

Article

Consumer Acceptance and Preference for Camel Milk in Selected European and Mediterranean Countries

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Abstract: In this paper, we analyse consumer acceptance, preferences and attitudes to camel milk based on a cross-country study based on qualitative focus groups with consumers. Outside the main consumption countries where camel milk is a regular part of the daily diet, many consumers buy this product primarily due to its promised health benefits. Furthermore, they are willing to pay a substantial price premium for camel milk. The findings from the literature study suggest the need for further research aimed at improving the sensory quality of camel milk, camel milk fermented products (such as yoghurt, kefir, etc.) and camel milk cheese. In addition, the application of flavours could be an option to cover the perceived salty taste of camel milk. Another aspect is that more research needs to be conducted to optimize the operating parameters and standardization of the production procedures of camel milk yoghurt in the future. In general, we can state that so far only a few consumer studies exist and, in particular, for European consumers, not much is known about their attitudes, preferences and acceptance to try or to buy such a product.

Keywords: camel milk; consumer; preference; acceptance; cross-country study; focus groups



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1. Introduction

Camel milk is an important nutrient in some arid and semi-arid environments of our planet. It is a primary source of food, nutritional and income security all year round for some pastoralists [1]. Furthermore, camel milk enhances livelihoods and contributes to national and global economic growth and development [2]. Camel milk was also reported to have other potential therapeutic properties such as anti-carcinogenic [3,4], anti-diabetic [5] and anti-hypertensive [6], and has been recommended to be consumed by children who are allergic to bovine milk [7]. Camel milk is at the core of some pastoralists' culture, life and health and is considered the "white gold of the desert" [8].

Traditional producers of camel milk produce and consume the product locally. Production is generally a low-tech business and there is limited world trade in camel milk. More than 80% of the camel population inhabits Africa, with 60% in the eastern African countries (Sudan, Somalia, Ethiopia and Kenya) [9]. The global camel dairy market is currently driven by its numerous health benefits. The price of camel milk is significantly higher compared to traditional cow's milk, owing to the fact that camel milk production is lower than cow's milk, and camel breeding costs are also higher compared to that of cows.

During the last decade, camel milk entered the market in many countries of the world. The urbanization and the modernization of the farming systems fostered the development of a camel milk commodity channel although, the organization of this value chain is just beginning [2]. In 2018, the global market for camel dairy products reached a value of USD 5.6 billion. According to the "Camel Dairy Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2019–2024" [10] an annual growth rate of 8.01%

during the years 2019–2024 is proposed to reach levels worth more than USD 8 billion by 2024. The annual world production of camel milk is estimated to be 2.9 million tonnes. Somalia is a top producer with about 1 million tonnes, followed by Kenya, Mali, Ethiopia, Saudi Arabia, Niger, Sudan, UAE, Mauritania and Chad. The total world camel milk production increased by 4.6 times from 629 to 2928 thousand tonnes between 1961 and 2013, mainly due to an increase in the production in Africa or to an improvement of the census of animals and their production.

Even in the main camel-milk-producing countries, the informal sector is still dominating (not only in volume, but mainly in the number of stakeholders), the distribution network, except for the bigger integrated farms, is limited to small shops in the towns. Camel milk is still very rarely available in the main chain of supermarkets. In Europe, camel milk is only a niche product and cannot be found in the main retail chains. Companies are selling camel milk mainly via pharmacies and online channels.

In this paper, we analyse consumer acceptance, preferences and attitudes to camel milk based on a cross-country study (Germany, Spain, Turkey, Algeria and France). For this purpose, qualitative focus groups with consumers have been carried out. The aim was to identify barriers and opportunities for this product.

The focus group approach was chosen to gather detailed information on the topic for Europe (France, Germany, Spain), Turkey and the Northern-African state of Algeria and to identify barriers and drivers for camel milk consumption. There are no qualitative or quantitative consumer studies concerning camel milk in these regions. Therefore, the qualitative approach was chosen to collect first information about European, Turkish and Algerian attitudes, knowledge, consumption patterns, taste expectations and initial reactions concerning camel milk.

2. Materials and Methods

2.1. Literature Review

A literature review for identifying consumer attitudes, acceptance and preferences for camel milk using google scholar was carried out. For this purpose, the general keywords “camel milk” and “consumer” were used and in total 2.360 sources could be found. Furthermore, we checked for the combinations “Lama milk”, “Llama milk” and “consumer”, “Alpaca milk” and “consumer”, and “Vincunya milk” and “consumer”. No results could be found for these combinations. Search results that delivered no consumer insight were not retained. Thus, out of the 2.360 search results only 10 studies can be regarded as concrete consumer studies related to the consumer. In addition, project partners from the PRIMA project CamelMilk (www.camel-milk.org, accessed on 5 September 2022) from Turkey, France and Algeria were asked about consumer studies in their native language that relate to camel milk. For the Italian language, the first author of this paper carried out the research by himself. A screening of the titles and abstracts showed that most of the studies dealt only with product properties and health effects of camel milk and only a few real consumer studies for this product exist. This holds in particular for the European market. The findings of the studies are summarized in this literature review.

2.2. Focus Groups

Objectives of the Qualitative Focus Groups

The overall study objective was to capture and understand consumers’ . . .

- awareness;
- knowledge;
- perceptions;
- attitudes;
- acceptance

of camel milk to determine their interest in and willingness to taste and buy it as a product. Focus groups are primarily exploratory research and are used to gain an understanding of underlying reasons, opinions, and motivations [11]. We want to highlight that to the best

knowledge of the authors there have not been carried out focus groups on the topic of camel milk in the considered survey regions (see the literature analysis). There were only some quantitative research and sensory-tasting studies with a focus on camel milk. Therefore, this study represents the first cross-country study that analyses consumer aspects of camel milk on a qualitative basis.

