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Research Paper

Food Fraud Conceptualization: An Exploratory Study with Portuguese Consumers

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ABSTRACT

Food fraud refers to deceptive practices conducted for economic gain, and incidents of such fraud are often reported in the media and scientific literature. However, little is known about how European consumers perceive food fraud. To address this gap, a study explored Portuguese consumers' knowledge and perceptions of food fraud using qualitative methods such as free word association and semi-structured interviews. For this research, 340 participants were recruited, providing 911 valid words, classified into categories, major categories, and dimensions. Differences between consumers' previous exposure to food fraud and sociodemographic characteristics were explored. Additionally, other thirty-six participants were selected and interviewed, following a semi-structured guide. Interviews were transcribed, coded, and analyzed using a thematic analysis procedure. The results suggest that Portuguese consumers view food fraud as a morally reprehensible deception and are aware of its causes and impacts. However, not all consumers know the different forms of food fraud or the types of products vulnerable to fraud. Among the most repeated words were "deception", "expiration date", and "falsification". Despite this food fraud awareness, most consumers believed they were not exposed to food fraud and stated that they do not conduct daily practices to reduce exposure to it. Following the chi-square and Mann-Whitney tests, significant differences ($p \leq 0.05$) were identified between participants exposed and not exposed to food fraud. The study also found that consumers with higher education and self-reported exposure to food fraud had a better understanding of the issue. This study provides insights for quantitative research on consumer perceptions and beliefs about food fraud to explore further vulnerable food categories and types of food fraud in real-world scenarios.

Food fraud is a broad concept used to designate an intentional and deceptive act for economic gain with food (Spink, Bedard, et al., 2019). Types of food fraud include but are not limited to substitution (e.g. replacing a high-value ingredient with a lower-value ingredient), dilution (e.g. mixing a liquid high-value ingredient with a liquid of lower value), concealment (e.g. hiding the low−quality of ingredients), counterfeiting (e.g. copying the brand name for economic gain), mislabeling or misrepresentation of food, food ingredients or food packaging (e.g. placing a false claim for economic gain), unapproved enhancement (e.g. adding unknown or undeclared materials to enhance the quality attributes), and grey market production/theft/diversion (KC-FFQ, 2022; Spink, Bedard, et al., 2019; Winkler et al., 2023). With the purpose of economic gain, the fraudster (e.g. primary producer, ingredient supplier, processor, distributor, retailer, food service) intentionally deceives the consumer about the quality and/or contents of the foods they wish to purchase (Codex Alimentarius Commission, 2018; FAO, 2021). The global cost of food fraud is diverse and estimated to range from $12,000 to $65,000 million annually (Brooks et al., 2021). The fraudulent practices can also have direct and/or indirect consequences on food safety (public health risk), arising from the undeclared introduction of any food ingredient that may be harmful to susceptible consumers, such as allergens or toxic compounds (Spink, Chen, et al., 2019). The 1981 Spanish Dangerous Olive Oil Incident, a severe food fraud involving the sale of industrial fuel oil

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for human consumption, resulted in 1,200 deaths and 20,000 hospitalizations and remains one of the most severe food fraud incidents (Visciano & Schirone, 2021). The "Horse Meat" scandal, which occurred in 2013, where traces of horse meat were found in products labeled as beef in several European countries, including Portugal, was the trigger to warning consumers, governments, and food business operators (FBOs) about the effects that fraud can have on the World food system (Agnoli et al., 2016).

These occurrences create adverse short-term effects on preferences and consumption habits associated with fraudulent food, which can more widely affect the overall effectiveness and efficiency of the food supply chain (Elliott, 2014).

Although in the European Union (EU) sphere, there is no exact definition of "food fraud", essential for establishing a common understanding of the problem, several attempts have been made by governments of the EU food system to ensure that food is safe and consumer interests are protected (European Commission, 2022a). The abundant EU food legislation, the Knowledge Centre for Food Fraud and Quality, and the Coordinated Control Programs are some measures to tackle food fraud in the EU (BSI, 2017; European Commission, 2022b). Following the EU statement, in Portugal, food fraud or deceptive practices and the adulteration of foods by economic motivation fall within the scope of article 8 of Regulation (EC) 178/2002 of 28/01, referred to as "General Food Law" (European Parliament, 2002).

Despite food fraud incidents being commonly reported in the media or described in scientific literature, especially large-scale incidents (Everstine et al., 2013), there is still a lack of knowledge about European consumers' perceptions and attitudes toward fraud in food systems. As suggested by Kendall et al. (2019), this information is particularly relevant as it may guide priorities in policy development and implementation of mitigation policies and predict and explain consumers' self-protective behaviors concerning food fraud (Elliott, 2014; Kendall et al., 2019). In Portugal, the studies toward food fraud focused mainly on food labeling (Moreira et al., 2021), food fraud printed media coverage (Mil-Homens et al., 2019; Azevedo et al., 2019), and technical methods such as DNA-based methods to address food authentication on goods such as rice, fish/seafood, dairy, and wine (Andrea et al., 2020; Baptista et al., 2021; Freitas et al., 2022; Sousa et al., 2021; Vieira et al., 2022).

To evaluate food consumer perceptions, indirect and direct qualitative research techniques are applied (Guerrero & Xicola, 2018; Mesías & Escribano, 2018). The free word association (FWA) technique is currently the reference projective technique to explore consumers' thoughts, beliefs, and perceptions in food studies. This indirect technique involves the conceptualization of the stimulus, and participants are asked to indicate the first thing that comes to mind when presented with a word or a list of words (Roininen et al., 2006). This cognitive task is an easy and quick technique to use and offers spontaneous thoughts, being a proxy of their intuition or automatic thoughts about food (Ares et al., 2015; Gambaro, 2018). Consumers struggle to express their food decisions because they are made unconsciously (Köster, 2009). The literature is clear on the assumption that the first associations given by consumers are the most salient and important in the consumers' minds, being linked to their product-related behavior (Roininen et al., 2006). The FWA has been widely used to explore the consumers' perception of specific food products as red meats (Popoola et al., 2021), wine (M. Fontana et al., 2023), perceived authenticity in cheeses (Fernández-Sánchez et al., 2023), and also general concepts as traditional food products (Guerrero et al., 2010), biodiversity/sustainability (Barone et al., 2020; Eylering et al., 2023; Sousa et al., 2021), labeling, and food additives/technology (Rojas-Rivas et al., 2022; Varela & Fiszman, 2013).

