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Food safety culture

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Summary

Food safety is not the responsibility of one. It is addressed to every interested party in the food chain. It is the result of the cooperation of their actions and the effective implementation of the food safety management system.

Osman, 2018 stated that "*By food safety culture, what is meant is a set of behaviours that are learned and shared among people, and which are based on accepted assumptions, values and beliefs, which are dynamically impacted by an array of factors and situations"*.

On 21st of March 2021, EFSA published the annex of 852/2004, (EU) 2021/382. Through this regulation it becomes now mandatory to acquire food safety culture in all organizations related to the food field and not only in those that are certified under the umbrella of GFSI (BRC, IFS, FSSC).

The assessment of food safety culture in foodservice industry plays an integral role to the improvement of existing food safety management systems. However, the research to that aspect is still immature and little. Assessing food safety culture is of major importance, in the sector of food industry. However, to date, there has been no in-depth research on the subject.

With present research, an attempt was made to collect data and evaluate the current situation in Greece, regarding the food safety culture of all stakeholders in the food industry. For the needs of the research, a questionnaire of 25 questions was drawn up, which was made available for anonymous completion via Google forms, for the convenience of the participants. The required time to complete it was approximately 8-10 min. Subsequently, the statistical evaluation of this followed, through the statistical program Minitab.

Through the questionnaire, it is concluded that the majority of the participants are experienced stakeholders from different backgrounds , which have received food safety training.

What is more, most of the answers indicated that the majority of the stakeholders are aware of the importance of food safety and have a high food safety culture. However, it was observed a higher rating of food culture evaluation from the quality assurance and management departments than from the general staff and production departments.

In a general context, the current situation in Greece is at a satisfactory level in relation to the food safety culture, nevertheless, there are some points for improvement such as the fact that only 17.5% of the participants are rewarded for their participation in the safe handling of food.

Keywords

Food Safety, Food Quality and Safety, Food Quality and Safety Management System, Food Safety Culture, Assessment of food safety culture, Food safety culture Greece

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Introduction

Persistent food safety issues remain an important global concern due to foodborne diseases that impact consumer health. According to (WHO, 2018) it is estimated that almost one out of ten people suffer from foodborne diseases and 420000 consumers eventually die per year. In 2008/2009 there have been numerous, large scale, high profile recalls and outbreaks across the USA costing millions of dollars to business and the nation resulting in serious illness and death (Marler, 2009).

As it far the listeriosis outbreak in South Africa the cost valuation was over 260 US$ millions of dollars (oLANYA, et al., 2019). Although the food industry, third party auditors and regulators have placed substantial effort on implementing and improving FSMS, incidences of foodborne illnesses still continue to be reported (FDA, 2011 (Crim, et al., 2015).

The Global Food Safety Initiative (GFSI), an industry-driven global collaboration dedicated to advancing food safety, believes that to be successful and sustainable, food safety must go beyond formal regulations to live within the culture of a company. And by food safety culture according to Osman, 2018 what is meant is " a set of behaviors that are learned and shared among people, and which are based on accepted assumptions, values and beliefs, which are dynamically impacted by an array of factors and situations.

Furthermore, according to (Crosby, 1972) an industry with poor safety culture can loss up to 20% of her sales in adequacy to industries with a strong safety culture.

It is now widely recognized, that food safety culture plays an integral role related to food safety performance and impact on brand and economics (Ribera, et al., 2012), (Ball, Wilcock, & Aung, 2009), (Griffith, Jackson, & Ryk, 2017)

1.1 Food safety

"*Food safety can be described as the strategies and activities aimed to protect foods from biological, chemical, physical, and allergenic hazards that may occur during all stages of production, distribution and consumption , from farm to fork*" (Abu Al-Rub et al., 2020, European Commision).

According to the Reg. (EC) No 178/2002 : "*food safety covers any stage of production, processing and distribution of food, and also of feed produced for, or fed to, food producing animals. 'food business' means any undertaking, whether for profit or not and whether public or private, carrying out any of the activities related to any stage of production, processing and distribution of food, 'feed' (or 'feedingstuff') means any substance or product, including additives, whether processed, partially processed or unprocessed, intended to be used for oral feeding to animals*".

1.2 The importance of food safety

Accomplishing a safer food supply chain results in reducing both the financial and disease burden of a Nation. For example, it isn't far away from the 2008 contamination of infant formula with melamine affected 300.000 infants and young children in China, leading 51900 to were admitted to the hospital and six of them passed away (Fung, Wang, & Menon, 2018)**.** In addition, in case of improper implementation or failure to implement a food safety protocol it is possible to lead to cross-contamination in the food chain Consequently, once infection is confirmed, food businesses must immediately recall the whole batch. Food recalls cost companies an average of $ 10 million USD in direct. However, in the long run a product recall can shake consumer confidence in the company and this can be even more costly (Wood, 2017). Furthermore, an even greater challenge to food safety is inextricably linked to the increase in the life expectancy of the human population, excessive urbanization, the mass production of food due to urbanization? and dietary changes in people's habits (Kaferstein, Motarjemi, Moy, & Quevado, 1999).

1.3 Legislative and Regulatory framework

The HACCP technique was developed in the 1960s in the United States by Pillsbury in collaboration with military laboratories and NASA for the safety of food produced for

intercontinental spacecraft crews. In 1989 the National Advisory Committee on Microbiological Criteria for Foods (NACMC) published a guide, which includes the seven principles with definitions and descriptions. Three years later, in 1992, the same committee revised the Guide, introducing a chart of decisions to determine CCPs. In 1993 the Codex Alimentarius Commission issued instructions for the adoption and performance of the HACCP System. In the same year, the European Community, based on the principles of the HACCP, adopts the horizontal directive 93/43 on food hygiene. This is followed by the publication of the draft General principles of Food Hygiene by the Codex Alimentarius Commission in 1994 and risk analysis in 1995.

The mandatory implementation and maintenance of a HACCP system by food businesses follows from European Directive 93/43 on food hygiene. In April 2005, the European Parliament and the Council of the European Union adopted Regulation 852/2004 on food hygiene, which entered into force in January 2006, repealing Directive 93/43, including primary production (Tsaknis, 2018).

At the same time, Regulation (EC) No 178/2002 is adopted according to which its general principles and requirements are defined Food Law, the European Food safety Authority is established and procedures related to food safety issues are established, too. It is the basis for health protection and establishes the general principles governing food and feed in terms of their safety. In addition, it sets out procedures that must be followed to ensure the hygiene and safety of food and feed.

In summary, the main points are:

- Establishes common principles, responsibilities and procedures.
- To ensure food safety, it is necessary to all aspects of the food production chain to be considered as a sequel, from primary production and production feed up to the sale or disposal of food to consumer “from farm to plate”.
- Every company has the primary legal responsibility for the production/ supply of safe food. Defined as “responsible” for each business.
- Risk analysis
- Principle of precaution
- Principle of transparency- informing the public.

- Protection of consumers' interests.
- Consumer protection against misleading labeling- advertising.
- Establishment of traceability systems
- General obligations during the import and export of food
- Management of food crisis
- The European Food Safety Authority is established. The committee deals, inter alia, with additives, perfumes and materials in contact with food, biological hazards. Their food chain contaminants, pesticide residues, dietary, functional and novel foods but also with genetic modified food.
- Early Warning System (RASFF).
- Ensuring a high level of protection of human health and consumer interest.

Table 1. The including regulations of European Legislation (Tsaknis, 2018)

1. General Regulation 178/2002, which is already in force from 1/01/2005 on the definition of the general principles and requirements of food law, the establishment of EFSA and the definition of food safety procedures
2. Regulation 852/2004 on food hygiene, which came into force on 01/01/2006
3. Regulation 853/2004 on the hygiene of food of animal origin, which came into force on 01/01/2006
4. Regulation 854/2004 on the organization of official controls on food of animal origin, which came into force on 01/01/2006
5. Regulation 882/2004 on the official control of food and feed, which enters into force on 01/01/2006
6. Regulation 2073/2005 on microbiological criteria for food
7. Regulation 183/2005 on the hygiene of animal feed
8. Regulation (EC) No 396/2005 of the European Parliament and of the law concerning the maximum residue levels of certain pesticides in or above certain products
9. Regulation 1881/2006 on the establishment of maximum levels for certain substances which contaminate food

1.4 Private Food safety systems

As referred before, current legislation in the European Union explicitly postulates that food businesses are primarily responsible for ensuring food safety. However, there was a general consensus that despite thorough European and national legislation, HACCP- based food safety management systems, training audits, and site inspections, foodborne breaches are still occurring with critical consequences to both consumers, employees, and the organization's brand reputation (De Boeck, Mortier, Jacxsens, Dequidt, & Vlerick, 2017)

Therefore, these crises prompted the formation of various consortia among every interested party. This has led to the development of various private standards for the proper guidance and implementation of food safety management systems.These

include the British Retail Consortium (BRC) standard, BS EN ISO22000, Safe Quality Food (SQF) (2018), and International Featured Standards (IFS-Food) (Manning, Luning, & Wallace, 2019).

These standards are known as food safety management Systems and include two basic definitions, Food Safety and Quality control (Henson, 2006). Private food safety standards are distinguished by clear instructions for companies to comply with legal requirements. In addition, many standards set stricter requirements than the applicable requirements, even for matters that may not be covered by it (Nyarugwe, Linnermann, & Luning, 2020). These standards consider as stricter because they set the bar higher in terms of some specific characteristics of food and they regulate more activities. Also, they are much more specific in how the goals will be achieved, it enforces the standard itself. Finally, Because the adoption and implementation of a system is considered a prerequisite HACCP or even ISO 22000 (Henson, 2006).

1.5 The role of GFSI

The Global Food Safety Initiative (GFSI) was originally set up as a result of food safety scares in early 2000. GFSI is a non-profit foundation, managed by the Consumer Goods Forum. Its mission is to: "Provide continuous improvement in food safety management systems to ensure confidence in the delivery of safe food to consumers worldwide". Gfsi is currently made up of four different divisions. The Gfsi Board which mainly include food producers and retailers, the Gfsi Technical Group which consists of experts in the fields of certification and accreditation. The GFSI Local .Groups and the GFSI Stakeholder Group. The main goal of the GFSI Stakeholder Group is to bring together all the previously mentioned interested members so that all those issues that are also the purpose of the organization can be discussed. Therefore, all stakeholders contributed to the creation of the Gfsi Guidance Document. This sets out the requirements for recognized food safety management systems schemes and provides the framework for their benchmarking.

The standards recognized by GFSI have been assessed and recognized by GFSI through the Guidance Documentation (GFSI, GFSI GUIDANCE DOCUMENT, 2014). These are:

1. IFS Standard: IFS Food Version 6
2. GLOBAL G.A.P. Standard: IFA Aquaculture. Standard: IFA Fruits and Vegetables. Standard
3. Global Red Meat Standard (GRMS) Standard: GRMS Version 6.
4. SQF Code Edition 8
5. FSSC 22000 Standard
6. Canada GAP Standard
7. Global Aquaculture Standard: Seafood Processing Standard Issue
8. BRC Standard: BRC Global Standard for Food Version 8.
9. BRC-IOP Global Standard for Packaging Materials
10. Primus GFS Standard: Primus GFS Version 3.

The above Standards are globally recognized and once an organization is certified with on of the above Standards, then it can operates globally (GFSI, GFSI GUIDANCE DOCUMENT, 2014) .

1.6 Framework of food safety culture

At June 2015, GFSI created a team of 35 members with chair of the working group to be, Lone Jepersen in order to draft the paper of food safety culture. A guide for the implementation of food safety culture. Professional Development Group in food safety culture established in July, 2017 and the position paper published in 2018. BRC, the first standard that was recognized by GFSI, was the first standard which adopted food safety culture. At 2018 BRC issued its eighth version and Food Safety Culture Plan added as a specific requirement within the Standard (BRC, Global standards Food Safety Issue 8, 2018).

Later, on 21st of March 2021, EFSA published the annex of 852/2004, (EU) 2021/382. Through this regulation it becomes now mandatory to acquire food safety culture in all organizations related to the food field and not only in those that are certified under the umbrella of GFSI (BRC, IFS, FSSC).

According to article XIa of the Annex 2021/382, reference is made to the acquisition of food safety culture in a documented manner. In fact, it is primarily addressed to the

management's commitment to the safe production of food, the availability of resources for the safe handling of food, the awareness of all employees about the risks associated with food and the active participation of all for the safe food handling, with open communication channels. While the management's commitments emphasize the training of the staff, and the encouragement of continuous improvement.

2 Culture

2.1.1. The meaning of culture

The word culture has its roots in the Latin “cultura”, which comes from the verb colo-ui-ere, and has been used since the 15th century in the French, English, and German languages to describe the process of growing plants and animals. Since the 18th century the meaning of the term changes mainly due to the evolution of the German word *kultur* which is used for the “cultivation of the human spirit” (Williams, 1981). Some of the most representative definitions used in the literature are the following:

Culture is “a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems” (Schein, 1992).

Culture is always a collective phenomenon, because it is at least partly shared with people who live or lived within the same social environment, which is where it was learned. It is the collective programming of the mind which distinguishes the members of one group or category of people from another (Hofstede, Cultures and Organizations: Software of the mind, 1991) (Hofstede, Hofstede, & Minkov, Cultures and Organizations: Software of the mind, 2010).

(Coreil, Bryant, & Henderson, 2001) states *‘‘Culture is patterned ways of thought and behavior that characterize a social group, which can be learned through socialization processes and persist through time.’’*

2.1.2 The organizational culture

Organizational culture is likened to the individual's personality, a subtle but ever-present force that gives meaning, direction and the basis of an action. Just as the actions and behaviors of a person are influenced by his personality, so in an organization (a set of people) the common values, norms and beliefs affect the attitude of employees and management in dealing with problems, in serving customers, in dealing with suppliers, competitors and in general in every activity (Oden, 1997). The organization is in other words a micrograph of society and consequently there is a causal relationship between it and culture (Brown, 1998). According to (Nielson J., 2014) organizational culture is a way to determine “how thing are done around here" and it has both formal and informal characteristics as it shown in Figure 1. The formal elements are visible and concrete but informal elements can have even bigger impact to the organization as they influence habits and relationships.

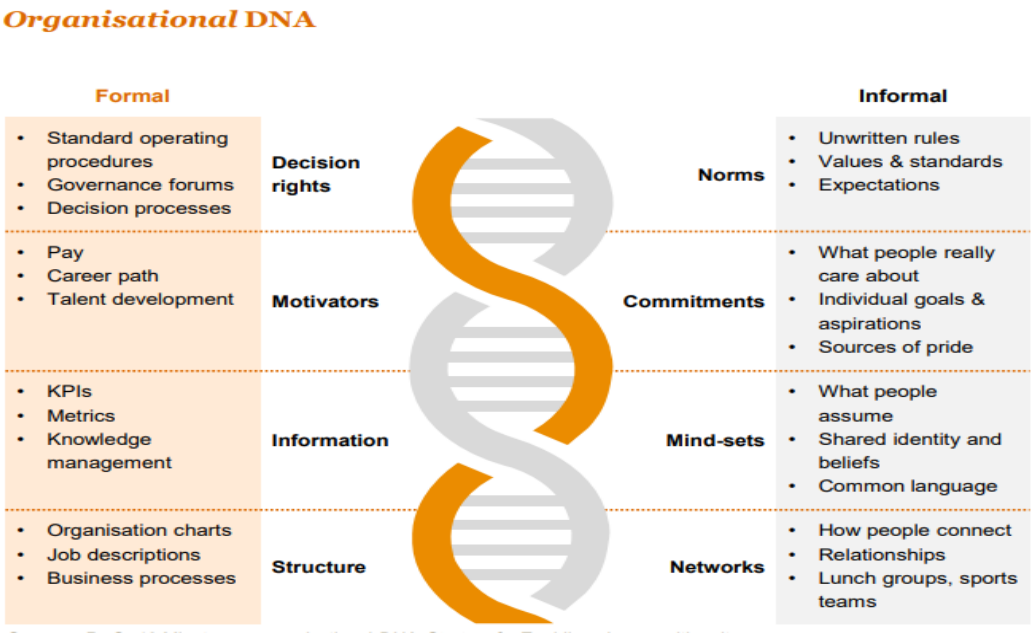


Figure 1 The dna of organizational culture (Nielson J., 2014)

2.1.3. The meaning of food safety culture

As already said before, the culture is the way we do thinks and when it comes to the food safety culture there are many definitions.

