

## CONSUMERS' PURCHASING HABITS AND FOOD POISONING RISK - A PORTUGUESE SURVEY

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### Abstract

In the Western countries, despite tight food safety legislation, food poisoning episodes are still quite frequent. According to the European legislation, it is mandatory for all European member states the annual reporting of information on food-borne outbreaks. In Portugal, the National Institute of Health (INSA) notifies each year the European Food Safety Authority (EFSA) about the data of the foodborne outbreaks occurred in Portugal, namely information about the pathogenic microorganism responsible, the food products involved and the places where the contamination or consumption have occurred. The aim of this research was to evaluate the Portuguese consumer knowledge about food products commonly responsible for poisoning outbreaks, and which pathogenic microorganisms are most associated to those food poisoning episodes.

In 2017, the Department of Food and Nutrition (DAN) of INSA, carried out laboratory research on 18 outbreaks of food-borne infections that occurred in Portugal which caused 323 cases of illness and involved 145 hospitalizations, with no deaths being reported. Also, we were collecting information through a questionnaire, which was disclosed in the google forms online platform.

Ethical issues were respected in the design and application of the questionnaire, and validated by the CERNAS Research Centre. The questionnaire was approved by the Ethics Committee at the Polytechnic Institute of Viseu, in June 2021 with reference 52/SUB/2021. The data was collected between June of 2021 and January of 2022, involving 350 adult participants that voluntarily answered the questionnaire. Data analysis was made using Excel.

In the EFSA report of 2017, a total of 5,079 foodborne outbreaks were reported. In these events, *Salmonella* spp. was the commonest detected agent, causing one out of seven outbreaks. Also, *Salmonella* spp. in eggs and in meat and meat products were identified as the highest risk agent/food pairs. Concerning the place where the food was prepared or consumed, 75% were in public places (institutions, residential, canteens, school bars, schools, colleges, kindergartens, day-care centers, restaurants, hospitals, and nursing homes) and 25% at home, i.e. all the patients involved belonged to the same household. The major foodborne pathogens, associated food vehicles, include: *Escherichia coli*, *Listeria monocytogenes*, *Salmonella typhimurium*, and *Staphylococcus aureus*. *Listeria monocytogenes* is able to grow at temperatures approaching 0 °C, and is responsible for outbreaks of listeriosis often associated to the consumption of ready to eat meat, dairy and fishery products.

The results show that consumers are quite well informed about food contamination by pathogenic microorganism. They consider products like eggs, meat, and dairy products, as having the greatest risk to the health of consumers and identify the salmonella as the microorganism most associated to those contamination.

**Key words:** Food poisoning, Pathogenic microorganisms, Chilled food, Portuguese consumer attitudes, Survey.

### 1. Introduction

According to the European legislation, Directive 2003/99/EC [1], it is mandatory for all European Member States the annual reporting of information on foodborne

outbreaks. This is important to provide information on the causative agents and food stuffs implicated in the outbreaks, as well as the circumstances, the events and the potential risk factors that may underlie the contamination of foodstuffs and the occurrence of the outbreaks, allowing the evaluation of trends and relevant origins [2]. In Portugal, the Alimentation and Nutrition Department (DAN) of National Institute of Health (INSA) notifies each year the European Food Safety Authority (EFSA) about the data of the foodborne outbreaks occurred in Portugal.

In the Western countries, including Portugal, despite tight food safety legislation, food poisoning episodes are quite frequent. In 2017, the DAN-INSA, carried out laboratory research on 18 outbreaks of food-borne infections that occurred in Portugal which caused 323 cases of illness and involved 145 hospitalisations, with no deaths being reported [2]. In the EFSA report of 2017 [3], a total of 5,079 foodborne outbreaks were reported. In these events, *Salmonella* spp. was the commonest detected agent, causing one out of seven outbreaks. Also, *Salmonella* spp. in eggs and in meat and meat products were identified as the highest risk agent/food pairs. Concerning the place where the food was prepared or consumed, 75% were in public places (institutions, residential, canteens, school bars, schools, colleges, kindergartens, day-care centres, restaurants, hospitals, nursing homes) and 25% at home, i.e. all the patients involved belonged to the same household [2].

