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Assessment of food integrity culture in food businesses through method triangulation

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ABSTRACT

Current food safety technological solutions and management systems need to be complemented with more-comprehensive food integrity tools and strategies to address, control and prevent food fraud throughout the global supply chain. In this paper, the novel construct of food integrity culture is introduced. Its definition is presented and its operationalization was investigated and tested through method triangulation in a Belgian large-scale meat distribution company. The three tools applied in the proposed method triangulation are: (1) the food integrity climate (FIC) self-assessment tool which acknowledges a company's food integrity climate through employees' perceptions (human dimension), (2) a key performance indicators interview which verified objectively the employees' perceptions through an on-site observation (operational dimension), and (3) a food fraud vulnerability diagnostic tool (SSAFE) which evaluates the company's opportunities and motivations to commit fraud in opposition to the organizational control measures to counteract it (technical and managerial dimension). Since food integrity culture encompasses technical, managerial and operational aspects of a food organization as well as human factors, the three tools applied in the method triangulation highlight different complementary aspects of food integrity culture, such as subjective versus objective and individual versus organizational perspectives. Results confirmed the hypothesis that in a company with a high perceived food integrity climate and high food integrity performance, an overall low food fraud vulnerability is found. To achieve a consolidated food integrity culture, food companies should include within their current food safety management systems regular assessments of their food integrity climate, food integrity performance as well as of potential food fraud vulnerabilities, and managing such human, operational, technical and managerial aspects as strategies of an integrated system.

1. Introduction and conceptualization

Increasing food fraud scandals worldwide have further raised the need to prevent deliberate food adulteration and counterfeiting threats within food companies across all their departments and supply chains (Manning & Soon, 2014; Silvis et al., 2017; Van Ruth et al., 2017). Due to the intentional and deceptive nature of food fraud, the fight to control it requires an approach that differs from the common food safety-based strategies and spaces into the discipline of food integrity (Manning, 2016, 2020; Spink et al., 2017). The concept of food integrity goes beyond the traditional food safety-related concerns, comprising in its notion all the aspects of food processing, handling and monitoring occurring along the whole food supply chain. As two opposed faces of the same coin, food integrity and food fraud consider not only technical and managerial factors but also the human dimension involved in the actual execution of processes (Ali & Suleiman, 2018; Manning, 2016; Wang et al., 2017).

Alrobaish et al. (2021) defined food integrity as "a multidimensional concept concerning the integrity of product, process, people and data, implying the controlled status of a food product to be intact, safe, of quality and authentic in its claims, as well as sourced, processed and distributed ethically throughout a food supply chain". To assess the human dimension behind food integrity, the four defining elements of food integrity (i.e. product, process, people and data integrity) (Manning, 2016) were each combined with five key components that shape a company's climate (i.e. leadership, communication, commitment, risk awareness and resources) (De Boeck et al., 2015). As a result, the concept of food integrity climate was introduced and defined as "the

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employees' shared perception of leadership, communication, commitment, risk awareness and resources regarding food integrity within the company's working environment in terms of product, process, people and data integrity" (Alrobaish et al., 2021).

In the research by Alrobaish et al. (2021), a food integrity climate (FIC) self-assessment tool was developed and validated. The FIC tool allows food companies to get a deeper insight on the human dimension behind food integrity through the assessment of twenty indicators obtained by combining the five climate components (leadership, communication, commitment, risk awareness and resources) with the four food integrity elements (product, process, people and data integrity). Results from the application of the FIC tool demonstrated that the perception of food integrity climate may differ between managers and operators of a food company as well as among company's affiliates (e.g. managers estimated product and people integrity higher than operators, while operators scored process and data integrity higher than managers) (Alrobaish et al., 2021). However, the FIC tool, as a self-assessment questionnaire, captures mainly employees' subjective perceptions about their company's food integrity climate, giving no objective measurement based on empirical data (Taylor, 2013). Moreover, the relation between food integrity and food fraud applied in the real context of a food organization's activities has not been studied yet. To fill these research gaps, in this paper we aim to take a step further and examine the concept of food integrity in relation to the broader notion of a company's culture.

The notion of climate, derived from the organizational climate theory, has been studied in a variety of settings and industrial sectors, and refers to the temporary perceptions of individuals regarding a certain context, whereas the concept of culture is seen as a wider concept relative not only to people's impressions giving meaning to a particular environment, but also to something more concrete that defines such environment (Wiegmann et al., 2002). In a company setting, organizational culture relates to the shared basic assumptions, values and beliefs that guide life in an organization and characterize its setting (Schneider et al., 2013). Approaching the field of safety, safety culture can be considered as the bigger framework of which safety climate is a component. It serves an overarching, sense-making context for the creation and maintenance of safety perceptions, attitudes and beliefs (Zohar, 2011).

In the context of food safety, food safety culture has been described as the long-term organizational beliefs, behaviors and assumptions learned and shared by employees, which impact the company's food safety performance (Sharman et al., 2020). Specifically, it represents the interplay of the food safety climate as perceived by the operators and the managers of a company (human route), and the context in which a company is operating with technological solutions and food safety management systems, consisting of control and assurance activities (techno-managerial route), resulting in a certain microbiological output (De Boeck et al., 2015). Moreover, Griffith et al. (2010) previously argued that specific factors of food safety culture, such as leadership, communication, commitment, environment, risk awareness and perception, influence food safety performance, which is determined by good safety management system and high level of compliance.

Therefore, a company's culture with regard to food-related activities encompasses multiple aspects that have mainly to do with the organizational climate or employees' perceptions of the company's settings (at a more abstract level), the operators' performance in terms of food safety, quality and authenticity of end products, and the various technological and managerial control measures to achieve such performance and prevent potential risks (at a more concrete level). Applied to food integrity, these three main aspects that characterize a company's culture are identified in this paper as: (1) food integrity climate, (2) food integrity performance and (3) food fraud vulnerability. Food integrity climate was already defined and operationalized by Alrobaish et al. (2021). Food fraud vulnerability was previously conceptualized by Spink et al. (2017) and Van Ruth et al. (2017) as the susceptibility of a system to food fraud due to internal or external weaknesses or flaws in such system, resulting from the combination of opportunities and motivations to commit fraud and control measures to counteract it. According to the views shared by Jacxsens et al. (2010) on food safety performance indicators, Griffith et al. (2010) on the assessment of food safety culture and performance, and Ali et al. (2021) on food supply chain integrity and food quality performance, food integrity performance can be described as the operators' work conduct in terms of compliance to food safety and quality standards as well as to the company's rules and procedures at the actual operational level.

Based on the addressed literature, we define food integrity culture as "the result of the interplay of the food integrity climate perceived by the employees of a food company (human dimension), the food integrity performance of operators in terms of product, process, people and data integrity (operational dimension), and the context in which the company is operating with technical and managerial control measures to prevent potential food fraud vulnerabilities (technical and managerial dimension)". Accordingly, Fig. 1 offers a conceptual model of food integrity culture and its aspects as defined in this paper.

