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Socio- economic characterization and value chain analysis of ghee consumption and production in Djelfa state, Algeria

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Abstract

This study's primary purpose is to apply the Valuelinks 2.0 approach to provide some socioeconomic comprehensive insights on the value chain map of ghee production and consumption in Algeria. Two main channels were used to collect the data: field surveys carried out in the Djelfa state and official national and international organizations. The value chain was then constructed and analyzed by grouping, classifying, and processing the data. The outcomes of this study have revealed an enormous potential of ghee production in Algeria which stems from the diversity of livestock in terms of the species that go into its composition, as well as the large size of this livestock, which allows the country to move closer to self-sufficiency in ghee production, especially with the availability of sufficient know- how among rural women to manufacture this type of dairy product. All of these facts indicate the opportunity of taking advantage of ghee division in order to accomplish the dual objectives of reducing the import bill as well as enhancing the role and status of rural women in increasing the economic income of ghee-producing households.

key words: Ghee, value chain map, socio-economic insights, rural women**,** import bill

1.Introduction

the growth of international trade in “Ghee” as the consequence of rising demand has been correlated with the increasing awareness throughout people across the world especially western countries regarding the consumption of healthy and organic foods such animal fats (butter, ghee..etc). (Kumbhare, Prasad, Khamrui, Wani, & Sahu, 2023; Pena-Serna & Restrepo-Betancur, 2020)

Ghee is a sort of anhydrous milk fat that results of heat treatment of only milk cream or butter. It is an ethnic and cultural heritage food known as "maslee," "D'han," or "samin," in Middle Eastern and North African countries (Abdullah & Alkhatib, 2021; Boussekine et al., 2020). Ghee is widely consumed in Idia, south Asian Tibetan and Mongolian cuisines(Ulambayar et al., 2024)

In addition of its crucial role in dietary and culinary traditions of those countries, the potential health advantages of ghee are primarily dependent on its fatty acid composition. Researches have indicate the correlation of functional fatty acids with health benefits including anticancer, antiatherosclerosis, and prevention of osteoporosis (Tian et al., 2023)Adequate consumption of ghee can enhance cognitive capabilities and brain health, lower inflammation of the digestive system, protect the heart by lowering cholesterol, and enhance the absorption of fat-soluble vitamins such as A, D, E, and K(Antony, Mehta, Sharma, Ratnam, & Aparnathi, 2018; Kataria & Singh, 2024; Ulambayar et al., 2024)

in Algeria, ghee, also known as "d'han," is one of multiple dairy products made from naturally fermented milk that produced by different animal species (cow, goat, sheep, and camel). It continues to have a significant impact on people's diets, particularly for those who live in rural regions(Boussekine et al., 2020). According to (Iradukunda, Aida, Ouafi, Barkouch, & Boussaid, 2018)the importance of this fermented product stems from being used as a flavoring component to enhance the flavor and aroma of many traditional dishes, such as couscous, Chekhchoukha, and R'fis, In conventional medicine, it's also used to lessen discomfort related to rheumatism, bone injuries, and some respiratory diseases such as seasonal flu and cold and the chilly feeling that comes with coughing.

Due to of the enormous size of the Algerian ruminant herd, ghee "d'han" production is being increased. This precise type of production assured by the rural households of the owners and breeders. on one hand, it is preserving method some natural proprieties of milk, which is represent a fast perishable dairy product, due to the lack of a cold chain and the high temperatures that characterize the arid, semi-arid, and Saharan climate of the zones with great intensity of breeding(Hutkins, 2006). On the other hand, because ghee is a drawer natural product with no additional coloring or preservative agents, its production generates a substantial economic income for particularly vulnerable rural households.

In spite of the multidimensional efforts made by the Algerian government in order to develop the dairy sector, and the relevance of fermented dairy products in nutritional, socio-economical levels, milkfats, “ghee” in particular remain an undiscovered field. In this setting, the few studies carried out of this subject were based on a cultural and ethnic point of view. To the best of our knowledge, no research has explored the socio- economic aspects of ghee production.

In the context of initiatives to boost ghee production and trade, this study is set out to investigate some socio-economic aspects associated with ghee production and commercialization through its value chain analysis

1. MATERIAL AND METHODS

1.1.Survey study

A field survey was carried out in the central Algerian area of Djelfa between January -June 2024. The region was selected based on the findings of a preliminary survey, which showed that the state’s high intensity of livestock farming and, more importantly, its transhumant and semi-sedentary lifestyle contributed to a high level of ghee production. On the other hand, the state’s geographical central location in the country contributed to the great cultural diversity of its inhabitants, which in turn influenced the ghee-related dietary and consumption habits.

A survey was conducted with 125 samples, dispersed randomly throughout nearly the whole state’s territory (delegated state of Ain Oussara in the north, Djelfa in the center, and delegated state of Messaad in the south). The samples were questioned on the production, marketing, and consumption of ghee. The study specifically addressed, breeders, retailers, older women with specific expertise (preparation, usage), as well as households in both rural and urban areas.

