

Consumer attitudes toward dairy products from sheep and goats: a cross-continental perspective

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Consumer attitudes toward dairy products from sheep and goats: A cross-continental perspective

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ABSTRACT

This study aimed to assess consumer knowledge, attitudes, and perceptions toward dairy products from sheep and goats. A web-based survey was conducted in Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh). From March to June 2021, adult participants answered an online survey available in 5 languages. In total, 1,879 surveys were completed. Categorical and ordinal data were analyzed as frequencies and percentages. To determine the relationship between the variables for purchasing and consumption behaviors of respondents who declared that they consume dairy products, a multiple correspondence analysis was carried out. Most completed surveys were from Mexico and Italy (30% and 33.7%, respectively). Most respondents were between 18 and 29 yr old, female, highly educated, and employed. The majority of respondents (70.8%) declared that they consume dairy products from small ruminants. Consumers preferred products from both sheep and goats (49.4%); however, it was observed that in Mexico, Denmark, and Bangladesh, more than 50% preferred goat dairy products. The most-consumed products were mature and fresh cheeses. Mature cheese was the most-preferred product in Chile; in Mexico, Italy, Greece, and Denmark, it was fresh cheese. Unlike

the rest of the countries, in Bangladesh, dairy product consumption from small ruminants was observed by more than 30% of respondents. In Mexico, a higher percentage of people do not consume sheep or goat dairy products because they are unfamiliar with them. In Mexico, Chile, and Bangladesh, limited market availability was also a variable responsible for nonconsumption. In European and Asian countries, sheep and goat dairy products are not consumed because consumers dislike them, in addition to a greater awareness of sustainability and climate change issues. The multiple correspondence analysis defined 5 dimensions. Dimension 1 was associated with the geographic location of the respondent (country and continent), the type of milk (sheep or goat), and the consideration of well-being and health as characteristics associated with the consumption of dairy products from small ruminants. Dimension 2 was associated with the respondent's country of origin and the frequency of consumption. Dimension 3 was associated with gender, education, and employment status. Dimension 4 was associated with the respondent's age, the association of the "healthy" concept of sheep and goat dairy products, and the consideration of the nutritional benefits of dairy as responsible for considering them healthy. Dimension 5 was associated with a "strong smell and taste" of sheep and goat dairy products. This study showed that consumer attitudes toward dairy products from sheep and goats vary between continents. In conclusion, results showed consumer interest in animal welfare and environmental impact issues related to small ruminant farming as well as a general attraction to local products. It seems that these factors contribute to consumers' perception of the

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quality of dairy products, so the industry and select farmers should carefully consider incorporating them into their supply chain.

Key words: cheese, consumer perception, knowledge, milk, small ruminant

INTRODUCTION

The importance of small ruminant farming differs based on the geographical region, and this is reflected in the herd size, production systems, and type of available products. In this regard, the European small ruminant (i.e., sheep and goats) farming sector largely contributes to the Sustainable Development Goals described by the United Nations (Animal Task Force, 2019). This sector produces 6% of meat and 3% of milk production in the European Union, representing an important share of the total livestock production in European countries such as the United Kingdom, Spain, Italy, France, and Greece (Belanche et al., 2021).

In developing countries, the importance of small ruminants to the socioeconomic well-being of people in terms of nutrition, income, and intangible benefits (e.g., savings, insurance against emergencies, cultural and ceremonial purposes) cannot be overlooked (Verbeek et al., 2007). Latin America has one of the world's largest meat and milk production herds, representing around 25% of the world's livestock-productive land area (Thornton et al., 2002). In Latin America, small ruminant farming systems range from highly technical to rural herds providing a significant source of income (Molento et al., 2011). In contrast, multipurpose livestock is integrated with cropping in the small-scale, mixed farming systems that characterize Asian agriculture. More than 90% of the total population of large and small ruminants are kept on mixed farms in Asia and more than 50% of ruminants are raised on farms of 5.0 ha or less (Devendra and Thomas, 2002). In Bangladesh, for example, small ruminants are reared by landless and marginal farmers all over the country—aside from the district of Noakhali, where sheep are mainly owned by large landholders (Barua et al., 2021).

Consumer country of origin is an important factor that influences their perceptions of food and purchasing behavior (Cristea et al., 2015). Consumer studies about perception and knowledge of food and nutrition (e.g., fats and fatty acids) are relevant to the public health sector because they can provide insights into how to improve consumer knowledge or awareness of nutritional information (Vargas-Bello-Pérez et al., 2020). Until now, no consumer surveys that focus on the consumption of dairy products from small ruminants have been published. This is necessary if dairy

markets want to identify consumer profiles and expectations. Therefore, the objective of this study was to assess consumer knowledge, attitudes, and perceptions toward dairy products from sheep and goats. Although dairy products from small ruminants are perceived as common foods in many countries, we hypothesized that consumer knowledge, attitudes, and perceptions toward dairy products from sheep and goats would be different within and between continents. Therefore, a survey was conducted in Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh).

This study provides a preliminary context of consumer attitudes toward dairy products from sheep and goats across continents, which is useful feedback for all parties involved in the dairy industry—consumers as well as the public health sector. Ascertaining consumers' understanding of dairy products from small ruminants will help the dairy industry satisfy consumer expectations and help reveal the dairy market's efficacy in positioning small ruminant dairy products, which can be useful for dairy product innovation and policy-makers.

MATERIALS AND METHODS

Data Collection and Participants

A web-based survey was designed and developed for data collection in 2021 using Google Forms. The survey was available online in 5 languages from March to June 2021. The survey link was circulated through social media outlets (e.g., Facebook and Twitter). The collected data were anonymous, as no personally identifiable information was used. The survey was voluntary, and participants had the opportunity to exit the survey at any time. The survey was anonymous, and no personally identifiable information was collected; therefore, ethical approval was deemed unnecessary. Only respondents of 18 yr of age or older were included in the analysis. The decision to close the survey was made when response rates started to decline (fewer than 5 answered surveys per week). For sample size, a post hoc power analysis was performed (SAS Institute Inc.) and the power of analysis ($1 - \beta$) was calculated, accepting a null hypothesis error of 0.05, considering the question, "Do you consume sheep or goat dairy products?" as a dichotomous variable.

Questionnaire Development

The questionnaire had 21 multiple-choice questions and was divided into the following sections: (1) sociode-

Table 1. Survey questions and choices used to assess consumer attitudes toward dairy products from sheep and goats

| Question | Choices |
|---|---|
| Sociodemographic information | |
| 1. In which country do you live? | Bangladesh; Chile; Denmark; Greece; Italy; Mexico; Spain |
| 2. What is your age? | 18–29; 30–39; 40–49; 50–59; 60+ |
| 3. What is your sex/gender? | Male; female; other |
| 4. What is the highest level of education you have completed? | Primary education; secondary education or vocational education; bachelor's; master's; PhD |
| 5. What is your employment status? | Employed (agricultural/veterinary/animal science); employed; unemployed; retired (agricultural/veterinary/animal science); retired (other disciplines); student (agricultural/veterinary/animal science); student (other disciplines) |
| 6. Did you grow up in the countryside? (up to 18 yr) | Yes; no |
| 7. Are you familiar with or related to livestock farming? | Yes; no |
| Consumption | |
| 8. Do you consume sheep or goat dairy products? | Yes; no |
| 9. Of which species do you prefer to consume dairy products? | Sheep dairy products; goat dairy products; both |
| 10. What type of goat and sheep dairy products do you consume/use? | Milk; fresh cheese; aged cheese (protected designation of origin or not); yogurt; dahi; ricotta; butter; milk candy; ice cream; cosmetics (soaps and creams) |
| 11. How often do you consume goat or sheep dairy products? | Every day; 3–6 times per week; 1–2 times per week; 2–3 times per month; 1–2 times per year; when necessary (for example, due to sickness) |
| 12. Where do you buy goat or sheep dairy products? Please choose up to 5 reasons. | Supermarket; local market; local farm; online suppliers; during countryside trips |
| 13. Are you interested in the nutrients of the sheep/goat dairy products? | I am interested; I am not interested |
| 14. Rank from 1 to 6 the following nutrients, with 1 being the most important and 6 the least important. | Fat; protein; lactose; fatty acids (omega fatty acids); minerals; vitamins |
| Nonconsumption of goat or sheep dairy products | |
| 15. What is the reason you do not consume goat or sheep dairy products? Please choose up to 5 reasons. | Dislike; I do not know them; lactose intolerance; allergy; health concern; ethical/animal welfare concern; sustainability/greenhouse effect concern; concern about added hormones or antibiotics; animal-to-human disease transmission; limited availability on the national market; cost; strong flavor and odor |
| Knowledge and perception | |
| 16. In your opinion, which of the following concepts do you relate to dairy products from goats and sheep? Please choose up to 3. | Healthy; unhealthy; tasty; traditional; strong flavor and odor; useful for cooking; expensive; family farm (small-scale farmers); other |
| 17. Which of the following characteristics do you associate with dairy products from goats and sheep? Please choose up to 3. | Wellness and fitness; Mediterranean diet; gourmet products; tasty; local farming; fair trade; fashion; social status; other |
| 18. From what source do you get your information about dairy products from goats and sheep? Please choose up to 3. | TV or radio; social media; newspapers or magazines; journals or books; education (e.g., school or university); family; friends or colleagues; other |
| 19. For which of the following alternatives would you pay more for dairy products from goats and sheep? Please choose up to 3. | Environmentally friendly product; sustainable product; animal welfare-friendly product; fair trade; functional product (nutritional benefits); local product; organic product; drug-free product (i.e., hormones and antibiotics); other |
| 20. How healthy do you perceive sheep or goat dairy products? | Very healthy; healthy; neither healthy nor unhealthy; unhealthy; very unhealthy |
| 21. Why do you think that dairy products from goats and sheep are healthy? Please choose up to 3. | Nutritional benefits; hypoallergenic; natural product; easy digestion; less processed; more traditional; remedy (for example, for asthma); other |

mographic information (age, sex, education, employment status, country, growing up in the countryside, familiarity with livestock farming); (2) type and frequency of small ruminant dairy product consumption; (3) knowledge and perception of small ruminant dairy products (Table 1).