In order to assess a company's food integrity culture, a triangulation of mixed methods is required, being culture a broad construct and food integrity a multidimensional concept. A triangulation of different methods also increases the reliability of the overall responses by confirming (or denying) and enriching the questionnaire scores with new insights collected from the company as well as minimizing bias (Kelle, 2006; Casey & Murphy, 2009; Santos et al., 2020), since the weaknesses of a single method can be mitigated by the strengths of other complementary methods (De Boeck et al., 2019). The added value of triangulating research methods and applying different subjective and objective tools or qualitative and quantitative measurements within the food industry has been recommended and shown empirically in the context of food safety culture assessment in food companies by Jespersen and Wallace (2017), Nyarugwe et al. (2018), De Boeck et al. (2016), De Boeck et al. (2019), Frankish et al. (2021), Zanin, Stedefeldt, and Luning (2021), Zanin, Luning, et al. (2021), and seems to be a promising avenue for research regarding also food integrity.

In the proposed method triangulation, food integrity culture is examined considering human, operational, technical and managerial aspects of a food organization, through both subjective and objective measurement tools aimed to assess the three main aspects that characterize a company's food integrity culture as conceptualized and detailed in this paper. To this purpose, the FIC tool, which estimates subjective perceptions of individual employees, was applied in triangulation with two different objective methods to consolidate and corroborate its results (Fig. 2). Firstly, a key performance indicators (KPIs) interview was undertaken during an on-site observation to verify objectively the company's food integrity performance against the four food integrity elements. The design of this verification method was inspired by one of the triangulation methods used by De Boeck et al. (2019) to assess food safety culture though companies' internal audits. Secondly, a food fraud vulnerability (FFV) diagnostic tool, namely SSAFE, was applied to target different technical and managerial aspects of a food organization. The SSAFE tool was developed by the international non-profit organization SSAFE (2022) and its operationalization is detailed in the research by Van Ruth et al. (2017). The triangulation of these complementary tools was tested in a large-scale meat distribution company, allowing to carry out a holistic and comprehensive evaluation of the prevailing food integrity culture. The relation between food integrity climate and food integrity performance as well as between food integrity climate and food fraud vulnerability are illustrated. Based on the results, suggestions on the specific organizational aspects that are shown in need of improvement are offered with implications for both practitioners and researchers.

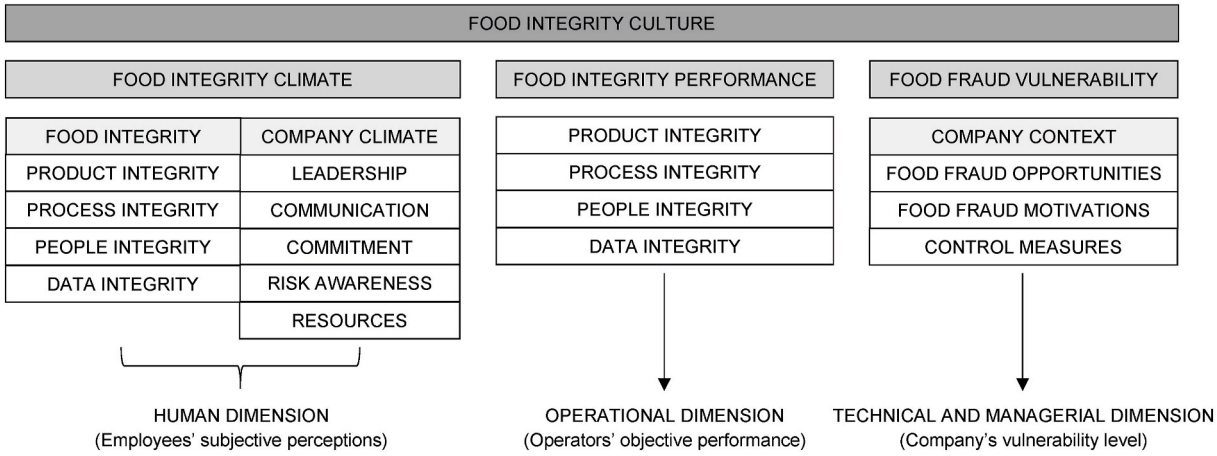
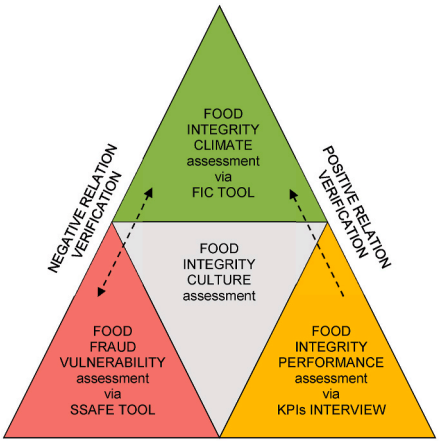


Fig. 1. Conceptual model of the food integrity culture defined as the result of the interplay of the food integrity climate perceived by the employees of a food company (human dimension), the food integrity performance of operators in terms of product, process, people and data integrity (operational dimension), and the context in which the company is operating with technical and managerial control measures to prevent potential food fraud vulnerabilities (technical and managerial dimension). The hypothesis is that when the food integrity climate perceived and the food integrity performance are high, the food fraud vulnerability is low.



TOOL	DIMENSION	MEASUREMENT	LEVEL	RECIPIENT
FIC	Human	Subjective	Individual	All employees
KPIs	Operational	Objective	Affiliates/departments	Only operators
SSAFE	Technical/managerial	Diagnosis	Organizational	Quality manager

Fig. 2. Food integrity culture assessment through method triangulation. The mixed methods applied in triangulation represent a combination of subjective and objective measurement types applied as complementary tools to access human, operational, technical and managerial organizational aspects. In particular, the FIC tool captures subjective individual perceptions of managers and operators to uncover the human dimension behind a company's food integrity climate (Alrobaish et al., 2021). The SSAFE tool measures primarily technical and managerial aspects of a food company through the quality manager's view on the organization's food fraud vulnerability level (Van Ruth et al., 2017). The KPIs interview is the objective measurement of operators' working mode and conduct through interview and field observation to verify the food integrity performance. By comparing the FIC tool with the KPIs interview results, the perceived food integrity indicators can be objectively verified (a positive relation is assumed). By comparing the FIC tool with the SSAFE tool results, the human dimension behind food integrity can be linked with the company's technological and managerial strategies to prevent food fraud (a negative relation is assumed). Throughout such triangulation, it is possible to acknowledge accurately and comprehensively the overall company's food integrity culture.

2. Materials and methods

2.1. Food integrity climate self-assessment tool to measure the perceived food integrity climate

For the assessment of food integrity climate, the data obtained from the study by Alrobaish et al. (2021) were considered for this research as part of the testing of the presented method triangulation. Specifically, the FIC tool was applied in eight randomly-selected affiliates and the general management of a large-scale meat distribution company operative in Belgium. All operators (n = 34) in the eight affiliated butcher shops and their managers (n = 18) filled out a Dutch version of the questionnaire voluntarily, anonymously and independently. Filling in the questionnaire implied consent and confidentiality was guaranteed. Respondents were asked to score the twenty indicators, addressing different aspects of the four food integrity elements in relation to the five climate components, on a five-point Likert answer scale, ranging from strongly disagree (1) to strongly agree (5), where responses closer to 5 imply a higher perceived food integrity climate. To facilitate the comprehension of the questionnaire and its indicators, definitions of food integrity and its elements were given at the beginning of each section in a user-friendly language, and contextual examples were added to each statement. An example of a FIC questionnaire statement is: "In my company, the importance of product integrity is recognized (e.g. leaders and employees' main priority is to meet high product standards and fulfill customer requirements)". Since integrity may represent a sensitive topic possibly leading to social desirability, both positive and negative statements were used in the questionnaire to mitigate the acquiescence bias of respondents (Jespersen et al., 2017). The complete English version of the FIC tool is reported in Alrobaish et al. (2021). Indicators are listed in Fig. 3.

