosti, država in potrošniki. Krovni dokument, ki v Evropski uniji (EU) ureja področje varnosti živil, je Bela knjiga o varnosti živil iz leta 2000. Razvejana

horizontalna in vertikalna zakonodaja s področja varnosti živil predstavlja obsežen del v evropskem pravnem redu. Strateški dokumenti v zvezi s prehransko politiko EU poudarjajo pomen zagotavljanja varne hrane vzdolž celotne živilske verige »od polja do krožnika« po načelu sledljivosti (Resolucija, 2005).

Po ugotovitvah številnih raziskav je zagotavljanje varnih živil najbolj problematično v enotah njene priprave in distribucije, še posebej v malih in srednje velikih podjetjih (Walker in Jones, 2002; Walker in sod., 2003; Walczak in Reuter, 2004; Sun in Ockerman, 2005; Jevšnik in sod., 2007). Kot je znano, primernost in usposobljenost ljudi, ki sistem vzpostavijo, tistih, ki z njim upravljajo in tistih, ki ga nadzirajo vpliva na učinkovitost sistema v praksi (Khandke in Mayes, 1998; De Winter, 1998; Mortimore, 2001; Azanza in Zamora-Luna, 2005). Za obvladovanje sistema HACCP, posebej v malih in srednje velikih podjetjih je potrebna reorganizacija načina usposabljanja in poudarek na ugotavljanju implicitnih predstav človeka, ne glede na to, kje posameznik vstopi v živilsko/prehransko/oskrbovalno verigo (Jevšnik in sod., 2004; Jevšnik in sod., 2006; Jevšnik in sod., 2007a).

Dosedanje raziskave so pokazale, da smo ob hkratnem poudarjanju učinkovitosti sistema HACCP (Ropkins in Beck, 2000; Konecka-Matyjek in sod., 2005), priča številnim medijsko odmevnim aferam o zastrupitvah s hrano doma in drugod po svetu (IVZ, 2005; Sun in Ockerman, 2005; Walczak in Reuter, 2004; Aycicek in sod., 2004). Podatki o zdravstveni ustreznosti živil, zbrani na osnovi rednega programiranega uradnega nadzora nad živili v javnih zdravstvenih ustanovah in na osnovi prijavljenih alimentarnih epidemij, kažejo, da kot najpogostejši vzrok zdravstvene neustreznosti živil v Republiki Sloveniji prevladuje mikrobiološka onesnaženost živil, medtem ko prekomerna kemična onesnaženost zaenkrat še ne predstavlja večjega zdravstvenega problema (Resolucija, 2005). V zadnjih desetih letih je bilo v Sloveniji 10.000 do 20.000 primerov črevesnih nalezljivih bolezní letno, kar je primerljivo s pogostnostjo prijav v sosednjih državah (Smole Možina in Hočevar Grom, 2004). V ZDA poročajo, da vsako leto zboli 76 milijonov ljudi (Tauxe, 2002), v Angliji pa 9.4 milijone (Walker in sod., 2003) za boleznimi povzročenimi s hrano. Kolikšen pa je delež neprijavljenih obolenj? Med črevesnimi boleznimi znane etiologije so najpogostejše salmoneloze, kampilobakterioze in rotavirusni enteritisi (Smole Možina in Grom, 2004; Sun in Ockerman, 2005).

Iz poročil o številu prijavljenih zastrupitev s hrano posledično izhaja potreba po iskanju vzrokov za neobvladovanje obstoječega sistema za zagotavljanje varnosti živil. Vprašanje je ali je naraščanje bolezní povzročenih s hrano paradoks ali neuspeh sistema HACCP (Motarjemi in Käferstein, 1999; Wallace in Williams, 2001). Avtorji z različnimi metodološkimi pristopi raziskujejo možne vzroke, ki ovirajo učinkovito implementacijo sistema v praksi, vendar si niso povsem enotni o vzrokih za njegovo neobvladovanje (Azanza in Zamora-Luna, 2005; Taylor in Taylor, 2004a; Taylor in Taylor, 2004b; Henroid in Sneed, 2004; Ramirez-Vela in Martin-Fernandez, 2003). Problematika zagotavljanja varnosti živil je v različnih enotah živilsko/prehransko/oskrbovalne verige obravnavana v številnih delih, vendar parcialno. Slednje odpira raziskovalno vprašanje o celoviti analizi vzrokov za nedoseganje zelene stopnje varnosti v verigi od polja do mize, z obstoječim konceptom.

Pri delu smo izhajali iz predpostavke, da je sistem HACCP primeren, ker je napisan v obliki strategije, ki omogoča individualni pristop izgradnje sistema v posameznih enotah

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

verige. Menimo, da problem v znanju zaposlenih, ki v kritičnih razmerah ne dosega zadovoljivega nivoja obvladovanja postopkov za zagotavljanje varnih živil. Zato je bil namen raziskave iz dokumentacijskih virov analizirati ovire, ki slabijo učinkovitost sistema HACCP in ugotoviti dejansko stanje obvladovanja varnosti živil na posameznih stopnjah živilsko/prehransko/oskrbovalne verige, vključno s potrošnikom.

METODE

Z metodo meta-analize smo analizirali vsebinske in metodološke značilnosti dokumentacijskih virov, ki raziskujejo ovire za učinkovitost sistema HACCP. Dokumentacijske vire smo iskali s kombinacijo ključnih besed: »HACCP in ovire in vzpostavitev«. Vsebinski kriterij za vključitev enote analize je pogojeval delo, ki obravnava ovire za učinkovito implementacijo sistema HACCP. Metodološki kriterij pa tipologijo virov, in sicer, da ima delo značaj izvirnega raziskovalnega dela z definiranim metodološkim pristopom po shemi IMRAD (Introduction, Methods, Results, Analysis, Discussion). Z oblikovanjem izključevalnih kriterijev smo neustrezna dela izključili iz nadaljnje analize, in sicer dela, pri katerih nismo prepoznali ovir pri implementaciji in/ali izvajanju dela po sistemu HACCP, neustrezna dela glede na vsebino in/ali tip dela, strokovna dela ter poljudna dela (osebna mnenja, dnevno časopisje, poljudne serijske publikacije, itd.). Z upoštevanjem izključevalnih kriterijev je bilo v meta-analizo vključenih dvanajst publiciranih znanstveno raziskovalnih del, katere smo analizirali in primerjali glede na metodološke in vsebinske kriterije. Strokovne vire, ki so zadostili vsebinskim kriterijem, smo obravnavali ločeno zaradi njihove metodološke šibkosti.

V posameznih stopnjah verige smo z anketno raziskavo preverili dejansko stanje obvladovanja varnosti živil. Za namene raziskave smo oblikovali tri različno strukturirane anketne vprašalnike, prilagojene pridelovalcem in predelovalcem, zaposlenim pri delu z živilom ter potrošnikom. Vsebinsko so bili vprašalniki razdeljeni na različne sklope. V strukturiranem vprašalniku, ki smo ga po pošti poslali vsem registriranim pridelovalcem zelja in kisarjem v Sloveniji ($n = 112$) so bila vprašanja razdeljena v štiri skupine. S prvo skupino vprašanj smo ugotavljali usposobljenost in seznanjenost anketiranih z dobro kmetijsko prakso (DKP), dobro higiensko prakso (DHP) in sistemom HACCP. Z drugim delom vprašalnika smo želeli ugotoviti kako so se dobre prakse in sistem HACCP integrirali v njihov način dela. Ali kmetje poznajo in upoštevajo načela DKP pri svojem delu smo ugotavljali s tretjim delom vprašalnika. V četrtem delu pa smo ugotavljali kje so po mnenju kisarjev tveganja, katera morajo obvladovati za proizvodnjo varnega izdelka in kakšno je njihovo mnenje o sistemu HACCP oz. kakšen pomen ima sistem pri obvladovanju tveganj v njihovi proizvodnji.

Za boljše in celovitejše razumevanje obravnavanega področja smo izvedli tudi deset ne strukturiranih intervjujev. Vključitev kvalitativnih metod omogoča poglobljen uvid v doživljanje in pojmovanje preučevanega pojava. Na ta način smo lahko izpostavili pojmovanje in doživljanje varnosti živil med kisarji. S kvalitativnega zornega kota je bila izvedena deskriptivna analiza, ki svoje osnove črpa iz utemeljene teorije (Strauss, 1996). Z ne strukturiranimi intervjuji (Gilling in sod., 2001) smo želeli ugotoviti kaj je za pridelovalce zelja in kisarje najbolj pomembno za varnost končnega izdelka, na poti od sadike do kislega zelja.

V kvantitativni raziskavi med zaposlenimi ($n = 386$) pri delu z živili, in sicer v industrijski proizvodnji kislega zelja, na turističnih kmetijah in v trgovinah z živili smo z anketnim vprašalnikom ugotavljali znanje o varnosti živil, odnos do zagotavljanja varnosti živil, stopnjo motivacije in zadovoljstva z delom.

S kvotnim vzorcem potrošnikov ($n = 1030$) smo ugotavljali znanje in zavedanje le-teh do zagotavljanja varnosti živil in njihovo ravnanje med nakupom, transportom in pri pripravi živil doma. V ta namen je bil pripravljen anketni vprašalnik, ki je vključeval vprašanja o načinu priprave živil doma, poznavanju mikrobioloških tveganj in odnosu do varnosti živil na splošno.

V raziskavi, ki je vključevala kombinacijo kvalitativne in kvantitativne metodologije smo želeli ugotoviti higiensko tehnično stanje v izbranih prehranskih objektih ($n = 100$), oceniti higiensko zavest zaposlenih, s poudarkom na opazovanju vključevanja zaposlenih v delovni proces (tehnika in pogostost umivanja rok) ter objektivno oceniti snažnost objektov z odvzemom mokrih brisov na snažnost. Raziskava je bila metodološko in terminsko razdeljena na dva dela. V prvem delu je sodelovalo sto naključno izbranih prehranskih objektov v Ljubljani (petdeset malih in petdeset srednje velikih). Med spremljajočimi higienskimi programi smo, s pomočjo opazovalne liste, ocenjevali le elemente dobre proizvodne prakse, ki se nanašajo na higiensko tehnične zahteve za prostore, namenjene zaposlenim (umivalnik za umivanje rok, sanitarije, prostor za čistila in čistilne pripomočke) ter elemente dobre higienske prakse, ki se nanašajo na zaposlene pri delu z živili (znanje, zdravje, osebna higiena, vključevanje v delovni proces). Opazovalno listo smo izdelali na podlagi veljavnih zakonskih in podzakonskih pravnih aktov, strokovne doktrine, literature na področju varnosti živil ter izkušenj, pridobljenih s pogostim opazovanjem okolja raziskovanja. Z namenom preverjanja ustreznosti opazovalne liste smo pred pričetkom raziskave izvedli poskusno opazovanje v dveh objektih. Ugotovljene pomanjkljivosti smo nato dodali v opazovalno listo. V drugem delu raziskave so bili odvzeti mokri brisi na snažnost ali odtisi iz vnaprej določenih čistih delovnih površin (deska za zelenjavo, deska za kuhano meso, deska za kruh, mesoreznica, delovna površina, kaseta za jedilni pribor in stena priročnega hladilnika) v petdesetih prehranskih objektih iz prvega dela (petindvajsetih malih in petindvajsetih srednje velikih prehranskih objektih), ki so privolili k sodelovanju v drugem delu raziskave.

Analiza rezultatov je bila opravljena s pomočjo programskih orodji Microsoft Excel in SPSS 13.0.

REZULTATI IN RAZPRAVA

Z namenom oblikovanja strategije celovitega zagotavljanja varnosti živil smo s kombiniranim metodološkim pristopom ugotavljali in vrednotili vzroke neučinkovitosti sistema HACCP, kot jih opisujejo avtorji znanstvenih in strokovnih del. Zaradi obsežnosti raziskave so v nadaljevanju predstavljeni le nekateri pomembnejši rezultati.

Z metodo meta-analize smo ugotavljali ovire, ki jih navajajo avtorji znanstvenih del, glede učinkovitosti sistema HACCP v enotah živilsko/prehransko/oskrbovalne verige. Raziskave smo razdelili v tri skupine, in sicer na kvantitativne, kvalitativne in kombinirane (kombinacija metodoloških pristopov). Ugotovili smo, da so v znanstvenih delih večinoma zastopane kvantitativne metode, vendar je sploh v zadnjem času zaznati trend uporabe kvalitativne metodologije, za analizo individualnih doživljanj posameznika. Samo v dveh

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

delih smo ugotovili metodološko zahtevnejši pristop, in sicer kombinacijo kvantitativnih in kvalitativnih metod, kar omogoča avtorjem kompleksnejšo poglobitev v obravnavano problematiko. Izbira primerne metodološke pristopa in metodološkega orodja je pomembna za pridobitev relevantnih podatkov, ki nam omogočajo vpogled v problematiko raziskovane tematike. Pri analizi izbranih znanstveno raziskovalnih del ugotavljamo, da avtorji ne upoštevajo dosledno vseh zakonitosti izbranega metodološkega procesa (npr. opis načina vzorčenja, vrednotenje realiziranega vzorca). Dobra plat kvantitativnih raziskav pa je možnost uporabe njihovih izsledkov na širši populaciji, ob ustrezno izbranem vzorcu in načinu vzorčenja. Smiselnost kombinacije je bila in je še predmet mnogih razprav tudi v Sloveniji. Doprinos uporabe kvalitativnih metod je v tem, da nam omogočajo poglobljen uvid v doživljanje in pojmovanje preučevanega pojava. Omogočajo torej vključitev individualnih izkušenj (Domajnko in sod., 2006). To pomeni, da je potrebno uporabiti kombinacijo obeh pristopov, da bi si ustvarili čimbolj celovito sliko o proučevani problematiki tako z zornega kota statistike kot analize tekstov. Avtorji, ki so uporabljali izključno kvalitativno analizo prav tako pomembno prispevajo k nadaljnji osvetlitvi raziskovanega področja. Izkazalo se je, da kljub obširnim kvantitativnim analizam še vedno ni zaslediti konkretnih rešitev oziroma ustreznih smernic za reševanje ugotovljenih ovir pri implementaciji sistema HACCP oziroma obvladovanju varnosti živil na različnih stopnjah verige.

S kvalitativno analizo, in sicer s poglobitvijo v doživljanje in delovanje človeka v družbenem okolju so avtorji (Karalis in Gupta, 2001; Taylor in Taylor, 2004a; Taylor in Taylor, 2004b; Eves in Dervisi, 2005) poskušali zapolniti vrzel v dosedanjih poskusih iskanja ovir na omenjenem področju. Pomembnost vključitve kvalitativnega pristopa preučevanja problematike je predvsem v njegovi sposobnosti prodreti v globino človekovega razumevanja sistema HACCP ali širše, zahtev glede obvladovanja varnosti živil, česar s kvantitativnimi metodami ne moremo zadovoljivo vrednotiti.

V nadaljevanju smo sistematično in izčrpno analizirali vsebinsko strukturo izbranih dvanajstih del. Enota proučevanja je bilo posamezno besedilo kot celota, analiza pa je bila intenzivna oziroma globinska. Dela smo primerjali po vnaprej določenih kriterijih, s pomočjo katerih smo prepoznavali namene raziskav, navedene ovire za uspešno implementacijo sistema HACCP in predlagane ukrepe. Ugotovili smo, da je bil namen vseh izbranih raziskav prepoznati ovire pri implementaciji sistema HACCP, pri čemer so bila izhodišča avtorjevih raziskav različna. Raziskave obravnavajo problematiko dokaj splošno, kar lahko pripišemo relativno kratkemu času od smernic oziroma priporočil do zakonske zahteve po uvedbi sistema HACCP, tako doma kot drugod po svetu. Predvidevamo, da se bodo nadaljnje raziskave osredotočile na kompleksnejše definiranje in reševanje prepoznanih ovir. Korak v tej smeri so že naredili Walker in sod. (2003), ki so proučevali zgolj znanje higiene pri zaposlenih v malih prehranskih podjetjih. Podrobnejša analiza omenjene ovire nudi kompleksnejši vpogled v ocenitev obstoječega znanja pri zaposlenih z živili, vendar ne ponuja konkretnih rešitev za odpravo ugotovljenih pomanjkljivosti.

Dela z opisom strokovne tematike smo izključili iz meta-analize in jih obravnavali ločeno, ker so bila metodološko šibka in so izpolnjevala le vsebinski kriterij. Pri proučevanju učinkovitosti sistema HACCP avtorji sedmih strokovnih del razpravljajo o ovirah, ki slabijo osnovni namen sistema HACCP. Njihove praktične izkušnje in komentiranje ugotovitev skozi pregled literature na obravnavanem področju odražajo njihov kritični pogled na ovire, ki pestijo predvsem mala in srednje velika prehranska podjetja.

Mojca Jevšnik in Peter Raspor. Tveganja na poti od polja do mize

Primerjava ovir pri implementaciji sistema, kot jih navajajo avtorji strokovnih in avtorji znanstvenih del je nemogoča, saj avtorji v strokovnih delih razpravljajo o ovirah in jih ne rangirajo po pomembnosti. Medtem ko avtorji znanstvenih člankov z različnimi metodološkimi orodji raziskujejo vrste ovir in njihove vzroke ter jih predstavijo po pomembnosti glede na ugotovitve raziskav.

Vsebinska analiza znanstvenih del o vzrokih ovir pri implementaciji sistema HACCP je pokazala, da imata največji faktor vpliva na neučinkovitost sistema HACCP oviri nezadostno usposabljanje zaposlenih in človeški viri. Sledijo ovire: načrtovanje, znanje in kompetence, dokumentacija in drugi viri. Tudi pri vsebinski analizi izbranih strokovnih del smo ugotovili, da pripisujejo avtorji največjo oviro za učinkovito implementacijo sistema HACCP virom, tako človeškim kot tudi ostalim (npr. pomanjkanju časa in denarja ter visokim stroškom izobraževanj in usposabljanj).

Pri prepoznavanju in razvrščanju ovir za učinkovito implementacijo sistema HACCP smo po večkratnem razvrščanju in poglobljeni analizi ovir ugotovili, da uporabljajo avtorji različne termine za vsebinsko in pomensko sorodne ovire, kar je oviralo njihovo razvrščanje in nadaljnjo sistematično obravnavo. Ugotavljamo, da je potrebno v strokovnih krogih vzpostaviti enoten način razvrščanja vsebinsko in pomensko sorodnih ovir. Korak v tej smeri smo naredili s prikazom novega koncepta terminološke klasifikacije ovir, ki temelji na 21 elementih, rangiranih po faktorju vpliva na učinkovitost sistema HACCP. Za preverjanje ustreznosti klasificiranja in globljega razumevanja obravnavane problematike smo s pomočjo relevantne strokovne literature širše orisali pomen posameznega elementa. S tem smo odprli pot razvoju nove dimenzije kvalitativne obravnave vsebin na področju varnosti živil.

S pregledom literature smo s teoretičnega zornega kota potrdili predpostavko, da znanje zaposlenih ne dosega nivoja obvladovanja vseh postopkov pri zagotavljanju varnega živila. Teoretično spoznanje smo želeli v nadaljevanju potrditi tudi z uporabo kombiniranega metodološkega pristopa v različnih enotah verige. S kvantitativno raziskavo med zaposlenimi pri delu z živili ($n = 386$) v treh različnih enotah živilsko/prehransko/oskrbovalne verige smo ugotavljali znanje o varnosti živil, odnos do zagotavljanja varnosti živil, motivacijo in zadovoljstvo z delom.

Rezultati kažejo, da so interna izobraževanja, ki jih pripravijo strokovnjaki v podjetju večini anketiranih najboljša oblika pridobivanja oziroma obnavljanja znanja o higieni živil. Ugotovili smo, da je znanje zaposlenih pomanjkljivo predvsem na področju poznavanja in preprečevanja mikrobioloških tveganj. Na primer več kot polovica (64%) anketiranih meni, da rastejo mikroorganizmi v hladilnih napravah zelo počasi. Med njimi je značilno manj trgovcev kot proizvajalcev. Kar 23.4% vprašanih pa meni, da mikroorganizmi v hladilnih napravah odmrejo, med njimi je več trgovcev kot gostincev in proizvajalcev. V raziskavi Walker in sod. (2003) je 21% vprašanih mnenja, da se z zamrzovanjem uničijo vse bakterije, le 63% pa jih pozna temperaturo v domačem hladilniku. Panisello in Quantick (2001) sta kot problem nezadostnega znanja v malih objektih navedla pomanjkanje notranja izobraževanja in strokovnega kadra, ki bi proučil dejanska tveganja ter glede na ugotovitve vzpostavil sistem HACCP. Ugotovili smo tudi nekatera nasprotja, kot npr. večina (81.8%) vprašanih meni, da je merjenje središčne temperature jedi med toplotno obdelavo pomembno, da vemo kdaj se v živilu uničijo škodljivi mikroorganizmi. Četrtna anketiranih pa ne pozna temperature za vzdrževanje toplotno obdelanih jedi, med njimi je

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

značilno manj gostincev kot trgovcev in proizvajalcev, kar je primerljivo z rezultati Baš in sod. (2006) ter Walker in sod. (2003).

Med higienskimi kršitvami pri delu z živili, ima po mnenju večine zaposlenih največji vpliv na varnost živil ne umivanje rok po uporabi sanitarij (93.2%). Velik vpliv ima po njihovem mnenju tudi uporaba nenamenskega delovnega pribora (67.5%) in nedosledna kontrola temperature v hladilnih napravah (57.6%). Ugotovljeno je, da se zaposlenimi pri delu z živili zavedajo pravil higienskega obnašanja, vendar se po mnenju 63% anketiranih vedno ne vedejo skladno z njimi (Clayton in sod., 2002). Prav tako zaposleni veliko pogosteje poročajo, da dosledno izvajajo dobre prakse, še posebej umivanje rok, kot pa jih dejansko v praksi tudi izvajajo (Manning in Snider, 1993).

S tretjim delom vprašalnika, ki je bil sestavljen iz štirih lestvic, smo merili splošno počutje zaposlenih v podjetju, in sicer zadovoljstvo z delom, odnos sodelavcev do zaposlenih, odnos nadrejenih do zaposlenih in dejavnike motivacije za delo. Trditve so bile postavljene v prvi osebi ednine, z namenom ugotavljanja subjektivnega vidika splošnega počutja zaposlenih v podjetju. Anketirani so nanje odgovarjali s petstopenjsko ocenjevalno lestvico od 1 do 5, kjer 1 pomeni sploh ne, 5 pa zelo. Najvišjo stopnjo strinjanja iz prvega sklopa trditvev smo ugotovili pri trditvah, ki se nanašajo na zadovoljstvo z izbranim poklicem in delom v aktualnem podjetju. Ugotovili smo, da bi zaposleni ponovno izbrali podjetje v katerem so zaposleni, če bi se še enkrat odločili za isti poklic, vendar se s to trditvijo strinja značilno več trgovcev kot proizvajalcev. Manj pozitivne so trditve, ki se nanašajo na sedanjo plačo in zanimivost sedanjega dela ter odločitvijo o pogovoru s sodelavci in nadrejenimi o problemih na delovnem mestu. Značilno manj gostincev in prodajalcev ($p < 0.001$) bi zapustilo sedanje podjetje, če bi jim kje drugje ponudili višjo plačo ali bolj zanimivo delo. Značilno več gostincev bi še enkrat izbralo isti poklic v primerjavi s trgovci ($p = 0.033$) in proizvajalci ($p = 0.007$). O osebnih problemih anketirani večinoma ne razpravljajo s sodelavci oziroma nadrejenimi. Tudi tekmovalnost med zaposlenimi ni prisotna. Glavna ovira pri izvajanju dela po zahtevah za varnost živil je po ugotovitvah Clayton in sod. (2002) časovna stiska in premalo zaposlenih, sledijo pa ovire kot npr. potreba po boljši opremljenosti delovnega prostora, premalo sredstev in prepoznavanje problemov med vodilnimi. Roberts in Sneed (2003) omenjata, da je določitev pooblastil zaposlenim v gostinstvu vplivala na večje upoštevanje zahtev dobrih praks. Nedvomno pa je uspeh pri uvedbi in izvajanju sistema HACCP po navedbah Panisello in Quantick (2001) v podjetjih odvisen od tega, katerim od štirih temeljnih gradnikov (pripadnost, izobraževanje in usposabljanje, razpoložljivost sredstev in zunanji pritisk), namenja podjetje prednost in kako so organizirani. Primerjava povprečnih razlik med skupinami v naši raziskavi je pokazala, da so proizvajalci značilno manj ($p < 0.01$) kot gostinci in trgovci zadovoljni s svojim delom, z možnostjo napredovanja, s tem kako nadrejeni cenijo in ocenjujejo njihovo delo, z ugodnostmi, ki jim jih nudi podjetje, s svojim položajem na delovnem mestu, z odnosom med njimi in njihovimi nadrejenimi, z delovnimi pogoji in s plačo. Po navedbah Brajše (1996) ni dovolj, da zaposlenim zagotovimo dobro plačo, sodobno tehnologijo, ugodne delovne razmere, zaposlitev, ampak jim je prav tako potrebno priznati, da so uspešni, jim prepustiti odgovornost, jim pomagati, da spoznajo smisel in rezultate svojega dela. Zavedati se je potrebno, da je osnovna celica uspešnosti vsakega podjetja posameznik, ki prispeva k uresničitvi skupne vizije in ciljev podjetja (Zupan, 2001).