1.2.Data collection:

In- person interviews were carried out to complete a questionnaire which had been utilized for collecting data. The interview lasted around 15 to 30 minutes once the questionnaire's purpose and structure were presented in advance of starting of the survey, Questions were reviewed and clarified when required before the answers were collected.

1.3.Broad survey content:

The questionnaire has been categorized into two segments: a common section which covers broad social factors such age, gender, education level, and residence, The second segment includes three sections: the initial segment pertains to ghee producers and inquiries about socio-economic insights of upstream and downstream operations of the production process; the subsequent segment discusses product marketing with retail dealers; and the final segment addresses consumer inquiries regarding the product, its varieties, consumption inclinations, applications, and purchase transactions

Every category was asked about the different limitations that they believed were impeding the business's development, each at their own level.

1.1.Value chain map construction and analysis

The value links 2.0 approach (Springer-Heinze, 2018)was followed to create the ghee value chain map using data outcomes from the field surveys conducted as detailed in the previous section. The map was structured on Three primary levels: the micro level, which has been shown by the white links at the top; the operators of each link are displayed in yellow squares; and the informal business ties between the various links are represented by the non-continuous line

arrows. Each link's operations and activities fall under the jurisdiction and supervision of one or more state-level or regional local organizations as support service providers that represent the meso- level, which are in turn subject to national government agencies (national ministries) representatives of the level macro. Meso and macro levels are both shown at the bottom of the map in yellow with one corner snipped and all corners snipped rectangles, respectively. The value chain map was subsequently analyzed using additional data gathered from both national and international organizations using the same Valuelinks 2.0 approach.

3. RESULTS

3.1. ghee production process

The outcomes of the questionary mentioned previously in section 2.5 have allowed to discover a typical process for producing ghee; this process is illustrated in Figure 1. In short, curdled milk known as “Rayeb” or “Raïb” was obtained following spontaneous fermentation into clotting process of raw milk material at ambient temperature, which require twenty-four to seventy-two hours according to the seasonal heat. “Lben” was then created after 20 to 60 Mn lasting of

