

## Review

# The Human Factor as A Trigger of Food Safety Culture Within Food Networks: The Review

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## Abstract

Currently, food safety is managed through the HACCP system, and different good practices and food safety standards at different levels in food supply chain. The impact of food safety culture on the food supply chain is discussed at different levels and the realisation of it is achieved by various actors in complex food networks. Innovative approaches in the food supply chain have a positive impact by raising the level of employee qualifications and motivation to work according to the principles of food safety. The food business operator or person that is responsible for food safety is a key factor in identifying weaknesses in food safety, changing entrenched habits of employees, and introducing innovative approaches to effectively and rapidly respond to changes in the internal and external environments. This can build a new dimension of food safety, the so-called food safety culture, which is based on ethics in the field of food safety. As has been shown, the current maintenance of food safety in the food supply chain can easily break down, but the introduction of food safety culture can manage this issue and enhance food safety activities in food supply chains.

**Keywords:** food handler, training, behaviour, responsibility, food safety culture

## Резюме

В момента безопасността на храните се управлява чрез системата АРККТ, както и различни добри практики и стандарти за безопасност на различни нива във веригата за доставка им. Въздействието на културата на безопасност на храните върху веригата на доставки на храни се обсъжда на различни нива и реализирането му се постига от различни участници в сложни хранителни мрежи. Иновативните подходи във веригата на доставки на храни имат положително въздействие чрез повишаване нивото на квалификация на служителите и мотивация за работа в съответствие с принципите на безопасността на храните. Операторът на хранителен бизнес или лицето, което отговаря за безопасността на храните, е ключов фактор за идентифициране на слабостите в безопасността на храните, промяна на утвърдени навици на служителите и въвеждане на иновативни подходи за ефективно и бързо реагиране на промените във вътрешната и външната среда. Това може да изгради ново измерение на безопасността на храните, така наречената култура на безопасност на храните, която се основава на етиката в областта на безопасността на храните. Както беше показано, текущото поддържане на безопасността на храните в хранителната верига може лесно да се разпадне, но въвеждането на култура за безопасност на храните може да управлява този проблем и да подобри дейностите по безопасност на храните във веригите за доставка на храни.

## Introduction

The occurrence of intense globalization of the food trade is having a major impact on food systems worldwide. Food systems are changing and are consequently resulting in consistent quality, enhanced safety, greater availability and diversity

of broad assortments of food throughout the year. Food issues (quality, adulteration, and food safety) have become a hot topic in mass media. Consumers have become increasingly concerned and demanding about the quality and safety of the food they are eating. The increased demand for safer food

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has resulted in the development and introduction of quality management systems (QMS), which are used to control the quality and safety of products, such as standards and good practices (Raspor *et al.*, 2013; 2020). Food safety requirements with changes in food supply chains, social, health and demographic situations, lifestyle and environmental conditions have led to significant efforts in the development of QMS in agribusinesses and food industries worldwide. Because such systems differ in several aspects, they are combined or integrated to assure a list of food quality elements. Quality is divided into aspects of product safety, product quality, and total quality, which embrace product safety and quality (Raspor and Jevšnik, 2008). Griffith (2010) summarized that safety is an important quality attribute and that its production requires an effective food safety system coupled with an appropriate food safety culture what is connected to food safety climate (Raspor *et al.*, 2019; Tomasevic *et al.*, 2020) and adopted practice (Steriša *et al.*, 2018). Although systems based upon the Hazard Analysis and Critical Control Point system (HACCP) are considered to be the most effective way to manage food safety, in recent decades it has been determined that the HACCP is not sufficient to assure food safety along the food chain including the consumer. EU regulations (852/2004 Article 5(1)) now require “all food businesses, other than primary producers, to put in place, implement and maintain a permanent procedure or procedures” (Regulation, 2004) based upon HACCP principles. “Food safety” is a broad term that means an assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (CAC/RCP 1-1969; 2003). Providing the consumer with safe and healthy food in the age of globalization represents a major responsibility and is a constant task in developed and developing countries as it is linked with different life styles of food habits. 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), which indicates that we need an inherent “glue” to link and integrate all elements in a permanent and timely manner. This glue is the food safety culture of food business operators. This culture is another risk factor at the organizational level of food business operators, and its importance has only been recognized relatively recently. It can be considered to be an “emerging risk factor”. Griffith and co-authors (2010c) proposed the aggregation of the prevailing, relatively constant, learned,

shared attitudes, values, and beliefs contributing to the hygiene behaviours used within specific food handling environments.

Food safety is of crucial importance to the health and wellbeing of consumers, the food industry, and the economy. Despite significant investment in technology and production and distribution facilities, the incidence of foodborne diseases is still not decreasing. Foodborne diseases caused by microbiological hazards are a public health problem in Europe and throughout the world. Mishandling of food plays a significant role in the occurrence of foodborne illness, which affects almost 1 in 10 people globally, who become ill every year from eating contaminated food, and 420,000 die as a result (WHO, 2015). According to the last official report from the European Food Safety Authority (EFSA), a total of 43.3% of reported foodborne outbreaks (with convincing evidence) in Europe have been traced to food eaten in professional food service settings (EFSA and ECDC, 2016). Among professional settings, catering establishments represent the major share. As reported by others (Todd *et al.*, 2007; Nørrung and Buncic, 2008), infected peoples’ bare-hand contact with food, improper hand-washing practices, and insufficient cleaning of processing equipment are the most frequent errors made by professional food handlers, resulting in subsequent outbreaks. Previous studies show that training that changes knowledge does not always translate into changed food-handling practices (Green *et al.*, 2006). Ovca and co-authors (2017) emphasized that European legislation requires food safety training in all EU countries. All food business operators are required to ensure that all their staff engaged in food-handling activities are suitably trained and/or instructed in food hygiene (Regulation, 2004). According to employees, training provided by experts and work supervisors is the most effective means of assuring proper food-handling practices, especially for those in food production, although food businesses (especially small and medium enterprises (SME)) often neither have adequate training practices nor policies for their staff (Jevšnik *et al.*, 2008a). We are facing both insufficient knowledge and limited awareness of food safety issues amongst food workers but also with substantial share of consumers who are not aware of food safety principles at home. It is truly astonishing that so much activity has been invested in this area from childhood onward, but the effect somehow remains minor (Ovca *et al.*, 2014).