The outcomes of the FIC tool allow to (1) assess the company's overall perceived food integrity climate and (2) compare how the food integrity climate is perceived among the operators of the eight affiliates

on a subjective level. Data collected from the questionnaires were processed statistically through IBM SPSS version 26 to perform descriptive analysis. Based on the 5-point Likert answer scale on the assessed twenty items, the FIC mean scores of the overall food integrity climate (from 20 to 100), the four food integrity elements (five questions each) (from 5 to 25) and the twenty food integrity climate indicators (from 1 to 5) were calculated for the total sample (participants n = 52), the managers (n = 18), each affiliated butcher shop (n = 8) and all affiliates' operators (n = 34). Higher scores in the FIC tool correspond to a higher food integrity climate. Therefore, for the overall food integrity climate, results were considered very high if scores were ranging between 90 and 100, high if they were ranging between 80 and 90, medium from 70 to 80, low from 60 to 70 and very low if they were inferior to 60.

2.2. Key performance indicators interview to measure objective food integrity performance

To verify the reliability of employees' responses of the FIC tool, which are subjective by definition, an objective compliance measurement, namely a key performance indicators interview, was chosen and designed addressing the performance of the four food integrity elements (product, process, people and data integrity). The questions and answer keys were tailor-made and defined by the researchers (the authors of this paper) in collaboration with the participating company's quality department based on the specific activities of the organization, resulting in a list of twenty items (e.g. "How and when are temperatures measured?"). The interview was conducted in Dutch in a standardized manner during an on-site observation in the same eight affiliated butcher shops where the FIC tool was applied. Informed consent was obtained from the board of directors of the participating company to conduct the study and publish anonymously the results. In each butcher shop, the shop manager and the present operators were interviewed (total n = 34). Operators were asked to orally answer to the KPIs questions and, at the same time, to demonstrate how to perform the task in question. The scores were assigned by the interviewers (the researchers) by means of a three-point answer scale, corresponding to perfect compliance (1), minor deviation (2) and major deviation (3) based on the correct predefined answer key. Objectivity in this measurement type is given by assessing the operators' knowledge on the execution of processes and compliance to the company's requirements as well as by observing their actual behavior and tasks performance on the field based on the specific question asked. The complete English version of the KPIs interview is reported in the Appendix. Indicators are listed in Fig. 4.

The outcomes of the KPIs interview allow to (1) assess objectively the overall company's food integrity performance, (2) evaluate the operators' performance in each of the eight affiliates, and (3) verify if these objective results corroborate the subjective employees' food integrity climate perceptions (FIC tool findings). Since organizational climate impacts human and organizational performance (Griffith et al., 2010), we assumed that a butcher shop characterized by a high food integrity climate will likely perform well on the food integrity indicators. As a low KPIs score reflects a high performance, it is hypothesized that the higher is the overall FIC score, the lower is the overall KPIs score. Data collected from the interviews were processed statistically through IBM SPSS version 26 to perform descriptive analysis. Based on the 3-point answer scale and the four food integrity elements assessed, the KPIs mean scores of the overall food integrity performance (from 4 to 12) and the four food integrity elements (from 1 to 3) were calculated for each butcher shop (n = 8) and for all the butcher shops jointly. Lower scores in the KPIs interview correspond to higher food integrity performance. Therefore, for the overall food integrity performance, results were considered very high if scores were ranging between 4 and 4.5, high if they were ranging between 4.5 and 5, medium from 5 to 5.5, low from 5.5 to 6 and very low if they were superior to 6. To verify the positive relation between food integrity climate and food integrity performance, affiliates were arranged by means of rankings based on their FIC and KPIs scores, and the order of the two rankings obtained was compared.

2.3. Food fraud vulnerability diagnostic tool to measure organizational food fraud vulnerability

To complement the results of the FIC tool, an established food fraud vulnerability diagnostic instrument, the SSAFE tool, was selected to target the opposite facet of food integrity, namely food fraud and its related aspects. The SSAFE tool aims to acknowledge the internal and external technical and managerial factors of a food organization that may be vulnerable to food fraud. In particular, food fraud vulnerability results from the combination of opportunities and motivations to commit fraud and control measures to counteract it (Spink et al., 2017; Van Ruth et al., 2017). Accordingly, the SSAFE tool is a questionnaire comprising fifty questions related to opportunities (e.g. "Is it simple or complex to adulterate your raw materials?"), motivations (e.g. "Has your company been involved in criminal offences previously?") and control measures (e.g. "How extensive is the tracking and tracing system of your company?"), and for each question a three-point answer scale presents descriptions of high, medium or low vulnerability situations to choose from. For the opportunities and motivations a low score (1) implies low vulnerability, whereas for the control measures a high score (3) implies low vulnerability. The complete version of the SSAFE tool is available online at www.ssafe-food.org/our-projects in multiple languages. Indicators are listed in Fig. 5.

Since SSAFE is a diagnostic tool assessing specific technical and managerial aspects of a food organization, only the principal quality manager of the participating company was asked to fill up a Dutch version of the SSAFE questionnaire. Filling in the questionnaire implied consent and confidentiality was guaranteed. The outcomes of the SSAFE tool in this method triangulation allow to (1) assess the level of food fraud vulnerability of the participating company and (2) explore the relation between the company's food fraud vulnerability (organizational level) and the prevailing food integrity climate (individual level) (FIC tool findings). It is assumed that the relation between food integrity climate and food fraud vulnerability is negative, meaning that the higher is the food integrity climate within a food company, the lower will be its vulnerabilities to commit food fraud, and vice versa. The SSAFE tool designed in Microsoft Excel processes results automatically by creating radar charts that give a visual representation of the results based on the participant's answers. The food fraud vulnerability level of the participating company is calculated by multiplying the opportunities score by the motivations score and the reversed control measures score (3–1 → 1–3) (opportunities × motivations × control measures = food fraud vulnerability level, where the highest level of vulnerability would be 3 × 3 × 3 = 27 and the lowest would be 1 × 1 × 1 = 1) (Van Ruth et al., 2018).

2.4. Method triangulation to measure food integrity culture

To ensure a balanced and comprehensive assessment of a company's food integrity culture, the results of the three mixed and complementary methods were triangulated (Fig. 2) and visually compared. In particular,

two linkages were analyzed to assess the positioning of the participating company in terms of food integrity culture: (1) the employees' subjective perceptions on food integrity (FIC tool outputs) were examined against the operators' on-site performance (KPIs interview results) to verify objectively the food integrity indicators, and (2) the same employees' subjective perceptions (FIC tool outputs) were correlated with the organizational food fraud vulnerability level (SSAFE tool scores) to obtain a link between the human dimension behind food integrity and the company's technological and managerial strategies to prevent food fraud. Multiple can be the assumptions on how the company can be positioned in terms of food integrity culture based on the three sets of results. In the best case, the food integrity climate perceived and food integrity performance are high and the food fraud vulnerabilities are low, whereas, in the worst case, the former appear low and the latter high. However, a food business may find itself even in other situations. For instance, on one side, a company that appears very sensitive to food fraud may compensate for its risky situation with a high food integrity climate. On the other side, a company that shows a low potential to commit food fraud may not always have a high food integrity climate.

