

THE CAMEL MILK SECTOR IN MEDITERRANEAN BASIN

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ABSTRACT

Camel milk is a new product on the market around the Mediterranean Basin (MB). The objective of the paper was to achieve a state-of-the-art regarding the camel milk sector around the MB and its constraints and challenges to overcome. The Southern bank of the MB involves 99.5% of the camel herd *vs* 0.5% only in the European countries. Few data are available in FAO database regarding camel milk production. Only 4 countries, all in north Africa, declared camel milk production: Algeria, Tunisia, Morocco and Libya. The total declared was more than 29,500 tons for 2023 with more than 51% in Algeria and 31% in Morocco. There are challenges for the camel dairy development in the MB. The introduction of camel milk on market is a recent feature, in general all over the world as it was already underlined. Longtime, the camel milk was a part of the “gift economy” contributing to the “subsistence economy” of the nomad people. The current mutation of the camel farming systems is not limited to some rich countries of the Middle East, but is involving also, most of the countries of the MB. Boosted by a growing urban demand in terms of quantity, quality and diversity of the dairy products, boosted also by the differential of price compared to cow milk based notably to the expected health effect of camel milk, the “commodification” of the camel milk is contributing to the emergence of true dairy camel sector at regional level. Camel milk remains a “niche product”, even if its recent growth was important. The high price of the product on the market cannot attribute to this product a competitive interest compared to cow milk, even in countries from the south bank of the MB where the camel population is important. Camel cannot be regarded as “the cow of the future” despite its advantages face to the current environmental challenges. However, the margin of development of the camel sector around the MB is not negligible and must be supported by more favourable regulations, notably in Europe. The different segments of the sector (production, processing, distribution) must be able to benefit from administrative and political support in the different concerned countries.

Key words: Camel milk, camel farming, Mediterranean basin

Camel milk is a new product on the market around the Mediterranean Basin (MB). For longtime, limited to the remote desert areas in the Maghreb countries for self-consumption of the nomadic populations in all countries of the southern bank of the Mediterranean Sea. Camel milk is appearing recently on market, not only in the other regions of these countries (northern part of Morocco, Algeria, Tunisia), but also in new countries such as Türkiye or Western Europe (Faye, 2022). The emergence of an international camel milk market based on the availability of milk powder was also observed recently, including in Western Europe (Konuspayeva *et al*, 2022). However, a fine knowledge of the current status of camel milk value chain around the MB faced to different constraints. Firstly, complete data regarding camel population is lacking, notably in

Western Europe. Secondly, some countries such as Egypt, Syria, Palestine, or Turkey did not declare camel milk production susceptible to be registered in FAO database. Thirdly, the importance of self-consumption by the households in the southern bank of the Basin is not quantified. In addition of that, the use or processed milk for non-food products, especially cosmetic, which can be important (Morocco, France) is not well documented in national and a fortiori in international database. These constraints make it difficult to accurately assess the situation of the camel milk sector in the region. However, in the frame of the European project CAMELMILK (project 2019-2022 within PRIMA Programme of the EU), some data were compiled by the partners of the project. Thus, the objective of the paper was to achieve a state-of-the-art regarding the

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Table 1. Camel demography in the Mediterranean Basin (source: FAOstat). The population in European countries (in grey) are estimated by the authors.

Country	Camel heads	Density/100 km ²	Nb camel/1000hab	Ann. Growth 1961-2023
Algeria	439134	18,44	9,51	2,94
Egypt	193667	19,33	1,69	0,20
Israël*	5619	25,46	0,61	-0,60
Jordan	13788	15,44	1,21	-0,52
Lebanon	131	1,25	0,02	-1,43
Libya	62852	3,75	8,60	-1,19
Morocco + WSahara**	175505	24,63	4,65	-1,22
Syria	33510	18,10	1,42	2,50
Tunisia	239042	146,10	19,59	0,62
Turkiye	1197	0,15	0,01	-1,56
France	900	0,16	0,01	N/A
Italy	300	0,06	0,01	N/A
Spain	4000	1,32	0,07	N/A
Greece	150	0,11	0,01	N/A
Balkan countries	100	0,06	0,01	N/A
TOTAL	1169895	13,49	2,13	0.03

*NB1: Although the camel population is attributed to Israël in FAO database, almost all the camels are belonging to the Palestinian Bedouins

**NB2: From 1961 to 2017, data from Western Sahara were separated from Morocco in FAO database. The entity WSahara has disappeared after 2017 from the database, but the camel population was not included in Morocco. So, for the period 2017-2023, the camel population was estimated based on the former population growth in the entity and added to the Moroccan population.

camel milk sector around the MB and its constraints and challenges to overcome.