It has been suggested that European education and training systems fall short in providing the right skills for employability and are not collaborating adequately with business or employers to bring the learning experience closer to the reality of the working environments (Raspor, 2012).

The inability to effectively improve the situation is a matter of major concern despite the very significant resources allocated to the problem of foodborne diseases. A closer look at the food field, which combines both the technical sciences and the social sciences, is giving a broad spectrum of possibilities on how to maintain food safety completely, with the consumer who stands at the end of the supply chain. Food safety represents a cross-section of four important fields: food regulation, food technology, analytics, and finally, public food safety knowledge and awareness. The purpose of these fields is to protect human health. 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 spectrum of the field of food, we can arrange them in three categories. The first category of good practices is directly connected with food technology (i.e., Good Manufacturing Practice (GMP)). The second category is indirectly connected with food issues (i.e. Good Research Practice (GRP), Good Educational Practice (GEP), Good Training Practice (GTrP)). The third category deals with all the activities regarding consumers' food handling (Good Housekeeping Practice (GHKP)). Finally, it must be acknowledged that food safety is not mastered according to the concept "From Farm to Fork", because consumers are not properly connected to the food supply chain (Raspor and Jevšnik, 2008; Raspor, 2008; Ambrožič *et al.*, 2011).

Currently, food systems represent a historical collection of knowledge and skills, which are necessary to handle food "from stable to table", "from farm to fork", "from spring to drink". The system of relevant good practices contributing to food quality and safety is not an integral part of a systems approach, which could be established scientifically in relevant disciplines that create food knowledge, including food science, medical science and consumer science. Even more, this knowledge is historically allocated in the fields of agronomy, economy, food technology, medicine, microbiology, nutrition, and veterinary medicine, and is not integrated in a manner appropriate for building food systems. Nevertheless, it is expected that the era of systems coined by systems biology will create systems nu-

trition, which will be reflected in good nutritional practice on the applied level (Raspor, 2006).

### **Food safety legislation, standards, and ethics**

The history of food safety is probably nearly as old as human history itself and may have started with the recognition and subsequent avoidance of foods that were naturally toxic (Griffith, 2006). Experiences, tradition, practice, and technical and scientific knowledge helped shaped the principles and techniques to achieve acceptable food safety. For example, the Old Testament contains several instructions on the manner of handling food. Griffith (2006) pointed out that with several thousand years of experience in food safety combined with over 150 years of food microbiology experience, including with the latest molecular biology techniques, it might be erroneously assumed that problems of food safety would have been resolved. In fact, the opposite is true, with increased reports of foodborne disease. The biggest changes in food production occurred during the 19th century (Lasztity *et al.*, 2004). Consequently, the first concepts regarding how to handle these issues, were borne in that time. The *Codex amimenatius austiacus* certainly represents one such important milestone, followed by other national legislation and finally by the *Codex alimentarius* of the 20<sup>th</sup> century. This significant document has inspired all global systems since it serves as an excellent transmission tool from the most advanced to less advanced environments in the food supply chain. It currently seems that the EU concept is among the most advanced in this area.

The use of HACCP principles at all levels of the food chain is compulsory under EU Directive 93/43/EEC and Regulation 852/2004/EC (European Communities Council, 1993; Regulation, 2004). The new hygiene rules were adopted in April 2004 by the European Parliament and the Council. They became applicable on 1 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 the production, processing, and distribution of food under their control satisfy the relevant hygiene requirements laid down in Regulation (EC) No 852/2004 (Regulation, 2004). The application of HACCP principles became law in the EU at the beginning of 2006. Successful implementation of the procedures based on the HACCP principles require the full cooperation and commitment of food business employees. To this end, employees should undergo training. The new hygiene rules take particular account of the following principles

(European Commission, 2015):

- primary responsibility for food safety borne by the food business operator;
- food safety ensured throughout the food chain, starting with primary production;
- general implementation of procedures based on the HACCP principles;
- application of basic common hygiene requirements, possibly further specified for certain categories of food;
- registration or approval for certain food establishments;
- development of guides to good practice for hygiene or for the application of HACCP principles as a valuable instrument to aid food business operators at all levels of the food chain to comply with the new rules;
- flexibility provided for food produced in remote areas (high mountains, remote islands) and for traditional production and methods.

The US is also progressing well, followed by many English-speaking countries around the world. After decades of failed regulatory attempts to verify food safety of the nation's food supply, the Food Safety Modernization Act (FSMA) puts the responsibility for food safety where the liability resides: with the food producers and processors. The FSMA directs the Centers for Disease, Control and Prevention (CDC) to enhance foodborne illness surveillance systems through the improved collection, analysis, and reporting of foodborne illness data. The CDC supports the FSMA with key activities (CDC and FSMA, 2011):

- creation and management of Integrated Food Safety Centers of Excellence with academic partners at state health departments to serve as resources for local, state and federal public health professionals to detect and respond to foodborne illnesses and outbreaks;
- implementation of activities to improve the collection, analysis, and reporting of foodborne surveillance data supported by guidance from a multidisciplinary working group;
- development and dissemination of guidelines to manage the risk of food allergy and anaphylaxis in schools and early childhood education programmes.

The FSMA includes the requirements of Hazard Analysis and Risk-Based Preventive Controls (HARPC), which necessitate a preventive food safety system for facilities handling/processing food or food ingredients. The food safety plan under HARPC requires a qualified person in each fa-

cility to evaluate the potential food safety hazards, to identify and implement potential preventive controls, to validate the performance of these controls, and to maintain records to minimize the occurrence of evaluated hazards using a scientific methodology (Grover *et al.*, 2016).

For a long time, the ethics of food was only concerned with food security (Coff *et al.*, 2008) and consequently with the distribution of food within developed and developing countries. Technological advances and organizational changes affecting food systems in recent years have been radical and rapid and have created many ethical dilemmas and social responsibility gaps. Food safety and its regulation are becoming major international concern in the ethical point of view (FAO, 2002). The ethics of food safety is a dynamic area that continues to challenge our perceptions of food consumption, health risks and public responsibility for foodborne illness. Ethics refers to the values, principles and codes by which people live (Food Ethics Council, 2015). The issue of food safety and foodborne risk is gaining widespread public attention. For building and maintaining the confidence in food safety systems, there is a need to define the role of ethics in food safety policy development, because ethical and moral values are often neglected and intentionally forgotten. Highly publicized food safety problems have given rise to a general state of distrust among consumers, the food industry, and the institutions established to safeguard the food supply (FAO, 2002). Managing food safety hazards and risks is a top priority for any who is involved at any step in the food supply chain, including consumers.