The (GFSI, A culture of food safety. A position paper from the global food safety iniatitive, 2018)GFSI defines food safety cultures as, “shared values, beliefs and norms that affect mindset and behaviour toward food safety in, across and throughout an organization.” In Figure 2, are listed in chronological order the most important definitions related to food safety culture.

Definitions	
Wilson, Tyers, and Wadsworth (2010)	
Culture	A manifestation of the values and beliefs and attitudes within a workforce. Its formation is dependent upon the knowledge, standards, motivation and leadership of the person in charge, how they communicate with, and are trusted by, the staff.
Safety culture	‘Good’ organisational safety culture… [is] where there are ‘shared, accurate perceptions of risks and everyone adopts the same positive attitudes to health and safety’.
Neal, Binkley, and Henroid (2012)	
Food safety culture	How and what the employees in a company or organization think about food safety. It’s the food safety behaviors that they routinely practice and demonstrate.
Wright, Leach, and Palmer (2012)	
Safety culture	The safety culture of an organization is the product of the individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization’s health and safety programs.
Culture	Culture is the patterned ways of thought and behaviour that characterize a social group, which can be learned through socialization processes and persist through time.
Food safety practices	The collective food safety practices used within an organization… taking into account both food safety culture and food safety management... the aggregation of the prevailing relatively constant, learned, shared attitudes, values and beliefs contributing to the hygiene behaviours used in a particular food handling environment and one must—provide staff with a common sense of food safety purpose.
Food safety culture	How and what the employees in a company or organization think about food safety… [and] the food safety behaviours that they routinely practice and demonstrate
Wilson (2015)	
Culture	A manifestation of the values and beliefs and attitudes within a workforce. Its formation is dependent upon the knowledge, standards, motivation and leadership of the person in charge, how they communicate with, and are trusted by, the staff.
Safety culture	‘Good’ organisational safety culture… [is] where there are ‘shared, accurate perceptions of risks and everyone adopts the same positive attitudes to health and safety’.
Jespersen, Griffiths, and Wallace (2017)	

Organisational culture	The culture of a group can now be defined as a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.
Food safety culture	The aggregation of the prevailing, relatively constant, learned, shared attitudes, values and beliefs contributing to the hygiene behaviours used in a particular food handling environment.
Osman (2018)	
Food safety culture	By food safety culture, what is meant is a set of behaviours that are learned and shared among people, and which are based on accepted assumptions, values, and beliefs, and which are dynamically impacted by an array of factors and situations.
GFSI (2018)	
Culture	Culture draws its power from the unspoken and intuitive, from simple observation, and from beliefs as fundamental as "This is the right thing to do" and "We would never do this." Rules state facts; culture lives through the human experience.
Food safety culture	Shared values, beliefs and norms that affect mindset and behaviour toward food safety in, across and throughout an organization.

Figure 2 Summary of definition related to food safety culture (Bolanos, 2018)

At the heart of an understanding of culture is, therefore, a reflection of shared attitudes and behaviours, and this is where the concept of a food safety culture becomes important. Can the "culture" of an organization, community or even country be geared towards a shared set of attitudes and behaviours that facilitate the production of safe food? If the answer is yes, how can this happen?

2.2 Importance of culture

2.2.1 The impact of culture on Foodborne illnesses

Persistent food safety issues remain an important global concern due to foodborne diseases that impact consumer health. According to (WHO, 2018) it is estimated that almost one out of ten people suffer from foodborne diseases and 420000 consumers eventually die per year.

The five factors identified by the (WHO, Five Keys to safer food maual, 2006), as primary contributors to foodborne illnesses are:

- Cooking procedures
- Temperature abuse during storage
- Lack of hygiene and sanitation by food handlers

- Cross contamination between raw and fresh ready to eat foods
- Acquiring food from unsafe sources

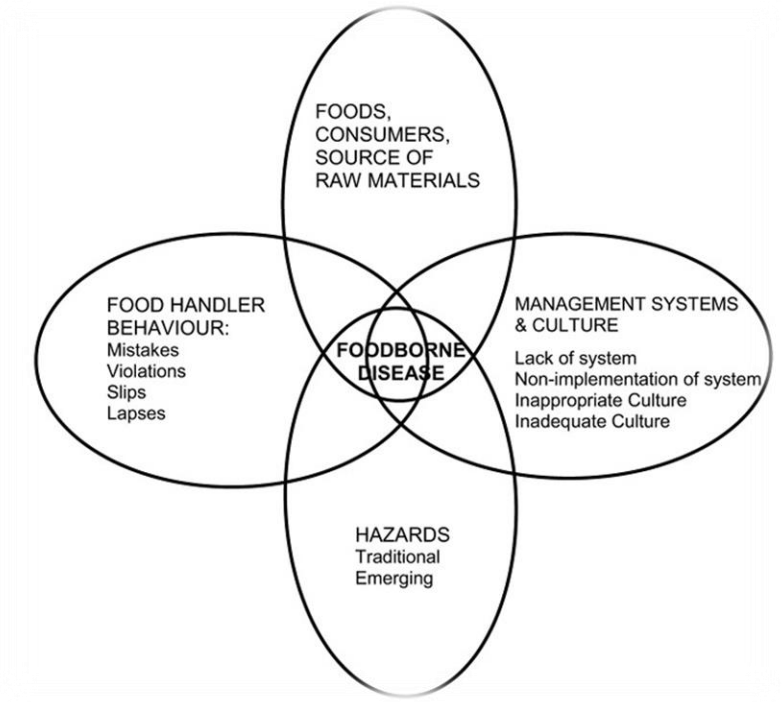


Figure 3 Interacting components of food safety (Griffith J, 2010)

All human behaviors that can be changed through a shift in organizational culture. This has led to the recognition of food safety culture as a key contributory factor to the food safety performance of food establishments. In Fig. 3 , according to Griffith, 2010 it is shown how culture can influence foodborne disease.

2.2.2 Examples of poor safety culture

According to (Powel, Jacob, & Chapman, 2010) two shaky examples having poor food safety culture and eventually leading to foodborne outbreaks were about the John Tudor & Son, 2005 and Maple Leaf foods, 2008. The first was about a catering butcher business, which caused an E.Coli O157 H:7 outbreak with 157 ill people and one death due to lack of sanitation, staff training, cleaning etc., despite the fact that William Tudor, the head office of business had an advanced food hygiene qualification. As far as Maple Leaf foods Inc was responsible for a Li. Monocytogenes outbreak that led to

57 illnesses and 22 deaths, in 2008. There was a Listeria Monocytogenes contamination in deli meat products which probably came from commercial meat slicers that despite the fact that were cleaned according to manufacturer's instructions, had meat residue trapped inside the slicing mechanism. According to independent investigate review, Maple Leaf foods had a HACCP plan, the staff was trained, they conducted environmental tests etc. In the last month staff identified the existence of L. monocytogenes in some samples but the Chief Executive Officer didn't reach the information. This failure in communication shows that food safety culture was immature yet in the company and couldn't manage the crisis. Then, in 2017 comes another outbreak of listeriosis on deli meat commonly reffered to as ''polony'' in South Africa. This processed meat was consumed such domestic as to Southern African development Coordination countries and to other Sub Saharan African countries. During the outbreak it took 60 weeks to identify polony as the culprit in the outbreak. Actual investigation about the role of polony in the outbreak was conducted in August 2017 and and it took almost a year March, 2018 until there been the first recall(Department of Health South Africa, 2018a, Department of Health South Africa, 2018b). The outbreak resulted in 978 illnesses and 183 deaths, putting 15 countries in danger (WHO, 2018).

2.2.3 Other factors forces the adoption of food safety culture

Except from the obvious factor, which is to reduce food safety incidents, there are several other reasons for the implementation of food safety culture. Some of them are the below:

- The increasing number of unannounced audits within the food industry. Having a mature food safety culture, companies ensure that their employees always work in the same way and there is no change in their behavior when they are evaluated so the companies are always "audit alert".

- The desire for companies to gain recognition for their positive cultures. Through the measurement of culture, companies gain recognition and marketing leverage for having a strong food safety (Emond & Taylor, 2018).

2.3 Core elements of food safety culture

According to the GFSI (GFSI, A culture of food safety. A position paper from the global food safety iniatitive, 2018) food safety culture main dimensions can summed up into the Figure 4.

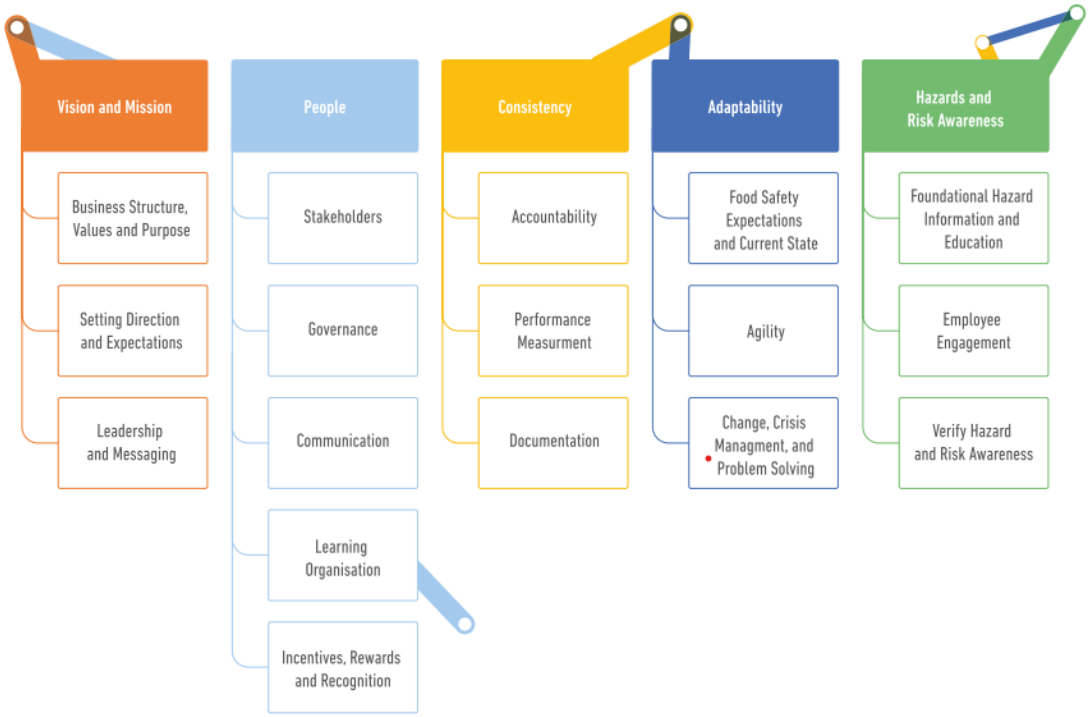


Figure 4 Core elements of food safety culture (GFSI V1.0 - 4/11/18, 2018).

The GFSI framework consists of five dimensions based on a review of seven existing culture evaluation tools. In order to build a strong food safety culture you must not miss out any of the steps including the subdimensions, each identified from GFSI as important (Jepersen, Robach, Beaumont, & Mortimore, 2018).

2.3.1. Vision & Mission

Food safety culture starts at the top and flows download (Yannas, 2009). The vision and mission of a business is established by leaders . Leadership behaviors inspire the

actions of others to drive better food safety performance. Leaders develop food safety policies and standards in alignment with the company's strategic direction, but policies alone are just documents and requirements (GFSI, 2018). The demanding part is that managers should find a way to provide motivation to employees in order to comply to food safety policies and procedures and eventually create behaviours commited to the purpose. Messaging plays a crucial role to business (Stir, 2021).

2.3.2. People

With "People," we refer here to everyone engaged within the food industry, from farm, field and fishing boat to processing, packaging, distribution and the serving of food (GFSI, 2018).

Stakeholders" in this context refers to everyone across all aspects of the supply chain, both within and outside of a company, who supply, support or otherwise influence that company (GFSI, 2018).

2.3.3 Communication

(Yannas, 2009) believes that "you can tell a lot about the food safety culture within an organization by their communication or lack of it". Communication is defined as a business process that described how individuals, groups, and organizations transmit information to other individuals, groups and organizations both within and outside businesses (Greenberg & Baron, 2008). When the communication is not done well, the organization will never fully understand the intended changes, their intended benefits, or the consequences if they are not addressed (Ades, Leith, & Leith, 2016). Communication can be accomplished by using multiple mediums. This way an organization strengthens food safety as part of their culture (Yannas, 2009). Channels of communication vary according to their degree of formality, the work environment

and the amount of technology utilized by the business There are an increasing range of communications options within a company ,like formal, informal and semiformal approaches individually, but a good communication policy should include a mixed way method including all of them. However, organizations supporting proactive communication systems having lower accident rates than organizations with reactive communication systems. The major advantage of an effective communication with employees is that can help them to feel involved and empowered, increase productivity and reduce staff turnover by increasing staff motivation and commitment (Griffith J. , 2010).

Practical ways to implement formal communication:

- Clear statement of the priority of food safety issue and to whom someone can address about it.
- Focused training programmes about communication.

Practical way to implement informal communication:

- Business events
- Flyers
- Posters
- Newsletters
- Signs
- Video company run television channels
- Company intranet sites
- Meetings
- Conferences
- Mentoring
- Feedback/ Suggestions process
- Award and Recognition
- Consequences ((Yannas, 2009). GFSI, 2018, (Stir, 2021).

According to (Yannas, 2009) an organization in order to succeed the right implementation of the communication has to be specific, determine the placement'

specific messages work best when not only tell employees what behaviour is needed, but also where the behaviour is needed, keep it simple and occasionally change the message.

