Food safety culture in food companies: evaluation of the perception of food safety culture in three Tuscan food companies

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Abstract

The Commission Regulation (EU) No. 2021/382 (European Commission, 2021), amending the Regulation (EC) No. 852/2004 (European Commission, 2004), introduced the obligation for companies to establish and maintain a food safety culture (FSC). The methodology to evaluate, implement, and enhance the level of FSC is up to the individual companies. This study aimed to investigate the perception of FSC among the employees of 3 Tuscan medium-sized enterprises in the food sector, producing cured meat (A), dairy products (B), and frozen fish products (C).

The survey was conducted through the development and administration of a questionnaire based on a 5 points Likert scale, referring to different aspects of FSC, organized in 6 sections with 5-6 statements each and subjected to a percentage of employees between 76 and 85%, classified also by the length of service (≤3 and >3 years). For all the companies, the minimum median and mode value for scores obtained by the different sections was 4, and the minimum median and mode value for the single statement was 3 (A, B; except for a bimodal value 2-4) and 4 (C). The section *awareness and perception of risk* showed the highest mean scores in all companies. As for the length of service, senior employees gave lower scores than junior ones in all sections in B and 3 sections in C. Overall, the results of the questionnaires showed a good perception of FSC, even though it was possible to identify some partial weaknesses.

Introduction

Today, foodborne diseases (FBDs) remain an issue of great concern among food industry stakeholders and regulators; it is estimated that almost 1 out of 10 people suffer each year from FBDs (World Health Organization, 2015). FBDs spread can be attributed to multiple factors, often related to inadequate or ineffective food safety management during production, manipulation, and distribution (Powell *et al.*, 2011; Zanin *et al.*, 2022). The implementation of a proper food safety management system (FSMS) is one of the main tools to ensure quality and safety along the supply chain. FSMSs are based on prerequisite programs (PRPs), good hygiene practices and good manufacturing practices (GHPs/GMPs), and the application of the hazard analysis and critical control point (HACCP) system. These elements configure the conditions and activities necessary to maintain a suitable food process environment. One of the PRPs is the training of food handlers, required by Reg. (EC) No. 852/2004, and framed in a wider context that should start with the commitment of the leadership, appropriate communication, and encouragement of continuous improvement.

The benefits of food handlers' training are well known and undisputed, but it should be considered that training by itself does not always lead to a positive change in attitude or to an increase of the risk perception (Rossi *et al.*, 2017; Insfran-Rivarola *et al.*, 2020). In fact, several studies demonstrated that the increase of knowledge through theoretical training does not always result into the improvement of food safety awareness, needed to reach adequate levels of safe practices in a food work environment (Garayoa *et al.*, 2011; Da Cunha *et al.*, 2014; McFarland *et al.*, 2019; Young *et al.*, 2019; Zanin *et al.*, 2021a). For this reason, in September 2020, the Codex Alimentarius Commission (Codex Alimentarius Commission, 2020), within the revision of its global standard on general principles of food hygiene (CXC 1-1969), introduced the food safety culture (FSC) concept as a general principle. In 2021, the Commission Regulation (EU) No. 2021/382, amending the Regulation (EC) No. 852/2004, followed closely behind intending to enhance the food handlers' perception on the impact of their actions on food safety. The Reg. (EU) No. 2021/382 did not detail methodologies for FSC implementation, investigation, or improvement, which have been recently evaluated by the European Commission Notice 2022/C 355/01 (European Commission, 2022). It contains an example of indicators for FSC assessment, to guide

companies towards a successful FSC adoption and dissemination, and a checklist to evaluate FSC for official control activities.

FSC has been the subject of scientific investigation for several years. The first studies on FSC can be traced back to Yiannas (2009) who emphasized the importance of human behavior in reducing FBDs especially in certain areas of the food chain. Nowadays, it is possible to summarize the commonly adopted definition for FSC as «the shared values, beliefs and norms that affect mindset and behavior toward food safety in, across and throughout an organization» (Global Food Safety Initiative, 2018).