V raziskavi, ki je vključevala kombinacijo kvalitativne in kvantitativne metodologije smo ugotavljali higiensko tehnično stanje v izbranih prehranskih objektih, ocenili higiensko

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

zavest zaposlenih, s poudarkom na opazovanju vključevanja zaposlenih v delovni proces (tehnika in pogostost umivanja rok) ter objektivno oceniti snažnost prehranskih objektov z mokrimi brisi na snažnost iz vnaprej določenih odvzemnih mest.

Rezultati raziskave kažejo higiensko tehnične pomanjkljivosti in/ali nepravilnosti tako v malih kot tudi v srednje velikih objektih. Večina srednje velikih objektov je prostorsko omejenih in ni gradbeno-tehnično ustrezno opremljenih za opravljanje prehranske dejavnosti. Podobne ugotovitve navajajo tudi Baš in sod. (2007). Tehnične in higienske pogoje za umivanje rok, smo v malih objektih ocenili kot pomanjkljive in zaskrbljujoče. Ne zanemarljiv delež (14%) malih objektov ne izpolnjuje niti minimalnih higiensko tehničnih pogojev za delo z živili (npr. umivalnika za umivanje rok sploh ni ali pa je le-ta neustrezno nameščen, tako da ne preprečuje križanja čistih in nečistih poti; neustrezni in dotrajani materiali ne onemogočajo učinkovitega čiščenja in vzdrževanja, itd.). V nekaterih srednje velikih objektih je oprema kuhinj dotrajana, kar onemogoča učinkovito higiensko vzdrževanje. Aarnisalo in sod. (2006) so s pregledom rezultatov številnih študij ugotovili, da je lahko oprema v živilsko/prehranskih objektih vir onesnaženja s patogenimi mikroorganizmi (npr. z *Listeria monocytogenes*). Zato je zelo pomemben že sam proces projektiranja celotnega objekta in vseh pripadajočih prostorov, ki morajo biti zadostni, gradbeno tehnično primerno zasnovani, zagotavljati morajo enosmernost od nečistega k čistemu in biti morajo ergonomsko primerno zasnovani za zaposlene.

Z opazovanjem zaposlenih med izvajanjem delovnega procesa smo ugotovili, da si večina zaposlenih v obeh skupinah objektov ne umije rok po vsakem nečistem opraviilu (npr. ko prehajajo iz nečiste na čisto fazo dela, po rokovanju z embalažo, itd.) ali si jih ne umijejo dovolj učinkovito (npr. brez uporabe tekočega mila, površna tehnika umivanja rok, itd.). Henroid in Sneed (2004) navajata, da si 33% zaposlenih v šolskih kuhinjah v ZDA ne umije rok vedno, kadar je to potrebno. Roke zaposlenih pri delu z živili so lahko ključni vektor prenosa povzročiteljev bolezni povzročenih s hrano zaradi nezadostne in/ali pomanjkljive higiene ali navzkrižne kontaminacije (Setiabudhi in sod., 1997). Taylor in sod. (2000) so ugotovili prenos enteropatogenih mikroorganizmov zaradi neustrezne higiene rok po uporabi sanitarij v območja priprave živil.

Na podlagi rezultatov mikrobiološke ocene snažnosti delovnih površin, naprav ter rok zaposlenih smo v malih objektih ugotovili slabše higiensko stanje. Število poraslih bakterijskih vrst je bilo značilno večje kot v srednje velikih objektih. Za vestno izvajanje načel osebne higiene ni pomembno v katerem prehranskem objektu so ljudje zaposleni, pač pa je to odvisno predvsem od higienske zavesti in vzgojenosti posameznika. Z rezultati potrjujemo predpostavko, da znanje zaposlenih v kritičnih razmerah ne dosega nivoja obvladovanja vseh postopkov pri zagotavljanju varnega živila in da prihaja do nedopustnega odstopanja v sistemu HACCP v kritičnih razmerah zaradi človeškega faktorja. Stopnja higienske zavesti je značilna za posameznika, zato je potreben individualen pristop in analiza motivacijskega profila posameznika.

Zaradi kompleksnosti področja varnosti živil smo poleg kvantitativne raziskave izvedli deset ne strukturiranih intervjujev med pridelovalci zelja, ki so hkrati tudi proizvajalci kislega zelja z namenom ugotoviti odnos, stališča in skrbi pri zagotavljanju varnosti živil v pridelavi. Z anketno raziskavo smo ugotovili vpliv pristojnih strokovnih služb (Kmetijsko gozdarske zbornice (KGZ) Republike Slovenije in inšpekcijskih služb) na dokaj dobro stopnjo informiranosti kisarjev o načelih in namenu dobre kmetijske in dobre higienske prakse ter sistemu HACCP. S kvalitativno analizo teksta pa se kaže predvsem

Mojca Jevšnik in Peter Raspor. Tveganja na poti od polja do mize

nezadovoljstvo in razočaranje kisarjev nad omenjenimi službami. Menijo, da je količina in vrsta informacij odvisna od komunikativnosti odgovorne osebe in predvsem od njihovega znanja, ki ga ocenjujejo kot pomanjkljivega. Sistem HACCP ocenjujejo kot delo za inšpektorje. Slednje odpira pomembno vprašanje o usposobljenih in kompetentnih strokovnjakih na obravnavanem področju. Poznavanje področja dela in razumevanje zahtev je bistveno za delo na področju svetovanja in nadzora.

Vodenju evidenc pri proizvodnji kislega zelja so anketiranci pripisali visoko stopnjo pomembnosti, še posebej vodenju evidenc o zdravstvenem stanju zaposlenih in o izvedenem čiščenju (kar potrjuje povprečna ocena nad 4 na ocenjevalni lestvici od 1 do 5). Nekoliko manj pomembno so ocenili vodenje evidenc med postopkom kisanja. Odgovori kisarjev nakazujejo vpliv izobraževanj o zahtevah sistema HACCP, kjer je pomen dokumentiranja izpostavljen in poudarjen. Analiza kvalitativne raziskave pa je pokazala, da predstavlja kisarjem izpolnjevanje obrazcev dodatno delo, v katerem ne vidijo pomena. Saj menijo, da je to potrebno samo zaradi inšpektorjev.

Za varnost končnega izdelka so po mnenju anketiranih pomembni tako higienski kot tehnološki dejavniki, s tem da jim ženske pripisujejo značilno večjo pomembnost ($p < 0.05$) kot moški. Kisarji, ki imajo dokazilo o usposobljenosti za kisanje, dajejo značilno manjši poudarek načelom osebne higiene kot kisarji, ki tega dokazila nimajo ($p < 0.05$). Rezultati nakazujejo poudarek izobraževalnih programov, kateri so očitno bolj usmerjeni v tehnologijo kisanja kot pa v higienske prakse. Rezultati obeh raziskav so enotni glede pomembnosti temperature za proces kisanja. Vendar s kvalitativno raziskavo ugotovimo, da temperatura kisarjem ne predstavlja problema, saj se kisanje izvaja v hladnejšem letnem času. Poudarili so nesmiselnost vodenja evidence temperature, ker že po občutku in organoleptični oceni vedo kakšna je kvaliteta zelja.

Zahteve glede uporabe fitofarmaceutskih sredstev so anketiranim poznane, kar ne preseneča, saj se morajo pridelovalci redno udeleževati zakonsko obveznih usposabljanj in spoštovati zahteve zakonodaje s področja zdravstvenega varstva rastlin in fitofarmaceutskih sredstev. V obeh raziskavah smo ugotovili, da je uporaba fitofarmaceutskih sredstev pogojena z željo po kakovostnem in količinsko večjem pridelku. Kvalitativna analiza je kot problem izpostavila predvsem željo po dodatnem informiranju, saj so postopki priprave raztopin pesticidov kisarjem zahtevni in dostikrat prezapleteni.

Ena izmed ključnih karakteristik obeh raziskav je nedvomno poudarek na higieni, na katero so zelo pozorni in jim je nekako temelj za proizvodnjo kakovostnega in varnega izdelka.

Če primerjamo rezultate kvantitativne in kvalitativne analize lahko vidimo da se dopolnjujejo. Kvalitativna analiza še dodatno poudari nekatera nasprotja (odnos do dela/sistem HACCP, občutek/dokumentiranje) in razlike med laičnim in strokovnim pojmovanjem dejavnikov tveganj na poti od pridelave zelja do kislega zelja. Prav skozi te ugotovitve smo prišli do spoznanja, da je področje varnosti živil potrebno obravnavati celovito, in sicer s kombinacijo kvalitativnih in kvantitativnih metod. Zavedati se moramo, da v vse člene verige od polja do mize vstopa človek, ki potrebuje kompleksno in individualno obravnavo. Higienska zavest posameznika je torej najpomembnejše orodje za zagotavljanje varnosti živil, zato je potrebno obravnavati človeka enakovredno kot ostale dejavnike tveganj.

Skrb za zdravje ljudi je danes eden izmed glavnih ciljev razvitih dežel in je v neposredni povezavi z zagotavljanjem zdrave in varne prehrane. Potrebno se je zavedati dejstva, da so lahko živila onesnažena z različnimi mikroorganizmi in da se lahko njihovo število povečuje na različnih stopnjah od pridelave do predelave in nazadnje pri končni pripravi (Tauxe, 2002). Zato je za zaposlene pri delu z živili izjemnega pomena, da poznajo in razumejo mehanizme mikrobioloških tveganj in načine preprečevanja oziroma obvladovanja le-teh, kar nedvomno velja tudi za zadnji člen živilsko/prehransko/oskrbovalne verige, za potrošnika. Potrošnik pričakuje, da bodo vsi akterji od polja do mize zagotavljali varnost živil, ga izobraževali in sproti obveščali o novostih.

Z anketno raziskavo med potrošniki smo ugotovili, da demografske značilnosti, razen spola, ne vplivajo na odnos anketiranih do parametrov, ki vplivajo na zagotavljanje varnosti živil. Rezultati kažejo, da ocenjuje potrošnik sebe kot najmanj odgovornega med ostalimi akterji živilsko/prehranske verige. Vendar je tega mnenja značilno več moških kot žensk. Ugotovili smo tudi nekatere nepravilnosti pri delu z živili, ki lahko vodijo do zastrupitev s hrano v domačem okolju tako v raziskavi, ki je vključevala potrošnike na splošno (Jevšnik in sod., 2007b) kot v raziskavi, ki je obravnavala rizično skupino potrošnikov – nosečnice (Jevšnik in sod., 2007c). Izkaže se, da je skrb za varnost živil na nekaterih področjih ravnanja z živili večja pri rizični skupini kot pri ostalih anketiranih, kar potrjuje dejstvo, da so ženske v skrbi za svoje zdravje in zdravje otroka bolj dovzetne za tovrstne informacije oziroma se jih zavedajo in pri delu tudi upoštevajo. Slednje je še posebej značilno za mlajše in prvič noseče ženske.

Pri vseh skupinah anketiranih potrošnikov smo ugotovili, da namenjajo najmanj pozornosti preverjanju in zagotavljanju hladne verige hitro pokvarljivih živil. Pri rokovanju z živili doma se kaže nezadostno informiranje potrošnikov glede možnosti navzkrižnega onesnaženja (npr. nepravilno zaporedje pri pripravi živil), postopkov pravičnega tajanja zamrznjenih živil, ohlajanja toplotno obdelanih jedi in ponovnega pogrevanja le-teh ter čiščenja delovnih pripomočkov. Rezultati so primerljivi s podobnimi tujimi študijami (Badrie in sod., 2006; Kennedy in sod., 2005; Surujlal in Badrie, 2004; 2000; Jay in sod. 1999). Tudi glede higienizacije rok so bile ugotovljene nepravilnosti, ki lahko vodijo do zastrupitev pri delu z živili doma, kar je še posebej nevarno za rizično skupino nosečnic. Delež, tistih, ki si med pripravo pravilno umijejo roke je nižji kot so ugotovili avtorji podobnih raziskav, npr. med potrošniki na Irskem (Kennedy in sod., 2005), v Trinidadu (Badrie in sod., 2006) in v Avstraliji (Jay in sod., 1999). Poleg tega je potrebno pri tehniki umivanja rok omeniti tudi čas trajanja umivanja, ki naj ne bi bil krajši od 20 sekund, če želimo, da so roke zadovoljivo čiste (Jay in sod., 1999). Zanimivo je, da potrošnikovo dožemanje varnosti živil ni močno povezano z objektivnimi tveganji (Verbeke in sod., 2007), temveč je bolj povezano s sociološkimi in psihološkimi karakteristikami. Obstaja velik prepad med objektivnimi in znanstveno dokazanimi tveganji in dožemanjem le-teh med potrošniki. Potrošnikova reakcija sledi subjektivnemu dožemanju tveganj, torej tistim, ki jih sami ocenijo kot tveganja.

SKLEP

Glavni dejavnik v krogotoku varnosti živil je človek, ki ima velik, dostikrat neposreden vpliv na zagotavljanje varnosti živil. Zato menimo, da je nujno iskati vzroke ovir za

Mojca Jevšnik in Peter Raspor, Tveganja na poti od polja do mize

učinkovitost sistema HACCP tako v organizacijski in komunikacijski klimi podjetja, kot tudi v kompleksnosti delovanja in dojemanja vsakega posameznika. To pa so področja, ki jih proučujejo tudi družboslovne vede. Zato je kljub, na prvi pogled naravoslovno tehničnim karakteristikam področja živilstva, kjer prevladujejo kvantitativni pristopi nujna vključitev kombiniranih metodoloških orodij in multidisciplinarni pristop, ki vključuje družboslovne vede. Na podlagi ugotovitev sklepamo, da je vstop premalo izobraženega in usposobljenega človeka v delovni proces žarišče problema na področju zagotavljanja varnosti živil. Izhajajoč iz omenjenega dejstva in z namenom uravnoteženja analiziranih sistemov, ki bi se morali celovito osredotočiti na zagotavljanje varnosti živil, je kot rezultat obstoječega stanja predlagan nov pristop, imenovan Dobra Prehranska Praksa (DPP) (Raspor in Jevšnik, 2008). Gre za nov pristop k obvladovanju varnosti živil v živilsko/prehransko/oskrbovalni verigi, ki v cilju zagotavljanja celovite oskrbe potrošnika z zdravstveno ustrezno hrano/živili, temelji na izobraženem in strokovno usposobljenem človeku, ki vstopa v sistem. Prikazana je pomembnost združevanja sedanjih načinov obvladovanja varnosti živil znotraj DPP, ki vključuje potrošnika in združuje vse sisteme, ki ob postavitvi DPP postanejo le podsistemi. Strukturno je DPP predstavljena kot platforma varnosti živil, ki združuje vse podsisteme sedanjih devetih dobrih praks in sistema HACCP ter jasno opredeli novo dimenzijo tveganj pri zagotavljanju varnih živil, t.i. človeški faktor.

LITERATURA

1. Aarnisalo K, Tallavaara K, Wirtanen G, Maiala R, Raaska L (2006). The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. *Food Control* 17: 1001-11.
2. Ayçiçek H, Aydoğan H, Kūçūkkaraaslan A, Baysallar M, Başıstaoğlu AC (2004). Assessment of the bacterial contamination on hands of hospital food handlers. *Food Control* 15: 253-9.
3. Azanza MPV, Zamora-Luna MBV (2005). Barriers of HACCP team members to guideline adherence. *Food Control* 16 (1): 15-22.
4. Badrie N, Gobin A, Dookeran S, Duncan R (2006). Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control* 17: 370-7.
5. Başı M, Şafak A, Kivanç G (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control* 17 (4): 317-22.
6. Başı M, Yuksel M, Cavusoglyu T (2007). Difficulties and barriers for the implementation of HACCP and food safety systems in food businesses in Turkey. *Food Control* 18 (2): 124-30.
7. Brajša P (1996). Sedem skrivnosti uspešnega managementa. Ljubljana: Gospodarski vestnik.
8. Clayton DA, Griffith DJ, Price P, Peters AC (2002). Food handlers' beliefs and self-reported practices. *Int J Environ Health Res* 12: 25-39.
9. De Winter RFJ (1998). The role of interactive workshops in HACCP training in a multinational environment. *Food Control* 9 (2-3): 147-9.

10. Domajnko B, Kvas A, Štrancar K, Bojc N, Pahor M (2006). Živeta interprofesionalna razmetja. V: Sodelovanje med medicinskimi sestrami in zdravniki v zdravstvenem timu: priložnost za izboljšanje kakovosti. Kvas A, Pahor M, Klemenc D, Šmitek J (ur.). Ljubljana: Društvo medicinskih sester, babic in zdravstvenih tehnikov, 235-60.
11. Eves A, Dervisi P (2005). Experiences of the implementation and operation of hazard analysis critical control points in the food service sector. *Hosp Manage* 24: 3-19.
12. Gilling SJ, Taylor EA, Kane K, Taylor JZ (2001). Successful hazard analysis critical control point implementation in the United Kingdom. *J Food Prot* 64 (5): 710-5.
13. Henroid D, Sneed J (2004). Readiness to implement Hazard Analysis Critical Control Point (HACCP) system in Iowa school. *J Am Diet Assoc* 104 (2): 180-5.
14. IVZ (2005). Epidemiološko spremljanje nalezljivih bolezni v Sloveniji v letu 2003. Ljubljana: Inštitut za varovanje zdravja Republike Slovenije. http://www.ivz.si/javne_datoteke/datoteke/798Epidemiolosko_spremljanje_nalezljivih_bolezni_2003.pdf. <marec 2007>
15. Jay LS, Comar D, Govenlock LD (1999). A national Australian food safety telephone survey. *J Food Prot* 62 (8): 921-8.
16. Jevšnik M, Bauer M, Zore A, Raspor P (2007a). Hygienic status of small and medium sized food enterprises during adoption of HACCP system. *Int J Food Sci Technol Nutr* 1 (1): 95-113.
17. Jevšnik M, Hlebec V, Raspor P (2007b). Consumers' awareness of food safety from shopping to eating. *Food Control*. V tisku, DOI: 10.1016/j.foodcont.2007.07.017
18. Jevšnik M, Hlebec V, Raspor P (2006). Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Aliment* 35 (3): 319-53.
19. Jevšnik M, Hoyer S, Raspor P (2007c). Food safety knowledge and practice among pregnant and non pregnant women in Slovenia. *Food Control*. V tisku, DOI: 10.1016/j.foodcont.2007.06.005
20. Jevšnik M, Tivadar B, Hlebec V (2004). Hidden factors of high hazard in food industry. In: CEFood Congress Programme and book of abstracts, 2nd Central European Congress on Food, 26-28 April 2004. Budapest : Central Food Research Institute: Complex Committee on Food Science of the Hungarian Academy of Sciences, 214.
21. Karalis T, Gupta L (2001). Microbiological status of Asian style perishable foods and the relation with procedural deficiencies in manufacture. *Food Technol Aust* 53 (5): 184-8.
22. Kennedy J, Jackson V, Blair IS, McDowell DA, Cowan C, Bolton DJ (2005). Food safety knowledge of consumers and the microbiological and temperature status of their refrigerators. *J Food Prot* 68 (7): 1421-30.
23. Khandke SS, Mayes T (1998). HACCP implementation. *Food Control* 9 (2-3): 103-9.

24. Konecka-Matyjek E, Turlejska H, Pelzner U, Szponar L (2005). Actual situation in the area of implementing quality assurance system GMP, GHP and HACCP in Polish food production and processing plants. *Food Control* 16: 1-9.
25. Manning CK, Snider S (1993). Temporary public eating places. *J Environ Health* 56: 24-8.
26. Mortimore S (2001). How to make HACCP really work in practice. *Food Control* 12: 209-15.
27. Motarjemi Y, Käferstein F (1999). Food safety, Hazard Analysis and Critical Control Point and the increase in foodborne diseases. *Food Control* 10: 325-33.
28. Panisello PJ, Quantick PC (2001). Technical barriers to Hazard Analysis Critical Control Point (HACCP). *Food Control* 12: 165-73.
29. Ramirez Vela A, Martin Fernández J (2003). Barriers for the developing and implementation of HACCP plans. *Food Control* 14: 333-7.
30. Raspor P (2004). Sedanji pogled na varnost živil. V: Varnost živil / 22. Bitenčevi živilski dnevi, 18. in 19. marec 2004, Radenci. Gašperlin L, Žlender B (ur.). Ljubljana: Biotehniška fakulteta, Oddelek za živilstvo: 1-14.
31. Raspor P, Jevšnik M (2008). Good nutritional practice from producer to consumer inclusive. *Crit Rev Food Sci Nutr*. V tisku.
32. Resolucija o nacionalnem programu prehranske politike 2005 – 2010 (2005). *Ur List RS* 39: 3681-719.
33. Roberts KR, Sneed J (2003). Status of prerequisite and HACCP program implementation in Iowa restaurants. *Food Prot Trends* 23 (10): 808-16.
34. Ropkins K, Beck AJ (2000). Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends Food Sci Technol* 11: 10-21.
35. Setiabudhi M, Theis M, Norback J (1997). Integrating hazard analysis and critical control point (HACCP) and sanitation for verifiable food safety. *J Am Diet Assoc* 97 (8): 889-91.
36. Smole Možina S, Hočevar Grom A (2004). Mikrobiološka varnost živil. V: Varnost živil / 22. Bitenčevi živilski dnevi, 18. in 19. marec 2004, Radenci. Gašperlin L, Žlender B (ur.). Ljubljana: Biotehniška fakulteta, Oddelek za živilstvo: 29-43.
37. Strauss LA (1996). *Qualitative analysis for social scientists*. Cambridge; New York; Melbourne: Cambridge University Press.
38. Sun Y-M, Ockerman HW (2005). A review of the needs and current applications of hazard analysis and critical control point (HACCP) system in foodservice areas. *Food Control* 16 (4): 325-32.
39. Surujlal M, Badrie N (2004). Household consumer food safety study in Trinidad, West Indies. *Internet Journal of Food Safety* 3: 8-14.
40. Tauxe RV (2002). Surveillance and investigation of foodborne diseases; roles for public health in meeting objectives for food safety. *Food Control* 13: 363-9.
41. Taylor EA, Taylor JZ (2004a). Using qualitative psychology to investigate HACCP implementation barriers. *Int J Environ Health Res* 14 (1): 53-63.

42. Taylor EA, Taylor JZ (2004b). Perceptions of 'the bureaucratic nightmare' of HACCP. *Br Food J* 106 (1): 65-72.
43. Taylor JH, Brown KL, Toivenen J, Holah JT (2000). A micro-biological evaluation of warm air hand driers with respect to hand hygiene and the washroom environment. *J Appl Microbiol* 89: 910-9.
44. Vebeke W, Frewer LJ, Scholderer J, De Brabander HF (2007). Why consumers behave as they do with respect to food safety and risk information. *Anal Chim Acta* 578: 2-7.
45. Walczak D, Reuter M (2004). Putting restaurant customers at risk. *Hosp Manage* 23: 3-13.
46. Walker E, Jones N (2002). An assessment of the value of documenting food safety in small and less developed catering businesses. *Food Control* 13: 307-14.
47. Walker E, Pritchard C, Forsythe S (2003). Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control* 14: 169-74.
48. Wallace C, Williams T (2001). Pre-requisites. *Food Control* 12: 235-40.
49. Zupan N (2001). Nagradite uspešne: Spodbujanje uspešnosti in sistemi nagrajevanja v slovenskih podjetjih. Ljubljana: GV Založba.

