Research Article

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Consumers' attitudes toward refrigerated ready-to-eat meat and dairy foods

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Abstract: The constant variation of people's lifestyle has been linked to changes in people's eating habits. The consumption of ready-to-eat (RTE) food products, such as fresh vegetables, salads, dairy, pre-cooked meat, or pre-cooked meals, has increased in all western countries. This study aims at characterization of the Portuguese consumers' attitude toward chilled RTE meat and dairy foods consumption. The study was performed using a questionnaire survey disclosed through an internet platform. The sample consisted of 350 individuals, who voluntarily answered the questionnaire. The survey included questions to characterize the Portuguese purchase and food safety attitudes related to dairy and meat RTE food products. The questionnaire also included questions for the sociodemographic characterization of the sample involved. According to the results, it is not clear to the customers as which is the safer refrigerated RTE food selling format, pre-packed or foods on request. The participants consider refrigerated RTE dairy and meat food products safer when purchased at the delicatessen department in the supermarket than those purchased at open markets or bazaars. With respect to the customers' habits, they usually purchase RTE dairy or meat food products mainly from the supermarket, and in pre-packed format. Globally, the results reveal that Portuguese consumers are conscious and follow assertive attitudes toward food safety, contributing to maintain the refrigerated food chain, even when they take the product home.

Keywords: Portuguese consumer attitudes, food safety, ready-to-eat food, dairy products, pre-cooked meat, survey

1 Introduction

The modern lifestyle of metropolitan populations, characterized by a hectic life with less free time has also affected people's eating habits. The food consumption habits have also changed due to the family structure changes, such as the increasing number of single or living alone people, or simply because of comfort or convenience. To meet people's needs, the food industry is constantly developing a great variety of food products. The ready-to-eat (RTE) food products can generally be eaten directly, and their consumption has increased exponentially [1,2].

RTE foods include a great variety of products that do not require additional preparation (as heating) before being eaten by the consumer, such as salads and vegetables [2,3], fresh-cut fruits [4], cooked meat and poultry [5,6], smoked/salted meat and dairy [7,8], or smoked/salted seafood [9].

In recent years, the demand for RTE fast meals prepared by the food catering sector, outside the home, has increased worldwide. In parallel with this trend, food products from food preparation systems such as cooked-chilled and cooked-frozen foods have also increased [10].

The key requirements for minimally processed chilled food products are good quality (organoleptic and nutritional), microbiological safety, and easy preparation at the point of consumption [11–13].

The storage temperature of foodstuffs is a crucial parameter in controlling the hazard of bacterial development [14]. Cooked RTE meat products are subjected to contamination by spoilage microorganism such as lactic acid bacteria and pathogens such as *Listeria monocytogenes*. These microorganisms contaminate cooked RTE meat products after the cooking step and may further grow during shelf-life potentially leading to spoilage or foodborne diseases [15]. *L. monocytogenes* is relatively

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heat resistant compared with other non-spore forming pathogens [16].

Listeriosis is a sporadic foodborne disease but with a high fatality, affecting mainly pregnant women, children, and adults over 65 years old. RTE meat products are the major associated food vehicles responsible for human infections [5,6,8,15,17]. In 2015 listeriosis caused 270 deaths in the European Union member states, and food was the route of transmission in 99% of all human infection cases [17]. Rodrigues et al. [7] reported that the presence of *L. monocytogenes* is higher in meat processing establishments than in dairy industries. According to European Food Safety Authority and European Centre for Disease Prevention and Control (EFSA and ECDC) [18], the notification rate of human listeriosis further increased in 2017, despite *Listeria* seldom exceeding the EU food safety limit in RTE food. In Tsaloumi et al. [5], the authors present a quantitative model predicting the listeriosis risk related to the consumption of RTE cooked meat products sliced at retail stores in Greece. They found the highest number of cases was predicted for mortadella, smoked turkey, boiled turkey, and parizer, which were the most frequently consumed product categories in Greece.

Among spore-forming pathogens found in RTE dairy products, *Clostridium botulinum* is the most dangerous, while *Bacillus cereus* is the most frequent [19]. Sodium nitrite is widely used in cured meat products and has several technological functions such as inhibiting the growth of pathogens (*C. botulinum*), conferring sensory (color, taste, and odor) and antioxidant properties to meat products [15].

The reformulation of RTE meat products can be considered of vital importance to protect public health and ensure stable microbiological products during shelf-life [15].

Some technologies have been evaluated for application to control contamination of RTE meat products after cooking as microbial contaminants are also present in the air and surface of equipment and food handlers [16].

Traditionally heat treatment causes loss of quality and nutrient loss [20]. The new non-thermal technology processing, reduces or avoids heat loss and deterioration of sensory quality, to provide consumers with highest quality foods. Ultrasound technology is one of the emerging nonthermal technologies. Compared with traditional thermal processing, ultrasound technology can shorten processing time, save energy, and hardly causes thermal damage to raw materials, improving food quality and extending the shelf life [21,22].

RTE meat products such as sausages, hams, and cheeses have characteristics such as pH, aw, and sodium chloride content that favor the development of *L. monocytogenes* during their shelf life [7].

