Journal of Consumer Protection and Food Safety (2019) 14:319–328
https://doi.org/10.1007/s00003-019-01228-2

Journal of Consumer Protection and Food Safety
Journal für Verbraucherschutz und Lebensmittelsicherheit

ORIGINAL ARTICLE

How to tackle food fraud in official food control authorities in Germany

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Received: 18 December 2018 / Revised: 14 May 2019 / Accepted: 22 May 2019 / Published online: 11 June 2019

Abstract

Food Fraud has been a problem for as long as food trade exists in human history. Recent food fraud scandals have attracted particular attention of the public and authorities. The fight against food fraud is still hampered by a lack of a clear definition stating which facts constitute a legal case of food fraud. Against this background, an online survey was conducted in the official food control authorities of the German federal states to obtain an overview of the facts considered as food fraud and to identify factors which, according to the respondents, could be used for the early detection of food fraud. The study was carried out in autumn 2017 with the online software tool Sosci Survey. The data collected was analysed descriptively using Microsoft Excel. The following facts are classified as food fraud by almost all participants: substitution of substances/liquids, imitation of foodstuff, omission of substances/liquids and the concealment of inferior quality of a product. The origin of the foodstuff is considered to be the most important factor in predicting possible food fraud, followed by the product category and price fluctuations. The results of this study show similarities and differences in the understanding of the term food fraud in the official institutions of Germany. Therefore they might be used for the development of a legal definition, which eliminates the identified ambiguities and is a prerequisite for a stringent and congruent fight against food fraud. The identified factors for predicting possible cases of food fraud could be used to develop an early warning system and could thus be part of an overall prevention concept.

Keywords Survey · Food fraud · Official food control authorities · Early warning · Definition

1 Introduction

A major problem in the fight against food fraud (FF) is that neither in Germany (DE) nor in the European Union (EU) a legal definition of the term FF exists. Rather, it is a collective term defined in different ways and on different levels of detail depending on the point of view of the observer (Spink et al. 2013a). One reason for these inconsistent definitions are the different types of FF which are not yet uniformly classified. The term FF itself is already misleading, as various types of FF are not covered by § 263 of the German Criminal Code (StGB 1998), according to which an action is only deemed fraud if it causes financial loss to the victim. This is not necessarily the case with FF.

Consumer confidence in food control has been increasingly shaken, partly by the numerous FF crises of recent years like the Melamine Scandal in 2008 (Sharma and Paradakar 2010), the Horsemeat Scandal in 2013 (Barnard and O'Connor 2017) and the so-called 'Gammelfleischskandal' (rotten meat scandal) in 2017 (Deter 2017). The fraud incidents were of very different nature and included the addition of chemical additives to simulate a given parameter (e.g. the addition of melamine to milk products that have been diluted with water to simulate a certain protein content), the substitution of substances or liquids (substitution of beef by horsemeat in lasagne; other examples are the addition of water to fish or the substitution of oil of lower quality to extra virgin olive oil), the concealment of inferior quality of food (illegal chemical treatment of rotten meat from Brazil in the

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00003-019-01228-2) contains supplementary material, which is available to authorized users.

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'Gammelfleischskandal' to enhance sensory appearance; other examples are the addition of colouring agents (Sudan red in spices or meat) to produce a more attractive colour or the addition of glycol to wine to give it a sweeter taste without failing the official sugar test or mislabelling (the products were not labelled as containing horsemeat in the Horsemeat Scandal; other examples are the re-labelling of eggs from barn to free-range eggs, the declaration of yellowfin tuna as red tuna or of conventionally manufactured products as organic products, the manipulation of the best-before date). These examples alone provide an insight into the wide range of the different types of FF.

For the prevention of FF primarily the food companies are responsible, as they are liable for the quality and safety of their products. On the basis of Regulation (EC) No 882/2004 and the German Food and Feed Code (LFGB 2013), the competent authorities have the right and the obligation to check the compliance with the legal requirements for food by official controls and sampling (Regulation [EC] No 882/2004). Regulation (EU) 2017/625, adopted in 2017 and valid from 14 December 2019, authorizes them to react to fraudulent practices by means of regular, unannounced and risk-based controls. In order to carry out these controls it is therefore essential—particularly with regard to the required risk-based approach—to clarify which infringements the official food control authorities (AE) must prosecute and how such controls should be carried out in relation to FF.

