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NOVEL FOOD SAFETY CONCEPTS FOR SAFE FOOD: CASE MEAT PROCESSING INDUSTRY*

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A b s t r a c t: Consumers´ 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. Meat, as one of the most sensitive industries regarding microbial contamination in food supply chain, deserves all this attention and we need to bring new skills to practice to manage food safety from the farm to the fork. The aim of this short review was to evaluate and compare the few food safety issues which are relevant for meat industry, namely food safety knowledge in practice, employees´ attitude toward food safety and employees´ work satisfaction and diversification of the systems connected to meat processing industry.

Today we master food safety through good practices at different levels of food production, distribution and consumption. The novelties which enter food supply chain through new substrates, new processes and technologies and new nutrition practices are key factor for building up a new dimension in food safety, which should be handled holistically. All these elements are very complex and closely connected to social factors, e.g. employees' knowledge, awareness and attitude. Based on the research results on this field it is determined that food safety 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.

***Key words**: food safetly, safe food, meat industry*

Novi koncepti bezbednosti hrane za dobijanje zdravstveno ispravnih proizvoda: industrija prerade mesa

S a d r ž a j: Zabrinutost potrošača za opasnosti povezane sa hranom je velika. Zbog skorašnje krize sa hranom u Evropi, kvalitet i bezbednost hrane su postali „vruće" teme u medijima. Industrija mesa, kao jedna od najosetljivijih oblasti u snabdevanju hranom sa aspekta mikrobiološke kontaminacije zaslužuje svu moguću pažnju i zbog toga moraju da se uvedu u praksu nove veštine u upravljanju bezbednošću hrane „od njive do trpeze". Cilj rada je ocena i poređenje nekoliko problema iz oblasti bezbednosti hrane relevantnih za industriju mesa – konkretno, saznanja o aspektima bezbednosti hrane u praksi, stav zaposlenih prema bezbednosti hrane kao i zadovoljstvo radom i razgranatost sistema povezanih sa industrijom prerade mesa.

Danas ovladavamo poljem bezbednosti hrane kroz dobru praksu na različitim nivoima proizvodnje, distribucije i potrošnje. Noviteti koji ulaze u lanac snabdevanja hranom, kao što su novi supstrati, novi procesi i tehnologije kao i novi načini predstavljanja, su ključni faktori za izgradnju nove dimenzije u oblasti bezbednosti hrane sa kojima se mora upravljati holistički. Svi ovi elementi su veoma kompleksni i tesno povezani sa socijalnom faktorima, na primer: znanja zaposlenih, svest i stav. Na osnovu rezultata istraživanja u ovoj oblasti utvrđeno je da su edukacija o bezbednosti hrane i individualna svest najvažniji alati za osiguranje bezbednog proizvoda – zato svako ko rukuje hranom zahteva da mu se posveti kompleksna pažnja na individualnom nivou. Ljudski faktor mora da se obradi jednako kao i ostali faktori rizika, kao što su higijena, tehnički i tehnološki faktori. Esencijalno je, sa aspekta bezbednosti hrane, da svaka karika u lancu snabdevanja razume i ispunjava svoje odgovornosti kao i da može da se osloni na prethodni i sledeći korak u lancu.

***Ključne reči:** bezbednost hrane, zdravstevno ispravni proizvodi, industrija mesa*

Novi koncepti bezbednosti hrane za Introduction

Since April 2004 when the European Parliament adopted Regulation (EU) No 852/2004 on the hygiene of foodstuffs it focused strongly on the system of food safety management until 1st of January 2006 when it has to be applied to all food operators. The main change in the law relates to food safety management systems, i.e. risk based methodologies to ensure the safety of food. Successful implementations of the procedures based on the HACCP prin-

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ciples are requiring 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 (*Vela and Fernandez*, 2003; *Walker et al.,* 2003; *Taylor and Taylor*, 2004a; *Taylor and Taylor*, 2004b; *Hennroid and Sneed*, 2004; *Azanza and Zamora-Luna*, 2005; *Baş et al.*, 2005; *Hielm et al.,* 2006). Among the key ones, *Walker et al.* (2003) 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 workforce and organising 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).

It is obvious that the food represents one of major problems in 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 basic principles of nature (*Raspor & Jevšnik,* 2008).