Conversely, in-depth interviews provide a more detailed understanding of consumers' food experiences and opinions, allowing a richer understanding of the topic under study. Following an interview guide, the participants directly provide more detailed and contextualized answers, explaining their answers, providing specific examples, and discussing their insights in greater depth, which can lead to a more complete understanding of the phenomenon under study (A. Fontana & Frey, 1994). The interview technique was also used to explore consumers' perceptions concerning food safety, food fraud, and nutrition (Mitterer Daltoé et al., 2017; Rijswijk & Frewer, 2012; Soon & Liu, 2020; Wilcock et al., 2004).

This study aims to evaluate how Portuguese consumers perceive, understand, and conceptualize food fraud, considering the influence of exposure to food fraud and their sociodemographic characteristics.

Materials and Methods

A mixed methodology was applied (Guerrero & Xicola, 2018), combining indirect methods, such as free word association (FWA), to obtain consumers' intuitive and spontaneous ideas about food fraud and face-to-face interviews to provide a more detailed understanding of consumers' perceptions, knowledge, and beliefs regarding food fraud (A. Fontana & Frey, 1994).

Participants. For this study, residents of mainland Portugal were recruited at two different times. Thus, the FWA and the interview participants are not the same. The eligibility criteria to participate, both on FWA and in the interviews, were 18 years old or over and not belonging to the same household as other previous participants.

Regarding the free word association (FWA), a convenience sample of consumers was recruited from digital devices (emails and messaging apps) and asked to spread the survey to family members (not from the same household), friends, and other members of their social network. Although a convenience sample is not representative of the population, this way of obtaining data is practical (Guerrero et al., 2010). It has the potential to provide diverse and large numbers of participants without the intervention of a researcher (Vidal et al., 2018).

For the interview task, participants were purposively sampled based on sex (male/female), age group (18–34 years old, 35–54 years old, and + > 55 years), and education level (higher education/lower education), to maximize variability between groups (categories) and minimize variability within these groups. These sociodemographic variables influence food fraud behavior and food risk (European Commission, 2020; Moreira et al., 2021; Théolier et al., 2021). The sample quotas do not reflect the demographic composition of a region/country. Instead, a sample distributed equally by sex, age group, and education level was chosen, as it allows direct comparison since, by balancing the quotas, it is possible to ensure that all groups are equally heard.

All the participants followed an informed consent procedure before their participation. Participation took place in an anonymous form, guaranteeing adherence to the European General Data Protection Regulation. All participants were voluntary and did not receive any incentive. The study was previously approved by the Ethical Committee of the *Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto*, with the reference number 22/2021/CEFCNAUP/2021.

Data collection of the questionnaire. A structured self-reported electronic questionnaire was applied using the Lime Survey software v.2.50 (LimeSurvey GmbH, 2020).

Firstly, participants were invited to spontaneously record the perceptions they associate with food fraud, writing down on the screen the first three words that came to mind when they think of "food fraud" on three blank spaces. This was followed by a question to indicate whether they had ever been a victim of food fraud (Yes/No). Additionally, sociodemographic data were also collected: gender, age, marital status, education, type of occupation and, on a Likert scale of up to seven points, area of residence (1 = rural/7 = urban), financial situation (1 = fairly difficult/7 = fairly good), assessment of food

expenses (1 = price/7 = quality), and health status (1 = unhealthy/7 = fairly healthy).

Following other food consumer studies using FWA (Rojas-Rivas et al., 2022), this study used the FWA questionnaire for three months, with a minimum of 300 respondents.

Data collection of the interviews. For the face-to-face interviews, a semi-structured interview guide of open-ended questions was developed considering the following dimensions: i) general perceptions and knowledge about food fraud, ii) risk perception regarding food fraud, iii) constructivist authenticity (individual's belief and expectations about a product), iv) food fraud consequences, v) food fraud prevention and detection practices, vi) COVID-19 pandemic context, and viii) perception of regulation and responsibility. Two moderators conducted four piloted interviews to ensure the interviewees understood all questions. The piloted interviews were not included in the analysis.

The interviews were performed by two moderators and took place at people's houses, workplaces, public places, and online platforms since COVID-19 pandemic restrictions were in place. They had an average duration of 17 ± 17 min. The participants were mainly residents of Northern Portugal. All the interviews were audio and/or videotaped to assist the researchers in the *verbatim* transcription of the contents and with the stated consent of the participants. Sociodemographic characteristics, like those described by FWA, were also collected. Both sets of data were collected from May to September 2021.

Data Analysis of the questionnaire. Regarding the FWA, the analysis began with a revision of each elicited word/term to correct for typos and misspelt words in all responses. All imperceptible and blank responses were removed and not considered for analysis. Data were analyzed by grouping each word/term with similar meanings into exclusive and exhaustive Categories. In the same way, the set categories with similar characteristics were grouped into Major Categories, and those major categories into Dimensions using the same procedure (Krippendorff, 2018). A consensus categorization was achieved after each researcher had individually categorized the response words. This analysis was done in the native Portuguese and only after being translated into English using the rules established by Anderson and Brislin (1976). The answers were analyzed according to the frequency of mention of the word/term in each Category, Major Category, and Dimension. The Major Categories and Dimensions including words/terms from at least 5% of participants were considered for further analyses. Taking the study's exploratory nature, 5% was selected as a cut-off point to avoid losing a large amount of information (Ares et al., 2015). The answers were analyzed according to the frequency of mention of the words in each Category, Major Category, and Dimension. According to self-reported previous exposure to food fraud, participants were also split into two groups. These two groups' frequency of words/terms and the possible differences were calculated concerning Major Categories and Dimensions. The differences between sex, age group, and education level were also examined. The chi-square test was run at a 95% confidence level. Analyses were performed using Excel and IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., 2019).

Data Analysis of the interviews. The transcripts of the interviews were explored using a qualitative data analysis software, QSR NVivo 12 (Copyright® QSR International Pty Ltd, Melbourne, Australia). Interviews were analyzed using a thematic analysis procedure that involves a progression from description to interpretation data (Braun & Clarke, 2006). A comprehensive process of data coding and identification of themes, consistencies, and discrepancies across themes was undertaken and explored to provide an in-depth understanding of the texts (Patton, 1990). Finally, after the individual categorization by each researcher, a consensus categorization was achieved. To support the analysis, a calculation of the number of participants who mentioned a particular theme and the number of extracts reported for each theme was performed as the best indicator of the prevalent theme (Namey et al., 2007). To illustrate the analysis, direct quotes by the participants are transcribed, describing the topic explored. Furthermore, participants were grouped into those who self-reported being previously exposed to food fraud and those who self-reported not being exposed. It explored the differences between these two groups concerning the mean number of extracts (references) on themes and subthemes. The Mann-Whitney U Test was performed at a 95% confidence level. Analyses were performed using Excel and IBM SPSS Statistics for Windows, version 26.0SPSS Software 16. (IBM Corp., 2019).