The major foodborne pathogens include *Escherichia coli*, *Listeria monocytogenes*, *Salmonella typhimurium*, and *Staphylococcus aureus* [4, 5].

*Listeria monocytogenes* is able to grow at temperatures approaching 0 °C [6], and is responsible for outbreaks of listeriosis often associated to the consumption of ready to eat meat, dairy and fishery products [7, 8].

A cook-chill system is a food preservation technology in which foods are fully cooked, rapidly chilled, refrigerated for storage, and reheated before serving. This technology can produce high-quality foods, while preserving their nutritional and sensory properties. During storage, the temperature conditions should be controlled to maintain the final core temperature above the freezing point at range of 0 to 5 °C, which gives an extended shelf life. During the initial thermal treatment step and the controlled low-temperature storage occurs the destruction and inhibition of microorganisms, especially the pathogenic ones [9].

Post-packaging decontamination technologies aim to reduce or inactivate pathogens and spoilage microorganisms present on the surface of ready-to-eat meat products. Low temperature plasma, high-pressure

processing, pulsed electric fields, pulsed ultraviolet light and ultrasound are promising alternatives in this segment. However, the choice of the most appropriate approach for post packaging decontamination of cooked ready-to-eat meat products depends on the type of product [7].

Aligned to the European Directive 2003/99/EC, the objective of this study was to collect information, through a questionnaire, related to food poisoning, namely Portuguese consumer knowledge about the potential pathogenic microorganisms involved and food products implicated in food contamination / food poisoning outbreaks. Also, it was enquired about the responsibility of the stakeholders in the food chain regarding the food safety issues.

## 2. Materials and Methods

### 2.1 Survey and data analysis

The methodology used in the present study consisted in collecting information through a questionnaire, which was disclosed in the google forms online platform.

Ethical issues were respected in the design and application of the questionnaire, and validated by the CERNAS Research Centre. The questionnaire was approved by the Ethics Committee at the Polytechnic Institute of Viseu, in June 2021 with reference 52/SUB/2021.

The data was collected between June of 2021 and January of 2022, involving 350 adult participants that voluntarily answered the questionnaire.

The data analysis was made using Excel database and spreadsheet functionalities.

### 2.2 Sample characterization

The first group of question were devoted to collect sociodemographic information to support result correlation and some conclusions, and the results are presented in Figure 1.

Concerning the distribution by gender, 72.6% of the participants were female against 27.4% of males.

A great majority of the participants are in the young or middle age ranges, 56.3% are in the range age 41 - 60 years old, and 32% in the range 21 - 40 years old. Concerning the participants' education level, it was verified that 86.3% are at least university graduated.

Related to the present professional situation, it was verified that most of the participants have a permanent job (83.7%).

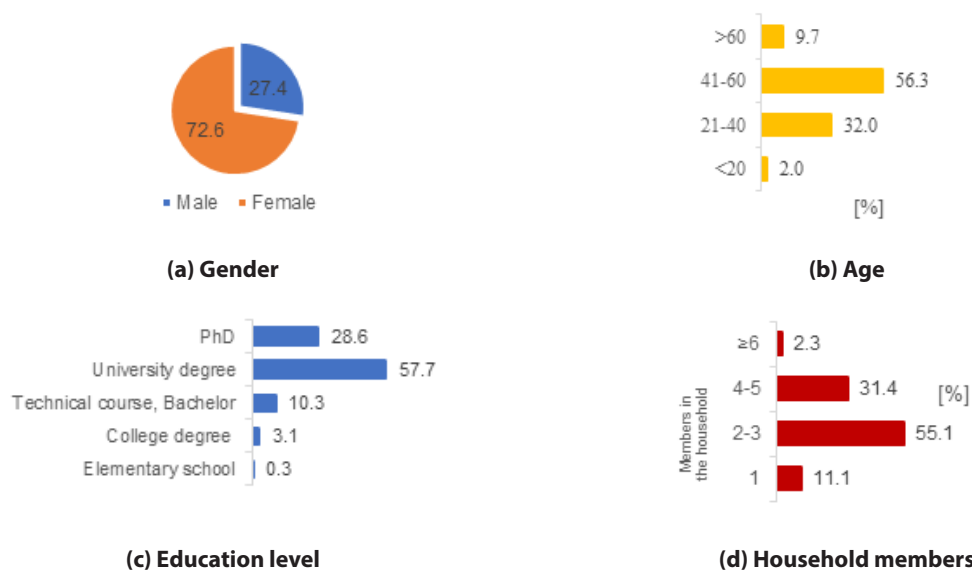


Figure 1. Sociodemographic Characterization of Participants distribution [%]

### 3. Results and Discussion

The questionnaire contained some questions about the characterization of the household and purchasing habits, the opinions about the food safety issues and the perceptions about the possible risks associated with certain types of foods, and the responsibility of the stakeholders along the food supply chain.