The aim of this work was to conduct a representative survey to determine the current status of FF control in the AE and to use the knowledge gained to develop prevention strategies against FF.

2 Materials and methods

An online survey on FF was carried out and addressed to the AE. The survey was conducted using the web-based software tool SoSci Survey (www.soscisurvey.de). The questions of the survey are outlined in Annex A (supplementary material). The standardized questionnaire was evaluated using Microsoft Excel.

3 Results

3.1 Response rate, participant profile and FF samples

Of the 412 respondents, 140 employees from 14 federal states took part in the survey. This resulted in a response rate of 34%. Bremen and Saarland are not represented in the survey. The federal states of Lower Saxony (14%), Baden-Wuerttemberg (13%), Bavaria (11%) and Hesse (11%) had the highest response rates. Approximately 83% of the participants are employed in a veterinary department, 4% in a supreme state authority, 2% in a border inspection post (BIP) and 11% in another official institution. The evaluation showed that the majority of participants were veterinarians (58%) or food inspectors (28%). In addition more than half of them (64%) had more than ten years of professional experience. FF related samples have been taken by the majority of participants (Supplementary data: food fraud samples).

3.2 Facts classified as FF

Figure 1 shows that most of the participants considered the "Concealment of inferior quality" as FF whereas the majority of the participants regard neither the "Sale of stolen goods" nor the "Illegally imported goods" as FF. Some of the participants pointed out that misdeclaration and mislabelling can be done with fraudulent intent, but also by accident. Of the participants, 15% indicated that there were other facts that should be added to the concept of FF. For example, the sale of rotten goods or the addition of rotten substances, the use of unauthorised genetically modified organisms (GMOs) in food and the use of contaminated additives as well as the falsification of the best-before date should be counted as FF.

3.3 Factors suitable for predicting FF

With regard to the suitability for predicting FF, the following three factors were ranked in descending order (Table 1):

- Origin of the foodstuff or raw material (mean value 7.96),
- Product category of the foodstuff (mean value 7.08),
- Price fluctuations of the food or its raw materials (mean value 6.74).

The opportunity to rank all seven factors was used by 41% of the participants. Even there, the same factors were ranked in the first three ranks. In both rankings, the standard deviation for "Origin of the foodstuff" is smaller than for the next two factors. The standard deviation of the first ranked category is lowest in relation to all ranked factors in the ranking with all factors, which means that its variance is the lowest.

3.4 Vulnerable food product categories

According to the participants, the three most vulnerable of the 23 listed product categories were (Table 2):

