

## Research Article

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# Knowledge about consumption of milk: Study involving consumers from two European Countries – France and Portugal

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**Abstract:** Milk assumes a pivotal role in human nutrition from early stages of life, although when going into adulthood the consumption habits can vary according to different perceptions from the consumer or even due to the presence of some intolerances. In this context, this research focuses on the consumption knowledge about the composition and nutritional value of milk and its effect on human health. The objective was to investigate how informed are the French and Portuguese participants and detect similarities or differences according to the country. For this purpose, a questionnaire survey was set up to recruit participants from two countries: France and Portugal. The total number of participants was 543, of which 333 were French and 210 were Portuguese. For treatment of data basic statistics and tests were used to compare the results between the two countries, using the software SPSS. The results showed significant differences between the two countries in what concerns the participant's knowledge about milk composition and nutritive value

and also the effects of milk on human health. From the 13 items used to assess knowledge about composition and nutritive value of milk, significant differences were found between countries for six of them. Regarding the ten items used to evaluate the effects of milk on human health, significant differences were found for seven of them. As so, the knowledge about the effects on human health are more differentiated between the participants from France and Portugal, than the knowledge about the milk composition. Factor analysis showed six groups of questions, with good internal reliability (values of alpha varying from 0.707 to 0.825). It is concluded that participants from different countries, exposed to different environments (societal, political, or educational) can have different perceptions about milk and its effects on health.

**Keywords:** consumer attitudes, healthy diet, milk consumption, survey

## 1 Introduction

Consumed for thousands of years, milk is a universal food, present in all civilizations. It is the vital food par excellence, it is both a food resource and a symbol of purity, synonymous with wealth and abundance. Milk has survived centuries and remains as one of the most important foods available for human consumption. Man began to consume milk following the domestication of certain mammals 12,000 years ago. The oldest traces of dairy farming ever discovered are in the Middle East. In ancient times, the Greeks and Romans consumed milk in the form of cheese. They drank very little of it, as they considered it a barbaric beverage, just good for people living outside their borders. The Gauls owned herds of cows whose milk they drank. In France, from the Middle Ages to the eighteenth century, milk was a privilege of the peasants; however, the techniques of conservation were not developed, leaving only 1 day to consume the milk. Milk was one of the first foods to enter the industrial era. The development of railroad and

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refrigeration solved the problem of transportation, while sterilization and pasteurization solved the problem of conservation [1–3].

The dairy market is the second largest agricultural sector in terms of production value, and Europe is a major global player. Cow's milk is the most important in this sector and both launches and sales are increasing. France and the United Kingdom are among the leading milk producers after Germany. The European Union (EU) is the world's largest exporter and one of the main players in the export of dairy products, whose demand continues to grow in countries such as the United States, Japan, and China. According to the International Dairy Federation, global milk production amounted to 864 million tons in 2018. The vast majority of this production corresponds to cow's milk, accounting for 704 million tons or 81% of the total production [4]. The milk sector across the EU has been changing, mainly owing to the characteristics of its internal productive systems. For example, significant increases in production have led to surplus supplies, which have a meaningful impact on the market's management. As a way to minimize this problem, the EU created the milk quota system in the 1980s, allowing a better control over the milk markets and thus prepare the sector for the following reforms originated by the agricultural policy instruments. Nevertheless, this system was a temporary measure from the Common Agricultural Policy and was eliminated in 2015, creating relevant impacts on the sector around Europe, including Portugal. The milk sector is controversial and requires special attention from the policy decision makers, especially to avoid asymmetries across the different EU member-states [5].

In 2020, despite a market context disrupted by the pandemic, global cow's milk collection continued increasing. In France, despite the drought, the decline in the dairy herd and the health crisis, collections are increasing. The health context has disrupted demand, home consumption is increasing, especially for fresh dairy products. Exports are maintained, supported by sales of milk powders [6]. The price of milk has decreased from April 2020, a decrease that continued in the beginning of 2021, but more moderately than in the previous spring. Cow's milk collection in the European Union accelerated in 2020, increasing by 1.2% compared to 2019 for a total of 144.2 million tons. Unfavourable weather events in several countries such as drought in the spring and a heat wave in the summer, do not seem to have had a significant impact on the annual level of European milk collection. This growth was driven by the Netherlands (+1.1%), Poland (+2.3%), and especially Ireland (+3.8%) [7]. Global milk production remains uncertain for several reasons. The COVID-19 pandemic brought restrictions to limit the spread of the virus, which disrupted

some habits. World milk production is not immune to weather hazards that may affect in particular the predominantly grazing dairy farms in the world. Indeed, climate change is increasing the risk of drought, floods, and diseases. Environmental legislation could also have a major impact on the evolution of dairy production. Greenhouse gas emissions from the dairy sector represent a significant share of total emissions in some countries (e.g., New Zealand and Ireland). Policy changes regarding access to water and the management of livestock effluents, which are increasingly moving toward sustainable practices, could impact global milk production [8,9].