In what concerns the number of members in the household, 55.1% consist of 2 - 3 persons, and 31.4% have 4 - 5 persons, in 11.1% lived just one person, and a small percentage (2.3%) of households have six or more members.

In order to assess the participants' familiarity about issues related to food products or food issues, it was

asked about some uses or responsibilities about shopping, namely, if they were the person responsible for purchasing, preparing or serving food in their household. According to the results (Figure 2), most of the participants are those that most of the time are responsible for purchasing, preparing and serving food in their household, with 65.7%, 66% and 74.3%, respectively. Just a very small percentage of the participants admit not being responsible for these tasks.

The questionnaire also included some request to better characterize de households, based in a group of statements where the participants were asked to answer Yes or No, and the results are presented in Figure 3.



Figure 2. Participant's responsibilities in their household related with food

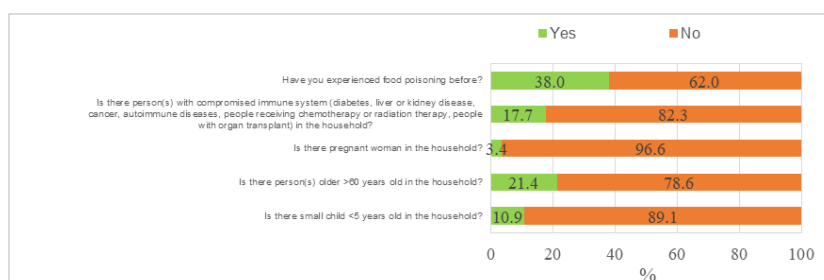


Figure 3. Some characteristic of the households

Even though most of the participants answered never having experienced a food poisoning episode (62%), a relevant percentage (38%) admitted to have had experienced foodborne intoxication.

In just 17.7% of the households there were persons with compromised immune system (diabetes, liver or kidney disease, cancer, autoimmune diseases, people receiving chemotherapy or radiation therapy, people with organ transplant). A small percentage of households (3.4%) actually included pregnant women.

According to Portuguese database [10], in 2020 the number of citizens living in Portugal with age of 60 years or over was almost 3 million (30% of the total of the Portuguese population). The same source refers those Portuguese citizens aged under five years reached 4.2%. The results for this study indicated that only in 21.4% of the homes lived persons older than 60 years old, and in just 10.9% of homes lived small children (< 5 years). In Portugal, a considerable number of citizens, normally older than 70 years old, live in social institutions such as resting homes for the elderly.

From the 350 participants in the survey, 133 admitted having experienced some kind of food poisoning

(38%). For these, a group of questions were proposed, and the results are shown in Figure 4. In this group of questions, the answer was optional and multiple selection was allowed, thus originating different responses frequency [N], as indicated for each of questions in Figure 4 (in straight brackets).

For the question about how long ago they had experienced food poisoning, 95 participants answered that the episode occurred more than a year ago, 28 didn't remember when it was, and a few admitted that was during the last year.

Concerning which food caused the poisoning, almost 57 answered "I don't know" or "I don't remember". 23 participants identified the eggs, and also 23 the fish and sea-food as the main responsible for poisoning. Just 14 participants identified the "meat" and 9 the "dairy" product as those cause the poisoning.

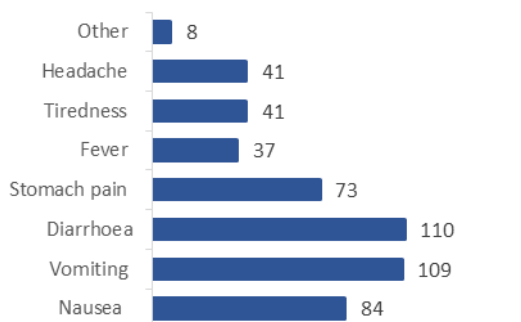
The participants were also inquired to select all the symptoms they have experienced during the food poisoning (Figure 4(c)). The symptoms more experienced were diarrhoea (110 answers) and vomiting (109 answers). Nausea and stomach pain were also frequent disease symptoms.