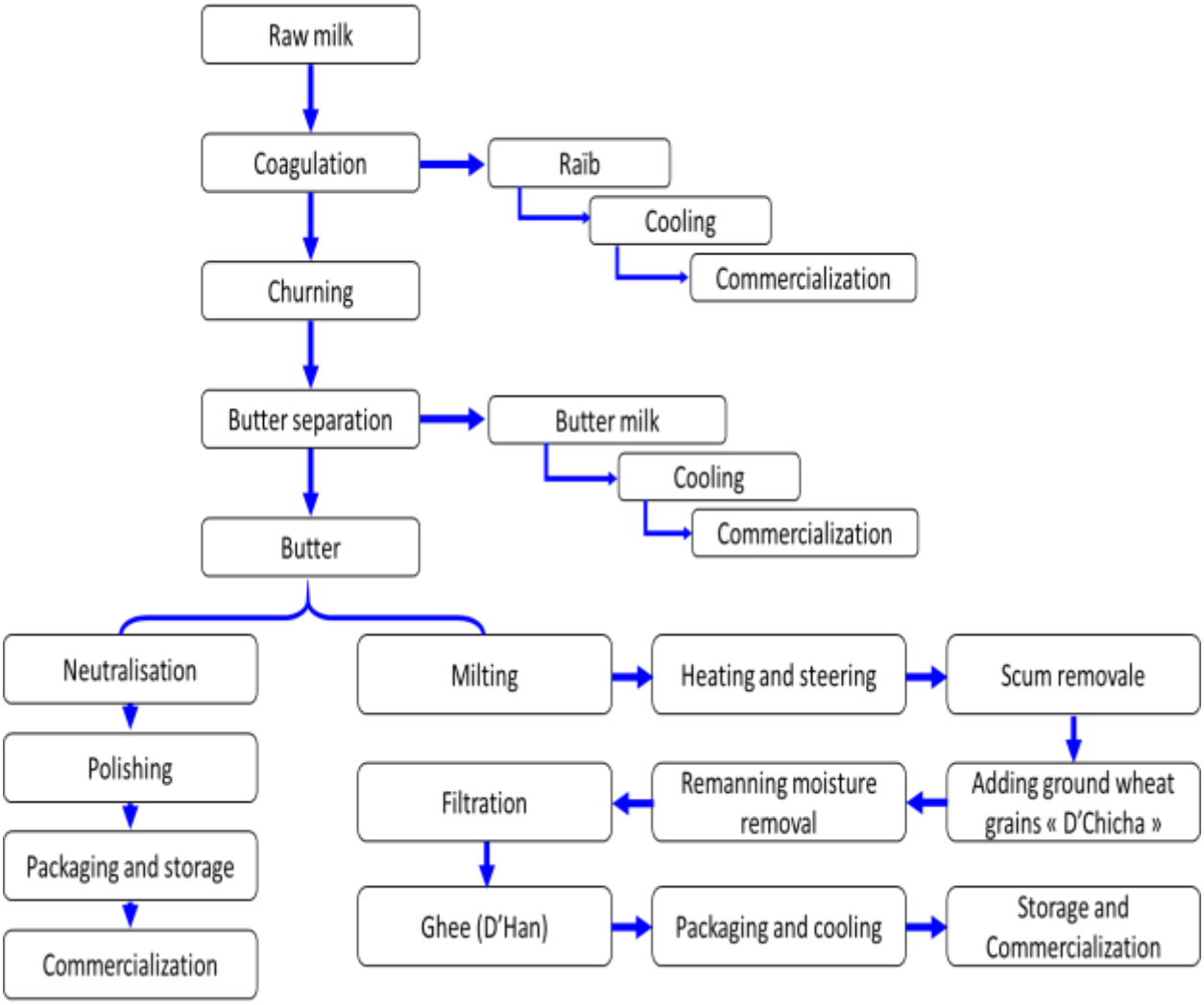

Figure 1: Illustrative global traditional diagram of ghee. ghee is obtained after transformation of the "Lben".

mechanical churning. the separated butter milk can be directly commercialized, while the butter, after being recovered from cold water bath, must be drained to eliminate the excess water, or undergo a clarification process to obtain the final ghee product wildly used overall Algerian regions and specially in step and Saharan zones. Many derivative dairy products which can be obtained before the clarification process, such as "*Raïb*" and buttermilk "*Lben*" present a verry consumed and appreciated dairy products by the local consumers especially as accompaniments with different traditional dishes

3.2. Socio- economic insights of ghee consumption and uses

The survey outcomes demonstrated the significance of women's roles in Algeria's ghee value chain. Not only are rural women (100%) responsible for producing ghee because their possession of the know- how of this profession, but, decisions regarding the consumption of various types of ghee and its multiple use purposes are made by women from (86.8 % urban,9.9% semi-urban and 4.4% rural) households, who belong to different age categories (ranging in this questionnaire as being between 20 and 60 years old), have varying educational backgrounds (fundamental 2% , secondary 11.11% , and university 86.8%), and engaged in various professional activities (51.7% employee in government and private sector, 11% private project owner and 37.4% with no professional activity)

According to the findings of this questionary, 39.6 % of consumers use ghee once a month, 12.1% once every two weeks, and over half consumers in this survey use ghee with high frequency ranging between once a week and daily uses, indicating the importance of ghee in Algerian steppe society. Natural animal ghee locally known as “D’han” is preferred by ¾ of consumers (75%). The decision was reached based on a several criteria, as the figure illustrates. About a quarter of the sample chose ghee because they wanted to experience the unique flavor that comes only from natural "D'han" ghee, while almost half of consumers think that they can benefit of the health proprieties of ghee's ingredients as a natural product with no additives. 13% of consumers are influenced by Steppe customs when making a purchase, while fewer than 10% of respondents consider the therapeutic Vertus of natural ghee to be a significant factor.