In both techniques, a consensus categorization was achieved after the first three experienced researchers individually categorized the words/terms or the extracts (Guerrero et al., 2010; Modell, 2005). Data analysis was done in the native Portuguese language, and only then was it translated into English using the rules established by Anderson & Brislin (1976).

Results

Participants' characterization of free word association related to food fraud. A total of 340 valid participants regarding free word association completed the survey. Of these, 100 participants reported that they were previously exposed (29.4%) to food fraud. As can be observed in Table 1, 56.2% of the participants were female, with an average age of 45.60 ± 15.07 (ranging between 18 and 72 years old), spread by three age groups (young adults: 18–34 years old, adults: 35–54 years old, and mature: +55 years old). The majority were employed (71.5%), married (58.2%), and had a higher education level (66.8%). About 82% of participants were residents in the North of Portugal, although there were participants from all other regions, apart from the autonomous regions of Azores and Madeira.

Free word association: conceptualization of "food fraud". A total of 911 valid words/terms were generated after consumers were asked to write down the first three words that came to mind when thinking about food fraud, of which 468 were exclusive (not repeated). Also, 41 words with derived words (e.g. "deceive", "deceiving", "deceit") were identified, and they were gathered and counted as the same word. A final set of 403 different words/terms was obtained. Of these, 69.2% of the words/terms appeared only once, without repetition. Also, 95.0% of the words had a frequency of mentions ≤8. The words/terms, including derivate words, that collected a frequency equal to or higher than nine were retained as the most repeated words. These represent 5% of the total (n = 403). The words "deception", "expiration date", and "falsification" were the top three most mentioned words by the participants as presented in Table 2.

The words/terms were grouped into 60 Categories, merged into 30 Major Categories and eight Dimensions (Appendix A). The Dimensions that were most mentioned were "Food fraud perception" (29.2%), "Types of food fraud" (17.0%), and "Food fraud impacts" (14.8%). On the other hand, 9.6% of the words/terms had a "Lack of connection with the concept", indicating that consumers make an unsuitable association or do not directly associate with the concept of food fraud (Fig. 1).

Participants perceived food fraud as an act of deception and morally damnable. The "Food fraud perception" dimension combines words/terms with similar semantic meanings of fraud (e.g. deceive, mistake, "a pig in a poke"), representing the "Deception category" 70% of words/terms in this dimension; it also combines words/terms associated to the moral and ethical aspect of food fraud ("Morally damnable" category), supporting findings from other studies about the consumer reactions to food fraud powered by feelings of deceit and betrayal by food chain stakeholders (Kendall et al., 2019; Regan et al., 2015).

Participants also elicited different words identified as "Types of food fraud". In this paper, the following types of fraud were considered: adulterations and their forms (namely substitution, dilution,

Table 1
Characterization of the free word association participants (n = 340)

Characteristics	Total frequency	Relative frequency	Reported exposure to food fraud	
			Previously exposed	Not previously exposed
Sex				
Female	192	56.2%	58	134
Male	146	43.2%	42	104
Rather not answer	2	0.6%	0	2
Age group (years old)				
18–34	89	26.2%	12	77
35–54	155	45.6%	52	103
55+	96	28.2%	36	60
Average ± SD: 45.60 ± 15.07				
Occupational status				
Employed	243	71.5%	71	172
Student	45	13.2%	7	38
Retired	31	9.1%	16	15
Other	21	6.2%	6	15
Marital status				
Single	96	28.2%	15	81
Married/living as married	198	58.2%	68	130
Separated/divorced/widow	46	13.5%	17	29
Highest level of participants' education				
Without higher education	113	33,2%	33	80
With higher education	227	66.8%	67	160
Household dimension (including himself)				
1	30	8.8%	8	22
2	79	23.2%	25	54
3	78	22.9%	18	60
4+	153	45.0%	49	104

Table 2
Frequency of mentions and % participants of the most repeated words (included derivate words)

Words/terms including derived words (original word/term in Portuguese)	Most repeated words	
	Frequency of mentions (≥9)	% Participants
Deception / *(engano)*	68	19.4%[¤]
Expiration date / *(data de validade)*	30	21.4%
Falsification /*(falsificação)*	18	5.3%
Health*/ *(saúde)*	16	4.4%[¤]
Lying / *(mentira)*	16	4.7%
Organic /*(biológico)*	15	4.4%
Disease / *(doença)*	14	4.1%
Profit/ *(lucro)*	13	3.8%
Sugar / *(açúcar)*	11	3.2%
Greed* / *(ganância)*	10	2.9%
Quality /*(qualidade)*	10	2.9%
Adulteration/ *(adulteração)*	9	2.6%
Fast food*/ *(fast-food)*	9	2.6%
Misleading advertising* / *(publicidade enganosa)*	9	2.6%
Preservatives*/ (conservantes)	9	2.6%

*Words without any derided word/term.
[¤] Participants used derived words/terms, so the % calculation is not straightforward.

concealment, and unapproved enhancement); mislabeling; counterfeiting; and grey market (KC-FFQ, 2022; Morin & Lees, 2018; Winkler et al., 2023). Some of the words correspond directly to types of fraud, and researchers classified others into types of fraud, i.e. words evoked such as “expiration date” and “product that is not the one mentioned on the label”; the investigators classified into “mislabeling”. Likewise, the words “tampered with” and “changed” were classified into “adulterations”, but specific types of adulteration were classified in their form (i.e. “dyes” were classified specifically in the form of addition).

The “Food fraud impacts” dimension identified two main categories: market functioning and health. For our participants, food fraud represents a threat to the proper functioning of the market and unfair competition, with an underlying economic motivation and undue advantage for the aggressor. In this sense, words/terms codified into economic motivation, law violation, and price categories were highly evoked. In the same way, words/terms concerning health and disease were also evoked (“healthy”, “intoxication”, and “cancer”). This could be due to the lack of food fraud product quality (words: “weak”, “bad quality”) and authenticity (“traceability”, “origin”) and by the lack of food safety (“Food Quality and Safety” dimension), as these products may be spoiled and contaminated, thus perceived as a danger and nefarious. Nevertheless, according to our participants, some food categories are more susceptible than others to being exposed to fraudulent practices with the purpose of economic gain (Appendix A). Among them, the top five products elicited by our participants were: “Light food products [such as low sugar or low fat] (21%)”, “Fast food (16%)”, “Organic products” (15%), “Processed foods” (10%), and “Sugar, salt and fat” (10%).