- Meat/meat products (excluding poultry) (mean value 4.70),

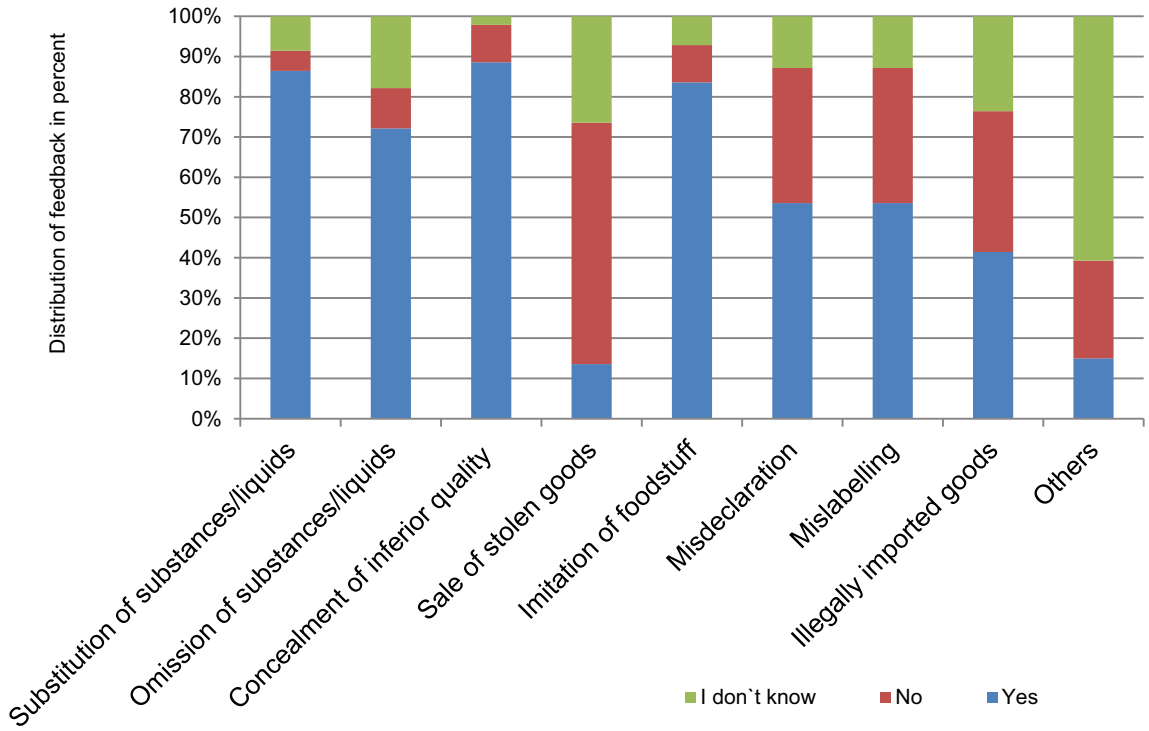

Fig. 1 Facts that are classified as FF. The participants (n = 140) of the online survey stated which facts are counted as FF at their workplace. For this purpose the facts presented were individually assessed as "Yes". "No" or "I don't know". The results are displayed as stacked bars

Table 1 Ranking of factors considered suitable for predicting possible occurrence of FF

Factor	Rank	Ranked with three factors		Ranked with all seven factors	
		Mean value	Standard deviation	Mean value	Standard deviation
Origin of the foodstuff or raw material	1	7.96	5.90	9.83	3.34
Product category of the foodstuff	2	7.08	6.32	9.72	3.97
Price fluctuations of the food or its raw materials	3	6.74	6.23	9.34	3.90
Previous FF cases within the company	4	5.03	5.93	8.24	3.71
Fluctuations in the flow of goods or its raw materials	5	4.58	5.84	7.40	3.72
Method of manufacture	6	2.61	4.87	6.10	3.48
Process chain length	7	1.83	4.19	5.38	3.60

Ranking according to the online survey. Left: ranked with three factors (n = 140), right: ranked with all seven factors (n = 58). At least three of the seven factors were ranked by participants in descending order from place one (most suitable) to place three (suitable). The participants could also rank all factors from place one (most suitable) to place seven (least suitable). The factor ranked first received 14 points, the factor ranked second received 12 points, and so on (two points for each rank in descending order, starting with 14 points). The mean and the standard deviation were then calculated for each factor. In both rankings, the following factors were ranked in descending order to places 1–3: "Origin of the foodstuff", "Product category of the foodstuff" and "Price fluctuations"

- Fish/seafood (mean value 3.07),
- Oils/fats (mean value 2.40).

The opportunity to rank five instead of three categories was used by 66% of the participants. The distribution among the first three ranks was confirmed here. The categories "Infant food", "Soups/sauces" and "Confectionaries" came in last in both evaluations and received a mean value of less than 0.20.

3.5 Tools in the fight against FF

The survey revealed that 72% of the participants are interested in a tool that could help them detect FF earlier and faster. When asked which methods should be further developed to solve FF cases better in the future, 76% stated that they would like to see further development of methods outside from laboratories that do not require complex tests

Table 2 Ranking of the most vulnerable product categories

Ranking of 3 out of 23 product categories				Ranking of 5 out of 23 product categories			
Total rank	Product category	Mean value	Standard deviation	Total rank	Product category	Mean value	Standard deviation
1	Meat/meat products	4.70	4.44	1	Meat/meat products	4.92	4.07
2	Fish/seafood	3.07	4.00	2	Fish/seafood	3.87	3.84
3	Oils/fats	2.40	3.73	3	Oils/fats	3.18	3.69
4	Food preparations	1.87	3.41	4	Food preparations	2.40	3.39
5	Alcoholic beverages	1.37	3.25	5	Alcoholic beverages	1.83	3.47
6	Food additives[a]	1.33	3.16	6	Dietetic Foods	1.63	3.35
7	Milk/milk products	1.20	2.94	7	Poultry/poultry products	1.48	2.78
8	Eggs/egg products	1.16	2.85	8	Eggs/egg products	1.25	2.73
9	Poultry/poultry products	1.09	2.64	9	Milk/milk products	1.10	2.53
10	Non-alcoholic beverages	0.96	2.81	10	Spices/herbs	1.05	2.48
11	Spices/herbs	0.71	2.28	11	Nuts/seeds	1.03	2.48
12	Nuts/seeds	0.63	2.09	12	Non-alcoholic beverages	0.99	2.81
13	Dietetic foods	0.63	2.20	13	Honey	0.95	1.97
14	Honey	0.54	2.02	14	Crustaceans/shellfish	0.88	2.16
15	Cereals/bakery products	0.54	1.99	15	Food additives	0.80	2.11
16	Crustaceans/shellfish	0.51	2.00	16	Cereals/bakery products	0.65	1.94
17	Contact material	0.41	1.72	17	Contact material	0.52	1.67
18	Fruits/vegetables	0.24	1.28	18	Fruits/vegetables	0.43	1.53
19	Feedstuff	0.24	1.28	19	Coffee/tea	0.32	1.54
20	Coffee/tea	0.14	1.19	20	Feedstuff	0.22	0.91
21	Infant food	0.14	0.98	21	Soups/sauces	0.19	0.89
22	Soups/sauces	0.10	0.84	22	Infant food	0.15	0.90
23	Confectionaries	0.00	0.00	23	Confectionaries	0.09	0.58