Consumers are increasingly interested in knowing more about the products they buy. As a result, transparency is becoming increasingly important in the dairy supply chain. Transparency includes the origin of ingredients, sustainability and ethics of production, farm management practices, and nutritional information. About 60% of global consumers say they are interested in knowing more about where their food comes from and how it is made. Nevertheless, the consumption of dairy products tends to be below recommended dosages [10]. Still, consumers are responsible when it comes to handling and conservation, and Portuguese consumers are conscious and follow assertive attitudes toward food safety [11].

Consumers are more aware of the impact of their diet on their health and are choosing foods and beverages based on their specific nutritional needs and health concerns. A research has shown that 54% of consumers worldwide would like to spend some time learning about ingredients that can improve their immune system [12]. Also there is a tendency to decrease the consumption of processed foods in detriment of more natural ones [13–15].

New plant-based products that are alternatives to animal-based dairy products are becoming increasingly popular. More and more consumers are turning to plant-based products such as soy beverages aimed to replace milk. It has been shown that 53% of consumers of plant-based products think that these are healthier for them. Also, some consumers are moving toward these products due to intolerance to animal dairy products (e.g., lactose intolerance) [16–18].

The objective of this study was to investigate the level of information of participants from Portugal and France regarding a set of facts related to the composition and health effects of milk. It also intended to compare the results between both countries to understand how informed are the participants in each of the countries studied and the lack of knowledge that can be identified so as to better respond to these needs in future informative campaigns.

## 2 Materials and methods

### 2.1 Instrument for data collection

The instrument used in this study was developed with an aim to collect data related to the knowledge and consumption habits of milk. The questionnaire contains different parts, although this particular work relates only to the part that measures knowledge. The questionnaire contains 23 items that measure the level of agreement of the participants with each of the 23 statements, using the following five-point Likert scale: 1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = totally agree.

Two of the 23 items were presented to the participants as false statements, specifically items 6 and 19. All the items presented are as indicated below:

1. Milk is a food with high nutritional value.
2. Milk is made up of proteins, carbohydrates, lipids, vitamins, minerals, and water.
3. Milk provides proteins of high biological value as they contain essential amino acids.
4. The main proteins in milk are caseins and whey proteins.
5. Lactose is the main sugar in milk.
6. Lactose is directly absorbed by the body, without needing enzymes (FALSE).
7. Whole milk has a fat content typically over 3.5%.
8. Semi-skimmed milk has a fat content around 1%.
9. Skimmed milk has a maximum fat content of 0.5%.
10. The main vitamins in milk are vitamins B<sub>2</sub>, B<sub>12</sub>, and A.
11. Vitamin A is naturally present in milk fat.
12. Skimmed milk has very small amounts of vitamin A.
13. Milk is a good source of calcium and iodine.
14. Milk provides minerals like potassium, zinc, phosphorus, and magnesium.
15. Calcium is fundamental for the good formation of bones and teeth.
16. Calcium fortified milk is a great choice to meet daily calcium requirements for those who do not consume dairy products or other calcium-rich products.
17. Vitamin D favours the body's absorption of calcium.
18. Children, as they are in a phase of growth and bone and dental formation, need to ingest calcium, as well as vitamins A, B complex, and some minerals that are present in milk.
19. Around the age of 30, the bone mass peak is reached and therefore there is no problem if you stop consuming milk (FALSE).
20. Women, during menopause, tend to lose calcium and, consequently, bone mass.

21. Pregnant and breastfeeding women should consume specific amounts of calcium per day. At this stage, the needs for B vitamins also increase.
22. The elderly should increase their intake of micronutrients such as B vitamins, calcium, and iron. A great source of these micronutrients is milk.
23. The intake of milk is advised at all stages of life.

Among the 23 statements there were two that were false (6 and 19). The use of some statements classified in reverse mode is a typical strategy to serve as verification and control that the respondents are paying attention to the questions and do not respond without thinking. In this case, two false statements were included randomly as opposed to the other statements that were true. However, that number must be kept to a minimum not to make the answering process too demanding for the respondents.

The research was approved by the Ethics Committee of the Polytechnic of Viseu with reference No. 11/SUB/2020.

### 2.2 Data collection

The data collection took place between September 2020 and May 2021 in both countries, Portugal and France. The invitation to participate was made through e-mail and social networks, following a snowball methodology and recruiting a convenience sample. The participants had to express their informed consent to participate in the study, and they could only access the questionnaire after confirming their participation. All ethical principles for data collection were strictly followed, such as anonymity of responses and the right to deny participation in the study or quit at any time without submitting the answers. The final number of responses obtained was 543 valid participations, of which 333 were from France and 210 were from Portugal.

### 2.3 Data analysis

The data were analysed using basic descriptive statistics such as frequency. Contingency tables and the chi-square test were also used to analyse differences for qualitative variables (items) among groups (countries). Cramer's *V* coefficients were also calculated as a measure of the association between the categorical variables tested. Cramer's *V* coefficient varies from 0 to 1; for  $V \approx 0.1$ , the association is considered weak; for  $V \approx 0.3$ , the association is moderate; and for  $V \approx 0.5$  or over, the association is strong [19].