Concerning the stage of the food chain (“Food system stages dimension”), only a few participants (3%) established an association between food fraud and food fraud cases detected in the primary production stage (“house-made”, “production”), and at the end of the food chain: food service (“restaurants”, “school canteens”) and retailing (“super and hypermarkets”, “herbalists”). In the same way, only a few participants elicited words (“law” and “control”) associated with the “Perception of regulation and responsibility” dimension.

For the Major categories, significant differences were found in the number of mentions between consumers exposed to food fraud and those not exposed. The chi-square test demonstrated an association between the Major categories of food fraud and exposition to food fraud (χ^2 (7) = 18,050; p = 0.012). The major category, “Deception”, was highly mentioned for exposing consumers to food fraud. On the other hand, the major category, “Food safety”, was well-mentioned by nonexposed consumers (Table 3). Those who had reported previous exposure to food fraud perceived it as an act of deception (probably because they were annoyed with one incident they had already

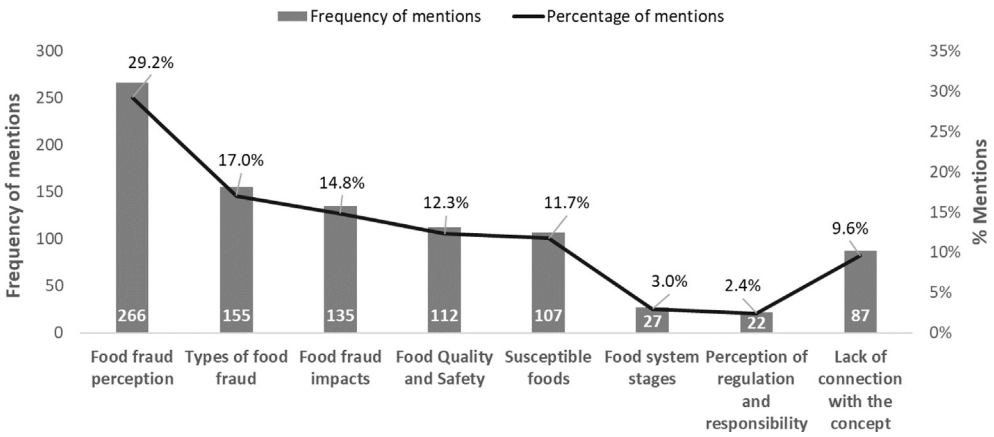

Figure 1. Frequency and percentage of mentions of words/terms on the dimensions of food fraud.

Table 3
Frequency of mention of the dimensions and major categories identified when participants were asked to write down the first three words that came to their minds when thinking of food fraud and results from the chi-square test, according to previous exposure to food fraud

Dimension	Major category (≥5% respondents)	Number of mentions	
		From exposed participants (n = 174)	From nonexposed participants (n = 460)
Perception of food fraud	Deception	65 (+) *	120 (−) *
	Morally damnable	25	56
Food fraud impacts	Market impact	21	61
	Health impact	14	39
Food quality and safety	Food safety	9 (−) *	66 (+) *
Types of fraud	Adulterations	16	31
	Mislabeling	13	46
Lack of connection with the concept	Others	12	44

Effect of the chi-square test per cell: (+) or (–) indicate that the observed value is higher or lower than the expected theoretical values according to the chi-square test, * $p < 0.050$.

experienced). Conversely, those with no previous exposition to food fraud incidents are worried about the possibility of food fraud occurring in the future.

The chi-square test demonstrated an association between major categories of food fraud and education ($\chi^2(7) = 19.344$; $p = 0.007$). The major category "Food safety" was highly mentioned by consumers with "higher education". There also exists a statistically significant difference (p regarding the "Lack of connection" dimension, whereas participants "without higher education") expressed higher values than the expected theoretical values. That is, they evoked more words/terms unrelated to food fraud than participants "with higher education", emphasizing their difficulty in conceptualizing food fraud. The sociodemographic characteristics, age, and sex did not significantly impact the number of mentions (Table 4).

Participants' characterization of the Interviews. Thirty-six consumers (50% male, 50% female), aged between 20 and 62 (average: 43.5 ± 13.9) years old (Table 5), were recruited for the interview task. Half of the participants had higher education; most were employed (80.6%) and married (58.3%). All participants were residents in the North of Portugal. Up to fifteen consumers reported previous exposure to food fraud (41.6%). The characterization of each of the participants can be found in Appendix B.

Findings from interviews. Five main themes were identified from the interviews, cutting across the different issues related to the research topics (Fig. 2). The theme "Expression of food fraud" was the most debated among the participants (747 references codified), followed by the themes "Fighting, preventing and detection of food fraud" (458 references codified) and "Characterization of food fraud" (471 references codified). The themes "Exposure to food fraud" and "COVID-19 and food fraud" were the least discussed, with 168 and 44 codified references, respectively. Each of these themes is described below.

Characterization of food fraud: concept, types of food fraud, causes, and impacts of food fraud. From the analysis of the interview's transcripts, it is reinforced that the meaning attributed by the participants to the food fraud (n = 22) "… *is deceiving the consumer*" (P22), because *"…there may be distortion between what reaches the consumer and what the consumer thinks he is buying*" (P9). That is why some interviewees (n = 14) were concerned about being misled about the true qualities of food, associating food fraud to: "*deteriorated foods, therefore, in bad conditions, … appearing high quality*" (P11). In this context, participants reported different faces of food fraud. However, two main types of food fraud emerged: mislabeling (n = 27), described as false claims or distortion of the information provided on the label/-packaging, followed by adulteration (n = 15), referred directly or in its different forms, as described in Table 6. By contrast, only three interviewees mentioned counterfeiting, and two mentioned the grey market.

According to most participants (n = 30), the occurrence of these fraudulent practices is driven by the economic gain of the FBO over consumer interests: *"…human greed …to immediate profit"* (P2). Participants also reported the increased competition within the food industry, which resulted in lower profit margins, as a potential driver of the proliferation of food fraud (n = 10). Participants consider that fraudulent FBOs apply different schemes, namely, adulterating ingredients, using cheaper or inferior quality substitutes, and mislabeling those ingredients ("… *say it is an organic product without being organic*", P21), to keep or reduce their food prices.