Ranking according to the online survey. Left: with three ranked categories (n = 140), right: with five ranked categories (n = 93). 3 or 5 out of 23 product categories were ranked by participants in descending order from places one to three respective five, with the product category most frequently affected by FF in first place. The product category that ranked first received ten points, the product category that ranked second received eight points and so on (two points for each rank in descending order, starting with 10 points). The mean and standard deviation was then calculated for each category. In both evaluations, the distribution of product categories in ranks 1–5 and 21–23 is the same, even if there are some minor differences within these ranks

[a]Definition based on Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives. OJ L 354/16-33

or test kits (Fig. 2). The "Checking and comparing of incoming and outgoing good inventories" (83%), the "Accounting audit" (77%), the use of a ready-made "Risk checklist" (61%) or of a "Risk matrix" (51%) and "Other factors" (12%) were seen as useful tools for detecting FF (Fig. 3). In the free text field, respondents indicated the importance of an intensified unrestricted exchange of information between authorities on an international level, the establishment of a central agency that collects and shares all information on FF incidents, the recruitment of more food inspectors and better training of inspection staff on the appearance/labelling of food, support from trained auditors and the development of a guideline to raise awareness of FF among businesses. Further publications are planned to present the results of the survey in more detail.

4 Discussion

4.1 Response rate, participant profile and FF samples

The results of the survey seem representative and meaningful with regard to FF, as the response rate of 34% can be described as good, compared to a usual response rate of 10–15% for external surveys (Fryrear 2015). All relevant AE were included in the survey and the participants