3. Results and discussion

3.1. Food integrity climate assessment

As detailed in the study by Alrobaish et al. (2021) on the testing of the FIC tool, statistical exploration of the results demonstrated that the company's overall food integrity climate as perceived by all the participating employees (managers and operators) (n = 52) was high (mean = 86.73/100). Although differences among food integrity elements were small, the total sample estimated product integrity highest (mean = 22.10/25), followed in order by process integrity (mean = 21.81/25), data integrity (mean = 21.63/25), and people integrity was the lowest-perceived one (mean = 21.19/25).

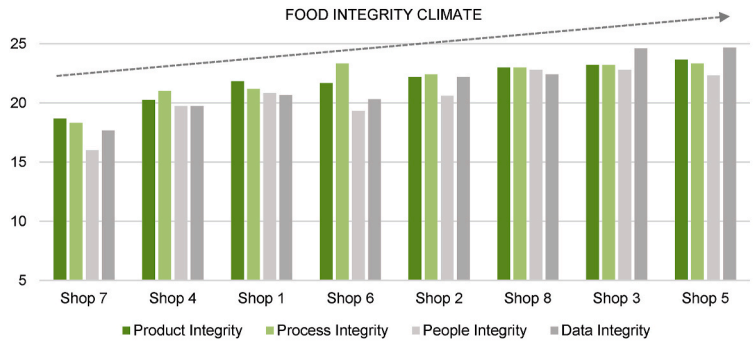
Differences among the eight affiliates were found concerning the perceived food integrity climate. By comparing the mean scores, affiliates could be clustered in three different groups: in order, (1) three affiliates (shops 5, 3 and 8) estimated the food integrity climate as very high (mean = 94.00, 93.80, 91.20/100), (2) four different affiliates (shops 2, 6, 1 and 4) rated it as high (mean = 87.40, 84.67, 84.50, 80.75/100) and (3) the remaining affiliate (shop 7) scored it as medium (mean = 70.67/100). Fig. 3 shows graphically the results of every food integrity element as perceived by each affiliate. In particular, the best scoring affiliate perceived data integrity as the highest food integrity element (mean = 24.67/25), while the worst scoring affiliate evaluated people integrity as the lowest food integrity element (mean = 16.00/25). People integrity is, therefore, an element to reconsider for the company as it registers the lowest scores both overall (managers + operators) and for the affiliates' operators subsample, mainly in terms of rewarding the employees' ethical behavior and conduct. Also in the research by Zanin, Stedefeldt, and Luning (2021) in which food safety culture was assessed through method triangulation the element found in need of improvement was related to people. Leaders should motivate their employees, give positive feedback and acknowledge good behavior, so that employees will be more stimulated to achieve food integrity (Griffith et al., 2010). Companies with a strong ethical corporate environment have employees who are strongly committed to adhere to the organizations' rules and regulations. This contributes to limit the risk of unethical behaviors. On the contrary, a culture characterized by demotivation, mistrust and dissatisfaction can be a breeding ground for unethical behaviors among employees (Van Ruth et al., 2017).

3.2. Food integrity performance assessment

Data processing of the KPIs interview results highlighted that the eight affiliates of the participating company share overall a high food integrity performance, since all the interviews scores averaged close to 1 (perfect compliance) (affiliates overall mean = 4.86/12). In particular, the best performing food integrity element recorded among the affiliates was product integrity (mean = 1.06/3), followed in order by process integrity (mean = 1.18/3), data integrity (mean = 1.29/3), and the one with more space for improvement was people integrity (mean = 1.32/3).

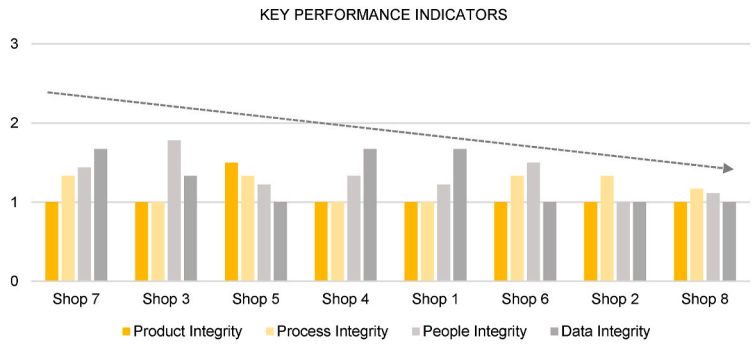
By comparing the performance of each butcher shop, it was noticed that the differences among the mean results were only minor. However, considering the more evident divergences, the eight affiliates could be arranged in three groups: in order, (1) two affiliates (shops 8 and 2) performed against the KPIs very highly (mean = 4.28, 4.33/12), (2) three different affiliates (shops 6, 1 and 4) performed highly (mean = 4.83, 4.89, 5.00/12), and (3) the remaining three affiliates (shops 5, 3 and 7) performed medium (mean = 5.06, 5.11, 5.44/12). Fig. 4 shows graphically the results of every food integrity element as performed by each affiliate, although differences were minimal.

As demonstrated by these objective results, the operational issues that employees should primarily work on improving are connected to



	FIC INDICATORS
PRODUCT INTEGRITY	Leaders set clear objectives
	Clear communication with employees
	Importance of product integrity is recognized
	Awareness of hazards and threats
	Availability of necessary resources
PROCESS INTEGRITY	Leaders have clear expectations
	Clear communication with employees
	Employees act constructively to solve issues
	Awareness of hazards and threats
	Availability of necessary resources
PEOPLE INTEGRITY	Leaders continuously improve people integrity
	Importance of people integrity is communicated
	Improving people integrity is rewarded
	Employees are alert of hazards and threats
	Sufficient investment are made
DATA INTEGRITY	Leaders continuously improve data integrity
	Importance of data integrity is communicated
	Leaders set good example
	Employees have a realistic picture of hazards
	Sufficient investment are made

Fig. 3. Column chart with mean results of the participating company's eight affiliates on the four food integrity elements as assessed by the FIC tool. Butcher shops are shown in progressive order from the affiliate which perceived the overall organization's food integrity climate as lowest (shop 7) to the affiliate which perceived it as highest (shop 5). Responses are based on a 5-point Likert answer scale ranging from strongly disagree (1) to strongly agree (5). The mean scores of the four food integrity elements per shop range from 5 to 25. Higher scores indicate a higher perceived food integrity climate.