Before implementing the final questionnaire, we performed a pilot survey among 40 participants to evaluate the questions in terms of clarity, the accuracy of response options, use of scientific and colloquial terminologies, and the overall flow of the survey. The questionnaire was initially developed in English and

was adjusted based on feedback from the pilot survey. Native Danish, Spanish, Italian, Greek, and Bengali speakers translated the final questionnaire separately. Depending on the language, the questionnaire was written using 3 different alphabets: Greek, Latin, and Bengali.

Data and Statistical Analysis

Question response alternatives that were scarcely selected or mentioned were regrouped to form a new category. Contingency tables were prepared, and chi-

squared tests were performed to determine the association between the country of origin, age, and gender. Categorical and ordinal data were shown as frequencies and percentages. Statistical analysis was performed using JMP v11 software (SAS Institute Inc.) and R software (R Core Team, 2021).

To determine the relationship between the variables for purchasing and consumption behaviors of respondents who declared consumption of dairy products, a multiple correspondence analysis (MCA) was carried out. The MCA is a data-analysis technique for nominal categorical data and is used to detect and represent underlying structures in a data set. The technique uses a reduction in dimensions of a group of studied variables to graphically represent the relationship structure of 2 or more qualitative variables through positioning maps.

Similarly, in the case of nonconsumers, an MCA was carried out to determine whether there was an association between sociodemographic variables and the reasons that justified nonconsumption. Before conducting the MCA analyses, some of the responses obtained were transformed into dichotomous variables (yes/no). The suitability of variables included in the MCA was assessed by the chi-squared test. The variables that showed significant correlations with fewer than 50% of the total variables were discarded. Eigen values greater than the value of the mean (Greenacre, 2006) and the Cronbach alpha index (George and Mallery, 2003) were used for the selection of an appropriate number of dimensions.

RESULTS

Sociodemographic Characteristics

In total, 1,879 surveys were answered and completed (Table 2). Most surveys were from Mexico and Italy (30% and 33.7%, respectively). Most respondents were aged between 18 and 29 yr old (51.7%) and female (56.5%). Bangladesh surveys were only answered by males. Most respondents had bachelor's (39.4%) or master's (24.3%) degrees and were employed (51.4%). More than half of respondents declared they did not grow up in the countryside (60.5%), but were familiar with or related to livestock farming (54.2%), with the highest prevalence of Denmark respondents (92%) who also declared to have grown up in the countryside (66%). The country of origin influenced the sociodemographic variables of age, gender, education, and employment correlations with their place of growth and their correlation with livestock production. Two members of the research team assessed the completeness and quality of the surveys.

Consumers of Sheep or Goat Dairy Products

Most respondents (74%) declared they consume dairy products from small ruminants, with the highest numbers from Italy, Spain, and Greece. Consumption frequency was 1 to 2 times per week. Mexico, Denmark, and Chile had a similar percentage of respondents consuming small ruminant products, and Bangladesh had the lowest (Table 3).

In the global sample (number of samples = 1,879), respondents preferred to consume products from both sheep and goats (49.4%); however, in Mexico, Denmark, and Bangladesh, more than 50% preferred goat dairy products. Consumers from Mediterranean countries declared a preference for sheep dairy products over goat dairy products. Overall, the most-consumed products were mature and fresh cheeses. Differences were observed between countries: Aged (mature) cheese was the preferred product in Chile and Spain; in Mexico, Italy, Greece, and Denmark, fresh cheese was in first place. Unlike the rest of the countries, in Bangladesh, milk consumption was reported for more than 30% of respondents, followed by yogurt consumption (more than 20%). Another aspect to highlight is the high percentage of respondents who consumed milk candy (*cajeta*) in Mexico (23.7%). More than 50% of respondents considered dairy products from sheep and goats healthy (Figure 1), with no differences between consumers and nonconsumers. The perception of healthfulness (from both consumers and nonconsumers of dairy products from small ruminants) was based on the nutritional benefits (31.5%) and the view of small ruminant dairy products as natural (20.2%), less processed (15.1%), traditional (13.4%), or easy to digest (12.5%). Proteins, followed by fatty acids and vitamins, were the most prioritized nutrients declared by respondents (Figure 2).

As the purpose of the MCA was to reveal purchasing behavior (frequency and reasons for consumption) and obtain consumer profiles, in the first analysis, only respondents who consumed dairy products were included (Figure 3), and 26 variables were used (country, continent, age, gender, education, employment, grew up in rural areas, relationship with livestock, preferred species of consumption, frequency of consumption, purchases from supermarket, purchases from local businesses, interest in nutrients consumed, consider healthy, consider tasty, consider traditional, consider that it has a strong taste and smell, associated with well-being and health, associated with appetizing, associated with the Mediterranean diet, would pay more for local production, would pay more for animal welfare, would pay more for environmentally friendly, healthy for less process-

Table 2. Characteristics of surveyed participants from Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh)

| Characteristic | Participants, n (%) | | | | | | | | Total 1,879 (100) | P-value ¹ |
|---|---------------------|-------------------|---------------------|-------------------|----------------------|---------------------|-------------------------|-------------------------|----------------------|----------------------|
| | Mexico 563 (30) | Chile 59 (3.1) | Italy 633 (33.7) | Spain 89 (4.7) | Greece 306 (16.3) | Denmark 44 (2.3) | Bangladesh 185 (9.8) | Bangladesh 185 (9.8) | | |
| Age | | | | | | | | | | |
| 18–29 | 337 (59.9) | 3 (5.1) | 236 (37.3) | 4 (4.5) | 200 (65.4) | 27 (61.4) | 164 (88.6) | 971 (51.7) | >0.001 | |
| 30–39 | 89 (15.8) | 3 (5.1) | 82 (13) | 26 (29.2) | 42 (13.7) | 9 (20.5) | 19 (10.3) | 270 (14.4) | | |
| 40–49 | 75 (13.3) | 28 (47.5) | 73 (11.5) | 32 (36) | 31 (10.1) | 2 (4.5) | 2 (1.1) | 243 (12.9) | | |
| 50–59 | 36 (6.4) | 17 (28.8) | 150 (23.7) | 18 (20.2) | 18 (5.9) | 4 (9.1) | 0 (0) | 243 (12.9) | | |
| 60 + | 26 (4.6) | 8 (13.6) | 92 (14.5) | 9 (10.1) | 15 (4.9) | 2 (4.5) | 0 (0) | 152 (8.1) | | |
| Sex | | | | | | | | | | |
| Male | 219 (38.9) | 31 (52.5) | 240 (37.9) | 15 (16.9) | 113 (36.9) | 6 (13.6) | 185 (100) | 809 (43.1) | >0.001 | |
| Female | 339 (60.2) | 28 (47.5) | 390 (61.6) | 74 (83.1) | 193 (63.1) | 38 (86.4) | 0 (0) | 1,062 (56.5) | | |
| Other | 5 (0.9) | 0 (0) | 3 (0.5) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 8 (0.4) | | |
| Highest level of education achieved | | | | | | | | | | |
| Primary education | 9 (1.6) | (0) | 6 (0.9) | (0) | 1 (0.3) | 1 (2.3) | (0) | 17 (0.9) | >0.001 | |
| Secondary education | 141 (25) | 3 (5.1) | 144 (22.7) | 10 (11.2) | 77 (25.2) | 11 (25) | 24 (13) | 410 (21.8) | | |
| Bachelor's | 308 (54.7) | 10 (16.9) | 104 (16.4) | 41 (46.1) | 148 (48.4) | 13 (29.5) | 117 (63.2) | 741 (39.4) | | |
| Master's | 82 (14.6) | 23 (39) | 215 (34) | 19 (21.3) | 61 (19.9) | 18 (40.9) | 39 (21.1) | 457 (24.3) | | |
| PhD | 23 (4.1) | 23 (39) | 164 (25.9) | 19 (21.3) | 19 (6.2) | 1 (2.3) | 5 (2.7) | 254 (13.5) | | |
| Employment status | | | | | | | | | | |
| Employed | 144 (25.6) | 22 (37.3) | 213 (33.6) | 43 (48.3) | 132 (43.1) | 12 (27.3) | 15 (8.1) | 581 (30.9) | >0.001 | |
| Employed (agricultural/veterinary/animal science) | 100 (17.8) | 32 (54.2) | 199 (31.4) | 24 (27) | (0) | 9 (20.5) | 22 (11.9) | 386 (20.5) | | |
| Unemployed | 43 (7.6) | 2 (3.4) | 39 (6.2) | 11 (12.4) | 18 (5.9) | 4 (9.1) | 5 (2.7) | 122 (6.5) | | |
| Retired | 8 (1.4) | (0) | 18 (2.8) | 5 (5.6) | 16 (5.2) | 1 (2.3) | (0) | 48 (2.6) | | |
| Retired (agricultural/veterinary/animal science) | 8 (1.4) | 2 (3.4) | 9 (1.4) | (0) | 48 (15.7) | (0) | (0) | 67 (3.6) | | |
| Student | 118 (21) | (0) | 71 (11.2) | 3 (3.4) | 39 (12.7) | 7 (15.9) | 10 (5.4) | 248 (13.2) | | |
| Student (agricultural/veterinary/animal science) | 142 (25.2) | 1 (1.7) | 84 (13.3) | 3 (3.4) | 53 (17.3) | 11 (25) | 133 (71.9) | 427 (22.7) | | |
| Grew up in the countryside | | | | | | | | | | |
| Yes | 212 (37.7) | 19 (32.2) | 233 (36.8) | 28 (31.5) | 117 (38.2) | 123 (66.5) | 11 (25) | 743 (39.5) | >0.001 | |
| No | 351 (62.3) | 40 (67.8) | 400 (63.2) | 61 (68.5) | 189 (61.8) | 62 (33.5) | 33 (75) | 1,136 (60.5) | | |
| Familiar or related to livestock farming | | | | | | | | | | |
| Yes | 242 (43) | 37 (62.7) | 341 (53.9) | 27 (30.3) | 168 (54.9) | 170 (91.9) | 33 (75) | 1,018 (54.2) | >0.001 | |
| No | 321 (57) | 22 (37.3) | 292 (46.1) | 62 (69.7) | 138 (45.1) | 15 (8.1) | 11 (25) | 861 (45.8) | | |