Some studies have proposed that FSC can be assessed by focusing on employees' food safety perception, leadership commitment, sharing of knowledge and information, accountability, risk perception,

and work environment (Yiannas, 2009; Griffith *et al.*, 2010; Powell *et al.*, 2011). Some authors (Nyarugwe *et al.*, 2018) worked on a FSC classification, identifying reactive, active, and proactive actions and phases. Others suggested examples of improved food safety maturity models also with the aim to realize an economic gain in the food industry (Jespersen *et al.*, 2019). Moreover, in the last years, the scientific community has questioned how to investigate the diffusion and permeation of FSC within the food sector. Various tools and approaches have been developed to support organizations in assessing FSC, analyzing the opportunity of quantitative rather than qualitative data collection and defining some recommendations to improve FSC (Zanin *et al.*, 2021b). Nevertheless, companies, especially small and medium-sized ones, often find it challenging to put into practice what the law requires.

In this study, designed and carried out before the release of the European Commission Notice, we developed and administered a questionnaire about FSC.

The aim of the study was to gather data on food handlers' perception about food safety and to assess their current level of FSC with a specific focus on medium-sized food companies.

Materials and methods

The study aimed to investigate the perception and permeation of food safety culture in 3 medium-sized food enterprises. The engaged companies are historically settled

Table 1. Questionnaire administered to employees of company A and results obtained for every statement.

Statement	Mo	Me	Av
SECTION 1 – Consistency and responsibility			
Employees are proactive in identifying potential internal or external factors that could affect production	4	4	3.46
Employees are responsible for their actions in the workplace	4	4	3.46
Employees carry out correctly any task assigned to them	4	4	3.83
Employees are consistent in doing the right thing in all aspects of their job	4	4	3.54
Employees are present for their entire work shift	5	4.5	4.07
The company's management puts food safety first	3-5	4	3.79
SECTION 2 – Employees training			
The level of training of employees within the company is adequate	3	3	3.62
The information acquired during the training courses is used to make improvements within the company	5	4	4.00
An interactive and computerized approach to employees training can be useful to improve the understanding of concepts related to food safety	5	4	4.14
Food safety is the priority of every employee	5	5	4.07
New employees receive adequate training to start working safely	4	4	3.79
Food safety information and rules are reviewed regularly	5	4	4.00
SECTION 3 – Risk awareness and perception			
A mistake can compromise the product safety	5	5	4.41
Bacteria and allergens may represent a health risk for consumers	5	5	4.52
Food safety procedures are reviewed periodically	5	4	4.00
A proper cleaning and sanitization of the work environment is essential to avoid contamination issues	5	5	4.72
After a mistake, careful analysis and corrective actions are put into place to solve related issues	5	4	3.55
Working safely reduces the risk of subsequent complaints and non-compliances	5	5	4.48
SECTION 4 – Teamwork			
When a lot of work needs to be done quickly, employees work together as a team to achieve goals safely	4	3	3.24
New employees and more experienced employees work together to ensure that food safety practices are correctly applied	5	4	4.10
There is a good cooperation among the employees to ensure that customers can have access to safe products	5	4	3.93
There is an effective mechanism within the team for solving problems	2-4	3	3.34
Employees clearly understand their role in the team	3	3	3.48
Teamwork helps the company's management to achieve its goals	5	5	4.31
SECTION 5 – Management commitment and leadership			
The company's management is committed to achieve an efficient food safety culture	5	5	4.14
The company's management believes that food safety is a primary objective to be achieved	5	5	4.38
The company's management invests time and resources in employees training	5	4.5	4.07
The company's management encourages employees to make suggestions for improving production processes for food safety purposes	3-5	3	3.59
The company's management applies food safety rules consistently with all employees	5	4	3.86
The company's management constantly provides information on food safety to employees	5	4	3.66
SECTION 6 – Communication			
Communication among co-workers is important to achieve common goals	5	5	4.55
Posters can be a useful method for reaffirming key concepts related to food safety	5	5	4.45
The possibility of anonymously reporting improper behaviors carried out by staff members brings an improvement in food safety	5	4	3.38
All information for working safely is clearly communicated	5	4	3.86
Food safety rules and procedures affect the daily working routine	5	4	4.07
The messages and objectives set by the company's management are clear and manifest to all staff	5	4	3.66