In each of the five selected countries (Turkey, Algeria, Germany, France and Spain), two 90-minute focus groups (10 total) were carried out with four to six participants per group. The countries were selected on the basis of the project partners in the PRIMA CamelMilk project. In Germany, the focus groups took place physically at the facilities of DIL German Institute of Food Technology at Quakenbrück, whereas in all other countries the discussions were online. In Turkey, Algeria and France, the agency Savanta was responsible for the moderation of the focus groups, whereas in Spain the CamelMilk project partner IRTA and in Germany the project partner DIL were in charge of this task. All discussions were run by native local moderators. IRTA and DIL supervised and attended the online focus groups of the agency Savanta for reasons of data quality. All sessions were recorded on audio and transcripts were produced. Data collection was carried out in the time period from 28th October to 23rd 2020.

For the focus groups, a mix of genders and ages from 21 to 55 years old were chosen. The participants had to be frequent consumers of milk and milk products. Furthermore, a mix of people in each group drinking milk in hot drinks and/or cereals (e.g., porridge) and/or milk by itself were selected. Furthermore, there was a mix of those drinking cow's milk and plant-based milk as their primary milk. None were rejectors of animal-based milk for vegetarian or vegan reasons. For the focus groups, the partners DIL and IRTA developed a discussion guide (see Appendix A). This guideline is the agenda for the moderator and assures that all relevant topics are covered. For the development of the discussion guide, the key findings from the desk research were used. According to the guide, the focus groups were structured as follows:

- Introduction and warm up (10 min)
- Current milk buying attitudes and behaviours (15 min)
- Knowledge/familiarity with camel milk (20 min)
- Health benefits and trade-offs (20 min)
- Expected taste (20 min)
- Wrap up (5 min)

For data analysis of the focus groups, all discussions were transcribed. Due to the fact that five countries were considered and a comparison between countries was the focus, the mentioned very structured discussion guideline was applied. Furthermore, we were interested in very specific topics identified in the literature review. In this context, we highlight that in the food sector in particular, taste (expectations) and consumers' perception of product benefits, as well as the price of the food product, play, in general, the most important role [12]. Therefore, and for budget and resource reasons, for data analysis we summarized central discussion aspects according to Rudat [13]. This simplified approach is based on using some steps of the "formulating" and "reflective" interpretation of Bohnsack [14]. For the first step, the basis for the analysis was the applied structured guideline. The anchor citations were selected based on the parameter's dominance and contrariness in the discussion. The first draft of the analysis was developed by two of the authors and then the results were discussed within the author group to reach a consensus on the final data analysis.

3. Results

3.1. Literature Review

Table 1 gives an overview of the found literature concerning consumer studies and the main findings. Search results that, e.g., related to topics such as health characteristics but that delivered no consumer insight are not listed in Table 1.

Table 1. Result of the literature review of camel milk consumer studies.

Authors	Title	Topic	Sample Size	Survey Location	Main Results
Akweya et al. (2012) [15]	The acceptability of camel milk and milk products from north eastern province in some urban areas of Kenya	Acceptability of camel milk and milk products (sensory test)	n = 138	Kenya	Most respondents consume camel milk on a daily basis. In this case, camel milk is predominantly consumed due to its nutritional value.
Al-Saleh et al. (2011) [16]	Physicochemical properties of probiotic frozen yoghurt made from camel milk	Sensory analysis frozen camel milk yoghurt	n = 20	Saudi-Arabia	Flavour scores of frozen yoghurt made from camel milk was significantly lower than those made from cow's milk.
Cheikh et al. (2022) [17]	Camel milk consumption patterns and perceptions in the UAE: A cross-sectional study.	Consumption patterns, knowledge of benefits and risks	n = 852	UAE	60% of the participants have tried drinking camel milk, but only a quarter were regular consumers.
Eissa et al. (2011) [18]	Physicochemical, microbiological and sensory characteristics of yoghurt produced from camel milk during storage	Sensory analysis of camel milk yoghurt	n = 10	Sudan	Camel milk yoghurt had lower consumer acceptability compared with cow's milk yoghurt. Participants attributed the low acceptability of camel milk yoghurt to the high concentration of salt.
Galeboea et al. (2018) [19]	Production of camel milk yoghurt: Physicochemical and microbiological quality and consumer acceptability	Sensory analysis camel milk yoghurt	n = 25	Botswana	Overall acceptance of the cow's milk yoghurt significantly excelled the camel milk counterpart.
Hashim et al. (2009) [20]	Quality and acceptability of a set-type yogurt made from camel milk	Consumer-acceptance test of camel milk yoghurt	n = 33	UAE	Processing of set-type yoghurt by use of gelatin or alginate plus calcium with acceptable sensory quality was reported for camel milk.
Hashim (2002) [21]	Acceptance of camel milk among elementary school students in al ain city, united arab emirates	School children's acceptance of camel milk (Sensory test)	n = 173	UAE	The flavoring of camel milk with chocolate enhanced the sensory quality of the milk.
Ibrahim and El Zubeir (2016) [22]	Processing, composition and sensory characteristic of yoghurt made from camel milk and camel-sheep milk mixtures	Sensory characteristic of yoghurt made from camel milk and camel-sheep milk mixtures	n = 10	Sudan	There is a low overall acceptability of camel milk yoghurt compared with yoghurt made from sheep milk.
Kempen et al. (2017) [23]	Expectancy-value theory contributes to understanding consumer attitudes towards cow's milk alternatives and variants	Consumers' beliefs that exist to influence their attitude towards cow's milk alternatives	n = 71	South-Africa	Consumers' acceptance of cow's milk alternatives such as camel milk depend on product-related expectations.
Maurizio (2017) [24]	Assessment of milk consumer preferences	Attitudes and perceptions of consumers toward donkey milk	n = 705	Italy	Consumers drink this special milk mainly because of food allergies.
Mohan et al. (2018) [25]	Consumer Acceptance of Camel Milk in Emerging Economy	Consumers' willingness to buy camel milk before and after knowing its health benefits	n = 120	India	There is a significant increase in the proportion of people willing to buy camel milk once they were aware of the benefits.

