Socio-economic and technological characterization of traditional cheeses produced in Chad

Abstract

In Chad, the fruits of the *Solanum dubium* plant, "*Jibbên*" in local Arabic, are used to coagulate milk and make a traditional cheese. This cheese, which represents a technical, economic, and cultural heritage, is poorly understood. This study aims to characterize the socio-economic and technological aspects of traditional cheeses produced in Chad. This work is a descriptive study carried out through a survey conducted in the city of N'Djamena, the department of Abougoudam (Ouaddaï province) and the department of Dar-al Fawakih (Wadi-Fira province). Three populations were targeted by this survey, namely breeders, cheese makers and consumers.

We have identified a total of five (5) cheese dairies operating in the urban and peri-urban areas of the city of Ndjamena. Several types of cheese are produced by these dairies. Jibben fruit is the most widely used coagulant in milk coagulation processes. This plant is known to 58.3% of pastoralists and agro-pastoralists. The results show that 4.6% of respondents consume local cheeses and 3% imported cheeses. 51% of respondents do not have access to this product because of its unavailability and 33% because of its high price. Cheese consumption frequency is very low, with only 0.8% of respondents regularly consuming cheese every week. Cheese-making technology is well known in Chad. However, this cultural heritage is threatened by low consumption rates and the abandonment of cheese-making by the new generation in rural areas.

Key words: milk; cheese; *Jibbên*; Chad.

I. INTRODUCTION

Livestock farming is a very important economic sector for many countries around the world. In Africa, it is a lever that can be relied on to improve food security and the nutritional and social status of the population (Faye and Alery, 2001). In Chad, the livestock, fishing, and forestry sub-

sector contributed 15% of national GDP and 44% of agricultural GDP in 2017 "Ministry of Finance and Budget ,2018" The livestock sector provides a livelihood for 40% of the Chadian population (Ministry of Livestock and Animal Resources (MERA). 2008). Among livestock products, cow's milk occupies an important socio-economic share. In addition to the economic aspect, milk and dairy products play important roles in the dietary, nutritional, and socio-cultural spheres (Chatellier, 2019; Ouedraogo et *al*., 2023). Because it is rich in water and other nutrients, milk is subject to rapid degradation by microorganisms (Aboudou et *al*., 2021). This situation calls for the development of preservation and processing techniques adapted to the socio-economic and environmental context (Sessou et *al*., 2013; Valery et *al*., 2023).

Throughout the world, various techniques such as fermentation, curdling, drying, skimming, and churning have been used to preserve milk. The desire to preserve milk in a variety of forms is probably at the origin of a multitude of products (Duteurtre, 2019). Converting milk into cheese not only brings income to processors and facilitates its preservation, but also provides them with a product of high nutritional value, thanks in particular to the presence of animal proteins (Niang et *al*., 2023). This processing relies on know-how and techniques that are mastered within the camp or within production units. In Africa, several plants with coagulating properties are used for milk coagulation, such as *Calotropis procera* in Benin (Sanni et *al*., 1999; Aboudou et *al*., 2021), *Cynara scolymus* in Egypt (El Kholy, 2015) and Algeria (Nouani et *al*., 2009), *Solanum dubium* in Sudan (Sana et *al*., 2011; Mohamed et *al*., 2016).

In Chad and Sudan, the fruits of Solanum dubium, "*Jibbên*" in Arabic, are used to coagulate milk and produce traditional cheese. Some research has been carried out in Sudan on the coagulating aspect of this plant; notably the work of Sana et *al*. (2011), EL-Owni et *al*. (2011) and Mohamed et *al*. (2016). This cheese, which constitutes both an economic and cultural heritage, is little known in Chad. Few studies have been carried out in this field, including the work of Talib et *al*. (2009) and Koussou et *al*. (2007). The aim of the present study is to characterize the socio-economic and technological aspects of traditional cheeses produced in Chad.

II. MATERIALS AND METHODS

II.1 Study setting

The study was carried out in the city of N'Djamena and in the departments of Abougoudam and Dar-Alfawakih in the provinces of Ouaddai and Wadi Fira respectively.

II.2 Information gathering.