A considerable number of published studies are dedicated to RTE food products, most of them being related to fresh vegetables, peeled fruits, salads [2,23], soups, or cooked meals [24], but few studies are devoted to refrigerated dairy or pre-cooked meat RTE products. The present study intends to characterize the Portuguese consumer habits and food safety attitudes about refrigerated RTE food products, namely meat and dairy products, at both formats, pre-packed products (sold in the original packaging, packaged by the food producer) or delicatessen food products (cut and packed foods on request for each individual consumer). It also investigated the location where these products are purchased, namely delicatessen department in the supermarket or open market or bazaar.

2 Materials and methods

A questionnaire was elaborated to collect information about the purchase and consumption habits, and also food safety attitudes' pattern of refrigerated RTE dairy and meat products. This study is part of an International study carried out in different countries and refers to the data collected in Portugal.

The questionnaire was organized in three groups. The first group included questions to collect information to characterize the sample involved. The second group included questions to characterize the consumer attitudes toward food safety of chilled RTE foods, and the last group was devoted to collect information about purchase preferences or habits of chilled RTE food products.

The questionnaire survey was disclosed through an internet platform to Portuguese consumers, and the confidentiality of the answers obtained was guaranteed. 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 sample size of the study consisted of 350 participants that voluntarily answered the questionnaire, using the Google forms online platform, and the data were collected in the period between June 2021 and January of 2022 through an online survey from the Portuguese consumers.

3 Results and discussion

3.1 Sociodemographic characteristics of the participants in the study

The first group of questions was devoted to collect sociodemographic information to support any results correlation. The obtained results are presented in Table 1.

Concerning the distribution by gender, most of the participants were female (72.6%) against 27.4% male. A great majority of the participants were in the young or middle age range, 56.3% were in the range of 41–60 years old and 32.0% in the range of 21–40 years old. Regarding the participants education level, it was verified that 86.3% had at least a university graduation. Additionally, it was found that most of the participants had a permanent job (83.7%).

Table 1: Sociodemographic characterization of the sample ($N = 350$)

Characteristic	Class	Percentage
Gender	Female	72.6
	Male	27.4
Age (years)	<20	2.0
	21–40	32.0
	41–60	56.3
	>60	9.7
Education level	Elementary school	0.3
	College degree	3.1
	Technical course, Bachelor	10.3
	University degree	57.7
	PhD	28.6
Professional situation	Unemployed	11.4
	Seasonal job	4.9
	Permanent job	83.7
Members of the household	1	11.1
	2–3	55.1
	4–5	31.4
	≥6	2.3

With respect to the number of members in the household, 55.1% of the households consist of 2–3 people, 31.4% have 4–5 people, 11.1% lived alone, and just a small percentage (2.3%) of households had six or more members.

3.2 Attitudes toward food safety of chilled meat and dairy RTE food products

3.2.1 Knowledge and opinion about food safety of refrigerated meat and dairy RTE food products

The participants were inquired about some of their habits or responsibilities about shopping, namely, if they were the person responsible for purchasing, preparing, or serving food products in their household. According to the results (Figure 1), most of the inquired people were usually responsible for purchasing, preparing, and serving food in their household, with 65.7, 66.0, and 74.3%, respectively. Just a very small percentage of participants admitted not responsible for these tasks.

The participants were asked to indicate their agreement to different statements related to attitudes toward food safety of refrigerated RTE foods, expressed on a scale with 5 levels fixed at the extremes, with “strongly disagree” and “strongly agree.” Further information was released to the enquired, to clarify the meanings of prepacked products – products that are sold in stores/supermarket in the original packaging, packaged by the food producer; delicatessen products – are cut and packed on the spot for each individual consumer, and are sold at delicatessen department in the supermarket, specialized shops, open market, or open bazaar. The results are shown in Table 2.

Statement 1 aimed to identify the opinion of the respondents about which are the safer RTE dairy products (fresh cheese, soft cheese): the pre-packed or foods

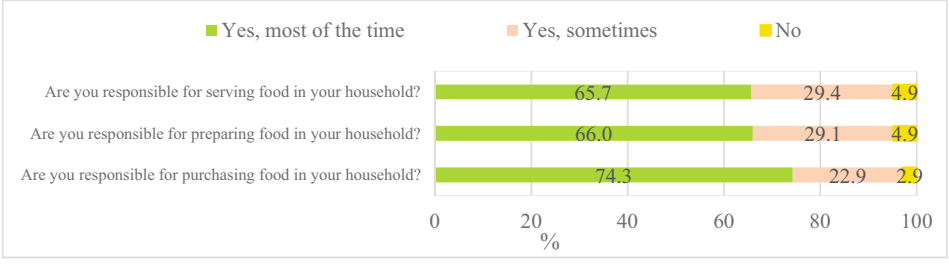

Figure 1: Participant’s responsibilities in their household related to food.