The items of the questionnaire were used to perform factor analysis (FA) using the principal components (PCs)

method. To perform FA it is necessary to ensure that certain conditions are met, to ensure suitability of the data to apply FA, namely the following criteria must be ensured [20,21]:

- (1) The correlation matrix should identify possible correlations between the variables.
- (2) The value of the Kaiser–Meyer–Olkin (KMO) measure of adequacy must be suitable according to the following scale: excellent for  $0.9 \leq \text{KMO} \leq 1.0$ , good for  $0.8 \leq \text{KMO} < 0.9$ , acceptable for  $0.7 \leq \text{KMO} < 0.8$ , tolerable for  $0.6 \leq \text{KMO} < 0.7$ , bad for  $0.5 \leq \text{KMO} < 0.6$ , and unacceptable for  $\text{KMO} < 0.5$ .
- (3) Bartlett’s test must be significant.

After confirming the suitability of the data to apply FA, we performed the analysis with the PC method and Varimax rotation. Kaiser normalization criteria indicated to extract the relevant factors with eigenvalues greater than 1. The communalities indicated the percentage of variance explained by the factors extracted [20]. For definition of the factors, variables (questions) with absolute value of factor loadings lower than 0.4 were excluded [22,23]. The internal consistency of each factor was assessed using the standard measure of Cronbach’s alpha ( $\alpha$ ) [20,24], whose reference values are that desirable values should be over 0.7 and preferably over 0.8, which corresponds to a very good internal consistency. Nevertheless, some authors also state that values over 0.5 could be acceptable [25–27].

The software used for data analysis was SPSS (Version 28) from IBM Inc., and the level of significance considered was 5% ( $p < 0.05$ ).

## 2.4 Sample characterization

The distribution of the participants by country was 61.3% French and 38.7% Portuguese. Most participants were female (65.7%) against 32.7% of males. The age varied from 18 to 89, with a prevalence of young adults (49.8% were aged between 18 and 25 years), followed by adults (35.4% aged between 26 and 50 years) and then a lower percentage of senior adults (14.8% aged 51 years or more).

Most participants had a university level of studies (67.2%) with less than 1% having only a basic school level. In terms of occupation, 44.5% of the participants were employed, 29.0% were students, and 9.8% were working-students, while the rest had other occupations (7.0% were chiefs, 5.2% were unemployed, 3.5% were retired, and 1.1% were domestic).

## 3 Results

Table 1 shows the results obtained for the items related to the composition of milk and its nutritional value. It presents the percentages of answers given by the participants from each of the countries separately as well as for the global sample. Additionally, the significance of the chi-square test is given to identify the possible differences between countries, and the value of Cramer’s  $V$  coefficient is also provided to evaluate the strength of the associations between each of the items and the variable country. The results showed that significant differences between countries were found for items It-1, It-3, It-5, It-9, It-11, and It-14 ( $p < 0.05$  in all cases). A moderate association with country was found only for item It-14 ( $V = 0.256$ ), referring to the minerals present in milk.

For all the items in Table 1 the percentage of answers for scores 1 (= totally disagree) and 2 (= disagree) were very low, regardless of the country, meaning that people do not tend to disagree with the sentences, which corresponded to all true facts. However, it was observed that for all items a high percentage of participants choosing score 3, which corresponds to not manifesting an opinion (3 = neither agree nor disagree), or an insecurity about the right answer. The items with lower percentages of score 3, for the global sample, were It-1 (18.9%) and It-2 (21.8%), corresponding to about one-fifth not having an opinion. On the other hand, items with highest percentages of score 3 were It-12 (60.6%) and It-11 (58.3%), both related to knowledge about vitamin A being present in milk fat and consequently diminished in skimmed milk.

Table 2 presents the results for items related to the effects of milk components on the human body and, consequently, on human health. Significant differences between country were found for some of the items, for which the  $p$ -value was lower than 0.05: It-6, It-15, It-16, It-18, It-20, It-21, and It-22. With respect to the strength of the associations, moderate associations were found for items It-21 ( $V = 0.330$ ), It-20 ( $V = 0.294$ ), It-16 ( $V = 0.236$ ), and It-6 ( $V = 0.228$ ).