Olsen and Banati (2014) stressed that food production is more complex than ever, and several ethical issues are raised in relation to agricultural practices and the food supply chain. Making good ethical decisions requires a trained sensitivity to ethical issues and a practiced method for exploring the ethical aspects of a decision. The more novel and difficult the ethical choice we face, the more we need to rely on discussion and dialogue with others about the dilemma. A dialogue about the ethical implications of food production, processing, policy, supply, and consumption may help involved partners in making better decisions.

### **Appropriate training approaches enhanced food safety**

To achieve the prevention of food-related diseases and the assurance of efficient safe food suitable for working environments from the hygienic-technical point of view, motivated, satisfied and

qualified personnel needs to be assured. Food hygiene training is fundamentally important (Jevšnik *et al.*, 2007; Jevšnik *et al.*, 2008a). All personnel involved in the process must be aware of their role and responsibility in protecting food from direct and indirect contamination. Those engaged in food operation that come directly or indirectly in contact with foods should be trained and/or instructed in the control of microbiological hazards to a level appropriate to the operations they are to perform. Griffith (2010) emphasized that a food handlers' knowledge of food safety is critical: they cannot behave hygienically if they do not know how to behave and why. This has led to increased emphasis on training; however, knowledge of food safety/hygiene does not always translate into the implementation of food safety practices (Clayton *et al.*, 2002). Training provides people with the knowledge allowing them to handle food safety when they are motivated to be hygienic (Griffith, 2010). A key element in the effectiveness of food hygiene training is the support given by managers, both pre- and post-training, to motivate food handlers to enact the safe food-handling practices learnt during training (Seaman and Evans, 2010). However, Seaman and Evans (2010) in their study suggest that many managers do not have sufficient awareness or the correct attitude towards food hygiene training to facilitate an effective learning environment within the workplace. Periodic assessment of the effectiveness of training and instruction programmes should be made as well as routine supervision and checks to ensure that procedures are being carried out effectively. That is why the managers and supervisors of food processes and operation facilities must also have the necessary knowledge of food hygiene principles and practices. Training and instructions must be periodically renewed by all food operators; as weaknesses are observed, more emphasis on refreshing trainings should be given. For this type of activities, it is reasonable to collaborate with outside experts. Public training courses can be organised for consumers too because consumers have inadequate knowledge about the measures needed to prevent foodborne illness in the home.

European legislation requires food safety training in all EU countries. All food business operators are required to ensure that all their staff engaged in food-handling activities are suitably trained and/or instructed in food hygiene (Regulation, 2004). It has been suggested that European education and training systems fall short in providing the right skills for employability and are not collab-

orating adequately with business or employers to bring the learning experience closer to the reality of the working environments (Raspor, 2012). Which type of training will prove to be more effective in the future remains a question. Irrespective of that, the most important fact according to Seaman and Eves (2010) 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 it does depend upon the hygiene awareness, education and skills of an individual person. According to employees, training provided by experts and work supervisors is the most effective means of assuring proper food-handling practices, especially for those in food production, although food businesses, especially small and medium enterprises (SME) often neither have adequate training practices nor policies for their staff (Jevšnik *et al.*, 2008a). Mortlock and co-authors (2000) suggested that it is also necessary to recognise 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. It is very important that those leading training have suitable food safety knowledge as well as teaching skills. Those people must be competent experts in their field so that adequate knowledge and skills can be passed on to the employees. Ovca and co-workers (2017) established that correct or desired behaviour demonstrated by the teacher can influence student behaviour, which is evident, for examples, regarding wearing jewellery observed among students and teachers. It is evident that teachers' frequent warnings (e.g. hand washing and surface cleaning) alone cannot improve bad practices demonstrated by students. However, if the system, especially instructors in the food business, are not educated and monitored, poor practices can also be experienced or, as reported before, practices learned correctly can be abandoned in the later professional life related to the food safety culture in food enterprises (Ovca *et al.*, 2017).

In the FSMA regulation, the establishment of training programmes for personnel and documentation of training are couched in the regulatory language of "shall" rather than the "should", meaning they are required and civil and criminal penalties could be assessed if companies do not comply. The training should be targeted towards defined individual employees in a culturally appropriate context. Training must be appropriate for their level of edu-

cation and should be delivered in ways that will accommodate the best way for the individual to learn (Shinbaum *et al.*, 2016). At regularly scheduled intervals, the training programme should be critically evaluated for learning objectives, to understand the effectiveness of the training and reassess the need for additional training for the individual. When people receive “education” they are learning the theory and information about a subject; training, however, gives people the experience and skills to do something rather than just knowledge about what their job entails (Barnes, 2014). A higher level of awareness of employees’ responsibility and commitment, based on ethical principles, is needed to make up an integrated food safety system.

Shinbaum and co-workers (2016) emphasized that there are a limited number of research studies that have reported on how commercial food-processing employees contribute to foodborne illness outbreaks; quite a number of reports have found that foodservice employees played a defining role in almost all of their customers’ illnesses. They summarized the findings of some other authors who have determined that training programmes in their current form are not effective to reduce mistakes and foodborne illnesses (e.g., approximately 97% of all food service-related foodborne illness could be traced back to employees improperly handling food (Egan *et al.*, 2006); 98% of the outbreaks were caused by poor food worker hygiene and/or food preparation practices (Gould *et al.*, 2013). The results of the study of Jevšnik and co-workers (2008a) show poor knowledge about microbiological hazards and their control among employees in retail, catering and food production units. Shinbaum and co-workers (2016) also pointed out FDA data regarding recalls related to current Good Manufacturing Practices (GMP) during 1999-2003 and found that 32% of those recalls were related to ineffective employee training.

One problem lies in small and medium size food establishments (SMEs), in which the owners of a company are usually the responsible persons for food safety programmes, which also includes training. Because of a lack of time or poor knowledge, such trainings are not carried out as intended by the law. MacAuslan (2003) stressed the importance of 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 competence. In 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.