2.2 OSTALO POVEZOVALNO ZNANSTVENO DELO

2.2.1 **Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers**

Odnos do zahtev za varnost in higieno živil (DKP, DHP, HACCP) med Slovenskimi kisarji

Mojca Jevšnik, Branka Strah, Valentina Hlebec in Peter Raspor

Food Control (2007), v recenziji

Namen raziskave, izvedene med proizvajalci kislega zelja, je dobiti celovit vpogled v problematiko zagotavljanja varnosti živil v tehnološkem procesu od pridelave zelja do proizvodnje kislega zelja. Metodologija raziskave temelji na kombinaciji kvalitativnega in kvantitativnega pristopa. Z anketnim vprašalnikom smo ugotavljali mnenje respondentov o pomembnosti in uporabnosti zahtev dobre kmetijske in dobre higienske prakse pri njihovem delu ter stopnjo znanja o tveganjih v tehnološkem procesu. Implicitne predstave o tveganjih pri proizvodnji kislega zelja smo ugotavljali z nestrukturiranimi intervjuji pri desetih proizvajalcih kislega zelja, ki so bili hkrati tudi pridelovalci zelja. Respondenti so prepričani, da je delo po tradicionalnih principih odločilnega pomena za kakovost končnega proizvoda. Poudarjajo pomen higiene pri delu, doslednost pri upoštevanju navodil za uporabo fitofarmaceutskih sredstev in upoštevanje pravil pri gnojenju. Menijo, da je senzorično preizkušanje osnova za oceno ustreznosti kislega zelja, namenjenega potrošniku. Varnost živil razumejo kot element kakovosti proizvoda, saj je le-to pomembno za obstoj na konkurenčnem trgu. Menijo, da je sistem HACCP nepotreben in obremenjujoč sistem, ki je narejen po meri inšpektorjev. Respondenti, ki so vključeni v integrirano pridelavo, namenjajo večji poudarek pravilni uporabi fitofarmaceutskih sredstev, medtem ko je bila pri respondentih konvencionalnega tipa pridelave izpostavljena pomembnost higiene pri delu z živilom. Z analizo intervjujev so se izpostavile tudi druge značilnosti, povezane z zavedanjem o varnosti živil in načinom dela. Izkaže se, da je higienska zavest posameznika najpomembnejše orodje za zagotavljanje varnosti živil, zato je potrebno človeka obravnavati enakovredno kot ostale dejavnike tveganj.

Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers

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Abstract

The aim of the research carried out among sauerkraut growers was to get a complete insight into food safety assurance during sauerkraut production. Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers were established by a questionnaire. Food safety experiences of ten sauerkraut growers were determined by in-depth narrative interviews. The results have shown respect of traditional sauerkraut production process which is estimate as guarantee for product quality and safety. On growers' opinion organoleptic testing of sauerkraut is a basic for food safety estimation. They stressed an importance of hygiene, following directions for use of plant protection products and proper methods of fertilization. HACCP was estimated as unnecessary, burdening system made for the inspectors. Sauerkraut growers, who are included in an integrated farming, attach greater importance to proper plant protection products use, while conventional growers attach greater importance to general hygiene requirements. All other determinations concerning food safety knowledge and practices are presented and discussed. Food safety has to be treated as a whole from natural to social sciences. Adequate training and appropriate education within human resources can lead to sufficient food safety through food supply chain.

Key words: Food safety, HACCP, Sauerkraut, Growing, Food handlers, Production, Qualitative and quantitative methods

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1. Introduction

Interdisciplinary in nature, the history of food is a subject well studied to research. It is a large space of inspirations for culture, technology and nutrition and human well-being (Raspor, 2006). Vegetables play an important role in human nutrition and health by providing minerals, micronutrients, vitamins, antioxidants, phytosterols and dietary fibres (Wennberg et al., 2006). Cabbage and cabbage products production are interesting from both marketing and dietary point of views because cabbage has a plenty of favourable effect on health. From the traditional point of view cabbage, e.g. sauerkraut is one of well known traditional foods. Traditional foods are an expression of culture, history and lifestyle (Trichopoulou et al., 2007). World cabbage production amounts approximately 55 million ton per year. Half of the quantity is produced in Near East; the biggest producer is China (Zhu & Zhou, 2001). In Slovenia white cabbage (C1635) production was 26 050 tons (32.4 tons of harvest on hectar) in 2006 (Statistical Office of the Republic of Slovenia, 2007).

As raw vegetables have a high microbial load and cannot be pasteurized without compromising product quality, most vegetable fermentations occur as a consequence of providing growth conditions (such as salt) that favour the lactic acid bacteria (Caplice & Fitzgerald, 1999). Food fermentation is the oldest “biotechnology”. It covers a wide range of microbial and enzymatic processing of food and ingredients to achieve desirable characteristics such as prolonged shelf-life, improved safety, attractive flavour, nutritional enrichment, and promotion of health (Giraffa, 2004). Today a variety of fermented foods is produced both in industrialized and developing countries using this technology at the household level, in small-scale food industry and in large commercial enterprises (Motarjemi, 2002). The majority of small-scale fermentation in developing countries and even some industrial processes such as sauerkraut fermentation are still conducted as spontaneous processes which are neither predictable nor controllable. When the yield is unstable and where the desired microorganisms might not grow, or where pathogenic microorganisms might also grow, a controlled fermentation is used (Giraffa, 2004).

Hazard Analysis and Critical Control Point (HACCP) studies of some fermented products have demonstrated that depending on the process and the hygienic conditions observed during preparation, some fermented foods may pose a safety risk. Fermented foods must therefore be studied following HACCP principles and small-scale food industries and households must be advised on the critical control points of fermentation processes and the control measures to be applied at this point (Motarjemi, 2002). Food hazards present at the level of primary production should be identified and adequately controlled to ensure the achievement of the objectives of the EU Regulation The application of HACCP principles to primary production is not yet generally feasible. However, guides to good practice should encourage the use of appropriate hygiene practices at farm level (EU, 2004). In sauerkraut production it is necessary to follow guidelines of Good Agricultural Practice (GAP) and Good Hygiene Practice (GHP). GAPs are defined as general practices to reduce microbial food safety hazards in the cultivation, harvesting, sorting, packing and storage operations for fresh fruits and vegetables, and should be developed in a stepwise manner based on the risk associated with individual fruits and vegetables and the scientific data available (Raspor, 2007; Da Cruz, 2006; De Roever, 1998; Pabrua, 1999). GHP consists of practical procedures and processes that return the processing environment to its original condition (disinfection or sanitation programmes); keep building and equipment in efficient operation (maintenance programme); control of cross-contamination during

manufacture (usually related to people, surfaces, the air and the segregation of raw and processed product) (Raspor, 2007).

Food safety legislation presents requirements and measures for assurance of safety and quality of food through food supply chain. Food safety is a responsibility of food business operators (EU, 2004). Research to date on barriers to successful HACCP implementation has been limited in terms both of amount and depth (Taylor & Taylor, 2004). Meta-analysis of barriers during HACCP implementation has shown that among twenty one elements we can allocate seven elements (training, human resources, planning, knowledge and competence, management commitment) representing almost 50% (47.8%) of all identified barriers (Jevšnik et al., 2006). Therefore in the food safety circle it is very important that all the included parts of the chain know and understand their responsibilities and fulfil the latter. An individual is an important part of understanding an attitude towards food safety (Jevšnik et al., 2007). For this purpose the research within group of food handlers, which are at the same time growers and producers was carried out.

This study explore the food safety assurance in sauerkraut production from the sauerkraut grower's point of view with qualitative survey, complemented by results of quantitative survey, in order to find general food safety knowledge and practices among respondents. The main aim of the study was to ascertain sauerkraut growers' silent beliefs about hazards which have to be controlled for preventing food borne diseases.

2. Materials and methods

2.1. Questionnaire

2.1.1. Questionnaire design

A self-administrable questionnaire was developed for this study by authors of the article. It includes 20 multiple choice questions with four, five or six possible answers, including "do not know" and "other", for the purpose of minimizing the possibility of selecting the correct answer by chance. On every question only one answer should be tick.

The questions were designed and structured in three groups. The first group of questions was designed to determine the sauerkraut growers' acquaintance with GAP, GHP and HACCP system. The aim of the second part of the questionnaire was to determine familiarity and integration of GAP, GHP and HACCP in their production process. By the third part of the questionnaire the sauerkraut growers' opinion of hazards and their control during the production process was determined. In addition, six questions were related with demographic characteristics of respondents (education level, type of settlement, gender, age, number of years in a food business, and certificate of qualification acquired¹).

The respondents completing the questionnaire remained anonymous. The questionnaire was pilot tested by 10 participants during April 2006, resulting in minor modifications of

¹ Qualifications for supplementary on-farm business are set in the Rules on the capacity for carrying out supplementary on-farm activities (Anon, 2004). For a certain supplementary on-farm activity a minimum qualification is finished secondary school or vocational school and certificate of qualification. A certification of qualification is a suitable certificate of knowledge for a certain topic. Knowledge is tested by the Chamber of Agriculture and Forestry, the Chamber of Crafts Industries of Slovenia, educational institutions or professional associations for certain activities. Farmers are beside a technology for a particular foodstuff taught of regulations regarding food safety and quality.

questions' wording. Each questionnaire took approximately 10 min to complete. A study was conducted from June to September 2006.

The questionnaires were sent to all the registered sauerkraut growers in Slovenia ($n = 112$). Information regarding the number of sauerkraut growers and their addresses were collected by data base of the Chamber of Agriculture and Forestry of the Republic of Slovenia (CAF RS). Questionnaires together with survey explanation and a short guidance for questionnaire fulfilment were sent by mail to sauerkraut growers. Each envelope included an empty letter with a post stamp and an address of the recipient, so that completed questionnaires could be sent back. After the first dispatch 21 (18.75%) completed questionnaires were received back. With the second letter we thanked to all the participants and we kindly asked again all of those, who hadn't completed the questionnaire yet, to complete it and send it back. After the second dispatch we received 14 (12.5%) completed questionnaires more. Total of 35 (31.25%) completed questionnaires were received.

2.1.2. Statistical analysis

The questionnaire responses were analyzed using SPSS version 13.0 software. Mean responses with standard deviation and percentages of responses in each category were calculated and presented in tabular form. To examine the relationship among and between the variables cross tabulations and χ^2 test, Pearson correlation coefficient, independent sample t-test and ANOVA were used.

2.2. Narrative interviews

Because perception of food safety is complex field and a quantity research with a questionnaire can not reveal peoples' implicit conceptions, ten narrative interviews were carried out among growers, which were also sauerkraut growers at the same time. A contribution of qualitative methods is possibility of a deeper view in experience and comprehension of studied phenomenon. They enable inclusion of individual experiences. That could expose experience and comprehension of food safety among sauerkraut growers.

A descriptive analysis, arisen from founded theory (Strauss, 1996), was carried out from the qualitative point of view. Because the validity of the results in the qualitative type of a research is not the same as in the quantitative methods, results are justified by triangulation. Three researchers with different disciplinary basic knowledge and with different experiences in research were included in the interpretation.

The methodology was narrative interviews aimed to create an open and trusting atmosphere, thus eliciting more in-depth results (Hollway & Jefferson, 2003; Gilling et al., 2001). Interview question: "Could you explain what in your opinion is the most important factor for the safety of the final product, from plant to sauerkraut?" was devised merely as a guide and was open to development and change. If the respondents' answers were retained, we asked three additional questions: (1) "How do you judge importance of packaging for sauerkraut safety and health status of people?"; (2) "Could you explain when is sauerkraut considered safe for a consumer?"; (3) "Who is responsible for informing farmers regarding novelties in the field of food safety?". Interviews lasted 20 min on the average. Eventual connection between type of farming and understanding the food safety was determined by the interviews. In order to keep respondents' identity anonymous they

were marked according to a type of farming (C-conventional farming, I- integrated farming).

Interviews were recorded by using a dictaphone and then later exactly copied in writing. Transcripts of the interviews were analyzed by coding the statements of the respondents by identified notion. The notions were gathered into topic categories.

Narrative interviews among sauerkraut growers were carried out from November 2006 to February 2007. Information regarding the number of sauerkraut growers and their addresses were collected by data base of the Chamber of Agriculture and Forestry of the Republic of Slovenia. Among 112 registered sauerkraut growers 28 were randomly selected and were invited over the phone to participate in the research. Ten of the 28 invited ones consented to participate.

3. Results and discussion

3.1. Questionnaire

3.1.1. Sample characteristics

Of the 35 farmers taking part in the research, 45.7% classified their farming type as an integrated one and 54.3% as a conventional one. None of the respondents classified their farming type as an ecological one. 77.1% of the respondents (40% of farmers with integrated farming and 37% of conventional farmers) possess a certificate of qualification. 17.1% of respondents with integrated farming possess no certificate of qualification for their business. Most of the respondents (68.6%) are male. Education level of almost third (31.4%) of the respondents is a finished vocational school, secondary school (25.7%), 22.8% finished primary school and 11.4% have finished high school or more. 77.1% of the respondents farms in villages and 22.9% in suburbs. Most of the sauerkraut growers (88.6 %) use their own heads of cabbage for acidification and 11.4 % use both; their own and bought ones.

3.1.2. Acquaintance with GAP, GHP and HACCP system demands

The majority of respondents are familiar with the principles of the GAP (94.3%), the GHP (94.3%) and HACCP system (97.1%). The respondents obtained the most of information regarding GAP and GHP from the CAF RS. 54.3% of the respondents obtained information about HACCP system from the support services and 40% from the inspectors (Table 1). Media present a smaller part of information sources, especially of GHP and HACCP system.

Table 1. GAP, GHP and HACCP system information sources.

Information about ... (n = 35)	Information sources (%)				
	Support Services	Inspectorates	Magazines - technical journals	I was not informed	Other sources ^a
... GAP	65.7	11.4	17.1	0.0	5.8
... GHP	71.4	20.0	5.7	0.0	2.9
... HACCP system	54.3	40.0	2.9	0.0	2.9

^a Other sources: seminars, additional training and exchanging information with sauerkraut growers.

Almost half of the respondents (45.7%) are familiar with the proper purpose of the good practice guidelines (to eliminate or to reduce hazards), which represent working instructions for farmers (Table 2). Among demographic characteristic only the higher level of education has statistically significant impact ($p < 0.05$) on that. The other part of the respondents (54.3%) comprehends good practice guidelines as exact working instruction for producers (20%), as pointing out mistakes in a production process (8.6%) or as guidelines for inspectors (Table 2).

Table 2. Sauerkraut growers' opinion about a purpose of good practice guidelines.

Claims ($n = 35$)	%
... to give guidelines and working instructions to a producer to prevent or reduce hazards to the acceptable level.	45.7
... to give exact instructions to a producer.	20.0
... to point mistake out to a producer.	8.6
... to give an inspector a chance of knowing exactly what to control and how to do it.	5.7
... to offer help if something goes wrong (e.g. could cabbage be used if something goes wrong)	5.7
... guidelines are senseless, because producers know best how to produce a good sauerkraut.	2.9
... other ^a . Please describe:	2.9 ¹

^a Other answers: to offer a quality product to a consumer.

3.1.3. Familiarity and integration of GAP, GHP and HACCP in sauerkraut production

The majority of the respondents believe that principles of GAP should be followed in sauerkraut production (Table 3). The smaller part of the respondents thinks records of sowing and planting of cabbage are unnecessary (14.3%), they express a similar opinion about product gathering (11.4%). The period of sowing and planting should be selected carefully, so that it does not increase a growth of harmful microorganisms. Therefore it is very important to record a time of sowing and planting, because it is a proof of a proper timing. Among demographic characteristic the higher level of education and certificate of qualification acquired has significant impact ($p < 0.05$) on consideration of the importance of GAP principles.

Table 3. The importance of GAP principles in sauerkraut production.

In cabbage growing it is necessary ... ($n = 35$)	Yes	No	I don't know
	%		
... to control soil for cabbage growing.	88.6	8,6	2.9
... to keep records of a time of cabbage sowing and planting.	77.1	14,3	8.6
... to store plant protection products in a separate room.	94.3	0.0	5.7
... to check a date of durability of a plant protection products.	88.6	5,7	5.7
... to consider a waiting time of a plant protection products.	97.1	0.0	2.9
... to keep records of a plant protection products usage.	88.6	5.7	5.7
... to record a time of cabbage gathering.	82.9	11.4	5.7
... other ^a . Please describe:	8.6		

^a Other answers: regular checking of plants growing; presence of pests; records of a time of acidification; it is already done even without HACCP system.

The respondents are familiar with the requirements regarding use of plant protection products. The result was expected, because regular training about this topic is obligatory (Anon, 2004; EC, 2004). The most of the respondents use plant protection products for improving the quality of a product and for increasing the quantity. The main reasons for use of it in cabbage growing, according to respondents statements, is: a better quality of a product (57.1%), larger harvest (22.8%), better resistance of plants (8.6%), and easier work (5.7%).

Records of production process (acidification activities) help to analyze activities performed during production and offer a starting-point for continuous improvement of planning. Records prove the quality and safety of a product in all the production phases. Following of GAP principles increases the value of agricultural products (Da Cruz et al. 2006), which influences a consumers' trust in quality of home-grown products. The respondents ascribed a great importance to record keeping in production of sauerkraut. The highest importance was ascribed to record keeping of personnel health status (mean value 4.2) and cleaning of facilities and equipment (mean value 4.0). The respondents ascribed less importance to records of acidification process (mean value = 3.9) (Table 4).

Table 4. A necessity of record keeping in sauerkraut production.

Record keeping (<i>n</i> = 35)	Mean^a	SD
Records of cleaning (facilities and equipment)	4,0	1,2
Monitoring during production	3,6	1,2
Records of procedures during production	3,9	1,1
Records of measuring	3,8	1,3
Record of staff health	4,2	1,2

^a Average of the rankings given and the respondents' opinion. Opinions were ranked from 1 (not at all) to 5 (very much).

Food business operators are to keep and retain records relating to measures put in place to control hazards in an appropriate manner and for an appropriate period, commensurate with the nature and size of the food business. Food business operators are to make relevant information contained in these records available to the competent authority and receiving food business operators on request (EC, 2004).

3.1.4. Hazards and their control during the sauerkraut production process

Hansen (2002) pointed out that the main problems to solve (or to improve) are still the old ones: reduce spoilage, avoid food borne diseases and finally preserve or develop an attractive flavour, taste and appearance of the food. Lactic acid bacteria have much to offer within food preservation and flavour generation.

For final product safety hygiene and technological factors are important by the respondents' opinion (Table 5). Women ascribed them more importance than man ($p < 0.05$). Sauerkraut growers, who possess a certificate of qualification, ascribed less importance to personal hygiene principles than those, who do not have such a certificate ($p < 0.05$). The results stressed training topics, which are more oriented at technology of sauerkraut making than at hygiene.

Table 5. Factors influencing sauerkraut safety during acidification process.

For safety of a final product in cabbage acidification it is the most important ... (n = 35)	Mean ^a	SD
... to check the quality of raw material.	4.7	0.7
... to use the right cabbage species.	4.2	1.1
... to check a temperature of acidification.	4.6	0.9
... to follow the hygiene principles.	4.8	0.5
... to check a quantity of added salt.	4.7	0.8
... to use basins and packaging, which are acid resistant.	4.8	0.6
... to use a well shaped packaging.	4.0	1.5

^a An average of the rankings given and the respondents' opinion. Opinions were ranked from 1 (not at all) to 5 (very much).

The respondents estimated all the production phases to be important for a safety of a final product (Table 6); all the mean values were above 4.8, except for gathering of heads of cabbage, where the mean value was the lowest (3.8). The latter was more important to sauerkraut growers, who finished primary school or less than those, who has a postsecondary education ($p < 0.05$). Women, respondents with higher education and those, with a certificate of qualification ascribed higher importance to some of the production stages ($p < 0.05$), i.e. gathering and cleaning of cabbage heads.

Table 6. A level of importance of a production stage for safety of the sauerkraut.

The production stages (n = 35)	Mean ^a	SD
... gathering of cabbage heads in a field.	3,8	1,2
... cleaning of heads of cabbage.	4,8	0,5
... cabbage slicing.	4,7	0,5
... basin filling, salt adding.	4,9	0,4
... cabbage acidification.	4,8	0,6
... packing and storing.	4,9	0,3

^a An average of the rankings given and the respondents' opinion. Opinions were ranked from 1 (not at all) to 5 (very much).

Food business operators producing or harvesting plant products have to keep clean and, where necessary after cleaning, to disinfect, in an appropriate manner, facilities, equipment, containers, crates, vehicles and vessels; to ensure, where necessary, hygienic production, transport and storage conditions for, and the cleanliness of plant products; to use potable water, or clean water, whenever necessary to prevent contamination; to take account of the results of any relevant analyses carried out on samples taken from plants or other samples that have importance to human health and to use plant protection products and biocides correctly, as required by the relevant legislation (EC, 2004).

The respondents are not enough educated about health status of persons handling food (Table 7). They are aware that persons with diarrhoea and hand wounds are not allowed to handle the food, because of a high possibility of infections. But when stating the other symptoms (e.g. coughing, fever, etc.), their answers were diverse. Their knowledge of possible corrective action for cuts or coughing (e.g. proper wound care, a protective mask when coughing) is poor as well.

Table 7. Health criteria, which influences food handling permission.

Is a worker allowed to handle the food if ... (n = 35)	Yes	No	I don't know
	%		
... he has diarrhoea.	0.0	100.0	0.0
... he has a high blood pressure.	82.9	11.4	5.7
... he has a cold.	5.7	91.4	2.9
... he has a toothache.	82.9	14.3	2.9
... he coughs and wears a protective mask.	37.1	62.9	0.0
... he has a fever.	17.1	82.9	0.0
... he vomits.	2.9	97.1	0.0
... he cut himself.	5.7	94.3	0.0
... he wears a nail polish.	20.0	71.4	8.6
... he is upset.	82.9	14.3	2.9
... he has wounds on his hands.	0.0	100.0	0.0

Food business operators producing or harvesting plant products has to ensure that staff handling foodstuffs are in good health and undergo training on health risks (EC, 2004).

3.2. Narrative interviews

The results in the sequel are supported by the quotations from the interviews, which are marked. A mark (I, C) represents a type of farming, while a number represents a running number (from 1 to 10). Ten interviews among cabbage growers, who are also sauerkraut growers at the same time, were carried out. Half of them are included in integrated farming (I) and half of them are conventional farmers (C).

When transcribed the interviews, answers to a question »What is important for safety of the final product from a plant to sauerkraut?« formed the first general impressions. A finding that the respondents rarely comprehend the food safety separately, but they experience it in different combinations like e.g. GHP importance and protection from pesticides, work awareness and following written rules, higher income and safety for consumers, system HACCP and work awareness, etc.; it is the most obvious in a statement:

I (VIII): ... if anything goes wrong, it can be seen immediately. The cabbage changes the colour, it is soft... I don't know if anything else can be wrong with the cabbage. It's common talk that cabbage is very good for health. And because is sour, I think that it is already some kind of protection and it is not problematic for a consumer.

According to the basic theoretic principles (Strauss, 1996) five topics were identified: healing power of cabbage, hygiene, technological process, harmful factors and other factors influencing the safety of a final product (Fig. 1). They have been formed on the basis of the topics, in which the statements were combined.

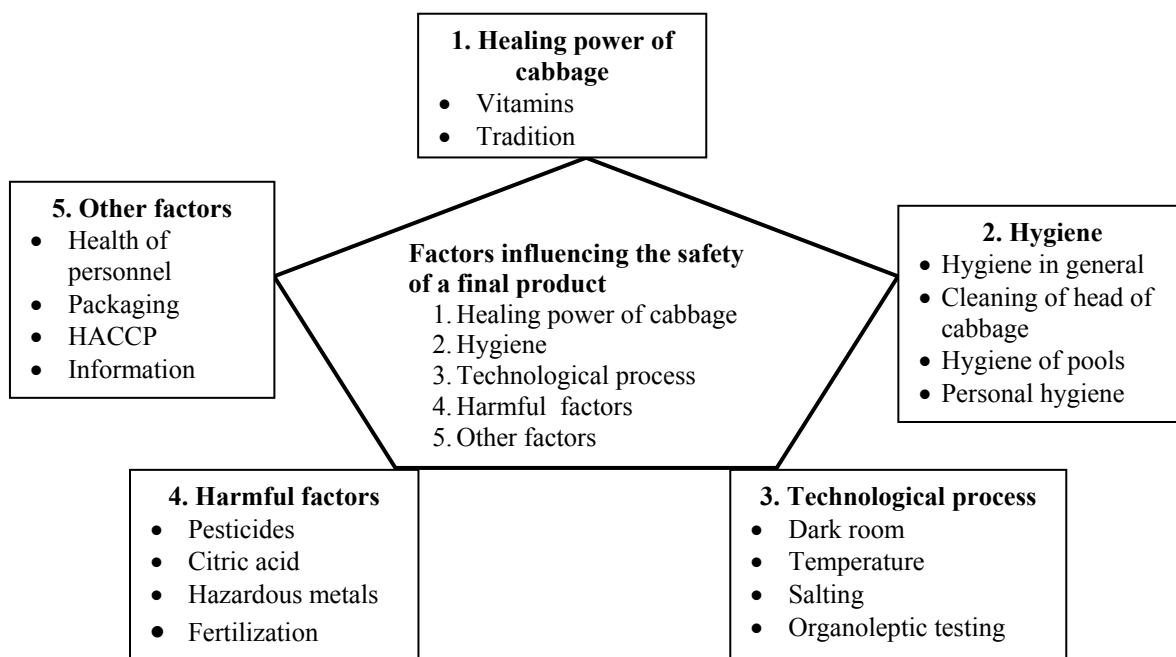


Figure 1. Topics of food safety comprehension among sauerkraut growers

3.2.1. Healing power of the cabbage

The majority of the respondents believe cabbage to be very healing food, because of its properties. They believe it cannot be dangerous for a consumer.