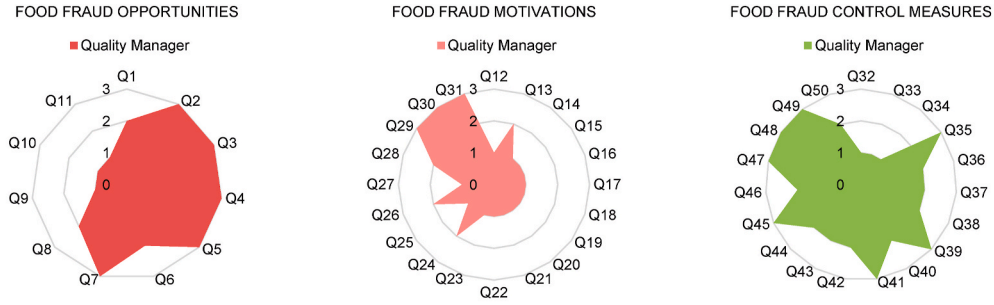
KPIs INTERVIEW ITEMS	
PRODUCT INTEGRITY	Products preparation
PROCESS INTEGRITY	Products expiry dates rules
PEOPLE INTEGRITY	Hand hygiene rules
	Wearing gloves rules
	Knowledge on food allergens
DATA INTEGRITY	Products lot number registration rules
	Temperatures measurement rules

Fig. 4. Column chart with mean results of the participating company's eight affiliates on the four food integrity elements as assessed by the KPIs interview. Butcher shops are shown in progressive order from the affiliate which performed against the KPIs worst (shop 7) to the affiliate which performed best (shop 8). Scores are assigned based on a three-point answer scale, corresponding to perfect compliance (1), minor deviation (2) and major deviation (3). Lower scores indicate an objective higher food integrity performance.

their food integrity performance related to people, such as rules on hand hygiene, wearing gloves and knowledge on food allergens. In a similar previous research on the assessment of food safety culture through triangulation of food safety climate, food safety management system and microbiological hygiene, De Boeck et al. (2016) concluded that a high food safety climate might not be sufficient to counteract the low levels of hygiene status that was found in the analyzed sample (i.e. farm butcheries), and, therefore, investment in the proper implementation of good practices as well as regular communication, effective leadership and training to improve hygiene and awareness among operators is crucial for food organizations.

3.3. Food fraud vulnerability assessment

Through a visual inspection of the results represented in the radar charts obtained from the SSAFE tool (Fig. 5), it is deductible that the participating company has an overall low food fraud vulnerability, with some space for improvement in specific areas. With regard to the opportunities to commit food fraud, indicators are divided into technical opportunities (Q1 to Q7) and opportunities in place and time (Q8 to



OPPORTUNITIES	
Q1	Complexity of adulteration raw materials
Q2	Technology & knowledge adulterate raw materials
Q3	Detectability adulteration raw materials
Q4	Technology & knowledge adulterate final products
Q5	Detectability adulteration final products
Q6	Complexity of counterfeiting
Q7	Detectability of counterfeiting
Q8	Interference processing lines
Q9	Transparency chain network
Q10	Historical evidence fraud raw materials
Q11	Historical evidence fraud final products

MOTIVATIONS	
Q12	Supply & pricing raw materials
Q13	Valuable components raw materials
Q14	Economic conditions own company
Q15	Organizational strategy own company
Q16	Ethical business culture own company
Q17	Criminal offences own company
Q18	Corruption level country own company
Q19	Financial strains suppliers
Q20	Economic conditions suppliers
Q21	Organizational strategy suppliers
Q22	Ethical business culture suppliers
Q23	Criminal offences suppliers
Q24	Victimization of suppliers
Q25	Corruption level country suppliers
Q26	Economic conditions branch of industry
Q27	Criminal offences customers
Q28	Ethical business culture branch of industry
Q29	Historical evidence branch of industry
Q30	Level of competition branch of industry
Q31	Price asymmetries

CONTROL MEASURES	
Q32	Fraud monitoring system raw materials
Q33	Verification of monitoring system raw materials
Q34	Fraud monitoring system final products
Q35	Verification of monitoring system final products
Q36	Information system own company
Q37	Tracking and tracing system own company
Q38	Integrity screening own employees
Q39	Ethical code of conduct own company
Q40	Whistle blowing own company
Q41	Contractual requirements suppliers
Q42	Fraud control system suppliers
Q43	Mass balance control suppliers
Q44	Tracking and tracing system suppliers
Q45	Social control chain network
Q46	Fraud control industry
Q47	National food policy
Q48	Law enforcement local chain
Q49	Law enforcement chain network
Q50	Contingency plans

Fig. 5. Radar charts with results of the participating company's quality manager on the SSAFE tool indicators divided in food fraud opportunities, motivations and control measures. For the opportunities and motivations, an emptier radar chart (scores close to 1) indicates lower opportunities and motivations to commit food fraud. Contrarily, for the control measures, a fuller radar chart (scores close to 3) indicates more effective control measures to prevent food fraud. Opportunities are divided into technical opportunities (in light grey) and opportunities in place and time (in dark grey). Motivations include economic drivers (in light grey) and motivations related to culture and behavior (in dark grey). Control measures are divided into technical (in light grey) and managerial (in dark grey). As the radar charts reflect respectively a quite low number of opportunities, few motivations and relatively good control measures, it can be deduced that an overall low food fraud vulnerability prevails in the participating company, with some space for improvement especially in specific technical aspects.

Q11). An emptier radar chart, corresponding to lower scores, implies lower opportunities to commit food fraud. The questions that were scored worst by the company's quality manager are relative to the technical opportunities to commit food fraud (Q2 to Q7). Specifically, risky aspects that need to be kept under control by the company relate to the fact that basic technologies and knowledge to adulterate raw materials and final products are generally available, whereas detection for adulteration requires advanced laboratory analysis and sometimes tests for counterfeiting are not available at all. This is often the case in the meat industry, being animal-derived products rather vulnerable to food fraud. Deliberate authentication threats on meat products may be related to speciation (e.g. horse meat labelled as beef), processing treatment (e.g. thawed meat labelled as fresh), misrepresentation of origins (e.g. geographic origins, wild against farmed meat or organic against conventional meat), and mislabeling of ingredients and their quantities (e.g. water, vegetable fat, batter or breadcrumbs) to increase the weight of meat processed products (Sentandreu & Sentandreu, 2014). The composition of the raw materials can also be tampered with by using food additives (e.g. colorants, aromas or preservatives) to enhance the visual quality of meat products, or by substituting original ingredients with less expensive low-quality materials (e.g. animal protein interchanged with vegetable protein such as soy or with organic compounds such as melamine and urea) (Ballin, 2010). Often no complicated methods are required to adulterate meat products and different substances or liquids can simply be mixed in or injected (Spink & Moyer, 2011). Fraudulent products may not be visually recognizable or detectable through simple methods. Due to money and time constrains, companies may not always afford extensive and complex laboratory tests for fraud detection (Pustjens, Weesepoel & Van Ruth, 2015).