As previously seen for the items in Table 1, also in Table 2 for practically all items the percentage of answers in scores 1 and 2 (disagreement) was very low, except in two cases, which corresponded to the false items (It-6 and It-19). For these two items, a good percentage of participants’ scores 1 and 2, showing disagreement with the false information provided in those statements, indicating that the participants were informed about those facts. But the high percentage of participants scoring 3 in all items as shown in Table 2 once again demonstrates that many of the participants were not sure enough to express an opinion. The lowest percentage was for item It-15 (16.8% of

**Table 1:** Results for items related to the composition of milk and its nutritional value

Item	Sample <sup>1</sup>	Percentage of answers in each of the scale points <sup>2</sup>					$p$ -value <sup>3</sup> $V^4$
		1	2	3	4	5	
It-1. Milk is a food with high nutritional value	France	0.8	11.3	20.6	42.4	24.9	$p = 0.008$ $V = 0.190$
	Portugal	0.0	3.5	16.1	42.7	37.7	
	Global	0.5	8.4	18.9	42.5	29.7	
It-2. Milk is made up of proteins, carbohydrates, lipids, vitamins, minerals, and water	France	2.1	6.3	23.1	38.2	30.3	$p = 0.209$ $V = 0.124$
	Portugal	0.0	3.5	19.6	41.3	35.6	
	Global	1.3	5.2	21.8	39.4	32.3	
It-3. Milk provides proteins of high biological value as they contain essential amino acids	France	1.3	8.8	42.0	30.3	17.6	$p = 0.003$ $V = 0.207$
	Portugal	2.8	4.9	25.8	37.1	29.4	
	Global	1.8	7.3	36.0	32.8	22.1	
It-4. The main proteins in milk are caseins and whey proteins	France	0.8	3.8	43.7	25.6	26.1	$p = 0.151$ $V = 0.133$
	Portugal	3.5	7.0	39.2	28.7	21.6	
	Global	1.8	5.0	42.0	26.8	24.4	
It-5. Lactose is the main sugar in milk	France	2.9	8.4	39.1	24.4	25.2	$p = 0.033$ $V = 0.166$
	Portugal	5.6	8.4	25.8	23.1	37.1	
	Global	3.9	8.4	34.1	23.9	29.7	
It-7. Whole milk has a fat content typically over 3.5%	France	6.7	7.6	52.6	19.7	13.4	$p = 0.986$ $V = 0.031$
	Portugal	5.6	7.7	51.7	21.7	13.3	
	Global	6.3	7.6	52.2	20.5	13.4	
It-8. Semi-skimmed milk has a fat content around 1%	France	2.5	6.3	55.9	22.7	12.6	$p = 0.606$ $V = 0.084$
	Portugal	1.4	7.7	49.6	28.7	12.6	
	Global	2.1	6.8	53.6	24.9	12.6	
It-9. Skimmed milk has a maximum fat content of 0.5%	France	5.5	6.7	60.5	15.5	11.8	$p = 0.003$ $V = 0.204$
	Portugal	0.7	7.7	47.5	25.9	18.2	
	Global	3.7	7.1	55.6	19.4	14.2	
It-10. The main vitamins in milk are vitamins B <sub>2</sub> , B <sub>12</sub> , and A	France	2.5	4.2	55.5	23.5	14.3	$p = 0.077$ $V = 0.149$
	Portugal	2.1	5.6	40.5	32.2	19.6	
	Global	2.4	4.7	49.8	26.8	16.3	
It-11. Vitamin A is naturally present in milk fat	France	2.5	4.6	64.8	17.6	10.5	$p = 0.008$ $V = 0.190$
	Portugal	1.4	10.5	47.5	25.9	14.7	
	Global	2.1	6.8	58.3	20.7	12.1	
It-12. Skimmed milk has very small amounts of vitamin A	France	4.6	7.6	64.3	14.3	9.2	$p = 0.121$ $V = 0.138$
	Portugal	4.2	14.7	54.5	18.9	7.7	
	Global	4.5	10.2	60.6	16.0	8.7	
It-13. Milk is a good source of calcium and iodine	France	3.8	6.3	30.3	38.2	21.4	$p = 0.100$ $V = 0.143$
	Portugal	2.8	4.2	23.0	36.4	33.6	
	Global	3.4	5.5	27.6	37.5	26.0	
It-14. Milk provides minerals like potassium, zinc, phosphorus, and magnesium	France	4.2	8.0	54.2	21.0	12.6	$P < 0.001$ $V = 0.256$
	Portugal	2.1	6.3	32.1	35.0	24.5	
	Global	3.4	7.3	45.9	26.3	17.1	

<sup>1</sup>Sample number of participants:  $N$  (France) = 333,  $N$  (Portugal) = 210,  $N$  (Global) = 543.

<sup>2</sup>Scale: 1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = totally agree.

<sup>3</sup>Test differences between France and Portugal with chi-square test at 5% level of significance ( $p < 5\%$ ).

<sup>4</sup> $V$  = Cramer's  $V$  coefficient.

score 3) about calcium being essential for bone and tooth health, while the highest percentage was found for item It-21 (47.3% of score 3) about the needs of pregnant and breastfeeding women in terms of calcium and B vitamins.

Figure 1 shows the results for only the global sample (considering the participants from both countries) and summing the percentages for disagreement (either moderate or strong disagreement) and the same for agreement.