It seems obvious that we must start to link hard and soft sciences more profoundly and transfer mutual findings to all involved in food supply chain, especially those who are directly involved in the production and distribution of foodstuffs. Olsen and Banati (2014) warn that it is not always straightforward to determine what is right and what is wrong when it comes to the production of food. Many ethical questions can be raised regarding the food supply chain, including proper systems of food safety education and training. Raspor stressed that we should have in mind that safe food is the aim of all; therefore, every misleading act and piece of information (intentional or unintentional) that could happen in food supply chains, affects consumers in the end. A more effective system of primary education and lifelong learning of food-related topics are needed. To achieve total quality and save lives, a multi-disciplinary and an innovative approach, which would be capable of quick and effective responses in the food supply chain is needed. This would involve and emphasize the importance of the subjective comprehension of health and safety concepts, which is a constituent part of wellbeing (Raspor and Jevšnik, 2008; Ovca *et al.*, 2017).

### **Human factors as triggers of food safety culture within the food network**

The field of food science and technology is a part of natural science and thus researched mainly with quantitative methodology (Jevšnik *et al.*, 2006). Reliable and valid scientific discoveries are a precondition for achieving the final goal of scientific research (Hlebec, 2001). It is understandable that complex behavioural barriers require detailed diagnostic tools and matching interventions to effectively overcome them, especially in the field of food safety. Behavioural research offers an innovative, yet logical approach to the problems in the field of food safety management, and one that has so far been mostly untouched (Gilling, 2001; Gilling *et al.*, 2001). People do not react to outside signals automatically but individually interpret their meaning. That is why it is essential to learn in detail about various ways of signal interpretation, which can be done with qualitative research techniques. Quantitative as well as qualitative methodologies have their advantages and disadvantages. None of the two methodological techniques can deliver completely valid and reliable data, but if combined, they can provide important insights into the dynamics of a society. In general, quantitative

data offer more static insights but enable research of basic patterns and structures. Qualitative data, in contrast, is less appropriate for determining patterns and structures in general, but enable more thorough and in-depth understanding of the process of changes in social life (Haralambos and Holborn, 1999). That is why further multidisciplinary food safety research should be encouraged to comprehend the importance of the human being in units of the food chain. Formal and informal organizational structures and relations should be taken into strong consideration. Due to the significant increase in information that scientists from different fields are currently facing, a systematic approach to the analysis of published discoveries has become essential. A multidisciplinary approach, including experts for food safety, food technology, psychology, sociology, and public health, is thus of great importance (Jevšnik *et al.*, 2006).

Yiannas (2008) argues that there should be a move away from traditional food safety management systems with a focus on “process, food science and a simplistic view of food handler behaviour” to ones “incorporating people as well as process, behavioural science and the belief that behavioural change is complex and not based on mere provision of factual information”. Zanin and co-workers (2017) discussed the fact that there is no translation of knowledge into attitudes/practices or attitudes into practices after training. Some satisfactory results were observed in this triad when more advanced techniques of education and training were used. The knowledge, attitudes, and practices (KAP) of food handlers are essential for identifying how efficient training in food safety is allowing the prioritization of actions in planning training and in its final realization in the daily practice.

Furthermore, one part of management is the extent to which managers become personally involved in food safety activities including training, and the ability to stay in touch with day-to-day food safety issues. The successful application of any management system is therefore dependent on managers being proactive (Griffith, 2010; Soon *et al.*, 2012). In 2001, Gilling and co-authors stated that HACCP has been described as a philosophy in theory and a tool in practice, so HACCP problems are a complex mix of managerial, technical, and behavioural issues requiring specific remedies (Gilling, 2001; Gilling *et al.*, 2001). By taking a psychological approach and utilizing practical experience and a theoretical knowledge of HACCP, Gilling and co-workers (2001) identified 11 key

barriers and organised them around a knowledge, attitude, and behaviour framework, which was also observed by Jevšnik and others (2006). After that, Mullan and co-workers (2016) summarized that a variety of theoretical models have been developed in to explain and predict behaviour; in particular, social cognition models are commonly used and known to be effective for developing theory-based health interventions. A core assumption of social cognition models is that people make rational decisions based on cost/benefit analyses of the potential outcomes of behaviour. Such models have been found to successfully predict health behaviours; however, few have investigated safe food-handling behaviour. Mullan and co-workers (2016) pointed out that there are currently a number of commonly used theories in health psychology, but the Theory of Planned Behaviour (Ajzen, 1991) is the most frequently used model in food research and has specifically been applied to food-handling behaviour.

An increasingly important role for food control systems is the delivery information, education, or advice to participants throughout the farm-to-table continuum. Insufficient product information can lead to products being mishandled at later stages in the food chain, which can result in foodborne illness; consequently, the prevention of insufficient product information is needed. At present there is both insufficient knowledge and awareness of food safety issues among food handlers as well as consumers insufficiently informed about food safety principles at home (Redmond and Griffith, 2003; Jevšnik *et al.*, 2008a; Jevšnik *et al.*, 2008b, Jevšnik *et al.*, 2008c, Jianu and Golet, 2014; Pichler *et al.*, 2014). In the study of Oyarzabala and Roweb (2017), less than one third of the participants properly defined hazards and risks. However, these results highlight the need for the incorporation of modules to discuss these important food safety terms and include more active learning modules to teach food safety classes. This study suggests that active learning helps food personnel better understand important food safety terms that serve as building blocks for the understanding of more complex food safety topics.