Regarding the motivations to commit food fraud, indicators are divided into economic drivers (Q12, Q13, Q14, Q19, Q20, Q26, Q30 and Q31) and motivations related to culture and behavior (Q15, Q16, Q17, Q18, Q21, Q22, Q23, Q24, Q25, Q27, Q28 and Q29). Also in this case, an emptier radar chart implies lower motivations to commit food fraud. This radar chart appears quite empty, which implies that, according to the quality manager, risk is low, except for a few aspects. Major threats derive from the fact that in the meat industry there is documented evidence of food fraud activities, the sector is highly competitive and the price policy of food ingredients and final products varies considerably across countries (Eurostat, 2019) (Q29 to Q31). Economic aspects such as high competition and price differences within an industry can make it difficult for some companies to meet their financial goals in a legitimate way, which can motivate them to commit fraud, especially if this sector is generally vulnerable to fraud as reported by historical evidence (e.g. European horse meat scandal in 2013) (European Commission, 2022). To minimize financial loss, organizations may decide to cut costs by reducing controls and traceability systems, and purchasing ingredients from cheaper or unknown suppliers (Ryan, 2015).

It must be considered that most of the risky aspects recorded both within the opportunities and the motivations represent external factors, deriving from outside the company (e.g. Q2, Q3, Q29, Q30, Q31 rated 3 or highly vulnerable by the quality manager). While it is positive that very low internal vulnerability level was registered, external drivers to food fraud are more difficult for the company to control or act on, as they often fall outside the reach of the organization. However, a greater risk awareness can contribute to reduce the vulnerability to fraud, since control measures will be more specifically designed if there is understanding of where potential threats come from. In particular, control measures should consider the entire food supply chain in order to enhance fraud protection instead of remaining at the company level. Moreover, transparent discussions with all parties connected with the company throughout the food supply chain, from the suppliers to the distributors, should be promoted to make the topics of integrity and ethics more prominent (Silvis et al., 2017; Van Ruth et al., 2017).

The radar chart related to the control measures appears fuller than the opportunities and motivations charts, which is positive, since, in this case, a fuller radar chart implies more effective control measures implemented by the company to mitigate or prevent food fraud. The indicators are divided into technical control measures (Q32 to Q37 and Q42 to Q44) and managerial control measures (Q38 to Q41 and Q45 to Q50). Remarkably, the least developed control measures recorded by the participating company are technical, and, specifically, they refer to the fact that there is no verification or monitoring system in place to detect fraud in incoming raw materials and finished products (Q32 and Q33). This is also the case in many other European food companies, where food safety management systems are well developed to ensure food safety and quality, but food fraud control and prevention strategies are not yet included (Spink et al., 2017).

Food safety management systems commonly involve preventive, intervention and monitoring strategies which work in combination with assurance activities such as validation and verification to ensure food safety (Luning et al., 2009). Fraud control requires a similar generic approach, but needs to target specific fraud issues and consider their intentional nature. Fraud monitoring systems should be in place to evaluate, remedy and improve organization's fraud prevention and detection techniques (Crain et al., 2016). In particular, the company should consider incorporating a structured control system for raw materials and final products, which includes evidence-based sampling plans, accurate and specific fraud detection methods, effective fraud control procedures, and systematic documentation with record of suspicious raw materials as an integral part of their food safety management system. This should be combined with regular verification of the fraud control tasks based on document analysis, observation and sample testing by an independent auditor (Van Ruth et al., 2017). The use of indirect data from tracking and tracing systems such as blockchains should also be enhanced to reduce fraud vulnerability. Because of the ability to find information on the history as well as the location of a product or ingredient, traceability tools prevent or eliminate illegal, unreported and unregulated products (Charlebois & Haratifar, 2015). Specifically, the blockchain technology stores data from chemical analysis in chronological order using cryptography so that information cannot be manipulated afterwards without leaving evidence, ensuring authenticity and transparency throughout the food supply chain (Galvez et al., 2018).

Overall, the SSAFE formula can be interpreted for the participating company as follows: a quite low number of opportunities to commit food fraud (mean = 2.18/3) × few motivations (mean = 1.50/3) × relatively good control measures (reverted scores mean = 1.78/3) = low food fraud vulnerability (5.82/27 = 0.64/3). The few motivations compensate for the opportunities of potential perpetrators to commit fraud, who are also discouraged and restrained by the existent control measures. However, such measures should be improved and new ones introduced, especially on a technical level, to further limit food fraud risks and opportunities.

3.4. Relation between food integrity climate and food integrity performance

As hypothesized, the subjective assessment of food integrity climate through employees' perceptions could be considered reliable if the objective operators' on-site performance confirmed them by revealing a positive relation between FIC and KPIs results. Since the sample was too small to perform and determine a meaningful statistical correlation, results were compared by means of a ranking similarly to the method applied by De Boeck et al. (2016) and De Boeck et al. (2019). By comparing the FIC and KPIs scores obtained from the operators of the eight participating affiliates, the hypothesis could be considered confirmed since scores obtained from both tools align for six out of the total eight affiliates. In fact, through a visual inspection of Figs. 3 and 4, it can be noted that, overall, butcher shop 7 scored worst (medium) on both tools, and, remarkably, affiliates 4, 1, 6, 2 and 8 rank in terms of scores precisely in the same order both in the FIC tool and the KPIs

interview. Only affiliates 3 and 5 contradict the hypothesis, since operators in both affiliates perceived a very high food integrity climate, but these positive results were not emerging through the KPIs interview, where both performed mediocrely compared to the other affiliates. Another interesting finding that confirms the hypothesis and the positive relation between the two sets of results concerns the fact that on both tools operators scored worst on the people integrity element, which is, in fact, the element the company should focus mostly on improving. It can be concluded that the KPIs results validated the FIC tool responses, considering both the overall food integrity climate perceptions among operators and the four food integrity elements separately.

In the research by De Boeck et al. (2019), in which a similar triangulation of methods was applied in sixteen food service outlets (i.e. cafeterias and restaurants) to assess different aspects of food safety culture, the combination between human oriented method (food safety climate assessment tool) and techno-managerial oriented methods (performance-verification measurements) led to different possibilities. Some outlets were found in the same position of the majority of affiliates analyzed in this research, where the perception of the operators on their company's climate and the food safety performance were both high. However, other outlets were found in different situations (climate perceptions were low and performance was high or both were low). The most dangerous situation was when a mismatch was revealed between operators' perceptions and performance on food hygiene and safety issues where the former were high and the latter low (De Boeck et al., 2019). This reflects the situation found in affiliate 3 and 5 of this study, which operators showed a high perception of their company's food integrity climate, but this was not in line with their actual performance on food integrity that was lower (as compared to the other affiliates in the ranking) (Figs. 3 and 4). Although in this research differences among scores were minimal, these described possibilities could be a reality for other food companies to consider, since optimistic bias and complacency among operators that overestimate their climate being unaware of hazards can pose a dangerous risk for the organization in terms of food safety and food integrity (De Boeck et al., 2019; Griffith, 2000).