I (VIII): ... it's common talk that cabbage is very good for health. And because is sour, I think that it is already some kind of protection and it is not problematic for a consumer.

The respect for a traditional sauerkraut making, which was adopted by their ancestors, was especially pointed out.

C (IV): ... it has been already done by our forefathers and they already new the healing power of cabbage.

I (VII): Cabbage is considered as a medicine. That is why our ancestors were so healthy – they live on sauerkraut and potato.

Traditionally foods and patterns may have potential health properties which have been tested over time (Trichopoulou et al., 2007).

3.2.2. Harmful factors

The respondents stressed that type of growing, work awareness and strict following of working instructions are important for safety of sauerkraut. They pointed out a danger of using too much of pesticides for cabbage. The importance of the latter is more stressed by the farmers involved in integrated farming.

I (VI): Nowadays it is most important that farmers strictly follow instructions for spraying the cabbage in fields.

I (VII): ... if you don't produce with heart and if you just spray and spray, the cabbage won't be healthy.

Different pesticides (insecticides, fungicides and herbicides) are applied ineluctably to control insect pests and diseases of the spring cabbage. Vegetables are susceptible to insect and disease attacks and pesticides are used widely. Therefore, residues of pesticide could affect the ultimate consumer's health especially when freshly consumed (Zhang et al., 2007). Virtually all chemicals can be shown to be dangerous at high doses and this includes the thousands of natural chemicals that are consumed every day in food but most particularly in fruit and vegetables (Trewavas, 2004). Sauerkraut growers are aware of importance of following the instructions for spraying. Traditionally adopted production of sauerkraut is a guarantee for safety and quality of a final product. They stressed an importance of hygiene, following directions for use of plant protection products.

They dislike using the citric acid for improving the quality and for extension a date of durability of sauerkraut. The conventional farmers stressed the importance of natural cabbage salting, without adding antibiotics and other additives, more.

C (IV): In shops additives are added to the cabbage, so it lasts longer. And that, you see, is not safe for health. Well, the records are probably OK, but our customers say they are satisfied with our cabbage because we add nothing. One lady said she had stomach-ache when she ate sauerkraut bought in a shop.

One of the respondents pointed out a proper fertilization:

C (X): It is also very important that raw material is not too much fertilized by manure or nitrogen.

And the others pointed out field location – main roads nearby, which can influence a hazardous metal content in heads of cabbage.

I (IX): If I was a consumer, it would be most important to me where the cabbage has grown – in a city or in a village. You know I was on a seminar, where I heard about a lead absorption in heads of cabbage. And there is lot of lead on the roads.

3.2.3. Hygiene

All the production phases in cabbage acidification are equally important to the respondents. They pointed out that none of the phases must be left undone. The following of hygiene principles during acidification was pointed out as a very important factor – as general hygiene:

C (IV): ... hygiene is very important...

I (VI): ... one has to follow hygienic rules.

personal hygiene:

I (V): ... hygiene was always important, not only now, when we have this HACCP. If one feels conscious, if one works with a heart, then one won't press the cabbage with dirty boots or cut the cabbage with a dirty grater, even if one is not familiar with HACCP.

I (VI): ... I always put a plastic bag on my hand. So I never touch the cabbage with a hand. When I charge, I always take the bag off. When sell I always wear a clean white apron.

hygiene of basins:

C (II): ... in order to have a good sauerkraut, basins must be clean.

I (VI): ..., one has to pay attention to cleanliness of basins and all the other accessories.

and cleaning of the heads:

C (IV): It is important that the heads are really clean prior slicing, so there are no snails or caterpillars or dirt. But if the cabbage is of top quality, then there's no problem with that.

Conventional sauerkraut growers lay greater stress on hygiene in general than sauerkraut growers, included in integrated farming. But few contradiction between former and modern way of acidification appeared. HACCP system requires precise cleaning schedule, which was not required in the past. One of the respondents believed that stricter requirements do not always contribute to the better result:

C (X): ... well, we wash all the basins with a steam at 100⁰ C. We didn't do that in the past and we still didn't have any problems. As I said everything with the steam, so all the cleaning is a hot one and after slicing we put a plastic foil on the top, the basin is closed immediately and weighted.

3.2.4. Technological process

Sauerkraut growers favour the traditional way of acidification, which includes changing of acidification method and regular organoleptic testing of the product. Traditional foods reflect cultural inheritance and have left their imprints on the respective dietary patterns, despite the fact that contemporary lifestyles do not encourage their preservation in our daily lives and customs (Trichopoulou et al., 2007). But the feeling and experiences of the sauerkraut are in contradiction with guidelines, which rest on hazard analysis and corrective actions on critical points of acidification process. Slovenian draft guidelines of good hygiene practice for crop production as critical control point during acidification recommended temperature and pH control (Anon, 2007).

A number of foodborne hazards are capable of surviving fermentation processing (Motarjemi, 2002). Lactic acid bacteria are widely used in the production of fermented food, and they constitute the majority of the volume and the value of the commercial starter cultures. The primary activity of the culture in food fermentation is to convert carbohydrates to desired metabolites as alcohol, acetic acid, lactic acid or CO₂. Alcohol and organic acids are good natural preservatives, but also appreciated in their own right in the fermented product (Hansen, 2002). Caplice & Fitzgerald (1999) summarized characteristic of lactic acid bacteria which are generally mesophilic but can grow at temperatures as low as 5°C or as high as 45°C. Similarly, while the majority of strains grow at pH 4.0-4.5, some are active at pH 9.6 and others at pH 3.2 strains are generally weakly proteolytic and lipolytic and require preformed amino acids, purine and pyrimidine bases and B vitamins for growth (Caplice & Fitzgerald, 1999). Enteropathogens, such as enterohaemorrhagic *E. coli*, show some patterns of acid resistance and may survive certain fermentation processes. In addition to being an agent for diarrhoeal diseases, food may also be a vehicle for chemical hazards, whether naturally present in the food (e.g. cyanide) or contaminating the food as a result of poor agricultural practices (e.g. pesticide residues) or environmental pollution (heavy metals, dioxins) (Motarjemi, 2002).

The respondents ascribed the great importance to the proper technological acidification process. But their comprehension differs from the branch's one. Darkening of rooms and basins were pointed out.

C (II): acidification room must be dark. This is important.

C (IV): well, the room must be dark; otherwise the sauerkraut is soft.

The proper salting method, which has an impact on quality rather than on safety, was pointed out as well.

C (I): The biggest problem that can occur in acidification is too much or not enough of salt. If cabbage is too much salted, the final product is too firm and if there's not enough of salt the sauerkraut is too soft.

I (VI): If I don't put enough of salt on the cabbage, the sauerkraut spoils...

Keeping of an optimal temperature (18°C) is important for lactic acid bacteria activity. In the first three weeks of acidification many of sauerkraut specific aromas, acids and esters develop. That is why odour and taste defects are result of improper lactic acid fermentation. In a draft of good hygiene practice guidelines for crop production a temperature is pointed out as the critical control point in the process of cabbage acidification. A temperature as an important factor influencing a time and the quality of sauerkraut were pointed out by both conventional and integrated sauerkraut growers. In the both group it was stressed that temperature monitoring during acidification is not necessary. They explained that claim with favourable weather conditions, because the acidification takes place during autumn, when the temperature is not so high, and with adequate basins for acidification, which are located in cold basements or in the ground. Above all their own instinct, experiences in such a production and regular organoleptic testing were pointed out.

C (III): If a temperature is higher yeast start to develop. But we don't measure the temperature, because I have a feeling about it. Our rooms are good, so we don't have problems with the temperature.

Their answers to the additional question: »When can you be sure that the sauerkraut is safe for a consumer?« were unified. They estimate the suitability of the sauerkraut by organoleptic parameters such as colour, smell, taste and firmness. If the product meets their criteria, which originate from traditional recipes and long-term experiences, then they can be certain that the sauerkraut is safe for a consumer.

C (II): ... well, that can be seen immediately. The sauerkraut is dark, almost brown and soft... one can never sell such sauerkraut.

C (X): Sauerkraut must give off a pleasant scent, when you open a basin. Once I opened a basin and the sauerkraut looked fine, but I knew something was wrong. And then it really started to change the colour. I had to throw the whole basin away.

3.2.5. Other factors

If the respondents' answers were retained, we asked them three additional questions: (1) "How do you judge importance of packaging for sauerkraut safety and health status of people?"; (2) "Could you explain when is sauerkraut considered safe for a consumer?"; (3) "Who is responsible for informing farmers regarding novelties in the field of food safety?". The respondents expose a health status of the food handlers, a packaging impact on safety of the final product, HACCP system, a responsibility for informing about novelties in discussed subject and surveillance of food safety assurance directly or when being asked an additional question.

The respondents link the health status with the difficulty of the performed work and not with possible infection of the product.

I (VI): ... to record if one is ill or not, makes no sense. If one is ill in one way or other, one can't work.

The most of the respondents think that ill person is not able to perform such a hard work as cabbage acidification that is why they do not link the health status with safety of the final

product, they see it merely as an ability to work. Only one respondent, a conventional farmer, stressed it's important for consumer protection that all the working personnel to be healthy.

C (IV): »During acidification I've been ill only once. Then the work has been performed by the others, because I was not allowed. There was a risk I could infect somebody.

The respondents do not link a packaging for sauerkraut with safety hazards. Only when being asked an additional question: »Could the packaging influence the sauerkraut safety?« most of them believed that the packaging should be clean and made of a suitable material.

C (IV): Well, our basins are made of plastic, of the plastic specially made for cabbage acidification. The gentleman, who sells the basins, gave us a certificate for the plastic. Customers buy from us every day, so we put the sauerkraut in 2 or 3 liter bags. Some of the customers buy more sauerkraut, so for them we pack in pails made especially for sauerkraut.

The sauerkraut growers think that the final product is more important than a packaging, because they have to sell it to earn the money. But from economic reasons they sell in cheap packaging like in plastic bags. They stressed that customers prefer to buy smaller units that is why they don't need to choose another kind of packaging.

C (I): We sell in ordinary plastic bags, because we sell in a market hall. Because that sauerkraut is fresh and meant for instant consumption, we don't put it in pails.

I (V): Good article is sold even without a pretty packaging. These days one does not eat the sauerkraut every day. When one buys it, one puts it in a pot immediately.

All the respondents are familiar with HACCP, but they don't believe in it. Because the legislation requirements they implemented it in their technological process. They comprehend HACCP system as additional burden, mainly because of the recording the performed activities and as a work for the inspectors. They believe the recording to be burdening and unnecessary.

I (VIII): For us, the sauerkraut growers, it is not important to fill in the HACCP forms. We know exactly when to clean or when we sliced the cabbage. One doesn't forget that, because one is then so busy. Writing is only an additional work.

Only two of the respondents expressed a positive attitude towards records keeping. A conventional farmer thinks that above all it is the most important to well organize the work and then records are no problem at all.

C (I): There's no problem in recording and writing. If one has everything in order and rooms are prepared according to HACCP, then that's the minor problem.

One of the integrated farmers stressed few advantages and weakness of records keeping. Because of the long-term experiences he can remember the activities and finds written records senseless.

I (IX): ... well, some of them are really clever ones. To record the time of slicing ... Usually one remembers that ... To write down when one sprays to know the abstinence, which makes sense. But to write down if one is healthy makes no sense. If one is ill, one can't work. And to write down if one washes hand is senseless as well. I wash mine 100 times a day. I do it automatically. A lot of that stuff is unnecessary. Otherwise HACCP is the same as we've done in the past.

The respondents believe that HACCP system brought nothing new or improved the process, because all the necessary has already been done in the past, before HACCP became obligatory. That is why they don't see any sense in it. They think that the feeling and to work with pleasure are important.

C (III): No HACCP will help if one does not have a feeling and if one doesn't work with pleasure.

Dissatisfaction with the inspectors was expressed, because some of them are satisfied when they see documentation and that formally everything is in accordance with HACCP system. They are not interested in the actual state.

C (II): Inspectors are only interested in a paper. As long as everything is in writing, everything is OK. The sauerkraut was good even before HACCP.

The respondents are disappointed with the Chamber of Agriculture and Forestry of the Republic of Slovenia and inspectorates in connection with informing the farmers and sauerkraut growers. They are left to their own resources, in spite of paying membership fee in the Chamber of Agriculture and Forestry.

C (III): I don't know who's responsible. We pay fees, but the Chamber of Agriculture and Forestry doesn't do anything. There are some seminars, but mainly about the spraying. There are the strictest requirements there. Our parents taught us how to make the sauerkraut and they were the best teachers. For work you have to have a feeling and one has to work with a pleasure.

C (I): The inspectors visit us at least five times a year; all kinds of inspectors, health, agricultural and market inspectors. Each of them wants to have something different. But they can't teach us, because we know more than them.

They are informed through the media and through consultation with other sauerkraut growers.

I (VIII): I don't know who's responsible, ... probably us. Sometimes we consult with one another, other times one hears something from the inspectors.

They get little information from inspectors when they visit them. They say that the visits by the inspectors are frequent. They stressed that quality and amount of information depend upon individual inspector, but above all on their education in technology field.

I (IX): ... these days everybody knows everything. All of them are so clever, but they don't know much about the cabbage. Sometimes I have to teach the inspectors. Well they haven't made any sauerkraut so far, so they can't know, even if they are experts. The praxis is something different. Everything depends on us. We don't get much help. That is something we expected from the beginning.

4. Conclusion

A combination of quantitative and qualitative methods was used in the research, because topics can be discussed more complete and in deep. A contribution of using the qualitative methods lays in deep view in experience and comprehension of studied phenomenon. They enable inclusion of individual experiences, which can not be obtained by quantitative methodology, which have been confirmed by the results of the research (Strauss, 1996).

An analysis of the quantitative research discovered that recording in process of acidification is very important for the sauerkraut growers. The influence of HACCP system training is evident, because in those trainings importance of record is pointed out. An analysis of the qualitative research showed that filling in the forms represent to the producers an additional work, which in their opinion is senseless. They believe it is necessary only because of the inspectors.

The results of both of the research are equal regarding a temperature importance for acidification process. But the qualitative research found out that the temperature represents no problem for the sauerkraut growers, because it takes place during autumn. They stressed that a temperature recording makes no sense, because the organoleptic testing shows the quality of the sauerkraut.

In both of the researches we found out that plant protection products usage depends upon desire for the quality product and higher quantity of the latter. The respondents are aware of dangerous use of plant protection products for people and the environment. The qualitative analysis pointed out a desire to be informed, because the instructions for preparation of pesticide solutions are too complicated.

One of the key characteristics' express in both researches is importance of hygiene, which sauerkraut growers find important and a basis for the production of the product quality and safety. The quantitative analysis shows that sauerkraut growers are not educated enough with health risks during production process. By qualitative analysis it was found that the health status of staff is connected with a hard work rather than with a possibility of product contamination. The quantitative results show rather good level of information obtained regarding good practices and HACCP system. In qualitative research a disappointment with the experts (advisors and inspectors) is pointed out. The respondents believe that a quantity and a quality of information depend upon the experts' personality and knowledge, which they were estimate inadequate. To improve respondents' negative attitude against safety demands set by the national law and guidelines it is necessary to restore constructive cooperation between experts and sauerkraut growers.

The combination of the research methodology has shown the connection between the results from both studies. The qualitative analysis additionally stresses some of the contrasts (attitude toward the work / HACCP requirements, personal feeling for safety and quality of a product / legal demands for record keeping) and differences between the laic (experiences of sauerkraut growers) and a professional comprehension of hazards (legal demands for primary production) during production process.

We can conclude that food safety have to be treated as a whole from natural to social sciences. In daily practice most of the critical points are hanging on particular person on particular place. If we do not perform adequate training, appropriate education within human resources (including experts and food handlers) we can not expect to have professionals with highly developed skills or high knowledge what makes sufficient food safety through food supply chain.

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References

- Anon. (2004). Rules on the capacity for carrying out supplementary on-farm activities. Official Gazette of the Republic of Slovenia No. 17/2004, 31/2005, 105/2006.
- Anon. (2007). Draft of good hygiene practice guidelines for production of foodstuffs of vegetal origin. 2007. Chamber of Agriculture and Forestry of the Republic of Slovenia, unpublished internal document.
- Caplice, E., & Fitzgerald G.F. (1999). Food fermentations: role of microorganisms in food production and preservation. *International Journal of Food Microbiology*, 50(1-2), 131-149.
- Da Cruz, A.G., Cenci, S.A., & Antun Maia, M.C. (2006). Good agricultural practices in a Brazilian produce plant. *Food Control*, 17(10), 781-788.

- De Rower, C. (1998). Microbiological safety evaluation and recommendations on fresh produce. *Food Control*, 9, 321-347.
- Dean, R.D. (1985). Training of Sanitary Engineers in Europe, World Health Organization, Regional Office for Europe, Copenhagen, 163-189.
- EU (European Union). 2004. Corrigendum to Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (OJ L 139, 30.4.2004). Official Journal of the European Union L226, 25/06/2004, 3–21.
- Gilling, S.J., Taylor, E.A., Kane, K. and Taylor, J.Z. 2001. Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioral adherence model. *Journal of Food Protection*, 64(5), 710-715.
- Giraffa, G. 2004. Studying the dynamics of microbial populations during food fermentation. *FEMS Microbiology Reviews*, 28(2), 251-260.
- Hansen, E.B. (2002). Commercial bacterial starter cultures for fermented foods of the future. *International Journal of Food Microbiology*, 78, 119– 131.
- Hollway, W., & Jefferson, T. (2003). *Doing qualitative research differently: free association, narrative and the interview method*, 166p, Sage, London, Thousand Oaks, New Delhi.
- Jevšnik, M., Hlebec, V., & Raspor, P. (2006). Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35(3), 319-353.
- Jevšnik, M., Hlebec, V., & Raspor, P. (2007). Consumers' awareness of food safety from shopping to eating. *Food Control*, doi: 10.1016/j.foodcont.2007.07.017
- Motarjemi, Y. (2002). Impact of small scale fermentation technology on food safety in developing countries. *International Journal of Food Microbiology*, 75(3), 213-229.
- Pabrua, F. (1999). Good agricultural practices: methods to minimize microbial risks. *Dairy, Food and Environmental Sanitation*, 19(7), 523-526.
- Raspor, P. (2006). Faces of foods on the world of food systems (Editorial). *Acta Alimentaria*, 35(3), 247–249.
- Raspor, P. (2007). Total food chain safety: How good practices can contribute? Trends in Food Science & Technology, doi:10.1016/j.tifs.2007.08.009.
- Statistical Office of the Republic of Slovenia. (2007). Crop production. Production of vegetables (ha, t, t/ha), Slovenia, annually. Available at: http://www.stat.si/pxweb/Dialog/varval.asp?ma=1502403S&ti=Pridelava+zelenjadnic+%28ha+%2C+t%2C+t%2Fha%29%2C+Slovenija%2C+letno&path=../Database/Okolje/15_kmetijstvo_ribistvo/04_rastlinska_pridelava/01_15024_pridelki_povrsina/&lang=2. Accessed November 10, 2007.
- Strauss, L.A. (1996). Qualitative analysis for social scientists. Cambridge University Press; Cambridge, New York, Melbourne, 319 pp.
- Taylor, E. A., & Taylor, J. Z. (2004). Perceptions of the »bureaucratic nightmare« of HACCP. A case study. *British Food Journal*, 106(1), 65-72.
- Trewavas, A. (2004). A critical assessment of organic farming-and-food assertions with particular respect to the UK and the potential environmental benefits of no-till agriculture. *Crop Protection*, 23(9), 757-781.
- Trichopoulou, A., Soukara, S., & Vasilopoulou, E. (2007). Traditional foods: a science and society perspective. *Trends in Food Science & Technology*, 18, 420-427.
- Wennberg, M., Ekvall, J., Olsson, K., & Nyman, M. (2006). Changes and carbohydrate and glucosinolate composition and white cabbage (*Brassica oleracea* var. *capitata*) during blanching and treatment with acetic acid. *Food Chemistry*, 95, 226–236.
- Zhang, Z.-Y., Liu, X.-J., & Hong, X.-Y. (2007). Effects of home preparation on pesticide residues in cabbage. *Food Control*, 18(12), 1484-1487.
- Zhu, A.-P., & Zhou, Y.-H. (2001). Analysis for requirements of vegetable market and China. *Journal of HuaZhong Agricultural University (Social Sciences Edition)*, 3(41), 26–31 and Chinese with English abstract.

2.2.2 Consumer interpretation of the term food safety

Razumevanje pojma varnost živil med potrošniki

Mojca Jevšnik, Valentina Hlebec in Peter Raspor

Acta Alimentaria (2008), oddano po recenziji

Pojem varnost živil je definiran in dobro poznan v strokovnih krogih. Pri raziskovanju laičnega razumevanja pojma med potrošniki so ugotovljene nove dimenzije pogledov na varnost živil, ki so lahko uporaben vir pri pripravi izobraževalnih gradiv. V raziskavi je bila uporabljena metoda kvalitativne analize vsebine odgovorov respondentov na odprto vprašanje: »Kako razumete pojem varnost živil?«. Predstavljeni rezultati so del širše raziskave z naslovom »Potrošniki in varnost živil«, ki je potekala od januarja do marca 2006, med potrošniki (n=1030) v različnih krajih po Sloveniji. Opravljena je bila tematska analiza 934 odgovorov na odprto vprašanje. Rezultati kažejo vsebinsko bogato in terminološko različno interpretacijo pojma varnost živil, ki bi lahko bila dobra podlaga pri oblikovanju izobraževalnih strategij za potrošnike. Prepoznanih je pet enopomenskih tematskih kategorij (A: škoduje zdravju, B: zdrava hrana, C: metoda proizvodnje, D: tehnološki proces, E: nadzor) in ena večpomenska kategorija F, ki vključuje vsebinsko celovitejše razumevanje obravnavanega pojma. Nakazuje se povezava med izjavami respondentov, uvršenimi v kategorijo A »škoduje zdravju« (38,4%) in strokovno definicijo varnosti živil, ki pojem opredeli z izrazom »brez dejavnikov tveganj«.

CONSUMER INTERPRETATION OF THE TERM FOOD SAFETY

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Abstract

The meaning of the term “food safety” is well known and defined in expert circles. But in researching how the term is interpreted by consumers, new dimensions are opening, which can be used as a guide in preparation of educational material for consumers. In the paper the authors analyse statements made by consumers when answering the question, “How do you interpret the term food safety?” The results are part of an extensive research titled “Consumers and Food Safety”, which took place from January to March of 2006, among 1030 respondents from different places in Slovenia. Findings of quota sample show considerable terminological diversity among statements made by respondents regarding a description of the term “safe food”. Based upon the code assignment five one meaning thematic categories were identified: A: Harmless for health, B: Healthy food, C: Production method, D: Technological procedure, E: Surveillance. The answers with extensive content included more one-theme categories and were classified in a category F. This category indicates the complex comprehension of the term food safety and the need to understand the relations between the answers. The results show a connection between 38.4% of consumers' statements in category A, (harmless for health), and a definition of food safety which mentions the term “without hazards”.

Key words: Consumer, Food safety, Qualitative survey

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The principal objective of the new general and specific hygiene rules is to ensure a high level of consumer protection with regard to food safety. Food business operators shall ensure that all stages of production, processing and distribution of food under their control satisfy the relevant hygiene requirements laid down in the Regulation (EC, 2004). The demand of application a Hazard Analysis and Critical Control Point (HACCP) system principles became a law in the European Union (EU) in January 2006.

Food safety has emerged as an important global issue with international trade and public health implications. In response to the increasing number of food borne illnesses, Governments all over the world are intensifying their efforts to improve food safety (SUDERSHAN et al., 2007). Weak food safety systems can lead to a higher incidence of food safety problems and diseases caused by micro-organisms such as *Salmonella*, *E. coli*, *Campylobacter*, and *Listeria*, by residues of agricultural chemicals (pesticides, veterinary drugs, etc.) and by the use of unauthorized food additives. Diarrhoeal diseases alone, mainly due to unsafe food and water, kill 1.8 million children every year (WHO, 2007). The consequences of carelessness and mistakes or negligence of food safety requirements can be fatal for consumers (RASPOR, 2004), especially for vulnerable groups such as elderly people, pregnant women, immune-compromised people, and children (McCABE-SELLERS & BEATTIE, 2004).