Table 4
Frequency of mention of the dimensions and major categories identified when participants were asked to write down the first three words that came to their minds when thinking of food fraud and results from chi-square regarding sex, age, and education

Dimension	Major category (≥5% respondents)	Number of Mentions						
		Sex (n = 631 valid)		Age (n = 634 valid)			Education (n = 631 valid)	
		Women	Men	18–34	35–55	55+	Without higher education	With higher education
Perception of food fraud	Deception	93	91	47	74	64	66	118
	Morally damnable	47	34	26	26	29	31	50
Food fraud impacts	Market Impact	44	38	27	32	23	28	54
	Health impact	26	26	15	23	15	12	40
Food quality and safety	Food safety	38	37	13	42	20	15 (−) *	60 (+) *
Types of fraud	Adulterations	27	20	7	23	17	13	34
	Mislabeling	35	23	16	32	11	14	44
Lack of connection with the concept	Others	34	22	18	22	16	27(+) *	29(−) *

Effect of the chi-square test per cell: (+) or (–) indicate that the observed value is higher or lower than the expected theoretical values according to the chi-square test, * $p < 0.050$.

Table 5
Characterization of interview participants (n = 36)

Characteristics	Total frequency	Relative frequency	Previous exposure to food fraud	
			Exposed (n = 15)	Nonexposed (n = 21)
Sex				
Male	18	50.0%	7	11
Female	18	50.0%	8	10
Age group (years old)				
18–34	12	33.3%	3	9
35–54	12	33.3%	7	5
55+	12	33.3%	4	8
Average ± SD: 43.5 ± 13.9				
Occupational status				
Employed	29	80.6%	13	16
Student	5	13.8%	1	4
Retired	1	2.8%	0	1
Other (Housewife)	1	2.8%	1	0
Marital status				
Single	10	27.8%	2	8
Married/ living as married	21	58.3%	12	9
Separated/divorced/widow	5	13.8%	1	4
Highest level of respondent education				
Without higher education	18	50.0%	8	10
With higher education	18	50.0%	7	11
Household size (including self)				
1	1	2.8%	1	0
2	6	16.7%	2	4
3	13	36.1%	3	10
4 +	16	44.4%	9	7

These practices may result in different consumer fraud concerns. Following the exploratory findings achieved in the FWA task, one of the impacts was particularly debated among 35 of our 36 participants: the fact that food fraud can be a threat to public health with immediate and direct effects (*"a person who is allergic to gluten*", P26), or long-term health impact associated with the effect of prolonged exposure: *"effects in the organism (…) carcinogenic or even metabolic"* (P15). Regarding the debate about the economic impacts of food fraud, the discourse of our participants was categorized in terms of macro (n = 16) and microeconomic (n = 26) consequences. As achieved in the FWA task, interviewed participants perceive food fraud, at the national level, as a significant threat that damages the country's economic reputation and exports. Furthermore, participants point out unfair trading practices that lead to a deregulated market due to unfair competition, as well as the consequences related to the escape from legal obligations. At the firm level, participants perceive food companies as suffering business interruption and sales losses due to damage to brand/traditional food reputation. Moreover, participants (n = 13/36) revealed concerns related to ethical and moral issues and asymmetries in the provision of information from buyers to consumers: "… *it is a matter of ethics (…) we are concerned with knowing what we buy, with knowing what we eat"* (P13).

Expression of food fraud: food fraud susceptibility regarding food categories and food chain stages, reporting of food fraud in media, food fraud geographical location. The topic "Expression of food fraud" deserved great reflections from all participants, with 747 references produced during the interviews (the most relevant topic as depicted in Fig. 2). When asked directly to report the food categories most susceptible to fraudulent practices, participants referred to: "Products of animal origin for human consumption" (n = 23), and "Products of plant origin for human consumption" (n = 14), followed by "convenience goods" (n = 10), among others (Fig. 3).

Concerning the stage of the food chain, participants reported that most food fraud cases occurred closest to the consumers, at the food

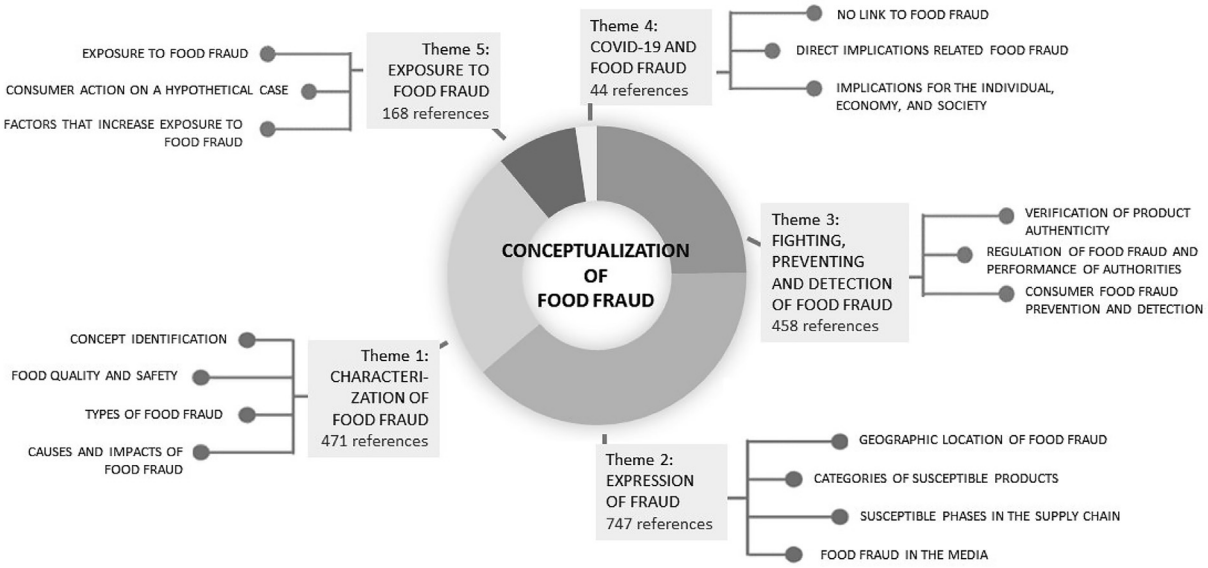

Figure 2. Thematic map of consumers' perceptions about food fraud (n = 36).