3.5. Relation between food integrity climate and food fraud vulnerability

Since results demonstrated that employees perceived a high food integrity climate (mean = 86.73/100) and this objectively appeared through their on-site performance (mean = 4.86/12), it was expected that the participating company would not have been very vulnerable to food fraud. Also this hypothesis was confirmed by the SSAFE tool results, which revealed an overall low food fraud vulnerability (score = 0.64/3) given by a quite low number of opportunities and few motivations to commit fraud, restrained by relatively good control measures. Because people integrity was the element perceived and performed worst by the company's employees, it was assumed that the managerial control measures and the motivations to commit fraud relative to culture and behavior would have also been rated worse by the company's quality manager, since these are the indicators more closely-related to the people dimension in the SSAFE tool (e.g. Q39, Q16, Q22, Q28). However, such items were scored positively by the quality manager, implying a possible mismatch between managers and operators' perceptions, or the fact that, even though an ethical code of conduct is in place in the company, some employees may not have full knowledge of its content or may not feel motivated to follow its guidelines if ethical behavior is not rewarded by the company (Griffith et al., 2010). Nonetheless, although the FIC and the SSAFE tools measure different, however complementary, food integrity aspects through distinct approaches, a negative relation between food integrity climate and food fraud vulnerability could be demonstrated for the vast majority of items analyzed by comparing results in terms of high and low scores. Since the FIC tool and the SSAFE tool have different sets of results, it was not possible to perform and determine such negative relation through statistical analysis. In a study on the integrity of organic foods and their suppliers, Van Ruth and DePagter-De Witte (2020) demonstrated through the application of the SSAFE tool that the climate in a food company is an important factor to consider when assessing the vulnerability of an organization to food fraud. A company's climate and its

Table 1
Overview of butcher shops rankings and overall scores of the three methods applied in triangulation: FIC tool, KPIs interview and SSAFE tool. The FIC tool scores range from 20 (worst possible score) to 100 (best possible score). The KPIs interview scores range from 4 (best possible score) to 12 (worst possible score). The SSAFE results are representative of the whole organization and described in terms of high, medium or low food fraud vulnerability. The SSAFE tool scores range from 1 (best possible score) to 3 (worst possible score). Overall, the participating company appears to have a high food integrity climate, confirmed by a high food integrity performance, and a low vulnerability to food fraud, which determine a prevailing positive food integrity culture. *scores out of 100; **scores out of 12; ***scores out of 3.

Shops Ranking based on FIC Results	FIC mean score*	Shops Ranking based on KPIs Results	KPIs mean score**	SSAFE Results for Overall Organization***
Shop 5	94.00	Shop 8	4.28	Opportunities mean → 2.18 medium vulnerability × Motivations mean → 1.50 low vulnerability × Control measures mean → 1.78 (reversed) low vulnerability = Overall fraud vulnerability → 5.82/27 = **0.64**/3 low vulnerability
Shop 3	93.80	Shop 2	4.33	
Shop 8	91.20	Shop 6	4.83	
Shop 2	87.40	Shop 1	4.89	
Shop 6	84.67	Shop 4	5.00	
Shop 1	84.50	Shop 5	5.06	
Shop 4	80.75	Shop 3	5.11	
Shop 7	70.67	Shop 7	5.44	
Overall (managers + operators)	**86.73**	Overall (affiliates)	**4.86**	
Higher scores imply higher food integrity climate		Lower scores imply higher food integrity performance		Lower scores imply lower food fraud vulnerability

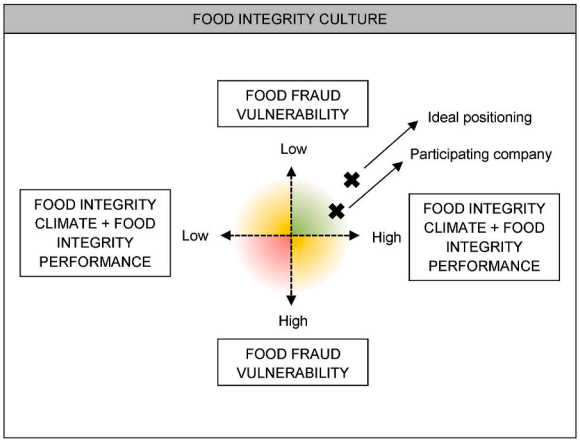


Fig. 6. Representation of the participating company's food integrity culture. A food integrity culture represents the interplay of a company's perceived food integrity climate, the operators' food integrity performance and the context in which the company is operating to prevent potential food fraud vulnerabilities. A negative relation between perceived and performed food integrity and fraud vulnerability is assumed, implying that the higher are the food integrity climate and performance in a company, the fewer will be its potential vulnerabilities to commit food fraud (green area), and vice versa (red area). However, a company may find itself even in other situations (yellow areas). The participating company was found to confirm the hypothesis since, overall, their very highly perceived food integrity climate and high food integrity performance corresponded to a relatively low food fraud vulnerability.

vulnerability to food fraud are, in fact, linked given the intentionality and human aspect involved in committing food fraud.

3.6. Food integrity culture assessment through method triangulation

In the method triangulation, overall scores of the three methods were combined, leading to a ranking of the company's affiliates (Table 1). The prevailing food integrity culture in the participating company appeared to be positive, with some room for improvement, primarily towards people integrity and technical fraud control measures. Specifically, as illustrated in Fig. 6, the company can be positioned within the green area, close to low food fraud vulnerability (organizational overall vulnerability from SSAFE results = 0.64/3) and very close to high food integrity climate (managers + operators overall mean from FIC results = 86.73/100). The high food integrity climate perceived by the employees and performed by the operators (affiliates overall mean from KPIs results = 4.86/12) may have contributed to reduce the few opportunities and motivations to commit fraud detected in the company, in conjunction with the fraud control measures that the organization has in place, and which could be further enhanced to achieve an overall excellent food integrity culture.

In the research by Zanin, Stedefeldt, and Luning (2021), similar dimensions assessed in the present study were used to measure food safety culture (i.e. people, communication, commitment, leadership, food safety management systems, risk and work environment) through a triangulation of mixed methods (quantitative and qualitative questionnaires), and, remarkably, also in their research, the element found in need of improvement within the analyzed sample was related to people. This highlights and confirms the importance of studying the human dimension and the need to acknowledge people-related aspects in food organizations to improve overall food safety and integrity performances. The study by Zanin, Stedefeldt, and Luning (2021) demonstrated how the used assessment tools (questionnaires) allowed to acknowledge the visible aspects of a food safety culture, but did not provide an assessment of the deeper layers of culture, for which continuous observation and action research combined with other methods may be required to gain insights on different levels, such as visible phenomena, espoused beliefs and underlying assumptions. In line with this recommendation, in the present study, the FIC and the SSAFE questionnaires were applied in combination with a tailor-made KPIs interview and on-site observation to obtain a more comprehensive and reliable assessment of food integrity culture within the participating company. Similarly, an internal audit was used by De Boeck et al. (2019) as one of the performance-measurement methods applied in triangulation to assess food safety culture, along with a verification of monitoring data of Critical Control Points (to shed light on the techno-managerial dimension) and the food safety climate self-assessment tool (De Boeck et al., 2015) (to investigate the human dimension of the participating companies). Also Jespersen and Wallace (2017) demonstrated the advantages of using subjective and objective measurement tools in triangulation (namely self-assessment scales against performance documents and interviews) to ensure a valid food safety culture evaluation. Further, Zanin, Luning, et al. (2021) argued that qualitative methods (such as participant observation, interviews and process evaluation) enable observation of actual daily routine, which, in combination with quantitative methods (questionnaires, check-list and microbiological laboratory analysis), can better avoid bias in the interpretation of results.