Table 2: Results of agreement level of expressions regarding attitudes or habits toward food safety of chilled RTE

	Attitudes toward food safety of refrigerated RTE foods	% answers				
		Strongly disagree	Disagree	No opinion	Agree	Strongly agree
1	Pre-packed RTE dairy products (fresh cheese, soft cheese) are safer than those on request	9.1	20.9	29.1	29.4	11.4
2	Pre-packed RTE meat products (ham, fermented meat products, dry meat products) are safer than those on request	9.1	24.0	31.7	23.7	11.4
3	Is safe to purchase on request RTE dairy products at the open market/open bazaar	7.7	33.1	30.3	23.4	5.4
4	Is safe to purchase on request RTE meat products at the open market/open bazaar	8.6	30.6	29.7	26.0	5.1
5	Is safe to purchase on request RTE dairy products at the delicatessen department in the supermarket	2.0	2.9	25.4	56.9	12.9
6	Is safe to purchase on request RTE meat products at the delicatessen department in the supermarket	2.0	2.6	23.7	58.6	13.1
7	It is important to check the expiration date of pre-packed RTE dairy and meat products, during purchasing	0.3	0.9	4.6	13.4	80.9
8	Pre-packed and on request RTE dairy and meat products have the same expiration date	30.0	31.4	24.0	6.6	8.0
9	I know the shelf-life and storage conditions of foods on request RTE dairy products from the open market/open bazaar	38.6	30.9	20.9	6.3	3.4
10	I know the shelf-life and storage conditions of foods on request RTE meat products from the open market/open bazaar	37.7	30.9	21.7	6.3	3.4
11	I know the shelf-life and storage conditions of foods on request RTE dairy products from the supermarket	20.6	20.9	31.1	20.3	7.1
12	I know the shelf-life and storage conditions of foods on request RTE meat products from the supermarket	19.7	22.6	30.0	20.6	7.1
13	It is important to store pre-packed RTE products according to storage instructions to ensure that it is safe to eat	0.0	0.0	6.9	24.3	68.9
14	Ensuring a refrigerator runs at ≤5°C is essential for maintaining the safety of RTE products	1.7	4.3	27.1	34.6	32.3
15	It is essential to store different types of RTE products on separate shelves in the refrigerator to avoid contamination	1.7	9.1	32.6	28.9	27.7
16	An unopened pre-packed sliced cooked ham, 2 days past its use-by date is still safe to eat	13.7	21.1	26.3	27.7	11.1
17	An opened pre-packed sliced cooked ham is safe to eat as long as it is within the use-by date	14.0	26.0	21.1	28.6	10.3
18	Foods on request sliced cooked ham from the supermarket delicatessen is only safe to eat for max. 2 days after purchase	7.4	24.3	36.9	24.3	7.1
19	Sliced cooked ham out of the refrigerator is safe to eat as long as they are eaten on the same day	25.4	27.7	25.1	15.4	6.3
20	I judge if RTE dairy products are safe to eat based on the smell, taste or appearance	13.1	22.0	29.4	29.4	6.0
21	I judge if RTE meat products are safe to eat based on the smell, taste or appearance	12.3	24.0	30.3	27.1	6.3
22	It is better to discard RTE dairy and meat after expiration date than to risk eating unsafe food	1.1	5.1	16.0	28.3	49.4

on request. The results are very dispersed across the different response options. This indicates that it is not consensual to the participants as which of these product formats are the safest. However, there is a small proportion of those who consider pre-packed safer than foods on request products, i.e., 29.4% agree against 20.9% disagree. This is also confirmed by the considerable percentage of the participants who selected the option "don't know" (29.1%). Similar results were obtained to statement 2, regarding the opinion about the safer meat products (ham, fermented meat products, and dry meat products), pre-packed or foods on request. In this case almost the same percentage of agree (23.7%) and disagree (24.0%) responses were obtained.

According to EFSA [25], most of the contamination by *L. monocytogenes* in RTE foods is connected with pre-packaged food products. Currently, the consumption of foods on request products (non-pre-packaged) as sliced meat products handled by employees in commercial retail establishments, such as supermarkets or delicatessen has increased. Usually, the pathogen contaminates the RTE products after processing during handling procedures such as cutting, slicing, or packaging [26]. In the case of pre-packed RTE foods, the contamination occurs during the manufacturing process while for retail packages, where the products are handled in retail establishments, the utensils used, the personnel, and the food service environment can lead to cross-contamination of the products handled at retail compared to the pre-packaged ones [27].

Generally, the practices in commercial retail facilitate more exposure for cross-contamination from one product to another. The retail environment is very different compared to food processing plants, given the exposure to public, deliveries of goods, and facility's employees. The possibility of cross-contamination of RTE products at the retail establishments may be the underlying cause for the higher contamination of the products [28].

Of great importance is the fact that the non-pre-packaged RTE cooked meat products are likely to offer a suitable environment for *L. monocytogenes* growth as well as the handling practices and the storage conditions on the consumer side which have the potential to have a negative impact on their safety [29].

In Djekic et al. [30], the authors present a multi-country survey on food safety and consumer patterns of food under COVID-19 pandemic, and the influence played by all stakeholders, referring that, for RTE meat and poultry products, staff awareness and hygiene are vital in controlling the contamination.

Statements 3–6 try to identify the opinions of the participants about the food safety issues concerning the place where they purchase RTE products. Regarding statement 3, if they "believe that is safe to purchase foods on request RTE dairy products at the open market/open bazaar," the results indicate that a greater percentage (33.1%) disagree, against 23.4% that agree. The same trend is verified in statement 4 related to the security of meat products purchased at the open market/open bazaar. However, there is a significant portion of participants that consider it safe to purchase RTE products at the open market/open bazaar (~30%, summing agree and strongly agree results). Finally, it was verified that about 30% of the participants did not have an opinion.