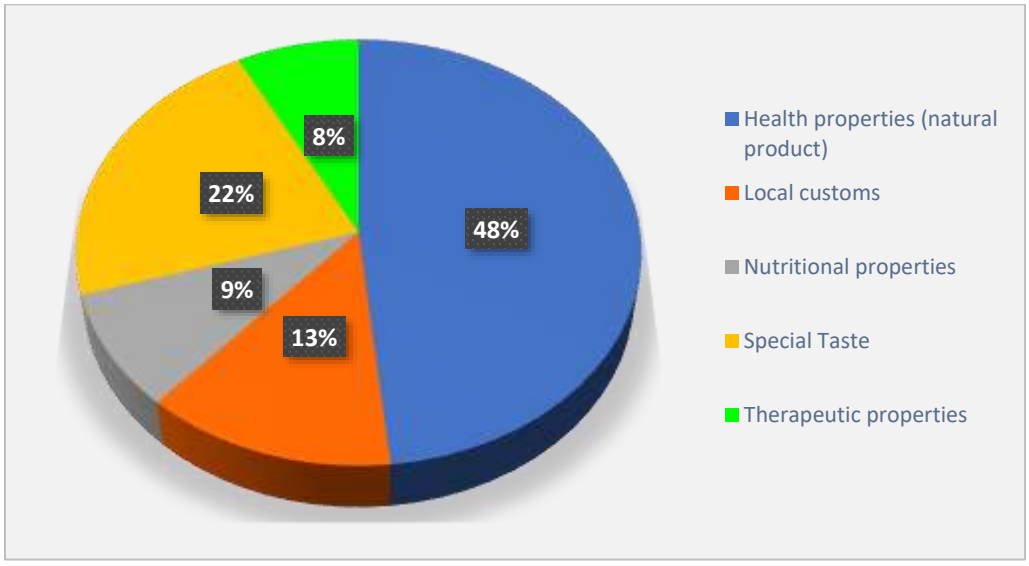

Figure 2:pie chart illustrates the ratio of uses of animal ghee

In terms of the competitive parameters among the various varieties of ghee in Algerian steppe society, the survey's findings, as showed in figure 04, indicate that sheep ghee is the most popular in the area. despite its high cost, its high co-potential stems from consumers' strong preferences, strong demand, and availability of this type of ghee.74% of its consumers use it in traditional dishes (Chekhchoukha, Couscous, R'fis etc.) and 21% for cooking. In second place, selected by 26% of customers, is cow ghee. Traditional cuisines account for 64% of its consumption, followed by cooking (20%) and its medicinal qualities (12%). Third position goes to goat ghee, which 36% of customers use for medicinal purposes, and lastly to camel ghee, which is only used in the study region for its therapeutic properties.

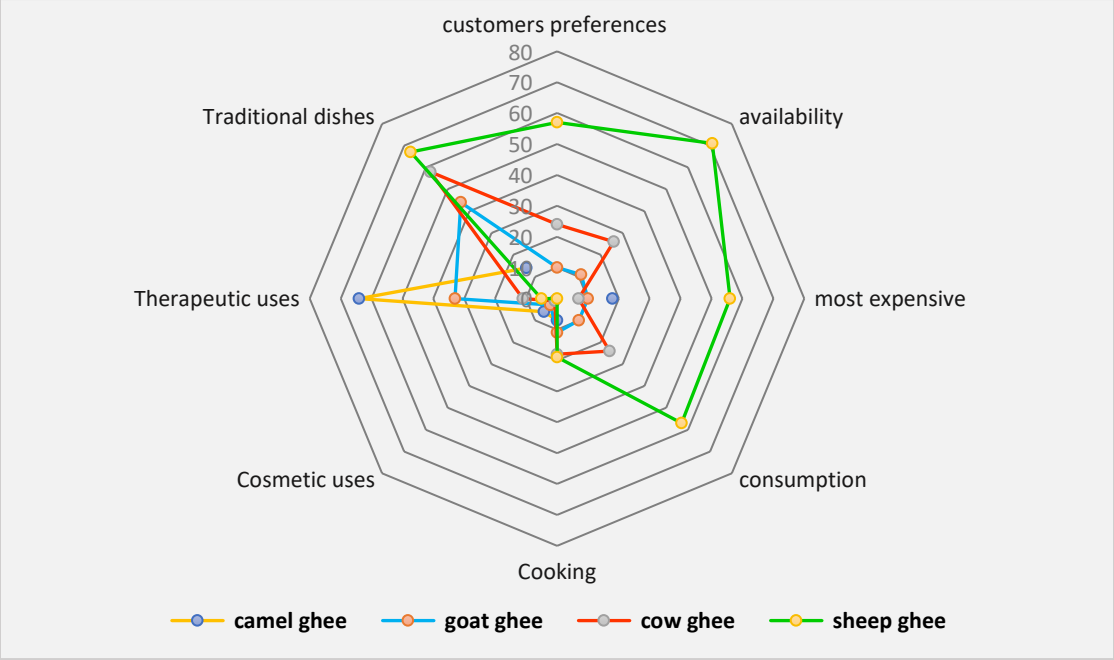

Figure 3:illustrative spider chart of competitiveness between four types of ghee produced in Algeria in Djelfa state

3.3. Value chain of Ghee production and trade in Algeria

Different data collected from producers, retailers and consumers were used to build up the value chain map of ghee production and consumption in Algeria as showed in figure 04.

As figure 04 illustrates, Upstream business operations include mainly 3 links in micro- level: Through unofficial channels to the second link: animal breeding, represented in this value chain by bovine, ovine and caprin farmers, the role of input providers (first link), primarily represented

by Agro-pastoral suppliers, which, with the assistance and coordination of formal meso-level institutions : national livestock feed board (NLFB) and grain and dry legumes cooperative (GDLC) of the state, ensures dairy animals of various kinds and species intended for breeding, as well as livestock feed, whether specialized for dairy farming or not. From choosing the breed and system to feeding and caring for the animals, the representatives of this link are in charge of the whole breeding process with coordination of meso- level organization: directorate of agriculture services (DAS) and the technical institution of animal husbandry (TIAH). Subsequently they supply the raw milk material through unofficial channels to the representatives of the third link, the milk collectors, who are exclusively females and typically rural women (the mothers, wives, daughters, or sisters of breeders). They are in charge of milking the animals and collecting and conserving raw milk.

It should be mentioned that, with the possible exception of a few small-scale breeders who may be females, the representatives of the first two links are males.