The information was collected using survey forms for respondents, i.e. farmers, cheesemakers and consumers. A total of 120 pastoralists and agropastoralists were surveyed, 237 consumers in 84 households and five cheese factories regularly producing cheese in the urban and peri-urban area of the city of N'Djamena were identified and visited

II.3. Target groups

A total of 120 pastoralists and agropastoralists were surveyed in the departments of Abougoudam and Dar-Alfawakih. The choice of these two departments was justified by their wealth of livestock on the one hand, and the presence of *jibben* plants on the other. The survey focused on assessing pre-existing knowledge of *jibben* and cheese and gathering information on cheese processing techniques in these rural areas. To this end, a 300 g piece of *Djibna malfoufa* cheese and a branch of *Jibben* plant were presented to each respondent in order to assess their knowledge of both.

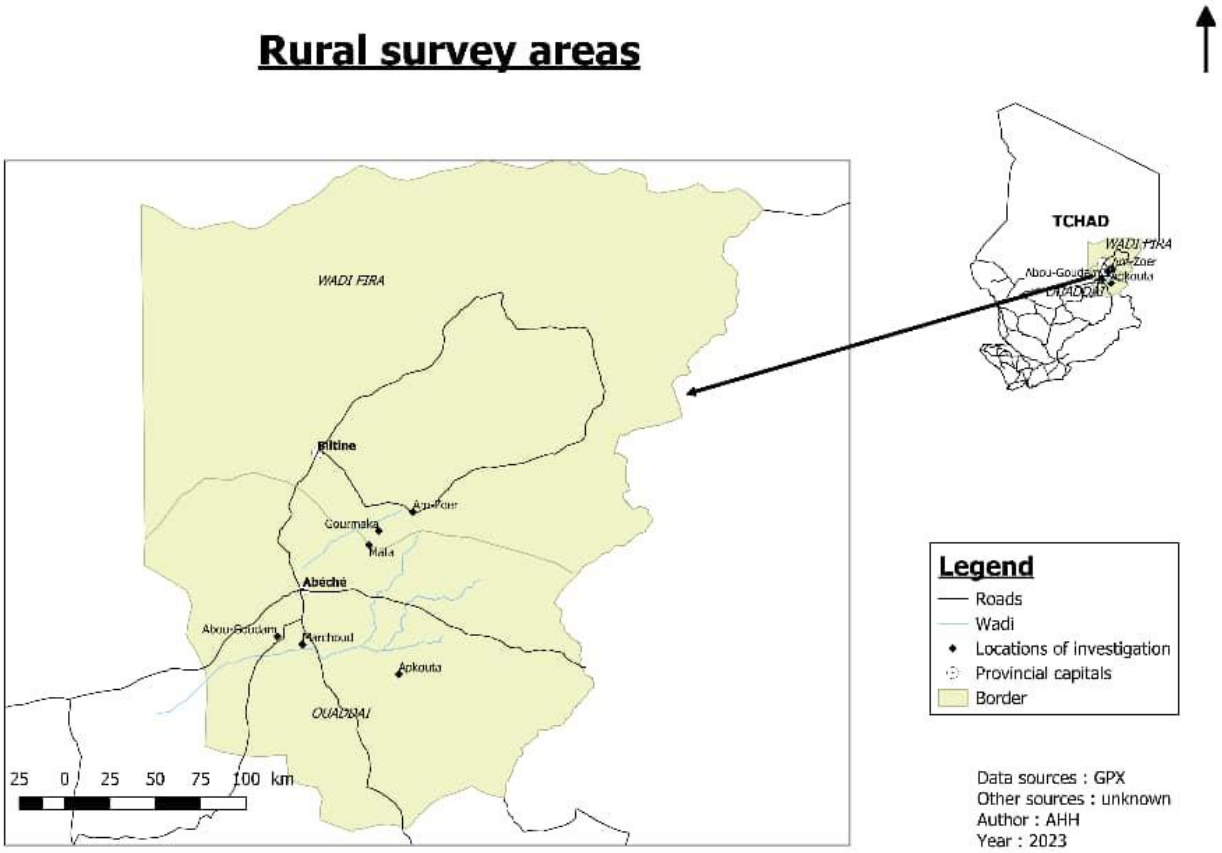

Figure 1: Rural survey areas

II.4. Selection of cheese dairies

A total of five cheese dairies regularly producing cheese in the urban and peri-urban areas of the city of N'Djamena were identified and visited. The city of N'Djamena was chosen because of the presence of small cheese factories in the area. The survey focused on the history of the cheese-making business, manufacturing technology, coagulants used, origin of raw materials, packaging, types of cheese produced and prices.