Concerning the opinion about food safety of foods on request RTE dairy products (statement 5) or meat products (statement 6) purchased at the delicatessen department in the supermarket, the results are the opposite to those in statements 3 and 4. Hence, most of the participants agree (~58%) or strongly agree (~13%) that it is safe to purchase foods on request RTE dairy and meat products at the delicatessen department in the supermarket. Only a small percentage (<5%) select disagree or strongly disagree.

The global results from statements 3–6 clearly indicate that participants consider RTE dairy and meat food products safer if purchased at the delicatessen department in the supermarket than those purchased at the open market/open bazaar. These results seem to be consistent. Although food safety laws and principles also apply to the open market/open bazaar sale activities, in supermarkets the safety principles are tighter. This seems to be in line with the perception of consumers.

Almost 95% of the participants consider that it is important to check the expiration date of pre-packed RTE dairy and meat products while purchasing (statement 7), with 80.9% strongly agree and 13.4% agree. The expiration date of a food product is a very important safety issue, even more in pre-packed RTE dairy and meat products. Most of the participants are not in accordance that "the expiration date of pre-packed and foods on request RTE dairy and meat products is the same" (statement 8). That is, 30.0% strongly disagree and 31.4% disagree. Also 24.0% of participants have no opinion. In principle, the participant's perception is correct, because, the package protects the product from microbiological contamination, or even has additional preservatives than foods on request.

A great majority of participants admit not knowing the shelf-life and storage conditions of foods on request RTE dairy products obtained from the open market/open bazaar. This is supported by 38.6% that select strongly disagree and 30.9% disagree to statement 9. Almost the

same results are observed for statement 10, related to the shelf-life and storage conditions of foods on request RTE meat products from the open market/open bazaar. To both statements 10 and 11 only 6.0% of the participants select the agree option. These results reveal a lack of confidence by the consumers, both in the shelf life and in compliance with minimum conservation food safety conditions in open market/open bazaar. These results are also in accordance to those obtained for statements 3 and 4.

A better, but not significant, consumer's knowledge is observed related to shelf-life and storage conditions of foods on request RTE purchased from the delicatessen department in the supermarket, both dairy products (statement 11) and meat products (statement 12). In these, around 27% select agree or strongly agree with the statements. However, a great majority of the participants seem to not know about the shelf-life and storage conditions of foods on request RTE from the delicatessen department in the supermarket. This is justified by the high percentage of participants that select the option: strongly disagree, disagree, or no opinion.

Concerning statement 13, almost all the participants agree or strongly agree that it is important to store pre-packed RTE products according to storage instructions to ensure that they are safe to eat.

Also, most of the consumers agree (34.6%) or strongly agree (32.3%) that "Ensuring that a refrigerator runs at ≤5°C is essential for maintaining the safety of RTE products," (statement 14). This reveals great consumer awareness of the need for refrigeration in RTE food preservation. In Gonçalves et al. [31] the authors also conclude that Portuguese customers are well-informed about food safety issues and seem to follow assertive attitudes when they purchase refrigerated food products. In Morelli et al. [14] the authors investigate the storage temperature of food products on sale in refrigerated display cabinets in bakeries, pork butcher's/delicatessens and cheese/dairy shops. According the criteria that foodstuffs must remain at temperatures below or equal to 7°C to avoid any hazardous bacterial growth, they found that 70% of time–temperature profiles were unsatisfactory.

The results to statement 15 "It is essential to store different types of RTE products on separate shelves in the refrigerator to avoid contamination" (56.6% are in accordance), revealing that consumers are well informed about good practices for storing food in refrigerators.

Concerning statement 16 "An unopened pre-packed sliced cooked ham, 2 days past its use-by date is still safe to eat," it seems like there is no definite trend in the responses. That is, 34.9% disapprove and 38.9% approve the statement. Also, 26.3% have no opinion. This means that a relevant percentage of consumers believe that it is safe to eat these products even 2 days after the date "safe to eat," at least if it is kept packaged (protected). Similar results are verified for statement 17, "An opened pre-packed sliced cooked ham is safe to eat as long as it is within the use-by date." This reveals that considerable percentage of consumers believe that it is safe to eat these products as long as they are within their period of validity.

The results show that almost the same percentage of participants agree (31.4%) and (31.7%) disagree with statement 18, "Foods on request sliced cooked ham from the supermarket delicatessen is only safe to eat for max. 2 days after purchase." A significant number of participants (36.9%) have no opinion.

The results for statements 16–18 seem to present an even distribution. In other words, there is no clear tendency to approve or disapprove the statements' meanings.

For statement 19 "Sliced cooked ham out of the refrigerator is safe to eat as long as they are eaten on the same day," the results indicate that most of the participants disapprove the statement's content. This indicates that participants consider the conservation by refrigeration more important than the time after it was purchased.

Some studies report the presence of *C. botulinum* bacteria in the minimal heat-processed meat products and its proliferation when stored at chilled temperature [32].