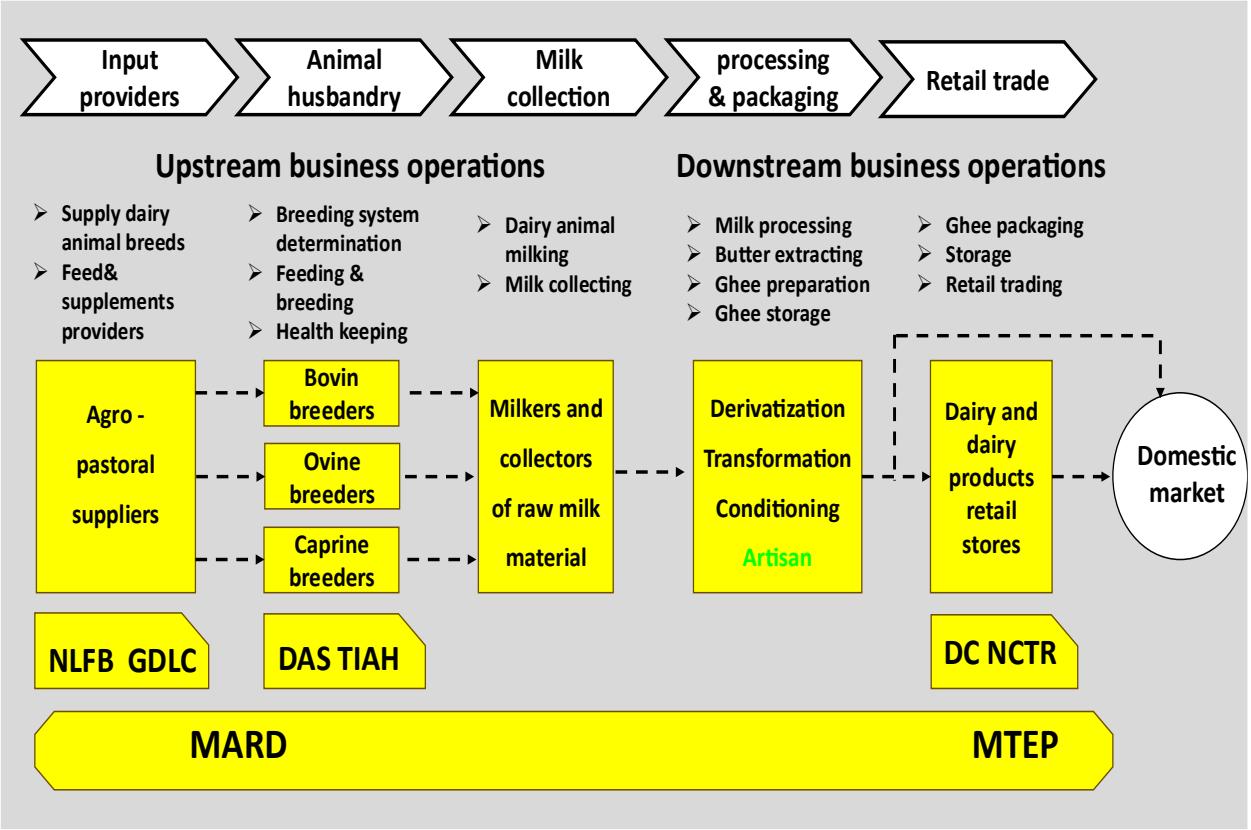

Figure 4:An overview of value chain map of ghee production and trading in Djelfa state, Algeria using Valuelinks 2.0 approach

Similar to the third link, the representatives of the fourth link, which is first part of the downstream business operations, are entirely female. The oldest rural women from the breeders' households—

mostly mothers and oldest wives— endowed with extensive know- how and expertise in the artisan dairy industry, they are in charge of transforming operations of raw milk material outcomes from third link into ghee by following the process outlined in section 3.1, then ghee conditioning and storage.

Ghee in its various varieties is provided to the domestic market through unofficial channels of the two links of downstream business operations. Under the state's directorate of commerce (DC), the representatives of Ministry of Commerce and Export Promotion (MCEP) at the macro level, milk and dairy product retail stores, representatives of the final link of the retail trade, who occasionally conduct the repackaging and storage of ghee, are suppling all ghee consumers with no exception.

Nevertheless, the local market is directly connected to the 4th link, considering the fact that a category of ghee consumers prefers to purchase it directly from the producer of the fourth link. On the one hand, they anticipate that the product will be more reliable (natural without additives) and less costly, and on the other hand, they consider it as an attempt to support the rural woman as a vulnerable producer.