A correct perception was assigned to participants who totally agreed or agreed with the TRUE items and to those who disagreed or totally disagreed with the FALSE items, whereas an incorrect perception was assigned to participants who totally disagreed or disagreed with the TRUE items and to those who agreed or totally agreed with the FALSE items. The results in Figure 1 revealed that the items with highest percentage of correct perceptions were It-15

**Table 2:** Results for items related to the effects of milk and its components on the human body and on health

Item	Sample <sup>1</sup>	Percentage of answers in each of the scale points <sup>2</sup>					<i>p</i> -value <sup>3</sup>
		1	2	3	4	5	
It-6. Lactose is directly absorbed by the body, without needing enzymes (FALSE)	France	26.9	17.6	41.6	7.6	6.3	<i>P</i> < 0.001
	Portugal	23.1	13.3	30.7	16.8	16.1	<i>V</i> = 0.228
	Global	25.5	16.0	37.5	11.0	10.0	
It-15. Calcium is fundamental for the good formation of bones and teeth	France	2.5	4.2	18.5	31.5	43.3	<i>p</i> = 0.046
	Portugal	0.0	2.1	14.1	27.3	56.5	<i>V</i> = 0.159
	Global	1.6	3.4	16.8	29.9	48.3	
It-16. Calcium fortified milk is a great choice to meet daily calcium requirements for those who do not consume dairy products or other calcium-rich products	France	4.2	12.6	37.4	29.8	16.0	<i>P</i> < 0.001
	Portugal	3.5	4.9	23.7	37.1	30.8	<i>V</i> = 0.236
	Global	3.9	9.7	32.4	32.5	21.5	
It-17. Vitamin D favours the body's absorption of calcium	France	2.1	3.4	47.8	24.4	22.3	<i>p</i> = 0.079
	Portugal	2.1	3.5	34.2	26.6	33.6	<i>V</i> = 0.148
	Global	2.1	3.4	42.8	25.2	26.5	
It-18. Children, as they are in a phase of growth and bone and dental formation, need to ingest calcium, as well as vitamins A, B complex, and some minerals that are present in milk	France	2.1	4.2	39.9	29.9	23.9	<i>p</i> = 0.004
	Portugal	0.0	0.7	31.5	28.6	39.2	<i>V</i> = 0.202
	Global	1.3	2.9	36.7	29.4	29.7	
It-19. Around the age of 30, the bone mass peak is reached and therefore there is no problem if you stop consuming milk (FALSE)	France	17.2	21.8	36.2	14.7	10.1	<i>p</i> = 0.711
	Portugal	18.2	18.2	32.8	18.9	11.9	<i>V</i> = 0.075
	Global	17.6	20.5	34.8	16.3	10.8	
It-20. Women, during menopause, tend to lose calcium and, consequently, bone mass	France	2.1	4.2	46.7	29.4	17.6	<i>P</i> < 0.001
	Portugal	0.7	1.4	25.8	30.1	42.0	<i>V</i> = 0.294
	Global	1.6	3.1	38.8	29.7	26.8	
It-21. Pregnant and breastfeeding women should consume specific amounts of calcium per day. At this stage, the needs for B vitamins also increase	France	2.1	7.1	57.2	23.1	10.5	<i>P</i> < 0.001
	Portugal	1.4	3.5	30.7	31.5	32.9	<i>V</i> = 0.330
	Global	1.8	5.8	47.3	26.2	18.9	
It-22. The elderly should increase their intake of micronutrients such as B vitamins, calcium, and iron. A great source of these micronutrients is milk	France	2.5	3.8	49.1	28.6	16.0	<i>p</i> = 0.016
	Portugal	2.8	2.1	35.0	31.4	28.7	<i>V</i> = 0.179
	Global	2.6	3.1	43.9	29.7	20.7	
It-23. The intake of milk is advised at all stages of life	France	9.7	12.6	24.8	25.2	27.7	<i>p</i> = 0.670
	Portugal	7.7	8.4	25.8	28.7	29.4	<i>V</i> = 0.079
	Global	8.9	11.0	25.3	26.5	28.3	

<sup>1</sup>Sample number of participants: *N* (France) = 333, *N* (Portugal) = 210, *N* (Global) = 543.

<sup>2</sup>Scale: 1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = totally agree.

<sup>3</sup>Test differences between France and Portugal with chi-square test at 5% level of significance (*p* < 5).

<sup>4</sup>*V* = Cramer's *V* coefficient.

(78.2%), It-1 (72.2%), and It-2 (71.7%). On the contrary, the items for which the participants revealed higher percentage of incorrect perception were It-19 (27.1%) and It-6 (21.0%), these two items precisely being those given as false statements. Finally, the items for which the respondents had more difficulty in expressing any kind of opinion were It-12 (60.6%), It-11 (58.3%), and It-9 (55.6%).

To perform the FA, three conditions were analysed to confirm if the data were suitable for utilization of this statistical technique. The first one was confirmed because the correlation matrix showed correlations between the variables, with ten values >0.5 (the highest was *r* = 0.638, for correlation between items It-8 and It-9). The second condition was also verified since the value of KMO was

excellent (KMO = 0.905) [21]. The third condition was also confirmed, as Bartlett's test was significant (*p* < 0.001), leading to rejection of the null hypothesis "H0: The correlation matrix is equal to the identity matrix."