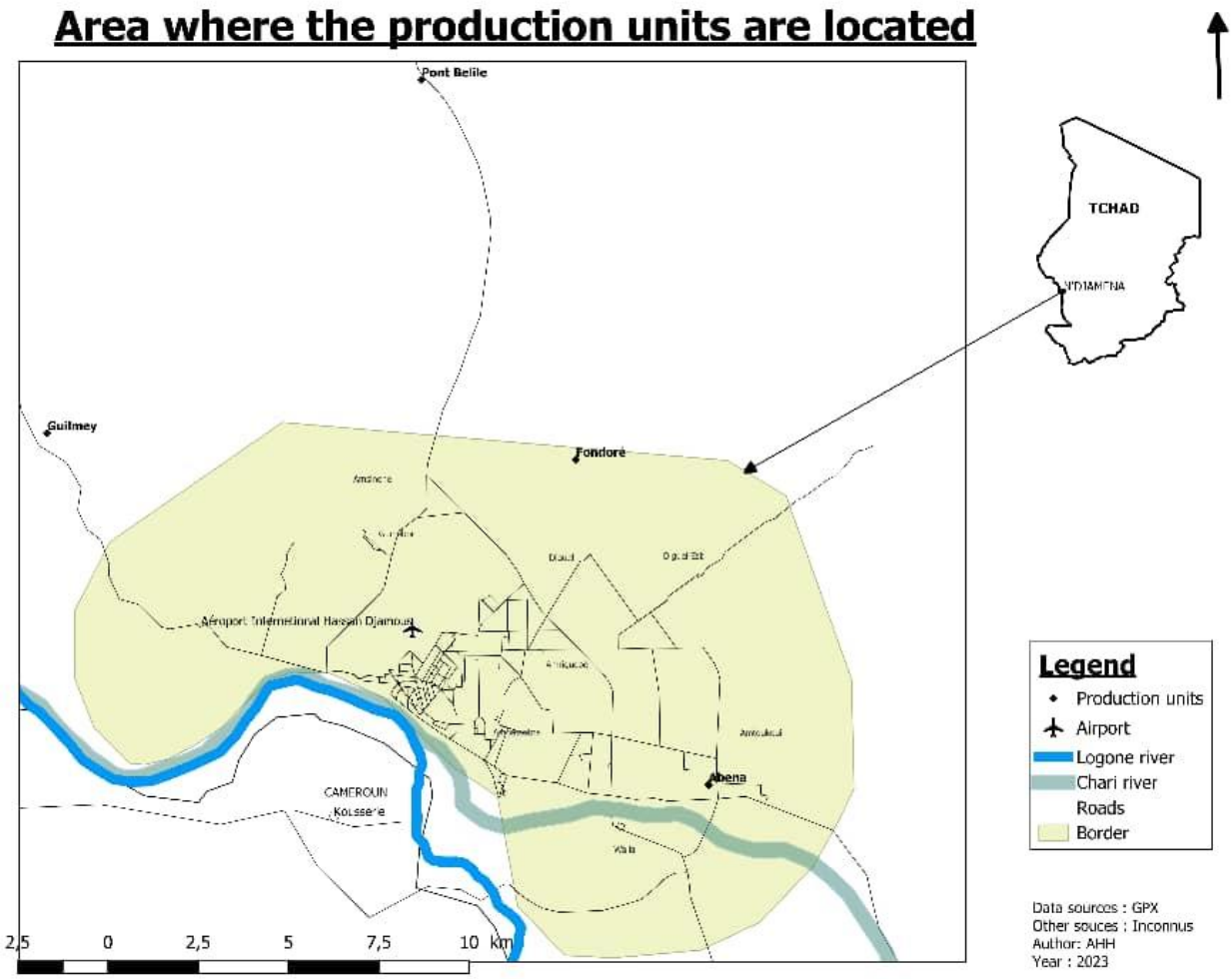

Figure 2: Areas where cheese production units are located.

II.5. Consumption of milk and milk products

The city of N'Djamena was chosen to conduct the consumer survey. The purpose of the survey was to collect information on the consumption rate of milk and milk products and consumer attitudes towards cheese. A total of 237 people from 84 households were surveyed.