Concerning statements 20 and 21, "I judge if RTE dairy products and meat products are safe to eat based on the smell, taste, or appearance," the results do not show a definite trend of agreement or disagreement. So, the sensory issues of smell, taste, or appearance, seem to be important but not mandatory to consider these RTE products safe. However, to statement 22, for food safety reasons, most of the participants (77.7%) indicate that it "is better to discard RTE dairy and meat after expiration date than to risk eating unsafe food." Generally, the meat products suffer pre-treatments of conservation (cooking, dehydration, salting, etc.), which give them a longer shelf life than dairy products [7].

Taking into account that the sample is mostly constituted by university graduates and PhD people, additional data correlation was performed. Somewhat surprising, considering only the questionnaires of the 48 participants who are not University graduated or PhD, very close results were found (same trend) to those obtained for the total sample.

Also, although the majority of the participants were female, no particular correlation of results related to gender was observed.

3.2.2 Self-reported practices toward food safety of chilled RTE food products

The study also investigated the attitudes or practices toward food safety of chilled dairy and meat RTE products. For this propose a group of 15 statements were presented to the participants, who were asked to select an answer for frequency from a scale with five levels, starting at never and ending at always. Table 3 presents the results from the respondents' opinion about these statements related to self-reported practices/attitudes toward food safety of chilled RTE foods.

The results for statement 1 "When purchasing, I check the expiration date of pre-packed RTE dairy products (fresh cheese, white brined cheese, cream)," indicate that almost all consumers check the expiration date of these pre-packed RTE products, confirmed by selection of answers always (76.9%) or often (15.7%). Very similar results are found for meat RTE products (statement 2). The results for statements 3 and 4 indicate that consumers do not usually ask the seller at the open market/open bazaar as to how to safely store white brined or fresh cheese at home.

For statement 5, the results show that consumers tend to have a preventive attitude for food quality preservation, by contributing to the maintenance of the food cold chain, keeping the RTE dairy and meat products in the refrigerator immediately after buying them (70.6% always and 21.1% often). Nevertheless, dispersed results were observed for statement 6 "I regularly measure the temperature in my refrigerator at home." Hence, it can be deduced that most of respondents do not measure the temperature of the refrigerator. Perhaps the question is somewhat ambiguous, because the intended question was whether respondents checked or monitored the temperature, and not measure. This may have caused some misinterpretation of the question.

For statement 7, the results clearly indicate that most of the participants (57.4% – always and 24.9% – often) placed (store) the RTE meat and dairy products on separate shelves from fresh fruits/vegetables." Very similar results were observed for statements 8–11. Thus, a clear positive attitude (response) was obtained, namely: "Before eating, I analyze the expiration date of pre-packed RTE dairy and meat products," and "Before eating, I judge the safety of RTE dairy and meat products by appearance, taste, or smell." That means that very often the consumers verify the expiration date and appearance, taste, or smell of pre-packed RTE, before they consume them. Also, most consumers admit to discard the RTE dairy and meat products after they reach the expiry date (statements 12 and 13).

Concerning statements 14 (RTE dairy products) and 15 (RTE meat products), the majority of consumers select never (~60%) and rarely (~15%) to the use of RTE dairy and meat products after reaching the expiration date,

Table 3: Opinion of respondents about some statements related to self-reported practices toward food safety of chilled RTE foods (results in %)

	Statement	% answers				
		Never	Rarely	Some-times	Often	Always
1	I check the expiration date of pre-packed RTE dairy products	0.9	2.6	4.0	15.7	76.9
2	I check the expiration date of pre-packed RTE meat products	1.7	2.3	4.0	18.0	74.0
3	I ask the seller at the open market, how to safely store white brined cheese at home	38.6	18.9	19.4	12.0	11.1
4	I ask the seller at the open market, for how long I can safely store fresh cheese at home	40.5	18.1	19.2	10.5	11.7
5	I immediately put RTE dairy and meat products in the refrigerator	1.1	1.7	5.4	21.1	70.6
6	I regularly measure the temperature in my refrigerator at home	32.6	15.4	24.0	18.0	10.0
7	At home refrigerator, RTE meat and dairy products are placed on separate shelves from fresh fruits/vegetables	2.6	3.4	11.7	24.9	57.4
8	Before eating, I analyze the expiration date of pre-packed RTE dairy products	2.0	4.9	9.4	23.7	60.0
9	Before eating, I analyze expiration date of pre-packed RTE meat products	2.9	6.1	10.1	22.8	58.2
10	I judge the safety of RTE dairy products by appearance, taste, or smell	1.7	4.6	9.1	26.9	57.7
11	I judge the safety of RTE meat products by appearance, taste, or smell.	1.7	4.3	7.7	26.3	60.0
12	I discard RTE dairy products after its expiration date	2.9	9.4	21.7	24.9	41.1
13	I discard RTE meat products after its expiration date	1.7	8.9	16.9	27.1	45.4
14	When RTE dairy products expire, I use them to prepare cooked meals (cheese pies/corn pies)	57.7	12.9	16.6	9.1	3.7
15	When RTE meat products expire, I use them to prepare cooked meals (pizza/rolls)	61.1	14.9	14.3	6.3	3.4

even if it is to prepare cooked meals like cheese pies/corn pies, pizza/rolls.