According to an official report of the European Food Safety Authority, a total of 43.3% of foodborne outbreaks in Europe have been traced (with strong evidence) to food eaten in professional food service settings (EFSA and ECDC, 2016). Among professional settings, catering establishments represent the major share. As reported by other researchers (Tood *et al.*, 2007; Nørrung *et al.*, 2008), infected peoples' bare-hand contact with food, improper

hand-washing practices, and insufficient cleaning of processing equipment are the most frequent errors made by professional food handlers, resulting in subsequent outbreaks. It was concluded that employees do not understand the meaning of proper handwashing and are not aware of the microbiological hazards that can occur due to dirty hands. The causes for the latter can be found amongst insufficient hygiene training, negligent, insufficient employee knowledge, and/or inefficient control by supervisors (Jevšnik *et al.*, 2007; Jianu and Golet, 2014; Pichler *et al.*, 2014; Zanin *et al.*, 2017). Ambrožič and co-workers (2010) summarized research results regarding hand hygiene and pointed out that microorganisms are always present on hands because they are a part of the normal microflora of the human body; nevertheless, in food production and trade, the presence of some bacteria is not allowed. In the research, blood agar plates were used for bacteriological analyses of hands, which enabled the quick estimation of the hygiene condition in the selected plants. In further analyses, a selective growth medium would be used only for bacteria considered dangerous; this would show the hygienic status of food-processing plants. It was determined that on the right hands of employees there were fewer microorganisms than on the left hands. When studying an individual person, in most cases it was observed that they have either low or high bacteria counts on both hands. Therefore, it may be wise to take swabs from workers' hands more frequently and to communicate the results, which 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 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 handwashing, much more frequently than they implemented them (Walker *et al.*, 2003; McIntyre *et al.*, 2013; Jianu and Golet, 2014; Pichler *et al.*, 2014; Mullan *et al.*, 2016; Oyarzabala and Roweb, 2017). This suggests that food handlers could be carrying out food safety practices less frequently than the self-reported data imply (Clayton *et al.*, 2002). Shojaei and co-workers (2006) cited the fact that many authors emphasized that the hands of food handlers are an important vehicle of food cross-contamination and that improved personal hygiene and scrupulous handwashing would lead to a basic reduction of contaminants and conse-

quently to better food safety. So consequently, education and training is of key importance (Ovca *et al.*, 2017; 2018).

Lues and Van Tonder (2007) summarized the results of several studies showing that various bacteria, amongst others *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* sp., survive on hands and surfaces for hours or even days after initial contact with these contaminants.

Every person working in a food-handling area must maintain a high degree of personal cleanliness and wear suitable, clean and (where necessary) protective clothing. It was determined that personal hygiene is significantly poorer in SEs (small enterprises) than in MEs (medium enterprises). More than a third (36%) of workers in SEs did not wear clean and suitable overalls, and 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; moreover, the owners do not provide necessary means for the safe food handling. In MEs, the situation regarding personal hygiene is better. In most of the MEs, there is a responsible person authorized by management, who is responsible for hygiene and has required professional education. Periodical training for workers is performed in accordance with a plan, and work performance is checked daily. The main problem identified amongst food handlers in SEs is related to the fact that they receive no specific or insufficient knowledge about food hygiene (Jevšnik *et al.*, 2007).

Previous studies show that training that changes knowledge does not always translate into changed food-handling practices (Clayton *et al.*, 2002; Green *et al.*, 2006; Rossi *et al.*, 2017; Ovca *et al.*, 2017; 2018). Translating knowledge into practice is a complex process (Liu *et al.*, 2015). Knowledge should be positively correlated with attitudes and practices, but there is some disagreement on this issue. A meta-analysis of barriers encountered during HACCP implementation has shown that among twenty-one elements, we can select 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 the frequency of their citation in analysed studies (Jevšnik *et al.*, 2006). Practical experience and a review of the food safety literature 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 best-equipped food companies with significant resources of money, technical expertise and management skills face a difficult challenge, whilst SMEs often feel that the difficulties of HACCP are potentially insurmountable. 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 an individual's reaction to received information (Jevšnik *et al.*, 2006). This can be approached from different perspectives as was indicated in 2001 for complex behavioural barriers in the food safety area (Gilling *et al.*, 2001) as discussed above. Obstacles regarding HACCP implementation are widespread. Because of that there are numerous research papers dealing with the ways of success to adopt the system in various food industries. In an attempt to bring the conclusions of the studies together, Jevšnik and co-workers (2006) reported the outcome of a meta-analysis. According to the results, around 50% of the hurdles were related to training, human resources, planning, knowledge and competence, and management commitments. Ten of the twelve studies investigated in the meta-analysis reported barriers related to worker motivation, awareness, interest, and familiarity with food safety controls. Other barriers classified by Jevšnik and co-workers (2006) relate to poor planning of implementation, excessive documentation, knowledge and competence, external support and lack of resources. The other results of the meta-analysis have shown that among 21 elements, we can select seven elements (training, human resources, planning, knowledge and competence, management commitment) representing almost 50% of all identified barriers.

Recent survey studies have determined 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 *et al.*, 2003; Green *et al.*, 2006; Shojaei *et al.*, 2006; Lues and Van Tonder, 2007; Tood *et al.*, 2007; McIntyre *et al.*, 2013; Liu *et al.*, 2015; Rossi *et al.*, 2017). Data on risk factors for foodborne diseases indicate that the majority of outbreaks result from faulty food-handling practices (Clayton *et al.*, 2002). Consuming and/or handling poultry meat is the most consistent risk factor, linked to the high prevalence of campylobacters in retail poultry meat (Kovač *et al.*, 2014). It is apparent in food processing that the risk of

foodborne illness due to contact with hands or surfaces depends on both the level of contamination as well as the probability of transfer and the importance of contaminated surfaces in relation to the potential transmission of pathogens to food. Proper food-handling practices provide the foundation that food safety assurance systems are built upon. Poor hygienic practices can contribute to outbreaks of foodborne illnesses and cause injury. The mishandling of food plays a significant role in the occurrence of foodborne illness, which affects a quarter of the population of the developed world (Scallan *et al.*, 2011). Although there is no comprehensive insight into the public health effects of foodborne diseases, through the metric of disability-adjusted life years (DALY) aggregating the loss of life and health due to illness, at the European level, a study done for Greece demonstrates that foodborne illnesses accounted for ca. 896 DALY per million inhabitants annually (Gkogka *et al.*, 2011).

Factors that have a significant impact on employers' behaviour are correlated with the organizational climate in the company, level of job satisfaction and labour conditions and with relations between employees. Marolt and Gomišček (2005) described a new management approach to employees, which motivates them to take initiative, to learn, to have devotion to the company, to self-confidence, to achieve greater efficiency and better team-work, which all contribute to higher successfulness and effectiveness of the organisation.

They emphasized the function of leadership, which plays a key role in the realization of the new principles into practical work and can thus significantly contribute to better usage of existing resources. A leader should persuade the employees to fulfil their needs and desires by working effectively and should enable them to use their potentials and, by doing so, to contribute to achieving the goals of the team and organisation. Ideally, people would be motivated to such level that 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 (Marolt and Gomišček, 2005).