All values of the correlations in the anti-image matrix were near 0.5 or above, with only one value under 0.5 (*r* = 0.487 for It-19), with second lowest being for It-6 (*r* = 0.787), and 17 values above 0.9, with the highest being for It-14 (*r* = 0.942). The results of the anti-image matrix lead us to assume that all the 23 variables can be included in the analysis.

The commonalities are presented in Table 3 and they represent the percentage of variance of each item that is explained by the FA solution. Practically all variables had a

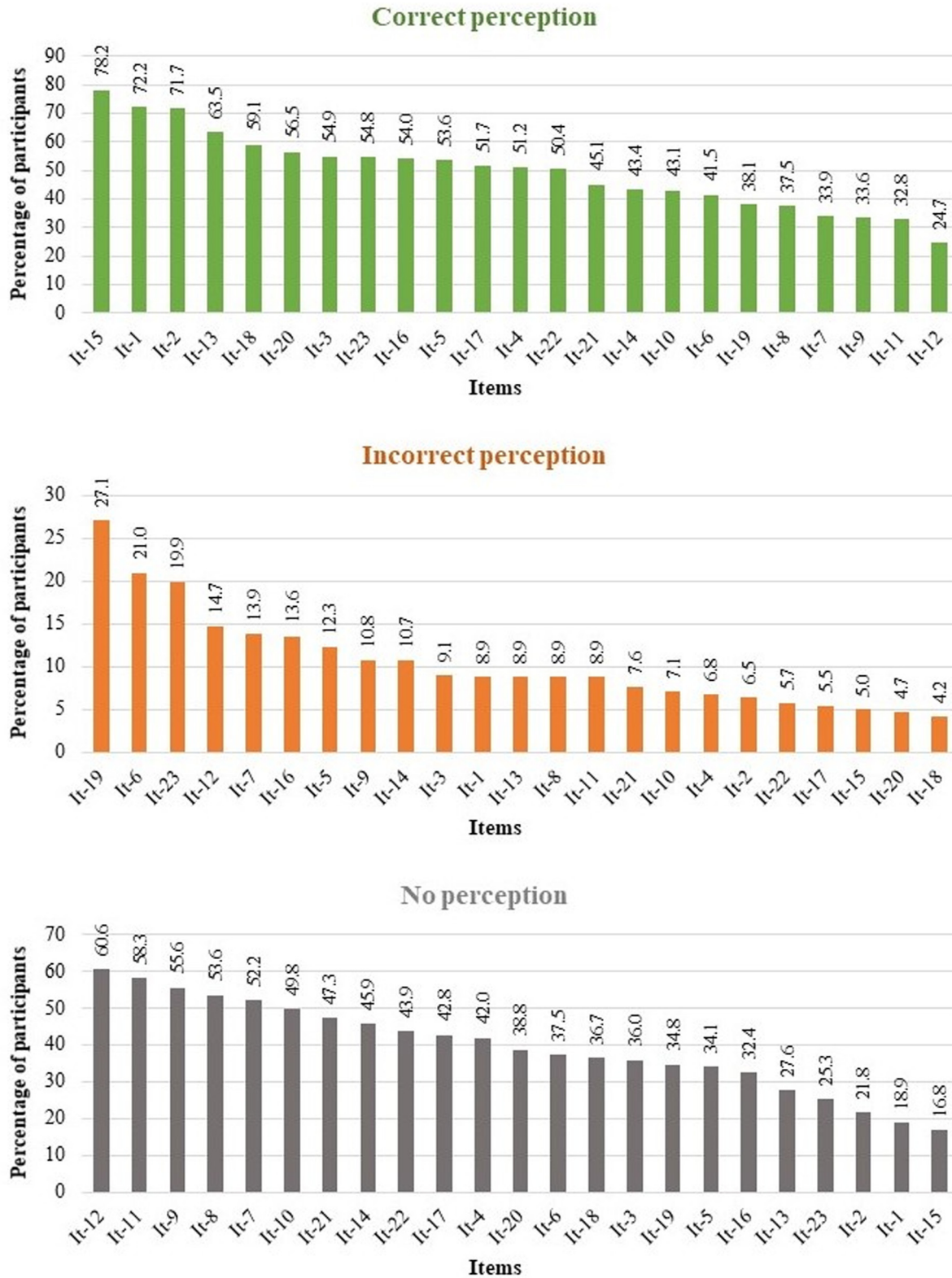


Figure 1: Perceptions of the participants toward all items considering the global sample.

**Table 3:** Communalities for the 23 items used in the FA

Item	%VE <sup>1</sup>	Item	%VE <sup>1</sup>	Item	%VE <sup>1</sup>	Item	%VE <sup>1</sup>
It-1	58.7	It-7	62.5	It-13	52.8	It-19	81.1
It-2	65.3	It-8	73.3	It-14	47.9	It-20	64.8
It-32	65.1	It-9	68.1	It-15	59.8	It-21	67.7
It-43	59.0	It-10	69.0	It-16	50.6	It-22	65.6
It-5	52.2	It-11	71.1	It-17	55.6	It-23	62.7
It-6	53.0	It-12	55.8	It-18	63.4		

<sup>1</sup>%VE = percentage variance explained.

minimum of 50% of their variance explained by the solution, with only one exception. The item with lowest communality was It-14 (%VE = 47.9) and the item with highest communality was It-19 (%VE = 81.1%).