¹The P-value indicates significant differences between countries for the distribution of the analyzed characteristic.

Table 3. Consumption of sheep and goat dairy products from Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh)

| Characteristic | Participants, n (%) | | | | | | | | | | P-value ¹ |
|--|---------------------|-----------|------------|-----------|------------|-----------|------------|--------------|--|--|----------------------|
| | Mexico | Chile | Italy | Spain | Greece | Denmark | Bangladesh | Total | | | |
| Consumption of sheep or goat dairy products | | | | | | | | | | | |
| Yes | 335 (59.5) | 37 (62.7) | 574 (90.7) | 80 (89.9) | 246 (80.4) | 27 (61.4) | 91 (49.2) | 1,390 (74) | | | |
| No | 228 (40.5) | 22 (37.3) | 59 (9.3) | 9 (10.1) | 60 (19.6) | 17 (38.6) | 94 (50.8) | 489 (26) | | | |
| Preferred animal species products | | | | | | | | | | | |
| Both | 132 (39.4) | 19 (51.4) | 290 (50.5) | 43 (53.8) | 170 (69.1) | 9 (33.3) | 24 (26.4) | 687 (49.4) | | | |
| Goat | 178 (53.1) | 14 (37.8) | 82 (14.3) | 14 (17.5) | 25 (10.2) | 14 (51.9) | 65 (71.4) | 392 (28.2) | | | <0.001 |
| Sheep | 25 (7.5) | 4 (10.8) | 202 (35.2) | 23 (28.8) | 51 (20.7) | 4 (14.8) | 2 (2.2) | 311 (22.4) | | | |
| Type of goat and sheep dairy products | | | | | | | | | | | |
| Fresh cheese | 281 (26.9) | 15 (22.7) | 885 (49.7) | 52 (25) | 212 (29.2) | 25 (40.3) | 14 (5.5) | 1,484 (35.8) | | | <0.001 |
| Aged cheese (protected designation of origin or not) | 155 (14.9) | 36 (54.5) | 503 (28.2) | 72 (34.6) | 193 (26.5) | 20 (32.3) | 4 (1.6) | 983 (23.7) | | | |
| Milk | 92 (8.8) | 2 (3) | 117 (6.6) | 27 (13) | 108 (14.9) | 6 (9.7) | 78 (30.8) | 430 (10.4) | | | |
| Milk candy | 247 (23.7) | 5 (7.6) | 0 (0) | 2 (1) | 32 (4.4) | 0 (0) | 21 (8.3) | 307 (7.4) | | | |
| Yogurt | 55 (5.3) | 1 (1.5) | 103 (5.8) | 19 (9.1) | 30 (4.1) | 5 (8.1) | 55 (21.7) | 268 (6.5) | | | |
| Butter | 69 (6.6) | 0 (0) | 48 (2.7) | 9 (4.3) | 62 (8.5) | 3 (4.8) | 32 (12.6) | 223 (5.4) | | | |
| Cosmetics (soaps and creams) | 74 (7.1) | 6 (9.1) | 80 (4.5) | 22 (10.6) | 20 (2.8) | 1 (1.6) | 15 (5.9) | 218 (5.3) | | | |
| Ice cream | 63 (6) | 1 (1.5) | 44 (2.5) | 4 (1.9) | 70 (9.6) | 2 (3.2) | 30 (11.9) | 214 (5.2) | | | |
| Other | 7 (0.7) | 0 (0) | 1 (0.1) | 1 (0.5) | 0 (0) | 0 (0) | 4 (1.6) | 13 (0.3) | | | |
| Consumption frequency | | | | | | | | | | | |
| Every day | 0 (0) | 1 (2.7) | 17 (3) | 4 (5) | 50 (20.3) | 1 (3.7) | 8 (8.8) | 81 (5.8) | | | <0.001 |
| 3-6 times per week | 34 (10.1) | 0 (0) | 71 (12.4) | 19 (23.8) | 83 (33.7) | 1 (3.7) | 10 (11) | 218 (15.7) | | | |
| 1-2 times per week | 50 (14.9) | 5 (13.5) | 219 (38.2) | 30 (37.5) | 67 (27.2) | 3 (11.1) | 15 (16.5) | 389 (28) | | | |
| 2-3 times per month | 131 (39.1) | 14 (37.8) | 211 (36.8) | 22 (27.5) | 31 (12.6) | 11 (40.7) | 15 (16.5) | 435 (31.3) | | | |
| 1-2 times per year | 110 (32.8) | 17 (45.9) | 49 (8.5) | 5 (6.3) | 8 (3.3) | 11 (40.7) | 23 (25.3) | 223 (16) | | | |
| When necessary (for example, due to sickness) | 10 (3) | 0 (0) | 7 (1.2) | 0 (0) | 7 (2.8) | 0 (0) | 20 (22) | 44 (3.2) | | | |
| Goat or sheep dairy products purchase place | | | | | | | | | | | |
| Supermarket | 243 (44.9) | 29 (50.9) | 441 (43.9) | 73 (51.4) | 221 (55.4) | 25 (69.4) | 20 (16) | 1,052 (45.6) | | | <0.001 |
| Local market | 120 (22.2) | 13 (22.8) | 268 (26.7) | 29 (20.4) | 89 (22.3) | 7 (19.4) | 59 (47.2) | 585 (25.4) | | | |
| Local farm | 59 (10.9) | 4 (7) | 210 (20.9) | 12 (8.5) | 42 (10.5) | 2 (5.6) | 30 (24) | 359 (15.6) | | | |
| During countryside trips | 109 (20.1) | 9 (15.8) | 76 (7.6) | 24 (16.9) | 43 (10.8) | 2 (5.6) | 13 (10.4) | 276 (12) | | | |
| Online suppliers | 10 (1.8) | 2 (3.5) | 10 (1) | 4 (2.8) | 4 (1) | 0 (0) | 3 (2.4) | 33 (1.4) | | | |

¹The P-value indicates significant differences between countries for the distribution of the analyzed characteristic.