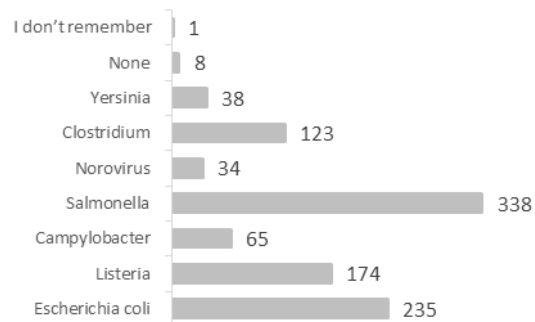
**(a) When have you experienced food poisoning?**  
[N = 132]



**(b) Which food caused the poisoning?**  
[N = 133]



**(c) Symptoms experienced**  
[N = 503, multiple answers were allowed]



**(d) Which bacteria that cause food poisoning have you heard of before**  
[N = 1015, multiple answers were allowed]

**Figure 4. Results of responses of those who admit have experienced food poisoning**

From a list available (Figure 4(d), it was also asked the participants to select the possible pathogen bacteria that they believe were responsible for the food disease. The bacteria (options) more frequently selected by respondents were: *Salmonella* spp. (n = 338), *Escherichia coli* (n = 235), *Listeria* spp. (n = 174) and *Clostridium* spp. (n = 123).

The participants were also asked about their knowledge about different foods associated to each pathogenic microorganism. Particularly, which food products they associate to the *Salmonella* spp. or *Listeria* spp. contamination. In these questions a multiple selection was allowed. According to the results (Figure 5), most of the respondents (n = 310) consider the salmonella contamination associated to eggs. Also, associated to salmonella contamination were identified the raw meat, fresh cheese and chicken for 137, 128 and 91 of the respondents, respectively. Just 10 of the respondents declared not knowing the foods associated to contamination by these bacteria.

Concerning the foods associated to the *Listeria* spp. contamination, a considerable number of the participants (n = 181) declared "I don't know" which foods are associated to these pathogenic bacteria. However, the food products more associated to *Listeria* contamination are: raw meat, fresh cheese and deli meats, for 103, 67 and 64 of the participants,

respectively. These results indicate that consumer's aren't so used to hear about *Listeria* spp. as they are about the *Salmonella* spp.

In fact, salmonellosis is recognised as one of the major foodborne infections. Most species of *Salmonella* spp. are pathogenic for humans, but the characteristics and severity of the diseases they cause are variable [11]. According to the Portuguese Food and Economic Safety Authority [11] the bacteria involved in foodborne diseases and the food products associated are: salmonella contamination in eggs (*Salmonella typhimurium*) and in chicken, duck and turkey (*Salmonella enteritidis*). Concerning the *Listeria* spp. contamination, the foods more frequent associated are: vegetables, meat, fish, cheeses, pasteurized milk and butter. Also, the pathogenic bacteria frequently found in meat products is *Clostridium botulinum*, namely in insufficiently cured meat or meat without conservatives, canned meat or vegetables. Other pathogenic bacteria frequently found in food products are: *Yersinia enterocolitica*, found in raw milk, poultry, meat, seafood, vegetables; and *Staphylococcus aureus* frequently found in meat, milk, eggs and derivatives.

Interestingly, the results reveal that the participants' perception or knowledge coincides with the data on the main microorganisms causing most food poisoning, and they also associate well the possible causative foods.