Camel population around the Mediterranean Basin

With a total camel herd of around 1.16 million heads, the countries of the MB gathered approximately 2.75 % of the world population based on the available data in the FAO database (FAOstat, 2024) and on the estimation of European population (not registered in the FAO database). A contrasted situation between countries occurred (Table 1). The Southern bank of the MB involves 99.5% of the camel herd vs 0.5% only in the European countries.

But, even among the southern countries, we can distinguish different situations according to different indicators. Countries with high camel density (more than 10 camels /100 km²) include in the order, Tunisia, Israel, Morocco, Egypt, Algeria, Syria and Jordan. Countries with the highest ratio camel/human (more than 5 camels/1000 hab.) include in the order Tunisia, Algeria and Libya (Table 1). Among the 10 countries of the southern bank, six have experienced a negative growth since 1961 (first year of available statistics in FAO database),

while two present a positive growth above 2% (in the order Algeria and Syria). The first ones represent 67% of the current camel population *vs* 29.7% only in 1961 (Fig 1). The strongest decline of the camel population was observed in Turkiye (-1.56 %/year) with a fall from 65,390 in 1961 to 1197 in 2023, even if a slight increase is occurring for the last 20 years (Faye, 2020).

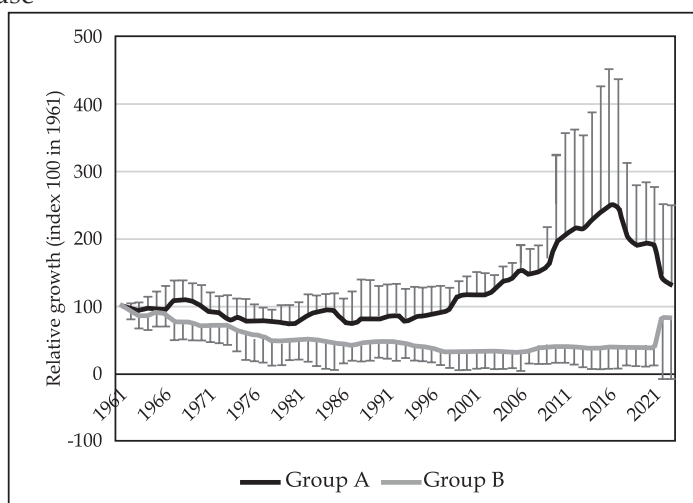


Fig 1. Changes in camel population in the southern bank of the MB, the group A gathering the countries with positive demographic growth (Algeria, Syria and Tunisia), the group B, the other countries of the region with negative growth.

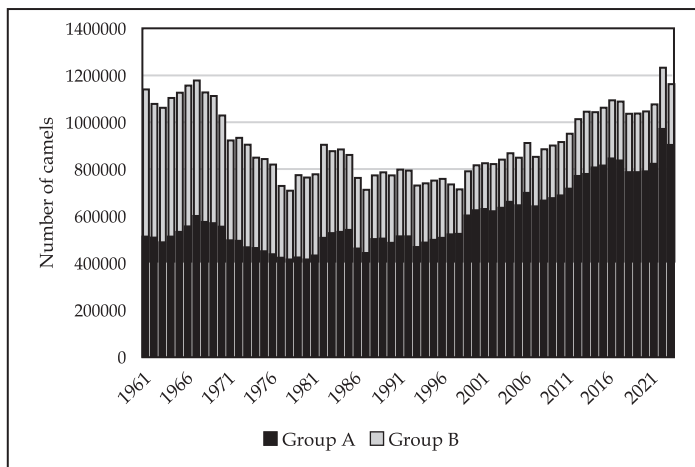


Fig 2. Cumulative histograms showing the changes in camel demography in Southern bank of MB (group A with positive and group B with negative growth)