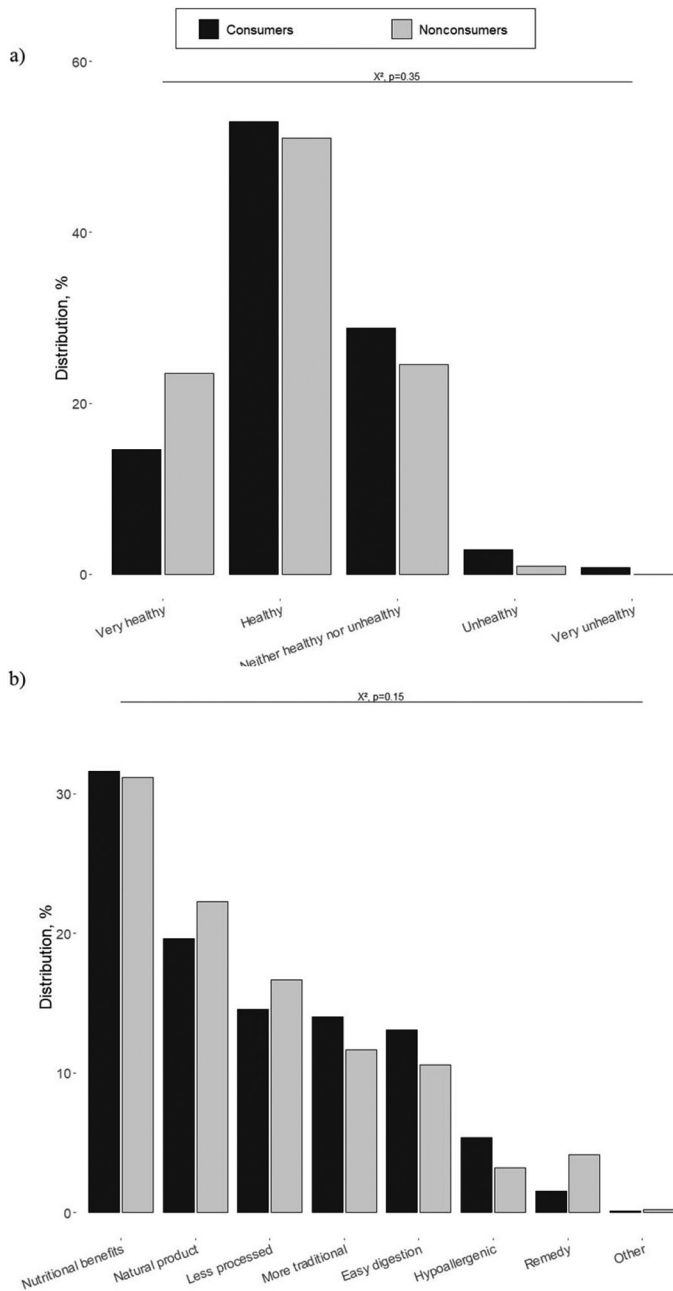


Figure 1. Perception of how healthy sheep and goat dairy products are by (a) consumers and (b) nonconsumers, and their reasons.

ing, healthy for nutritional benefits, healthy for being a natural food).

Based on the correlation between pairs of variables determined by the chi-squared test, 10 variables were eliminated (grew up in rural areas, relationship with livestock, local production or fair trade, consider traditional, associated with appetizing, would pay more for local production, would pay more for animal welfare, would pay more for environmentally friendly, healthy for less processing, healthy for being a natural food).

As a result, 16 variables were included in the MCA (Figure 3). From those variables, it was possible to define 5 dimensions that explained 76% of the variability with a Cronbach's Alpha value of 0.628. Cronbach's α value relates to a weighted average of the correlations between the variables that were registered in the MCA. This allowed us to quantify the level of reliability of the new measurement scale built through the extracted dimensions so that the obtained value is considered acceptable (Taber, 2018).

Dimension 1 was associated with the geographic location of the respondent (country and continent), the type of milk (sheep or goat), and the consideration of well-being and health as a characteristic associated with the consumption of dairy products from sheep and goats. Dimension 2 was also associated with the respondent's country of origin and the frequency of consumption. Dimension 3 was associated with gender, education, and employment status. Dimension 4 was associated with the age of the respondents, the association of the "healthy" concept with sheep and goat dairy products, and the consideration of the nutritional benefits of dairy as responsible for considering them healthy. Finally, dimension 5 was associated with the "strong smell and taste" of sheep and goat dairy products.

Except for Denmark, European countries had the highest consumption frequencies, and Greece had the highest rate of respondents with daily consumption of dairy products from sheep and goats (Figure 4). In Latin American and Asian countries, consumption was less frequent, thus, the response to a consumption rate of once or twice per year was more common. In retired respondents (regardless of discipline) and people older than 60 yr in European countries, frequent consumption of sheep and goat dairy products was observed, as well as an association of these products with the Mediterranean diet. In the younger population or students, consumption frequency was lower, with a tendency to associate sheep and goat dairy products with a strong smell and taste. Consumption frequency was slightly higher in men, who considered these products healthier than women and associated them with wellness and fitness (Figure 3). Most respondents (45.6%) declared they buy sheep and goat dairy products from supermarkets, though Bangladesh consumers mainly purchase them from local markets (Table 3).

Nonconsumers of Sheep or Goat Dairy Products

To perform an MCA in nonconsumers, 29 potential variables to incorporate were initially defined: country; continent; age; gender; education; employment; grew up in rural areas (yes/no); relationship with livestock (yes/no); does not consume due to: allergy, intolerance,

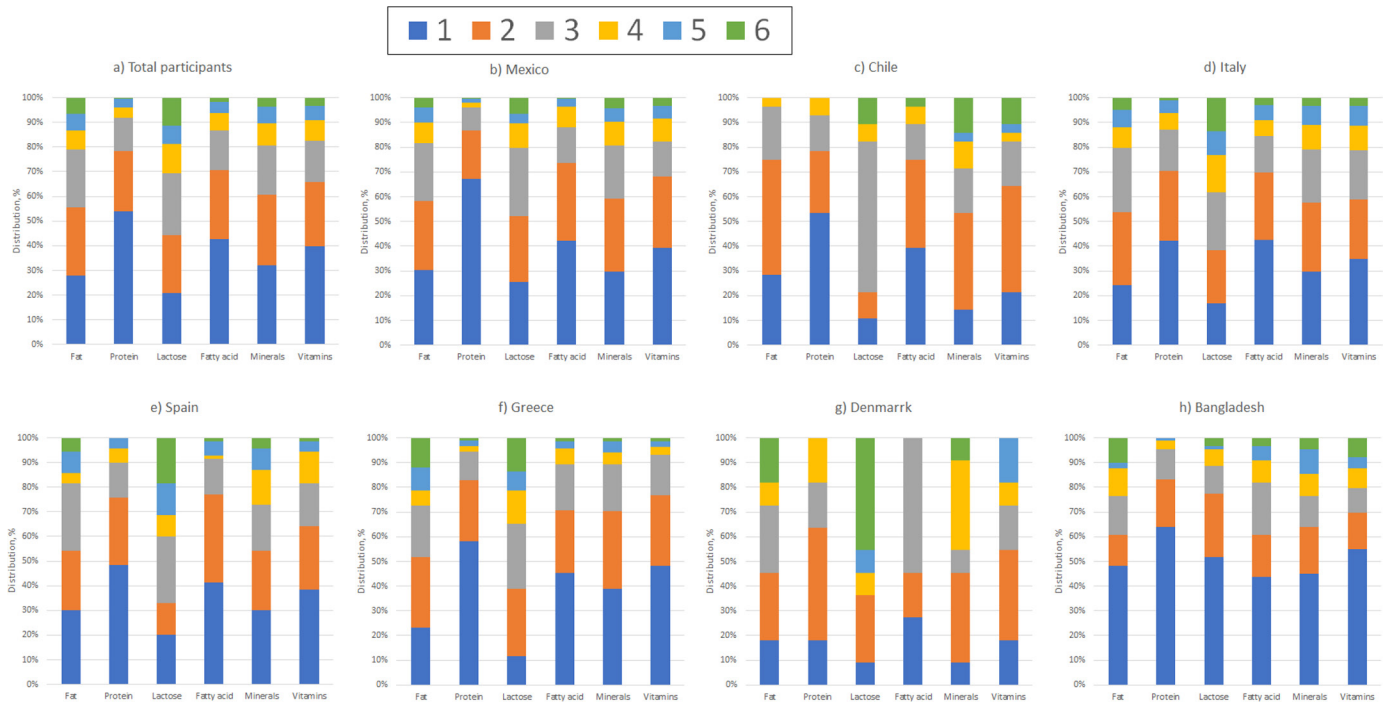


Figure 2. Reported prioritized nutrients (fat, protein, lactose, fatty acids, minerals, and vitamins) of sheep and goat dairy products for the (a) total sample and stratified by country: (b) Mexico, (c) Chile, (d) Italy, (e) Spain, (f) Greece, (g) Denmark, and (h) Bangladesh. Response options range from 1 (most important) to 6 (least important).

limited availability, I do not know them, strong flavor and odor, price, ethical/animal welfare concern, health concern, concern about added hormones or antibiotics, zoonoses, sustainability/greenhouse effect concern, dislike; characteristics related to dairy products: healthy, tasty, traditional, strong flavor and odor; concepts associated with sheep or goat dairy products: wellness and fitness, Mediterranean diet, local farming, gourmet products; I would pay more: for animal welfare-friendly product, environmentally friendly product, drug-free product, nutritional benefits, and organic product.