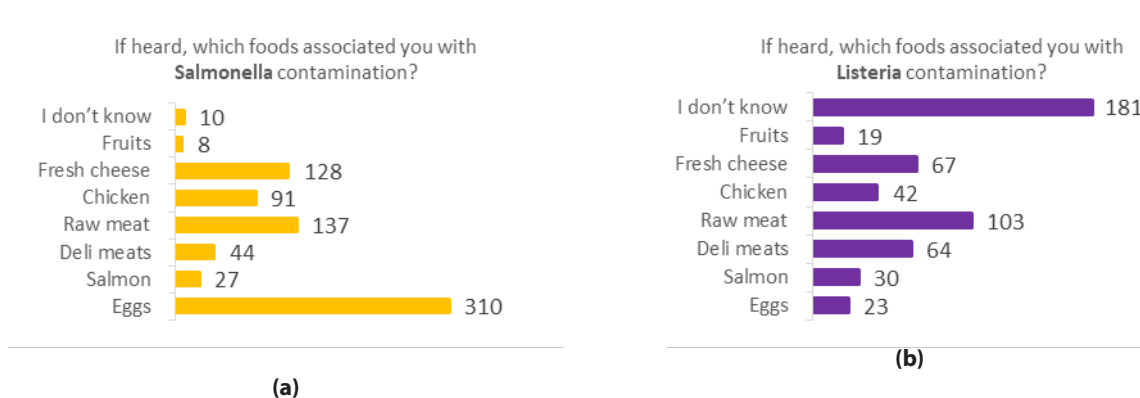


Figure 5. If heard, which foods associated you with: (a) *Salmonella* contamination [N = 755]; (b) *Listeria* contamination? [N = 529]. (Multiple selection was allowed)

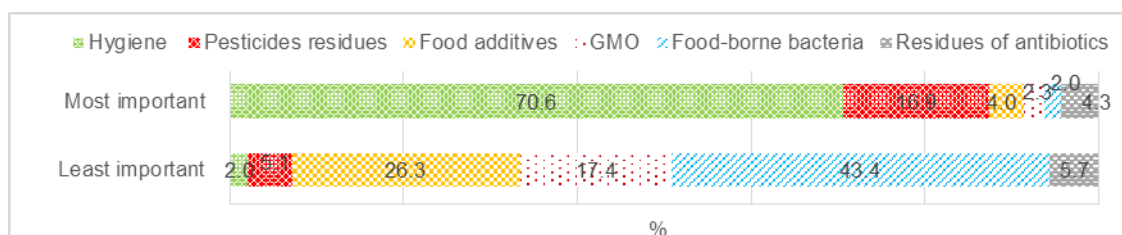


Figure 6. Results to the question: "In your opinion, what is the most and the least important thing for food safety?"

Among six possible issues or sources, the participants were asked to select “which one they consider the Most and the Least important to influence the food safety”. According to the results (Figure 6), the Most Important issue for food safety was the Hygiene (70.6%). On opposition, the issue selected as the Least Important was the Food-borne bacteria (43.4%).

Following the same previous methodology, among six different food types, the participants were asked to select that posing the “Greatest risk” and the “Smallest risk” to the health of the consumers. To this matter, Figure 7 shows that, almost with the same percentage, ‘Fruits and vegetables’ (46.6%) and ‘Cereals and cereals products’ (48.6%) were selected as those with the smallest risk to the health of the consumers.

As presenting the greatest risk to the health of the consumers, the respondents consider food products like: ‘Eggs and egg products’ (45.4%), ‘Meat and meat products’ (26.3%), and ‘Milk and dairy products’ (18.6%). These results reveal a good knowledge of the participants about the main food products that can be vehicles for food poisoning.

In the EFSA report about food-borne outbreaks in 2017 [3], *Salmonella* spp. was the commonest detected agent, and *Salmonella* spp. in eggs and in meat and meat products were the highest risk agent/food pairs.

The questionnaire results reveal that Portuguese consumers are quite well informed about the food products more susceptible to causing food poisoning. However, it must be taken into account that most of the

participants (86.3%) are at least university graduated. Finally, among different stakeholders in the food area, the participants were asked to select, in their opinion, who was the most and the least responsible for food safety. Figure 8 shows that, for the participants, the stakeholders most responsible for food safety are: Food industry (36%) and Inspections (32.3%). On the opposite, the stakeholders considered the least responsible for food safety are the Final consumers (51.7%). Primary producers were selected as the second food chain intervenient least responsible (16.9%) for food safety.