Mo, mode; Me, median; Av, average.

in Tuscany and involved in different types of production: a cured meat factory (A), a dairy company (B), and a frozen fish products company (C). All the companies were born as family-run in the 1950s-1960s, and over the years, they have established themselves both in the national and foreign market.

The number of employees ranged between 34 (A) and about 100 (B and C). The participating companies have adopted some common voluntary certification standards such as UNI EN ISO 9001:2015 (A, B, C), British Retail Consortium (B, C), and International Food Standard (B, C).

The investigation was conducted by the administration of a questionnaire, developed with the companies' quality assurance offices taking into account companies' peculiarities and survey priorities. The basic draft was drawn up after careful analysis of Yiannas' study (Yannas, 2009) and of the questionnaire described by Abidin (Abidin *et al.,* 2013), which served as a conceptual starting point. The questionnaire was divided into two parts: the first part aimed to identify the employee working area (data not shown) and the working period within the company (≤3 or >3 years) and the second part was specifically about FSC. This part counted 6 sections. Each section dealt with a topic considered fundamental in establishing and promoting an efficient FSC. The questionnaire draft was then reviewed by each company. Two companies (A and B) fully adopted the initial draft (Tables 1 and 2); conversely, company C elaborated a series of changes due to specific priorities (Table 3). Particularly, company C chose to use fewer statements per section (5 instead of 6) and to introduce a miscellaneous section on various aspects of food and personnel safety. This miscellaneous section replaced the one entirely devoted to communication (section 6, A and B), and the statements on that topic were partially

Table 2. Questionnaire administered to employees of company B and results obtained for every statement.

Statement	Mo	Me	Av
SECTION 1 – Consistency and responsibility			
Employees are proactive in identifying potential internal or external factors that could affect production	5	4	4.05
Employees are responsible for their actions in the workplace	5	5	4.43
Employees carry out correctly any task assigned to them	5	4.5	4.30
Employees are consistent in doing the right thing in all aspects of their job	5	4	3.97
Employees are present for their entire work shift	5	5	4.70
The company's management puts food safety first	5	5	4.54
SECTION 2 – Employees training			
The level of training of employees within the company is adequate	3	3	3.26
The information acquired during the training courses is used to make improvements within the company	5	4	3.46
An interactive and computerized approach to employees training can be useful to improve the understanding of concepts related to food sa-fety	5	5	4.25
Food safety is the priority of every employee	5	5	4.50
New employees receive adequate training to start working safely	3	3	3.38
Food safety information and rules are reviewed regularly	5	4	3.92
SECTION 3 – Risk awareness and perception			
A mistake can compromise the product safety	5	5	4.91
Bacteria and allergens may represent a health risk for consumers	5	5	4.93
Food safety procedures are reviewed periodically	5	4	4.09
A proper cleaning and sanitization of the work environment is essential to avoid contamination issues	5	5	4.92
After a mistake, careful analysis and corrective actions are put into place to solve related issues	5	5	4.33
Working safely reduces the risk of subsequent complaints and non-compliances	5	5	4.80
SECTION 4 – Teamwork			
When a lot of work needs to be done quickly, employees work together as a team to achieve goals safely	5	4.5	4.15
New employees and more experienced employees work together to ensure that food safety practices are correctly applied	5	4	4.09
There is a good cooperation among the employees to ensure that customers can have access to safe products	5	4	3.97
There is an effective mechanism within the team for solving problems	5	4	3.82
Employees clearly understand their role in the team	5	4	3.79
Teamwork helps the company's management to achieve its goals	5	5	4.70
SECTION 5 – Management commitment and leadership			
The company's management is committed to achieve an efficient food safety culture	5	4	4.05
The company's management believes that food safety is a primary objective to be achieved	5	5	4.45
The company's management invests time and resources in employees training	3	3	3.38
The company's management encourages employees to make suggestions for improving production processes for food safety purposes	5	4	3.78
The company's management applies food safety rules consistently with all employees	5	5	4.30
The company's management constantly provides information on food safety to employees	5	4	3.88
SECTION 6 – Communication			
Communication among co-workers is important to achieve common goals	5	5	4.70
Posters can be a useful method for reaffirming key concepts related to food safety	5	5	4.47
The possibility of anonymously reporting improper behaviors carried out by staff members brings an improvement in food safety	5	4	3.66
All information for working safely is clearly communicated	5	4	3.75
Food safety rules and procedures affect the daily working routine	5	4	4.24
The messages and objectives set by the company's management are clear and manifest to all staff	5	4	3.75