The correlation between pairs of variables determined by the chi-squared test resulted in the elimination of 13 variables (education; does not consume due to: allergy, intolerance, strong flavor and odor, price, health concern, concern about added hormones or antibiotics, zoonoses; characteristics related to dairy products: traditional, strong flavor and odor, tasty; concepts associated with sheep or goat dairy products: Mediterranean diet, local farming, gourmet products; I would pay more for: animal welfare-friendly product, environmentally friendly product, and drug-free product).

Carrying out an MCA with the 16 remaining variables allowed the extraction of 4 dimensions, which explained 70% of the data variability and yielded a Cronbach's Alpha value of 0.636. Dimension 1 was as-

sociated with the respondent's place of origin, gender, and employment and explained 37% of the variability. Dimension 2 explained 18.5% of the variability and was associated with the place of origin, lack of knowledge, and the taste of sheep or goat dairy products. Dimension 3 explained 12.7% of the variability and was associated with the opinion on ethics/animal welfare, sustainability/greenhouse gases, and healthfulness. Finally, dimension 4 explained 11.6% of the variability and was associated with the place of origin (Figure 5).

Mexico had the highest percentage of people (20.2%) who do not consume sheep or goat dairy products because they are not familiar with them. In Mexico, Chile, and Bangladesh, limited market availability was the reason for nonconsumption. In European and Asian countries, nonconsumption was attributed to the fact that consumers dislike them, in addition to their concern about sustainability and climate change issues. Accounting for all respondents, the main reasons for nonconsumption were limited market availability, strong flavor and odor, and lack of knowledge about sheep and goat dairy products (Table 4). Bangladesh had the highest proportion (77%) of respondents who declared that the lack of market availability of small ruminant dairy products was the main reason for nonconsumption.

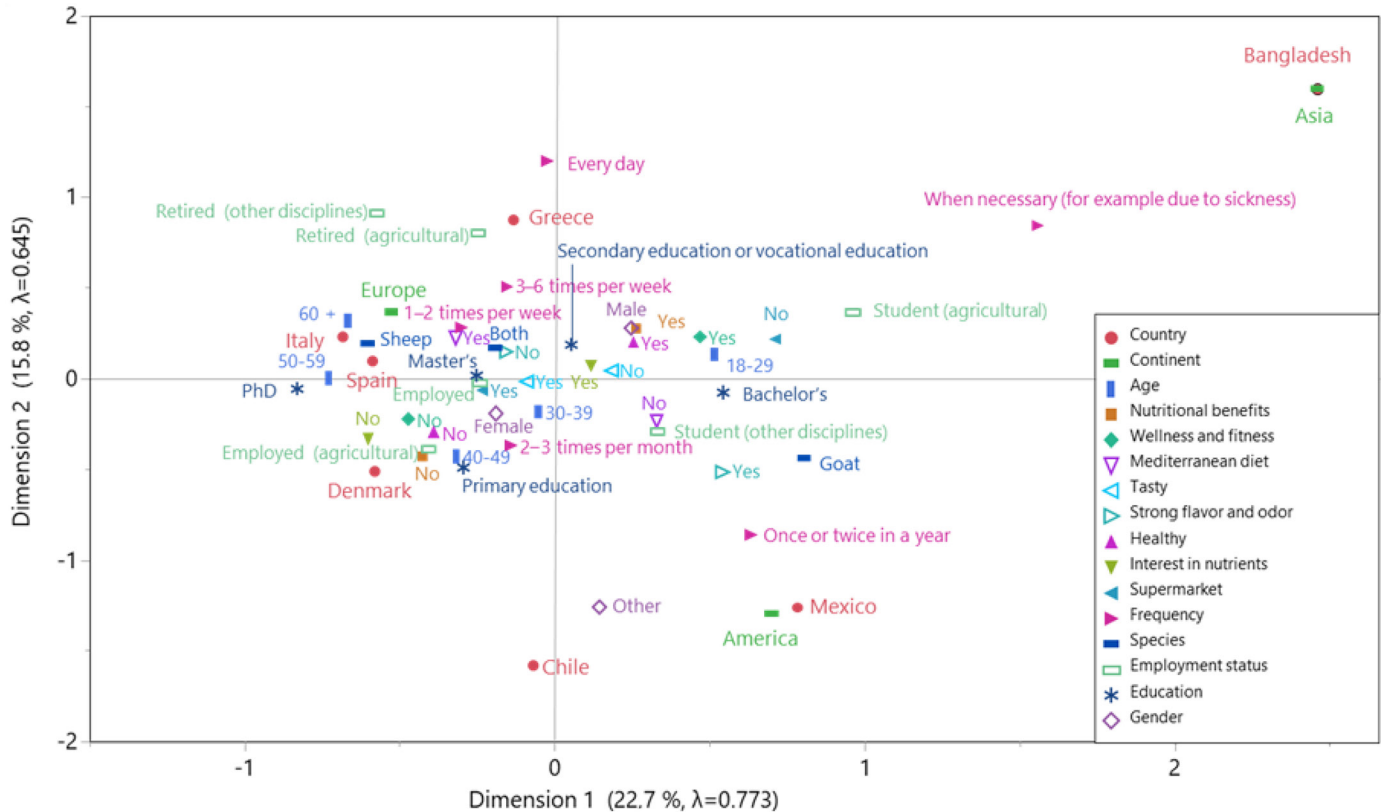


Figure 3. Multiple correspondence analysis (MCA) biplot from consumers of sheep and goat dairy products.

Knowledge and Perception

In terms of concepts, respondents perceived sheep and goat dairy products as tasty (20.7%), healthy (20.6%), and traditional (18.2%). Italian respondents had the highest perception of the products as tasty and traditional. In terms of associations, respondents declared to relate these products to local farming (22.2%), tastiness (20.5%), the Mediterranean diet (18.6%), and wellness and fitness (18.1%). Italy had the highest association with local farming, and Greek respondents perceived these products as a part of the Mediterranean diet. Except for retired people, respondents related to the livestock sector or professions and studies in the agricultural sector tended to associate dairy products with favorable qualities such as having nutritional benefits, associating them with wellness and fitness, considering them natural products, and perceiving them as healthy products, and justified their nonconsumption with limited market availability.

Most respondents (83.1%) were interested in nutrients from dairy products from sheep and goats. Compared with the rest of the countries, Bangladesh respondents were the most interested in nutrients (97.8%), while Danish respondents were less interested (59.3% not

interested) (Table 4). The features that respondents would consider paying more for (for dairy products from sheep and goats) were animal welfare-friendly products (18%), followed by local products (14.9%), and environmentally friendly products (13.9%). Denmark, Italy, and Spain were the most interested in animal welfare, followed by Mexico, Bangladesh, Greece, and Chile.

The source of information on sheep and goat dairy products was mostly obtained from formal education (i.e., schools and universities) (18.8%) and family members (16.9%). In Greece, information about these products was mainly obtained from family members (25.5%). Social media was the most important source of information in Spain (23.7%) and Mexico (20.2%).

DISCUSSION

Our results showed a clear difference between continents in terms of sheep and goat dairy product consumption. In general, dairy consumption varied between geographical regions. It has been reported that the total intake of these products is higher in Europe and North America, the Middle East, and South America than in other regions (Dehghan et al., 2018; Bhupathi et al., 2020). This partly agrees with our

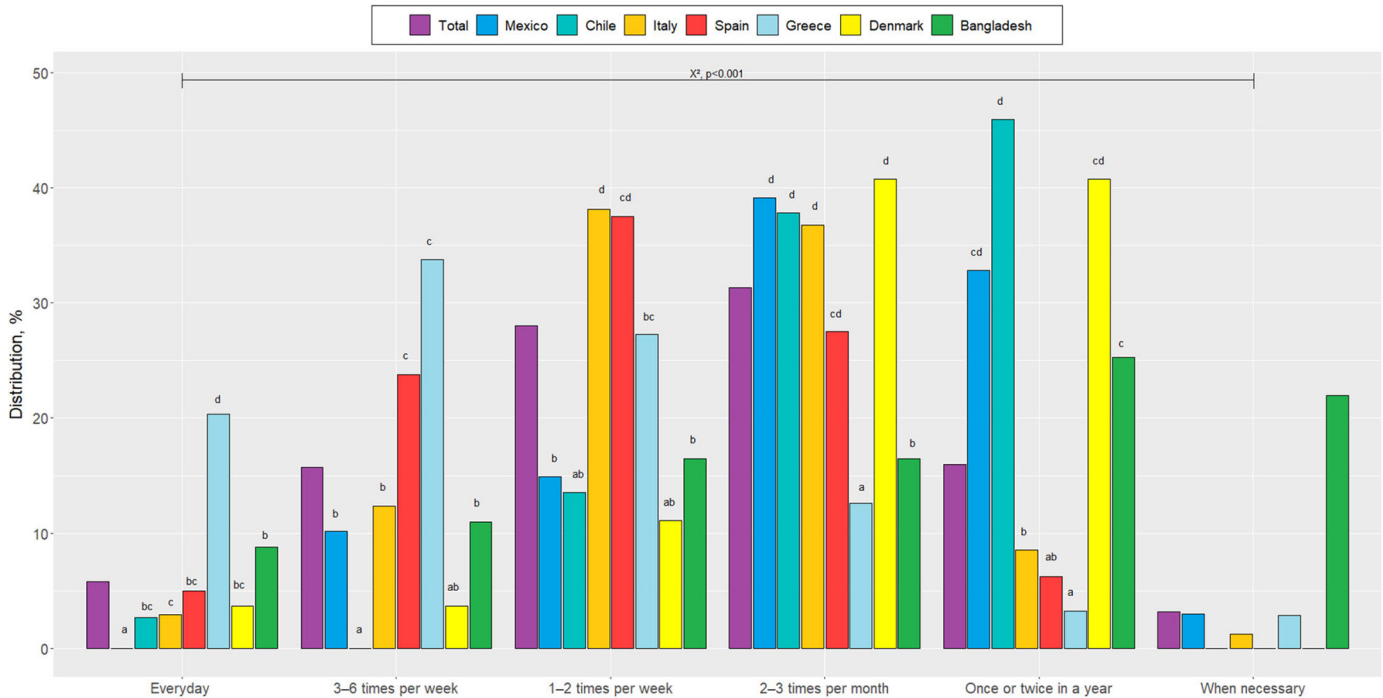


Figure 4. Frequency of sheep and goat dairy milk consumption in Mexico, Chile, Italy, Spain, Greece, Denmark, and Bangladesh. Different letters above the bars indicate significant differences between countries ($P = 0.05$).