According EFSA [3], all the stakeholders in the food sector (as politicians, food operators, food handlers, consumers) are responsible for ensuring the safety, since food contamination can occur at different stages of the food chain and may include, among others, the following sources of contamination: (i) in primary production (animal feed that can then contaminate human food, milk, eggs, or other vegetables, etc.); (ii) During processing (food handlers can contaminate food); (iii) in kitchens (cross contamination through kitchen or utensils or by food handling). Also in the published report of (INSA) about Food-borne disease outbreaks laboratory investigation [2], it is reported that the inadequate heat treatment, time/temperature abuses and cross-contamination continue to be the main factors contributing to the occurrence of food-borne outbreaks. Concerning the pathogenic agent and/or toxins, these were identified in 50% of the outbreaks: four *botulinum* toxin type B, one *C. perfringens*, one *Salmonella enteritidis*, one *Listeria monocytogenes*, one *E. coli*, and one *Shigella sonnei*.

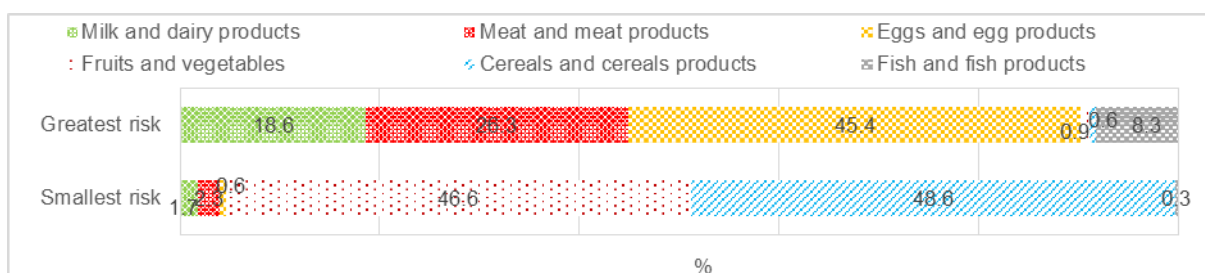


Figure 7. Results for the question “In your opinion, which type of food poses the greatest and the smallest risk to the health of consumers?”

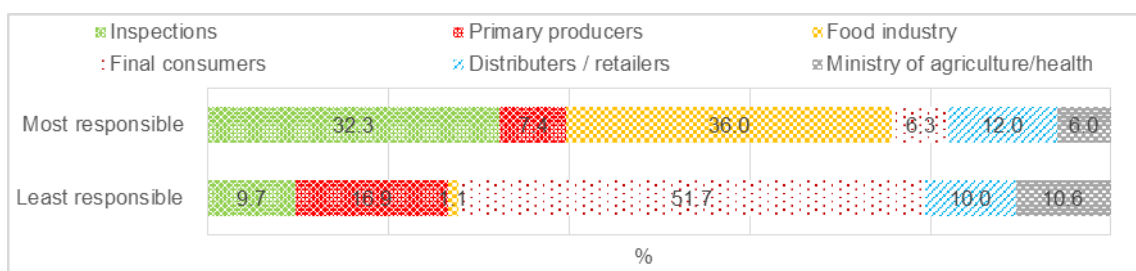


Figure 8. Results for the question “In your opinion, who is the most and the least responsible for food safety?”

*Listeria monocytogenes* can be found in various environments, so the food products can be contaminated in any of the various stages of processing and distribution [12].

#### 4. Conclusions

- This paper presents a survey questionnaire that intended to highlight the consumer positive food safety attitudes or procedures towards the minimization of eventual food poisoning episodes.

- Despite tight hygiene rules required by legislation, namely the appropriate hygienic systems applied by workers in food preparing places, or handlers on the retail sector, also the consumers must have knowledge about different routes of bacteria spreading, and contribute to the decrease of the risk of food contamination.

The results show that consumers are quite well informed about food contamination by pathogenic microorganism, and the food products more associated with food poisoning. However, we must remember that most of the participants in this survey are university graduated, and therefore the extrapolation of these results to the global population might not be possible.

- Participants seem to know (identify) the food products associated with bacterial contamination by salmonella, but are not so used to hear about *Listeria* contamination.

- Among different issues, the participants consider the Hygiene as the most important issue for food safety.

- Concerning to food products, participants consider products like eggs, meat and dairy products, as having the greatest risk to the health of consumers.

- They also consider that, among the different stakeholders (or players) on the food chain, the most responsible for food safety are the food industry sector and also the inspection authorities.

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