2.3.4 Learning Organization

Training employees on food safety practices has been shown to be the one of the most important programs that food service can implement, and are essential to the People dimension However, results also provide evidence that traditional approaches used to educate and train employees may not be particularly effective, and new behavior-based approaches need to be developed (Neal, Binkley , & Henroid, 2012). Moreover, most of the times senior management don't participate in food safety trainings. As a result, managers aren't in position to understand food safety risks nor the need for resources for the assurance of food safety (GFSI,2018). According to (Summers, 2022), one of the disadvantages of the traditional training programs is that the training is not contextually accurate. In more details, it has often incorrect educational level, there lasting too long, in office situations, too theoretical. Secondary learning is distanced from everyday work, making it difficult to translate to frontline work environment, as it lacks practicing skills. Furthermore, with the absence of feedback mechanism, lack of recognition for behavior change and not tied to personal performance metrics leads to failure to reinforce. On the other side innovative training programs equips leaders with a small number of competencies presented in a contextually correct manner to make the biggest impact. Secondary, Learning is done in the plant using real-life scenarios so it can be practiced in the plant. In addition to, concise modules are available 24/7 and can be retaken as many times as needed. It is also used interactive question for supervisor/manager introspective. Moreover, according to Canadian Institute of Food Safety, 2020, a good practice is to find ways to build a five – minutes training session into employees' daily schedule and use visual cues to remind them to do and how to to various tasks in the business such as hand washing poster in the staff bathroom, cleaning agents sheer in the chemical storage area, safe food cooking temperatures fact in the hot food station, information about food allergens and how to identify them on product food labels etc. In order to food training and education to be successful there needs to be better understanding not only of the

organizational culture of the establishment but also of the human dimension of the employees (Neal, Binkley , & Henroid, 2012). In fact, Emond et al., 2018, mark that that the percentage of people using cultural assessment as a way to measure the impact of their training has increased almost 20%.

2.3.5 Incentives, Rewards and Recognition

In order for the work offered by the employee to gain meaning, the purpose and contribution to it must be made clear by the company. Appreciation of value and recognition of contribution is well-being for an organization. Appreciation is most effective when it's delivered in timely, personal, and in meaningful ways. According to (Holly Mockus, 2015) providing positive reinforcement, it is the best motivator. It helps keep every team member on board with food safety commitments. "Employee engagement is about the connection employees have with their work. Highly engaged employees do their work not just because they are paid, but because they care about doing a good job." Cultures that provide purpose, opportunity, success, appreciation, wellbeing, and modern leadership increase the probability of great work for every type of employee Focus on the key elements of workplace culture Integrate recognition to satisfy employee needs make sure employees' accomplishments are known throughout the organization and reward them for it. Provide modern leadership The secret to effective, meaningful recognition is making it personal and no matter the type of recognition (public, eCard, monetary, or nonmonetary), giving and receiving it builds connection Many organizations assume that leaders and employees know how to show appreciation, but not everyone knows the best ways to create meaningful recognition experiences. 70% of employees say recognition is most meaningful to them when it's personalized, yet only 54% of employees say their leaders know what they do in their role.

Practical ideas for the implementation of appreciation:

- Setting up reward and recognition schemes, such as a cash bonus for those with the fewest food safety mistakes

- Supporting the training of employees who want to develop professionally in food safety and quality management.

- Reward simple everyday behaviors that promote food safety culture. You can use a card or a mementos for the recognition of the employee.

- Work on “just- culture” approach to running the business. This approach focuses on finding why problems happen, not who is to blame.

- Implement the method with green and red card for positive and negative behaviour relating to food safety (Caccamo et al., 2018).

2.3.6 Expectations

According to the Canadian Institute of Food Safety, 2022 in order to build a strong food safety culture , everyone in the business must understand their role in food safety and why it is important. For example, let people know that the company has a policy that no cell phones are permitted on the production floor, in the warehouses or loading/receiving docks. And, make sure that they understand why (Stier R., 2021). one of the biggest challenges of safety excellence is the shift in the resolution of responsibilities and safety measures and the assumption of the precautions to minimize accident probability (Mathis & Galloway, 2013). Each team needs to have it’s own routine, set of rules and documentation that is customized to the tasks they perform. You can’t expecting from employees to do the job best, if “best” isn’t clearly defined for them Canadian Institute of Food Safety, 2022. Everyone should follow the rules and guidelines—from visitors to the CEO to the plant manager to the hourly employee. A “no exceptions” policy will drive a culture that is sustainable and drive a

"this-is-just-how-we-do-things" mindset (Holly Mockus, 2015). Emphasize what is expected of each person and the metrics for evaluating performance, and do let them know what is unacceptable. In Figure 5, it is showed examples of good practises and the difference between generic and specific approaches.

Foodborne Risk Factor (Generic)	Expected Behaviors (Specific)
Poor Personal Hygiene	Do not work with food if ill with gastrointestinal symptoms such as nausea, vomiting, fever, or diarrhea
	Do not contact ready-to-eat foods with bare hands. Instead, use single service gloves, deli tissue, or other suitable utensil.
	Wash your hands thoroughly with soap and warm water in a designated hand sink before starting your shift or returning from a break; after using the restroom; before and after changing single use gloves; after coughing, sneezing, or using a handkerchief; and before working with food, beverages, or utensils.

Figure 5 Specific behaviors related to risk factors (Yannas,2009).

2.3.7 Consistency & Accountability

It is important to hold the staff accountable. It is shown that when an employee holds accountable and his responsibilities are understood and clear in relation to the company's food safety procedures and policies, then the chances of him doing his job well with or without supervision increase (Canadian Institute of Food Safety, 2022). You can have the best documented standards in the world, but if they're not consistency put into practice by people, they re useless (Yannas, 2009). Employees in a company observe the behaviors of senior management, both good and bad. That's why managers should stay loyal to the rules and policies to food safety, in order to be the good example to their employees (Canadian Institute of Food Safety, 2022). Moreover, executive leaders will be noticed when attending team meetings, visiting sites, engaging business partners, and in many other situations and this way is it will be reinforced and employees' behavior (Jepersen, Griffith, Maclaurin, Chapman, & Wallace, 2016). Yannas, 2009 stated that "In an organization with strong food safety culture employees will do the right thing not because someone is watching but because they know it's right and they care".

Practical suggestions for senior leaders to set the right tone in maintaining consistency:

- Always ask food safety- related questions and provide direct, immediate and specific verbal feedback when on visits to manufacturing facilities.
- Try to ask targeted food safety questions of production workers and answer questions directly and specifically
- Share with HACCP team members and other members involved information about food safety that may arise from partners, inspections or meetings (Jepersen, Robach, Beaumont, & Mortimore, 2018).

2.3.8. Food safety performance

The basis of good food safety performance is a good food safety management system (Griffith J. , 2010). The key of achieving a better food safety performance is to establish clear, achievable and understandable goals, as it discussed earlier (Yannas, 2009). Measuring the performance of a mature food safety management system must take into account not only the product and processes but also actions, decisions and behaviours (GFSI, 2018).

Food safety performance then needs to be assessed, measured against standards and the results feedback to employees who should be accountable

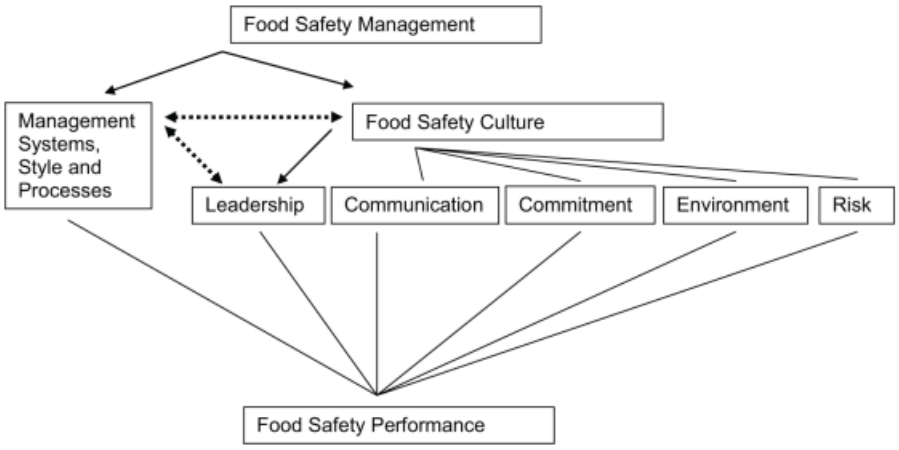


Figure 6 Factors influencing food safety performance (Griffith J., 2010)

A documented food safety management system should contain an overall food safety policy containing aims supported by food safety objectives setting out how the aim will be achieved (Griffith, 2009). This provides a marker for food safety leadership and communication. Secondary levels of the documentation should cover operating methods, instructions and procedures and a tertiary level report forms and procedures. HACCP is a food safety management system that is currently promoted internationally because it enables food business operators to control food safety risks

at all points along the production line, rather than waiting for microbiological testing of the final product (Tuominen, Hielm, Aarnisalo, & Raaska, 2003).

Taking food safety culture into account is a promising way to improve food safety performance in the food industry. Food safety culture (FS-culture) research is expanding from an organisational perspective to include characteristics of the internal and external company environment (Nyarugwe, Linnermann, & Luning, 2020).

Evidence presented from a number of industries suggested that an organisation's FS-culture is an “emerging risk factor” when inadequate, and that there is a link between food safety and the prevailing FS-culture (Griffith J. , 2010).

2.3.9 Adaptability

Practical ideas for senior leaders to set the tone for adaptability:

- Have an open challenging discussion of food safety policies and programs with key stakeholders when they are being drafted and through rollout to ensure true alignment. A well- represented review team can often flag significant challenges and possible solutions at an early stage. A senior leader can set the right tone by seeking to ensure visibility and buy-in at the earliest stage possible.

- A senior leader should advocate and support standardized risk assessment tools and models that drive local-level ownership in identifying risks and solutions to manage them. These will create a robust and factual discussion around deviating conditions and how these are being managed.

- Regular, focused, deep review of specific food safety programs, with collective subject matter experts, will foster and active and open dialog concerning solutions and the manner in which local adaptations have been applied for

achieving the same principle requirements (Jepersen, Robach, Beaumont, & Mortimore, 2018).

When it comes to an effective food safety culture, characteristics that need to be considered by an organization according to Ades et all. are:

- The engagement of everyone within a company towards food safety and not limited to a specific group
- Committing all employees towards food safety ensure easier decisions
- Suitable decisions for the company while engaging communication and collaboration from different departments
- Assess problems and work as teams to provide solutions
- Measure performance so the excellence can be rewarded
- Ensure food safety is not degraded when encountering budget limitations
- Communicate within the company that cases of noncompliance have consequences
- Support and promote the work culture of correct decision making in all situations
- Communicate food safety often and with detail
- Communicate work instructions in detail to ensure processes are carried out correctly
- Reward employees for their work
- Ensure decision making is based on clearly defined directions or objectives
- Promote excellence within the company
- Promote continuous improvement within processes
- Include the support of technology for the effective task completion
- Ensure that in the decision making process the food safety is considered

3.1. Assessment of food safety culture

There is no one method or model for assessing food safety culture that will be applied as a panacea to every business. In order for a company to evaluate its own food safety culture, it should create a customized model. The methods that can be used are divided into qualitative, quantitative or a combination of the two. Some of the qualitative methods that one can use can be while correspondingly some of the quantitative methods include questionnaires adapted to the needs of the business (Griffith J. , 2010). Recent research has developed tools to assess FS-culture (De Boeck E. , Jacxsens, Bollaerts, & Vlerick, 2015), maturity models (Jepersen, Griffith, Maclaurin, Chapman, & Wallace, 2016), and FS-culture concepts (Taylor, 2011).

3.2. De Boeck method

At 2015, De Boeck developed a self assessment tool for the evaluation of food safety culture with 28 indicators and a Linkert based answer scale. As it shown in the Figure 7, De Boeck defined food safety culture 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 current implemented FSMS, consisting out of control and assurance activities (so called 'techno managerial route') resulting in a certain microbiological output.

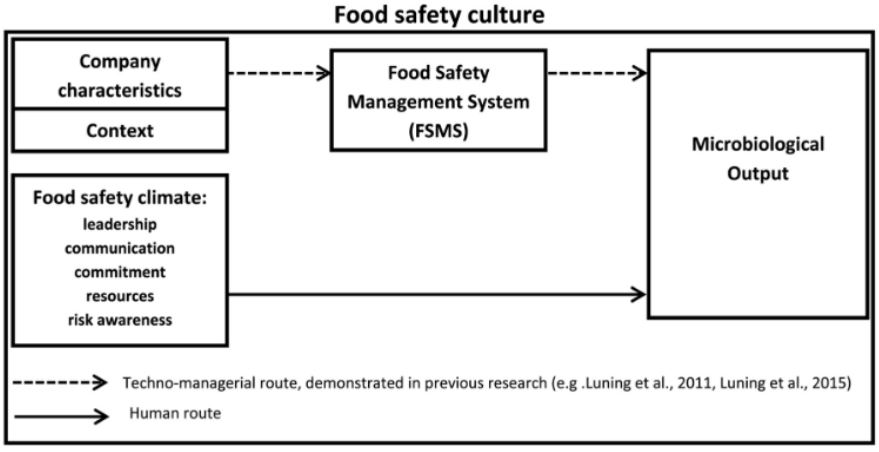


Figure 7 Food safety culture conceptual model (De Boeck, 2015)

He set the five components of food safety culture (Leadership, communication, commitment, resources and risk awareness) and then five to six indicators for each component (see Figures 8-12). The results were assessed by 5- point Linkert answer scale The self – assessment survey aims to enable companies to identify how the

company's climate concerning hygiene and food safety is perceived by their employees.

Leadership	
L1	In my organization, the leaders set clear objectives concerning hygiene and food safety.
L2	In my organization, the leaders are clear about the expectations concerning hygiene and food safety towards employees.
L3	In my organization, the leaders are able to motivate their employees to work in a hygienic and food safe way.
L4	In my organization, the leaders listen to employees, if they have remarks or comments concerning hygiene and food safety.
L5	In my organization, hygiene and food safety issues are addressed in a constructive and respectful way by the leaders.
L6[a]	In my organization, the leaders strive for a continuous improvement of hygiene and food safety.

[a] Indicator added after the expert validation.

Figure 8. The indicators of De Boeck method regarding leadership.

Communication	
C1	In my organization, the leaders communicate regularly with the operators about hygiene and food safety.
C2	In my organization, the leaders communicate in a clear way with the operators about hygiene and food safety.
C3	In my organization, it is possible for the operators to communicate about hygiene and food safety with the leaders.
C4	In my organization, the importance of hygiene and food safety is permanently present by means of, for example, posters, signs and/or icons related to hygiene and food safety.
C5	I can discuss problems concerning hygiene and food safety with colleagues in my organization.

Figure 9. The indicators of De Boeck method regarding communication.

Commitment	
E1	In my organization, the leaders clearly consider hygiene and food safety to be of great importance.
E2	My colleagues are convinced of the importance of hygiene and food safety for the organization.
E3	In my organization, working in a hygienic and food safe way is recognized and rewarded.
E4	In my organization, the leaders set a good example concerning hygiene and food safety.
E5	In my organization, the leaders act quickly to correct problems/issues that affect hygiene and food safety.
E6	In my organization, employees are actively involved by the leaders in hygiene and food safety related matters.

Figure 10. The indicators od De Boeck method regarding commitment.

Resources	
M1	In my organization, employees get sufficient time to work in a hygienic and food safe way.
M2	In my organization, sufficient staff is available to follow up hygiene and food safety.
M3	In my organization, the necessary infrastructure (e.g. good work space, good equipment …) is available to be able to work in a hygienic and food safe way.
M4	In my organization, sufficient financial resources are provided to support hygiene and food safety (e.g. lab analyses, extern consultants, extra cleaning, purchase equipment …).
M5	In my organization, sufficient education and training related to hygiene and food safety is given.
M6	In my organization, good procedures and instructions concerning hygiene and food safety are in place.

Figure 11 The indicators of De Boeck method regarding resources.