findings, however, among European countries, we had very few respondents from Spain. This low response rate may be explained by a lack of interest in answering online surveys from different social media outlets. It is also possible that Spanish respondents considered the survey length excessive (Monroe and Adams, 2012).

The MCA allowed the association of variables that define respondents' profile and consumption behavior. For example, dimension 1 has a social profile, as it was associated with geographical location, type of dairy product, and the relationship between consumption of sheep and goat dairy products with health and well-being. Dimensions 3 and 4 were associated with demographic characteristics. In fact, dimension 3 was associated with gender, education, and employment; dimension 4 was associated with age and healthy perception of sheep and goat dairy products, with retired respondents mostly from European countries who associated dairy consumption with the typical Mediterranean diet. In Latin American countries, milk production from sheep and goats is very low compared to global production (Pulina et al., 2018), and in this study, this was somehow reflected in the low consumption frequency, regardless of demographic or social variables. A similar situation was seen in Bangladesh, where the consumption of sheep and goat dairy products occurred when necessary (due to sickness).

In the case of nonconsumers, dimension 1 was associated with demographic variables, dimension 2 with the country of origin, and dimension 3 with the perception of animal welfare and greenhouse gases. As shown in Figure 5, dimension 2 differentiates continents. For example, in Latin American countries, the main reason for not consuming small ruminant dairy products was due to a lack of knowledge about them, whereas taste was the reason for nonconsumption in Asia and Europe.

Perception of dairy products was associated with gender and employment (dimension 1): Participants who had a job related to agriculture considered dairy products to have nutritional benefits and they associated them with well-being and health, and this pattern was higher in men.

Small ruminant production systems are important for Mediterranean countries, as they preserve the environment and cultural heritage (Todaro et al., 2015, ISMEA, 2020). In this study, these factors may explain the fact that Mediterranean consumers are acquainted with small ruminant products and, interestingly, the majority (80%) of consumers from Mediterranean countries declared consumption of dairy products from small ruminants at least once weekly. The widespread consumption of sheep and goat dairy products in Mediterranean countries is also likely related to the economic importance of small ruminants in the livestock sector

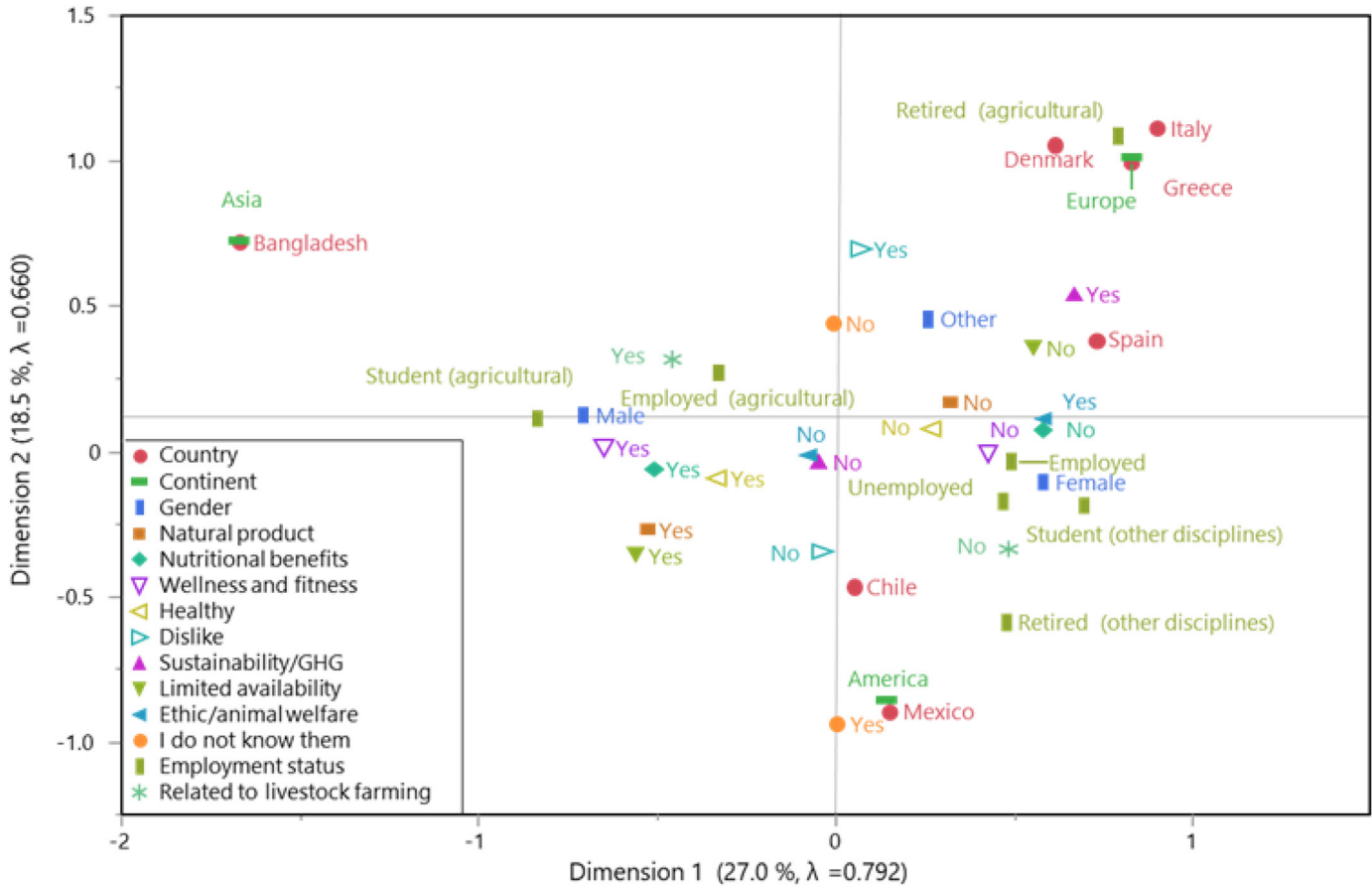


Figure 5. Multiple correspondence analysis (MCA) biplot from nonconsumers of sheep and goat dairy products.

in comparison to other European countries: being Italy first ewe cheese producer, Spain the second goat cheese producer (after France with the highest specialized goat sector; Miller and Lu, 2019), and Greece as the first ewe milk producer in the European Union (ISMEA, 2021).

Regarding dairy products in Mediterranean countries, cheeses labeled as protected designation of origin (PDO) play a key role, particularly for Italy (Pecorino cheese) and Greece (feta cheese), in the national and international markets (Pulina et al., 2018). In an Italian survey (ISMEA, 2019), respondents stated they chose whether to purchase a product based on the organoleptic features first, followed by the origin of the products. They also valued the quality-price ratio and presence of a PDO label. The survey from Cruz Maceín et al. (2019), reported that PDO labels are important for Spanish consumers as well. From the present survey, consumers acknowledged local farming and taste as characteristics of small ruminant products, followed by the association with a Mediterranean diet, with the exception of Bangladesh, where dairy products were mostly associated with wellness and fitness. Indeed,

Bangladeshi consumers declared they would pay more for enriched nutritional products. According to our data, goat dairy products from a local market are more prevalent than ewe products in Bangladesh. Moreover, goat milk is particularly appreciated in Bangladesh due to its recognized therapeutic properties (Hossain et al., 2004; Getaneh et al., 2016).

It has been reported that consumption of dairy products is generally low in low-income and middle-income countries (Dehghan et al., 2018). This general assumption about consumer distribution was not particularly supported by our findings. Nonconsumers from Mexico, Chile, and Bangladesh declared they were particularly unmotivated to consume sheep or goat dairy products because of the limited availability in their national markets (Table 4), whereas in Denmark, nearly half of the nonconsumers dislike them, partly because they perceive them as having a too-strong flavor.