Food safety management and personnel

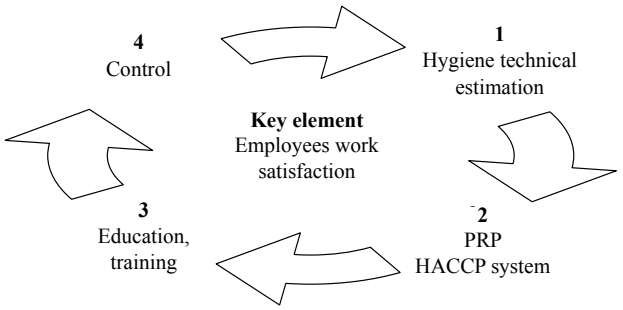
The acceptance of food safety systems has put employee training under the microscope (Collis, 2002). Under the personnel programme of HACCP, employees must be trained in such areas as food safety, manufacturing controls and personnel hygiene. Once HACCP plans have been established, employees must be trained to manage any critical control points (CCPs). Though numerous companies have developed documented and implemented training programmes, few understand why employee training is important, what their training requirements are, or how to assess the effectiveness of in-house training programmes. 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 means of ensuring safety. HACCP has been described as a philosophy in theory and a tool in practice (*Gilling et al.,* 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 organized 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 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 et al.*, 1995; *Mortimore and Smith,* 1998; *Khandke and Mayes*, 1998; *Williams et al.,* 2003). *MacAuslan* (2003) cited *Aston* (2001) who 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 towards 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 thing".

Personal as main food safety factor

Factors, which have a significant impact on employers' behavior, are correlated with organisa-

tional climate in the company, level of job satisfaction and labor conditions and with relations between employees. *Marolt and Gomišček* (2005) described a new management approach to employees, which stimulates employees to be initiative, to learn, to devote 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 realisation of the new principles into practical work and thus can significantly contribute to better usage of existing resources. A leader should, with his leadership function, persuade the employees to fulfill their needs and desires by effective working and should enable them to use their potentials and by doing so, to contribute and 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. Skills of a successful leader motivation, communication, improvement and introduction of modifications are also mentioned (*Černetič,* 2001; *Marolt and Gomišček*, 2005). In review on history of motivational research and theory *Latham and Ernst* (2006) summarised that psychologists now know 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 reinforces 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 generalise their positive affect to the task (*Locke and 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 recognized by employees who will minimize their effects (*Jannadi,* 1995).

For efficient food safety management, *Jevšnik et al.* (2007) 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 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 (*Jevšnik et al*., 2007).



Scheme 1. "Four elements analysis" model for HACCP system effectiveness
Shema 1. Model "Četiri elementa" za efektivnost HACCP sistema

Personnel management and education

Human resource management and education of food safety managers in food premises has not captured the strong attention of researchers until recently (*Jevšnik et al.,* 2008). 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 classical 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, organising, managing, education and training at all levels, from employers to employees (*Likar et al.,* 2001; *Likar and Jevšnik,* 2004). 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. *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 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 recognize that whilst 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 as stated by *Jevšnik et al.* (2008).

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 (*Jevšnik et al.,* 2008).

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. A novel food safety concepts for safe food separate activities and procedures in 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 et al.,* 2001; *Likar and Jevšnik*, 2004; *Jevšnik et al*., 2008).

Current limitations in food safety management

In most Small Enterprises (SE) there are area limitations and they are not constructive-technical suitable for performing food related activities (*Baş et al.,* 2006, *Jevšnik et al.,* 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.). *Aarnisalo et al.* (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 et al.,* 2006). In some of Medium Enterprises (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 (Regulation, 2004).

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 ad 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. The causes for the latter can be found among insufficient hygiene training, negligent, insufficient employees' knowledge and/or inefficient control by supervisors. (*Jevšnik et al.,* 2007)

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 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 and Snider,* 1993). This suggests 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 faces--to-hand-to-mouth spread of potentially pathogenic transient micro-organisms. *Lues and 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 (Regulation, 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 theirs own, beside that the owners do not provide necessary means for the safe food handling. In MEs situation regarding personal hygiene is better (*Jevšnik et al*., 2007). 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 us checked daily. The main problem identified among food handlers in Ss 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% SEs and in 20% of MEs temperatures were registered in advance and for the past (*Jevšnik et al.,* 2007). 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 et al*., 1999, *Ramìrez Vela and Martin Fernàndez,* 2003, *Yapp and 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 and 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 isincomplete, 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 852/2004 the responsibilities for food safety lays entirety on food business operators, which means that operators are responsible for education and training of their employees as well (Regulation, 2004).

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 and Eves* (2007), is that the training will only lead to an improvement in food safety if the knowledge imparted leads to desired changes in behavior 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.