3.1.1. Health Effects of Camel Milk as Buying Factor

In the traditional African and Arab main consumption areas, the medical value of camel milk is an important factor for preference building. A consumer study carried out in three regions of Kenya revealed that the demand for camel milk by most consumers in urban areas is driven by perceived superior quality as well as the acclaimed medicinal value [15]. Concerning the impact of health effects, one has to highlight the study of Mohan et al. [25]. They analysed the consumers' willingness to buy camel milk in India before and after knowing its health benefits and focused on the linkage between lifestyle diseases and consumers' willingness to buy. The study revealed that there is a significant increase in the proportion of people willing to buy camel milk once they were aware of the benefits. Furthermore, it was found that people exposed to lifestyle diseases are more willing to buy camel milk. Hence, the authors argue that support of market-based awareness campaigns to stimulate demand for quality camel milk among consumers could be realized through information dissemination and awareness campaign [25]. In this context, an Italian study [24] is highlighted that dealt with donkey milk. It is hypothesized that the study findings can be transferred to the camel milk case as well. Maurizio [24] conducted a survey in randomly selected supermarkets in Italy in order to identify the attitudes and perceptions of consumers toward donkey milk. Interestingly, it was found that consumers drink this special milk mainly because of food allergies or intolerances

and thus, it has the same application area as camel milk. The results showed that those who occasionally consume special milk choose it because it is more nourishing or for health reasons. There is also a significant association between the judgment on prices of special milk and the frequency of purchase. The estimation of a generalized linear model showed that age and the presence of health problems respectively intolerances are significant predictors of special milk consumption [24]. The latter finding corresponds with some of the mentioned camel milk studies. A recent bigger consumer study from UAE (..) found results in line with the already displayed studies that camel milk consumers preferred it over other types of milk due to its nutritional value and medicinal properties.

3.1.2. Taste of Camel Milk—Advantage or Disadvantage?

Camel milk has a different taste and aroma (higher salt content depending on the animal diet) compared to cow's milk, which affects its acceptance. A study carried out by Hashim et al. [21] in the United Arab Emirates revealed that school children evaluated cow's milk better than camel milk concerning the parameters of taste, aroma and overall acceptance (see Table 2). This observation corresponds with the findings of Eissa et al. [18], who reported that camel milk yoghurt had lower consumer acceptability compared with cow's milk yoghurt. The study participants attributed the low acceptability of camel milk yoghurt to the high concentration of salt in camel milk.

Table 2. Mean hedonic ratings for appearance, colour, taste, aroma and overall acceptance of camel milk (n = 173).

Milk	Appearance	Color	Mean Hedonic Ratings ¹			Overall Acceptance
			Taste	Texture	Aroma	
Fresh camel milk	5.7a ²	5.8a	3.2b	4.7b	4.1b	3.8b
Fresh cow's milk	6.2a	6.1a	5.8a	5.7ab	5.9a	5.8a
Dried cow's milk	5.9a	6.0a	5.3a	5.3ab	5.7a	5.5a
Flavoured camel milk	6.1a	6.1a	6.4a	6.0a	6.3a	6.2a
LSD	0.78	0.46	1.32	1.20	0.97	0.86

¹ 17-point hedonic scale (smiling faces) was used with frown face (1) = dislike very much, and smile face (7) = like very much. ² Means within a column not followed by a common-letter are significantly different ($p \leq 0.05$). Source: [21].

In this line, a sensory test in Botswana showed that most of the panellists were able to notice a salty taste in the camel milk yoghurt, which is not common in cow's milk yoghurt [19]. In the overall acceptance the cow's milk yoghurt significantly excelled over the camel milk counterpart (see Table 3). Likewise, Ibrahim and El Zubeir [22] found low overall acceptability of camel milk yoghurt compared with yoghurt made from sheep milk or a mixture of sheep and camel milk. Hashim et al. [20] demonstrated that yoghurt made from camel milk had the lowest ratings for all analysed sensory attributes. Concerning frozen yoghurt, Al-Saleh et al. [16] revealed that flavour scores of frozen yoghurt made from camel milk were significantly lower than those made from cow's milk.

Table 3. Comparison of the sensory evaluations of camel milk yoghurt vs. cow's milk yoghurt (n = 25).

Sensory Attribute	Camel Milk Yoghurt	Cow's Milk Yoghurt
Color	5.80 ± 1.23 a	7.00 ± 0.9 b
Aroma	5.50 ± 1.30 a	7.60 ± 0.75 b
Sweetness	5.60 ± 1.20 a	6.30 ± 0.85 b
Sourness	6.00 ± 1.26	5.70 ± 1.32
Mouth feel	3.50 ± 1.17 a	6.30 ± 1.20 b
Overall acceptability	4.10 ± 1.03 a	6.70 ± 1.59 b

9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely). Source: [19]. Note: Means with different letters in a row are significantly different ($P < 0.05$);

In the mentioned sensory test carried out in Botswana [19], it was found that yoghurt made from camel milk lacks firm texture, which is in agreement with the findings of Ibrahem and El Zubeir [22] and Hassan et al. [26].