In this study, consumption from European countries reflected the importance and existence of products in supermarkets. For example, Greece is the largest producer of goat dairy products, with a production of

Table 4. Knowledge and perception from surveyed participants on sheep and goat dairy products from Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh)

| Characteristic | Participants, n (%) | | | | | | | | | | P-value |
|---|---------------------|-----------|------------|-----------|------------|-----------|------------|--------------|--------|--|---------|
| | Mexico | Chile | Italy | Spain | Greece | Denmark | Bangladesh | Total | | | |
| Reason for not consuming goat or sheep dairy products | | | | | | | | | | | |
| Limited availability in the national market | 130 (19.5) | 16 (34) | 6 (5.1) | 5 (31.3) | 6 (5.6) | 5 (15.2) | 77 (27.5) | 245 (19.3) | <0.001 | | |
| Strong flavor and odor | 90 (13.5) | 8 (17) | 21 (17.8) | 5 (31.3) | 32 (29.9) | 9 (27.3) | 47 (16.8) | 212 (16.7) | | | |
| I do not know them | 135 (20.2) | 4 (8.5) | 9 (7.6) | 1 (6.3) | 12 (11.2) | 4 (12.1) | 28 (10) | 193 (15.2) | | | |
| Dislike | 58 (8.7) | 4 (8.5) | 21 (17.8) | 1 (6.3) | 33 (30.8) | 8 (24.2) | 38 (13.6) | 163 (12.8) | | | |
| Price | 80 (12) | 10 (21.3) | 3 (2.5) | 2 (12.5) | 5 (4.7) | 3 (9.1) | 30 (10.7) | 133 (10.5) | | | |
| Lactose intolerance | 51 (7.6) | 4 (8.5) | 11 (9.3) | 0 (0) | 4 (3.7) | 2 (6.1) | 13 (4.6) | 85 (6.7) | | | |
| Ethical/animal welfare concern | 31 (4.6) | 0 (0) | 11 (9.3) | 1 (6.3) | 6 (5.6) | 1 (3) | 6 (2.1) | 56 (4.4) | | | |
| Concern about added hormones or antibiotics | 30 (4.5) | 0 (0) | 9 (7.6) | 1 (6.3) | 2 (1.9) | 0 (0) | 5 (1.8) | 47 (3.7) | | | |
| Animal-to-human disease transmission | 24 (3.6) | 0 (0) | 5 (4.2) | 0 (0) | 1 (0.9) | 0 (0) | 9 (3.2) | 39 (3.1) | | | |
| Health concern | 19 (2.8) | 1 (2.1) | 4 (3.4) | 0 (0) | 2 (1.9) | 0 (0) | 12 (4.3) | 38 (3) | | | |
| Sustainability/greenhouse effect concern | 12 (1.8) | 0 (0) | 17 (14.4) | 0 (0) | 3 (2.8) | 0 (0) | 4 (1.4) | 36 (2.8) | | | |
| Allergy | 8 (1.2) | 0 (0) | 1 (0.8) | 0 (0) | 1 (0.9) | 1 (3) | 11 (3.9) | 22 (1.7) | | | |
| Concepts related to dairy products from goats and sheep | | | | | | | | | | | |
| Tasty | 277 (17.5) | 38 (22.4) | 419 (24.6) | 64 (25.5) | 145 (17.8) | 21 (18.8) | 102 (20.1) | 1,066 (20.7) | <0.001 | | |
| Healthy | 332 (21) | 29 (17.1) | 299 (17.6) | 62 (24.7) | 204 (25) | 18 (16.1) | 113 (22.3) | 1,057 (20.6) | | | |
| Traditional | 232 (14.7) | 15 (8.8) | 400 (23.5) | 36 (14.3) | 197 (24.2) | 11 (9.8) | 44 (8.7) | 935 (18.2) | | | |
| Strong flavor and odor | 254 (16.1) | 31 (18.2) | 241 (14.2) | 34 (13.5) | 135 (16.6) | 26 (23.2) | 89 (17.6) | 810 (15.8) | | | |
| Family farm (small-scale farmers) | 186 (11.8) | 23 (13.5) | 247 (14.5) | 26 (10.4) | 83 (10.2) | 15 (13.4) | 86 (17) | 666 (13) | | | |
| Expensive | 165 (10.4) | 30 (17.6) | 29 (1.7) | 14 (5.6) | 23 (2.8) | 11 (9.8) | 48 (9.5) | 320 (6.2) | | | |
| Useful for cooking | 110 (7) | 4 (2.4) | 47 (2.8) | 11 (4.4) | 22 (2.7) | 7 (6.3) | 14 (2.8) | 215 (4.2) | | | |
| Unhealthy | 14 (0.9) | 0 (0) | 16 (0.9) | 3 (1.2) | 6 (0.7) | 1 (0.9) | 5 (1) | 45 (0.9) | | | |
| Other | 11 (0.7) | 0 (0) | 5 (0.3) | 1 (0.4) | 0 (0) | 2 (1.8) | 6 (1.2) | 25 (0.5) | | | |
| Characteristics associated with dairy products from goats and sheep | | | | | | | | | | | |
| Local farming | 240 (15.7) | 25 (15.2) | 477 (29.4) | 39 (16.3) | 163 (21.5) | 24 (23.3) | 122 (24.4) | 1,090 (22.2) | <0.001 | | |
| Tasty | 253 (16.6) | 31 (18.9) | 381 (23.5) | 64 (26.7) | 139 (18.3) | 21 (20.4) | 118 (23.6) | 1,007 (20.5) | | | |
| Mediterranean diet | 190 (12.5) | 36 (22) | 345 (21.2) | 54 (22.5) | 228 (30) | 28 (27.2) | 31 (6.2) | 912 (18.6) | | | |
| Wellness and fitness | 283 (18.6) | 19 (11.6) | 237 (14.6) | 43 (17.9) | 145 (19.1) | 4 (3.9) | 156 (31.3) | 887 (18.1) | | | |
| Gourmet products | 354 (23.2) | 43 (26.2) | 92 (5.7) | 32 (13.3) | 45 (5.9) | 21 (20.4) | 14 (2.8) | 601 (12.2) | | | |
| Fair trade | 82 (5.4) | 1 (0.6) | 63 (3.9) | 5 (2.1) | 19 (2.5) | 1 (1) | 16 (3.2) | 187 (3.8) | | | |
| Social status | 82 (5.4) | 4 (2.4) | 20 (1.2) | 0 (0) | 8 (1.1) | 1 (1) | 31 (6.2) | 146 (3) | | | |
| Fashion | 33 (2.2) | 5 (3) | 4 (0.2) | 3 (1.3) | 11 (1.4) | 2 (1.9) | 9 (1.8) | 67 (1.4) | | | |
| Other | 7 (0.5) | 0 (0) | 5 (0.3) | 0 (0) | 1 (0.1) | 1 (1) | 2 (0.4) | 16 (0.3) | | | |
| Interest in the nutrients of the dairy sheep/goat products | | | | | | | | | | | |
| Interested | 299 (89.3) | 28 (75.7) | 442 (77) | 70 (87.5) | 216 (87.8) | 11 (40.7) | 89 (97.8) | 1,155 (83.1) | <0.001 | | |
| Not interested | 36 (10.7) | 9 (24.3) | 132 (23) | 10 (12.5) | 30 (12.2) | 16 (59.3) | 2 (2.2) | 235 (16.9) | | | |
| Features you would pay more for | | | | | | | | | | | |
| Animal welfare-friendly product | 244 (15.8) | 24 (15.3) | 381 (21.6) | 41 (16.7) | 126 (15.6) | 29 (25.7) | 78 (15.8) | 923 (18) | <0.001 | | |
| Local product | 167 (10.8) | 34 (21.7) | 292 (16.6) | 55 (22.4) | 150 (18.6) | 14 (12.4) | 55 (11.1) | 767 (14.9) | | | |
| Environmentally friendly product | 229 (14.8) | 19 (12.1) | 248 (14.1) | 30 (12.2) | 86 (10.6) | 13 (11.5) | 90 (18.2) | 715 (13.9) | | | |
| Functional product (nutritional benefits) | 235 (15.2) | 25 (15.9) | 172 (9.8) | 28 (11.4) | 78 (9.7) | 6 (5.3) | 139 (28.1) | 683 (13.3) | | | |
| Drug-free product (i.e., hormones and antibiotics) | 150 (9.7) | 13 (8.3) | 225 (12.8) | 36 (14.7) | 165 (20.4) | 6 (5.3) | 62 (12.5) | 657 (12.8) | | | |
| Sustainable product | 220 (14.2) | 17 (10.8) | 222 (12.6) | 16 (6.5) | 47 (5.8) | 27 (23.9) | 35 (7.1) | 584 (11.4) | | | |
| Organic product | 137 (8.8) | 6 (3.8) | 158 (9) | 15 (6.1) | 120 (14.9) | 9 (8) | 24 (4.8) | 469 (9.1) | | | |
| Fair trade | 164 (10.6) | 19 (12.1) | 62 (3.5) | 23 (9.4) | 36 (4.5) | 6 (5.3) | 12 (2.4) | 322 (6.3) | | | |
| I would not pay more | 1 (0.1) | 0 (0) | 2 (0.1) | 1 (0.4) | 0 (0) | 1 (0.9) | 0 (0) | 5 (0.1) | | | |
| Other | 2 (0.1) | 0 (0) | 2 (0.1) | 0 (0) | 0 (0) | 2 (1.8) | 0 (0) | 6 (0.1) | | | |
| Information sources | | | | | | | | | | | |