II.6. Statistical analysis

The results obtained were presented in the form of means ± standard deviation using Microsoft Office Excel 2013 software. These means are the result of three tests or two replicates. Analysis of variance (ANOVA) at the 5% probability threshold allowed us to compare the means and a

Fisher post hoc test was carried out to classify the means using Minitab version 18.Ink software. XLSTAT 2014 software allowed us to carry out a Principal Component Analysis (PCA).

III. Results and discussion

III.1 Results

III.1.1. Cheese-making practices in rural areas

III.1.1.1. Survey of knowledge of Jibben and cheese

The majority of respondents (58.3%) answered (yes) to questions related to knowledge of Jibben. Knowledge of Jibben varied by community (p-value 0.000). The Abcharib answered 12/12 or 100%, the Maba 18/26 or 69.20%, the Arabs 36/55 or 65.50%, the Mimi 2/7 or 28.60%, the Kreda 2/13 or 15.40%, and no one from the Zakhawa community answered Yes or 0/7. (figure 3).

In terms of communes, the highest rate of knowledge was recorded in Am-Zoer (70%), followed by Gourmaka and Mata (both 65%). Abougoudam had a knowledge rate of 60%. The lowest rate of awareness was recorded in the communes of Abkhouta and Marchoud, with 45% each (figure 4).