Also, in this group of questions, a refined analysis of the results was made. Again, no special correlation was observed related to sociodemographic characteristics, such as educational level or gender.

3.3 Purchase and consumption habits of refrigerated meat and dairy RTE food products

It was also investigated the retail places where the participants purchase different dairy or meat RTE food products. The results (in %) are shown in Figure 2. In this group of questions, the respondents could select more than one option (even all).

Observing Figure 2, we may conclude that customers usually purchase RTE food products mostly in the supermarket. We may also observe that purchase in pre-packed format is more frequent, than in foods on request. We may observe that, just a small percentage of participants admit purchasing the listed RTE products in specialized shops (foods on request), and even less in open market (foods on request). Also relevant is that a considerable percentage of participants do not buy RTE sliced salmon or sliced fermented meat products. Understandable, is to verify that butter/cream is the RTE listed product most frequently purchased in pre-packed format (by 292 participants). The sliced cooked ham is the RTE product most purchased in supermarket delicatessen foods on request (by 156 respondents). In particular, regarding the "Sliced salmon," it was verified that participants purchase more frequently (n = 169) in supermarket (pre-packed), followed by the supermarket delicatessen in the form of foods on request (n = 43), but an expressive part do not usually buy this product (158 participants).

One other aspect investigated was related to the ways in which the participants consume the listed types of food products, the results are shown in Figure 3. In this group of questions, a multiple answer selection was allowed. Globally, we may observe that listed dairy or meat RTE products are more frequently consumed as "ingredient for salad or sandwich" (second set of bars – light cream), followed by "eaten as aperitif" (first set of bars – light blue).

The sliced salmon is the RTE product more consumed in salads or sandwiches (by 215 participants), and the sliced dried meat products are more commonly consumed in both, salads or sandwiches (n = 165) and eaten as aperitif (n = 163). The sliced cooked ham is more frequently consumed in salads or sandwiches (n = 245). This is also the main consumption format for RTE butter/cream (n = 190%) and fresh cheese/cream cheese (n = 212). The RTE products least consumed in all formats are sliced fermented meat products and sliced salmon) (not used by 208 and 173 participants, respectively). Finally, we may also conclude that the listed dairy or meat RTE products are not exclusively consumed in family fests (green set of bars in graph).

It further investigated as to how long the participants usually store the pre-packed food items in the refrigerator, even after they are opened. The results in Figure 4 reveal that fresh cheese/cream cheese (n = 171) and sliced salmon (n = 79) are the RTE products that most consumers store in the refrigerator for just 1–2 days after

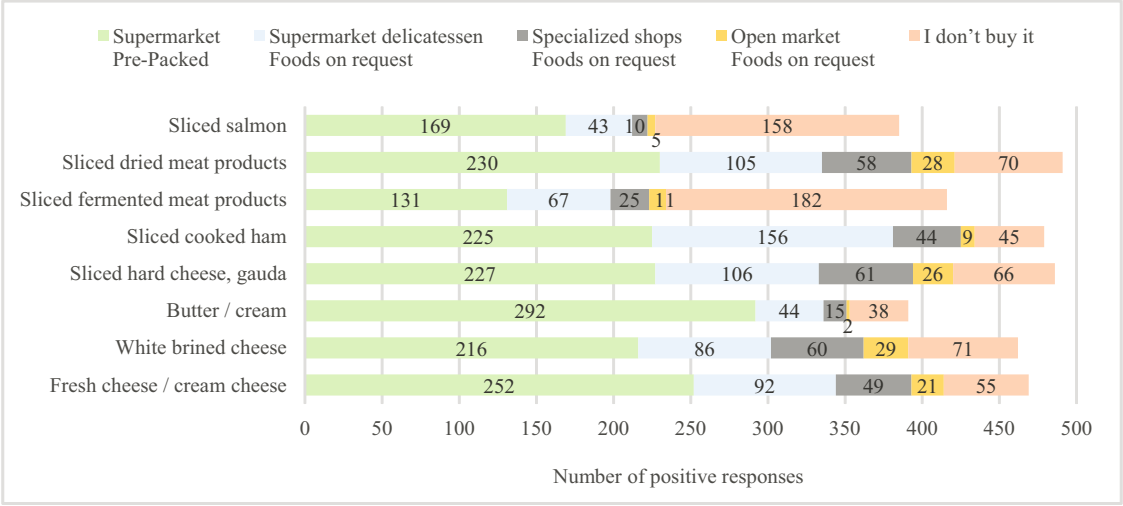

Figure 2: Places where the participants purchase RTE foods. (The respondents (N = 350) could select more than one option.).