Continued

Table 4 (Continued). Knowledge and perception from surveyed participants on sheep and goat dairy products from Latin America (Mexico and Chile), Europe (Italy, Spain, Greece, and Denmark), and Asia (Bangladesh)

| Characteristic | Participants, n (%) | | | | | | | Total | P-value |
|--|---------------------|-----------|------------|-----------|------------|-----------|------------|------------|---------|
| | Mexico | Chile | Italy | Spain | Greece | Denmark | Bangladesh | | |
| Education (e.g., school or university) | 266 (18.4) | 21 (14.5) | 255 (19.2) | 25 (12.1) | 106 (15.1) | 13 (16.9) | 141 (29.1) | 827 (18.8) | <0.001 |
| Family | 214 (14.8) | 21 (14.5) | 201 (15.1) | 39 (18.8) | 179 (25.5) | 10 (13) | 76 (15.7) | 740 (16.9) | |
| Social media | 292 (20.2) | 19 (13.1) | 159 (12) | 49 (23.7) | 89 (12.7) | 11 (14.3) | 84 (17.3) | 703 (16) | |
| Friends or colleagues | 248 (17.2) | 35 (24.1) | 233 (17.5) | 27 (13) | 92 (13.1) | 16 (20.8) | 38 (7.8) | 689 (15.7) | |
| Journals or books | 217 (15) | 20 (13.8) | 219 (16.5) | 35 (16.9) | 95 (13.5) | 10 (13) | 38 (7.8) | 634 (14.4) | |
| Newspapers or magazines | 75 (5.2) | 14 (9.7) | 158 (11.9) | 20 (9.7) | 40 (5.7) | 7 (9.1) | 49 (10.1) | 363 (8.3) | |
| Other | 4 (0.3) | 0 (0) | 20 (1.5) | 0 (0) | 0 (0) | 5 (6.5) | 0 (0) | 29 (0.7) | |

¹The P-value indicates significant differences between countries for the distribution of the analyzed characteristic.

around 600,000 t of milk (Pulina et al., 2018). In Scandinavia, Norway is likely the biggest producer of goat dairy products, as the Norwegian dairy, Tine, processed 20,000,000 liters of goat milk in 2019 (Tine, 2020), compared to Sweden's production of an estimated 1,500,000 kg in 2018 (Statens Jordbruksverk, 2019). Denmark has a very limited number of goat and sheep herds (Halasa and Boklund, 2014), and its production of goat dairy products is difficult to estimate, as neither the Ministry of Environment nor the Danish Agriculture and Food Council has published any numbers on the production size. In this study, these factors, paired with the lack of knowledge of small ruminant products, may have contributed to the lack of interest and response rate obtained from Danish consumers.

It is noteworthy that currently, the world is experiencing a "nutrition transition" that is marked by rapid changes in the composition and quantity of our diets; particularly, diets are becoming more dominated by animal protein, sugar, and saturated fats (Rizvi et al., 2018). In this sense, our results show that this transition is reflected by the 2 different types of profiles that we found using MCA (consumers vs. nonconsumers of small ruminant dairy products). It is generally known that senior respondents seem to perceive dairy products as more beneficial compared to younger consumers because they can help counteract health issues related to aging, such as high blood cholesterol and high blood pressure (Bimbo et al., 2017). This agrees with the results found in the MCA from consumers of small ruminant dairy products.

In this study, only male responses were recorded from Bangladesh. This pattern has been reported in different types of surveys (Sudo et al., 2004; Coates et al., 2010; Ferdous et al., 2020). In northwestern Bangladesh, females had a lower consumption frequency of nutritious foods and have lower energy intake compared with males (Sudo et al., 2004). It has been reported that, in the household, males and females have differences in their ability to choose food for their own consumption (Coates et al., 2010). Although Bangladesh is a multi-ethnic country with vastly different economic income, education levels, and traditions (Ferdous et al., 2020), in this study, the consumer profile differed from other continents and was very uniform.

Greek respondents declared consumption of small ruminant dairy products daily. Small ruminant production is a common agricultural activity in many areas of Greece (rural, mountainous, arid, semi-mountainous, and semi-arid; IEEP, 2006). Sheep milk is mostly used for cheese manufacturing and goat milk is normally used to supplement sheep cheeses with a PDO (Pappa et al., 2021). In a recent study assessing the changes in dietary habits in Greece, it was observed that females

consumed more dairy products than men, and a higher educational level was correlated with decreased consumption of dairy products. Interestingly, human health problems (heart attack history, hypercholesterolemia, and obesity) appear to be correlated with decreased odds of reporting higher dairy product consumption (Skourlis et al., 2020).

In this study, protein, followed by fatty acids and vitamins, were the most prioritized nutrients declared by respondents. Similarly, in a Polish consumer survey, protein and fatty acids (particularly n-3) were reported to be highly appreciated by consumers, especially for those with a “health-oriented” profile (Sajdakowska et al., 2020) or a high level of education, which agrees with results from the present study.

Regarding animal-production systems, including animal welfare-friendly practices, studies of European consumers have indicated that public perceptions of farm animal welfare are an important driver for consumption behavior (Toma et al., 2012). This aspect was confirmed in the present study for most of the surveyed countries, as was the positive perception of local products and the interest in reducing the environmental repercussions of dairy products (Table 4), which has also been reported by Canavari and Coderoni (2020). Indeed, in their study, a positive consumer preference for dairy products with a low carbon footprint was reported. It is interesting to note that only Denmark had more respondents declare more interest in sustainable products than in environmentally friendly products, while in Greece, more than one-third of respondents declared a preference for either drug-free or organic dairy products (Table 4).

To understand the cultural aspects of purchasing behavior in other national contexts, more research needs to be conducted in Mediterranean, Latin American, and Asian countries. This is important, as expanding the group of countries subject to analysis can allow food companies to reach international markets more effectively (Bimbo et al., 2017).

We recognize the significant differences in the distribution of demographic characteristics across countries. To address the possible confounding factors from this study, we chose to complement and support our table data with the MCA, a unique feature of this study that allowed us to obtain consumer and nonconsumer profiles with more accuracy, regardless of demographic characteristics. Further surveys should consider including a larger number of respondents per country, restricting enrollment to ensure all participants have the same level of the confounder, and matching respondents regarding confounding variables.

Some social aspects were reflected in the obtained data. This was noted in Bangladesh, where only males

answered the survey. This could be considered a sample bias; however, this could be explained by the fact that women have a lower education level than men, less decision-making power over household income, and time constraints due to a triple burden of productive, domestic, and community responsibilities (Quisumbing et al., 2021). A recent report by Action Aid Bangladesh in the Star Business Report (2016) revealed that Bangladeshi women spend 5 times more time on unpaid household chores than men, which may be one reason for avoiding the survey. Another explanation could be that, in Bangladeshi culture, shyness or diffidence (related to modesty and obsequiousness) is regarded as a highly desirable trait for young girls or women (Bosch, 2005).

This is the first study characterizing consumer attitudes toward dairy products from small ruminants among different countries, and more precise surveys are necessary to yield more accurate estimates in the future. Despite the limitations of the study, some emerging aspects related to the nutritional quality, sustainability, and the environmental effects of dairy products seem to be relevant in consumer choices, especially for young people.

CONCLUSIONS

This study showed that consumer attitudes toward dairy products from sheep and goats vary, specifically in consumer preferences for small ruminant dairy products, between continents. Among consumers in Italy, Greece, Denmark, and Mexico, fresh cheese is ranked as the most desirable, and aged cheese is the preferred product in Spain and Chile. In Bangladesh, consumption of milk from small ruminants came in first place, whereas a high percentage of respondents in Mexico consume milk candy. Another significant aspect was that consumption frequency was the highest in Mediterranean countries (Italy, Spain, and Greece). In Latin American countries (Chile and Mexico), consumption was limited to 2 to 3 times per month, whereas frequency in Bangladesh was 1 to 2 times per year, or as necessary due to sickness. These differences have important implications for the dairy industry. The strong relation between small ruminants and social, cultural, and landscape features of the different countries involved in the survey may partially explain the differences in the consumer attitudes observed in the present study. Therefore, the dairy industry might be expected to invest in the aspects discussed herein, as people declared themselves willing to pay more for them. A quote of the value related to these specific quality traits (i.e., environmentally friendly product, sustainable product, animal welfare-friendly product, fair trade, and local product) requested by consumers could also be trans-

ferred to the farmers able to supply milk produced in more sustainable livestock farming systems.

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