A possible option for improving the taste of camel milk could be flavouring. Hashim [21] found that the flavouring of camel milk with chocolate enhanced the sensory quality of the milk. Study participants found the sensory attributes of chocolate-flavoured camel milk to be very acceptable. Likewise Galeboea et al. [19] showed that the inclusion of maple strawberry syrup improved the aroma and flavour of the camel milk yoghurt. In general, the findings from the literature review suggest the need for further research aimed at improving the sensory quality of camel milk and camel milk yoghurt. In addition the application of flavours could be an option to cover the perceived salty taste of camel milk. Another aspect is that more research needs to be conducted to optimize the operating parameters and standardization of the production procedures of camel milk yoghurt in the future.

3.1.3. Problem of Non-Familiarity of Camel Milk

Using the expectancy-value theory approach, Kempen et al. [23] explored consumers' beliefs that exist to influence their attitude towards cow's milk alternatives. For this purpose, focus groups were conducted in South Africa. The semi-structured discussions explored and gave insight into consumer attitudes and perceptions that influence acceptance of cow's milk variants. It was found that the primary factors that influence consumers' beliefs and attitude formation and acceptance of cow's milk alternatives "are acquired through knowledge and perceptions coming from (1) direct experiences, such as familiarity with the products' internal and external attributes, conditional willingness and causal factors, (2) indirect experiences ingrained from childhood and (3) association, where consumers had no reference to the product to attach attributes for belief formation, leading to being astonished at the thought, being curious about the product or having no interest in it" [23]. Thus consumers' acceptance of cow's milk alternatives such as camel milk depends on product-related expectations that are mainly based on product familiarity.

3.2. Focus Groups

3.2.1. Current Milk-Buying Attitudes and Behaviours

Usage and perception

Cow's milk is the default milk consumed across all five markets and is seen as traditional. Most have drunk it since childhood and are nostalgic about how familiar and comforting it is. It is perceived as a low-price product with a simple taste and smell. For some participants, the calcium level and its natural origin are also very important. It is to highlight that in particular in Algeria the consumption of fresh milk is preferred over processed and powder milk.

Cow's milk is predominantly consumed cold, straight from the refrigerator (under 8–12 degrees Celsius) and typically in the morning. Hot milk is consumed, but far less commonly and not every day. Many participants consume cow's milk in coffee or in the form of yoghurt. Occasionally, it is consumed in cheese or ice cream. Furthermore, in France milk is used for cooking as a lighter alternative to cream to make food such as sauces, quiches, pancakes or mashed tomato. In Turkey, it was mentioned that cow's milk is traditionally used to produce yoghurt at home and that this yoghurt is used in pastries. In the German focus groups, one participant expressed the opinion that people consume much more milk than they are aware of.

"If we reflect on this more intensively, we have to say that we probably consume more milk products than we are aware of."—German participant

Concerning consumption, relatively often the usage of cow's milk as the basis for cocoa drinks was mentioned.

"I find in cacao belongs beautiful, delicious, fresh milk."—German participant

Satisfaction with cow's milk Most participants are satisfied with the (cow) milk they are currently buying and are not searching for new alternatives. As they are largely satisfied, they have to be convinced of the additional (health) benefits to consider trying, or switching to, another type of milk. The price would also have to be similar to what they are currently buying as there is no willingness to pay more. The alternative would also have to be easy to buy through accessible channels, e.g., supermarkets. Although most of the participants are not actively seeking alternatives, they do “stumble” across options through the following:

- Supermarkets including organic stores, specifically the “Foods of the world” sections (fresh/chilled);
- To some extent in cafés when ordering coffee and they notice there is an option for other milk (most often oat milk);
- Family and friends’ recommendation;
- Doctors or nutritionists (if visited);
- Rare, but some mentions of social media advertising.

3.2.2. Consumption of Cow's Milk Alternatives

Following cow's milk, plant-based milks are the next most common. Plant-based milks, e.g., soy, oat and almond are also consumed, but usually only if the participant is not completely satisfied with cow's milk. As typical reason it was mentioned that plant-based milks are suitable for vegetarians or vegans. Furthermore, in general plant-based alternatives are seen as healthier in comparison to cow's milk. The following health benefits have been mentioned:

- Lighter and easier to digest;
- Less fatty;
- Less calorific;
- Non-GMO;
- Rich in protein;
- More vitamins.

In addition, it has been noted that alternatives, e.g., coconut milk are useful for certain exotic recipes. Table 4 gives an overview of the awareness and consumption of cow alternatives across the survey regions.

Table 4. Overview about the consumption of cow's milk alternatives across countries.

Milk Type	France		Algeria		Germany		Turkey		Spain	
	Aware	Cons. ¹	aware	Cons.	Aware	Cons.	Aware	Cons.	Aware	Cons.
Cow	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Almond/soy/oat	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Spelt	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Goat	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sheep	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Ewe	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Buffalo	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Donkey	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Camel	no	no	yes	yes	yes	no	yes	no	no	no

¹ Cons. = Consumption.

3.2.3. Camel Milk—Knowledge, Interest, Familiarity, Preferences

Knowledge, familiarity and initial reactions

During the focus groups, the participants were asked about their knowledge of and familiarity with camel milk. In general, in all countries camel milk is relatively unknown and only in Turkey, Algeria and Germany had some participants heard about it before. Furthermore, none of the participants even in these countries has tried it before (see Table 5).

In Germany, two participants had a slight knowledge of where camel milk is mainly consumed and one of them even knew how camel milk is milked. One participant mentioned an increased protein level in camel milk compared to cow’s milk. Another person indicated that the sale of camel milk in Europe was forbidden for a long time. However, as in all other countries, no participants had ever seen, bought or drunk camel milk.