Mo, mode; Me, median; Av, average.

included in the section on consistency and responsibility (section 1, C). Therefore, even if the surveys were partially different, they resulted covering the same areas of investigation. The employees were asked to rate their agreement with each statement using a 5 points Likert scale, where 1 meant complete disagreement and 5 total agreement.

The survey was administered to the employees in different ways to meet the companies' needs, taking into account the restrictions due to COVID-19 pandemic.

For companies A and B, the survey was administered in paper format and preceded by an oral presentation; for company C the survey was digitally administered to all employees. In this case, they could rely on an e-mail address and a mobile phone number to contact for doubts, clarifications, or the request of the paper format in case of issues with the digital compiling.

Due to practical reasons, the questionnaire was not administered to all employees. Even though the number of employees was different in the 3 companies, the percentage of participants was comparable and in the range of 76-85%: 29 employees out of 34 for A (1 ≤3 years of employment and 28 >3 years of employment); 76 out of 100 for B (33 ≤3 years and 43 >3 years); 81 out of 102 for C (38 ≤3 years and 43 >3 years).

Statistical analysis

In the questionnaires, the number of different obtained scores was computed for each statement and section, and the mode, median, and mean values were calculated on the given answers. All statistical analyses were performed with the software R v.4.1.2 (R Foundation for Statistical Computing, Vienna, Austria). Due to the not normal distribution of the answers' scores, non parametric tests were used. Kruskal-Wallis test, followed by Wilcoxon pairwise comparisons with Bonferroni correction, was used to evaluate the statistical differences among the different sections of each questionnaire. Furthermore, Wilcoxon test was used to evaluate the statistical significance of the employment time on sections' scores. All statistical tests were considered significant if associated with a $P < 0.05$.

Table 3. Questionnaire administered to employees of company C and results obtained for every statement.