4. DISCUSSION

Analysis of the value chain map of ghee production and trading in Algeria

4.1.Market size and shares of ghee value chain in Algeria

4.1.1. Production and consumption

Milkfats and Ghee in particular, which is produced by the majority of worldwide pastoral societies(Ulambayar et al., 2024) is yet unexplored territory in Algeria. The production and consumption of ghee, primarily represented by the bovine, ovine, caprine, and camelina species, are strongly correlated with the geographical distribution of the types of breeding of the aforementioned species**.** Despite the different ruminant species origins of the final ghee product, it is always resulting of the same manufacturing process as showed in figure 1 and in accord with the findings of (Boussekine et al., 2020; Leksir, Boudalia, Moujahed, & Chemmam, 2019)

4.1.2. Small ruminant ghee (sheep and goat ghee)

Despite the fact that the primary purpose of sheep farming in Algeria, where there is a livestock of over than 19 million sheep, is red meat supplying which surpass 50% of national production (Harkat et al., 2015), the country's milk production—which averaged more than 420 thousand tons between 2012 and 2022 according to (FAO 2024) - remains extremely high and is only surpassed by that of raw cow milk. All raw sheep's milk is processed into ghee, according to milk producers and processors in the survey, because to the massive quantities produced, which cannot be preserved due to the high temperatures in the areas with intense sheep breeding and the lack of cold chains as well as the economic income that producer-processor households can receive from this kind of production. For similar reasons, the vast majority of goat milk production, which ranked third with nearly 300 thousand tons and is often intended for domestic use of producer's households as well as small-scale sales of raw milk to retail stores, is transformed into ghee in the same time frame.

Ghee processing for the Algerian pastoral community is one of the approved methods to preserve the qualities of raw milk, which according to (Feliciano et al., 2022) is a perishable commodity whose rising ambient temperature encourages the growth of the bacteria and microorganisms which lead to the milk deterioration.

In the dairy industry, heat treatment is a crucial processing technique which extending the dairy products shelf life and guaranteeing their safety for human use by eliminating harmful and spoiling bacteria from this item.(Rauh & Xiao, 2022)

According to the ghee manufacturers, this old approach, which is applied to the ghee at one of its processing phases (discussed in section 1.1), aims to ensure ghee safety and improve its self-life which It may be defined according to (Rauh & Xiao, 2022) as the length of time food can be kept in storage without degrading or losing its nutritional value.

4.1.3. Cow ghee

in contrast with ovine and caprine milk production, bovine milk production which ranks first with nearly 3 million tons per year, and within the framework of contract farming and subsidized production, as parts of the Algerian state's policy to ensure self-sufficiency in milk production for daily local consumption, the majority of the produced quantities of cow's milk are converted to

dairy factories for processing and canning before being released for consumption in the local market. Apart from that, the remaining family farms focused mostly on self-consumption and had low output levels, and in an attempt to increase their financial income, some families turn a significant portion of their raw milk output into ghee which is destined for personal use and modest-scale sales that directly supply consumers and certain retail dairy stores

The intake of natural bio-Products by different groups of people worldwide is frequently influenced by their cultural and civilizational legacy, consumer culture, personal preferences and degree of awareness. Since it was recently demonstrated that consuming natural animal ghee outcomes of various animal species is estimated to have a 15-fold lower risk of cardio-vascular diseases than consuming manufactured ghee, the trade of this product has rebounded, with an increase in global production occurring concurrently with an increase in demand ((Pena-Serna & Restrepo-Betancur, 2020).

Algerian people make no exception, The consumption of natural animal ghee is regarded as a significant component of the socially embedded cultural and civilization legacy of the Algerian people(Boussekine et al., 2020). Additionally, according to (Kumbhare et al., 2023) Demand for functional foods has increased as public awareness of health issues has improved. Foods that offer health advantages above and beyond meeting basic nutritional needs, like ghee, have been referred to as functional foods. Algerian consumers are becoming more aware of the many advantages of consuming natural, additive-free animal ghee, including its numerous culinary applications as well as its nutritional, therapeutic, and even cosmetic benefits in accordance with the finding of(Antony et al., 2018; Bharti et al., 2023; Maiza et al., 2020; Ulambayar et al., 2024). Users of this product witnessed a qualitative shift in their consumer culture as a result of all of these variables.

The amount of natural animal ghee consumed by Algerian consumers, which constitute an important component of the typical diet in the vast majority of Algerian states due to their excellent nutritional value,(Johansen, Owusu-Kwarteng, Parkouda, Padonou, & Jespersen, 2019) depends on several factors, the most significant of which are the consumption frequency of this product and how much of it is included, as a necessary ingredient in cooking and traditional dishes, which are frequently connected with substantial socio- ethnic occasions that are distinctive to each region. It is also influenced by the product's availability and ease of access in the local market. Since natural animal ghee is classified as a hand-made drawer product made in a traditional manner and in

relatively limited quantities compared to population density and potential raising demand, its price, which is subject to the law of supply and demand, and reflect somehow ghee quality, is thought to be the most influential factor. However, (Mamine, Montaigne, & Boutonnet, 2016) reports that customers who have controversial perceptions find it challenging to determine whether a product's pricing really reflects its quality. Price is no longer the only metric of quality that influences customers' decisions to buy. Issues in price estimate are frequently encountered by consumers, which reduce their satisfaction Growing.