Food safety is a term which is used in different fields such as agriculture, food production, nutrition and medicine. Many requirements have to be respected, as well as the scientific and professional principles that are key points in assuring safe food through the food supply chain. Food safety is defined as a degree of confidence that food will not cause sickness or harm to the consumer when it is prepared, served and eaten according to its intended use (FAO/WHO, 2003). All hazards must be identified and removed or restrained to an acceptable level. A hazard can be defined as a biological, chemical or physical agent in a food, or condition of food with the potential to cause an adverse health effect (EC, 2002). If we move to a wider definition of food safety, nutrition value of food is also important. Risk assessors and risk managers are becoming now aware that public perceptions of risks and benefits of food are crucial for the future acceptance of a technology or product (VERBEKE et al., 2007). Food safety assurance is one of the most important tasks initiated in the European Union.

To achieve global food safety, consumers should be well informed regarding basic principles of food safety practice at homes (Good Housekeeping Practice), because food safety begins and ends at consumer daily practice (RASPOR & JEVŠNIK, 2008). JONES (1998) stressed that it is by all means important to pay attention to hygienic measures and that they can decrease numerous potential risk factors, which stresses the importance of acknowledging HACCP principles also at home. A review of consumer food safety studies indicates many gaps which have impact on foodborne illnesses in the home (JAY et al., 1999; YANG et al., 2000; LI-COHEN & BRUHN, 2002; HILLERS et al., 2003; KENDALL et al., 2004; GARAYOA et al., 2005; KENNEDY et al., 2005; UNUSAN, 2007; JEVŠNIK et al., 2007a; JEVŠNIK et al., 2007b). Epidemiologic surveillance summaries of foodborne illnesses clearly indicate that consumer behaviours, such as ingestion of raw/undercooked foods and poor hygienic practices, are important contributors to foodborne outbreaks (PATIL et al., 2004). Epidemiological data from Europe, North America, Australia and New Zealand indicate that a substantial proportion of foodborne illnesses are attributable to improper food preparation practices in consumers' homes (REDMOND & GRIFFITH, 2003). To achieve adequate food safety, a coordinated plan is needed for all involved in the food chain, including primary and

secondary production, distributors, and consumers (GARAYOA et al., 2005). In Slovenia there is a similar situation as identified in Spain (GARAYOA et al., 2005) so in the last few years most of the work has been centred on hazard control in the production sector, but the government has not dedicated the same effort to improving food safety education of consumers. Effective risk communication to inform consumers of the possible health risks of foodborne illnesses and encouraging safer food handling practices in the home is probably the best way to ensure food safety at the consumer end of the food chain (PATIL et al., 2005).

Field of food science and technology is a part of natural science and thus researched mainly with quantitative methodology. But it is encouraging that some food safety researchers decided to use also qualitative methods lately. The fact that a person is and will be responsible for food safety calls for an in-depth analysis and understanding of individual's reaction to received information (JEVŠNIK et al., 2006). The ultimate targets in food safety circle are consumers. To assure entire food safety it is necessary to educate consumers and study their needs and aspects of consumer satisfaction. Consumers are not provided with sufficient, processed and easy-to-understand information (BÁNÁTI & LAKNER, 2006).

The aim of the study was to establish the comprehension of and familiarity with the term "food safety" among consumers in Slovenia.

1. Methods

A cross-sectional study of consumer food safety knowledge and practices was conducted from January to March 2006 in different parts of Slovenia. A food safety and nutrition questionnaire was designed, which consisted of demographic questions (gender, age, education, marital status) and 48 questions covering issues related to food safety and nutrition habits. The questionnaire was pilot tested by 20 participants during October and November 2005 to confirm question clarity, identify response options, and gauge likely interview duration. The questionnaire was revised on the basis of pre-test results and other recommendations.

The revised questionnaire was divided into four sections: (1) a demographic section, (2) food safety knowledge, (3) food safety practices from purchase to home, and (4) food handling practices at home. One question in section one was an open type: "How do you interpret the term food safety?" Each questionnaire took approximately 20 min to complete. Data were collected on weekends and weekday afternoons when a member of the particular target group would most likely be at home or in the shopping centres. A quota sample of 1030 consumers was obtained. Gender and age distribution were controlled (to assure a balanced structure of the sample) by thirty-five interviewers, each of whom distributed 30 questionnaires. Interviewers were trained, final-year University students, who visited selected households or interviewed consumers in larger shopping centres across Slovenia. Interviewers briefly explained the purpose and nature of the study to the potential adult respondent (over 18 years of age), and sought permission for inclusion of their views in the survey. To guarantee anonymity of respondents and enable easier identification of questionnaires, identity numbers were assigned to each questionnaire when collected at the College of Health Studies. As students conducted interviews in their home cities, a considerable geographical distribution of data was obtained. The questionnaire responses were analyzed using SPSS version 13.0 software.

This study presents the results of qualitative content analysis of one open question, which was part of an extensive research titled "Consumers and Food Safety" (JEVŠNIK et

al., 2007a). For analysing the open question “How do you interpret the term food safety?” we used the description method based on qualitative content analysis (DENZIN & LINCOLN, 1994; MESEC, 1998), which is based upon grounded theory (STRAUSS, 1996). Methodology used helped us to identify the key thematic viewpoints of the term “food safety” comprehension among respondents. Validity of the interpretation is justified by the expert triangulation. Three researches of different expert pre-knowledge and research experiences were included in the interpretation. The basis for the qualitative content analysis represented the transcripts of the answers to the mentioned question. The answers were suitable marked and a numbers of individual questionnaires were added to the research code (CFS) The transcript of the answers had 31 pages. The content analysis was started by assigning the codes to the major topics. The codes were assigned to individual statements or parts of the statements according to repeated reading of the answers. Codes were joined in thematic categories. The categories and the codes had been upgraded until the majority of the respondents’ statements could be organized. Answers were even further interpreted in greater detail (as allowed by the length of answers) and characteristic, possible influences, consequences, but mainly mutual relations were differentiated.

2. Results and discussion

2.1. Profile of respondents

A total of 1030 questionnaires were obtained. Demographics characteristics of survey participants are listed in Table 1. The majority of respondents were female (60.1%). Most of the respondents were married with an average age of 38 (SD: 14.1) and had a secondary school education.

Table 1. Demographic characteristics of respondents

Demographic characteristics	n ^a	%
Gender (<i>n</i> = 1028)		
Male	410	39.9
Female	618	60.1
Age group (<i>n</i> = 1023)		
≤ 30	417	40.8
31 – 49	380	37.1
≥ 50	226	22.1
Education (<i>n</i> = 988)		
Primary school or less	344	34.8
Secondary school	426	43.1
Higher education	218	22.1
Marital status (<i>n</i> = 985)		
Married or living together as married	612	62.1
Single	203	20.6
Separated or divorced	170	17.3

^a Number of respondents.

2.2. The term “food safety” comprehension

Among 1030 consumers nine hundred and thirty four (90,7%) answered the open question: “How do you interpret the term food safety?” The consumers’ answers were read through many times in order to get an impression of the whole answer. Differences in language

style or language differences among the answers were determined. There were not many sentences with extensive or structured content. Language variety was strongly expressed as well. Based upon the code assignment five thematic categories were identified (Table 2); A: Harmless for health, B: Healthy food, C: Production method, D: Technological procedure, E: Surveillance. Fourteen answers were excluded from the qualitative content analysis because they did not meet the content criteria. For example ten respondents answered with the statement, "I do not know." Three respondents indicated they do not trust in food safety (e.g. "Safe food does not exist.", "Food safety is a vision.", "Everything is artificial."). One respondent did not understand the term food safety (e.g. "That does not exist, this is not a term."). RÖHR et al. (2005) reported that food quality and food safety are abstract terms which can be interpreted in various ways. They also emphasise that it is important to take subjective interpretations into consideration are in relaying information to consumers at.

Table 2. Determination of thematic categories, based on code assignment upon respondents description of the term food safety

Thematic category	Codes
A - Harmless for health	more proper, acceptable, edible, suitable, faultless, unspoiled, does not set off poisoning, good, trust its quality, clean, without hazards, without consequences, safe for consuming, without harmful additives, without micro-organisms, does not set off health problems
B – Healthy food	healthy, provides a state of health (good feeling), tasty, fresh, good, without cholesterol, high nutritional value, contains whole grains, high energy value in moderate amounts, protect human health, balanced food
C – Production method	ecological, biological, homemade, natural, grown without pesticides, grown without artificial manure, known producer, self-grown/produced
D - Technological procedure	date of usability, packaging, declaration, technological procedure, without supplements (additives, preservatives, colorants)
E - Surveillance	under surveillance, adhering to regulations, inspected, certificate of quality

The majority of respondents (76%) describe the term food safety with one meaning. According to the content of answers we ascribe them codes, which describe the meaning of similar answers. Then we classified them into thematic categories, presented in Table 2. The answers with extensive content (24%) included more one-theme categories. They were classified in a new category F (Fig 1). This category indicates the complex comprehension of the term food safety and the need to understand the relations between the answers.

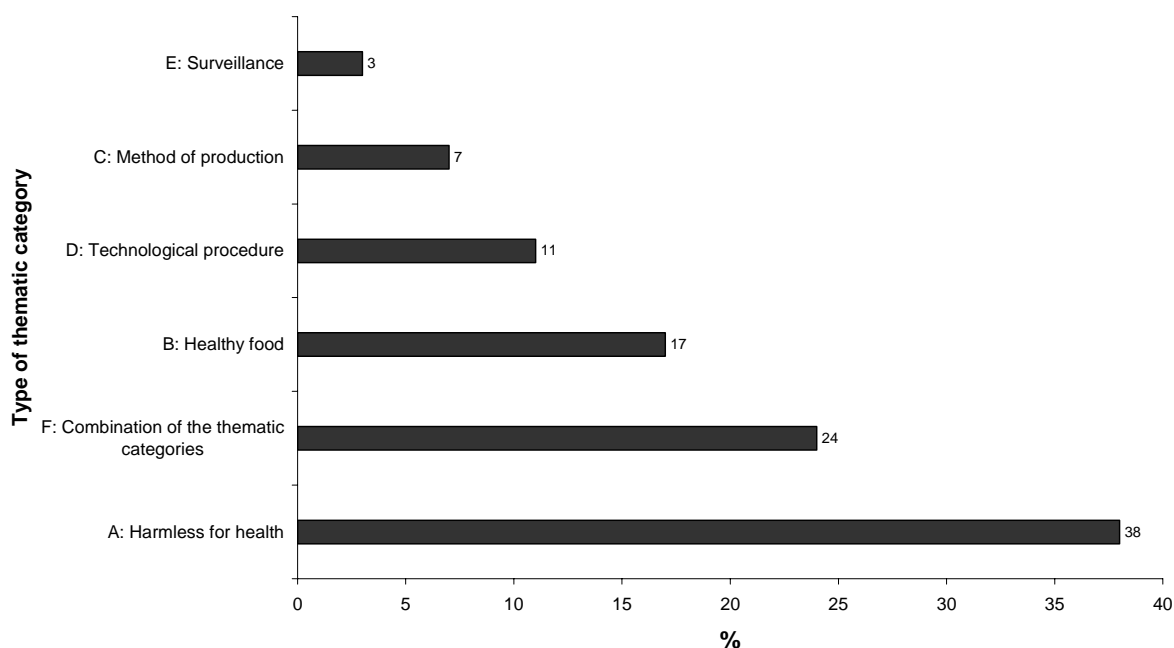


Fig. 1. Ratio of individual thematic category, identified according to respondents answers

The statements classified in thematic category A show a strong connection of the term food safety with hazards. This means that respondents connect the term safe food with the consequences that can occur if food is not safe. The results of EUROBAROMETER (2006) also show that consumers are concerned about topics like GMO, hormones, influence on their health, microbiological and chemical contamination. The thematic category A was the most frequent (38,4%) in single-meaning statements made by the respondents. More detailed analysis divided this category into two qualitative levels: negative and positive comprehension. The positive comprehension is marked by the topics: suitable, acceptable, safe.

CFS [356]: Suitable for consumption.

CFS [195]: Safe for consumption.

The negative comprehension of the term is marked by topics: risk, harmless, unsuitable, food poisoning.

CFS [195]: That is not dangerous for health.

CFS [195]: Safe food is food that does not cause food poisoning.

CFS [309]: Does not cause health problems.

CFS [610]: That is not risky.

Consumer concern about dangers associated with food is high. Due to recent food crises in Europe, food quality and food safety have become a hot topic in the media. Risk perception research indicates that lay people perceives risks differently from experts (SLOVIC, 1993). The literature on public perceptions of food related hazards is relatively recent (SPARKS & SHEPHERD, 1994a, b; FIFE-SCHAW & ROWE, 1996; GROBE et al., 1999; WILLIAMS & HAMMITT, 2001). The research has suggested that the public's reaction to risk is underpinned by quality hazards not taken into account by experts (SLOVIC, 1993). Public opinion on the evolution of food safety over the last ten years is divided: 38% consider that it has improved, 29% feel that it has stayed about the same and 28% believe that we are now worse off (EUROBAROMETER, 2006). Communicating

about risk and hazard should be an interactive exchange of information about risk and non-risk factors pertaining to risk management (BRUHN, 2005). It is necessary to communicate about risks and to provide consumers with science-based information relative to the risk and benefits of an issue. Only conscious consumers can use and understand information of the science in combination with their values and life style to make decisions. Consumer research provides information essential for designing and evaluating communication efforts. An effectively communication strategy moves people toward a more accurate perception of the likelihood of ill effects and empowers people to make informed decisions relative to potential benefits. Global food safety will be achieved only than, when every single link in the food chain will entirely (in its indoor and outdoor environment) become master of its particular area and will trust in activity of both previous and following link in the food safety circle »from farm to table«, not ignoring consumer as the one who should be aware of potential risks, proper handling and preparation of food for safe and balanced everyday meal (RASPOR & JEVŠNIK, 2008).

Seventeen percent of respondents' answers were classified in the thematic category B, which reflects the connection of the term safe food with the concept of healthy food. Health is the most important personal capital and it is fundamental for quality of life. This information is not a surprise because people are generally concerned about their health and are sensitive for any kind of information regarding health benefits.

CFS [605]: Safe food is food which protects us and has a good impact on health.

CFS [522]: If you eat more vegetables than meat, than you eat safe food.

CFS [417]: We use foodstuff with less fat and more foodstuffs that are rich with omega 3; we also use balsamic vinegar.

Food, eating and nutrition are shaped by culture. More than half of the Europeans believe that healthy nutrition has a positive effect on staying healthy and prevention of diseases. Greater cross-cultural variability was observed in the perceived barriers to healthy eating. The most important barrier categories reported were lack of time and self-control. The majority of Europeans believe there is no need to change their eating habits as they were already healthy enough (SABA, 2001). VERBEKE et al. (2007) reported that consumers place much importance on factors that may not contribute to technical risk estimates, while apparently underestimating other factors, which potentially represent a substantial threat to the human health.

In seven percent of respondents' answers the term food safety were described as some kind of production method. Through analysing respondents' answers we perceived fear, because they stress the importance of home food production and organic production. Thematic category C is strongly connected to methods of food production and it is obvious that this group of respondents do not trust in other conventional food production methods.

CFS [348]: Produced in a healthy way, I mean bio or organic production of food.

CFS [87]: Food produced without artificial manure or food that I produce on my one.

CFS [357]: Food bought by a farmer, that I personally know and I know the way of the production.

The organic food markets and this type of farming are growing fast. SIDERER et al. (2005) reported that consumers, due to health concerns, environmental consciousness, social status consideration and other reasons are interested in the organic farming products. At the same time, they want to have more information on these products they eat and usually buy at higher prices.

Thematic category D represent 11% of the respondents answers and it is strongly connected with technological process of food production. In respondents' statements importance were stressed on proper storing of foodstuffs, labelling, durability date and food additives.

CFS [229]: Food, which is safe, must have a printed date of durability and undamaged packing.

CFS [425]: That all criteria are considered during preparation: temperature, distribution, storage.

CFS [311]: Food, which is well prepared and that has had the time to be sufficiently cooked.

Food safety can be mishandled at any number of places during food preparation, handling and storage (UNUSAN, 2007). JEVŠNIK et al. (2006) analysed barriers or hindrances which have impact to the effective implementation of HACCP in food production units, described by authors of analysed scientific and professional's articles. They found out that almost half of all barriers belong to human factor (e.g. insufficiently trained and educated employees). According to GRIFFITH (2000) one of the major problems is that the food workers often lack interest and they often have a negative attitude towards food safety programs. Foods consumed in institutions and other foodservices are considered the leading locations for foodborne outbreaks (IVZ, 2005). The latter indicates correlation between the term food safety interpretation and location, where food poisonings are more frequently occur.

Food that meet legislative requirements, that is regularly controlled and under inspectors supervision is important to 3% of the respondents. Trusting in quality certificated could be perceived in some of the statements. All these codes which determined respondents statements were described with thematic category E.

CFS [34]: Food, which is consistently supervised from production to consumer.

CFS [144]: Food, which is controlled by different specialists during processing.

CFS [143]: Food, which is produced, stored and offered according to regulations

In the study by RÖHR et al. (2005) it was found that food safety can be employed as a credence dimension. Credence attributes are characterised by a higher need of information. In their study they communicated food safety by mentioning an intensified inspection.

2.3. Relations among respondents' statements

Answers with extensive content (24%) included more one-meaning thematic categories (A, B, C, D, E), that is why they were joint in the thematic category F (Fig 2). The respondents, who described the term food safety as multi-mining, understand the mentioned term as more complex. In the thematic category F there were 19,6% of combinations which included two one-meaning thematic categories, 3,7% of combinations which included three one-meaning categories and 0,5% of combinations which included four one-meaning categories. The category A was mentioned in more than half (14,7%) of combined statements (Fig.2), which means that the majority of the respondents connect food safety with hazards for human health.

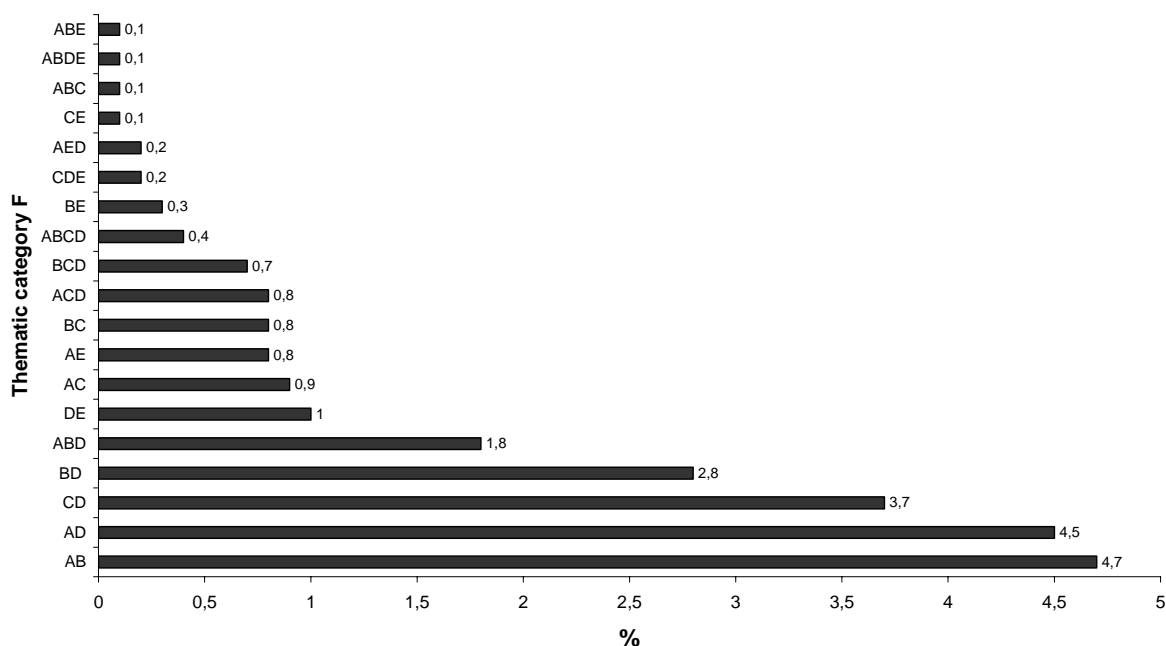


Fig. 2. Description of the thematic category F, which is composed as a combination of two, three or four basic categories (A: Harmless for health, B: Healthy food, C: Production method, D: Technological procedure, E: Surveillance)

Results of our study have shown three groups of respondents regarding their opinion toward food safety. In the first group there are those, whose statements are the closest to the professional definition of food safety and ascribed food safety as hazards to human health. In the second group respondents are health and well being oriented, and in the third group included the respondents, for whom production process in general is important. The results can confirm that nearly the third of consumers come near the professional food safety definition, which indicates impact of the media on awareness of the people in that group. The remaining two groups are partly close to the explanation of the professional definition. The fact that interpretation of the term in the second and the third group are connected to general health concern must not be ignored. Understanding of risk and perceptions of reliability could lead to more effective food policies aimed at maintaining consumer confidence in food safety (ROSATI & SABA, 2004). The consumers' answers are an indication of the impact of media on such a global food affairs. Beside that, awareness of the ongoing duty of each citizen is also noticed. For example a survey by BÁNÁTI & LAKNER (2003) shown that most of the Hungarian consumers want to be informed on the GM-content of food. These duties are shown as each citizens' responsibility for his/her health which is based on recognizing individual needs, on the ability of critical decision-making and on accepting the responsibility that comes with the pursuit of a healthy lifestyle.

3. Conclusion

In qualitative research a frequency of a certain result can not be interpreted in the same way as in quantitative research. Results can not be generalized as well, but nevertheless some elements and relations, repeated in food safety comprehension were disclosed. For more detailed research and understanding of the latter, the other way of data collecting e.g.

semi-structured interview, which could enable the more in depth data, should be selected. Food safety can be considered as potential factor on human health from consumer point of view.

It was demonstrated that more than half of the respondents understand the term food safety correctly, comparable with professional definition. In one-meaning statements it was connected with hazards for human health and in multiple-meaning statements it was understudied as factors, important for total food supply chain safety. A complexity of the term studied asks for deeper, multi-dimensional approaches in researching these phenomena.

The results of performed analyses can be an effective tool for creating educational material for consumers. For efficient risk communication, scientists and/or educators must identify the full range of consumer concerns. Risks should be determined and monitored and consumers should be educated how to control and/or reduce them. When this trust is established than benefits provided by new product or technology are public acceptable. Lack of knowledge and misunderstanding can lead consumers to avoid new or traditional products that offer important benefits. Consumers' interpretation of the term food safety is extremely important issue for producers, but can not be delivered properly to the consumer if education is not involved.