In a review of the history of motivational research and theory, Latham and Ernst (2006) summarized that psychologists 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 behaviour by administering environmental reinforcers and punishers contingent upon a person's response (Skinner's contingency theory). They also underscore the importance of attaining employees' goals: they not only feel satisfied, they generalize their positive affect to the task (Jevšnik *et al.*, 2008a). Food handlers are the ones who carry out the work in a company, and they are the most important factor in food safety behaviour. Human behaviour is vital, and it is difficult to control, so handling people requires situational leadership. Hazards cannot be solved and eliminated just through engineering control. They also need to be recognised by employees who will minimize their effects. Human resource management and education of food safety managers in food premises is not sufficiently covered by current food safety legislation.

#### *Food handler behaviour*

Researchers' observations of food handlers behaviour has been changing through the decades, due to changes of methodology applied in research, but also are influenced by food handlers. The food handlers' fluctuation in the food business is higher and higher and the employees are coming from economically less-favoured countries.

Griffith (2010) pointed out that while knowledge of microbiology is extremely important in food safety an over reliance on "microbiological or technological solutions" may have contributed to the problem: "Food handlers often do not implement known food safety procedures", and "Food safety has implications for food, medical and behavioural scientists" (Griffith, 2010). Proper food handling is vital at each stage of the food chain and neglecting human behaviour can be significant. Following an outbreak, the causes or risk factors may be investigated, but the underlying root cause(s) can be missed (Griffith and Redmond, 2009). For example, if the undercooking of food is identified as a contributing factor this could be due to faulty equipment, changes to raw materials, or human error. When food handler behaviour has been recognized as a problem, the conventional solution has been more knowledge-dominated training without considering the use of psychological approaches to understand and eventually "modify" behaviour (Griffith, 2000). Over the past 20 years, greater attention has been given to food handler behaviour rather than just the provision of food safety knowl-

edge; this could prove particularly useful in helping to reduce levels of food poisoning in the future. It has been suggested that poor food-handling practices contributed to 97 per cent of foodborne illness outbreaks in food service businesses (Howes *et al.*, 1996), which are the most frequently reported location for outbreaks (Griffith, 2000). If correct, this would make food-handling behaviour the single most important factor affecting the control of food hazards. Initial studies of food handlers tended to concentrate on their knowledge and beliefs (Clayton *et al.*, 2002). Food handlers' knowledge of food safety is critical: they cannot behave hygienically if they do not know how to behave and why. This has led to increased emphasis on training; however, knowledge of food safety/hygiene does not always translate into the implementation of food safety practices.

Da Cunha and co-workers (2014a) established that a food handler believes that other food handlers are worse than he or she is. Environmental characteristics can empower food handlers and increase their optimistic bias, as observed among schools' and hospitals' food handlers. They emphasized that understanding food handlers' perceptions can enable the discussion of different effective strategies of training. In another paper, Da Cunha and co-workers (2014b) showed that training based on theoretical aspects is not related to the attitudes, self-reported practices and observed practices of Brazilian food handlers from different food services. However, training seems to be an effective tool for improving knowledge. The current wording of Brazilian legislation motivates food handlers to undergo training only for certification. Food safety laws should not only require certification but also enable the establishment of policies to monitor and ensure the adequacy of food services. McIntyre and co-authors (2013) established that FOODSAFE-trained food handlers reported significantly better hand washing practices and attitudes compared with an untrained food handler group. These results support a requirement for the recertification of trained food handlers and demonstrate a need for the education of untrained food handlers with a food safety training programme such as FOODSAFE.

The knowledge, attitudes, and practices (KAP) of food handlers are important for identifying how efficient training in food safety is allowing prioritize actions in planning training (Zanin *et al.*, 2017). Lee and co-workers (2017) conclude that the studied food handlers had adequate food safety knowledge, but the perceived knowledge failed to

be translated into practices at work. For that reason, Zanin and co-workers (2017) suggest that KAP evaluations are important to detect that the assessment be applied before and after training. However, the evaluation of KAP is limited to these answers and not to deliver refined conclusions about the behaviour of the food handler and on action strategies related to psychological factors that affect practices. The researchers understand the evaluation of KAP to be the first step to understand the food handler's point of view. After this evaluation other diagnostic strategies become necessary to enhance this understanding, especially considering the gap in the studies included. Consequently, models and longitudinal strategies, with environmental suitability, considering psychological, social factors and experience that shapes the behaviour of food handlers can be designed in the hope of promoting food safety and minimizing the causative factors of food-borne disease.

### **Food safety culture**

Nayak and Waterson (2017) summarized some facts regarding safety culture and pointed out that the Chernobyl accident transformed the landscape of industrial safety and gave birth to the concept of "safety culture", although some would understand food safety culture to be a much older part of human culture. This is based on the proverb "Do not serve to anyone any food you would not eat yourself or you would not feed your children". However, in modern times, we still understand this saying in the frame of food safety, but in food networks it is not implemented strictly, since the food business operator is not directly facing the one who would eat its food product. According to Edwards and co-workers (2013), safety culture is considered multi-dimensional and is often used to refer to human and organisational behaviour (what people do and the way a company operates). According to Cooper (2000), Gadd and Collins (2002) define the safety culture in a workplace as a group of people's behaviours (based on their beliefs, perceptions and values of safety). Griffith and co-workers (2010b) explained that the concept of food safety culture has direct parallels with "safety culture" and in the prevention of healthcare-associated infections. Nayak and Waterson (2017) summarized from some other researchers in this field that in recent years, safety culture has been applied within the food industry as the food industry is a complex sociotechnical system, and a systems approach would be required to help adopt a proactive approach. Sarter and Sarter (2012) emphasized that beyond traditional ap-

proaches based on training, food analysis and official inspections, there is a need to ensure a "food safety culture" to improve food safety performance. As defined by Yiannas (2009), food safety culture is the way in which an organisation or a group approaches food safety in thought and in behaviour. According to Powell and co-workers (2011), this means that operators: 1) know the risk associated with the food they produce; 2) know how it should be managed and effectively manage it; 3) promote a value system that focuses on preventing illness. According to Griffith and co-workers (Griffith *et al.*, 2010b), food safety culture has been described as an emerging risk factor and has been defined as "the aggregation of the prevailing relatively constant, learned, shared attitudes, values and beliefs contributing to the hygiene behaviours used within a particular food handling environment" (Griffith *et al.*, 2017).