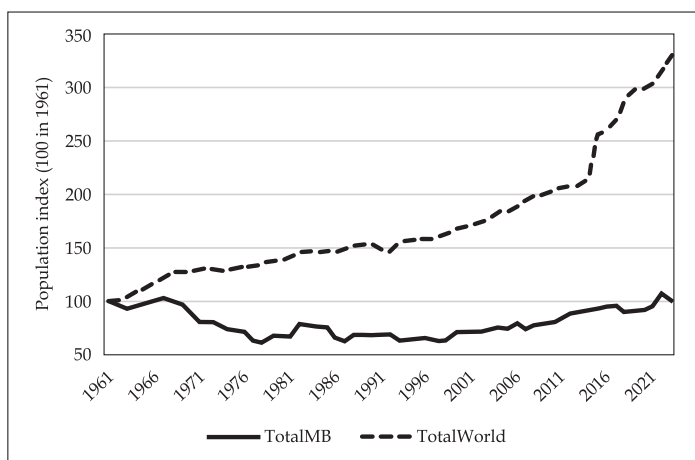


Fig 3. Comparative changes 1961-2021 in camel population around MB and at world level (Source: FAOstat)

Despite this disparity between countries, the global camel population remained stable with an annual growth of 0.03% in the region. However, two phases can be observed: after a regular decline from 1961 to 1998 (-1%/year), the global number of camels around the MB increased by 2.5%/year from 1998 to 2023 (Fig 2). At the same time, the annual camel demography growth 1961-2023 at world level was 3.68% (Fig 3).

It is difficult to know with accuracy the situation in Europe, due to the lack of census and for long time of registration in national and international database (in France, the registration in the national database eSIRECam started in 2018). Except in Canary Islands (Spain), the status of camel in Europe was poorly documented (Wilson and Gutierrez, 2015). Despite of its presence attested since roman empire (Pigière and Henrotay, 2012) and since Middle-age

in Italy (Dioli, 2015) or in France (Dierkens, 2005), the “modern” camel was until recently mainly confined in zoological gardens and circus. However, for the last decennials, private farmers were implemented for various activities (tourism, trekking, sport, dairy production) or even as pet animals (Faye *et al*, 1995; Smits *et al*, 2023). Such trends let think that the camel population in Europe is increasing also, especially as the camel meat consumption is not developed leading to the absence of culling of the young males and old females.

Camel milk Production in the MB

Few data are available in FAO database regarding camel milk production. Only 4 countries, all in north Africa, declared camel milk production: Algeria, Tunisia, Morocco and Libya. The total declared was more than 29,500 tons for 2023 with more than 51% in Algeria and 31% in Morocco. The annual growth of the production was 0.64% only for the last 63 years, but with three phases: a first phase of decline from 1961 to 1977 when the milk production fell by -2.17% annually; a second phase from 1978 to 1989 when the production remained stable and a third phase with a positive growth since 1990 by 2.2% annually. However, the situation was very contrasted between these 4 countries. While Algeria experienced a sustained annual growth by 3.8% and Morocco by 1.6%, Tunisia and Libya showed a negative growth, -1.3 and -0.9%, respectively (Fig 4).

The differences in those patterns could be linked to the main purpose of the camel breeding. In Tunisia and Libya, camel farming was mainly devoted to meat production with a very recent development of the milk sector. For example, in Tunisia, the first introduction of the camel milk into market dates from 1995 only (El-Hatmi *et al*, 2003).

To assess the “dairy vocation” of the camel stock, an important indicator was the percentage of lactating camels in the camel herd. Those proportions were 31% in Morocco, 22% in Algeria 17% in Libya and 1.5% only in Tunisia in 2023, i.e., 18.2% for these four countries. At world level, the percentage of producing dairy camels is estimated to 22.5%. If in Algeria, this percentage was stable since 1961 (it was estimated to 24% at this date), the proportion of lactating camels increased by 70% in Libya and by 200% in Morocco. For Tunisia,