“I have already heard that camel milk is drunk mainly in Arab countries.”—male, Germany

“I know, of course, that camel milk is consumed in North Africa.”—male, Germany

Table 5. Awareness of the existence of camel milk across markets

	France	Algeria	Germany	Turkey	Spain
awareness	No awareness across anyone in either of the 2 groups.	Although many in the 2 groups had heard about camel milk in the past (through friends and family) and, therefore, knew of its existence, their knowledge of it (taste, availability) is very shallow.	Low awareness but two respondents have heard about it.	7 respondents across the 2 groups had heard of camel milk before—mostly through friends/relatives from Middle-Eastern countries, and 1 participant mentioned that the owner of the fresh grocery market she visits first told her about it.	None of the participants were aware of the existence of camel milk, it was a totally new alternative for them.
experience	Therefore, this is a totally new concept for them, and no one in the group had tried camel milk before.	No one in the group had tried camel milk before.	Therefore, this is for most a new concept for them, and no one had tried camel milk before.	No one in the groups had tried it before. 2 of these respondents tried to buy camel milk in the past, but they could not find it in Turkey.	

Before the topic of familiarity with camel milk was discussed in detail, each individual respondent had to write down their answers for each of the following two questions:

- How much do you like the concept of camel milk in general (out of 1–10, 10 being very interested)?
- In a few words, why did you give that score out of 10

With values between 5.4 (Germany) to 6.1 (Algeria) the initial reactions to the idea of camel milk were fairly positive (see Table 6).

Table 6. Initial reactions to the idea of camel milk.

Market	1st Group	2nd Group	Both Groups
France	6.8	4.6	5.7
Algeria	7.5	4.7	6.1
Turkey	5.8	5.8	5.8
Spain	5.2	6.3	5.8
Germany	5.3	5.5	5.4
Overall	6.1	5.4	5.8

Average score out of 10 for the level of interest (10 being very interested in the idea of camel milk).

As reasons for a good evaluation, the following aspects were mentioned:

- originality;
- healthy characteristics;
- accordance with religious food restrictions.

3.2.4. General Associations to Camels and Camel Milk

Camel associations are predominantly positive. Although there are mostly positive associations with this animal, only a few respondents link it to milk. Some respondents

believe/assume that camels can retain minerals and conclude that the milk would, therefore, be full of nutrients. The following associations with camel as an animal emerged across markets:

- Vessel of the desert;
- Represents Arabia;
- Strong animals, who are robust, resilient and durable;
- Can survive on very little water and can retain minerals for long periods of time;
- For France specifically: thought of as more exotic—North African, desert animal;
- For Algeria specifically: thought of a patient and tolerant animal. Additionally, specifically, the Qur'an mention is also very relevant—"Prophet Muhammad loved camels";
- Main negative association is that camels are perceived as quite strong-smelling animals.

3.2.5. Expected Sensory Characteristics of Camel Milk

Consumers expect camel milk to have a distinct taste. When asked what they think camel milk will be like, they are largely comparing it to cow's milk (as many peoples default milk) and predict for taste, aroma and colour the following:

- **Taste**
- Across all markets:
 - Strong
 - More pronounced
 - Intense
 - May leave an aftertaste
- In Algeria, they predicted more specific flavour profiles such as salty, but also acidic and slightly bitter
- **Aroma**
- Across all markets:
 - Likely to be the hardest part to tolerate as they predict the smell will be strong, potentially overpowering
 - Many think this because they associate camels being strong-smelling animals, which live in areas which again have a distinct odour.
- **Colour**
 - In Algeria, a few respondents predicted camel milk would potentially have more of a yellow colour
 - In France, Germany and Turkey, there were no specific predictions about the aesthetics of camel milk

For a more detailed discussion, the respondents received from the moderator the information that camel milk has a different taste and aroma compared to cow's milk and that it has in particular a higher salt content. The reactions to being told that camel milk has a "fine salty note" were down to personal preference although a minority said they are trying to cut down on salt content, so this discourages them from trying camel milk. Most importantly, knowing that camel milk is saltier meant that it was seen as only suitable for a limited range of savoury purposes such as drinking by itself specifically cold, to optimise the health benefits (all markets) or cooking instead of using crème fraîche or salted butter (France). It was also, therefore, thought not suitable to replace their current main milk, but as an additional milk (but very rarely). Furthermore, we want to highlight that the salty note represents a barrier for some of the participants.

In the first German focus group, the participants were only told how camel milk tastes as in the other countries and thus only taste expectations were recorded. One German person, in particular, expressed himself relatively positively and with ideas for the usage of salty camel milk. In addition, the salty taste was judged by two other participants as a distinguishing feature of camel milk. Three German participants could imagine the taste in ice cream, for example, and two in cheese. On the other side, two participants were critical

of the salty taste in coffee. Additionally, in strawberry milk or yoghurt they do not really want to have the salty note.

“In cheese I can imagine it.”, “For cappuccino I can imagine it. Salt is becoming more and more popular. Salty chocolate, for example.”—male, Germany

“Yes, that’s quite a differentiating factor!”—female, Germany

3.2.6. Sensorial Tasting, Germany

For the sensorial tasting in Germany, raw camel milk from a German producer was used for the second focus group. Before the tasting the participants were asked for their taste expectations as done in all other focus groups. The expectations of the taste varied. One participant hoped that the milk would not have a taste too strong on its own. Likewise, other participants expected a stronger taste than cow’s milk.