Novel Solutions in food safety management

As Raspor stated in 2008, 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 programmes and procedures. In theory it seems that we manage food safety completely, but practical experiences show some deviations. For that reason we have to proceed to new solutions which are based on synthesis of all relevant key factors included in food supply chain. One of possibility is to link all relevant Good practices in good nutritional practice (Fig 1.), as it was published recently (*Raspor,* 2008; *Raspor and Jevšnik,* 2008).

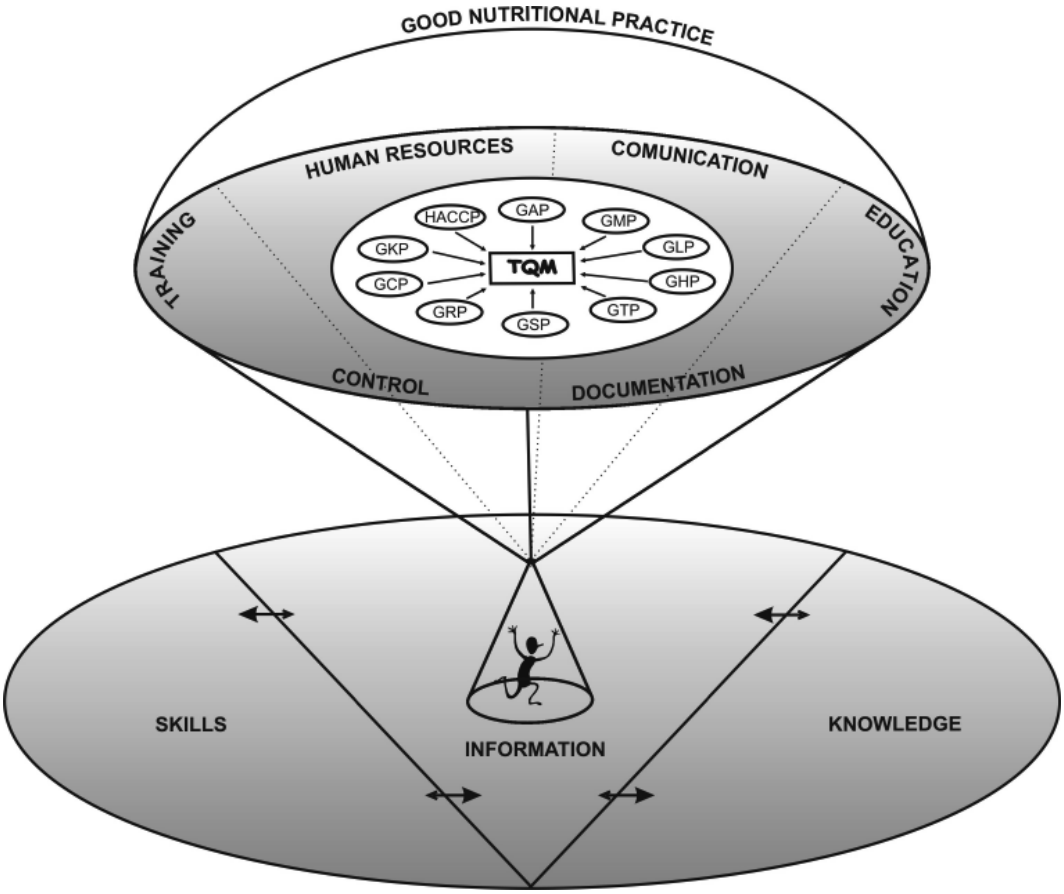


Figure 1. Food safety platform: balanced model for ensuring food safety from Good Nutritional Practice viewpoint (*Raspor and Jevšnik,* 2008; with Permission of CRC)

Slika 1. Platforma bezbednosti hrane: balansirani model za osiguranje bezbednosti hrane sa gledišta dobre nutricionističke prakse (*Raspor i Jevšnik,* 2008; sa dozvolom CRC)

Today we master food safety with different good practices which are the consequence of human culture, history and lifestyle. If we analyse good practices in the broad spectre of food area we could arrange them in three categories. First category of good practices is directly connected with food technology (i.e. Good Manufacturing Practice - GMP). Second category is indirectly connected with food issues (i.e. Good Research Practice - GRP, Good Educational Practice - GEP, Good Training Practice - GTrP). Third category deals with all the activities regarding consumers' food handling (Good Housekeeping Practice - GHKP). Consumers are not connected to food supply chain according to chain principles.

However, it has been shown that present maintenance of food safety in food supply chain can be easily broken down, because of different kind of barriers or simple misunderstanding. Therefore a new approach called "Good Nutritional Practice" (GNP) was coined to manage food safety (*Raspor,* 2008, *Raspor and Jevšnik*, 2008). It is important to reconstruct the existent food safety system with GNP, which includes consumers, and is based on a model that covers subsystems from other good practices.