As explained and summarized by De Boeck and co-workers (2017), the behaviour of all employees, regardless of their hierarchical position in the company, is believed to be influenced by the food safety climate prevailing in the company.

For now, there is limited research in the area of food safety culture in different units in the food supply chain, although some studies are being assessed within food establishments. However, recent studies have also highlighted the importance of food safety behaviour (e.g. decision making and execution of procedures) of employees working in food-processing companies). It is also important to distinguish between two related concepts: between food safety climate and food safety culture. De Boeck and co-workers (2015) presented a distinction between these two concepts. Food safety climate was conceptualized as the perception of the individual employees regarding the food safety situation in their company, whereas food safety culture can be considered by all stakeholders in the business. Food safety culture was then defined as the interplay of the food safety climate perceived by the employees and the managers of a company (so-called "human route") and the context in which a company is operating, the currently implemented Food Safety Management System (FSMS), consisting of control and assurance activities (so-called "techno-managerial route"). These two routes can be considered to be mechanisms driven by different variables, both believed to influence the (microbiological) output (e.g., the safety and hygienic status of the final delivered or processed food products, production environment, and hands of the work-

ers) (Boeck *et al.*, 2017). Griffith and co-workers (2017) explained that the type of food safety culture existing within a business can explain why food handlers choose not to implement known food safety practices and why training, although important, may not change practices. Whilst studies on food safety culture remain in their relative infancy, attempts have been made to identify its underlying structure (Griffith *et al.*, 2010c). Yiannas (2009) states that if the food safety performance in the food supply chain is to be improved, the way people do things must be changed. Or, even simpler, he states that food safety equals behaviour. However, few studies have used perceptual measures to explore food safety culture in the food industry.

In accordance with the reviewed literature in the field of food safety culture, it has been established that the culture in organizations remains very poorly understood. However, recent interest has led to the development of several tools (questionnaires, observational methods) to measure food safety culture/climate in organizations (Griffith, 2006; Boeck *et al.*, 2015). Some of them are developed from the perspective of regulators or through their own measurement systems in food companies (De Boeck *et al.*, 2017), but commercial measurement systems also exist (e.g., Campden BRI/TSI). For example, Ungku Fatimah and co-workers (2014) present a model for determining the food safety culture with the help of a questionnaire, which included nine areas: leadership, communication, self-commitment, management system and style, environment support, teamwork, accountability, work pressure, and risk perception. Recently, Jespersen and co-workers online proposed a food safety culture maturity model that combines a survey tool with a more behavioural-based assessment to determine the company's stage of food safety culture maturity ([https://foodsafetytech.com/feature\\_article/food-safety-culture-measure-what-you-treasure/](https://foodsafetytech.com/feature_article/food-safety-culture-measure-what-you-treasure/)). Nyarugwe and co-workers (2016) put forward a system-based model, in which the interdependence and relationships of all components are studied, and hierarchies of subsystems are indicated. In line with De Boeck and co-workers (2015), Nyarugwe and co-workers (2016) stress the importance of measuring both food safety culture elements and actual food safety performance to obtain a picture of the food safety culture in the organization as a whole.

Based on a literature search and expert discussions. De Boeck and co-workers (2017) extended existing the food safety culture model, introducing new variables and relationships establishing

the individual human route. In their study, model safety behaviour is considered twofold: on one hand "safety compliance" is considered, being the execution of the obligated safety related activities (e.g., following of procedures and use of protective clothing), on the other hand "safety participation" is proposed, being the execution of voluntary safety related activities (e.g., assisting colleagues to make sure they can work in a safe manner).

In their research, Nayak and Waterson (2017) established that stakeholders valued the importance of "food safety culture" and were aware of the risks of degradation in safety culture even in "mature" organisations. They understood the benefits of assessing safety culture in food businesses and had various thoughts on what the factors were that were to be measured and how to measure them. But promotion of food safety culture is very much needed (Asamani, 2020). Assessing safety culture in one guise or another can be useful as it provides valuable insights when used appropriately.

The concept of food safety culture has received increased attention in recent years from both academics and practitioners. In 2009, Yiannas thrust the concept to the forefront, with the publication of "Food Safety Culture: Creating a Behavior-Based Food Safety Management System" (Yiannas, 2009). This book provides an overview of food safety culture and presents measures and tactics to change it in food service establishments. Chris Griffith, a renowned researcher in food safety culture, published a series of papers in which he discusses food safety culture based on learnings from other disciplines, such as organizational culture and occupational health and safety (Griffith *et al.*, 2010c). Griffith and co-workers suggests that dimensions of food safety culture are similar to those found in these other disciplines so that knowledge gained from studying other organizational cultures can be applied to food safety culture. They go on to define food safety culture and propose components to consider when assessing the effectiveness of it but omit the significance of the work group. The formation of organizational culture, including food safety culture, takes place in groups of individuals (Griffith *et al.*, 2010c).

Food culture is complex, and many interlinking factors are at play. The analysis of food culture literature showed that food safety culture researchers emphasized the importance of food handlers' behaviour at all levels in the food supply chain and management system. Nyarugwe and co-workers (2016) emphasize that major elements to be con-