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References

- BÁNÁTI, D. & LAKNER, Z. (2003): Modern biotechnology and the Hungarian consumers. *Acta Alimentaria*, 32(Spplement), 5-23.
- BÁNÁTI, D. & LAKNER, Z. (2006): Knowledge and acceptance of genetically modified foodstuffs in Hungary. *J. Fd Nutr. Res.*, 45(2), 62-68.
- BRUHN, C.M. (2005): Explaining the concept of health risk versus hazards to consumers. *Fd Control*, 16, 487-490.
- DENZIN, N.K. & LINCOLN, Y.S. (1994): Handbook of qualitative research. Thousand Oaks, London, New Delhi: Sage Publications, 643 pp.
- EC (2002): Regulation of the European Parliament and of the Council No. 178 of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. *O. J.*, L 31/1.
- EC (2004): Regulation of the European Parliament and of the Council No. 852 of 29 April 2004 on the hygiene of foodstuffs. *O. J.*, L 226/3.
- EUROBAROMETER. (2006): Risk issues. Special Eurobarometer No. 238/Wave 64.1 – TNS Opinion & Social. Fieldwork September – October 2005. European Commission, (available on-line: http://www.bfr.bund.de/cm/221/risk_issues_executive_summary_on_food_safety.pdf).
- FAO/WHO (2003): Codex Alimentarius, Basic text on food hygiene. 3rd ed., Italy, 75 pp.
- FIFE-SCHAW, C. & ROWE, G. (1996): Public perceptions of everyday food hazards: a psychometric study. *Risk Anal.*, 16, 487–500.
- GARAYOA, R., CORDOBA, M., GARCIA-JALON, I., SANCHEZ-VILLEGAS, A. & VITAS, A. I. (2005): Relationship between consumer food safety knowledge and

- reported behavior among students from health sciences in one region of Spain. *J. Fd Prot.*, 68, 2631-2636.
- GRIFFITH, C.J. (2000): Food safety in catering establishments. -in: FARBER, J.M. & TODD, E.C.D. (Eds), *Safe Handling of Foods*, Marcel Dekker, Oshawa, pp. 235-256.
- GROBE, D., DOUTHITT, R. & ZEPEDA, L. (1999): A model of consumers risk perceptions toward recombinant bovine growth hormone (rgGH): the impact of risk characteristics. *Risk Anal.*, 19, 661-673.
- HILLERS, V.N., MEDEIROS, L., KENDALL, P., CHEN, G. & DIMASCOLA, S. (2003): Consumer food-handling behaviors associated with prevention of 13 foodborne illnesses. *J. Fd Prot.*, 66, 1893-1899.
- IVZ. (2005). Epidemiološko spremljanje nalezljivih bolezni v Sloveniji v letu 2003. (Epidemiological tracing of infectious diseases in Slovenia in 2003.). Inštitut za varovanje zdravje Republike Slovenije, (available on-line: http://www.ivz.si/javne_datoteke/datoteke/798-Epidemiolosko_spremljanje_nalezljivih_bolezni_2003.pdf).
- JAY, L.S., COMAR, D. & GOVENLOCK, L.D. (1999): A video study of Australian domestic food-handling practices. *J. Fd Prot.*, 62, 1285-1296.
- JEVŠNIK, M., HLEBEC, V. & RASPOR, P. (2006): Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35, 319-353.
- JEVŠNIK, M., HLEBEC, V. & RASPOR, P. (2007a): Consumers' awareness of food safety from shopping to eating. *Fd Control*, (in press, corrected proof, available on-line: <http://www.sciencedirect.com>).
- JEVŠNIK, M., HOYER, S. & RASPOR, P. (2007b): Food safety knowledge and practices among pregnant and non-pregnant women in Slovenia. *Fd Control*, (in press, corrected proof, available on-line: <http://www.sciencedirect.com>).
- JONES, M.V. (1998): Application of HACCP to identify hygiene risks in the home. *Int. Biodeter. & Biodegrad.*, 41, 191-199.
- KENDALL, P.A., ELSBERND, A., SINCLAIR, K., SCHROEDER, M., CHEN, G., BERGMANN, V., HILLERS, V.N. & MEDEIROS, L.C. (2004): Observation versus self-report: validation of a consumer food behavior questionnaire. *J. Fd Prot.*, 67, 2578-2586.
- KENNEDY, J., JACKSON, V., BLAIR, I.S., MCDOWELL, D.A., COWAN, C. & BOLTON, D.J. (2005): Food safety knowledge of consumers and the microbiological and temperature status of their refrigerators. *J. Fd Prot.*, 68, 1421-1430.
- LI-COHEN, A.E. & BRUHN, C.M. (2002): Safety of consumer handling of fresh produce from the time of purchase to the plate: a comprehensive consumer survey. *J. Fd Prot.*, 65, 1287-1296.
- McCABE-SELLERS, B.J. & BEATTIE, S.E. (2004): Food safety: Emerging trends in foodborne illness surveillance and prevention. *J. Amer. Diet. Assoc.*, 104, 1708-1717.
- MESEC, B. (1998): Uvod v kvalitativno raziskovanje v socialnem delu. (Introduction in qualitative research in social work. Ljubljana.), Univerza v Ljubljani, Fakulteta za socialno delo; Ljubljana, 470 pp.
- PATIL, S.R., CATES, S. & MORALES, R. (2005): Consumer food safety knowledge, practices, and demographic differences: findings from a meta-analysis. *J. Fd Prot.*, 68, 1884-1894.

- PATIL, S.R., MORALES, R., CATES, S., ANDERSON, D. & KENDAL, D. (2004): An application of meta-analysis in food safety consumer research to evaluate consumer behaviors and practices. *J. Fd Prot.*, 67, 2587-2595.
- RASPOR, P. & JEVŠNIK, M. (2008): Good nutritional practice from producer to consumer. *Crit. Rev. Fd Sci. & Nutrit.*, 48, 276-292.
- RASPOR, P. (2004): Sedanji pogled na varnost živil. (Current viewpoint on food safety.). - in: GAŠPERLIN, L. & ŽLENDER, B. (Eds) Varnost živil (*Food safety*), 22. Bitenčevi živilski dnevi, Radenci, 18. in 19. marec, 2004; Biotehniška fakulteta, Oddelek za živilstvo, Ljubljana, pp. 1-14.
- REDMOND, E.C. & GRIFFITH, C.J. (2003): Consumer food handling in the home: a review of food safety studies. *J. Fd Prot.*, 66, 130-161.
- RÖHR, A., LUDDECKE, K., DRUSCH, S., MULLER, M.J. & ALVENSLEBEN, R.V. (2005): Food quality and safety – consumer perception and public health concern. *Fd Control*, 16, 649-655.
- ROSATI, S. & SABA, A. (2004): The perception of risks associated with food-related hazards and the perceived reliability of sources of information. *Int. J. Fd Sci. Technol.*, 39, 491-500.
- SABA, A. (2001): Factors influencing consumers food choice. -in: FREWER, L., RISVIK, E., SCHIFFERSTEIN, H. (Eds), *Food, People and Society: a European Perspective of Consumers' Food*. Springer, Berlin, pp. 233-246.
- SIDERER, Y., MAQUET, A., & ANKLAM, E. (2005): Need for research to support consumer confidence in the growing organic food market. *Trends in Food Sci. & Technol.*, 16, 332-343.
- SLOVIC, P. (1993). Perceived risk, trust and democracy. *Risk Anal.*, 13, 675-682.
- SPARKS, P. & SHEPHERD, R. (1994a): Public perceptions of food-related hazards: individual and social dimension. *Food Qual. & Pref.*, 5, 185-193.
- SPARKS, P. & SHEPHERD, R. (1994b): Public perceptions of the potential hazards associated with food production and food consumption. An empirical study. *Risk Anal.*, 14, 799-805.
- STRAUSS, L.A. (1996): *Qualitative analysis for social scientists*. Cambridge University Press; Cambridge, New York, Melbourne, 319 pp.
- SUDERSHAN, R.V., SUBBARAO, G.M., PRATIMA RAO, VISHNU VARDHANA RAO, M. & KALPAGAM POLASA. (2007): Food safety related perceptions and practices of mothers – A case study in Hyderabad, India. *Fd Control*, (in press, corrected proof, available on-line: <http://www.sciencedirect.com>).
- UNUSAN, N. (2007): Consumer food safety knowledge and practices in the home in Turkey. *Fd Control*, 18, 45-51.
- VEBEKE, W., FREWER, L.J., SCHOLDERER, J, D.E. & BRABANDER, H.F. (2007): Why consumers behave as they do with respect to food safety and risk information. *Anal. Chim. Acta*, 578, 2-7.
- WHO. (2007): Countries urged to be more vigilant about food safety. World Health Organization, Media Centre. (Available on-line: <http://www.who.int/mediacentre/news/releases/2007/pr39/en/index.html>).
- WILLIAMS, P.R.D. & HAMMITT, J.K. (2001): Perceived risks of conventional and organic produce: pesticides, pathogens, and natural toxins. *Risk Anal.*, 21, 319-330.
- YANG, S., ANGULO, F.J. & ALTEKRUSEM, S.F. (2000): Evaluation of safe food-handling instruction on raw meat and poultry products. *J. Fd Prot.*, 63, 1321-1325.

3 POVEZOVALNA RAZPRAVA IN SKLEPI

Izhajajoč iz delovne hipoteze (A in B), predstavljene v Preglednici 1, smo prišli do pomembnih ugotovitev s ciljem integralnega vrednotenja vključitve sistema HACCP pri zagotavljanju varnih živil.

Glavni namen dela je ugotoviti dejansko stanje obvladovanja varnosti živil na različnih stopnjah živilsko/prehransko/oskrbovalne verige. Zaradi kompleksnosti obravnavane tematike je delo sestavljeno iz petih elementov, od katerih vsak element predstavlja zaključeno enoto in je hkrati povezovalni člen z ostalimi elementi. Prvi element raziskave, obravnavan v delu »Good nutritional practice from producer to consumer«, opisuje izhodišča problematike zagotavljanja varnosti živil in izpostavi tveganja v živilsko/prehransko/oskrbovalni verigi, ki jih predstavljajo različne, med seboj formalno nepovezane, dobre prakse in človek v sistemu HACCP. V drugem elementu raziskave, objavljene v delu »Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety«, je opredeljen raziskovalni problem, ki vključuje celovit pregled literature o vrstah in vzrokih ovir pri vzpostavitvi in obvladovanju sistema HACCP. Objektivna ocena higiensko tehničnega stanja v prehranskih objektih je predstavljena kot tretji element in je objavljena v delu »Hygienic status of small and medium sized food enterprises during adoption of HACCP system«. Delo združuje celovit vsebinski in metodološki pristop pri proučevanju ovir za učinkovitost sistema HACCP v prehranskih objektih. Četrty element obsega analizo dejanskega stanja obvladovanja varnosti živil v pridelavi, proizvodnji, prometu, pripravi in ravnanju z živili doma. Rezultati analize so obravnavani v petih delih: »Attitudes towards national safety and hygiene demands (GAP, GHP, HACCP) among Slovenian sauerkraut growers«; »Integrity insight in maintaining food safety among food handlers in Slovenia«; »Consumers' awareness of food safety from shopping to eating«; »Food safety knowledge and practice among pregnant and non-pregnant women in Slovenia« in »Consumer interpretation of the term food safety«.

Peti element »Tveganja na poti od polja do mize« združuje rezultate vseh zgoraj navedenih raziskav in jih povzema v slovenskem jeziku. Namen tovrstnega preglednega dela je prikazati pomembne ugotovitve na področju zagotavljanja varnih živil v živilsko/prehransko/oskrbovalni verigi in opozoriti na pomembnost razvoja in poenotenja strokovne terminologije na področju varnosti živil.

Namen prvega elementa raziskave je predstaviti in analizirati vrste in namen sedanjih dobrih praks skozi zgodovinski oris potrebe po vzpostavitvi dobre proizvodne prakse, ki je postavila temelje za razvoj ostalih praks. Predpostavljali smo, da ima lahko sedanji način obvladovanja varnosti živil pomanjkljivosti v smislu samozadostnosti posamezne dobre prakse in nepovezovanja vključenih v živilsko/prehransko/oskrbovalno verigo, vključno z zadnjim členom verige, s potrošnikom.

Skozi vsebinsko analizo obstoječega sistema za zagotavljanje varnosti živil in aktualnih dobrih praks smo ugotovili, da v vseh dosedanjih sistemih in praksah ne najdemo dobre prakse, ki bi obsegala vse postopke, pomembne za pridelavo, predelavo in dodelavo ter pripravo živila/hranila/obroka za končnega potrošnika. Izkaže se, da se vsi sistemi celovitega obvladovanja kakovosti, kamor sodijo dobre prakse in sistem HACCP, približujejo potrošniku, vendar se ga ne dotaknejo, čeprav so postavljene z namenom, da bi mu služile, ga puščajo zunaj svojega obsega. Pomanjkljivost sedanjih sistemov je v njihovi

samozadostnosti, ker temeljijo na obvladovanju postopkov dela, specifičnih za posamezno prakso in ne na upoštevanju realnosti dotikajočih se sistemov. Z vsebinsko analizo koncepta posamezne dobre prakse, izhajajoč iz aktualnih definicij posamezne prakse, smo določili glavna področja delovanja posamezne prakse ter spremljajoča področja, ki celovito opredelijo posamezno prakso (opisano v poglavju 2.1.1). Z iskanjem skupnih vsebinskih konceptov dobrih praks smo identificirali šest področij, ki so značilna za vse dobre prakse, in sicer: komunikacija, nadzor, dokumentacija, izobraževanje, človeški viri in usposabljanje. Značilnost skupnih področij je, da so v neposredni povezavi s človeškim faktorjem, katerega znanje, veščine in pretok informacij so pogoj za zagotavljanje varnosti živil v danem okolju. Izhajajoč iz omenjenega spoznanja in z namenom uravnoteženja analiziranih sistemov, ki bi se morali celovito osredotočiti na zagotavljanje varnosti živil, je kot rezultat obstoječega stanja predlagan nov pristop, imenovan Dobra prehranska praksa (DPP). Gre za nov pristop k obvladovanju varnosti živil, ki v cilju zagotavljanja celovite oskrbe potrošnika z zdravstveno ustrezno hrano/živili, temelji na izobraženem in strokovno usposobljenem človeku, ki vstopa v sistem. Prikazana je pomembnost združevanja sedanjih načinov obvladovanja varnosti živil znotraj DPP, ki vključuje potrošnika in združuje vse sisteme, ki ob postavitvi DPP postanejo le podsistemi. Strukturno je DPP predstavljena kot platforma varnosti živil (Slika 3, str. 20), ki združuje podsisteme sedanjih devetih dobrih praks in sistema HACCP ter jasno opredeli novo dimenzijo tveganj pri zagotavljanju varnih živil, t.i. človeški faktor.

3.1 POVEZOVALNA RAZPRAVA

Z namenom preverjanja delovne hipoteze (A in B) so v znanstvenih delih uporabljeni različni metodološki pristopi, in sicer: kvantitativni, kvalitativni in kombinirani. Tako prvi kot drugi del hipoteze smo z različnimi raziskovalnimi instrumenti preverjali v vseh stopnjah živilsko/prehransko/oskrbovalne verige (Preglednica 1).

Preglednica 1: Rezultati preverjanja delovne hipoteze: (A) Medsebojno nezaupanje in nesodelovanje vključenih v posamezno stopnjo živilske verige je vzrok neučinkovitosti sistema HACCP ter (B) Do nedopustnega odstopanja v sistemu HACCP pride v kritičnih razmerah zaradi človeškega faktorja in prikaz uporabljenih metodoloških pristopov ter merskih instrumentov v publiciranih znanstvenih delih.

Št. ¹	Metodološki pristopi / merski instrumenti	Hipoteza ²	
		A	B
2.1.2	Meta-analiza	-	+
2.1.3	Opazovanje	+	+
	Strukturirani intervjuji	+	+
	Objektivna ocena snažnosti	-	+
2.1.4	Anketni vprašalnik	+	+
2.1.5	Anketni vprašalnik	+	+
2.1.6	Anketni vprašalnik	+	+
2.2.1	Anketni vprašalnik	-	+
	Nestrukturirani intervjuji	+	+
2.2.2	Kvalitativna analiza vsebine	+	-

¹ Zaporedna številka znanstvenega dela, predstavljenega v poglavju (2.1) Objavljena znanstvena dela in (2.2) Ostalo povezovalno znanstveno delo.

² Potrditev hipoteze (+), zavrnitev hipoteze (-).

Vsebinske in metodološke ugotovitve rezultatov meta-analize (opisano v poglavju 2.1.2) so bile vodilo pri oblikovanju merskih instrumentov za potrebe raziskave, ki so raziskovani problematiki primerno vključevali tako kvantitativne kot kvalitativne pristope, podrobneje predstavljene v posameznih znanstveno raziskovalnih delih.

3.1.1 HACCP kot dejavnik sodelovanja v živilski verigi

Poglavje začnemo s spoznanjem o terminološki nepoenotnosti na področju varnosti živil (opisano v poglavju 2.1.2). Če izpostavimo termin »živilska veriga« ugotovimo, da je preozek in nepoenoten s pomenom besede v angleškem jeziku »Food Supply Chain«, od koder je bil povzet. Če želimo natančno pojasniti in razumeti slogan, ki se v angleškem jeziku glasi »From Farm to Fork«, v slovenskem pa »Od polja do mize« ali »Od vil do vilic«, je potrebno termin »živilska veriga« preimenovati v »živilsko/prehransko/oskrbovalna veriga«. Nov termin izpostavi tri pomembna področja: živilstvo, prehrano in oskrbo, ki povežejo dobre prakse na poti od polja do mize v sklenjen krog zagotavljanja varnih in zdravih živil za potrošnika. Sporočilo nove terminološke paradigme poudari koncept zdravja in varnosti, ki sta gradnika kakovosti življenja.

Prvi del hipoteze (A), ki pravi, da je medsebojno nezaupanje in nesodelovanje vključenih v posamezno stopnjo živilske verige vzrok neučinkovitosti sistema HACCP, smo z rezultati meta-analize (opisano v poglavju 2.1.2) ovrgli. V celoti (opisano v poglavju 2.1.4) ali delno (opisano v poglavjih 2.1.3 in 2.2.1) smo jo potrdili v raziskavah, ki obravnavajo zaposlene pri delu z živali. Prav tako smo jo v celoti potrdili v raziskavah, ki obravnavajo potrošnika (opisano v poglavjih 2.1.5, 2.1.6 in 2.2.2).

Raziskava o aktivnostih in dejavnikih, ki vplivajo na zagotavljanje varnosti živil, med 386 zaposlenimi v gostinstvu, proizvodnji in trgovini, je omogočila odkriti bistvene elemente, ki kot zakriti dejavniki tveganj vplivajo na učinkovitost sistema HACCP (opisano v poglavju 2.1.4). Elementi so vezani na medsebojne odnose na delovnem mestu (vertikalne in horizontalne), zadovoljstvo z delom in motivacijo za delo. Zanimivo je, da bi večina zaposlenih ponovno izbrala podjetje, v katerem so zaposleni, če bi se še enkrat odločili za isti poklic, vendar se s to trditvijo strinja značilno več trgovcev kot proizvajalcev. Manj pozitivne so trditve, ki se nanašajo na zadovoljstvo s plačo, zanimivost sedanjega dela in komunikacijo med sodelavci in nadrejenimi. Z lestvico, ki je merila mnenje zaposlenih o sodelavcih, smo ugotovili visoko stopnjo strinjanja s trditvami, ki se nanašajo na dobro razumevanje s sodelavci, vendar se razlike v povprečnih vrednostih po skupinah zaposlenih značilno razlikujejo. Proizvajalci so značilno slabše ocenili razumevanje s sodelavci, saj jih le-ti bolj ovirajo in imajo od njih manj pomoči kot gostinci. Prav tako so proizvajalci mnenja, da jih sodelavci značilno bolj ignorirajo, so bolj sebični in se manj zavzamejo za njih, v primerjavi z gostinci in trgovci. Mnenje zaposlenih o njihovih nadrejenih je v povprečju dokaj dobro, vendar so v povprečnih vrednostih značilne razlike med skupinami. Proizvajalci so značilno slabše ocenili nadrejene kot ostali dve skupini, še posebej pri trditvi, da jih nadrejeni nagradijo za dobro opravljeno delo.

Preko trditve, ki merijo zadovoljstvo z delom in motivacijo za delo, smo ugotovili nizko stopnjo zadovoljstva glede možnosti napredovanja na delovnem mestu, delovnih pogojev in plače ter s tem, kako nadrejeni cenijo delo zaposlenih. Pri vseh trditvah smo v

povprečjih po skupinah zaposlenih ugotovili značilne razlike, in sicer značilno nižjo stopnjo zadovoljstva med skupino zaposlenih v proizvodnji, v primerjavi z ostalima skupinama.

Navedene ugotovitve potrjujejo, da je eden od vzrokov neučinkovitosti sistema HACCP medsebojno nesodelovanje vključenih v posamezno stopnjo živilsko/prehransko/oskrbovalne verige, katerega posledica je nezaupanje med zaposlenimi na horizontalni in vertikalni ravni. S tem smo izpostavili pomen organizacijskih in psihosocialnih dejavnikov, ki so del organizacijske kulture podjetja. Očitno je, da vodstvo živilskih podjetij postavlja ekonomski vidik pred ostale dejavnike, pomembne za uspešnost podjetja, kar predstavlja dodatno tveganje za varen in kakovosten končni izdelek. Brajša (1996) navaja, da ni dovolj, da zaposlenim zagotovimo dobro plačo, sodobno tehnologijo, ugodne delovne razmere, zaposlitev, ampak jim je prav tako potrebno priznati, da so uspešni, jim prepustiti odgovornost, jim pomagati, da spoznajo smisel in rezultate svojega dela. Zavedati se je potrebno, da je osnovna celica uspešnosti vsakega podjetja posameznik, ki prispeva k uresničitvi skupne vizije in ciljev podjetja (Zupan, 2001). Marolt in Gomišček (2005) opisujeta nov pristop managementa k zaposlenim, ki spodbuja zaposlene k iniciativnosti, pripravljenosti do učenja, predanosti organizaciji, samozaupanju, večji učinkovitosti in boljšemu timskeemu sodelovanju, kar vse prispeva k večji uspešnosti in učinkovitosti organizacije. Pri tem izpostavita funkcijo voditeljstva, ki ima glavno vlogo pri realizaciji novih načel v prakso in lahko močno prispeva k boljši izkoriščenosti obstoječih virov.

Prvi del hipoteze smo z uporabo kombiniranega metodološkega pristopa dodatno potrdili v raziskavi z opazovanjem delovnih pogojev in delovnega procesa v malih in srednje velikih prehranskih obratih (opisano v poglavju 2.1.3). Rezultati raziskave kažejo higiensko tehnične pomanjkljivosti in/ali nepravilnosti v obeh skupinah obratov. Večina srednje velikih je prostorsko omejenih in ni gradbeno tehnično ustrezno opremljenih (npr. dotrajana oprema, neustrezni in dotrajani materiali, kar onemogoča učinkovito higiensko vzdrževanje) za opravljanje prehranske dejavnosti (Tabela 1, str. 66). Podobne ugotovitve navajajo tudi Baš in sod. (2006). Higienske pogoje za umivanje rok smo v malih obratih ocenili kot pomanjkljive in zaskrbljujoče. Nekateri obrati ne izpolnjujejo niti minimalnih higienskih pogojev za delo z živili (npr. umivalnika za umivanje rok sploh ni ali pa je le-ta neustrezno nameščen, tako da ne preprečuje križanja čistih in nečistih poti) (Tabela 2, str. 68), kar vpliva na možnost prenosa različnih mikroorganizmov. Aarnisalo in sod. (2006) so z analizo rezultatov številnih študij ugotovili, da je lahko oprema v živilsko/prehransko/oskrbovalnih obratih vir onesnaženja z različnimi patogenimi mikroorganizmi, med katerimi so izpostavili bakterijo *Listeria monocytogenes*. Ugotovitve kažejo na neučinkovito vertikalno komunikacijo oziroma nesodelovanje vodilnih struktur z ostalimi zaposlenimi. Vse premalo pozornosti je namenjenih higiensko tehničnim elementom, ki so bistveni za učinkovito delo po zahtevah dobrih praks.

Problem torej izhaja iz pretirane samozadostnosti vodilnih struktur v obravnavanih podjetjih, katerih cilji niso vedno v skladu s potrebami in pričakovanji zaposlenih glede vrste in zahtevnosti dela. S tem se izpostavi potreba po učinkovitejšem sodelovanju tako med zaposlenimi v podjetju kot tudi med vodilnimi strukturami podjetja in različnimi strokovnimi službami.

Tudi v raziskavi s kombiniranim metodološkim pristopom med pridelovalci zelja in proizvajalci kislega zelja (v nadaljevanju kisarji) potrjujemo problem nesodelovanja in nezaupanja na ravni pridelovalec/predelovalec in strokovnjaki pristojnih služb svetovanja in nadzora (opisano v poglavju 2.2.1). Anketna raziskava je pokazala pozitivno povezavo

med vključevanjem pristojnih strokovnih služb (Kmetijsko gozdarske zbornice (KGZ) Republike Slovenije in inšpekcijskih služb) na dokaj dobro stopnjo informiranosti kisarjev o načelih in namenu dobre kmetijske in dobre higienske prakse ter sistemu HACCP (Tabele 1-4, str. 133-135). Rezultati nestrukturiranih intervjujev pa so osvetlili nekatere negativne individualne izkušnje kisarjev, ki se kažejo kot nezaupanje, nezadovoljstvo in predvsem razočaranje nad omenjenimi službami (str. 143). Izpostavljen je problem komunikativnosti strokovnjakov in nivo njihovega strokovnega znanja ter neutemeljenost potrebe po vzpostavitvi sistema HACCP, ki je ocenjen kot nepotrebno breme in delo za inšpektorje. Slednje odpira pomembno vprašanje o usposobljenih in kompetentnih strokovnjakih na obravnavanem področju. Poznavanje področja dela in razumevanje predpisanih zahtev je bistveno za strokovnjake v vlogi svetovanja in nadzora. Nedvomno vpliva nivo strokovnega znanja svetovalcev na zaupanje izvajalcev in posledično omogoči osnovo za dobro sodelovanje med njimi. Torej obstaja povezava med stopnjo zaupanja in sodelovanja vključenih ter učinkovitostjo sistema HACCP v praksi.