Table 6
Forms of adulterations reported by participants (n = 15)

Forms of adulterations	Example of quotations
Substitution	"*… advertise that you are selling octopus…and have a squid*" (P27)
Dilution	"*… the milk producers…That add water [to milk]*" (P28)
Concealment	"*… change the flavours of the products (…) the illusion that products are safe to use*" (P10)
Unapproved enhancement	"*… put stuff inside the wine (…) when it reached the consumer, he would not believe that the wine did not have the best quality*" (P34)

service and physical and online retail facilities, rather than in the primary production and food industry (Fig. 4). For our participants, in the food service stage, consumers are in contact with cooking/prepared products that may have been tampered with within the process (adulterations). They also referred that some meal components are not in the original food packaging, leaving them in the hands of the information provided by the waiter: *"in restaurants, they can say goat and then it is not … say organic "alheira" and, it is a traditional "alheira"* [typical Portuguese sausage] (P1)*"*.

Most participants believe food fraud is widespread worldwide, with continents like Africa, Asia, and South America being most affected. A lack of control measures in less developed countries often weakens food hazard protection (Visciano & Schirone, 2021). In the EU, consumers believe Portugal and other EU member states have similar food fraud cases due to the same regulations and laws (n = 28).

Curiously, only fourteen of our interviewed participants (38%) reported specific cases of food fraud when asked to identify cases reported in the media. In this context, the majority mentioned the horse meat in ground beef and specific insignias involved in the scandal, the melamine addition to infant milk and other dairy products in China, the refined oil added to extra virgin olive oil in Spain, and recent seizures of goods developed by Portuguese authorities.

Fighting, preventing, and detection of food fraud. The participants referred to two main actors when debating different measures

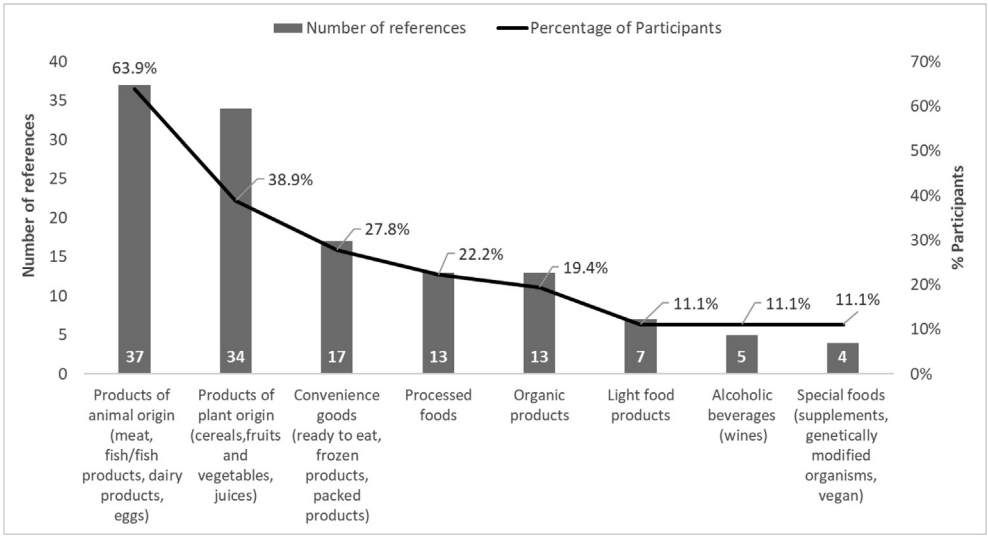

Figure 3. Food categories considered as more vulnerable to food fraud, expressed in the percentage of participants and number of references produced.

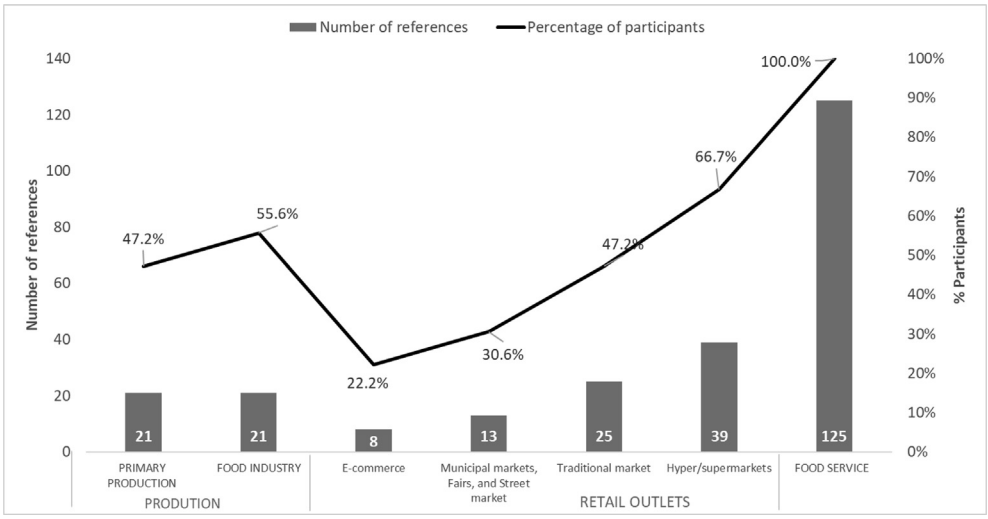

Figure 4. Stages of the food chain considered as more vulnerable to food fraud, expressed in the percentage of participants and number of references produced.

to combat and prevent food fraud incidents: i) official control authorities and ii) consumers. Participants trust and consider relevant the work developed by official control authorities, such as ASAE (*Autoridade de Segurança Alimentar e Económica*) – the Portuguese Food Safety Authority, in identifying, preventing, and combating food fraud. However, participants also demand additional control and inspection actions. According to them, not all legislation is complied with, and the frequency of inspections is not sufficient to protect consumers against fraudulent practices due to the lack of resources faced by official control authorities: *"I trust the work, I distrust the total effectiveness due to lack of resources"* (P5). In a more minor extension, participants (n = 5) also demand a more pedagogical and less sanctioning action of Portuguese authorities toward FBOs: "*ASAE, act and apply the fine. I often ask what was done before? To prevent that situation from happening?"* (P32). Also, with a minor expression, participants referred to the need for actions and awareness campaigns about food fraud aimed at consumers (n = 9), as all citizens should be informed and trained on food safety issues, correct food labeling, and be aware of situations in which they can be deceived (Visciano & Schirone, 2021).

Regarding the role of the consumers in combating and preventing food fraud incidents, most participants (n = 30) reported different preventive tactics to be implemented by consumers (Table 7).