Risk awareness	
R1	In my organization, the risks related to hygiene and food safety are known.
R2	In my organization, the risks related to hygiene and food safety are under control.
R3	My colleagues are alert and attentive to potential problems and risks related to hygiene and food safety.
R4	In my organization, the leaders have a realistic picture of the potential problems and risks related to hygiene and food safety.
R5	In my organization, the operators have a realistic picture of the potential problems and risks related to hygiene and food safety.

Figure 12 The indicators of De Boeck method regarding risk awereness.

3.3. The Jepersen model

This system was developed by Lone Jepersen in 2010. The system is focused on the food safety domain and consist of five capability areas. A capability area is defined as "an area thought to be critical to food safety performance and thought to exist in food manufacturing organizations at progressive levels." Jepersen implemented and tested the system at a company in north America. Key pillars for assessing food safety culture according to Jeperson's model are the combination of self-assesment surveys, behavioral observations, interviews and performance assessments. Results were assessed both qualitatively and quantitatively through a food safety maturity model (see Figure 13). Food safety culture score by plant for each capability area. Each capability area could range between 1 and 5 depending on the participants responses to each capability area statement. Minimum maturity level equals a core if indicating, a doubt state of maturity and a score of 5 indicating an internalized state of maturity. Average for each plant was calculated and a percentage achieved calculated to quantify strength of each plants food safety culture (Jepersen, Griffith, Maclaurin, Chapman, & Wallace, 2016)

Capability area	Stage name				
	Stage 1 Doubt	Stage 2 React to	Stage 3 Know of	Stage 4 Predict	Stage 5 Internalize
Perceived value	Completing tasks because regulators make us do so. Food safety performance data is not collected and reported regularly to all stakeholders.	Little to no investment in systems (people and processes) to prevent food safety firefighting. Little understanding of true food safety performance.	Food safety issues are solved one at a time, getting to the root of the issue, to protect the business. Strong, databased understanding of true food safety performance.	Reoccurrence of food safety issues is prevented by used of knowledge and leading indicators.	Ongoing business improvement and growth is enabled by food safety.
People system	Tasks are only completed when senior leader's demand, without understanding responsibility, the task, or why it is important. Tasks being completed out of fear for negative consequences. Top management having to individually certify the accuracy of food safety information.	Responsibilities for problems are established as the problems are discovered and solved mostly by use of negative consequences. Tools are invented as new problems arise and the tools are rarely incorporated into systems for future use.	Deeper understanding for the importance of foods safety systems, where responsibilities are clearly defined and communicated, is gained one issue at a time. Consequences are mostly managed when mistakes happen, seldom through a defined plan, with both positive and negative consequences.	Develop and assess tools for improving processes through knowledge and data. Responsibilities and accountabilities are discussed, communicated, and assessed with patience. Processes are developed, including consequences (positive and negative), and managed preventive through communication and assessment.	Strategic direction is set across the complete organization with defined accountabilities, responsibilities, and food safety as one of the business enablers. Preventive definition and continuous improvement of specific food safety behaviours, consequences and tools.
Process thinking	Unstructured problem solving to remove the immediate pain.	"Plan, Do, Check, Act" with emphasis on control in the check phase and expectation of an immediate 100% perfect solution.	Structure problem solving with significant risk of over analyzing.	"Plan, Do, Study, Act" with emphasis on study and not control. Problem solving is accepted as an iterative process.	Horizon scanning and continuous improvement are used to identify risks. Risks inform the development and/or improvement of mitigation plans. Mitigation plans are integrated in the global business management system.
Technology enabled	Little technology being adopted and few see this to be an issue.	Responsibility is left to the individual to identify data needed and there is a high reliance on the individual to derive information from the data.	Standard technology is adopted on going and standardized training provided to individuals as needed. It is unlikely to see that issues are prevented by use of data-driven information.	Data is collected in a precise and accurate manner to constantly improve processes. Automation is used in a limited or fragmented way.	Integrated, global information systems (e.g., ERP) are in place in the organization making it quick to adapt, improve, and use automated workflows.
Tools and infrastructure	Minimal tools in the hands of few individuals.	It takes a problem to get the right tools. This often leads to findings the right tools in a hurry and resulting in rework.	The organization invests readily in the right tools and infrastructure when solving a problem calls for it.	Food safety tools and infrastructures are in place and are continuously improved for ease of use and cost of the organization.	Investment in tools and infrastructure is evaluated long-term and prioritized along with other business investments.

Figure 13 Food Safety maturity model by Jepersen et al., 2016

3.4. The TSI evaluation tool

This system was developed by TSI in 2015. The model of Food Safety Culture ExTcellence is built on decades of research from a broad range of academic disciplines

and industry sectors, as long as in the area of HACCP application conducted in U.K ., small and medium size companies and food service restaurants, as an audit tool. It is an online self-assessment survey with four different dimension, Purpose, People, Process and Proactivity (See Figure 14). The online tool allows large number of employees within a company to be surveyed anonymously and confidentially in multiple manner(Taylor et al., 2015).

Category	Dimension	Explanation
People	Empowerment	Empowering people to take food safety actions
	Reinforcement	The reinforcement of food safety practices
	Teamwork	The effectiveness of food safety and HACCP teams
	Training	The effectiveness of food safety training and communications
Process	Control	The level of food safety management control
	Coordination	The coordination of food safety across the company
	Consistency	The level of consistency and agreement in food safety
	Systems	The effectiveness of food safety management systems
Purpose	Vision	The role of food safety in the long-term vision of the company
	Values	The role of food safety in core company values
	Strategy	The strategic direction for food safety
	Objectives	The setting and management of food safety objectives
Proactivity	Awareness	Having awareness of external food safety issues and status
	Foresight	Having foresight in relation to food safety risks
	Change	Being able to change and innovate when required
	Learning	Enabling food safety organisational learning

Figure 14 The Food Safety Culture Excellence Model by TSI, 2015

3.5 The NSF model

The system was developed by NSF in 2016. The model uses a range of assessments and interventions that were developed in conjunction with workplace psychologists. The survey was conducted on nearly 10000 trained food handlers. The online assessment tool measures factors of behavior such as cultural, attitudinal, lack of knowledge and include behavioral theories such as “Social Cognitive Theory” etc. The system evaluates behavior across six core markers:

- Regulatory Governance
- Management Systems
- Policies & Standards
- Assessments
- Talent Development

- Culture & Behaviours

The evaluation scores are a combination of employee self assessment and on site activities are mapped on a scale of four progressive generations, ranging from reactive to core value, as it is shown in Figure 15 (Fone & International, 2012).

Figure 15 The 4 generations of NSF model, (NSF,2014)

3.6 The Ball model

This system developed by Brita Ball in 2009. It was applied to a small and medium-sized meat production enterprise in Ontario, Canada. The purpose of the model was to implement a food safety management system such as GMP and Haccp. The direction followed was qualitative and mainly included interviews either in-depth or targeted using open-ended questions.

Main topics of the questions were about production, organization and members of staff features. The data reflected three main themes related to production systems, operational characteristics and employee characteristics. Production system included process characteristics, product characteristics, facilities and equipment. Organizational characteristics included training, supervision of and feedback to employees, management commitment and approach to integration. Finally employee characteristics included skills and knowledge, attitude, influence of others, execution of food safety practices and external factors.

3.7. Other Food Safety Culture measurement tools

These are:

- Cultivated Food Safety Culture Maturity – uses Jepersen et al tools and its validated based on published research
- BRC Culture Module – uses TSI tool
- Camden Food Safety Culture Excellence- partnership with TSI
- De Boeck et,2015 al food safety climate survey – validated based on published research at Ghent University but not currently commercial available
- NSF Culture Maturity Model
- Gartner Quality Culture Maturity Model
- FSA Toolkit for Inspectors
- Enlighten 4C Food Safety Culture model

4. Research for the assessment of food safety culture in Greece

4.1 Research methodology and data collection

Through this present research, an attempt was made to collect data and evaluate the current situation in Greece, regarding the food safety culture of all stakeholders in the food industry. For the needs of the research, a questionnaire of 25 questions was drawn up, which was made available for anonymous completion via Google forms, for the convenience of the participants. The required time to complete it was approximately 8-10 min. Subsequently, the statistical evaluation of this followed.

The questionnaire was divided into 5 parts according to the indicators to evaluate the food safety culture. In the first part of the questionnaire, the general characteristics of the respondents are given, in order to create an image of their profile. All questions are closed type. Whereas, the Likert scale has been used for the answers in the following parts:

1. I totally agree

2. I probably agree

3. Neither Agree nor Disagree (Neutral)

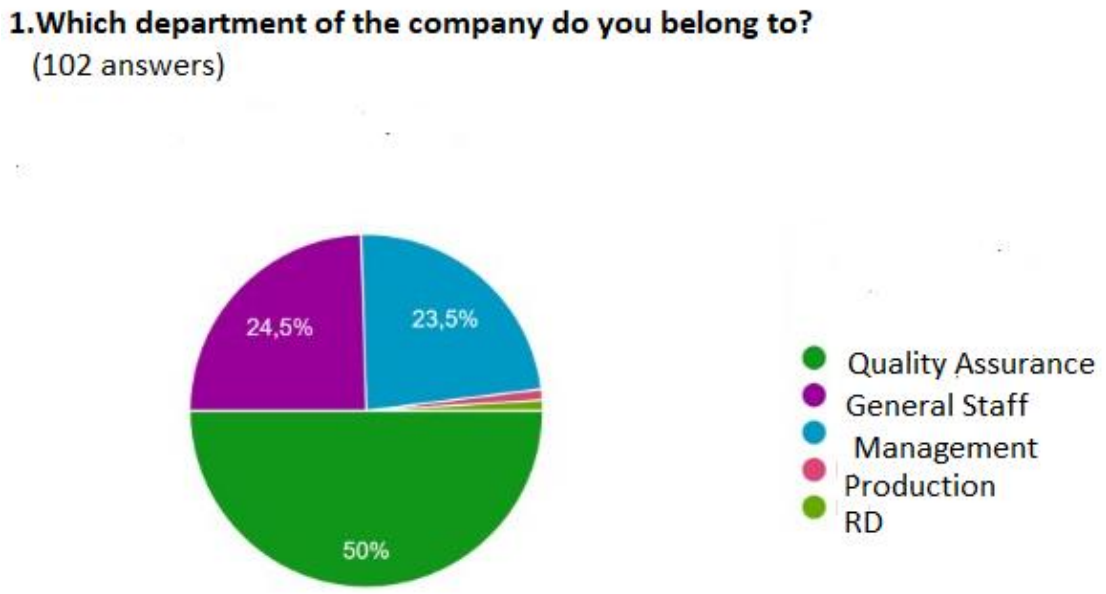
4. I probably disagree

5. I strongly disagree

The questionnaire was answered by a total of 103 people. Following is a graphic illustration per question.

4.2 Questionaries' results

Figure 16 Q1 In which department of the company do you belong to?



As can be seen from the graph, the majority of respondents belong to the Quality Assurance department with a percentage of 50%. This is followed by the general staff with a percentage of 24.5%. Management occupies a 23.5%. There are also 2 answers regarding production and Research & Development departments.

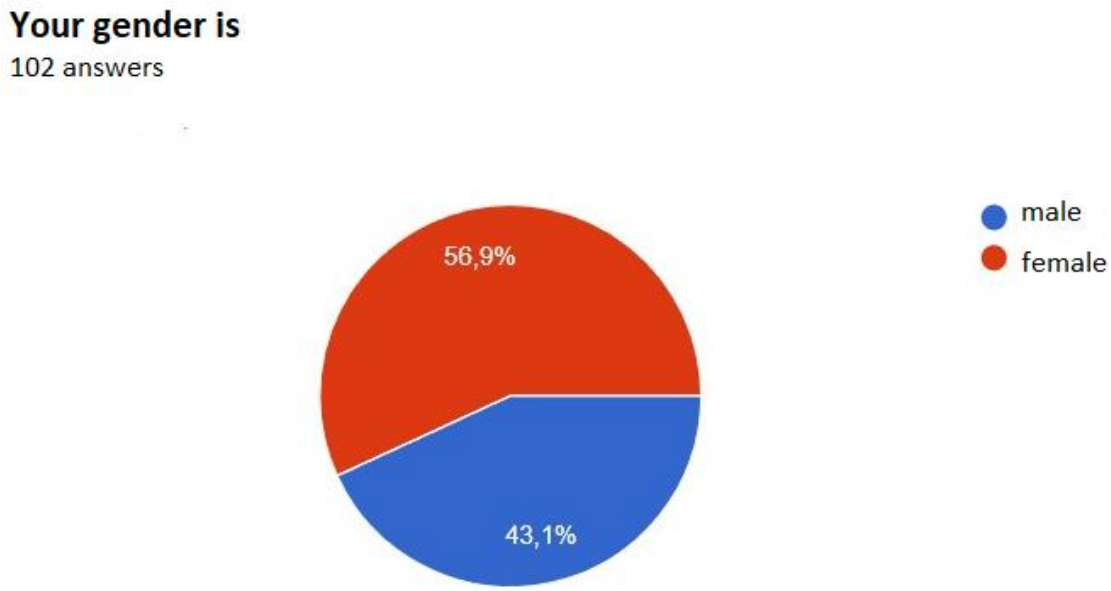


Figure 17 Q2. Your gender is male/female

As shown in the graph, the participation of both sexes is almost equal. 56.9% of respondents are women while 43.1% are men.

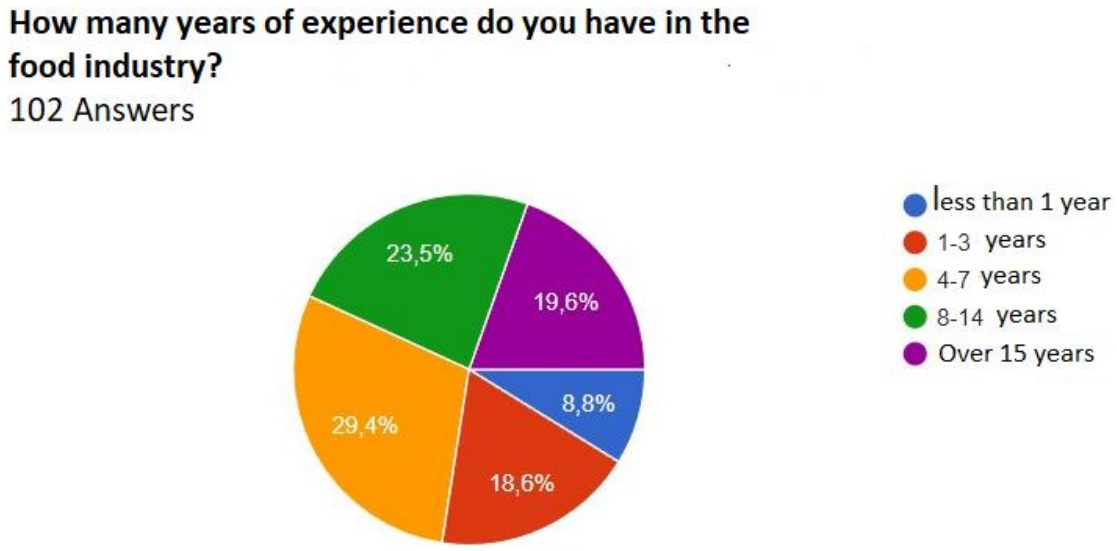


Figure 18 Q3 How many years of experience do you have in the food industry?