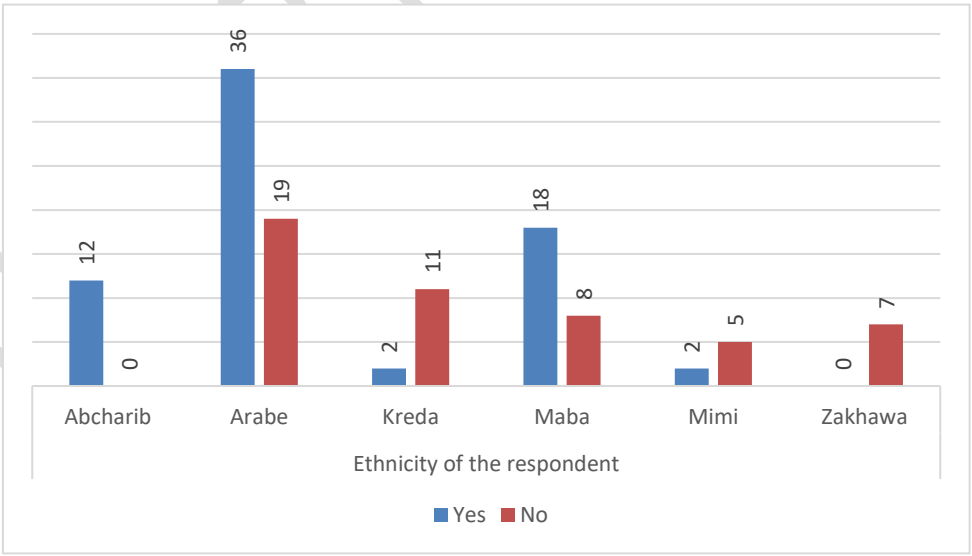

Figure 3: knowledge of Jibben by communities

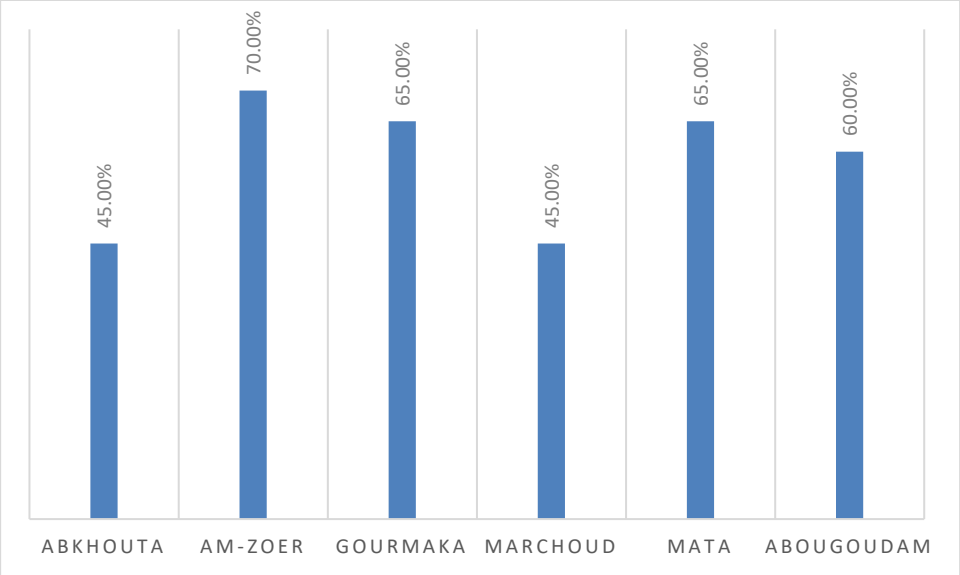

Figure 4: Knowledge of Jibben by local authorities

Figure 5 shows that awareness of Jibben increases with the age of respondents. The awareness rate for people aged under 36 is no more than 25%, while the awareness rate for people aged 36 and over is over 67%. At 56 and over, the awareness rate of Jibeben is 100%.

Figure 6 shows the Jibben awareness rate by gender. The rates were 58.9% and 56% respectively for male and female respondents (P value 0.790).