Če primerjamo rezultate kvantitativne in kvalitativne analize v raziskavi obvladovanja varnih živil v stotih prehranskih objektih (opisano v poglavju 2.1.3) in med kisarji (opisano v poglavju 2.2.1), lahko vidimo, da se dopolnjujejo in jasno pokažejo nekatera nasprotja, kar z enostranskim metodološkim pristopom ne bi bilo mogoče ugotoviti. Na primer z anketnim vprašalnikom smo ugotovili, da je upoštevanje načel dobre higienske prakse anketiranim zelo pomembno, kar pa z opazovanjem vključevanja zaposlenih v delovni proces ne moremo potrditi, saj več kot polovica zaposlenih ne spoštuje pravil higiene rok med delom z živili. Še posebej izrazito se nasprotja pokažejo na primeru analize doživljanj delovnega procesa med intervjuvanimi kisarji. Izkaže se, da spoštovanje tradicionalnih postopkov dela ter odnos do dela zasenčijo zahtevo po implementaciji sistema HACCP. Intervjuvanci namreč menijo, da je pomembna ljubezen do tovrstnega dela in spoštovanje tradicionalnih znanj, ki so se generacijsko prenašala skozi rodove. Slednje negativno vpliva na potrebo po dokumentiranju določenih proizvodnih aktivnosti/parametrov med tehnološkim procesom. Pomembno nasprotje se kaže tudi med laičnim in strokovnim pojmovanjem dejavnikov tveganj na poti od pridelave surovine do končnega izdelka, v našem primeru kislega zelja.

Kompleksnost ugotovitev dodatno izpostavi potrebo po vključitvi kombiniranih metodoloških pristopov, ki omogočajo več dimenzionalno sliko o proučevani problematiki, tako z zornega kota statistike kot analize tekstov. Pri preverjanju prvega dela hipoteze smo posredno potrdili tudi drugi del hipoteze (B), ki pravi »Do nedopustnega odstopanja v sistemu HACCP pride v kritičnih razmerah zaradi človeškega faktorja.« Z gotovostjo lahko trdimo, da je potrebno človeški faktor kot dejavnik tveganja na področju živilstva obravnavati na dveh ravneh, in sicer neposredno – kot zaposlene pri delu z živili in posredno – kot zaposlene v funkciji svetovanja in nadzora.

Problematika sodelovanja pristojnih strokovnih služb se je pokazala tudi pri proučevanju zadnjega, najšibkejšega člena živilsko/prehransko/oskrbovalne verige – potrošnika. Z rezultati kvantitativne raziskave smo ugotovili, da je potrošnik na splošno premalo informiran o tveganjih med nakupom in pri delu z živili doma (opisano v poglavju 2.1.5 in 2.1.6). Nizka stopnja informiranosti je še posebej izrazita med rizično skupino prebivalstva, skupino nosečih žensk. Le-te v času organiziranega izobraževanja med nosečnostjo ne prejmejo zadostnih informacij o tveganjih pri pripravi hrane doma (Tabela

3, str. 108, opisano v poglavju 2.1.6) in pri uživanju hrane izven doma. Nekatere nepravilnosti (npr. nepravilni načini odmrzovanja živil, ponovnega pogrevanja in čiščenja) lahko vplivajo na pojav bolezni povzročenih s hrano doma (Tabela 4, str. 109). Nosečnost in poporodni čas je obdobje, ko je ženska v skrbi za zdravje otroka in svoje zdravje zelo motivirana za pridobivanje informacij s področja javnega zdravstva. Z rezultati omenjenih raziskav nakazujemo nujnost priprave splošnega gradiva o zagotavljanju varnosti živil za potrošnike in gradiv z opredelitvijo specifičnih vsebin za rizične skupine prebivalstva. Da so različne oblike izobraževanja nosečnic učinkovite, navajajo Athearn in sod. (2004), ki so ugotovili, da je proučevana skupina nosečnic po izobraževanju delno spremenila način prehrane v nosečnosti in upoštevala sedem od dvanajstih priporočil. Glede načina informiranja smo ugotovili, da so brušure ali zloženke, ki jih dobijo ljudje na dom, in televizijske oddaje najbolj priljubljena oblika informiranja.

Kvalitativna analiza teksta (opisano v poglavju 2.2.2) pa nam je omogočila ugotoviti način razumevanja pojma varnosti živil med potrošniki. Iz analize je razviden vpliv medijev o medijsko odmevnih aferah glede zastrupitev z živili in nevarnostmi za zdravje, saj je tretjina respondentov pojem varnost živil povezala z dejavniki tveganja za zdravje (Graf 1, str. 152), kar je v povezavi s strokovno definicijo. Ostali respondenti povezujejo pojem z zdravjem, tehnološkim procesom, nadzorom in načinom pridelave živil ali pa sploh ne vedo, kaj le-ta pomeni. Z rezultati dodatno potrjujemo ugotovitev, da je večina potrošnikov premalo informirana o načelih zagotavljanja varnosti živil in da je nivo vključevanja strokovnih služb, posebej na področju informiranja, nezadosten.

3.1.2 Človek kot dejavnik tveganja v sistemu HACCP

Drugi del hipoteze (B) »Do nedopustnega odstopanja v sistemu HACCP pride v kritičnih razmerah zaradi človeškega faktorja« smo potrdili v vseh raziskavah (razen v raziskavi 2.2.2), ki so obravnavale posamezno stopnjo živilsko/prehransko/oskrbovalne verige (Preglednica 1) in v teoretičnem delu raziskave, ki je vključevala pregled dokumentacijskih virov na področju ugotavljanja ovir za učinkovitost sistema HACCP (opisano v poglavju 2.1.2). Kritične razmere smo opredelili kot vsa ravnanja pri delu z živili, ki niso v skladu s principi dobrih praks in lahko ogrozijo varnost živil ter posledično vplivajo na zdravje potrošnika. Preko različnih kazalcev kritičnih razmer, opredeljenih v metodologiji posameznega dela, smo med proučevanjem različnih skupin zaposlenih pri delu z živili in med potrošniki ugotovili, da je žarišče problema zagotavljanja varnosti živil premalo izobražen, usposobljen, motiviran in/ali zadovoljen človek. Izkaže se, da je potrebno človeka, ki vstopa v procese dela z živili, obravnavati enakovredno kot ostale dejavnike tveganj.

Z metodo meta-analize (opisano v poglavju 2.1.2) smo s teoretične perspektive potrdili drugi del hipoteze. Preko vsebinskih in metodoloških kriterijev smo analizirali dvanajst znanstvenih del in ugotovili dejavnike, ki vplivajo na učinkovitost sistema HACCP ter uporabljene metodološke pristope. Vsebinska analiza znanstvenih del o vrstah in vzrokih ovir pri implementaciji in delovanju sistema HACCP je pokazala, da imata največji faktor vpliva na učinkovitost sistema HACCP oviri: nezadostno usposabljanje zaposlenih in človeški viri na splošno (Graf 1, str. 49). Sledijo ovire: načrtovanje, znanje in kompetence, dokumentacija in viri na splošno. V obravnavo je bilo vključenih tudi sedem strokovnih

del, ki so izpolnjevala le vsebinski kriterij in so bila zaradi metodološke šibkosti izključena iz meta-analize. Za razliko od znanstvenih del so v strokovnih delih ovire obravnavane subjektivno, na podlagi pregleda literature in praktičnih izkušenj avtorjev. Ugotovitve kažejo, da tudi avtorji strokovnih del pripisujejo največjo oviro za učinkovitost sistema HACCP različnim virom, tako človeškim kot tudi ostalim, predvsem finančnim (pomanjkanje denarja za izobraževanja in usposabljanja) in časovnim (pomanjkanje časa za delo po sistemu HACCP). V delih, ki so obravnavala zaposlene pri delu z živili (opisano v poglavjih 2.1.3 2.1.4 in 2.2.1), smo s kombiniranimi metodološkimi pristopi potrdili ugotovitve teoretičnega dela raziskave o vrstah ovir pri implementaciji in delovanju sistema HACCP. Razlika se je pokazala le v rangiranju ovir glede njihovega vpliva na učinkovitost sistema. Medtem ko v teoretičnem pregledu skoraj polovica ovir pripada področju ravnanja s človeškimi viri, je bilo v praktičnem delu raziskave, poleg nezadostnega izobraževanja in usposabljanja zaposlenih, v enaki meri zaslediti tudi oviro glede higienske in tehnične opremljenosti prehranskih objektov.

Pri obravnavanju ovir je potrebno izpostaviti, da uporabljajo avtorji analiziranih del različne termine za vsebinsko in pomensko sorodne ovire, kar je oviralo njihovo razvrščanje in primerjavo z ugotovitvami praktičnega dela raziskave. Ugotovitev nakazuje potrebo po enotnem načinu razvrščanja vsebinsko in pomensko sorodnih ovir, tako v strokovnih kot v znanstvenih krogih. Korak v tej smeri smo naredili s prikazom novega koncepta terminološke klasifikacije ovir, ki temelji na enaindvajsetih elementih, rangiranih po faktorju vpliva na učinkovitost sistema HACCP (opisano v poglavju 2.1.2). Za preverjanje ustreznosti klasificiranja in globljega razumevanja obravnavane problematike smo s pomočjo relevantne strokovne literature širše orisali pomen posameznega elementa (Tabela 9, str. 45-48). S tem smo odprli pot razvoju nove dimenzije kvalitativne obravnave vsebin na področju ugotavljanja učinkovitosti sistema za zagotavljanje varnosti živil.

Z anketno raziskavo med zaposlenimi pri delu z živili (opisano v poglavju 2.1.4) smo ugotovili pomanjkljivo znanje predvsem na področju poznavanja in preprečevanja mikrobioloških tveganj (npr. poznavanje temperature za vzdrževanje hladne in vroče verige) (Tabela 1, str. 85), kar so s primerljivimi raziskovalnimi instrumenti ugotovili tudi nekateri drugi avtorji (Walker in sod., 2003; Baş in sod., 2006; Baş in sod., 2007). Med proučevanimi skupinami zaposlenih ni bilo značilnih razlik. Polovica anketiranih npr. meni, da bi lahko po neprijetnem vonju, okusu ali izgledu z gotovostjo trdili, da je hrana okužena z bakterijami, ki povzročajo bolezni, povzročene s hrano, kar je primerljivo z rezultati Walker in sod. (2003). Med higienskimi kršitvami pri delu z živili so anketirani izpostavili neumivanje rok po uporabi sanitarij, uporabo nenamenskega delovnega pribora in nedosleden nadzor temperature v hladilnih napravah (Tabela 4, str. 87). Clayton in sod. (2002) navajajo, da se zaposleni pri delu z živili zavedajo pravil higienskega obnašanja, vendar se vedno ne vedejo skladno z njimi, kar še posebej velja za umivanje rok (Manning in Snider, 1993). Slednje se je potrdilo tudi v naši raziskavi z opazovanjem zaposlenih pri delu z živili in oceno higiensko tehničnih pogojev (opisano v poglavju 2.1.3). Z opazovanjem vključevanja zaposlenih v delovni proces smo ugotovili dokaj nizko stopnjo higienske zavesti, saj si več kot polovica zaposlenih v obeh skupinah objektov ne umije rok po vsakem nečistem opravilu (npr. ko prehajajo iz nečiste na čisto fazo dela, po rokovanju z embalažo, itd.) ali si jih ne umijejo dovolj učinkovito (npr. brez uporabe tekočega mila, površna tehnika umivanja rok, itd.), ne nosijo vedno pokrivala za zaščito las in nimajo vedno ustrezne in čiste delovne obleke (Tabela 2, str. 68). Tudi ugotovitve

nekaterih drugih avtorjev izpostavijo nizko stopnjo higienske zavesti zaposlenih. Na primer Henroid in Sneed (2004) navajata, da si približno tretjina zaposlenih v šolskih kuhinjah v ZDA ne umije rok vedno, kadar je to potrebno. Roke zaposlenih pri delu z živili so lahko ključni vektor prenosa povzročiteljev bolezni povzročenih s hrano zaradi nezadostne in/ali pomanjkljive osebne higiene ali navzkrižnega onesnaženja (Setiabudhi in sod., 1997). Taylor in sod. (2000) so ugotovili prenos enteropatogenih mikroorganizmov zaradi neustrezne higiene rok po uporabi sanitarij v območja priprave živil. Roke so pomemben vektor prenosa patogenih mikroorganizmov (Shojaei in sod., 2006), zato je nujno vpeljati učinkovitejše tehnike usposabljanja zaposlenih o osnovnih zahtevah osebne higiene pri delu z živili. S tem potrjujemo že ugotovljena dejstva (Clayton in sod., 2002), da prejeta znanje o higieni živil ne vodi vedno do spremembe vedenja zaposlenih.

Rezultate opazovanja delovnega procesa smo podkrepili še z objektivno metodo ocene snažnosti prehranskih obratov (opisano v poglavju 2.1.3). Za odvzem mokrih brisov na snažnost smo določili šest odvzemnih mest, ki so pokazatelji čistosti obrata in nakazujejo stopnjo higienske ozaveščenosti zaposlenih ter upoštevanje načel dobre higienske prakse. Izbirali smo mesta oziroma površine v čisti fazi dela in roke zaposlenega osebja. Rezultati mikrobiološke ocene snažnosti kažejo slabše higiensko stanje v malih obratih (Tabela 3, str. 70). Število poraslih bakterijskih vrst je bilo na delovnih površinah v manjših obratih značilno večje kot v srednje velikih, vendar ni preseгло normativov za skupno število mikroorganizmov v nobenem od odvzetih brisov. Na rokah zaposlenih so bakterije porasle v razponu od nekaj do 100 in več bakterij na posamezni roki. Identificirane so bile različne bakterijske vrste, med katerimi sta bili tudi patogeni bakterijski vrsti *Staphylococcus aureus* in *Pseudomonas aeruginosa* (Tabela 4, str. 71). Z rezultati potrjujemo predvidevanja, da zaposleni ne izvajajo dela vedno skladno z zahtevami dobrih praks, zato znanje zaposlenih v kritičnih razmerah ne dosega pričakovanega nivoja obvladovanja vseh postopkov za zagotavljanje varnega živila.

Na podlagi ugotovitev sklepamo, da je vestno izvajanje načel osebne higiene pogojeno s higiensko zavestjo in vzgojenostjo posameznika in ne samo s stopnjo izobraženosti in usposobljenosti za delo z živili. Po navedbah Seaman in Eves (2007) bo usposabljanje prineslo izboljšanje na področju varnosti živil le, če bo pridobljeno znanje vodilo k zelenim spremembam vedenja zaposlenih v delovnem okolju. Pri tem lahko dodamo, da je izobraževanje vodilnih struktur in odgovornih oseb pri delu z živili temeljnega pomena za dvig stopnje razumevanja predpisanih zahtev in higienske kulture podjetja. Z navedenimi rezultati potrjujemo predpostavko, da znanje zaposlenih v kritičnih razmerah ne dosega nivoja obvladovanja vseh postopkov pri zagotavljanju varnega živila in drugi del hipoteze, da prihaja do nedopustnega odstopanja v sistemu HACCP v kritičnih razmerah zaradi človeškega faktorja. Stopnja higienske zavesti je značilna za posameznika, zato je potreben individualen pristop z upoštevanjem specifične delovnega mesta. Prav tako bi morale imeti vodilne in odgovorne strukture zaposlenih znanja s področja ravnanja z ljudmi; še posebej za analizo usposobljenosti zaposlenih za specifično delo in za določanje motivacijskega profila posameznika.

Ne smemo zanemariti tudi dejstva, da smo tako v malih kot tudi v srednje velikih prehranskih obratih ugotovili nekatere higienske in gradbeno tehnične pomanjkljivosti in/ali nepravilnosti, ki ovirajo delo po zahtevah dobrih praks in slabijo učinkovitost sistema HACCP (opisano v poglavju 2.1.3). Večina srednje velikih obratov je prostorsko omejenih in ni gradbeno tehnično ustrezno opremljenih za opravljanje prehranske dejavnosti. Podobne ugotovitve navajajo tudi Baş in sod. (2006). Tehnične in higienske pogoje za

higieno rok smo v malih obratih ocenili kot pomanjkljive in zaskrbljujoče. V nekaterih obratih namestitve umivalnikov za umivanje rok v prostorih priprave živil ne preprečuje križanja čistih in nečistih poti. Higijenska opremljenost umivalnikov je bila pomanjkljiva predvsem v malih obratih. Zaradi prostorskih omejitev je bila namembnost sanitarnih prostorov v nekaterih malih in srednje velikih obratih neustrezna (npr. iste sanitarije uporabljajo gostje in zaposleni) ter pomanjkljivo higijensko opremljena, kar povečuje možnost prenosa bakterij fekalnega izvora. Ocena higijensko tehničnih pogojev za delo z živilom kaže, da je potrebno tudi delovno okolje obravnavati kot dejavnik tveganja preko analize organizacijskih in psihosocialnih kazalcev.

Rezultati kvantitativne raziskave med zaposlenimi kažejo, da se le-ti udeležujejo izobraževanj o higieni živil in kot najboljšo obliko pridobivanja znanj ocenjujejo interna izobraževanja, ki jih pripravijo strokovnjaki v podjetju (opisano v poglavju 2.1.4). Vendar z rezultati kvalitativne raziskave ne moremo potrditi, da so le-ti tudi dovolj usposobljeni za preprečevanje mikrobioloških tveganj pri delu z živilom. Ugotovili smo, da je proces izobraževanja in usposabljanja neučinkovit predvsem v malih podjetjih, saj izobraževanja v večini primerov izvajajo nekompetentne osebe, brez ustreznega strokovnega in pedagoškega znanja. Rezultati so primerljivi z rezultati drugih podobnih študij (Panisello in sod., 1999; Ramirez Vela in Martin Fernández, 2003; Yapp in Fairman, 2006), kjer avtorji ugotavljajo, da imajo zaposleni v manjših podjetjih pomanjkljivo znanje o higieni živil, manj izkušenj s sistemom HACCP in pomanjkanje ljudi, ki bi jim potrebno znanje posredovali, kar posledično vpliva na nezadostno razumevanje koristi dobrih praks in učinkovitost sistema HACCP. Izkaže se, da je spoštovanje načel dobre higijenske prakse v manjših obratih slabše tudi zaradi pomanjkanja nadzora s strani usposobljene odgovorne osebe. Zaposleni so v večini primerov prepuščeni sami sebi. Še posebej izrazito se to pokaže pri izpolnjevanju predpisanih evidenc po HACCP planu, saj smo v obeh skupinah prehranskih objektov ugotovili, da je dokumentacija o spremljajočih higijenskih programih pomanjkljiva in v nekaterih primerih tudi nepopolno izpolnjena. Mitchell (1998) navaja, da je HACCP plan včasih le »papirologija«, ki preobremeni mala podjetja in v praksi ne deluje. Slednja ugotovitev se pokaže tudi v našem primeru pri vseh raziskavah med zaposlenimi (opisano v poglavju 2.1.3, 2.1.4 in 2.2.1). Z opazovanjem delovnega procesa in intervjuji med zaposlenimi se je pokazala površnost oziroma nerazumevanje koristi beleženja parametrov/podatkov, saj se evidence v nekaterih primerih izpolnjujejo samo za potrebe inšpekcijskega pregleda oziroma za nazaj ali za naprej. Kot primer navajamo ugotovitev kvalitativne raziskave med kisarji. In sicer temperatura med procesom kisanja intervjuvanim ne predstavlja kritične kontrolne točke, saj menijo, da je zaradi letnega časa, v katerem poteka kisanje, vodenje evidenc nesmiselno. Poudarili so tudi pomembnost veselja za tovrstno delo, občutek za delo in organoleptično oceno, po kateri vedo, kakšna je kakovost in posledično varnost kislega zelja.

Potrebno se je zavedati dejstva, da so lahko živila onesnažena z različnimi mikroorganizmi in da se lahko njihovo število povečuje na različnih stopnjah od pridelave do predelave in nazadnje pri končni pripravi (Tauxe, 2002). Za zaposlene pri delu z živilom in za potrošnike je izjemnega pomena, da poznajo in razumejo mikrobiološka tveganja in načine obvladovanja le-teh. Potrošnik pričakuje, da bodo vsi akterji od polja do mize zagotavljali varnost živil, ga izobraževali in sproti obveščali o novostih. Rezultati kažejo, da ocenjuje potrošnik sebe kot najmanj odgovornega med ostalimi členi verige (Tabela 2, str. 96, opisano v poglavju 2.1.5). Ugotovljene so nekatere nepravilnosti pri delu z živilom, ki lahko vodijo do zastrupitev s hrano v domačem okolju (Tabela 5, str. 99-100), kar je še posebej

nevarno za rizično skupino potrošnikov – nosečnice (Tabela 4, str. 109, opisano v poglavju 2.1.6). Izkazuje se, da je skrb za varnost živil na nekaterih področjih ravnanja z živili večja pri rizični skupini kot pri ostalih anketiranih, kar potrjuje dejstvo, da so ženske v skrbi za svoje zdravje in zdravje otroka bolj dovzetne za tovrstne informacije oziroma se jih zavedajo in pri delu tudi upoštevajo. Slednje je še posebej značilno za mlajše in prvič noseče ženske.

Pri vseh skupinah anketiranih potrošnikov smo ugotovili, da namenljajo najmanj pozornosti preverjanju in zagotavljanju hladne verige hitro pokvarljivih živil. Pri rokovanju z živili doma se kaže nezadostno informiranje potrošnikov glede možnosti navzkrižnega onesnaženja (npr. nepravilno zaporedje priprave živil), postopkov pravilnega tajanja zamrznjenih živil, ohlajanja toplotno obdelanih jedi in ponovnega pogrevanja le-teh ter čiščenja delovnih pripomočkov. Rezultati so primerljivi s podobnimi tujimi študijami (Jay in sod. 1999; Meer in Misner, 2000; Kennedy in sod., 2005; Badrie in sod., 2006). Tudi glede higiene rok so bile ugotovljene nepravilnosti, ki lahko vodijo do zastupitev pri delu z živili doma, kar je še posebej nevarno za rizične skupine potrošnikov (v našem primeru skupine nosečnic). Delež tistih, ki si med pripravo pravilno umijejo roke, je nižji kot so ugotovili avtorji podobnih raziskav, npr. med potrošniki na Irskem (Kennedy in sod., 2005), v Trinidadu (Badrie in sod., 2006) in v Avstraliji (Jay in sod., 1999). Poleg tega je potrebno pri tehniki umivanja rok omeniti tudi čas trajanja umivanja, ki naj ne bi bil krajši od 20 sekund, če želimo, da so roke zadovoljivo čiste (Jay in sod., 1999). Zanimivo je, da potrošnikovo dožemanje varnosti živil ni v močni povezavi z objektivnimi tveganji (Verbeke in sod., 2007), temveč je bolj povezano s sociološkimi in psihološkimi lastnostmi človeka. Obstaja velik prepad med objektivnimi in znanstveno dokazanimi tveganji in dožemanjem le-teh med potrošniki. Potrošnikova reakcija sledi subjektivnemu dožemanju tveganj, torej tistim, ki jih sami ocenijo kot tveganja.

Informiranje potrošnikov o principih zagotavljanja varnosti živil doma je vitalnega pomena za doseg celovite varnosti živil od polja do mize. Samo informiran potrošnik je lahko enakovreden člen v živilsko/prehransko/oskrbovalni verigi.

Glede na kompleksnost obravnavanega področja je potrebno izpostaviti metodološke pristope pri raziskovanju področja varnosti živil. Z rezultati meta-analize smo ugotovili, da se poleg uveljavljenih kvantitativnih metodoloških pristopov v zadnjem obdobju vse bolj uveljavljajo tudi kvalitativni pristopi, kar nakazuje trend humanizacije v osnovi naravoslovno-tehničnega področja živilstva.

Izbira primerne metodološkega pristopa in raziskovalnega instrumenta je pomembna za pridobitev relevantnih podatkov, ki nam omogočajo celovit vpogled v problematiko raziskovane tematike (opisano v poglavju 2.1.2). Analiza metodoloških kriterijev v izbranih znanstveno raziskovalnih delih je pokazala, da avtorji ne upoštevajo dosledno vseh zakonitosti izbranega metodološkega procesa. Pri kvantitativnih analizah je najmanj dosledno opisan način vzorčenja in vrednotenje realiziranega vzorca, kar onemogoča verodostojno uporabnost njihovih izsledkov na širši populaciji in primerjavo z drugimi raziskavami. Ob tem je potrebno izpostaviti tudi nove smernice kvalitativnih raziskav na področju proučevanja psiho-socialnega vidika posameznika pri delu z živili. Slednje je skozi modele predstavljeno v znanstvenih delih Gilling in sod. (2001), Ramirez Vela in Martin Fernandez (2003) ter Azanza in Zamora-Luna (2005).