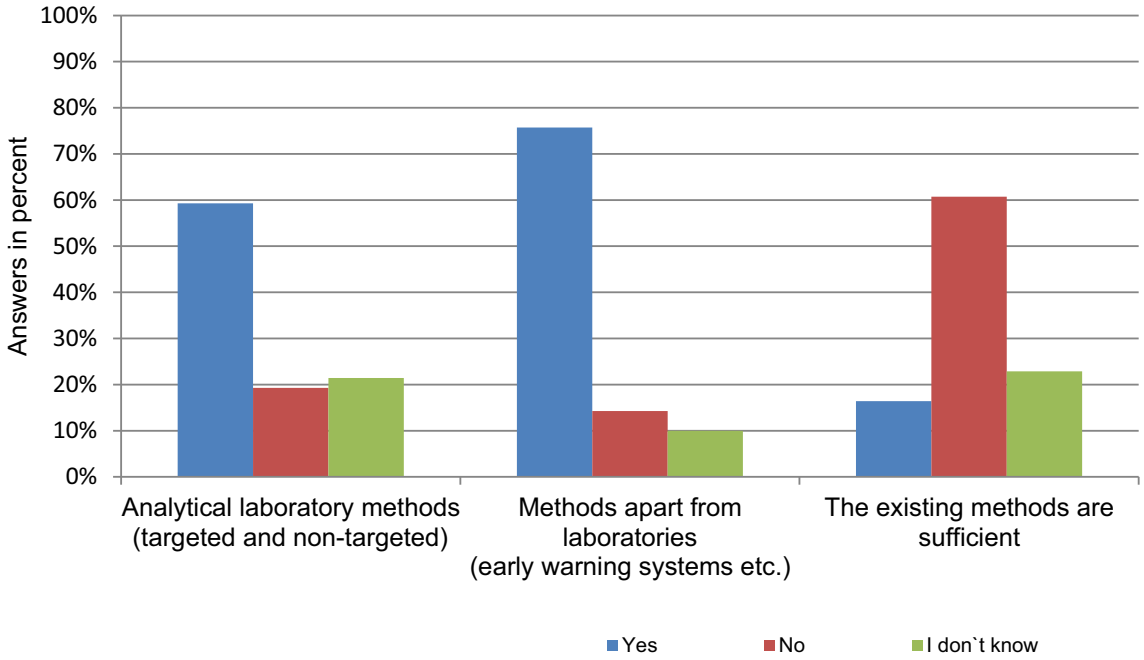

Fig. 2 Methods that should be further developed in order to solve FF cases more effectively. The answer options presented had to be assessed individually with "Yes". "No" or "I don't know" by the participants of the online survey. The distribution of the answers is presented as a percentage for each answer option. 76% (n = 106) of the participants (n = 140) stated that they would like to see further development of methods apart from the laboratories, e.g. early warning systems. More than 60% of participants assessed the existing methods as insufficient to solve FF cases efficiently

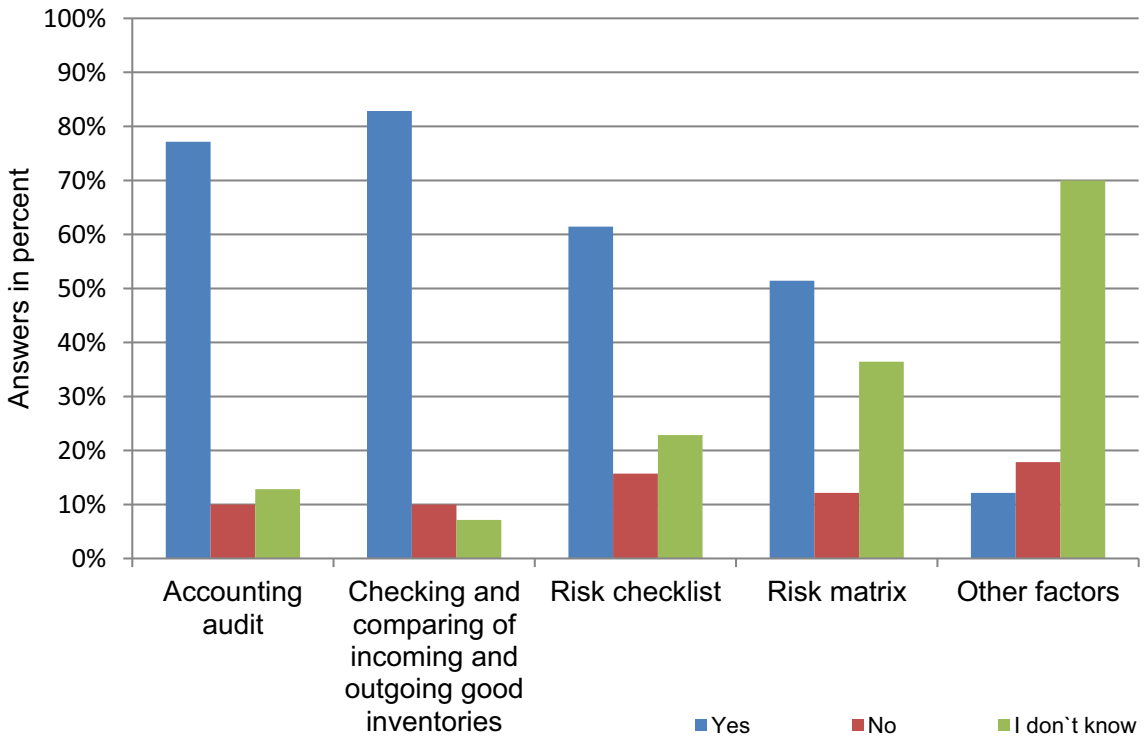

Fig. 3 Instruments which, in addition to laboratory methods, are useful for the detection of FF. The instruments presented were individually assessed by the participants (n = 140) of the online survey with "Yes". "No" or "I don't know" for the detection of FF. The percentage distribution of the assessments is presented in bar charts

represent almost all German federal states. They were all experts and persons confronted with FF in their field of work. The vast majority of them had many years of professional experience and many were in leading positions. All this increases the accuracy of the results and thus, according to Janssen (2016), the reliability of the conclusions.