“I hope it does not have too strong a taste of its own.”—female, Germany

“I think more like a goat, or a sheep, something like that. More strong in any case.”—male, Germany

The findings from the subsequent taste evaluation were relatively mixed. The female participants found the taste mild and low-fat, but delicious. Three of the four participants could even perceive a slightly sweetish taste. The male participants were not convinced of the taste of the camel milk. Interestingly, the women noticed a salty note, whereas the men could not detect it. None of the participants stated to prefer camel milk compared to cow’s milk after the tasting. One male participant missed the specifics of camel milk and the other male participant did not like the taste at all. The women were a little bit more positive about the milk, but likewise they did not want to replace cow’s milk with camel milk completely.

“I think it is mega sweet at the beginning, so I was really shocked. Well it tastes fresh, but the sweetness at the beginning is really gross.”—male, Germany

“Yes, but I find it too normal to declare it a special product and to give it to any guest for 11 Euro per litre.”—female, Germany

“Yeah, more salty than sweet, a mix somehow.”—female, Germany

“Rather not like that, so I didn’t notice the sweetness that much, so for me it tasted very much like normal cow’s milk”—male Germany

“Well, it doesn’t taste like normal cow’s milk either. This initial taste, maybe that’s a taste you get used to, but the first time I tried it, I just don’t like it.”—male, Germany

“I think it tastes okay, but I still think cow’s milk is even better.”—male, Germany

3.2.7. Preference for Different Camel Milk Products

Camel milk in bottles and ice cream garnered the most appeal across all markets. Yoghurt (or Laban) based on camel milk followed in the third rank. Cappuccino or café latte with camel milk took the fourth rank and were only liked in Turkey, Algeria and Spain. The idea of cosmetic products made from camel milk was liked in particular in Germany and Spain. Cheese made of camel milk received a muted response in Algeria and Turkey, whereas French participants did not like this idea because they have high expectations from French cheese.

3.2.8. Health Benefits and Trade-Offs

All participants were most drawn to the health benefits, but not completely convinced. Consistently across all five markets, health benefits such as treating several diseases, fighting against diabetes and hepatitis and the advantage of no allergic reactions to camel milk were the most appealing part of the stimulus. Although these are appealing benefits

for the participants, there are questions about its credibility. Concerning the reactions to specific wording and phrasing in detail, consistently across markets, phrasing related to the health benefits resonated. Any phrasing that was not concrete, e.g., “claims” or “not proved” made the consumers question/feel sceptical about the benefits of camel milk. For France, Germany and Turkey specifically, although almost all participants like the idea of a story and history behind the product, mentions of eastern Africa or Arabia made them question the hygiene of the product as it would have to travel geographically far (e.g., France).

3.2.9. Expected Price

Consistently, in participants across markets, cow’s milk is by far considered the cheapest/most affordable milk option, with plant-based milks (soy, almond) being at least twice (or even more) expensive than cow’s (see Table 7). For camel milk, the following key observations can be stated:

- Camel milk is expected/predicted to be at least the same price as soy/almond or slightly more expensive because it is unusual, exotic and harder to access;
- At a total level, consumers say they would not be willing to actually pay more for camel milk than soy/almond because they are not convinced of the health benefits so far;
- Those who are already paying more for soy/almond (for health reasons) are willing to pay more for camel milk (on the assumption the health benefits ring true).

Table 7. Expected price per litre.

Market	For Cow’s Milk	For Soy/Almond/Oat/Rice /Soy/Hazelnut	For Goat’s Milk
France	0.50–0.80 EUR/L	1.50–3.00 EUR/L	No one drank this
Algeria	MDL 25 (0.16 EUR/L) *	MDL 530–800 (3.33–5.02 EUR/L) *	No one drank this
Turkey	TRY 4.50–5.50 (0.50–0.61 EUR/L) **	TRY 30 (3.32 EUR/L) **	TRY 15 (3.32 EUR/L) **
Germany	0.80 EUR/L	1.50 EUR/L	No one drank this
Spain	0.56–1.20 EUR/L	1.50–2.00 EUR/L	No one drank this

* Exchange rate MDL/EUR = 1.00/0.0063 (12.03.2021), ** Exchange rate TRY/EUR = 1.00/0.11 (12.03.2021).

When consumers received the information that camel milk costs about EUR 9–10 per litre in Turkey and Germany and EUR 3–5 in Algeria, the price was felt to be positioned too high for all markets—certainly too expensive for everyday or regular use (which is the way they normally think of milk). For quite a few, the expensive price put them off of even trying camel milk. For a small selection of participants, they said they would maybe try it once (again out of curiosity). This suggested price point is by far the biggest barrier for consumers to try. Due to the high price, participants can imagine using camel milk as a luxury or cosmetic product, but not for everyday use.

3.2.10. Barriers and Drivers

Although there are potential drivers, there are several strong barriers to purchase as well:

- All markets: when consumers are satisfied with their current, easily available and affordable milk options, they are naturally less eager to try something new because there is less of a need to other than curiosity;
- All markets: concerned about the expected stronger taste or aroma to be unpleasant;
- France particularly (but also in Algeria and Turkey depending on proximity to the desert): Not attracted by the need for long-distance (airplane) transportation from the desert (not ecological). This means they predict it is likely to be not easily accessible and more expensive. It also goes against current trends of “eating local”, supporting local farmers/producers;
- France specifically: Do not like the idea of camel milk “farming” (industrial) process.

For those keen on trying camel milk, there is a selection of potential drivers to purchase:

- All markets: Some expectation that it might provide (health) benefits e.g., specific nutrients such as iron, vitamin C ;
- All markets: Expect quite a different taste (but hoping for not as strong as goat's or sheep's milk);
- All markets but France particularly: Originality, novelty, pure curiosity to try;
- France specifically: Sounds exotic, like to try foreign food (Japanese, Mexican);
- Algeria specifically: There were mentions of liking that camel milk can be given instead of breast milk to babies, it is good for children, some heard it is good for recovering from cancer, but also the fact it is mentioned in Quran is a positive.