As can be seen in the graph there is a diversity in the responses of the respondents regarding their experience. 29.4% have 4-7 years of experience in the food industry. 23.5% of respondents have 8-14 years of experience in the food industry. This is followed by 19.6% who have more than 15 years of experience in the industry. An 18.6% belongs to the food sector from 1 to 3 years and finally the percentage (8.8%) with the smallest participation in this research belongs to young people in the sector with experience of less than one year.

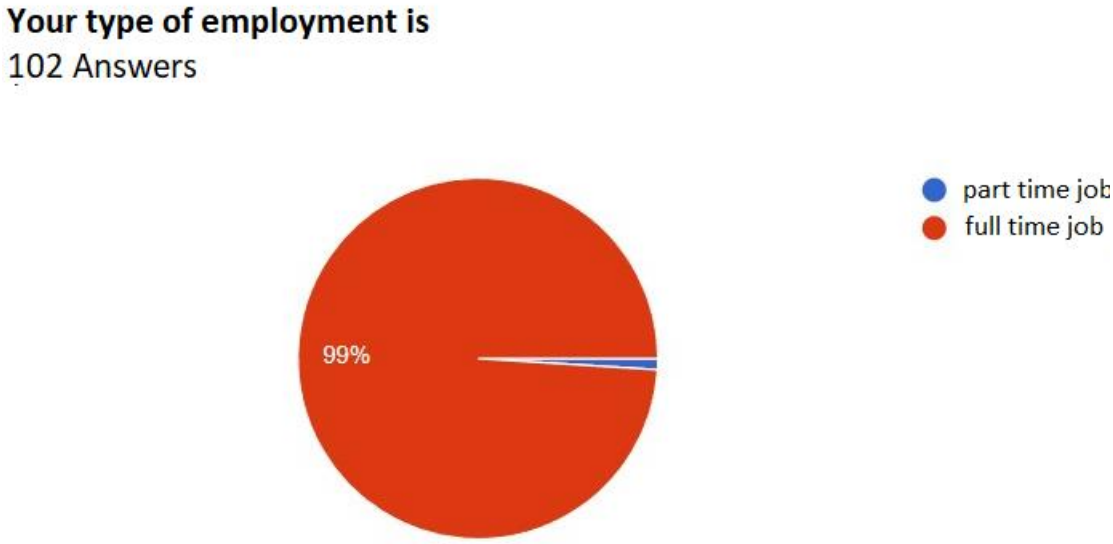


Figure 19 Q4 Your type of employment is part time/full time

As can be seen from the graph, the vast majority 99% concern participants with full-time work. While only one participant answered that he is active in the industry on a part-time basis.

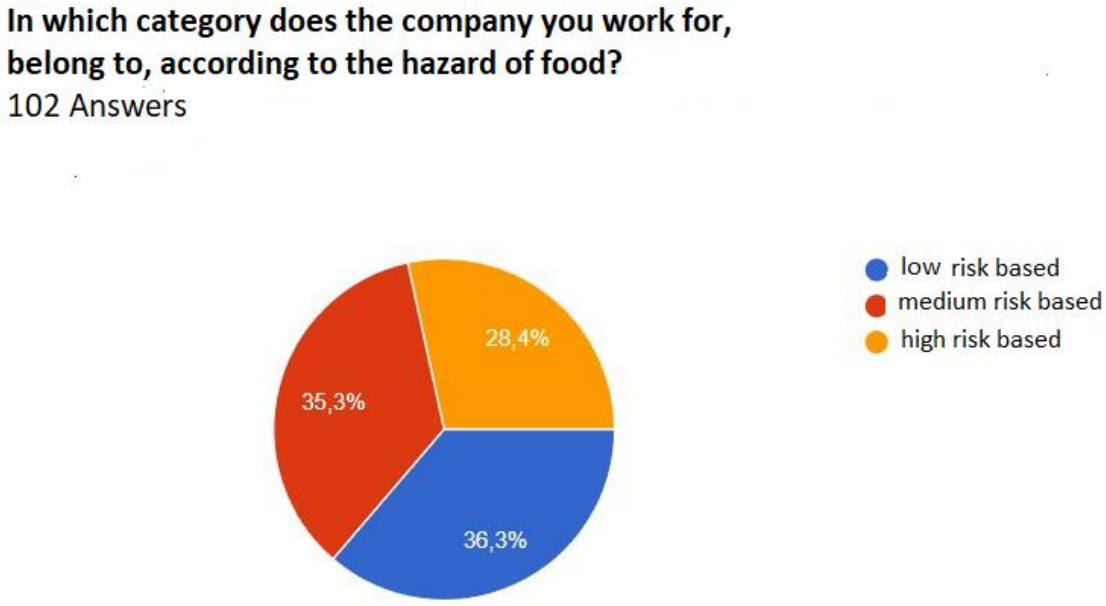


Figure 20 Q5 In which category does the company you work for, belong to, accorfing to the hazard of food?

As can be seen from the graph, the participation of the respondents regarding the food hazard category to which each participant belongs does not differ. More specifically, 36.3% of respondents work in a high-risk sector of the industry. 35.3 % work in medium risk sectors of the industry. Finally, 28.4% of respondents are active in businesses that handle low-risk foods.

What is the company's average number of employees?
102 Answers

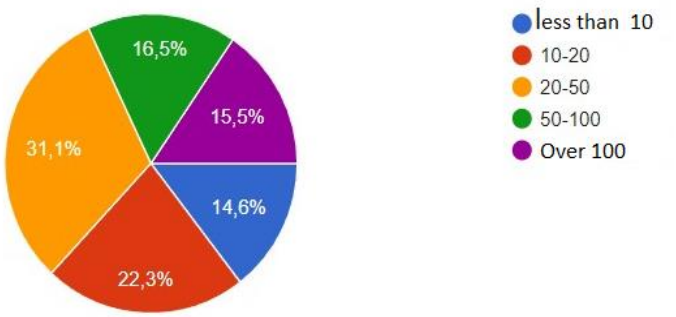


Figure 21 Q6 What is the company's average number of employees?

With regard to the size of the businesses that the respondents are active in, 31.1% belong to businesses that employ 20-50 people. 22.3% of the respondents are active in companies employing between 10 and 20 workers. This is followed by a percentage of 16.5% for companies with 50 to 100 employees. 15.5% of the respondents belong to companies with more than 100 employees. Finally, 14.6% of respondents are active in businesses with fewer than 10 employees.

Figure 22 Q7 Have you received any food safety training?

According to the responses of the respondents, 98% have received some training on food safety. However, 2% of respondents have not received any training.

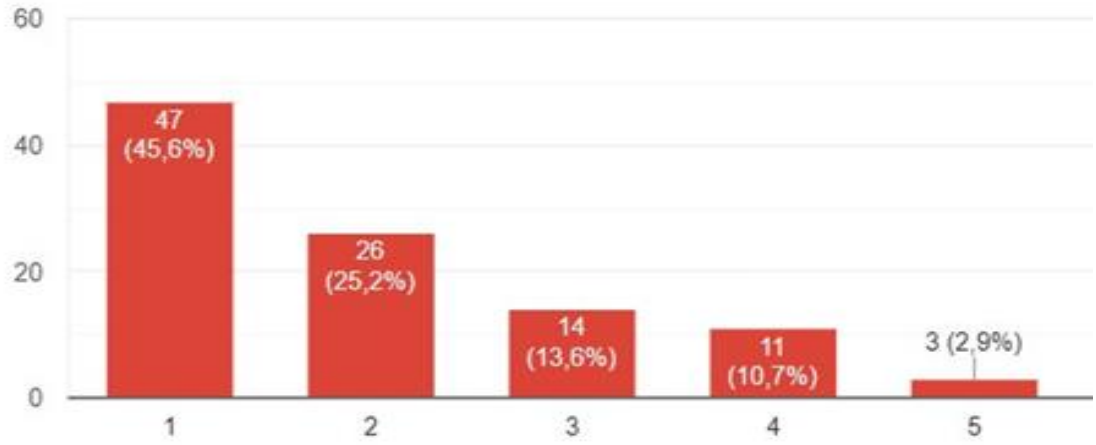


Figure 23 Q8 Management inspires me to follow safe food handling practices.

As can be seen from the graph, 45.6% of the respondents strongly agree with the fact that management inspires them to follow safe food handling. Subsequently, 25.2% of respondents agree. 14 participants answered that they remain neutral. There were 11 responses from participants who stated that they disagreed and 3 responses that stated that they strongly disagreed. In the majority of respondents (70.8%), it is observed that the Administration is an example of inspiration for those concerned. However, 13.7% of respondents do not work under these conditions.

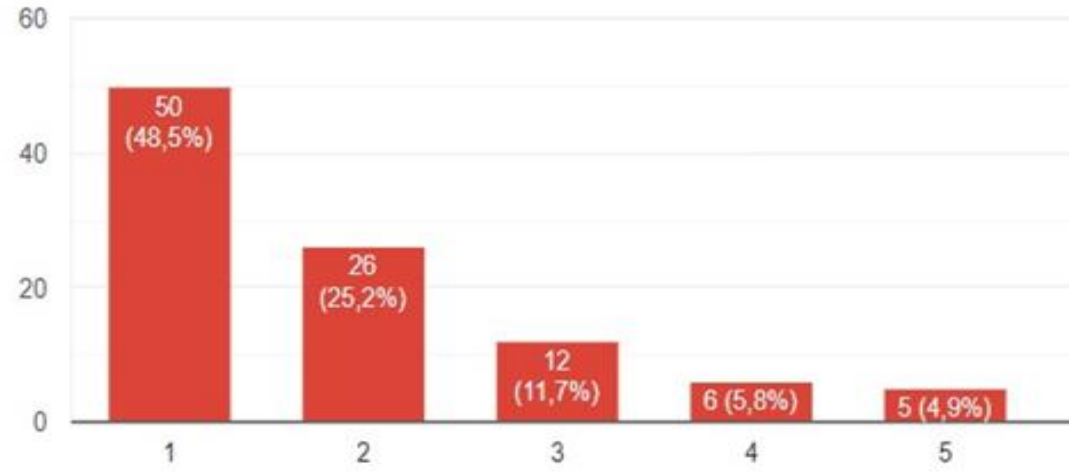


Figure 24 Q9 My Manager is actively involved in ensuring safe food handling practices (e.g. adheres to all prescribed rules of good hygiene practice).

When participants were asked if their Supervisor is actively involved in safe food handling, 48.5% said they strongly agreed. 25.2% said they agreed. There were 12 responses that neither agreed nor disagreed. However, 5.8% of respondents said they disagreed with the proposal, while 4.9% disagreed completely. In conclusion, 73.7% responded positively, 11.7% remained neutral towards the proposal, while 10.7% presented a negative attitude towards the proposal.

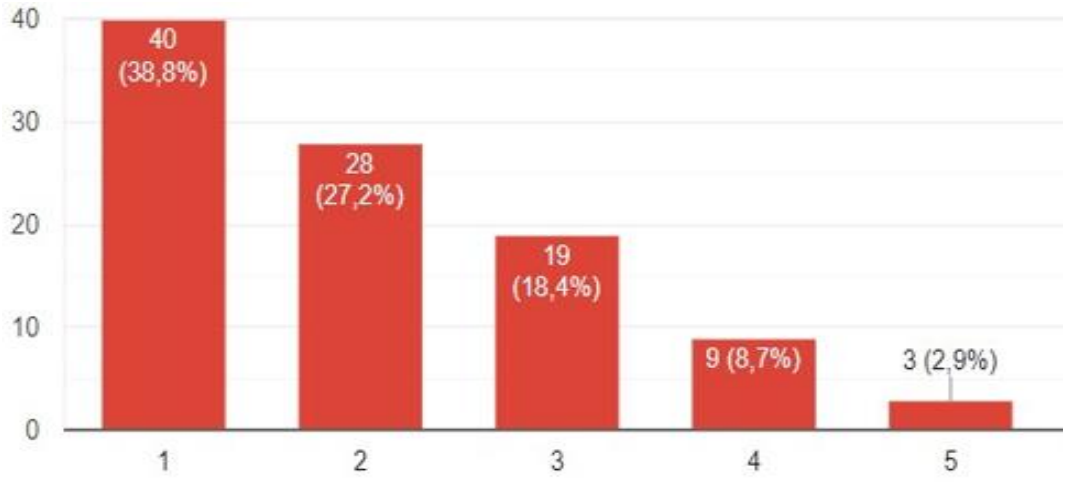


Figure 25 Q10 I think my supervisor always put food safety ahead of production.

When asked whether they believe their supervisor's priority is safe food handling over production, 38.8% of respondents answered that they completely agree. 27.2% of them answered that they agree. 9 participants neither agree/disagree. 8.7% of respondents disagree, while 3 participants strongly disagree with the aforementioned proposition.

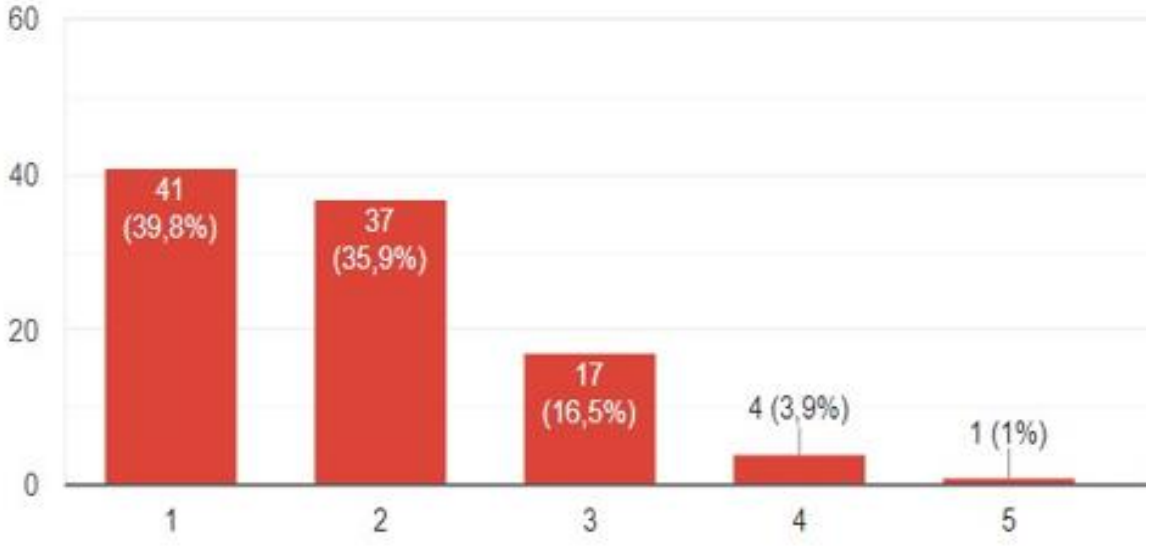


Figure 26 Q11 I appreciate when a co-worker points out to me if I am doing something that could affect food safety in a bad way.

When the participants were asked if they appreciate the suggestions of their colleagues, in case their behavior could harm food safety, then 39.8% answered that they completely agree and 35.9% that they agree. There were 17 participants who stated that they neither agreed nor disagreed. Subsequently, there were 4 participants who stated that they disagreed and one participant who stated that they strongly disagreed. In conclusion, the negative attitude of the respondents to this question was reduced to half (4.9%) compared to the previous 2 questions.