Nevertheless, five participants revealed that consumers have no responsibility to prevent and fight food fraud, considering that the authorities oversee the food system, ensuring the absence of food fraud.

Exposure to food fraud. The interviewees were asked if they had experienced any previous exposure to food fraud. As registered in the FWA task, most believed they were not exposed to food fraud (n = 21). Among the participants reporting being exposed to food fraud (n = 15), only six participants could identify a real case that had happened to them. Four participants identified cases that happened to relatives. In both cases, consumers stated that they had rejected the product (did not consume the product), and some of them (n = 5) said that they made a complaint and returned the product to the place of purchase, supporting the tactics to prevent and fight against food fraud described in Table 7. Specifically, concerning the report to the authorities, the performance of the consumer in the face of the exposure of a case of food fraud is dependent on their perception of the incident severity: "*If it was a meaningless situation, I let it go, if it were a more serious situation of illness, I would report it to the authorities*" (P28).

Participants also identified factors increasing the chance of exposure to food fraud, including consumer difficulty in recognizing

Table 7
Tactics reported by participants to be implemented by consumers to prevent and fight against food fraud

Tactics	Number of participants who reported the strategy	Example of quotations
Search for authenticity		*"I have more confidence in these products"* (P31)
Certification (DPO/PGI)	31	*"I always try to buy Portuguese products* (P20)
Origin	26	"*I am not a consumer if the products come from China*" (P28)
Reporting food fraud: Complaint and peers/family communication	20	*"R… report it to the competent authorities"* (P25) "*Draw attention at the point of purchase when something is not correct"* (P16)
Search for Information	15	*"… more information, look for information when we do not have it"* (P32)
Do not buy dubious products	9	"*Avoid buying products that are not properly referenced*" (P2)
Buy products that offer confidence	6	*"Selecting credible brands/suppliers"* (P7)

adulterated products when buying or during home food preparation (n = 25). In this context, participants also discussed the role of food trends and marketing (n = 12), as rising food demand leads less scrupulous FBOs to make false claims to stay competitive.

Regardless of the strategies suggested by our participants to prevent food fraud, it is quite remarkable that most interviewees (n = 22) stated that in their daily lives, they do not engage in practices to reduce exposure to food fraud.

COVID-19 pandemic and food fraud. When asked participants about the impact of the COVID-19 pandemic, two-thirds of them (n = 24) considered that it had increased the risk of food fraud. At the same time, one-third (n = 12) did not establish any connection between food fraud and the COVID-19 pandemic, but it should be noted that the interviews were conducted during May 2021, when some contingency measures were taken. According to our participants, several factors during the COVID-19 pandemic led to increased risk of food fraud, as the increased food demand at retailing settings contributed to shortages of foods, providing opportunities for fraudsters to forge their illicit goods into supply chains authenticity: "… *they*

no longer had retail sales (…) leading to some carelessness in terms of storage and shelf life", P32. Moreover, according to the participants, with the COVID-19 pandemic, there was a suspension of food inspections and audits resulting from the lockdown, working from home, self-isolation, and hospitalization. Additionally, the boost in online food shopping could also lead to an increase in food fraud risks, as reported by this participant: "*I made online purchases, and I feel that the origin is further away from me"* (P8).

Analyses between the themes and characteristics of participants. Statistically significant differences ($p < 0.05$) were observed between categories of exposition and the mean number of references on the theme "Characterization of food fraud", according to the Mann-Whitney test. The mean of references in consumers who reported exposure to food fraud is higher than the nonexposed group, which seems to indicate that the previously exposed group can better explain what food fraud is. These differences were significant ($p < 0.050$), specifically in subthemes on "Food quality and safety" and "Causes and impacts of food fraud", as provided in Table 8. In the remaining four themes, no differences existed between the number of references and previous exposition to food fraud.

Table 8
Mean number of references produced by food fraud themes, according to previous exposure to food fraud

	Previous exposure to food fraud Mean ± S. D.		p-value[a]
	Exposed (n = 15)	Nonexposed (n = 21)	
Characterization of food fraud	11.0 ± 2.6	8.9 ± 2.5	**0.013***
Concept identification of food fraud	2.7 ± 1.3	2.4 ± 1.1	0.465
Food quality and safety	1.4 ± 1.4	0.2 ± 0.4	**0.004***
Types of food fraud	2.2 ± 1.4	1.8 ± 1.7	0.141
Causes and impacts of food fraud	6.7 ± 1.8	5.5 ± 1.5	**0.011***
Expression of food fraud	12.7 ± 2.6	13.2 ± 3.5	0.874
Geographic location of food fraud	3.9 ± 1.3	4.2 ± 1.1	0.485
Categories of susceptible products	2.3 ± 1.3	2.5 ± 1.6	0.874
Susceptible phases in the supply chain	5.4 ± 1.7	5.4 ± 1.9	0.727
Food fraud in the media	1.1 ± 0.9	1.6 ± 1.2	0.294
Fighting, preventing and detection of food fraud	11.7 ± 3.4	11.0 ± 3.5	0.391
Verification of product authenticity	3.5 ± 0.5	3.6 ± 0.9	0.800
Regulation of food fraud and performance of authorities	5.0 ± 2.6	4.7 ± 2.4	0.634
Food Fraud Prevention and detection by consumer	3.5 ± 1.9	3.1 ± 1.6	0.704
Exposure to food fraud			
Exposure to food fraud	1.1 ± 0.4	1.1 ± 0.7	0.949
Factors that maximize exposure	2.0 ± 1.8	1.9 ± 1.9	0.751
COVID-19 and food fraud	1.1 ± 0.3	1.2 ± 0.6	0.924

[a]from the Mann-Whitney U Test.
* Statistical results for $p < 0.050$.

Discussion

The findings of this research emphasize that the meaning attributed by Portuguese consumers to food fraud is deceiving purchasers and gaining undue advantage therefrom, which aligns with the experts' views (Robson et al., 2021).