4.2 Facts classified as FF

Currently, there is no legally established definition of the term FF in European law (European Parliament [EP] 2013). According to Spink and Moyer (2011), FF is rather a collective term covering a large number of facts, which constitute an act of fraud. As the survey shows, also in DE different facts are summarized under the term FF. Some facts are clearly attributed to FF by almost all participants, others are almost equally clearly rejected, and in some cases approval and rejection are balanced. The ambiguities can best be explained by the different areas of responsibility of the AE. For example, the "Import of illegal goods" is considered as FF by 41% of the participants. This result may be influenced by the participation of border inspection posts, for whom this topic is of great importance. In contrast to our results, some facts are clearly regarded as FF in other countries, e.g. the "Sale of stolen goods" (Spink et al. 2013a). Unexpectedly, "Mislabelling" was classified as FF by only half of the participants. This is remarkable, as a third of them estimated that more than 70% of all FF cases are based on mislabelling. This appraisal corresponds to a report by the European Commission (EC) (2018) stating that 59% of the 597 reported cases in the Administrative Assistance and Cooperation System (AAC system for the exchange of data regarding non-compliances with food and feed legislation for EU countries) in 2017 were caused by mislabelling. This example illustrates the different approaches to FF and the need for a comprehensive definition. An important aspect in the definition process refers to the determination which types of FF may pose a threat to food safety. In general fraudsters do not want to be discovered and therefore try to avoid health risks for consumers. However, there is always a risk if allergenic substances are added (Everstine et al. 2013; Dickerson 2014; Spink et al. 2015), e.g. the substitution of hazelnuts by cheaper peanuts. A similar health risk arises from substances that are unsuitable for human consumption or even toxic, which are added by counterfeiters to fake certain quality characteristics of the products (Everstine et al. 2013; Spink et al. 2015). Examples are melamine in infant formula or Sudan red in spices. In these cases, ingredients have been replaced or added without the consumer's knowledge. As to be expected, these types of FF which put the consumers' health at risk were among those that the participants ranked in the first places.

The results clearly underline the need for a comprehensive definition of FF, as this is indispensable for a coordinated control approach and a reliable risk estimation.

4.3 Factors suitable for predicting FF

There are several factors that give rise to the suspicion of FF. One of these factors is a crop failure caused by e.g. bad weather conditions, social or political crises or armed conflicts. An example for this is the influx of cold air in Turkey in 2014, which destroyed a large part of the hazelnut harvest. As a result, prices rose sharply, promising exceptionally high profits, while suppliers faced contractual penalties if they were unable to meet their supply contracts. Thereby they were greatly tempted to solve their problems using FF. Another example are the repeated cases of adulterated extra virgin olive oil from Italy, where after crop failures as in 2014, the Italian olive oil was stretched with cheaper oil from other countries. The product category is another factor. It is well known that the substitution of a high-quality, expensive food or raw material with a cheaper and often less valued counterpart is used to gain higher profits. This is especially frequent for seafood products such as fish and shellfish. Here the risk of detection is very low because the identification of the species is difficult in fish fillets and at the same time the profit margins are very high (Rodríguez and Ortea 2017).

The participants gave a clear ranking of the given factors in relation to the prediction of FF which was confirmed by both rankings. They ranked the "Origin of the foodstuff" first and the categories "Product category" and "Price fluctuations" just behind. The "Origin of the foodstuff" showed the smallest standard deviation of all ranked factors indicating a homogeneous vote distribution, confirming this statement. The highly ranked factors are directly related to the above examples and may have indicated an increased risk of FF if used in an early warning system. Therefore, it seems reasonable to take the results into account with regard to the development of an early detection system for FF.

4.4 Vulnerable food product categories

Unfortunately comprehensive and meaningful data on product categories particularly frequently affected by FF are not available for DE. The report from the EP (2013) listed ten product categories increasingly affected by FF in the EU. The Food Fraud Network (FFN), established in 2013, has also been publishing annual reports since 2014 in which the infringements recorded in the AAC system are

presented. However, the annual reports contain only highly aggregated data and do not provide detailed information on FF for specific product groups. Representative data on product categories particularly affected by FF or typical FF cases of certain product categories are not available in the literature either. Nonetheless, scientists from the University of Wageningen revealed in a query of various FF databases that in the period between 2008 and 2013 the six most frequently reported commodity groups were herbs and spices, olive oil, fish products, dairy products, meat, and other oils and fats (Weesepoel and van Ruth 2015). These results are to a large extent in line with the results of this survey.