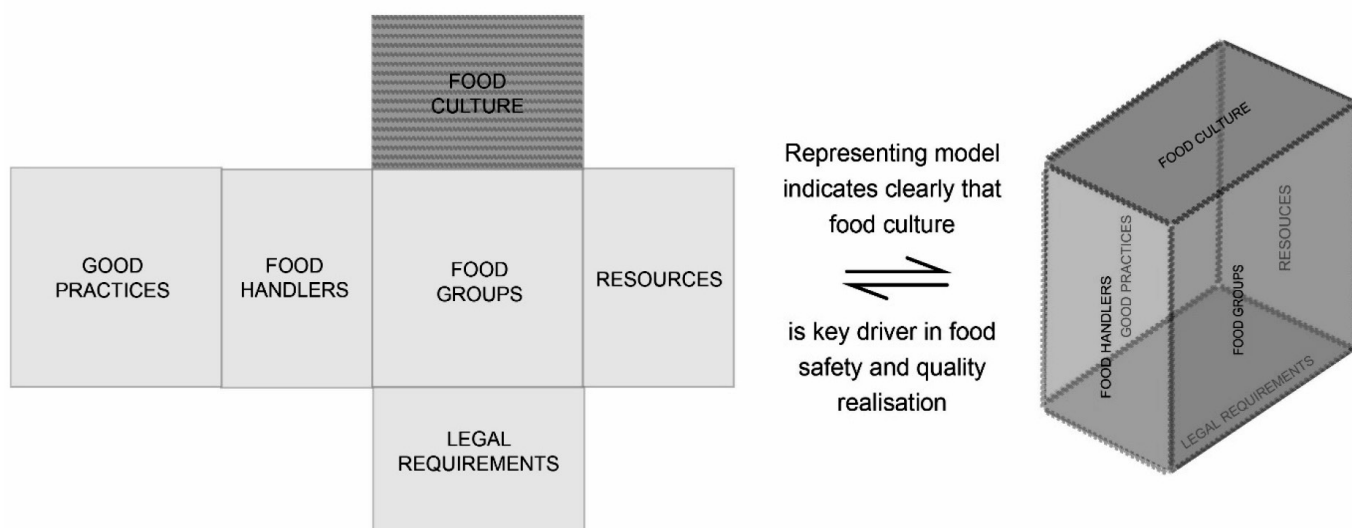
sidered in food safety culture research include organisational and administrative characteristics (i.e. food safety vision, communication, commitment, leadership, training), technical facilities/resources (i.e. food hygiene/safety tools, equipment, and facilities), employee characteristics (i.e. attitudes, knowledge, perceptions and risk awareness), group characteristics, crucial FSMS characteristics, and actual food safety performance at global level (Nyarugwe *et al.*, 2020).

Throughout the world, major shifts in food consumption at global and regional levels are occurring with considerable health consequences, which result in increasing food safety and quality demands and requirements. A food safety management system is a set of interacting elements forming a network to ensure that food presents a minimal risk to consumers and includes good practices, the HACCP system, management policies, traceability systems, and standards considering

the production of food. Many ethical questions can be raised regarding the food supply chain (Raspor *et al.*, 2016).

Raspor and Jevšnik (2016) discuss all interactions within food supply chains, and not many contact points do have the attention they would deserve. This complexity opens questions: shall we really discuss the future of food safety management in food chains? This implies that we accept linearity as a key principle in current food systems. We know from daily practice that this is not the case. Thus, we shall start to redesign our approach and thinking, and we shall start to think about food supply networks. It is quite common to speak about networking when we speak about people, organizations, companies, and various subjects in different areas of expertise.

The representational model (Fig. 1) indicates that food culture is a key driver in the realization of food safety and food quality.



**Fig. 1.** Food culture as key interconnecting elements assuring the realization of food safety and food quality.

food safety regulation. The vast numbers of laws, regulations, standards, good practices, and codes confuses everybody, even those who are working in the field on a regular basis and are forced to keep up with the developments. To achieve the prevention of food-related disease and efficient safe food assurance is a complex task. Primarily, we need suitable hygienic working environments and, secondly, motivated, satisfied and qualified personnel. It is obvious that we must start to more profoundly link the hard and soft sciences and transfer mutual findings, experiences, and skills towards consumers by engaging all elements of the food supply chain (Raspor *et al.*, 2016). Olsen and Banati (2014) warned that it is not always straightforward to say what is right and what is wrong when it comes to

Five elements are essential for the successful development and maintenance of food culture in an organization in the food supply chain: legal requirements, good practices, food handlers, food groups and resources. Global food safety will be achieved only when every single link in the food chains systems will master his/her particular area and will trust in the activity of both the previous and following links in the food safety circle “from farm to table”. For this to occur, we first need knowledge of all aspects of food production, preparation, and distribution, then we have to educate and train food handlers, provide suitable resources, and ensure adequate legal requirements.

As one can see, food culture is not just one element; it is that which creates the proper milieu for

all activities needed along each step of food supply chains in the complex food networks of our time.

Based on the concept presented in Fig. 1, it is crucial to create proper milieus for all technical and nontechnical activities along each step of food supply chains, keeping in mind the complexity of food networks. Food businesses are intended for commercial success and profit, which is not always congruent with food safety and the high quality of food products or services. Therefore, we must cultivate food safety culture daily among all employees, not just those dealing directly with food items.

## Conclusion

Undoubtedly, the human factor is the trigger of food safety culture within food networks. Furthermore, this issue has a few essential elements. First, the large majority of advanced processing solutions in current manufacturing practice is run by processing equipment and technologies with reduced numbers of workers. Second, people are excluded as major players in this concept since all crucial tasks are planned and controlled by computerized solutions. Third, the food supply chain counts on employees with reasonably low education and corresponding salaries, which are not the most attractive to retain skilled and knowledgeable workers for long periods. Consequently, employee turnover is high, and there is no time to build strong relations in terms of friendly cooperation, trust, and long-lasting dedication towards the work and operational tasks.

Assuming these facts, among other issues discussed in the publications survey and mentioned in this paper, it is obvious that we have moved from known customers to totally unknown customers in food production and processing. Today, the overwhelming majority of global food production is not following the basic concept of food supply: “I know who will eat it”. In current reality, the food is produced for someone, and will be eventually consumed by someone somewhere. Conscious producers will not be affected by this fact, but the low-paid and low-respected workers in the food chain are easily vulnerable to this challenge. This is why food culture and its propagation are so important in food networks. Legislation, traceability, and inspection protocols were found to be extremely helpful in the previous century, but even these cannot in all cases overcome greed in food supply chains.

We hope that continuous education and building higher respect for the professions and jobs within food supply networks will bring food safety culture to the desired point, which will maintain high

levels quality, safety, and trust in food supply systems. However, the task of rebuilding home food safety culture remains, as it has slowly disappeared with the dilution of traditional families and their values by the modern lifestyle fuelled by the “all by myself” philosophy.

## Acknowledgment

The authors acknowledge the financial support from the Slovenian Research Agency (research core funding No. P3-0388). The authors would also like to express their gratitude to Lidija Baša for her help with graphic design.

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