New techniques for reducing pathogen contamination in meat and poultry are entering meat processing field every day. It is hard to cope with all novelties since is not always totally clear what is really new and what is just improvement of existing technique or protocol. The compilations done by different author or authorities around the globe are trying to solve this issue. However such information can provide a reference for processors worldwide searching for better ways to improve food safety in their plants. The new technologies have to bring significant improvements to the safety of meat and poultry. In recent years new technology has been defined as new, or new applications of equipment, substances, methods, processes, or procedures affecting the slaughter of livestock and poultry or processing of meat, poultry, or egg products.

General believes that increased public and industry awareness of the new technologies being used could further promote their use, by small and very small plants in particular, towards improving the safety of meat, poultry, and egg products. The new technologies listed should be viewed as information of current state of the art.

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 and Jevšnik*, 2008).

Table 1: Selection of new/ novel technologies and Protocols to improve meat safety
Tabela 1. Odabir novih tehnologija i Protokola za unapređenje bezbednosti mesa

Application of Sodium Metasilicate on Raw Beef Carcasses as an Anti-microbial Processing Aid.	Chemical
Hyperchlorinated (≤200 ppm) solution applied to beef hide surfaces utilizing a washing/rinsing cabinet.	Chemical
Use of, a bromine-based biocide, as an effective poultry carcass antimicrobial when used in poultry chiller water in poultry processing plants at a level up to 100 ppm available bromine in the supply water.	Chemical
Use of up to 5% lactic acids on hot beef carcasses.	Chemical
Use of acidified sodium chlorite antimicrobial solutions as processing aids on i) pre- or post-chill poultry or red meat carcasses, carcass parts, trim or organs, or; ii) on processed, comminuted or formed meat products, in meat and poultry establishments pre-chill for COP (continuous-online-processing) in poultry processing.	Chemical
Ozone wash system using aqueous ozone on ready-to-eat (RTE) meat and poultry products for control of **Listeria monocytogenes**.	Chemical
Use of a bromine-based biocide, as an effective poultry carcass antimicrobial when used in poultry chillers and/or inside-outside bird washers (IOBW) at a level up to 100 ppm available bromine in the supply water.	Chemical
Cryovac Barrier Foam Tray/ LID551P Tray/Lid peelable barrier package with carbon monoxide as a component of a low oxygen modified atmosphere package (MAP) system.	Combination
High Pressure Processing (HPP) as a post-lethality, post-packaging intervention method for **Listeria monocytogenes** contamination in ready-to-eat foods such as deli sliced meats. HPP uses pressures up to 87,000 psi to inactivate pathogens and spoilage organisms throughout the product package.	Physical
Germicidal UVC light systems and equipment for surface decontamination of food products and food contact surfaces.	Physical
Infra-Red Grill is a radiant oven used as a pre-package surface pasteurization for the control of **Listeria** in RTE products.	Physical
Aquaflow Water Pasteurizer used as a post-package surface pasteurization system either alone or in combination with the Infra-Red Grill system (radiant oven used for pre-package surface pasteurization)for the control of **Listeria** in RTE products.	Physical
Video Food Safety Technology is a non-intrusive imaging system, which identifies organic contamination on meat and other surfaces utilizing a portable device similar in size and weight to a video camera.	Video
Carcass Inspection System (CIS) is a non-intrusive imaging system which identifies organic contamination in real-time on full carcass (beef) sides on the rail within a slaughter plant.	Video

Also we can ignore effort of ISO 22000 which is planed to harmonise various standards which we have today in different supply chains today and they have few aim.

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

Conclusion

Meat, as one of the most sensitive industries regarding microbial contamination in food supply chain, deserves all this attention and we need to bring new skills to practice to manage food safety from farm to the fork.The aim of this short review

was to evaluate and compare the few food safety issues which are relevant for meat industry, namely food safety knowledge in practice, employee attitude toward food safety and employee work satisfaction and diversification of the systems connected to meat processing industry. It has to be stressed that all this elements are very complex, in particular when one understand high fluctuation of workers in meat industry. Their knowledge and awareness is constantly unnourished, due to fast regulatory changes in the area, but also due to social factors which were mentioned before. It looks that the system for food safety assurance is not the weakest at the technological level, as we get impression, but it is the weakest at workers level, which is not always respected as it should be, neither in Good practices nor in HACCP realization. ISO 22000 tray to compensate few of this shortcomings, but far the best would be the concept of GNP. The future will ask for it realization.

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