Mislabeling and adulterations were the most important types of food fraud reported by consumers. As consumers' demand for healthy and safer foods has increased in recent years, food labeling has gained enormous importance (Aung & Chang, 2014). For perishable food products, Portuguese consumers pay attention to food labeling, specifically the expiration date (Gonçalves et al., 2023). This study supports this result since the second most frequently used word was "Expiration date" on FWA and mislabeling the most reported type of food fraud. According to Moreira et al. (2021) study, only about half of consumers stated that the information displayed on food labels is trustworthy, and over 55% declared distrust in the information provided by food manufacturers regarding food composition, representing food fraud as a parallel problem to food labeling. The Special Eurobarometer on Food Safety also shows that European consumers are concerned about contaminants, quality and shelf-life, and additives (European Union, 2022). This suggests that participants evoked different "Types of food fraud" according to their daily food choices and consumption experience. In FWA and interviews, few consumers referred to counterfeiting, concealment, the grey market, and dilution. This may mean that not all consumers are aware of the different forms of food fraud occurrence. A recent study in Serbia and Montenegro reinforces that consumers are less aware of some forms of food fraud, namely grey market, counterfeiting, and concealment (Djekic & Smigic, 2023).

Consumers also identify the food product categories perceived as most susceptible to fraud. The categories directly reported by interviewed consumers as the highest risk for food fraud incidents were meat, fish/fish products, dairy products, fruits and vegetables, juices, and cereals. Following Köster's (2009) insights, in the interview task, participants reported their food fraud experience based on what they remembered from past food purchases/consumption (Köster, 2009). Those products are the most consumed in the Portuguese diet (Lopes et al., 2017). The FWA analysis adds other information, as consumers are exposed to fewer constraints than typically imposed in interviews (structured questions). From these, the top five elicited products were all processed foods. Processed/packaged foods are more likely subject to food fraud than unpackaged, fresh foods, substituting or adding ingredients without disclosing the information to the manufacturer or consumer (PwC, 2016; van Ruth et al., 2017). Interestingly, both in interviews and in FWA, other categories, such as olive oil, honey, coffee, tea, and spices, have been identified in official EU reports (European Union, 2021, 2023) as being vulnerable to food fraud, and are widely used in Portuguese national cuisine (Lopes et al., 2017), were not mentioned by the participants. This could be explained by the fact that participants were not aware of these products as being more susceptible to food fraud. On the other hand, Portuguese tend to show more confidence in less-processed products than in those subjected to more industrial processing. Indeed, olive oil has been considered one of the foodstuffs that generates more confidence among Portuguese consumers (Moreira et al., 2021).

Consumers also discussed the economic and health impacts of food fraud, as described in several studies, understanding fraud as a macro and microeconomic threat to the functioning of the market and fair competition, as well as a threat to health, immediate or long term (Davidson et al., 2017; Elliott, 2014; Gossner et al., 2009; Moyer et al., 2017; Visciano & Schirone, 2021).

Associated with the most susceptible phases in the supply chain, most of the consumers highlighted sectors where they are an integral part of the business transaction as having direct contact with the buyer: food services and retailing (supermarket/ hypermarkets). According to Van Ruth et al. (2020), casual dining restaurants appeared most vulnerable to food fraud, followed by fine dining restaurants (Pardo et al., 2016; van Ruth et al., 2020). Furthermore, Portuguese consumers identify farmers (87%) and national official authorities (86%) as trustworthy sources of information on food risks, comparatively to 74% and 66% of EU-27 consumers (EFSA, 2019). As this study states, most consumers reported trust in national authorities on food fraud control.

To prevent and fight against food fraud, consumers reported different preventive tactics, like previous studies that also looked at the use of heuristic tactics in consumer purchase decisions to avoid food fraud, namely product avoidance, brand switching, or authenticity cues based on credence attributes like product certification, packaging, or labeling (Agnoli et al., 2016; Barnett et al., 2016; Kendall et al.,

2019). Heuristic tactics can help consumers navigate food purchasing uncertainty as they must make choices amid asymmetric information and the complexity of the globalized and industrialized food system (Davidson et al., 2017; Esteki et al., 2019; Moyer et al., 2017).

Previous exposure to food fraud appears to impact the characterization of fraud, given that both in the FWA and in the interviews, the number of mentions and references produced is greater in the exposed consumer groups ($p < 0.050$). Those victims of food fraud could better characterize what it is. Nevertheless, most participants believe they have never been victims of food fraud, suggesting a potential distancing from the concept (70.6% on FWA and 58.3% on interviews). Consumers often underestimate their risk exposure due to optimistic bias. However, more alarmed consumers estimate that certain food products are fraudulent.

Despite the questionnaire sample size and the effort to recruit participants with a meaningful sociodemographic diversity, the sampling approach did not follow a probabilistic design, meaning that care should be taken if extrapolating for the whole Portuguese population, specifically regarding the significant differences found in the characteristics of sex, age and education, and dimensions of food fraud. This study provides contributions to the EU for a definition of food fraud. An official EU definition of food fraud would allow for more efficient legislation enforcement and, consequently, better control by authorities. This definition should include references to deceptive and morally reprehensible acts, health, and economic impacts, and how food fraud can occur. This study also provides insights for quantitative research on consumer perceptions and beliefs about food fraud to further explore vulnerable food categories and types of food fraud in real-world scenarios. It is also essential to clarify how other parties involved in the food supply chain perceive food fraud, including the FBO, as the different stakeholders are interconnected along the food system. This may allow for a broader understanding of stakeholders' perceptions regarding food fraud and its fight. The use of combined methods allows us to deeply understand food fraud through a combination of the strengths of both types of methods. While qualitative methods provide a deep understanding of the subject, exploring the diversity and complexity, quantitative data can help confirm trends identified in qualitative analysis and allow to generalize (Coe et al., 2017).

Conclusion

Portuguese consumers perceive food fraud as an act of deception and morally damnable and seem aware of the causes and impacts of food fraud. They proposed measures to ensure the authenticity of food products and fight food fraud, namely the intensification of control and inspection by official authorities and informative actions next to FBO and consumers. They also suggested a set of practical consumer heuristics tactics to prevent food fraud, namely, searching for authenticity, reporting food fraud, searching for information, buying products that offer confidence, and avoiding dubious products. Despite this food fraud awareness, most consumers believed that they were not exposed to food fraud and stated that they do not conduct practices to reduce exposure to food fraud in their daily lives. The study also found that previous exposure to food fraud and sociodemographic characteristics influence consumer perceptions of food fraud. Consumers with higher education and self-reported exposure to food fraud seem to characterize food fraud within the scope of its conceptualization in the EU.

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CRediT authorship contribution statement

Maria João Costa: Writing – original draft, Investigation, Formal analysis. **Isabel Sousa:** Writing – original draft, Investigation, Formal analysis. **Ana Pinto Moura:** Writing – review & editing, Writing – original draft, Supervision, Formal analysis, Conceptualization. **José A. Teixeira:** Writing – review & editing, Supervision. **Luís Miguel Cunha:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jfp.2024.100301.

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