Table 4 shows the solution obtained with FA, converging in ten iterations. It comprises six factors, which globally explain 62.0% of variance. This solution included only 22 items because It-14 was excluded for having a loading lower than the stipulated threshold of 0.4 (absolute value) in at least one of the factors.

**Table 4:** Solution obtained by FA

Factor	Eigenvalue	%VE <sup>1</sup>	Item <sup>2</sup>	Loading	Cronbach's alpha ( $\alpha$ )
F1	7.511	13.2	It-17	0.508	0.825
			It-18	0.631	
			It-20	0.776	
			It-21	0.734	
			It-22	0.653	
F2	1.938	12.3	It-1	0.584	0.749
			It-3	0.536	
			It-6*	0.432	
			It-13	0.590	
			It-15	0.529	
			It-16	0.650	
F3	1.402	11.2	It-2	0.745	0.707
			It-4	0.654	
			It-5	0.620	
F4	1.271	10.8	It-7	0.739	0.780
			It-8	0.809	
			It-9	0.720	
F5	1.095	9.1	It-10	0.703	0.723
			It-11	0.747	
			[It-12]	0.633	
F6	1.035	5.4	It-19*	0.890	N.A. <sup>4</sup>

<sup>1</sup>%VE = percentage variance explained.

<sup>2</sup>Items with asterisk are false statements.

<sup>3</sup>The value of alpha increased from 0.723 to 0.770 if item It-12 is removed.

<sup>4</sup>N.A. = not applicable, factor with only one variable.

\* False item (used in reverse mode).

All factor loadings were above 0.5, except for It-6 (loading = 0.432). The highest loading was for item It-19 (loading = 0.890), which was also a false statements, but constituted a single factor (F6). The highest the loading factors are, it means the items strongly contribute to the definition of the factor where the item is allocated.

The internal consistency of the items in each factor was assessed by calculating the value of Cronbach's alpha ( $\alpha$ ) [20], which assumed values considered very good for factor F1 ( $\alpha = 0.825$ ) and good for all other factors ( $\alpha$  values varying from 0.707 to 0.780). Note that in the case of factor F5, it is recommended to remove item It-12, leading to an increase of the alpha value from 0.723 to 0.770 [25–27]. Therefore, the final FA solution was considered with only 21 of the items, because It-14 was excluded for having a load under 0.4 in any of the factor, and item It-12 was also excluded from factor F5 based on the results of internal consistency analysis.

## 4 Discussion

From the items evaluated, it was observed that high levels of correct perceptions were found for the following items, in all cases with above 60% of the participants: It-15 (calcium is fundamental for the good formation of bones and teeth), It-1 (milk is a food with high nutritional value), It-2 (milk is made up of proteins, carbohydrates, lipids, vitamins, minerals, and water), and It-13 (milk is a good source of calcium and iodine). Globally, 13 of the items had levels of correct perceptions above 50%. This shows that most of the participants had a good knowledge of the composition and nutritional value of milk, especially regarding its macronutrients. The fact that most participants had a university degree (67.2%), could influence these results. It is reported that higher levels of education, including university degree, influence food literacy, and that food knowledge is a way for better nutrition and health [28]. Food literacy is undoubtedly recognized as a means for dietary education [29,30] and improvement of general health status among the general population or people with some chronic diseases related to food, like diabetes [31,32], cardiovascular diseases [33] among others.

The items that obtained the highest levels of correct perceptions are related to the milk consumption benefits and/or characteristics that are widely used in commercials or marketing campaigns in the media, namely, milk as a source of calcium for proper bone growth or source of energy and high nutritional value. Calcium and protein present in milk are considered relevant to maintain bone

health [34]. Many studies have demonstrated the unquestionable role of milk for bone health in particular, focusing on different aspects, like osteoporosis [35–37] or risks of fracture [38–40], and among different populations, like for example post-menopausal women [41], adults [42], children and adolescents [43,44], or university students [45].

Several items also showed lower levels of correct perceptions, such as It-12, It-11, etc. In fact, these items focus on more technical issues that are less known by the participants, i.e., these items refer to micronutrients such as vitamins present in milk, or percentage compositions of macronutrients such as fat. These results indicate that fewer participants have a correct perception of these specific characteristics. To be able to read food labels adequately to understand the product's nutritional characteristics is very important, but not always practiced by those who go to the supermarket to buy foods on a daily basis. An et al. [46] discussed the effect of front-of-package nutrition labelling on food purchase, and the results from their systematic review highlighted that front-of-package labels like traffic lights, health star rating, daily intake guides, health warnings, and high sugar symbol labels, were found effective for helping participants make healthier food purchase decisions.