Even though ghee is a "belief" item with barely any verifiable information about its qualitative attributes (due to its high cost) or even lack of verifiability, trust and reputation can be used as coordination mechanisms in this case, where the costumer comes up against challenges in quality assessment(Bijman, Muradian, & Cechin, n.d.) , especially with the complete lack of studies and researches to characterize ghee and measure its quality.

Based on the limited available statistics, an overview of ghee production and consumption may be created, however, as result of the lack of comprehensive data and the challenge of gaining access to the available one at the level of official national and international specialized institutions (Ministry of Agriculture, FAO) as well as the absence of a general perception nor a national production and trading regulatory plan of the ghee sector, it seems to be highly challenging to precisely estimate the size of ghee production and consumption at the national and even local levels.

4.2.Part of ghee value chain in import /export bills

4.2.1. Size of ghee imports in Algerian market

The FAO (2024) reports that throughout the previous 20 years (2002–2022), Algeria has imported just one kind of ghee: ghee made from cow's milk. The data for 2014 indicates that, along with the growing import values of different dairy products, fats and oils produced from animal milk, including ghee, and cow's milk powder, this was the highest year for ghee imports, with over 16,000 tons and an import cost above 90 million. Cow ghee import Values during this period fluctuated between those of the year 2014 and 2977 tons for an invoice of approximately 7.3 million recorded during the year 2009.

The figure's most intriguing result is that official import data for fats and oils derived from animal milk for the time frame 2018–2021 are completely missing from government websites and those of international organizations, such as TRADE MAP and the FAO website. FAO estimations for the same years vary from 6,000 tons for an expected bill of 27 million in 2020 to 353 tons for approximately two million in 2021. Compared to the value of imports of cow's milk powder and other dairy products, there was a significant decline in the amount of cow ghee imports reported in 2022 (1385.5 tons for a bill of barely over 9.5 million).

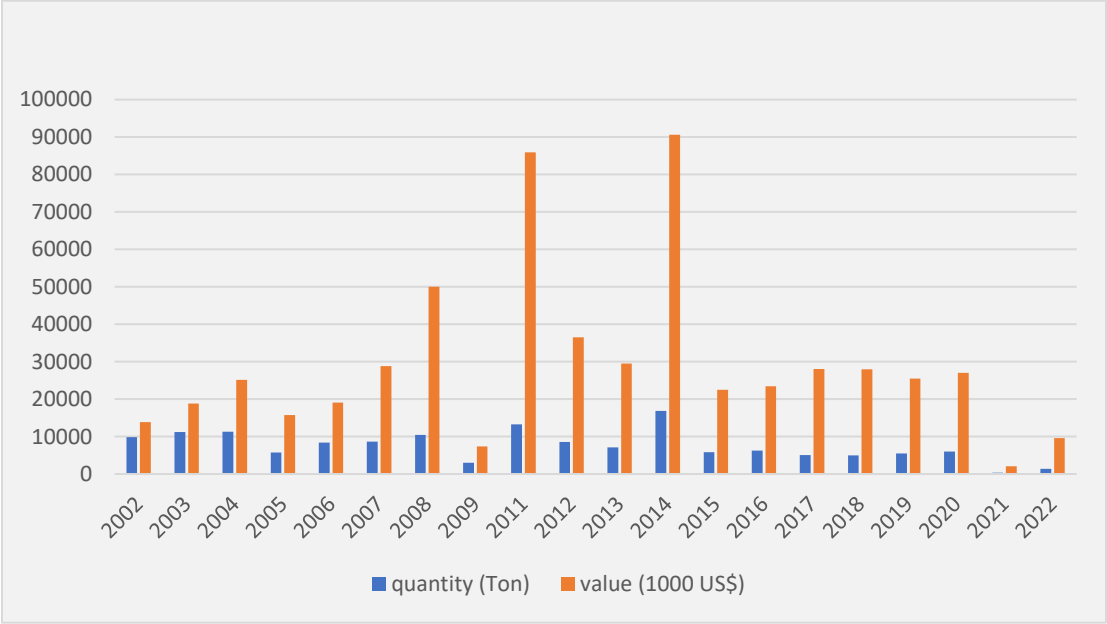

Figure 5:variation of Algerian imports of ghee from cow milk

4.2.2. Exporting countries shares in Algerian ghee market

Twenty nations that shared the Algerian ghee market were among Algeria's partners for supplying the national market with cow's ghee throughout the research period (2002–2022). For a period of 14 years on average, three countries—France, the Netherlands, and New Zealand—are regarded as the product's permanent suppliers. Belgium, Spain, and Argentina are regarded as semi-permanent suppliers. For a period of one to four years, the remaining economic partners supplied the Algerian market either regularly or occasionally.

According to estimates, the suppliers with the biggest yearly market shares are New Zealand, which by itself held nearly half of the market share with over 46%. the other economic partners

who shared the remaining cow ghee market with shares of no more than 6% each, came next Spain and Brazil with about 12%, 8%, respectively.