4. Discussion

The findings from the literature that came from non-European countries suggest the need for further research aimed at improving the sensory quality of camel milk, camel milk fermented products (such as yoghurt, kefir, etc.) and camel milk cheese. In addition the application of flavours could be an option to cover the perceived salty taste of camel milk. Another aspect is that more research needs to be conducted to optimize the operating parameters and standardization of the production procedures of camel milk yoghurt in the future.

In the group discussions, it was found that the expected saltier taste note (this is in line with sensory findings from literature) limits the use cases of camel milk to as a drink by itself (cold, not hot), or in cooking. Cow's or plant-based milks already available are thought to be more versatile and drinkable every day—as a drink by itself (hot and/or cold), in cooking, for breakfast cereals and with fruit, in hot drinks or for making yoghurt and pastries (in Turkey). In general, the taste expectation are relatively negative in all analysed countries and many participants expect a salty, strong, pronounced note or even an aftertaste. In this context some of the debaters draw a line between the (strong) smell of camels and their milk. The mixed taste expectations were confirmed by the sensory camel milk tasting in Germany. As in the studies from the literature, negative taste (expectations) appears to be a major barrier to increased consumption.

Furthermore, the literature study revealed that outside the main consumption countries where camel milk is a regular part of the daily diet, many consumers buy this product primarily due to its promised health benefits. Furthermore, they are willing to pay a substantial price premium for camel milk. Likewise, in the focus groups participants were most drawn to the health benefits. However, we highlight that some consumers require more firm/concrete reasons respectively scientific proof to believe in the supposed health characteristics of camel milk.

In the focus groups, the participants were very interested in the subject of camel milk. Nonetheless, across all analysed countries and all groups, there is only a little knowledge about the characteristics of the milk and how it is produced. However, all participants are very open to trying camel milk and other camel milk products. Contrarily, there is a strong cow's milk culture in each analysed market.

In this context, only a few are willing to pay a substantial price premium for camel milk. As outlined in the introduction, the price of camel milk is significantly higher compared to traditional cow's milk. At the current price level, camel milk will struggle for uptake in all analysed countries. Whilst there is some interest in the idea of camel milk (curiosity, potential nutrients/benefits), the product price (at best some might pay EUR 4–5 e.g., in Germany) is too high to try it out just out of curiosity.

For France specifically, camel milk is perceived as potentially being “unsustainable” because it is not made locally, not “made in France” and “not ecological”.

5. Conclusions

In general, we can state that so far only a few consumer studies exist, and, in particular, for the consumers in the analysed countries not much is known about their attitudes, preferences and acceptance to try or to buy such a product. Nonetheless, the focus groups

provided the fact that there is at least a certain willingness to try camel milk. This finding could be a starter for tasting campaigns at the point of sale.

However, before such campaigns can be run, the sensory performance of camel milk has to be improved and consumer sensory tests with bigger sample sizes have to be carried out in the analysed markets. Thus it can be checked on a representative level if saltiness and other taste characteristics display a reason for refusal or if there are consumer segments who are in even favour of such a special taste. In this context, product developers could test options such as flavouring or the usage of different food technologies for optimizing the taste characteristics of camel milk.

Findings from the literature study and the qualitative study both point out that the supposed health characteristics could be a potential driver of consumer demand. For proving these benefits clinical trials and/or chemical product analyses e.g., for validating the vitamin content are necessary. If applicable producers could apply for health claims at the European Food Security Agency (EFSA) respectively employ “general function” health claims under Article 13.

For defining an optimal price level for camel milk, we recommend a demand-driven approach. Findings from the focus groups demonstrate that the willingness to pay is limited in particular when special health characteristics are not proven. Via quantitative research (e.g., choice experiments, store tests) the willingness to pay under different information treatments (e.g., information that certain claims are EFSA-proven vs. no claims) can be determined and used for identifying the optimal pricing and communication (labelling) strategy for camel milk and camel milk products.

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Appendix A. Discussion Guide

1. Introduction and warm up (10 min)
 2. Current milk buying attitudes and behaviours (15 min).
 3. Knowledge/familiarity with camel milk (20 min)
 4. Health benefits and trade-offs (20 min)
 5. Expected taste (20 min)
 6. Wrap up (5 min)
1. Introduction and warm up
 - Welcome participants and introduce yourself
 - Moderator to explain the purpose of the session: to understand perceptions around milk and milk products consumption and their interest in cow milk alternatives

- Explain the presence and purpose of recording equipment and introduce observers
 - Address the issue of confidentiality. Reinforce that information discussed is going to be analysed as a whole and that participants' names and affiliations will remain confidential and transcriptions will not be shared outside the researcher group.
 - Participants will sign a consent sheet
 - Outline general ground rules and discussion guidelines such as the importance of everyone being provided an opportunity to speak, talking one at a time, and being prepared for the facilitator to interrupt to assure that all the topics can be covered.
 - Participants should write their names on a folded sheet of paper
 - (a) Individual introductions:
 - i. Name
 - ii. Family/lifestage
 - iii. Job
 - iv. 10 s summary of their attitudes to eating
2. Current milk buying attitudes and behaviours (15 min)
- Before the group can speak, each individual respondent to write down their answers for each:
 - What milk do they buy at the moment?
 - Why do they buy that specific type of milk
 - How have their milk buying habits changed in the last couple of years? E.g. buying a different type, drinking frequency, what they have with it, and any other changes
 - After writing down their individual notes, then discuss as a group:
 - How do they feel about milk?
 - Who in the group likes vs. loves it
 - What milk are they each buying?
 - Why do they drink the type of milk that they do? Spontaneous first, but if struggling:
 - Why do they drink the type of milk that they do? Spontaneous first, but if struggling:
 - Taste
 - Origin
 - Nutritional value
 - Fat content
 - Sustainability
 - Price
 - Other
 - How are they drinking milk and how often? Spontaneous first, but if struggling:
 - Milk alone, as a drink
 - In hot drinks like tea or coffee
 - In cereal or porridge
 - Other
 - Does anyone in the group drink more than one type of milk?
 - Why?
 - When do they drink one type (e.g., almond) vs. another (e.g., cows)?
 - When did they start doing this?
 - How have their milk buying/drinking habits changed?
 - Why do they think that is?
 - What prompted the change?