Z rezultati kvalitativne in kvantitativne raziskave med zaposlenimi pri delu z živili sta kritično ovrednotena in dopolnjena obstoječa modela (Gilling in sod., 2001; Azanza in

Zamora-Luna, 2005), s katerima so raziskovalci do sedaj pojasnjevali ovire pri vzpostavitvi in obvladovanju sistema HACCP. Model "HACCP od zavedanja do privrženosti" (Gilling in sod., 2001) prikazuje enajst potencialnih ovir, ki se nanašajo na znanje, odnos in obnašanje in bi lahko bile vzrok za neuspeh pri implementaciji sistema HACCP. Model predstavlja orodje, ki diagnosticira, identificira in locira probleme in tako pripomore k njihovem konstruktivnemu in učinkovitemu reševanju. Stopničasti model podaja obrazložitev glavnih kategorij ovir: znanje kot steber pridobljenih ugotovitev, odnos do sistema HACCP kot mentalna reakcija na znanje, vedenje kot posledica pridobljenega znanja in razvitega odnosa do sistema HACCP. Model je bil v praksi že preizkušen (Ramirez-Vela in Martin-Fernandez, 2003) in na podlagi ugotovitev raziskav tudi že nekoliko modificiran (Azanza in Zamora-Luna, 2005). Azanza in Zamora-Luna (2005) sta preučevali ovire za privrženost sistemu HACCP med člani HACCP skupine. Ovire sta predstavili s pomočjo modela, ki združuje kognitivni in behavioristični koncept in prav tako za osnovo povzema tri glavne skupine ovir za uspešno vzpostavitev sistema HACCP, t.i. znanje, odnos do sistema HACCP in na podlagi prejšnjih dveh izoblikovano vedenje. Oviro "znanje" sta razdelili v tri podkategorije: zavedanje, seznanitev in razumevanje. Odnos do sistema sta razdelili oziroma opisali z dvema podkategorijama, in sicer strinjanje ter zavezanost. Naslednja ovira, "vedenje", je razdeljena na usvojitev ali prevzem ter na vdanost oziroma privrženost. Slednje je tudi zadnja faza ali predpogoj za učinkovito vzpostavitev sistema HACCP. Avtorici sta ugotovili, da morajo vsi zaposleni (od vrha navzdol) preiti vse omenjene faze, če želimo, da bo vzpostavitev sistema HACCP učinkovita.

Predstavljena modela na podlagi ugotovitev raziskav dopolnjujemo z vstopno oviro, ki kot dejavnik tveganja obravnava tako delovno okolje kot človeka, ki vstopa v delovni proces. Rezultati kažejo, da je potrebno žarišče problematike zagotavljanja varnosti živil v enotah živilsko/prehransko/oskrbovalne verige obravnavati na dveh nivojih. Prvi nivo obravnava človeka pri delu z živili, in sicer stopnjo njegove izobrazbe, usposobljenosti za specifično delo, dejavnike motivacije in zadovoljstva z delom. Drugi nivo obravnava delovno okolje, preko analize organizacijskih, psihosocialnih in ergonomskih dejavnikov tveganj. S tem smo izpostavili potrebo po obravnavanju delovnega okolja in človeka, ki vstopa v živilsko/prehransko/oskrbovalno verigo, enakovredno kot ostale dejavnike tveganj (opisano v poglavju 2.1.1). Gre za nov pristop k obvladovanju varnosti živil, ki v cilju zagotavljanja celovite oskrbe potrošnika z zdravstveno ustrezno hrano/živili, temelji na izobraženem in strokovno usposobljenem človeku in zdravem delovnem okolju.

To pa nakazuje, da je v izobraževalnem procesu še vedno preskromno odmerjeno znanje, ki bi gradilo vedenje posameznika o higieni živil in vseh spremljajočih dobrih praksah ter sistemu HACCP. Tako bi veljalo postaviti učinkovitejši sistem primarnega izobraževanja pa tudi vseživljenjskega izobraževanja na temo živilstva, saj se ta dimenzija z razvojem, industrializacijo, globalizacijo ter onesnaženjem okolja spreminja. V cilju doseči celovito kakovost in varnost življenja je potreben multidisciplinaren in inovativen pristop, ki bo v živilsko/prehransko/oskrbovalni verigi sposoben učinkovitega in hitrega odzivanja na spremembe v okolju. Vključil in poudaril naj bi pomembnost subjektivnega načina dojemanja koncepta zdravja in varnosti, ki sta gradnika kakovosti življenja.

3.2 SKLEPI

Na osnovi rezultatov analize dokumentacijskih virov o ovirah za učinkovitost sistema HACCP in analize dejanskega stanja obvladovanja varnosti živil na različnih stopnjah živilsko/prehransko/oskrbovalne verige lahko povzamemo pridobljena spoznanja:

- Permanentno medsebojno nesodelovanje aktualnih proizvodnih praks in njihovih akterjev pripelje do nezaupanja, ki se odraza na (ne)učinkovitosti sistema HACCP.
- Človeški faktor, na organizacijski in izvedbeni ravni, je vzrok nedopustnih odstopanj v sistemu HACCP, ki se kot tveganja izrazijo v kritičnih razmerah.

4 POVZETEK (SUMMARY)

4.1 POVZETEK

Številne medijsko odmevne afere o zastrupitvah s hrano, manjših ali večjih razsežnosti doma in drugod po svetu so vzpodbudile dvom o učinkovitosti obstoječega sistema za zagotavljanje varnosti živil, t.i. sistema HACCP. Z namenom analize ovir za (ne)učinkovitost sistema HACCP so uporabljeni različni kvantitativni in kvalitativni metodološki pristopi. Pri proučevanju ovir uporabljajo avtorji znanstvenih in strokovnih del različne termine za vsebinsko in pomensko sorodne ovire. Z namenom poenotenja strokovne terminologije na obravnavanem področju je podan nov koncept terminološke klasifikacije ovir. Rezultati meta-analize izbranih dokumentacijskih virov kažejo, da je skoraj polovica ovir za učinkovitost sistema HACCP vezanih na človeški faktor. Področje živilstva je v osnovi naravoslovno tehnično, kar se v analiziranih delih izkazuje preko izbire metodološkega pristopa, ki je večinoma kvantitativen. V zadnjem času je zaslediti uporabo kvalitativnih metod, kar nakazuje trend humanizacije v osnovi naravoslovno tehničnega področja živilstva.

Rezultati kombiniranega metodološkega pristopa v posameznih stopnjah živilsko/prehransko/oskrbovalne verige osvetlijo dejavnike, ki pomembno vplivajo na vedenje zaposlenih pri delu z živili in so povezani z organizacijsko klimo podjetja, odnosi, stopnjo motivacije in zadovoljstva z delom, delovnimi pogoji in komunikacijo. Ugotovljene so pomanjkljivosti pri razumevanju mikrobioloških tveganj tako med zaposlenimi pri delu z živili kot pri potrošnikih. Zaposleni pri delu z živili dela ne izvajajo vedno v skladu z zahtevami dobrih praks. Ugotovitev nakazuje potrebo po reorganizaciji sedanjega načina usposabljanja in opozarja na pomanjkanje usposobljenih in kompetentnih strokovnjakov na obravnavanem področju. Usposobljenost za delo in higienska zavest posameznika je pomembno orodje za zagotavljanje varnosti živil, zato potrebuje vsak zaposleni pri delu z živili kompleksno in individualno obravnavo.

Potrošniki so nezadostno informirani o načelih varne priprave hrane doma. Verodostojnost informacij, način informiranja ter kontinuiteta le-tega je temeljnega pomena za dvig osveščenosti vseh, vključenih v živilsko/prehransko/oskrbovalno verigo. Predlagana Dobra prehranska praksa združuje vse sisteme dobrih praks in postavi v enakovreden položaj potrošnika. S tem ga označi kot enakopravnega partnerja v živilsko/prehransko/oskrbovalni verigi.

Z rezultati analize dokumentacijskih virov o ovirah za učinkovitost sistema HACCP in rezultati analize dejanskega stanja obvladovanja varnosti živil na različnih stopnjah živilsko/prehransko/oskrbovalne verige se potrdi prvi in drugi del hipoteze: (A) Permanently medsebojno nesodelovanje aktualnih proizvodnih praks in njihovih akterjev pripelje do nezaupanja, ki se odraža na (ne)učinkovitosti sistema HACCP; (B) Človeški faktor, na organizacijski in izvedbeni ravni je vzrok nedopustnih odstopanj v sistemu HACCP, ki se izrazijo v kritičnih razmerah. Ugotovitve nakazujejo potrebo po vzpostavitvi učinkovitejšega sistema primarnega in vseživljenjskega izobraževanja na temo živilstva. Izpostavljena je potreba po obravnavanju delovnega okolja in človeka, ki vstopa v živilsko/prehransko/oskrbovalno verigo, enakovredno kot ostale dejavnike tveganj. V cilju doseči celovito kakovost in varnost življenja je potreben multidisciplinaren in inovativen pristop, ki bo sposoben učinkovitega in hitrega odzivanja na spremembe v okolju. Vključil in poudaril naj bi pomembnost subjektivnega načina dojetja koncepta zdravja in varnosti, ki sta gradnika kakovosti življenja.

4.2 SUMMARY

Numerous of food borne affairs all over the world with wide repercussion in the media have started doubts about efficiency of HACCP system. Different quantitative and qualitative methodological approaches were used to analyze barriers, which weaken HACCP system efficiency and to determine the actual state of food safety management in food supply chain. Authors of scientific and technical papers use different terms for similar barriers, which complicates their ranking and further systematic handling. By introducing a new concept of terminological classification of barriers will open new dimensions in assuring common language among food safety professionals in the future. The results of meta-analysis have shown that almost half of the barriers to HACCP system efficiency are connected with the human factor. In the field of food science quantitative methodological approaches are mainly used. Lately the use of qualitative methods can be noted, which indicates a humanization trend in the discussing field.

The results of the combined methodological approaches in individual stages of food supply chain point out the factors influencing behaviour of food handlers. These factors are connected with organisational climate in a company, relationships, motivation, job satisfaction, working conditions and communication. Deficiencies in comprehension of microbiological hazards among food handlers and consumers were found out. Food handlers do not always follow requirements of good practices, which indicate the need for reorganizing the current educational techniques and points out the lack of trained and competent experts in the field. Qualification and hygiene awareness of an individual is an important tool for food safety assurance. Employees are responsible for effective HACCP system management, so individual discussing and in deep analysis of work environment are needed.

Consumers are not sufficiently informed about food safety assurance at home. Reliable information, information method and continuity of the latter is essential for better awareness off all included in the food supply chain. The proposed Good Nutritional Practice strategy combines all good practice systems, puts a consumer in an equal position and clearly defines a new hazard dimension, the so-called human factor, in food safety assurance.

The results of meta-analysis and the results of the actual state in different stages of the food supply chain confirm that (A) permanent mutual non-cooperation of current good practices and their participants leads to mistrust, which is reflected by the inefficiency of the HACCP system, and (B) the human factor in organizational and execution levels is the reason for unacceptable deviations from the HACCP system, which appear in critical situations. A more effective system of primary education and lifelong learning of food-related topics is needed. Work environment and an individual in the food supply chain need to be discussed equally as all the other hazards. A multi-disciplinary and innovative approach is required that provides quick and effective responses to maintain the safety of foods in the food supply chain. This would involve acknowledging the importance of the subjective comprehension of health and safety concepts, which is a component of well-being.

5 VIRI

- Aarnisalo K., Tallavaara K., Wirtanen G., Maijala R., Raaska L. 2006. The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. *Food Control*, 17: 1001-1011.
- Ajzen A. 1991. The theory of planned behavior. *Organizational behavior and human decision processes. Journal of Fundamental Research and Theory in Applied Psychology*, 50, 2: 179-211.
- Athearn P.N., Kendall P.A., Val Hillers V., Schroeder M., Bergmann V., Chen G., Medeiros L.C. 2004. Awareness and acceptance of current food safety recommendations during pregnancy. *Maternal and Child Health Journal*, 8, 3: 149-162.
- Ayçiçek H., Aydoğan H., Küçükaraaslan A., Baysallar M., Başustaoğlu A.C. 2004. Assessment of the bacterial contamination on hands of hospital food handlers. *Food Control*, 15: 253-259.
- Azanza M.P.V., Zamora-Luna M.B.V. 2005. Barriers of HACCP team members to guideline adherence. *Food Control*, 16, 1: 15-22.
- Badrie N., Gobin A., Dookeran S., Duncan R. 2006. Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control*, 17: 370-377.
- Baş M., Şafak A., Kıvanç G. 2006. The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control*, 17, 4: 317-322.
- Baş M., Yuksel M., Cavusoglyu T. 2007. Difficulties and barriers for the implementation of HACCP and food safety systems in food businesses in Turkey. *Food Control*, 18, 2: 124-130.
- Brajša P. 1996. Sedem skrivnosti uspešnega managementa. Ljubljana, *Gospodarski vestnik*: 195 str.
- Clayton D.A., Griffith D.J., Price P., Peters A.C. 2002. Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12: 25-39.
- Cotterchio M., Gunn J., Coffill T., Tormey P., Barry A. 1998. Effect of a manager training program on sanitary conditions in restaurants. *Public Health Reports*, 113, 4: 353-358.
- De Winter R.F.J. 1998. The role of interactive workshops in HACCP training in a multinational environment. *Food Control*, 9, 2-3: 147-149.
- Denzin N.K., Lincoln Y.S. 2003. Introduction: The discipline and practice of qualitative research. V: *Strategies of qualitative inquiry*. Denzin N.K., Lincoln Y.S. (eds.). 2nd ed. Thousand Oaks, London, New Delhi, Sage Publications: 1-45.
- Domajnko B., Kvas A., Štrancar K., Bojc N., Pahor M. 2006. Živeta interprofesionalna razmerja: kvalitativni pogled. V: *Sodelovanje med medicinskimi sestrami in zdravniki v zdravstvenem timu: priložnost za izboljšanje kakovosti: zbornik z recenzijo*. Kvas A., Pahor M., Klemenc D., Šmitek J. (ur.). Ljubljana, Društvo medicinskih sester, babic in zdravstvenih tehnikov: 235-260.
- Ehiri J.E., Morris G.P. 1997. Hygiene training and education of food handlers: does it work? *Ecology of Food and Nutrition*, 35: 243-251.
- Eves A., Dervisi P. 2005. Experiences of the implementation and operation of hazard analysis critical control points in the food service sector. *Hospitality Management*, 24: 3-19.
- Flick U. 2002. An-introduction to qualitative research. 2nd ed. London, Sage Publications: 310 str.

- Foster G.M., Käferstein F.K. 1985. Food safety and the behavioural sciences. *Social Science and Medicine*, 21, 11: 1273-1277.
- Gilling S.J., Taylor E.A., Kane K., Taylor J.Z. 2001. Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioral adherence model. *Journal of Food Protection*, 64, 5: 710-715.
- Haralambos M., Holborn M. 1999. *Sociologija. Teme in pogledi*. Ljubljana, DZS: 966 str.
- Heggum C. 2001. Trends in hygiene management – the dairy sector example. *Food Control*, 12: 241-246.
- Henroid D., Sneed J. 2004. Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *Journal of the American Dietetic Association*, 104, 2: 180-185.
- IVZ. 2006. Epidemiološko spremljanje nalezljivih bolezni v Sloveniji v letu 2005. Ljubljana, Inštitut za varovanje zdravja Republike Slovenije. (november 2006) http://www.ivz.si/javne_datoteke/datoteke/798-Epidemiolosko_spremljanje_NB_2005.pdf, 8-39.
- Jay L.S., Comar D., Govenlock L.D. 1999. A national Australian food safety telephone survey. *Journal of Food Protection*, 62, 8: 921-928.
- Jevšnik M., Bauer M., Zore A., Raspor P. 2007. Hygienic status of small and medium sized food enterprises during adoption of HACCP system. *International Journal of Food Science Technology and Nutrition*, 1, 1: 95-113.
- Jevšnik M., Tivadar B., Hlebec V. 2004. Hidden factors of high hazard in food industry. V: *CEFood Congress Programme and book of abstracts, 2nd Central European Congress on Food, 26-28 April 2004, Budapest*. Budapest: Central Food Research Institute, Complex Committee on Food Science of the Hungarian Academy of Sciences: 214-214.
- Karalis T., Gupta L. 2001. Microbiological status of Asian style perishable foods and the relation with procedural deficiencies in manufacture. *Food Technology in Australia*, 53, 5: 184-188.
- Kennedy J., Jackson V., Blair I.S., McDowell D.A., Cowan C., Bolton D.J. 2005. Food safety knowledge of consumers and the microbiological and temperature status of their refrigerators. *Journal of Food Protection*, 68, 7: 1421-1430.
- Khandke S.S., Mayes T. 1998. HACCP implementation: a practical guide to the HACCP plan. *Food Control*, 9, 2-3: 103-109.
- Konecka-Matyjek E., Turlejska H., Pelzner U., Szponar L. 2005. Actual situation in the area of implementing quality assurance system GMP, GHP and HACCP in Polish food production and processing plants. *Food Control*, 16: 1-9.
- Krušič M. 1984. *Stare kulture. Velika ilustrirana enciklopedija*. Slovenska izdaja s priredbami. Ljubljana, Mladinska knjiga: 173 str.
- Likar K., Jevšnik M. 2002. Sustaining a cold chain in the food trade. V: *1st Central European Congress on Food and Nutrition, 2nd Slovenian Congress on Food and Nutrition*. Ljubljana, September 22-25, 2002. Raspor P., Hočevar I. (eds.). Ljubljana, Biotehniška fakulteta, Oddelek za živilstvo, Slovensko prehransko društvo: 83-83.
- Likar K., Jevšnik M. 2004. Pogoji za vzpostavitev učinkovitega notranjega nadzora. V: *Obvladovanje higienskih procesov v vrtcih in domovih za starejše. Zbornik seminarja*, Ljubljana, 26.05.2004. Ferfila N., Jevšnik M. (ur.). Ljubljana, Inštitut za sanitarno inženirstvo: 69-78.

- Manning C.K., Snider S. 1993. Temporary public eating places: food safety knowledge, attitudes and practices. *Journal of Environmental Health*, 56: 24-28.
- Marolt J., Gomišček B. 2005. Management kakovosti. Kranj, Moderna organizacija: 574 str.
- Meer R.R., Misner S.L. 2000. Food safety knowledge and behavior of expanded food and nutrition education program participants in Arizona. *Journal of Food Protection*, 63, 12: 1725-1731.
- Mitchell R.T. 1998. Why HACCP fails. *Food Control*, 9: 101-101.
- Mortimore S. 2001. How to make HACCP really work in practice. *Food Control*, 12: 209-215.
- Motarjemi Y., Käferstein F. 1999. Food safety, hazard analysis and critical control point and the increase in foodborne diseases: a paradox? *Food Control*, 10: 325-333.
- Nel S., Lues J.F.R., Buys E.M., Venter P. 2004. The personal and general hygiene practices in the deboning room of a high throughput red meat abattoir. *Food Control*, 15: 571-578.
- Panisello P.J., Quantick, P.C., Knowles, J.M. 1999. Towards the implementation of HACCP: the results of a UK regional survey. *Food Control*, 10: 87-98.
- Panisello P.J., Quantick P.C. 2001. Technical barriers to hazard analysis critical control point (HACCP). *Food Control*, 12: 165-173.
- Ramírez Vela A., Martín Fernández J. 2003. Barriers for the developing and implementation of HACCP plans: results from a Spanish regional survey. *Food Control*, 14: 333-337.
- Raspor P. 2004a. Sedanji pogled na varnost živil. V: Varnost živil. 22. Bitenčevi živilski dnevi, Radenci, 18.in 19.marec 2004. Gašperlin L., Žlender B. (ur.). Ljubljana, Biotehniška fakulteta, Oddelek za živilstvo: 1-14.
- Raspor P. 2004b. Koliko varnosti lahko pričakujemo od mikrobiologije in biotehnologije v naslednjih letih? V: Mikrobiologija in biotehnologija v proizvodnji varnih živil. Raspor P. (ur.). Ljubljana, Biotehniška fakulteta, Oddelek za živilstvo: 87-193.
- Resolucija o nacionalnem programu prehranske politike 2005 – 2010. 2005. Uradni list Republike Slovenije: 15, 39: 3681-3719.
- Roberts K.R., Sneed J. 2003. Status of prerequisite and HACCP program implementation in Iowa restaurants. *Food Protection Trends*, 23, 10: 808-816.
- Ropkins K., Beck A.J. 2000. Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends in Food Science and Technology*, 11: 10-21.
- Seaman P., Eves A. 2007. The management of food safety - the role of food hygiene training in the UK service sector. *International Journal of Hospitality Management*, 25: 278-296.
- Setiabudhi M., Theis M., Norback J. 1997. Integrating hazard analysis and critical control point (HACCP) and sanitation for verifiable food safety. *Journal of the American Dietetic Association*, 97, 8: 889-891.
- Shojaei H., Shooshtaripoor J., Amiri M. 2006. Efficacy of simple hand-washing in reduction of microbial hand contamination of Iranian food handlers. *Food Research International*, 39, 5: 525-529.
- Smole Možina S., Hočvar Grom A. 2004. Mikrobiološka varnost živil. V: Mikrobiologija in biotehnologija v proizvodnji varnih živil. Raspor P. (ur.). Ljubljana, Biotehniška fakulteta, Oddelek za živilstvo: 29-43.
- Soriano J.M., Rico H., Moltó J.C., Mañes J. 2002. Effect of introduction of HACCP on the microbiological quality of some restaurants meals. *Food Control*, 13: 253-261.

- Sperber W.H. 2005a. HACCP does not work from farm to table. *Food Control*, 16, 6: 511-514.
- Sperber W.H. 2005b. HACCP and transparency. *Food Control*, 16, 6: 505-509.
- Sun Y-M., Ockerman, H.W. 2005. A review of the needs and current applications of hazard analysis and critical control point (HACCP) system in foodservice areas. *Food Control*, 16, 4: 325-332.
- Tauxe R.V. 2002. Surveillance and investigation of foodborne diseases; roles for public health in meeting objectives for food safety. *Food Control*, 13: 363-369.
- Taylor E.A., Taylor J.Z. 2004a. Using qualitative psychology to investigate HACCP implementation barriers. *International Journal of Environmental Health Research*, 14, 1: 53-63.
- Taylor E.A., Taylor J.Z. 2004b. Perceptions of 'the bureaucratic nightmare' of HACCP. A case study. *British Food Journal*, 106, 1: 65-72.
- Taylor J.H., Brown K.L., Toivonen J., Holah J.T. 2000. A micro-biological evaluation of warm air hand driers with respect to hand hygiene and the washroom environment. *Journal of Applied Micro-biology*, 89: 910-919.
- Tivadar B. 2003. Prihraniš čas, zapraviš ljubezen: ambivalentni odnos do kupljene (pol)pripravljene hrane. *Annales. Anali za istrske in mediteranske študije = Annali di Studi Istriani e Mediterranee = Annals for Istrian and Mediterranean studies. Series Historia et Sociologia*, 13, 1: 87-102.
- Ule M. 2000. Temelji socialne psihologije. 3. izd. Ljubljana, Znanstveno in publicistično središče: 509 str.
- Untermann F. 1999. Food safety management and misinterpretation of HACCP. *Food Control*, 10: 161-167.
- Van der Spiegel M., Luning P.A., Ziggers G.W., Jongen W.M.F. 2003. Towards a conceptual model to measure effectiveness of food quality systems. *Trends in Food Science and Technology*, 14, 10: 424-431.
- Verbeke W., Frewer L.J., Scholderer J., De Brabander H.F. 2007. Why consumers behave as they do with respect to food safety and risk information. *Analytica Chimica Acta*, 578: 2-7.
- Walczak D., Reuter M. 2004. Putting restaurant customers at risk: unsafe food handling as corporate violence. *Hospitality Management*, 23: 3-13.
- Walker E., Jones N. 2002. An assessment of the value of documenting food safety in small and less developed catering businesses. *Food Control*, 13: 307-314.
- Walker E., Pritchard C., Forsythe S. 2003. Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control*, 14: 169-174.
- Wallace C., Williams T. 2001. Pre-requisites: a help or a hindrance to HACCP? *Food Control*, 12: 235-240.
- Warde A. 1999. Convenience food: space and timing. *British Food Journal*, 101, 7: 518-527.
- Yapp C., Fairman R. 2006. Factors affecting food safety compliance within small and medium-sized enterprises: implications for regulatory and enforcement strategies. *Food Control*, 17: 42-51.
- Zupan N. 2001. Nagradite uspešne: Spodbujanje uspešnosti in sistemi nagrajevanja v slovenskih podjetjih. Ljubljana, GV Založba: 304 str.

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