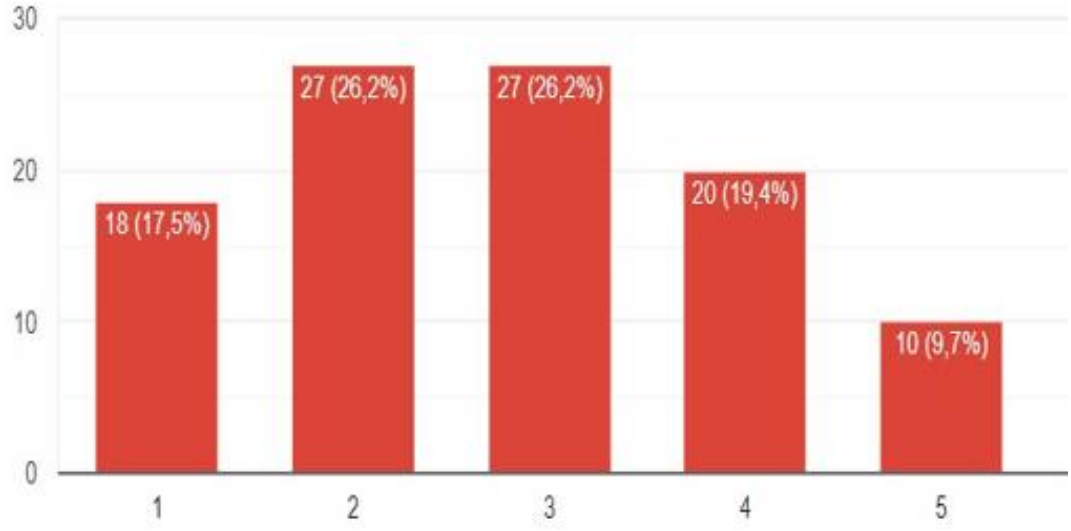


Figure 27 Q12 Employees get recognized for their contribution to making sure that they produce safe food.

In the question about the recognition that employees receive for their participation in the production of safe food, the answers of the respondents, as can be seen from the graph, differed quite a bit compared to the previous questions. More specifically, 17.5% answered that they completely agree with the proposal. There were 27 respondents who answered that they agree with the proposition and 27 participants who remained neutral with the proposition. Subsequently, 19.4% of respondents disagreed with the proposal while 10 participants strongly disagreed. In conclusion, 43.7% answered positively, 26.2% remained neutral, while 29.1% answered negatively. As it turns out, the percentage of participants who neither agree/disagree has increased compared to the previous questions, while the percentage of participants who answered negatively is 3 times higher compared to previous questions.

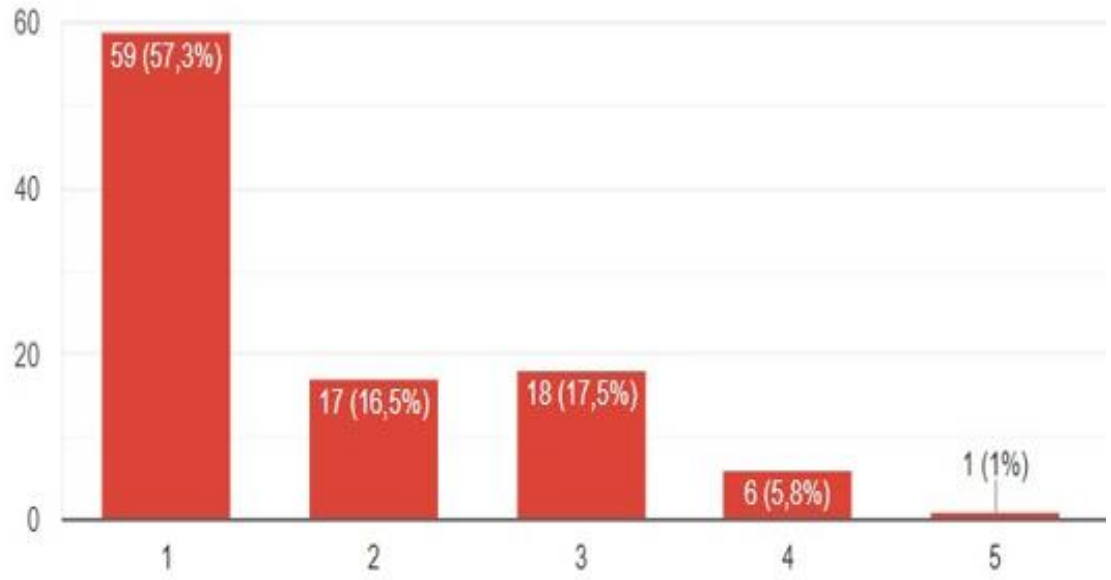


Figure 28 Q13 Employees are reprimanded when they fail to follow food safety practices.

When asked if employees are reprimanded when they fail to follow safe food safety practices, as shown in the graph, 57.3% answered that they completely agree. 17 participants stated that they agree and 18 that they neither agree/nor disagree. 5.8% stated that they disagree and there was also one participant who stated that he completely disagreed.

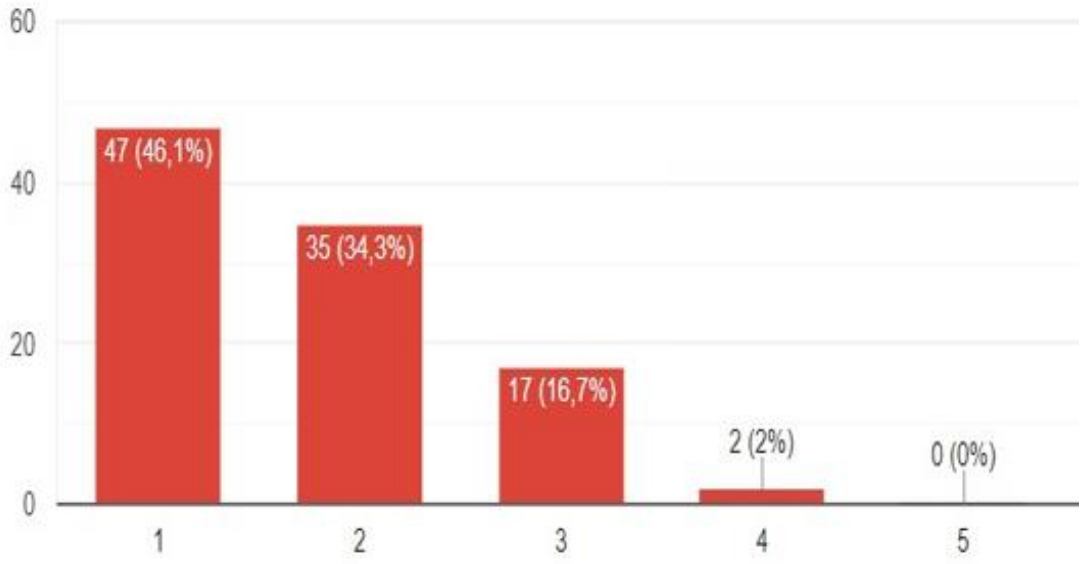


Figure 29 Q.14 I can speak freely when i see that something has the potential to adversely affect food safety.

To the question of whether one can speak freely in case he notices that something is in a position to harm food safety, as shown in the graph, 46.1% stated that they completely agree. 34.3% said they agree. 17 respondents answered that they neither agree/nor disagree. 2% answered that they disagree while there was no answer that someone completely disagreed. In conclusion 80.4% answered positively, 16.7% remained neutral and 2 participants negatively.

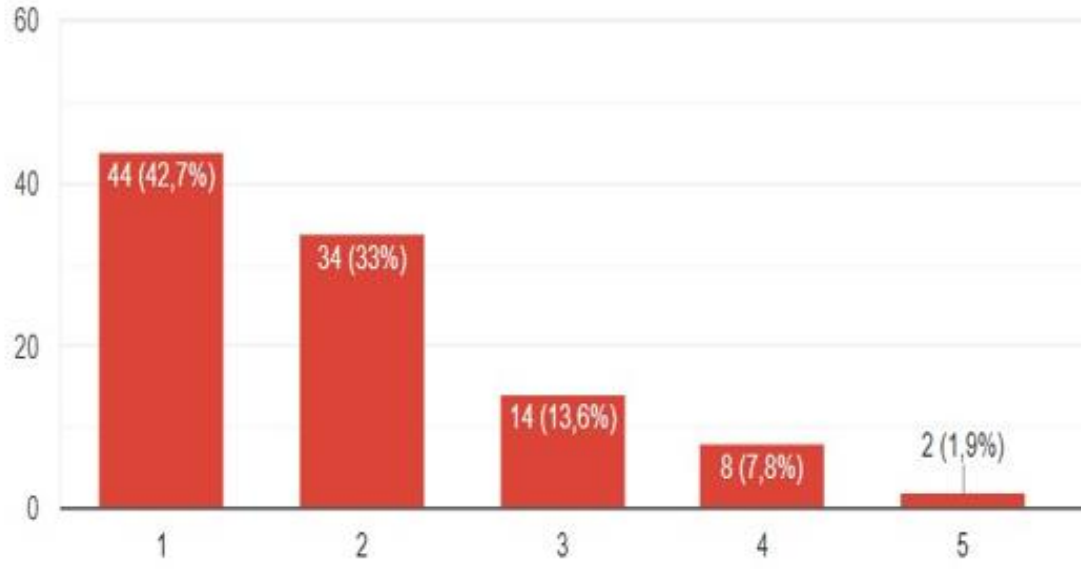


Figure 30 Q.15 My Supervisors generally give appropriate instructions for safe food handling.

When the participants were asked whether their <supervisors generally give appropriate instructions for safe food handling, as shown in the graph, 42.7% said they strongly agreed. Furthermore, 34 participants answered that they agree. 13.6% remained neutral. However, 7.8% answered that they disagree while there were also 2 participants who stated that they completely disagree. The total percentage that answered negatively is 9.7%, a percentage that is consistent with the previous questions.

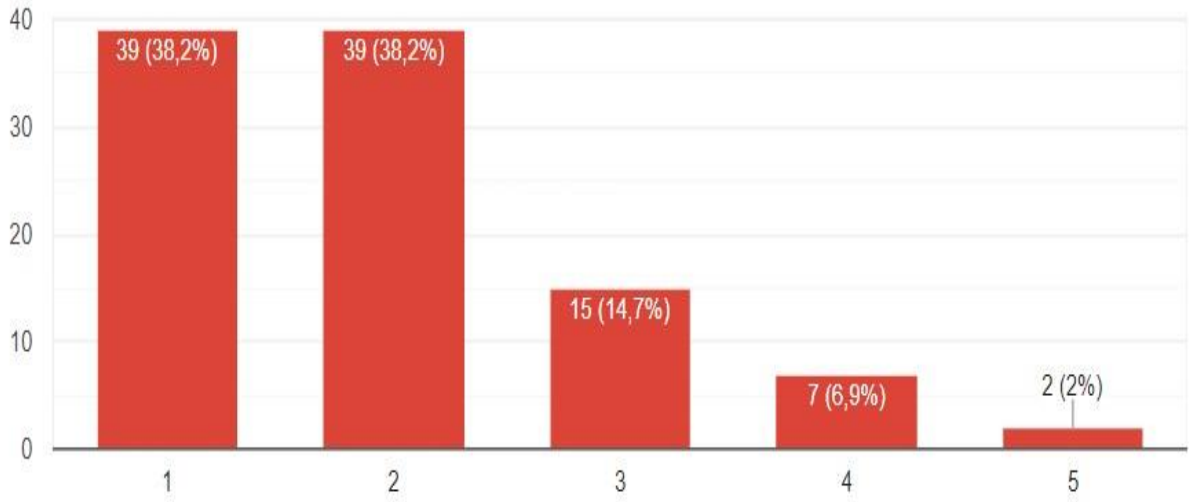


Figure 31 Q.16 All the necessary information for the safe handling of food is readily available to everyone.

In the question about whether all the necessary information about the safe handling of food is available to everyone, as can be seen from the graph, 38.2% said that they completely agree and 38.2% that they agree. 14.7% remained neutral. 7 respondents answered that they disagree and 2 that they completely disagree. In conclusion, 76.4 answered positively and 8.9% negatively.

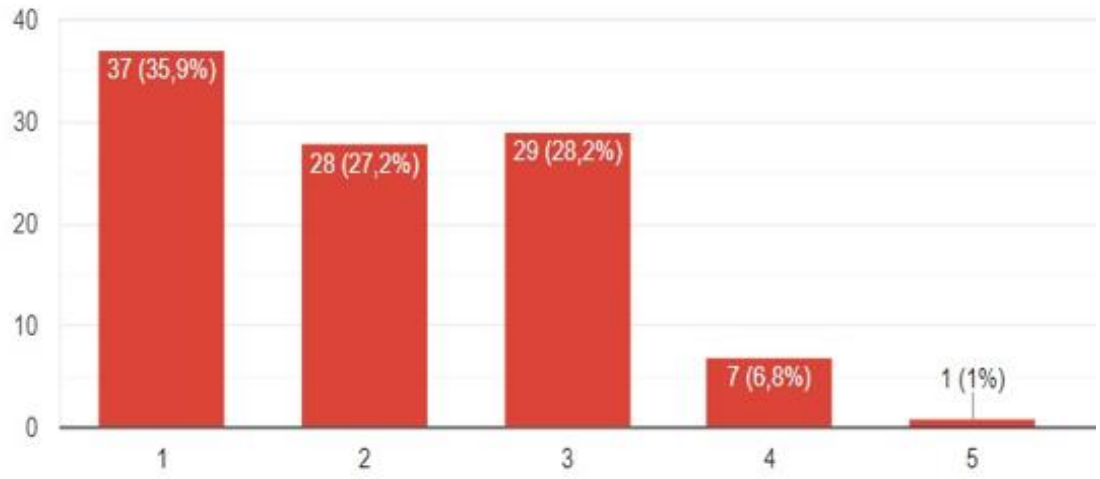


Figure 32 Q.17 I am encouraged to provide information to improve existing food safety practices.

When asked whether they are encouraged to provide information to improve existing practices for safe food handling, 35.9% of respondents answered that they completely agree and 27.2% that they agree. As can be seen from the graph, a significant percentage (28.2%) of the respondents remained neutral, a fact that the position of the authorities on the matter has not yet become clear, resulting in confusion. 6.8% answered that they disagree and one participant answered that they completely disagree.

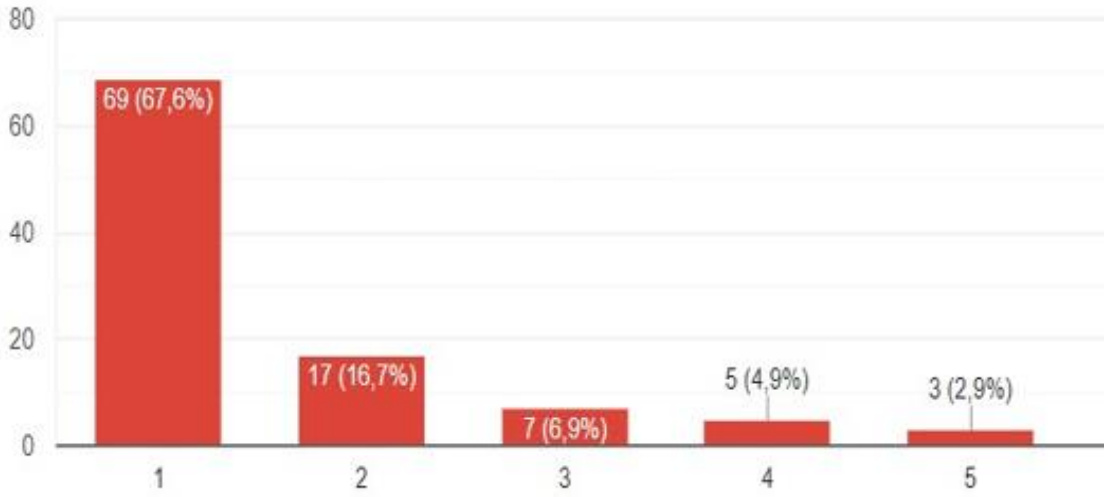


Figure 33 Q.18 I follow food safety rules because it is my duty to do so.