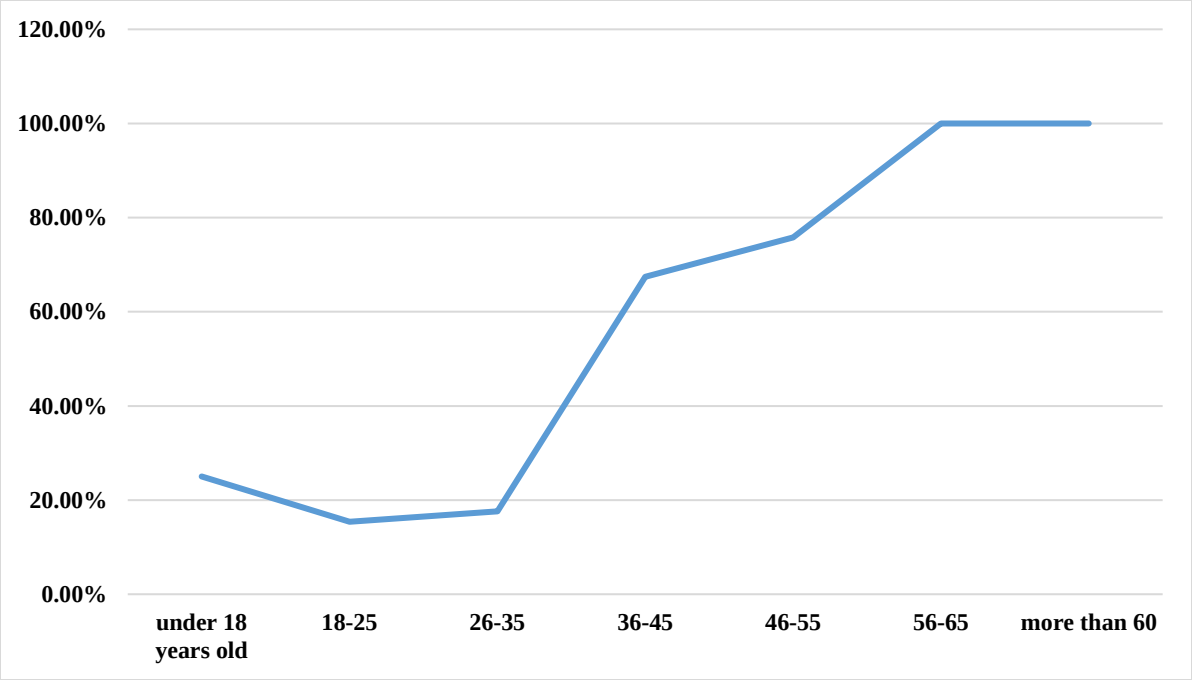

Figure 5: Level of knowledge of Jibben according to age

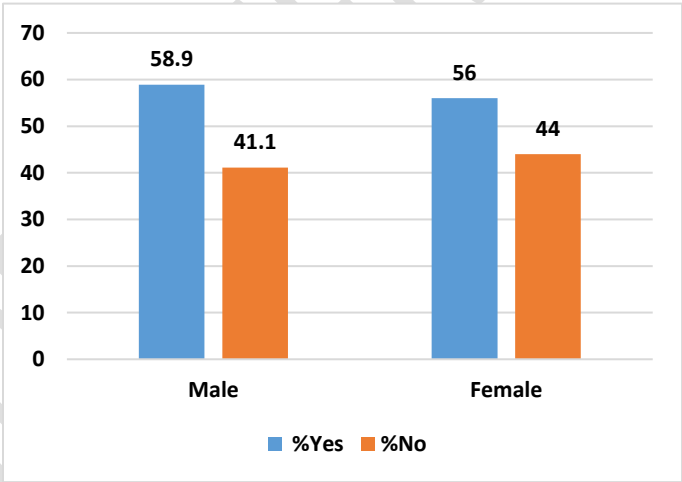

Figure 6: Awareness of Jibben by Gender

Figure 7 illustrates the rate of knowledge of cheese, which stood at 67.5%. This rate varies by commune (p value 0.039). The communes of Marchoud and Mata have the highest knowledge rates, at 90% and 85% respectively. Figure 7.