Statement	Mo	Me	Av
SECTION 1 – Consistency – Responsibility – Communication			
The company's management puts food safety first	4	4	4.13
Employees carry out their duties consistently with the company's vision and mission	4	4	4.08
The company's management should inform employees of changes and news regarding corporate standards	5	5	4.51
The responsibilities /tasks within the company are clearly defined	4	4	3.69
The possibility of anonymously reporting improper behaviors carried out by staff members brings an improvement in food safety	4	4	4.08
SECTION 2 – Employees training			
Food safety is the priority of every employee	5	4	4.22
Food safety information and rules are reviewed regularly	4	4	4.19
New employees receive adequate training to start working safely	4	4	3.74
The information acquired during the training courses is used to make improvements within the company	5	4	4.34
An interactive and computerized approach to employees training can be useful to improve the understanding of concepts related to food safety	5	4	4.26
SECTION 3 – Risk awareness and perception			
Working safely reduces the risk of subsequent complaints and non-compliance	5	5	4.74
After a mistake, careful analysis and corrective actions are put into place to solve related issues	5	4	4.32
Personal protective equipment provided are suitable for the employees' duties (facial masks, gloves, protective clothing, etc.)	5	4	4.25
Employees know who to contact in case of a food safety or a workplace safety issue	5	4.5	4.41
The company's management provides employees with examples to identify and manage any food-related and non-food-related risks	4	4	4.09
SECTION 4 – Teamwork and adaptability			
Employees respond positively to changes within the work environment	4	4	3.87
Employees work together as a team to achieve the set goals	4	4	3.66
New employees and more experienced employees work together to ensure that food safety practices are correctly applied	4	4	4.03
Employees are able to respond promptly to a problem /non-compliance	4	4	4.05
Employees remind each other to follow food safety practices	4	4	3.91
SECTION 5 – Management commitment and leadership			
Corporate values are clearly expressed so that they are understood by all employees	4	4	4.32
The company's management invests sufficient financial and human resources for food safety	5	4	4.39
The company's management responds positively to suggestions from employees	4	4	3.81
The company's management believes that food safety is a primary objective to be achieved	5	5	4.65
The company's management applies food safety rules consistently with all employees	5	4	4.30
SECTION 6 – Safety (miscellaneous)			
A proper cleaning and sanitization of the work environment is essential to avoid / prevent risks for the production	5	5	4.86
People unrelated to the company cannot easily enter the plant	5	4	4.19
The company provides employees with suitable medical checks	4	4	3.96
Employees are never asked to speed up processes and reduce costs over safety	5	4	3.86
The company's management evaluates/takes into consideration how staff members follow safety practices	4	4	3.94

Mo, mode; Me, median; Av, average.

Results

The detailed results concerning every statement for the 3 companies are shown in Tables 1, 2 and 3 for A, B and C, respectively. Overall section results are shown in Table 4.

The overall results show a good perception of FSC values in the 3 companies: for all the companies, the minimum median and mode value for scores obtained by the different sections was 4, and the minimum median and mode value for the single statement was 3 (A, B; except for A, statement 4, section 4, bimodal result 2-4) and 4 (C). The mean values obtained by the different sections ranged from 3.69 (section 1 *consistency and responsibility*) to a maximum of 4.28 (section 3 *risk awareness and perception*) for A, 3.80 (section 2 *employees training*) and 4.66 (section 3 *risk awareness and perception*) for B, and between 3.90 (section 4 *teamwork and adaptability*) and 4.37 (section 3 *risk awareness and perception*) for C. For single statement, the minimum mean value was 3.24 (statement 1, section 4) for A, 3.26 (statement 1, section 2) for B, 3.66 (statement 2, section 4) for C, whereas the maximum mean value was 4.72 (statement 4, section 3) for A, 4.93 (statement 2, section 3) for B, 4.86 (statement 1, section 6) for C.

Regarding the different sections, section 3 *risk awareness and perception* registered the highest mean scores in all companies, and in B the number of high scores were statistically significant (P<0.001).

As regards to the lower overall scores, the results were more diversified. In B, section 2 *training* had the lowest overall scores, statistically lower than those of all the other sections (P<0.01), except only for section 5 *management commitment and leadership*. In C, section 4 *teamwork and adaptability* scores were statistically lower than those of the other sections, while in A, no section had significantly lower scores.

The assessment on the seniority of service (> or ≤3 years) was conducted only for companies B and C (data not shown) since in A there was just one worker employed for 3 years or less. For B, differences based on the length of service were significant for all sections (P<0.01). Less seniority of service was associated with higher scores, with a median value of 5 for all the sections. For C, the differences between the scores of the two seniority classes were significant (P<0.05) only for section 1 *consistency - responsibility - communication*, section 2 *training* and section 4 *teamwork and adaptability*; for these sections, less seniority of service was associated with a higher percentage of scores 5, which was the most reported score (data not shown).

In general, although the situation in the 3 companies was generally positive, some partial weaknesses could be identified.