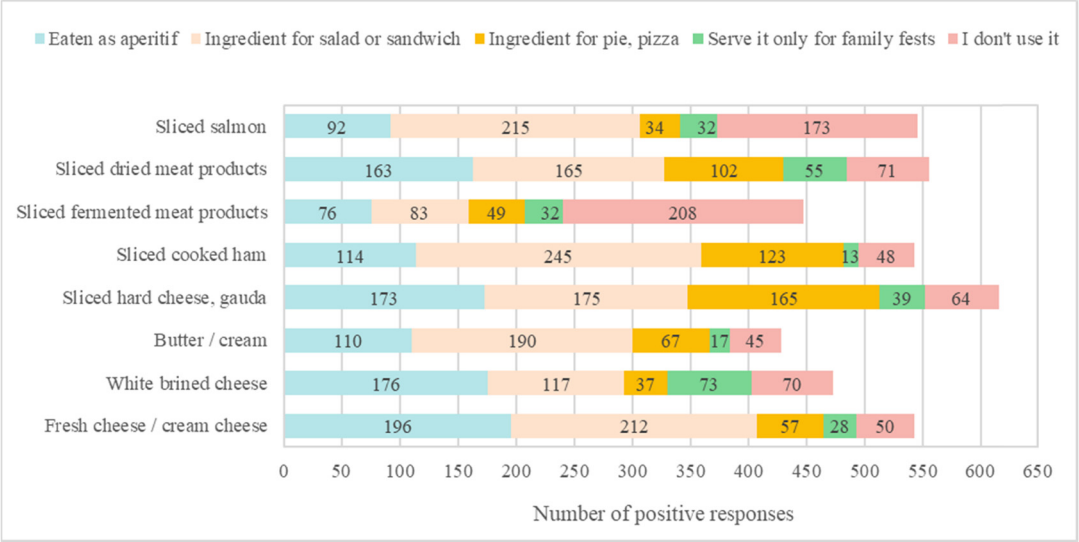

Figure 3: Results to the question "How do you consume RTE foods?" (The respondents (N = 350) could select more than one option.).

the package has been opened. So, we may conclude that they believe that those are the most perishable RTE products. The items that participants more frequently store in the refrigerator for 3–5 days (after the package is opened) are sliced cooked ham (for 1,852 participants) and fresh cheese/cream cheese (n = 110). The RTE opened pre-packed food that consumers usually store in the refrigerator for more than 5 days are butter/cream (n = 225), sliced hard cheese (n = 187), white brined cheese (n = 159), and sliced dried meat products n = 155). These seem to be correct attitude, since these are the products with a longer shelf life, either because they have a lower water activity, or contain preservatives or are pre-cooked. Just a very few of the enquired people admit storing in the refrigerator opened pre-packed food items, based on their organoleptic characteristic modifications such as taste, smell, or appearance. Furthermore, a significant percentage of participants declare that they do not buy sliced fermented meat products (n = 204) and sliced salmon (n = 175), because in Portugal these food items are not usually consumed, particularly fermented meats are not usually on sale in Portuguese markets.

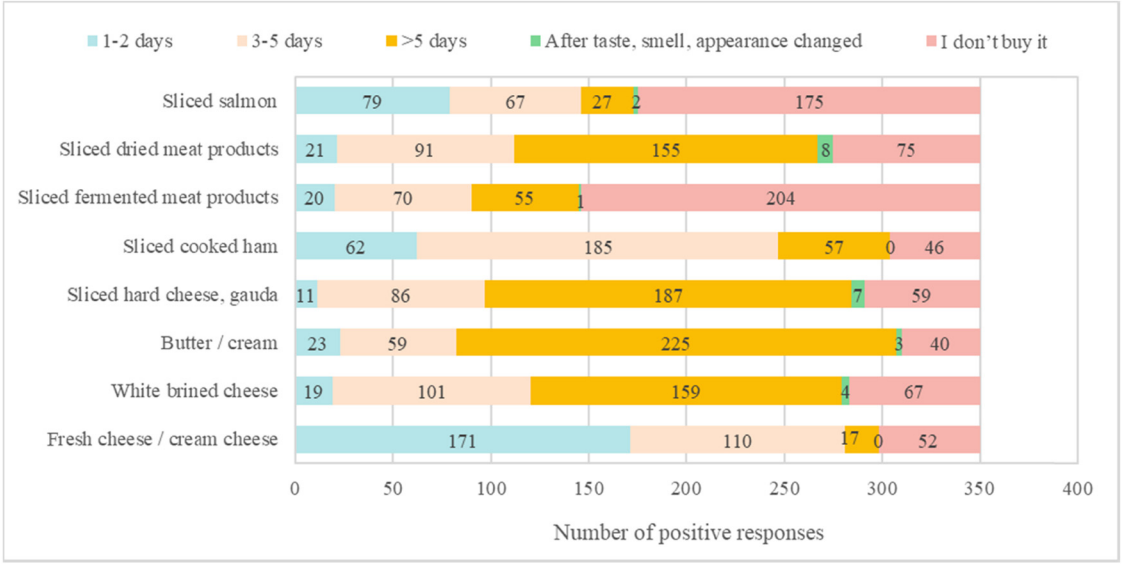

Figure 4: Results to the question "For how long do you usually store in the refrigerator OPENED pre-packed food items?" (The respondents (N = 350) could select only one option).