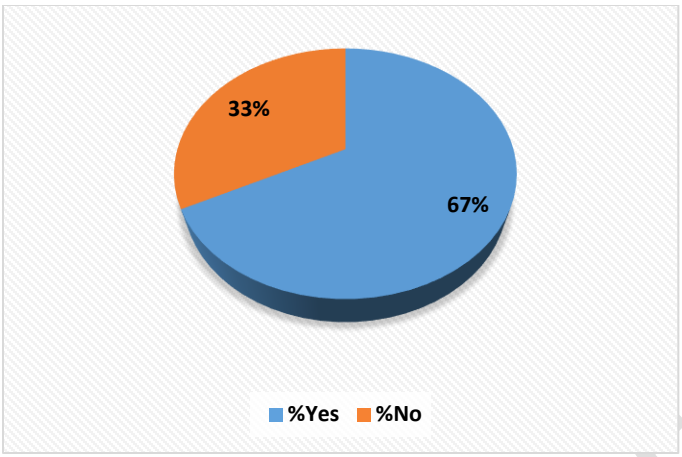

Figure 7: Level of cheese knowledge

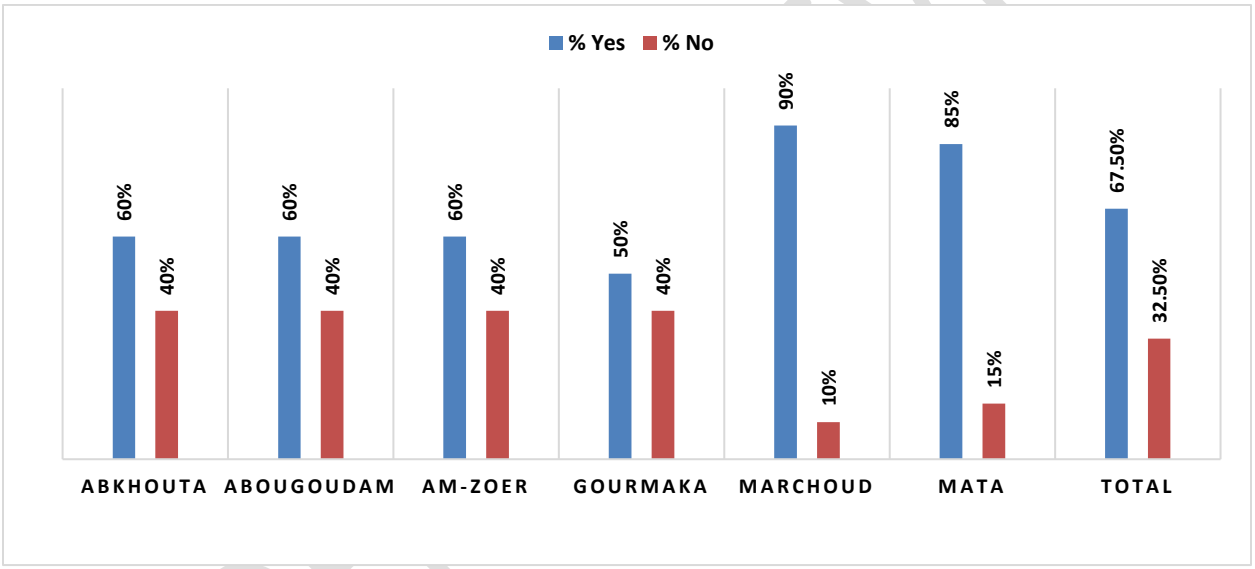

Figure 8: Level of cheese knowledge by municipality

III.1.1.2. Cheese production in rural areas

The majority of farmers surveyed (92.5%) confirmed that butter (Zibdé) and curdled milk (Rouaba) were their main processing products (Figure 9). However, 18.3% of respondents confirmed that they had processed milk into cheese at some point in their lives. According to our respondents, this practice in rural areas was generally carried out in the past, by young Shepherds during grazing.

Surveys of cheese makers have shown us that, the technology used to make this traditional cheese is shown in (Figure 10): after processing the milk in a container, the whole Jibben fruit is

crushed and added to the milk (1 Jibben fruit/1 liter of milk) and left to rest for around 30 min in a warm place. After coagulation, the whey is removed by filtration through a perforated funnel. The resulting curd is a fresh cheese called *Djibna baida*.

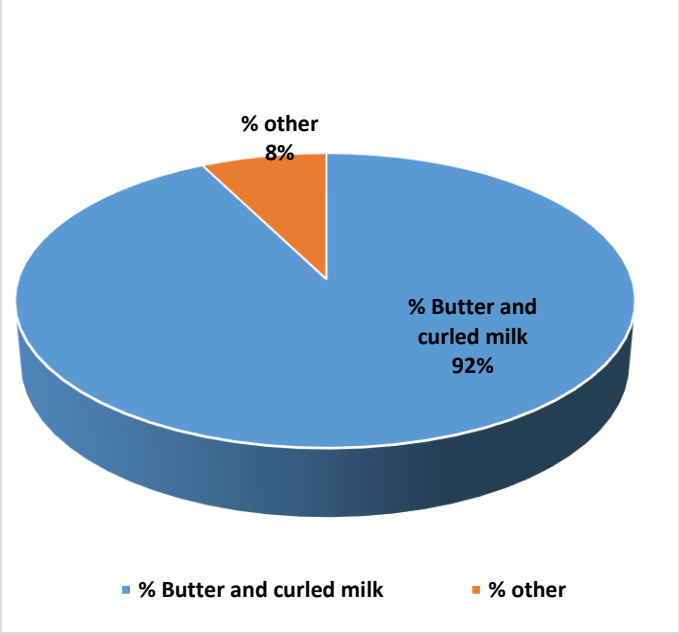

Figure 9: Dairy processing products in rural areas

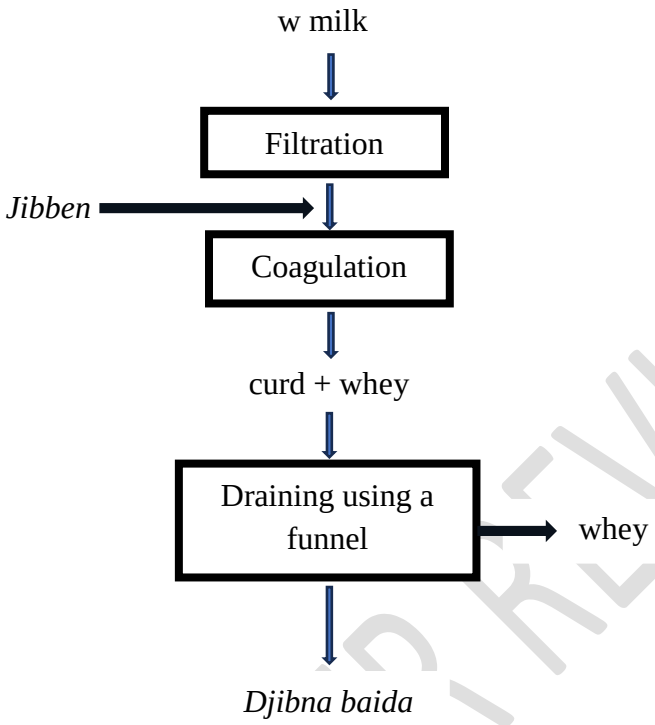

Figure 10: Diagram of artisanal cheese making in rural areas

III.1.2. Cheese dairies in the urban and peri-urban area of N'Djamena city

We identified a total of five (5) cheese dairies operating in the urban and peri-urban areas of N'Djamena (fromagerie Zina, Batoul Sossal, Durand, Alkhiza and Abigael). According to these cheese-makers, the business of transforming milk into cheese was first carried out by European missionaries and Lebanese-Syrian traders. The latter buy milk from the local population and transform it into cheese for their own consumption. The first Chadian player in this field was Mr. Ramat Abdel-bagi, who founded the Zina cheese dairy in 1964.