When participants were asked if they follow food safety regulations because it is their duty to do so, 67.6% said they strongly agreed. As can be seen from the graph, this answer was given by most of the respondents with a clear difference from the rest. In more detail, 17 respondents answered that they agree, 7 that they neither agree/neither disagree, 5 that they disagree and 3 that they completely disagree.

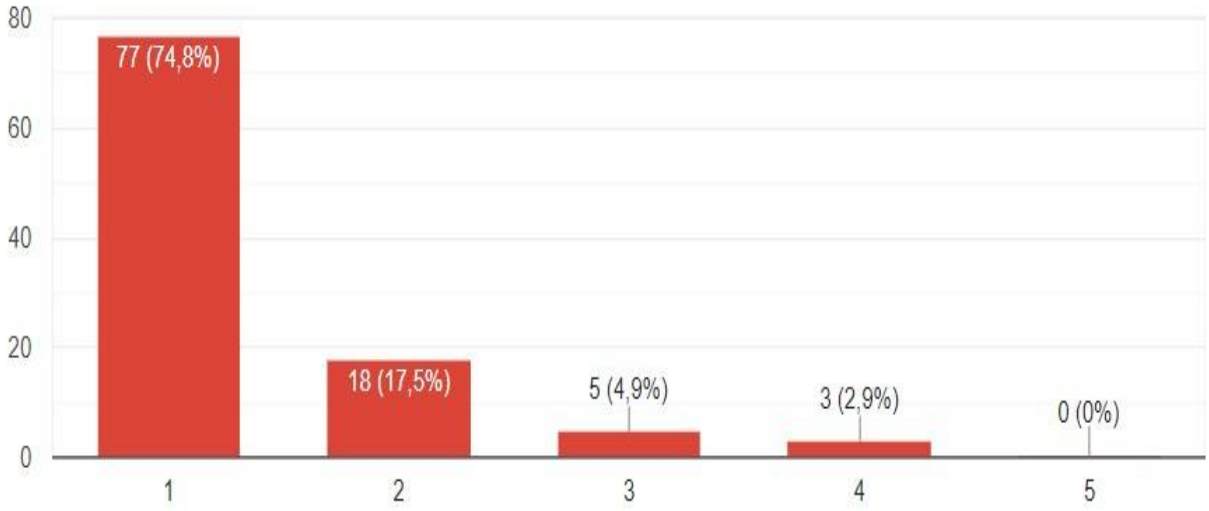


Figure 34 Q. 19 Food safety is a top priority for me.

When participants were asked if food safety was a top priority for them, 74.8% said they strongly agreed. 17.5% said they agree. As can be seen in the graph, 5 respondents remained neutral, 3 disagreed and there was no answer for strong disagreement. As in the previous question, the position of the respondents is overwhelmingly positive.

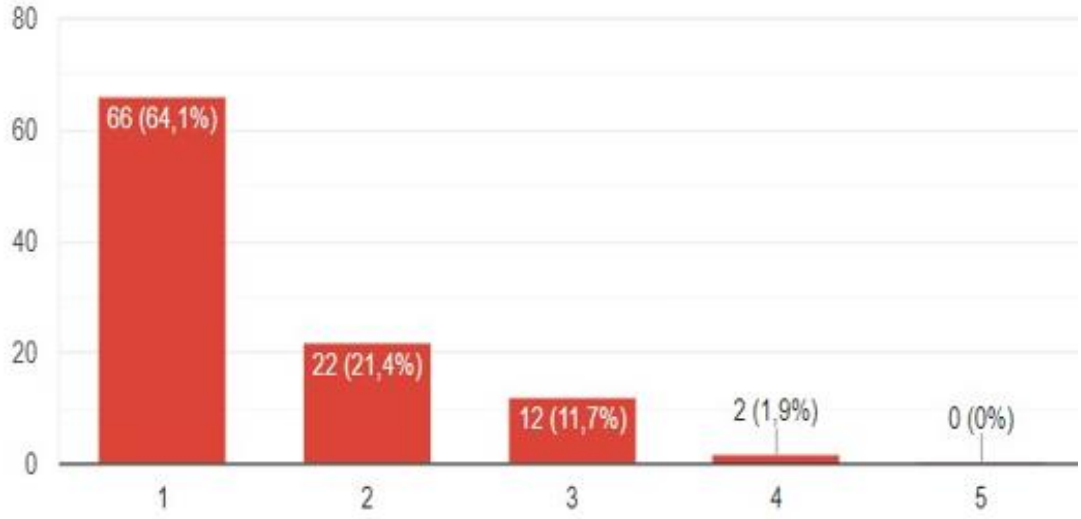


Figure 35 Q.20 I strictly follow all food safety rules.

When asked if the participants strictly follow all the rules for the safe handling of food, 64.1% stated that they completely agree and 21.4% that they agree. 12 participants answered that they neither agree/nor disagree and 2 that they disagree. Finally, there was no response from the participants that they completely disagree.

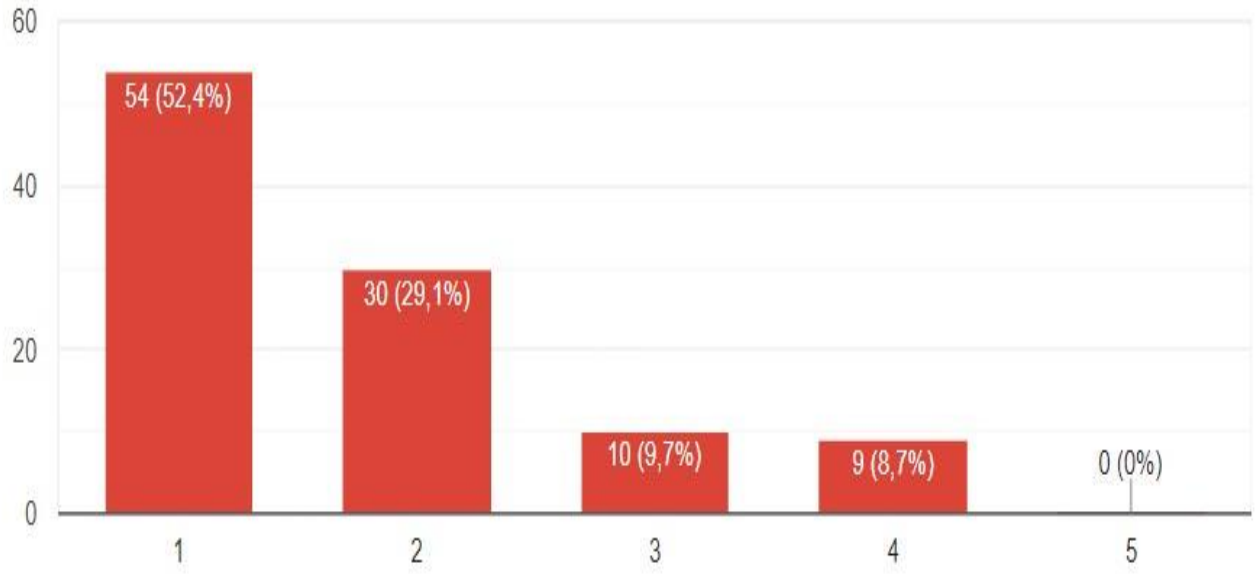


Figure 36 Q.21 The equipment that is necessary for the preparation of safe foods (eg pasteurizers, stoppers, etc.) is immediately available and accessible.

When participants were asked if the necessary equipment for safe food handling is readily available and accessible, 52.4% responded that they strongly agreed and 29.1% that they agreed. 10 participants stated that they neither agree/disagree and 9 that they disagree. There was no response from the participants that they completely disagree.

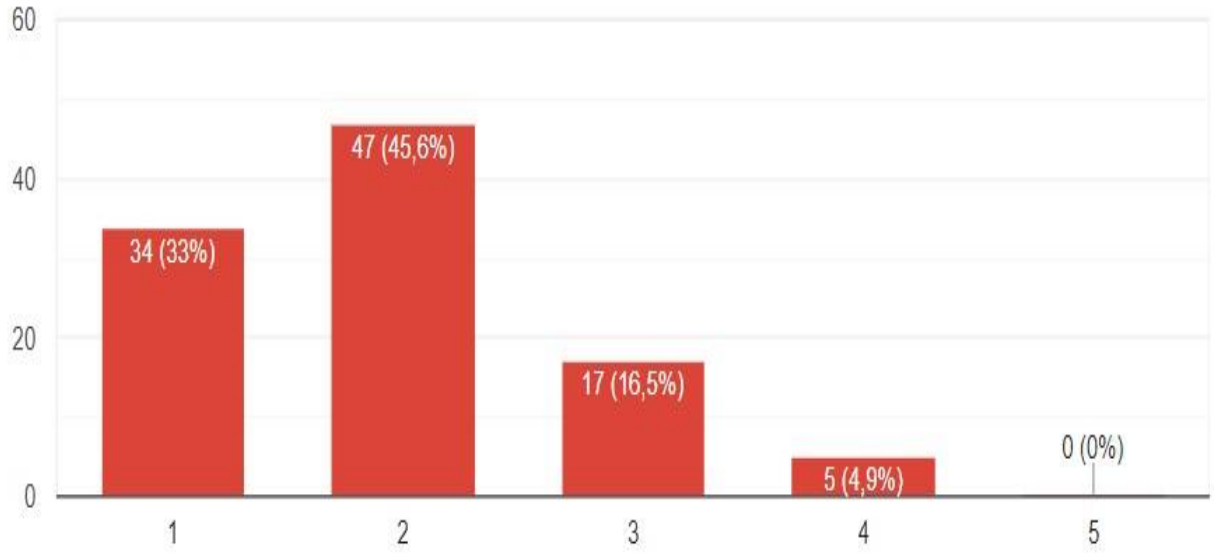


Figure 37 Q.22 Adequate supplies are readily available to perform good food safety practices (eg disposable gloves, aprons etc.)

When participants were asked if the necessary supplies for safe food handling (such as disposable gloves, hats, etc.) are readily available, 33% strongly agreed and 45.6% agreed. 17 respondents remained neutral, 5 disagreed. However, there was no response indicating strong disagreement.

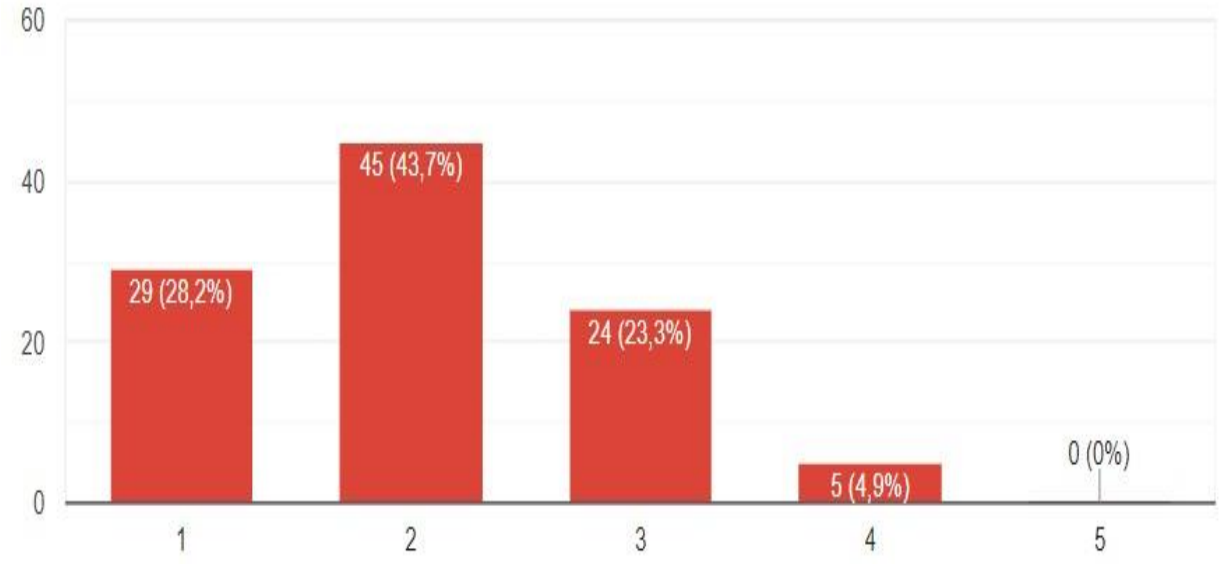


Figure 38 Q.23 I am provided with equipment that enables me to apply good practices for safe food handling.

When participants were asked if they were provided with equipment to implement safe food handling rules, 28.2% strongly agreed and 43.7% agreed. 24 participants answered that they neither agree/disagree and 5 participants stated that they disagree. However, there was no response indicating strong disagreement.

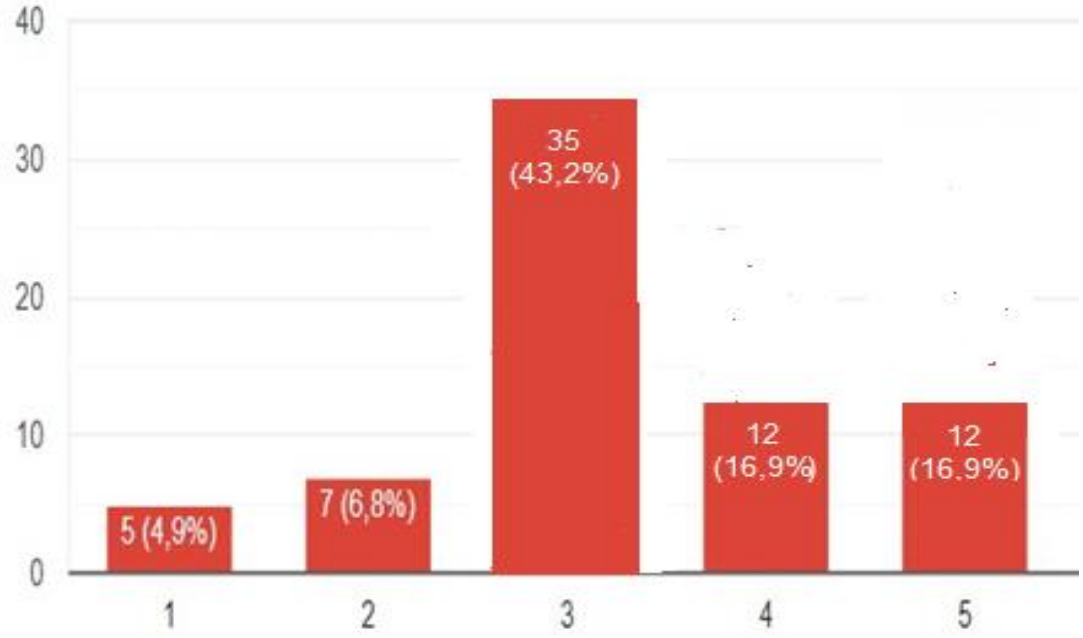


Figure 39 Q.24 I believe that written food safety policies and procedures are nothing more than a cover-up in case of a lawsuit

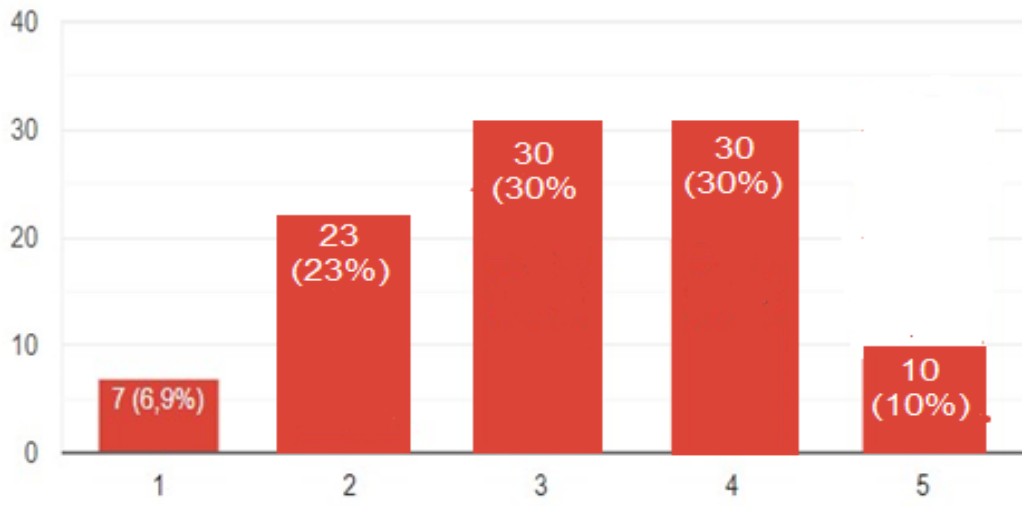


Figure 40 Q.25 When under pressure to complete production, management demands that food safety regulations be circumvented in order to make a profit.