The items for which the level of incorrect perceptions were higher, with more than 20% of participants, were It-19 (around the age of 30, the bone mass peak is reached and therefore there is no problem if you stop consuming milk) and It-6 (lactose is directly absorbed by the body, without needing enzymes), both of them presented to the participants as false statements. The incorrect perception related to It-19 (which is a FALSE statement) includes the answers agree plus strongly agree ( $16.3 + 10.8 = 27.1\%$ ). In fact, a widely reported aspect of marketing commercials is that milk consumption is associated with bone growth, which is more significant up to the age of 18 or 20 years. This perception may have considerably contributed to the percentage of participants who agreed with the statement (It-19). The items with the highest incorrect perception were It-6 – 21% (also FALSE) and It-23 – 19.9%. Lactose is a sugar (glucose and galactose) contained in milk and dairy products, providing energy and playing an important role in nutrition. In fact, lactose is digested by lactase enzyme, so statement It-6 is false. However, it should be noted that for these items, even a higher percentage of participants have a correct perception of these statements, i.e., It-19 – 38.1%, It-6 – 41.5, and It-23 – 54.8%. The knowledge about lactose effects on human health are perhaps more widely disseminated among the general population, due to the alert that some individuals are intolerant to lactose [47–49], and therefore seek for alternatives, namely from vegetable origin, to the traditional consumption of cow milk [50,51].

Many studies have demonstrated the usefulness of those beverages as milk alternatives [52–55], but because they are not so nutritive as milk, they must be fortified with calcium, vitamin B12, or vitamin D.

Items in which the participants showed higher difficulty to express an opinion, with more than 50% of the participants choosing 'neither agree nor disagree', were It-12 (skimmed milk has very small amounts of vitamin A), It-11 (vitamin A is naturally present in milk fat), It-9 (skimmed milk has a maximum fat content of 0.5%), It-8 (semi-skimmed milk has a fat content around 1%), and It-7 (whole milk has a fat content typically over 3.5%). The insecurity in selecting a positive or negative answer may be due to the fact that these items are related to more technical issues, which are less well known to the general public. In other words, as mentioned above, these items refer to the nutritional composition of milk, such as vitamins, or the percentage composition of macronutrients, such as fat. These issues, although better known to people involved in the food industry, are less well known for many participants. Skimmed milk, low-fat, or fat-free milk is obtained by removing some of its fat. Some of the nutrients that can be affected by the removal of fat are liposoluble vitamins A and D. Since skimmed milk has had its fat removed, it might have lower levels of vitamin A compared to whole milk. However, most skimmed milk of the commercial milk brands, are often fortified with vitamin A to compensate for the loss of this nutrient during fat removal. Vitamin A is important for maintaining a healthy condition, as for example, immune function. One of the most recent development in this area is the microencapsulation of fat-soluble vitamins to incorporate into skimmed milk, to be delivered later on upon human consumption [56]. Studies have also focused on the binding of vitamin A by casein micelles in commercial skimmed milk [57]. It can also be noted that the exact vitamin A content in skimmed milk can vary depending on the brand and the fortification practices of the milk manufacturer. Therefore, it is of the most relevance that consumers rely on the nutritional information provided through the labels when purchasing milk, like any other food products.

This work showed significant differences between Portuguese and French consumers' level of information for a great number of items about milk composition and health benefits. These differences indicate that Portuguese participants tend to be more informed when compared with the French participants. Country plays a role in the participant's knowledge, owing much to the differences in health promoting policies, as well as social and cultural contexts and traditional knowledge. The work by Abdul-Aziz et al. [58] revealed that dairy consumption among Libyan university students was rather high, also revealing

good nutritional knowledge about dairy products and their consumption, but revealed poor knowledge about their health benefits. Myers *et al.* [59] aimed to educate those who consume insufficient amounts of dairy products about several facts related to dairy nutrition. They concluded that nutrition educational messages about dairy products help increase the participants' knowledge. Additionally the purchasing and consumption also increased by 20%. The contexts of early learning in school are recommended to establish assimilation patterns and build better knowledge for the adulthood, and milk is one such example [60].

## 5 Conclusions

This work focused on the knowledge about milk composition and nutritional value as well as its effect on human health, and it aimed to investigate the knowledge on two samples from different countries, Portugal and France. The obtained results showed that for the majority of the items investigated significant differences were found between the participants from both countries. In what concerns the composition of milk and its nutritional value, differences were encountered for items related to the high nutritional value of milk, the biological value of milk proteins, lactose being the main sugar in milk, the fat content of skimmed milk, the presence of Vitamin A, and the richness of milk in minerals of dietary importance. Regarding the health effects of milk, differences between the countries were found for absorption of lactose; the role of calcium for bone and tooth health; milk fortified with calcium is good for those who consume low amounts of sources of calcium; and milk is recommended particularly for children, the elderly, and for women at menopause, pregnant, or breastfeeding. Results from FA concluded that the scales used have good internal consistency. In conclusion, the knowledge about milk can depend on a participant's country of origin, and consequently be influenced by different social and political environments or educational systems.

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