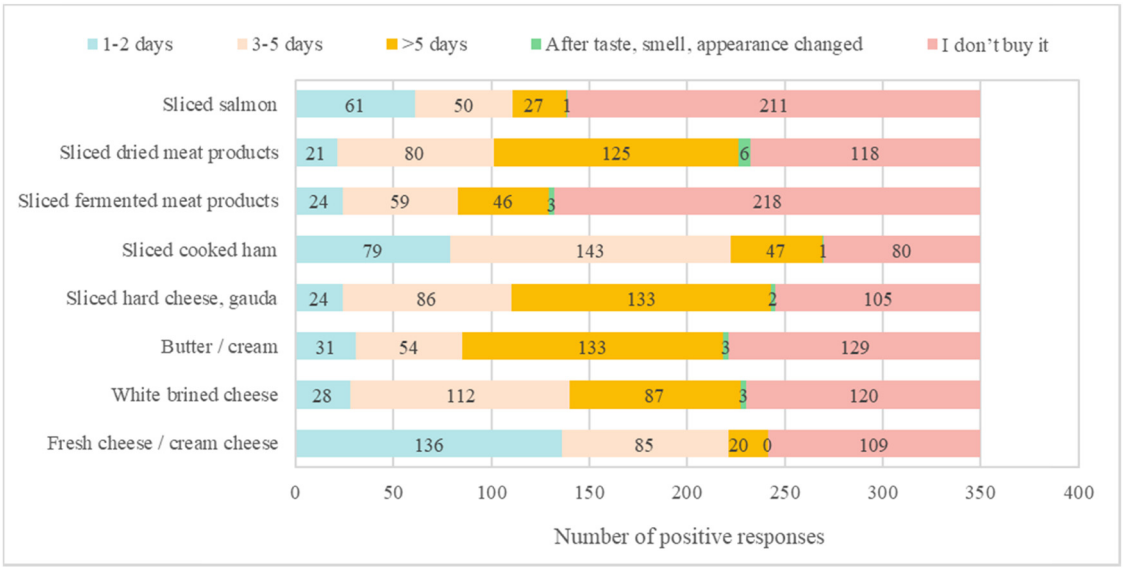

Figure 5: Results to the question "For how long do you usually store in the refrigerator cut-at-order food items (bought at delicatessen or open market)?" (The respondents (N = 350) could select only one option).

The respondents were also asked to select for how long they usually store in the refrigerator cut-at-order RTE food items regardless of being bought at delicatessen or open market. Results are shown in Figure 5, and they indicate that the RTE foods on request products that consumers most frequently store in the refrigerated for a shorter period (1–2 day) are fresh cheese/cream cheese (136 participants), sliced cooked ham (n = 79), and sliced salmon (n = 61). These results indicate that consumers believe that these are the most perishable RTE products. The foods on request items that participants more frequently store in the refrigerator for 3–5 days are sliced cooked ham (n = 143) and white brined cheese (n = 112). According to Figure 5, the RTE foods on request items usually stored in the refrigerator for more than 5 days are butter/cream and sliced hard cheese (n = 133 in both cases). These results from Figure 5 are similar and coherent with those from Figure 4, considering that pre-packed RTE products after opening the original package are similar to foods on request products.

4 Conclusions

This study allowed some specific conclusions regarding the different aspects investigated. As such, the participant's opinion toward food safety of chilled RTE foods can be summarized as:

- Concerning the format of the RTE meat and dairy products, the results indicate that it is not clear to consumers as which is the safest format: pre-packed or foods on request.
- Most consumers are conscious about the importance of storing the RTE products according to storage instructions and at adequate refrigeration conditions, as a way to ensure their safety.
- Most participants do not agree that the expiration date of pre-packed and foods on request RTE dairy and meat products is the same.
- Participants consider chilled RTE dairy and meat food products safer if purchased at the delicatessen department in the supermarket than those purchased at the open market/open bazaar. This is also confirmed by the consumers' lack of confidence, both in the shelf life and in compliance with minimum conservation food safety conditions in open market/open bazaar.

Relatively the attitudes or practices toward food safety of chilled dairy and meat RTE products, it can be pointed that:

- Most participants check the expiration date of pre-packed RTE dairy products.
- A large majority of consumers have a good food safety attitude toward the maintenance of the food cold chain, keeping the RTE dairy and meat products in the refrigerator.
- Most participants admit placing (storing) the RTE meat and dairy food products on separate shelves from fresh fruits/vegetables in the refrigerator.

Concerning the participants' purchasing habits, it was found that:

- Customers usually purchase RTE dairy or meat food products mostly in the supermarket, and in pre-packed format.
- The dairy or meat RTE food products are more frequently consumed as ingredients for salads or sandwiches, followed by their consumption as aperitif.
- Relatively for how long the participants usually store the dairy or meat opened pre-packed food items in the refrigerator; the results indicate that the period can exceed 5 days, but is dependent on the food products. Most consumers keep the fresh cheese/cream cheese in the refrigerator for just 1–2 days , for 3–5 days the sliced cooked ham, and for more than 5 days the butter/cream and the sliced hard cheese.

Globally, the results reveal that consumers are conscious and follow assertive attitudes toward food safety.

It has also to be highlighted that, despite of tight hygienic rules required by legislation, namely the appropriate hygienic systems applied by workers in food preparing places, also the consumers play an important role in terms of food safety, so consumers must have knowledge about different routes of bacteria spreading, and contribute to the decrease of the risk of food contamination.

Additionally, we must remember that most of the participants in this survey are university graduated, and therefore particular care must be taken in the extrapolation of these results to the global population.

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