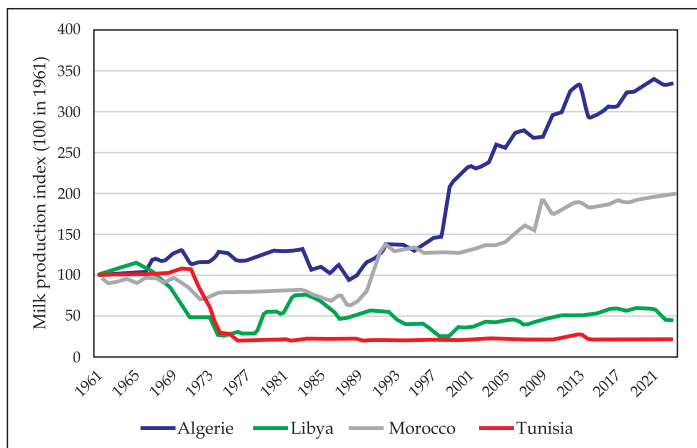


Fig 4. Relative changes in camel milk production in 4 countries of MB 1961-2021 (Source: FAOstat).

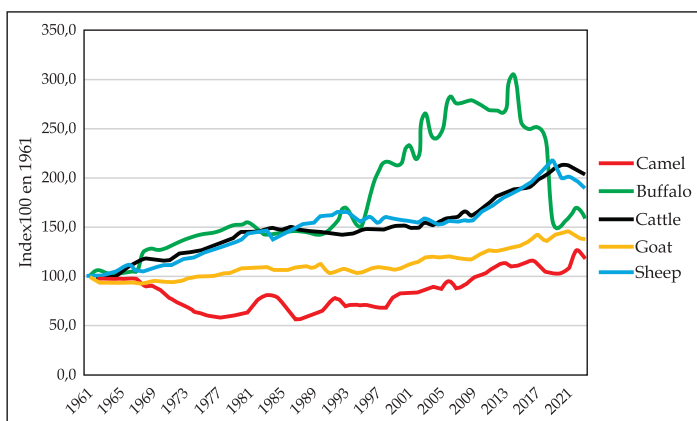


Fig 5. Relative changes in milk production around the MB from different dairy species (calculated from FAOstat, 2025).

the percentage of lactating camels seems to have decreased from 5.8% in 1961 to 1.5% nowadays. If the percentage of 18.2% (MB average) can be applied on average for all other countries (except in Europe where the number is approximately known), with a mean productivity of 1200-1600 L/lactation in Maghrebi camels (Abdalla *et al*, 2015), the potential of production around the MB can be estimated (Table 2).

On this base, the potential is more than 8 times the quantity declared in FAO database. However, if the mean milk productivity applied by FAO at world level (375 L/lactating camel/year) is retained, the total potential of production for the MB would be 45,893 tons of camel milk only. Compared to other dairy species, camel milk growth for the last 63 years remains lower (Fig 5).

Thus, it is difficult to know exactly the quantity of camel milk available in the region. According to the mode of calculation, important gaps are observed. Moreover, few parts of this milk are available on market due to the importance of self-consumption. Whatever the estimation, the quantity of camel milk around the MB is less than 1% (around 0.6%) of the total milk produced in the region. At world level, it is 0.42%. Obviously, high

Table 2. Declared and potential camel milk production according to the number of lactating camels in the different countries, declared (D) or estimated (E) and based of a milk productivity of 1200 L/lactation.

Country	Camel heads (2023)	Nb of lactating camels	Declared milk production (t)	Potential milk production (t)
Algeria	439134	97595(D)	15013.26	117114.00
Egypt	193667	18129 (E)	N/A	21754.82
Israel	5619	1022 (E)	N/A	1226.53
Jordan	13788	2483 (E)	N/A	2979.63
Lebanon	131	24 (E)	N/A	28.61
Libya	62852	10841 (D)	2215.43	13009.20
Morocco + WSahara*	175505	54643 (D)	9138.78	65571.60
Syria	33510	6533 (E)	N/A	7839.03
Tunisia	239042	3651 (D)	1105.2	4381.20
Turkiye	1197	219 (E)	N/A	262.95
France	900	30	N/A	36
Italy	300	0	N/A	0
Spain	4000	120	N/A	144
Greece	150	0	N/A	0
Balkan countries	100	0	N/A	0
TOTAL	1169895	195290	27473.01	234347.58