4.3 Statistical Analysis

4.3.1 Control of Normal distribution

The normal distribution, also known as the Gaussian distribution, is a type of continuous probability distribution for a real-valued random variable. Through the normal distribution the type of controls to be applied to the sample can be determined. More specifically, if the sample follows the normal distribution then the controls that will be applied to it will be parametric. In contrast, the tests applied to the sample will be non-parametric.

The control of the normal distribution in the present research is done through the Kolmogorov-Smirnov analysis. This analysis compares the P-Value with the significance level (α= 0.05) to determine whether the data follow a normal distribution or not. If the P-Value is less than the value of the significance level, then the null hypothesis is rejected and the alternative hypothesis is accepted, i.e. the sample does not follow a normal distribution (Petridis D., 2016). Table 5 summarizes the results of the Kolmogorov-Smirov analysis for all questions of the questionnaire.

Table 2 Normal distribution test with the Kolmogorov-Smirnov method

Questions	Mean	St. Dev	N	P- Value	Normal Distribution
1	1,767	0,8768	103	<0,010	**No**
2	1,544	0,5005	103	<0,010	**No**
3	3,262	1,220	103	<0,010	**No**
4	1,971	0,1698	102	<0,010	**No**
5	1,971	0,8455	103	<0,010	**No**
6	2,806	1,291	103	<0,010	**No**
7	1,951	1,106	103	<0,010	**No**
8	2	1,221	103	<0,010	**No**
9	1,981	1,057	103	<0,010	**No**
10	1,971	1,024	103	<0,010	**No**
11	2,689	1,221	103	<0,010	**No**

12	2,214	4,195	103	<0,010	**No**
13	1,796	0,8559	103	<0,010	**No**
14	1,864	0,9807	103	<0,010	**No**
15	1,971	0,9544	103	<0,010	**No**
16	2,058	1,037	103	<0,010	**No**
17	1,534	0,9269	103	<0,010	**No**
18	1,437	0,8004	103	<0,010	**No**
19	1,495	0,7653	103	<0,010	**No**
20	1,748	0,9468	103	<0,010	**No**
21	1,981	0,8854	103	<0,010	**No**
22	2,107	0,8846	103	<0,010	**No**
23	3,883	1,105	103	<0,010	**No**
24	3,990	1,052	103	<0,010	**No**

As can be seen from Table 5, the data for each survey question does not follow a normal distribution as long as the P-Value < α (α=0.05). Therefore, in the following, non-parametric tests will be applied.

4.3.2 Non-parametric controls

4.3.2.1 One Sample Sign test

The one sample sign test, is a non parametric hypothesis test. Sign test is used to test the null hypothesis that the median of a distribution is equal to some hypothesized value x, or whether it exists statistically significant difference between the median of a non – normally distributed continuous data set. By using, this analysis it can be defined whether the median is different from the median that we set and it can be calculated the with that possibly contain the median of the population (Petridis D., 2016).

So, in this research as null hypothesis it is set the value of 3 (neutral) from the Linkert scale 1-5, H_o: $\eta = 3$ and the alternative H_1: $\eta > 3$ in order to examine if 3 is a reasonable estimate of the median for each of the questions under consideration. Table 6 presents the results obtained from the analysis of data using the 1-SampleSign Test.

Table 6. One SampleSign test results.

Null Hypothesis, Ho: n=3, Alternative Hypothesis, Ha: n<3						
Sample	Number<3	Number=3	Number>3	Median	P-Value	N
2.1	75	15	13	2	1.000	103
2.2	75	13	15	2	1.000	103
2.3	73	20	20	2	1.000	103
2.4	77	16	10	2	1.000	103
2.6	75	17	11	1	1.000	103
3.1	83	17	3	2	1.000	103
3.2	81	13	9	2	1.000	103
3.3	78	18	7	2	1.000	103

3.4	66	28	9	2	1.000	103
4.1	90	7	6	1	1.000	103
4.2	94	5	4	1	1.000	103
4.3	90	11	2	1	1.000	103
5.1	81	15	7	1	1.000	103
5.2	80	15	8	2	1.000	103
5.3	71	25	7	2	1.000	103
6.1	13	15	75	4	1.000	103
6.2	7	21	75	4	1.000	103

As observed from the Table, for questions 2.1 to 5.3 the null hypothesis that the number of values is equal to 3 is rejected and the alternative hypothesis that the number of values is less than 3 is valid. Most questions have a median of 1 and 2.

From the above it follows that all stakeholders are aware of the importance of food safety and have a high culture for food safety.

4.3.2.2. Krustall wallis test

The Kruskal and Wallis (1952) statistical test is a non-parametric way of testing the hypothesis that three or more random samples come from the same population, against the alternative hypothesis that at least two of the samples come from populations that differ in medians. From the form of the alternative hypothesis, it is immediately apparent that the Kruskal-Wallis statistical test essentially assumes equality of population fluctuations. We further assume that the data is at least orderable (Petridis D., 2016).

- H_0: population medians are equal.

- H_1: population medians are not equal.

In our control the population is the department of organization. This analysis examines whether the four seniority groups are statistically significantly different at the α=0.05 level of significance in terms of the department of the organization they belong to in relation to the point of view of food safety culture to determine if there is a significant difference. We define the null hypothesis as follows: H0: The k samples come from the same population and the alternative H1: At least one sample comes from a different population at significance level α=0.05. If the null hypothesis is rejected then at least two populations differ statistically significantly in terms of their median value.

To determine whether the four samples are from the same population or whether the difference of the four sample medians (k =4) of the department of the organisation population is significant, the P-Value will be compared at the α=0.05 level of significance. In the event that the P-Value ≤ α, the difference between the population medians is statistically significant (we reject H0) and when the P-Value > α then the difference between the population medians is not statistically significant (failure to reject H0). In table 7 it is represented only the answers from the questionnaire that are statistically different the samples.

Table 7. Kruskal-Wallis Test analysis based on the department of the organization to which the respondents belong.

Questions	Department of organization	N	Median	Mean Rank	P-Value
2.4	1	52	2.0	49.4	0.026
	2	25	2.0	66.1	
	3	24	2.0	45.6	

	4	2	1.0	21.0	
	Overall	103		52.0	
2.5	1	52	3.0	56.0	0.001
	2	25	3.0	61.6	
	3	24	2.0	31.5	
	4	2	3.5	74.0	
	Overall	103			
3.1	1	52	2.0	50.3	0.001
	2	25	2.0	71.4	
	3	24	1.0	36.1	
	4	2	1.5	43.8	
	Overall	103			
3.2	1	52	2.0	51.7	0.015
	2	25	2.0	66.0	
	3	24	1.0	38.7	
	4	2	1.5	43.8	
	Overall	103		52.0	
3.3	1	52	2.0	52.4	0.005
	2	25	2.0	65.1	
	3	24	1.0	35.7	
	4	2	2.5	72.8	

	Overall	103			
3.4	1	52	2	50.9	0.001
	2	25	3	69.6	
	3	24	1	38.5	
	4	2	1	21.0	
	Overall	103		52.0	
4.3	1	52	1	47.6	0.003
	2	25	2	71.0	
	3	24	1	43.2	
	4	2	1	34.0	
	Overall	103		52.0	
5.1	1	52	1	49.7	0.003
	2	25	2	63.8	
	3	24	1	46.7	
	4	2	1	28.0	
	Overall	103		52.0	
5.2	1	52	2.0	48.8	0.001
	2	25	2.0	71.7	
	3	24	1.0	38.0	
	4	2	2.5	58.3	
	Overall	103		52.0	

5.3	1	52	2.0	48.6	0.000
	2	25	3.0	73.6	
	3	24	1.0	36.4	
	4	2	2.5	57.3	
	Overall	103		52.0	
6.1	1	52	4.0	53.3	0.015
	2	25	4.0	37.4	
	3	24	5.0	64.8	
	4	2	4.0	49.0	
	Overall	103		52.0	
6.2	1	52	4.0	53.3	0.007
	2	25	4.0	36.7	
	3	24	5.0	65.9	
	4	2	3.0	43.5	
	Overall	103		52.0	

From the Table, it is observed that the P-values <0.05 for questions 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 4.3, 5.1, 5.2, 5.3, 6.1 and 6.2 concluding that the differentiation of the medians of the populations is statistically significant and the null hypothesis that all medians are equal is rejected.

More specifically, a higher rating of food culture evaluation is observed from the quality assurance and management departments than from the general staff and production departments.

5.1. Conclusions

In this paper an attempt was made to investigate the food safety culture through a questionnaire of 25 questions. The questionnaire was addressed to all interested parties active in the food industry in the Greek market.

The first part of the questionnaire concerned the demographic characteristics of the respondents from which it can be concluded that 50% of the participants belonged to the quality assurance department, followed by the general staff with 24.5% participation and the Administration department with 23.5%. There was little participation from both the research and development and production departments. Regarding the gender of the participants there was a homogeneity in the sample as 56.9% were women and the remaining 43.1% were men.

Also, through the questionnaire, it is concluded that the majority of the participants are experienced stakeholders as only a percentage of 8.8% concerned participants with work experience of less than one year, 29.4% had work experience of 4-7 years, 23.5% 8 -14 years and 19.6% over 15 years of experience.

In addition, 99% of participants are active in the food industry full-time. Regarding the category of companies based on the risk of food to which the respondents belong, a uniformity is also observed as 28.4% of the sample belongs to high risk based companies, 35.3% to medium risk based and finally 36.3% to low risk based.

Regarding the size of the companies in which the participants are active, they are structured as follows: 14.6% of the respondents belong to companies with less than 10 employees, 22.3% to companies with 10-20 employees, 31.3% to companies with workforce 20-50 people, 16.5% of respondents in companies with a workforce of 50-100 people and 15.5% in companies employing more than 100 employees. Finally, the vast majority of participants 98% have received food safety training.

From the second part of the questionnaire, the following conclusions emerge through the responses of the participants:

POSITIVE POINTS

- Management inspires employees to follow safe food safety practices and Supervisors are actively involved in ensuring these
- Appropriate instructions are given for safe food handling and all information is readily available.
- Safe food handling is a priority for all stakeholders in the questionnaire.
- Basic equipment necessary for safe food preparation is readily available.
- Employees are reprimanded when they fail to follow safe food handling practices.
- Also, the responses showed that the majority of participants are receptive to the correct instructions for the safe handling of food.

POINTS FOR IMPROVEMENT

- Only 17.5% of respondents answered that their contribution to food safety is fully recognized.
- Through the responses of the respondents to question 24, it is established that there is no trust in the written Policies and procedures.
- Also, through the answers to question 25 it is established that in conditions of intense pressure it is possible to bypass practices for the safe handling of food for the purpose of profit.

Also, through the One Sample Sign test statistical analysis, it emerges that most questions have a median of 1 and 2, which indicates that all stakeholders are aware of the importance of food safety and have a high culture of food safety.

Finally, through the Kruskal-Wallis index, a higher rating of food culture evaluation is observed from the quality assurance and management departments than from the general staff and production departments.

5.2. Future proposals

• It is proposed to increase the participation sample of the questionnaire and possibly to analyze the regions of the Greek territory separately.

• In addition to the use of the questionnaire, it is also suggested to add a series of interviews for more valid results.

• Finally, a re-evaluation of the participants after a cycle of training on food safety culture is proposed.

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Annex 1

In this Annex the link to the questionnaire is provided (Questionnaire of Food Safety Culture) as well as the questions:

Questionnaire of Food Safety Culture

Question 1: In which department of the company do you belong to?

- Quality Assurance
- General Staff
- Management
- Production
- RD

Question 2: Your Gender is

- Male
- Female

Question 3: How many years of experience do you have in the food industry?

- Less than 1 year
- 1-3 years
- 4-7 years
- 8-14 years
- Over 15 years

Question 4: Your type of employment is:

- Part time job
- Full time job

Question 5: In which category does the company you work for, belong to, according to the hazard of food?

- Low risk based
- Medium risk based
- High risk based

Question 6: What is the company's average number of employees?

- Less than 10
- 10-20
- 20-50
- 50-100
- Over 100

Question 7: Have you received any food safety training?

- Yes
- No

Question 8: Management inspires me to follow safe food handling practices.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 9: My Manager is actively involved in ensuring safe food handling practices (e.g. adheres to all prescribed rules of good hygiene practice).

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 10: I think my supervisor always put food safety ahead of production.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 11: I appreciate when a co-worker points out to me if I am doing something that could affect food safety in a bad way.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 12: Employees get recognized for their contribution to making sure that they produce safe food.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 13: Employees are reprimanded when they fail to follow food safety practices.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 14: I can speak freely when i see that something has the potential to adversely affect food safety.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 15: My Supervisors generally give appropriate instructions for safe food handling.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 16: All the necessary information for the safe handling of food is readily available to everyone.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 17: I am encouraged to provide information to improve existing food safety practices.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 18: I follow food safety rules because it is my duty to do so.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 19: Food safety is a top priority for me.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 20: I strictly follow all food safety rules.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 21: The equipment that is necessary for the preparation of safe foods (eg pasteurizers, stoppers, etc.) is immediately available and accessible.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 22: Adequate supplies are readily available to perform good food safety practices (eg disposable gloves, aprons etc.)

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 23: I am provided with equipment that enables me to apply good practices for safe food handling.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 24: I believe that written food safety policies and procedures are nothing more than a cover-up in case of a lawsuit

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**

Question 25: When under pressure to complete production, management demands that food safety regulations be circumvented in order to make a profit.

Linear Scale from **1 to 5** where:

1. **Strongly Agree**
2. **Strongly Disagree**