In particular, for company A, statement 1 (mean: 3.24) and 4 (mean: 3.34) of section 4 concerning teamworking and statement 3 of section 6 about the possibility of anonymous reports of improper behavior (mean: 3.38) could be identified as potential shortcomings.

For company B, even if in an overall reassuring situation, the most critical aspects concerned the level of employees' training, particularly of new employees (statement 1 and 5 of section 2, with mean of 3.26 and 3.38) and the amount of resources invested in employee training (statement 3 of section 5, mean: 3.38). For company C, the most improvable section concerned teamworking, particularly the capacity of employees to work together to achieve the set goals (statement 2 of section 4, mean: 3.66), and the definition of responsibilities within the company (statement 4 of section 1, mean: 3.69). Moreover, as for company B, it would be desirable to reflect on the different FSC perception observed for different length of service. This would therefore be an important factor to consider in the pursuit of continuous improvement of the level of awareness and involvement of employees.

Discussion

The obtained results and the above considerations were shared with the companies to intervene on the weaknesses found and address them to promote a continuous improvement and proactive approach. The exploration of the FSC level within each company and the identification of strengths and weaknesses have confirmed how the FSMS implementation and the FSC dissemination nowadays should be not only process-focused but also people-focused. Food environments are structures in continuous change and development and require a multidimensional, multidisciplinary, dynamic, and inclusive approach. Thus, the usual food safety management procedures should be integrated to improve employees' behaviors, using a systematic and global approach in line with specific company needs, indicators, and strategic priorities.

Although each organization might find

Table 4. Overall section results for companies A, B, and C.

	S1c	S2bc	S3a	S4bc	S5bc	S6ab
Company A						
Mo	4	5	5	5	5	5
Me	4	4	5	4	4	4
Av	3.69	3.94	4.28	3.74	3.95	3.99
Company B	S1b	S2d	S3a	S4c	S5cd	S6bc
Mo	5	5	5	5	5	5
Me	5	4	5	4	4	5
Av	4.33	3.80	4.66	4.09	3.97	4.09
Company C	S1c	S2bc	S3a	S4d	S5ab	S6abc
Mo	4	4	5	4	5	5
Me	4	4	4	4	4	4
Av	4.10	4.15	4.37	3.90	4.30	4.23

Mo, mode; Me, median; Av, average. In each row different letters show statistically significant differences among sections' scores (P<0.05).

it useful to adopt its own methodology for FSC evaluation, the presence of guidelines and assessment tools should definitely be considered a facilitator for the process, especially in its starting phase. The examples of indicators included in the FSC assessment tool of the European Commission Notice 2022/C 355/01 (European Commission, 2022), which was published just after the conclusion of this study, are similar in many aspects to those in the questionnaires used in this study. The European Commission Notice questionnaire comprises 5 sections with 6 statements each to be evaluated with a 5 points Likert Scale. The sections are entitled *leadership*, *communication*, *engagement and commitment*, *awareness*, and *resources*; thus they cover the same topics included in the questionnaires developed and administered in this study (in our case, resources were analyzed within the other sections).

Conclusions

As a result of a FSC evaluation process, specific educational actions aimed at FSC improvement should be implemented to consolidate proper behaviors of every role within a company. The willingness to carry out the study indicated good potential growth of the tested companies in this regard, and the study allowed the identification of areas for improvement, particularly concerning the outcomes of training and the importance of teamwork in consolidating the companies' food safety objectives.

Indeed, a strong culture is necessary to ensure people make the right decisions every day at every level of the organization. In the long run, it can also help prevent and mitigate accidents that might harm consumers and avoid scandals that can affect brand value.

Considering the relevance and actuality of the matter, its impact on food safety management and its increasing integration inside regulations and voluntary standards, it is advisable to develop models, guidelines, assessment tools and examples of possible customization for FSC evaluation, as well as strategies for its dissemination within companies and along the supply chain.

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