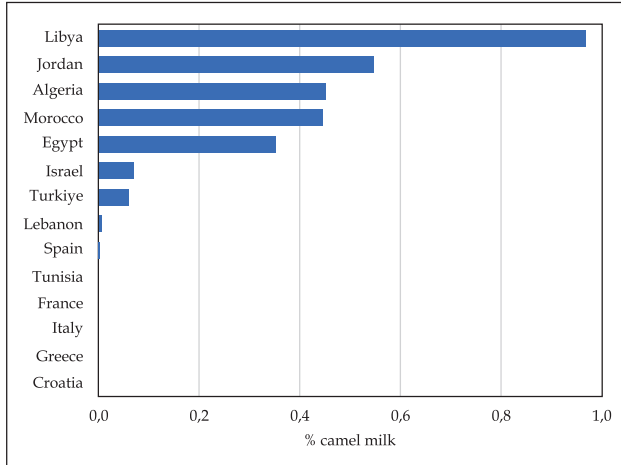


Fig 6. Percentages of camel milk in total milk produced around the MB (in %).

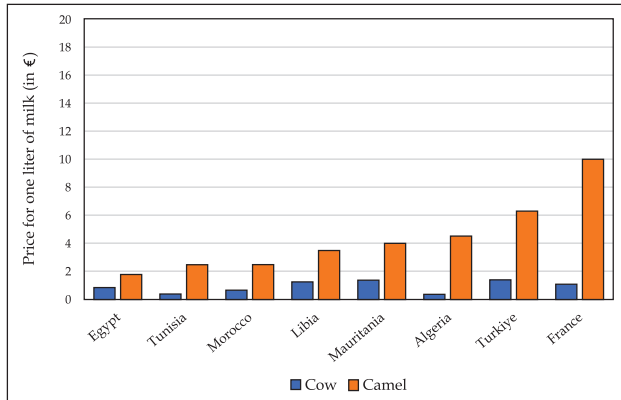


Fig 7. Differential prices between cow and camel milk in the MB.

differences occur between countries. In Libya only, the percentage was almost 1%, in Libya (Fig 6).

Moreover, within the countries, notably in North Africa, the proportion of camel milk in the total produced milk is more important in the desert part



Fig 8. Truck of the dairy factory “Tedjane” at El-Oued (Algeria).

of the country. For example, in Saharan provinces of Morocco, it could reach 30% of the milk diet (Faye *et al*, 2014).

The challenges for the camel dairy development in the MB

The introduction of camel milk on market is a recent feature, in general all over the world as it was already underlined (Konuspayeva *et al*, 2022). Longtime, the camel milk was a part of the “gift economy” (Mauss, 1924), contributing to the “subsistence economy” (Polanyi, 1977) of the nomad people. The current mutation of the camel farming systems is not limited to some rich countries of the Middle East, but is involving also, most of the countries of the MB. Boosted by a growing urban demand in terms of quantity, quality and diversity of the dairy products, boosted also by the differential of price compared to cow milk based notably to the expected health effect of camel milk, the “commodification” of the camel milk is contributing to the emergence of true dairy camel sector at regional level. At the same time, these mutations have an important impact on a certain “modernisation” of the camel farming systems (use of diet with high-concentration in energy and protein, low-mobility, machine milking, reproduction management, on-farm milk processing) and on the implementation of dairy plant processing exclusively or not camel milk. Although it was not strictly in a country of the MB, one of the pioneers regarding camel milk processing for the market was the dairy factory “Tiviski” in Mauritania (Abeiderrahmane, 1997). In Morocco, small-scale dairy plants were established in the southern part of the country. In Algeria, the dairy plant “Tedjane” started the marketing of



Fig 9. The small-scale dairy plant in the camel farm “La Camellerie” in France

fermented (laban) and pasteurized milk in 2018 (Fig 8). In Tunisia, several projects of camel dairy plants have started (Faye *et al*, 2014). In Türkiye, the first camel cheeses were proposed recently in dairy plant “Ovacik”. In France, one first camel dairy farm with on-farm processing (pasteurised, milk, kefir, cheese) was implemented since 2021 (Fig 9). In Spain, the implementation of a milking parlour in the Goroy farm at Fuerteventura is started.