The proposed method triangulation elaborated and applied for the purpose of this study was designed considering that an organizational culture is made by a visible (technical, managerial and operational) dimension and a more underlying (human) dimension, therefore specific subjective and objective measurement tools uncovering both individual and organizational aspects are required. The rationale behind the selection of the used tools (FIC self-assessment tool, SSAFE FFV diagnostic tool and KPIs interview) considered also the nature of the novel concept that we aimed to explore, being food integrity a more-comprehensive discipline as compared to food safety, where the positive intentionality (integrity) or the negative intentionality (fraud) behind a company's decision-making process plays a major role. Ethical business culture and organizational climate were proven to be very important aspects of food fraud vulnerability and require sufficient attention in fraud mitigation plans (Van Ruth & De Pagter-De Witte, 2020).

This study demonstrated that the results of assessing food integrity culture overall in a centrally-managed organization with affiliates distributed in different territorial locations may not be representative of the food integrity culture recorded in each of its affiliates. In fact, interesting differences were detected among the eight affiliates examined. Differences might also prevail among the different departments or professional groups within a food organization, as demonstrated by Alrobaish et al. (2021), where managers and operators were seen to have different perceptions in terms of food integrity related aspects. Separate assessments for each group should be undertaken and compared in order to develop more tailored and reliable strategies for a durable improvement of the company's food integrity climate, performance and culture at large (De Boeck et al., 2017).

4. Conclusions and future perspectives

Given the lack of research in the emerging discipline of food integrity and the need to examine the interplay between technical and managerial food fraud strategies and the human dimension involved in an organization's decision-making process, the concept of food integrity culture was introduced along with its defining aspects and investigated through method triangulation in a Belgian large-scale meat distribution company.

This study demonstrated that the use of method triangulation is highly promising in food integrity. Specifically, being culture a broad construct and food integrity a multidimensional concept, by combining mixed complementary methods, different aspects of food integrity culture could be explored and assessed comprehensively and accurately, as the weaknesses or bias of a single method could be mitigated by the strengths of other methods. In particular, through the FIC tool a company is able to acknowledge the subjective perceptions of the organizational food integrity climate through the assessment of five climate components in relation to four food integrity elements (human aspects). Through the KPIs interview designed for the purpose of this study to assess the four food integrity elements and the company's food integrity performance, the results of the FIC tool could be verified objectively (operational aspects). Through the SSAFE tool these subjective and objective assessments of the company's food integrity climate could be enriched by complementing them with a food fraud vulnerability assessment, which evaluates opportunities and motivations to commit fraud in opposition to control measures to counteract it (technical and managerial aspects).

In this study, in line with our hypothesis, results revealed that a high food integrity climate, as perceived by the employees of the participating food company, is associated with high food integrity performance and an overall low food fraud vulnerability. However, such assumptions are relative and case-specific, since other situations could be verified in other food companies. Therefore, to achieve a strong and consolidated food integrity culture, it is crucial for food companies to include regular

assessments of their food integrity climate within their standard food safety management systems as well as periodic assessments of potential food fraud vulnerabilities, and managing such human, technical, managerial and operational aspects as strategies of an integrated system. By acknowledging the weakening factors or drivers in each of these strategies, the overall food integrity climate and performance could be substantially improved and potential food fraud threats significantly prevented.

To consolidate the statements made in this paper, further food integrity culture research is needed and might explore how such a culture develops and may be changed. Future research might focus on the potential role of other antecedents (e.g. employees' behavior, personal characteristics and company's organizational characteristics) analyzing how and whether they could affect a company's food integrity culture. Since this study served as a testing of the proposed method triangulation, future replications may be conducted as case studies in larger samples considering a number of food companies in comparison to uncover other potential patterns and aspects of food integrity culture.

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Institutional review board statement

The study was conducted in accordance with the ethical standards of first authors' institutional research committee and with the 1964 Helsinki declaration and its later amendments.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Ethical approval

Ethics approval was not required for this research.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CRediT authorship contribution statement

Waeel Salih Alrobaish: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing. **Liesbeth Jacxsens:** Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Pauline Spagnoli:** Investigation, Data curation. **Peter Vlerick:** Writing – review & editing, Supervision.

Declaration of competing interest

All authors state that they have no competing interests to declare.

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Appendix

Food Integrity Key Performance Indicators Interview

Element	Question	Item/operator to audit	Correct answer	Interviewer score	QN
Product integrity	How do you prepare this product?	Product 1: High turnover product (e.g. pork beef sausage)	The recipe from the recipe book must be followed 100%. The working method at the manufacturing and hygiene levels must be respected.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q1
		Product 2: Low turnover product (e.g. orloff roast)		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q2
Process integrity	What are the rules regarding the expiry date of this product?	Product 1: A marinated product (e.g. beef steak)	Marinated products that were marinated more than 48 h ago must be destroyed.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q3
		Product 2: A first prepackaged product (e.g. lasagna)	Pre-packaged products may only be sold up to 48 h before the expiry date.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q4
		Product 3: A second prepackaged product (e.g. pita sauce)		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q5
		Product 4: Minced meat	Minced meat may be sold up to 24 h after preparation.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q6
		Product 5: Wok or pita vegetables (e.g. Wok Colli)	For vegetables that are given to the customer, the rule applies that these products must still have a minimum shelf life of 1 day.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q7
	How do you organize to respect these rules?	Operator	Products that have exceeded the internal expiration date must be destroyed in the bone box.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q8
People integrity	Which rules do you follow regarding hand hygiene? Can you explain how you do it?	Operator 1	Hands are washed at the start of work, after every use of the toilet, after every work interruption and generally after every action that soaks the hands. Nails must be cut short, nail polish and jewelry are prohibited.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q9
		Operator 2		1 : Perfect compliance 2 : Minor deviation	Q10

(*continued on next page*)

(*continued*)

Food Integrity Key Performance Indicators Interview					
Element	Question	Item/operator to audit	Correct answer	Interviewer score	QN
		Operator 3		3 : Major deviation 1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q11
	What rules do you follow regarding the wearing of gloves? Can you explain how you do it?	Operator 1	Blue gloves are used in production. When wearing blue gloves for sale it is mandatory to additionally wear a pair of transparent disposable gloves. Transparent gloves are replaced with every new customer, after touching poultry and with every possible contamination.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q12
		Operator 2		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q13
		Operator 3		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q14
	If a customer asks you whether a food contains a particular allergen, how do you answer this question?	Operator 1	I follow the learned procedure for finding allergen information on the balance. I only communicate to the customer the information of the balance sheet.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q15
		Operator 2		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q16
		Operator 3		1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q17
Data integrity	Where is the lot number of this product registered and how?	Product 1: A piece of raw meat (e.g. beef and veal)	Traceability data (including lot number) of beef and veal are communicated on a poster in the store. They must be always up-to-date and correct.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q18
		Product 3: A ready to eat product (e.g. tuna salad, sausage and vol-au-vent)	The lot numbers are placed in the register for 10 days.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q19
	How and when are temperatures measured?	Operator	The temperature is measured with a properly functioning thermometer. First the probe must be disinfected with the disinfectant alcohol, only then can the core temperature be measured hygienically. The temperature is measured with every delivery and at least once a month on all products present. The permitted ceilings are the following: poultry and minced meat: 4 °C, meat and processed fruit and vegetables: 7 °C.	1 : Perfect compliance 2 : Minor deviation 3 : Major deviation	Q20

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