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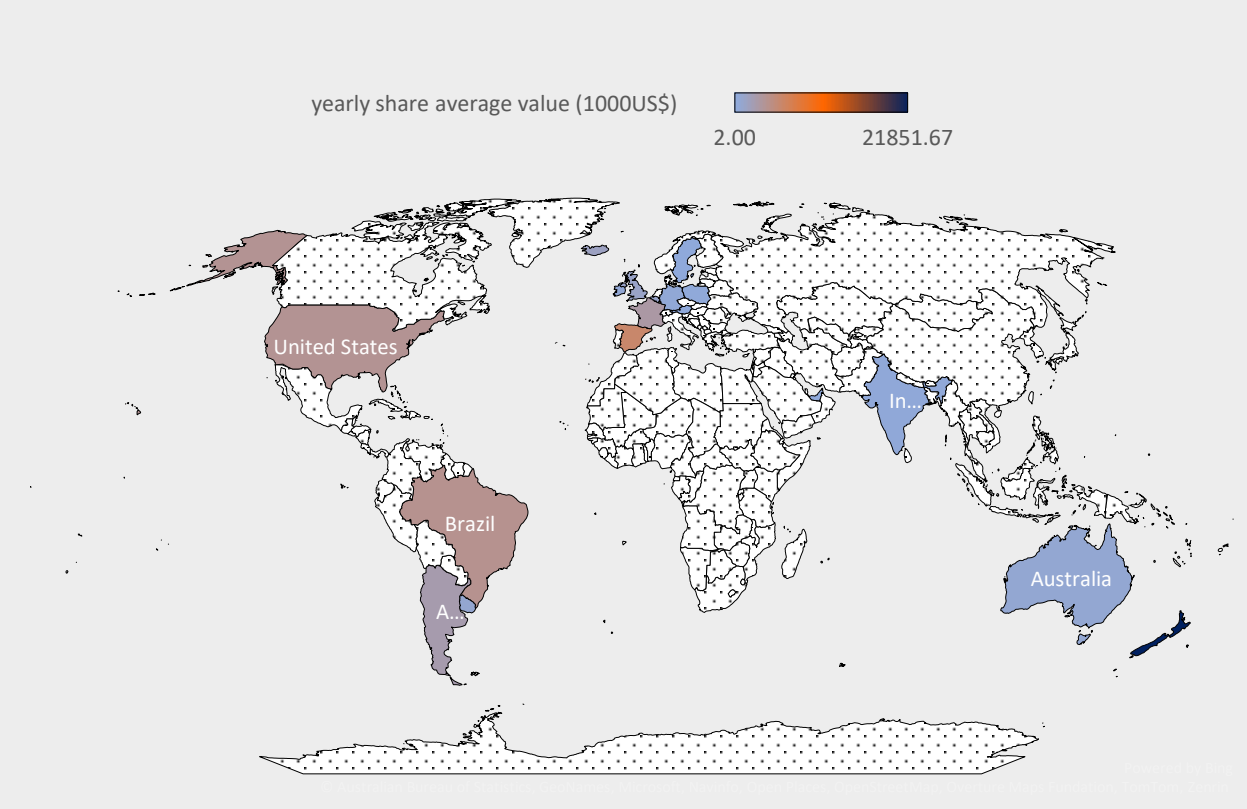

Figure 6:Repartition of annual share value of ghee exporting nations in Algerian market

Indeed, the 20 nations that export cow ghee to Algeria are essentially major suppliers of cow powder milk to the Algerian market, which may explain why Algeria has the strongest commercial ties with the previously mentioned nations in terms of cow ghee. One-way economic collaboration is how the current relationship is described. According to official figures from the Ministry of Trade and Export Promotion, Algeria has not exported any "ghee" in any of its forms.

5. Conclusion

in the context of the attempts to accomplish the dual goal of developing the natural animal ghee sector and reducing the import costs, this study aims to be the first of its kind through the construction of the value chain map of ghee sector in Algeria and analyzing some of its economic and social aspects. notwithstanding some limitations, such as the absence of

reliable data and statistics and the challenge of access to the available of it, the findings of this study have highlighted the significant Algeria's potential in this field steaming from the country's large and diverse dairy producing livestock on one hand, and the efficient role played by rural women in this industry owing to their possession of the required know- how, techniques and skills on the other. The current study has contributed to enhance our comprehension of the Algerian ghee business and establishes the framework for more extensive cross-nation future researches that will be necessary to accurately understand the different aspects of the Algerian ghee industry and its development by improving output through efficient use of resources, assisting vulnerable groups (producers), and enhancing the role of rural women.

Declaration of interests:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement:

H. KHERROUBI: ressources, Investigation (Data collection, and experiments performing), Formal analysis, visualization, Writing – original draft, data curation

N. MAHBOUB, N. SLIMANI: Conceptualization, validation, Supervision, Funding acquisition, Project Administration, Methodology

All authors have thoroughly reviewed and provided their consent to the final version of the manuscript for publication.

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