For answering to the growing demand in terms of quality and to be in accordance with the national regulations, an important effort was done to improve the hygienic conditions at milking, storage, transport and processing. In Europe, notably, the regulation regarding milk pasteurisation control must take in account the non-convenience of the use of alkaline phosphatase (ALP) as indicator of pasteurisation and the necessity to suggest other indicators such as lactoperoxidase or glutamyl transpeptidase (Lorenzen *et al*, 2011). Globally, the camel milk industry must propose a high variety of products adapted to the local eating habits, for example, types of cheese or fermented products.

The question of the price

One of the main constraints of camel milk development, is the price differential with the milk from other species, notably cow. Globally, camel milk price is between 2.5 to 20 times higher than cow milk (Fig 7)

Such differences could be justified by the higher production costs of camel milk production, due notably to the higher price of the animals and overall, to their lower productivity, especially around the MB where dairy cows are mainly high-yield breed such as Holstein or Montbeliard. Indeed, except in the eastern part of the MB (Türkiye, Syria, Lebanon, Israel, Palestine), the main camel breed is Maghrebi type, even if different phenotypes are described in the region (Chniter *et al*, 2013; Oulad-Belkhir *et al*, 2013; Boujenane *et al*, 2019). This type is among the relatively low-yield camels (Al-Hadrami and Faye, 2022) with a range of 1200-1800 L/lactation (Abdalla *et al*, 2015). Moreover, in most of the countries from the southern bank of MB, the areas of camel milk production are in desert wilayas far away from the consumption basins closed to the coastal areas. Such geographical configuration leads to adding costs linked to the transport of a highly perishable product. In Europe, the rare camel dairy farms face to a wide geographical demand at national or even European level, leading to similar constraints of transport.

In such conditions, camel milk will be never a substitution product of cow milk. Usually, the consumers accept to pay higher price on the believe that camel milk is beneficial for their health. In their survey on consumer acceptance and preference for camel milk, Profeta *et al* (2022) confirmed that expected or true health effect of camel milk is an important “buying factor”, both for non-European



Fig 10. Pasteurised, fermented camel milk and camel cheese from the farm “La Camellerie” sold in the Festival of Janvry (France).



Fig 11. Pasteurised milk from the farm “Chamelait” in Tunisia sold at the conference “Milk, vector of development”, Tunis (Tunisia).

and European consumers, even if these last appeared less completely convinced by the health claims. However, in Europe, the “exotic” image of the product is also a commercial argument. Moreover, the important community of Maghreb origin in France and Spain notably could represent a potential market for camel milk producers.

The market availability

As mentioned above, one of the constraints for the development of camel milk sector is the remoteness of production areas. Several stakeholders in the sector as well as policy makers regularly evoke the implementation of a spray-drying system to produce powder milk, rather for the international market than for the national one (Konuspayeva *et al*, 2022). However, the high cost of the necessary investment constitutes a brake for the implementation of one drying tower. Nowadays, only European market is supplied with camel milk powder produced mainly in United Arab Emirates that get European agreement to export (Nagy *et al*, 2014). The camel dairy farm implemented in Holland (Smits *et al*, 2023) is proposing also camel milk powder for the European market, but the quantity is limited. Camel milk powder is also available in on-line market managed by on-line platforms based overall in China and USA (Konuspayeva *et al*, 2022).

Pasteurised and fermented milk can be present in supermarket on few occasions (for example in Algeria), but in most of the cases, a small network of retailers is implemented in the production areas or out. A significant part of the products (milk, cheese, cosmetics) is sold during various events as fairs, festivals, open days, or conferences (Fig 10 & 11). But in all the cases, the distribution network of liquid milk comes from short circuits with a low number of middlemen. The market is for the moment too narrow to be integrated in the more important distribution networks implying cow milk.

Camel milk sector in the MB is just emerging in the economic landscape of the involved countries. Camel milk remains a “niche product”, even if its recent growth was important. The high price of the product on the market cannot attribute to this product a competitive interest compared to cow milk, even in countries from the south bank of the MB where the camel population is important. Camel cannot be regarded as “the cow of the future” despite his advantages face to the current environmental challenges. However, the margin of development of the camel sector around the MB is not negligible and

must be supported by more favourable regulations, notably in Europe. the different segments of the sector (production, processing, distribution) must be able to benefit from administrative and political support in the different concerned countries.

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