- Does anyone have any plans to change the milk they buy in the near future?
 - If yes, how so? Why?
 - What other types of milk do they know about other than the ones mentioned already?
 - What do they think about those other types?
 - How do they find out/discover new milk products? Spontaneous first, but if struggling:
 - In the supermarket
 - From friends and family
 - In cafes (e.g., when ordering coffee)
3. Knowledge/familiarity with camel milk (20 min)
- Before the group can speak, each individual respondent to write down their answers for each:
 - How much do they like the concept of camel milk in general (out of 1–10. 10 being very interested)?
 - In a few words, why did they give that score out of 10
 - After writing down their individual notes, then discuss as a group:
 - Have people heard about camel milk before today?
 - What score did everyone give out of 10 for interest in camel milk?
 - Has anyone in the group bought it before?
 - And if so, where did they first hear about it?
 - What was the information they got about it?
 - What are their initial reactions to the idea of camel milk?
 - Do they like the idea? Why?
 - Do they not like the idea? Why?
 - What do they associate with camels as an animal?
 - What are the positive associations they have with camels?
 - What are the more negative associations they have with camels?
 - Do they associate milk with camels? Why?
 - Can they name product examples?
 - Can they name buying locations/channels?
 - PROBE I: Moderator to further give more information what different kind of camel milk product exists (raw, pasteurized, powder milk, yoghurt, leben, cheese, camelious-products, cosmetics.)
 - Now they have seen images of some camel milk products (Probe I) ...
 - * Is there interest in trying camel milk or camel milk products?
 - * If so, which advantages do you think/expect it has?
 - * If not, what are reasons, concerns, or barriers?
 - Probe: check for considerations such as taste, appearance, nutritional value, health benefits, environmental considerations, price, animal welfare, local product (in Argelia and Turkey), trust
 - * Specifically, which of the products shown in Probe I do they like the idea of?
 - * Why those?
 - * Specifically, which of the products shown in Probe I do they not like the idea of?
 - * Why those?
4. Health benefits and trade-offs (20 min)

- PROBE II: Moderator to further give more background information about the traditional consumption of camel milk in African and Arabian states and explain the health benefits of camel milk
 - Does any of this match your expectations from earlier?
 - Anything that is surprising in here?
 - Does the additional information (in probe II) about health benefits changed your level of interest in trying camel milk?
 - If so, which is the main reason?
 - If not, what are reasons or concerns or barriers?
 - Probe: check for considerations such reliability of health-related information, food safety
 - What wording/phrasing do they like in probe II?
 - What wording/phrasing do they not like in probe II?
 - What in probe II do they believe and trust or not believe and trust? Why?
 - Before the group can speak, each individual respondent to write down their answers for each:
 - What do they pay for their current milk for per litre?
 - How much do they think a litre of camel milk would cost?
 - How much would they be willing to pay for a litre of camel milk?
 - After writing down their individual notes, then discuss as a group:
 - A recap of how much they are each spending on milk per litre
 - How much do they think a litre of camel milk would cost?
 - More or less than cow's milk?
 - More or less than soy/almond/other?
 - Why more or less?
 - How much would they be willing to pay for a litre of camel milk?
 - Why this price?
 - PROBE III: Moderator give information about the price.
 - What do you think about the price level for camel milk suggested?
 - Is it close to their expectations?
 - It is acceptable?
 - How does it compare to what they pay now for milk?
 - Would they pay this to try it? Why/why not?
 - Why do they think it is placed at the suggested price point?
5. Expected taste (20 min)
- What is your taste expectation of camel milk? Probe: check for considerations such as taste of cow, goat or sheep milk.
 - Why do they think it will taste like they think?
 - What is their expectation of aroma (how it would smell)? Probe: check for considerations such as taste of cow, goat or sheep milk.
 - Why do they think it will smell the way they think?
 - What would be the way they would be most likely to consume it? Probe:
 - As a drink, by itself
 - Milk alone, as a drink
 - In hot drinks like tea or coffee
 - In cereal or porridge
 - Other
 - Would it replace the milk they currently consume, or be consumed in addition? Why?
 - If consumed in addition to their current milk, what would the camel milk be used for vs. their normal milk?
6. PROBE IV: Participants receive an explanation how camel milk taste

- What do you think, would you like this taste?
- Is there still interest in trying/buying camel milk?
- What score out of 10 would they give it now?
- Has the score dropped or risen?
- If so, which is main reason?
- If not, what are reasons or concerns or barriers?
- Probe: check for considerations such as bad taste, taste matters/does not matter due to health benefits or environmental considerations
- Now knowing more about the taste, would they change the way they would choose to consume it? Why?
- As a drink, by itself
- Milk alone, as a drink
- In hot drinks like tea or coffee
- In cereal or porridge
- Other
- Now knowing more about the taste, do their opinions of using it as a replacement or additional milk from before still stand?

Moderator to check if client observing has any additional questions to ask
Summarise, thank and close.

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