"Meat/meat products (excluding poultry)" was ranked consistently among the first ranks. Yet according to the EP report (2013), this product group is not one of the ten product categories most frequently affected by FF. On the other hand, 28 out of 156 FF cases reported in the AAC system for 2016 concerned meat and meat products, making it the most affected product category (EC 2017) and van Ruth et al. (2017) placed the meat chain on place three of various supply chains with regard to FF vulnerability. The reason for the high ranking may be that the AE in DE have been sensitised to the presence of foreign proteins in the wake of the Horsemeat Scandal of 2013 and the 'Gammelfleischskandal' of 2017. In addition, large quantities of meat are consumed in DE and meat is an important economic factor for the country. Apart from that, the abilities to analyse foreign proteins have been continuously improved in recent years, enhancing the chance to identify FF. According to Ballin (2010), the following points are considered particularly important with regard to the meat-specific types of FF: origin of the meat and the feeding system, substitution by meat components of other animal species, tissues, fats or proteins, changes in processing methods and addition of non-meat ingredients such as water or other additives. More recent studies underline this statement and prove that the addition of additives and in particular of foreign proteins by meat components of other animal species still poses a major problem (Espinoza et al. 2015; Chuah et al. 2016; Iammarino et al. 2017; Shehata et al. 2019).

The results of the survey regarding the categories "Oils/fats" and "Fish/seafood" are in line with the experiences in the EU (EP 2013) and Weesepoel and van Ruth (2015). Vegetable oils are particularly susceptible to FF in the form of substitution, misdeclaration or as food ingredients (Spink and Moyer 2011), while fish is often mislabeled or whole fish filets are replaced by cheaper filets of other species (Pardo et al. 2016; Rodríguez and Ortea 2017). The low ranking of coffee and tea (rank 20 out of 23 categories) reflects that there have been no important FF cases with these products in DE up to now and therefor differs from the findings of the EP report (2013) where it was placed on rank seven.

Although "Eggs/egg products" are not mentioned in the report of the EP (2013), they are considered as vulnerable products in the survey. One reason for that could be the FF incidents associated with the mislabelling of eggs, such as the 2017 Egg Scandal in Lower Saxony, when large quantities of eggs were labelled as free-range eggs, although keeping poultry indoors had been mandatory due to animal health law for more than 12 weeks in DE (Lebensmittelpraxis 2017).

The lowest ranking food categories include "Soups/sauces", "Infant food" and "Confectioneries" which is in line with the EP report (2013) and the EC reports (2017, 2018) in which these product categories were not among the vulnerable product categories either. However, the Melamine Scandal of 2008 has clearly shown that infant food can also be affected by FF (Ingelfinger 2008). In DE infant food is considered relatively safe because products intended for the nutrition of infants and young children are subject to special controls and to the strict requirements of the national Dietary Regulation (Diätverordnung 2005).

4.5 Tools in the fight against FF

Based on Spink et al. (2016), the fight against FF should rest on three pillars: detection, deterrence and prevention. Prevention in this context means the practical application of countermeasures to reduce the possibility of fraud. In an earlier article, Spink et al. (2013b) already pointed out that the main focus of research should be on the prevention of FF by creating a system that can stop adulterations from getting into food at all. As the greatest challenge, the authors cite the unique complexity of food authentication resulting from the complexity of profiling a multi-component food that requires methodologies not yet available and the incredible amount of inherent variations of the same food produced over the course of a year. Particularly these aspects can be a reason why the majority of participants favoured the development of non-laboratory-based methods in order to solve FF cases more effectively. Although the existing targeted methods can already efficiently detect specific known adulterations and are the basis for routine analyses and official food controls (Busch 2010), they are too specific to detect every type of fraud or unknown adulteration. Non-targeted methods can detect these unknown falsifications, but do not meet other important prerequisites (e.g. method validation, reference databases with representative authentic samples, etc.) (Esslinger et al. 2014). Therefore, they can hardly be used routinely at present. Non-laboratory-based methods allowing to focus on particularly critical products would be of great

advantage as they could significantly limit the number of samples to be examined. Classical components of the quality management, such as "Checking and comparing incoming and outgoing good inventories" and "Accounting audits" are seen as suitable means of detecting FF. However, the establishment of a "Risk checklist" or a "Risk matrix" to identify products at risk and to allocate resources more effectively is also popular with the participants and could be used. The factors they mentioned as suitable to predict FF could be used for the development of such a checklist/matrix.

Several organisations are currently dealing with the problem of FF and how to tackle it. Among the most important organisations are the EU with its FFN, and the Global Food Safety Initiative (GFSI) (Fritsche 2018). As part of their work, they developed tools to combat FF. At European level, e.g., the AAC system is used by EU member states to exchange information on FF, while the Rapid Alert System for Food and Feed (RASFF; established in 1979) is used to inform about food safety risks. In DE, the Bavarian State Office for Health and Food Safety (LGL) has set up an early warning system designed to detect emerging health risks and potential FF at an early stage. There, the factors "price" and "flow of goods" are used as so-called drivers for the identification of upcoming risks (Müller and Verhaelen 2016). The driver "price" refers directly to the factor "price fluctuations" identified in the survey as useful for predicting FF. "Flow of goods" refers indirectly to the "origin of foodstuff" factor, so that the practical assessment by the AE corresponds to the scientific findings in this field. Based on the results of this survey, the Bavarian system could be extended by the factor "product category of the foodstuff". For this purpose the data from the AAC system and the RASFF could be evaluated and used. A considerable disadvantage of the aforementioned tools is that they are only accessible to official authorities.

In the private sector, GFSI, as the superordinate body for benchmarking and mutual recognition of food safety standards, is also dedicated to combating FF. Therefore, GFSI established 2012 the Food Fraud Think Tank (FFTT) to provide guidance and recommendations to businesses on how to protect consumers from potential harm from FF. A corresponding position paper (GFSI 2014) identified the performance of FF vulnerability assessments (VA) and the implementation of related control plans as the two key elements in the fight against FF. Therefore, these elements were included in Version 7 of the GFSI Benchmarking Requirements and fully implemented in Version 7.2 in March 2018 (GFSI 2018). All standards recognised by GFSI (e.g. IFS Food Standard (IFS), British Retail Consortium (BRC) Global Standard, Food Safety System Certification (FSSC) 22000, Global Red Meat Standard (GRMS), Global G.A.P.) must include corresponding demands in their catalogue of requirements (Sulzer 2017). Threat Assessment and Critical Control Points (TACCP) and especially Vulnerability Assessment and Critical Control Points (VACCP) are tools often used to perform VA within the framework of standard requirements (Global Food Safety Resource 2019). Another organisation tackling FF is SSAFE (the Safe Supply of Affordable Food Everywhere), a global non-profit organisation set up to promote food safety at all stages of the supply chain. SSAFE has developed a tool for assessing FF vulnerabilities (SSAFE 2016) based on a questionnaire of fifty questions in cooperation with PricewaterhouseCoopers (PwC) and Wageningen University. A tool not specifically designed for FF has been developed by Safefood-Online. It processes RASFF information and enables multi-dimensional analyses and user-specific queries, which can also be used in relation to FF (Safefood-Online, w.D.). Unfortunately, it is not possible to analyse the FF specific data of the AAC-system with Safefood-Online, as this system is not publicly accessible.

According to the survey results, the focus in the combat against FF should be on the identification of possible hazards (e.g. particularly vulnerable products, processes, origin of food). All tools mentioned above aim at detecting and eliminating risks for FF as far as possible. In conjunctions with the factors found in this survey they could be used for developing a checklist suitable to minimise the potential risk for FF.

5 Conclusion

The survey clearly reveals the ambiguities in the understanding of FF. The highest priority in the fight against FF therefore lies in a legally binding definition that describes all facts that constitute an act of FF, as it is the most crucial prerequisite for a harmonized fight against FF and an urgent necessity for risk-based official controls. The facts identified in the survey as FF can be used in the development of such a definition. The further extension of the existing data and information systems (e.g. RASFF, AAC-system) is necessary to obtain valid data on the occurrence of FF and vulnerable food categories and to enable effective action in case of an incident. Instruments to fight FF are considered necessary by the AE and should therefore be further developed, as should a tool for predicting FF, using the results of this survey. A practical checklist to assess the fraud potential of food seems useful and appreciated to carry out an initial risk assessment and to support the work of the AE. In summary, far-reaching efforts must be made to ensure that the AE can adequately fulfil their responsibilities in relation to FF.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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