Table 1: Cheese dairies operating in the urban and peri-urban areas of N'Djamena

Cheese factory	Date of creation	Location
Zina	1964	Pont Bellilé
Durand	1997	Gilmay 1st district
Batoul sossal	2001	Pont Belilé
Al-khiza	2008	Fandor 8th district
Abigaël	2012	Abbena 7th district

III.1.2.1. Types of cheese produced and production technologies.

Cheese dairies in the urban and peri-urban areas of N'Djamena produce several types of cheese. These can be divided into three groups, depending on the type of milk and coagulant used.

1- Cheese made from cow's milk and coagulated with *Jibben*.

2- Lactic curd cheese.

3- Goat's cheese.

III.1.2.1.1. Cheese made from cow's milk and coagulated by the Jibben process.

Cheese made from cow's milk and coagulated by Jibben is the best-known cheese in Chad. Coagulation is achieved by the fruits of Jibben (*Solanum dubium*), a wild woody herb of the Solanaceae family, which grows widely in the Sahelian zones of Chad.

There are four types of this cheese: Djibna malfoufa, Djibna baida, Djibna nadjda and Mozzarella.

Djibna malfoufa

Also known as Pont-Bellilé cheese, Djibna malfoufa is a twisted cheese, the paste is cooked then braided. It is characterized by its elasticity. According to producers, this is the best-known and best-selling type of cheese.

Production technology

The results of the surveys show that, the manufacturing process for this cheese is as follows:

- After filtration, the milk is left to rest for around an hour at 37°C to promote spontaneous lactic coagulation;

- Coagulation takes place at 45° C for an hour after the addition of coagulant (aqueous extract of 5 jibben fruits for 5 L of milk);

- After the curd has coagulated and rested, a test is carried out to check its elasticity. This test is carried out by placing a small piece of curd in a hot metal pan and checking the elasticity of the piece by crushing it at the bottom of the pan with a spoon. The test is repeated several times until the required elasticity (a stringy texture) is obtained.

- Once this texture has been achieved, the curd is poured into the saucepan with a little whey to cook over a low heat. During the cooking process, the curd is turned several times until the whey turns a light yellow and the curd becomes creamy;

- At the end of this stage, the curd is ladled into a container, then stretched and curled by stretching a piece of curd with both hands and gluing the two ends together to form a circle. You then pull on both ends of the circle to flatten it and glue the two ends together. This action is repeated several times until a braided paste is formed (Djibna malofufa).

The finished product can be stored in brine for several months.

Djibna nadjda

The result of our study shows that, this type of cheese is cooked and not pressed. Its manufacturing technology is similar to that of Djibna malfoufa, the only difference here being the absence of braiding; after coagulation, the paste is cooked directly, then the curds formed are transferred by ladle into perforated molds, which allow separation of the whey. This draining

stage is carried out in a pressure-free cloth. The resulting cheese is a hard cheese that oozes for 24 hours. Salting is dry.

Pressed cheese

This type is an uncooked pressed cheese. The milk used to make this cheese is raw milk, which undergoes no heat treatment during processing. After filtration, the milk is left to stand for an hour at 37°C to promote spontaneous lactic coagulation, before the coagulant is added (for 5 L of milk, 5 *S. dubium* fruits are crushed and soaked in 40 ml of water for 1 h of the time, then filtered) and the milk is placed under the temperature of the sun. After coagulation, the resulting curd is drained using a cloth, to remove the whey, by first shaking the cloth and then placing it on a table with a board and pausing a weight on it for pressing. The cheese thus obtained is placed in a warm, well-ventilated place, then preserved by dry-salting.

MAZZARELLA

This type of cheese is made from preheated milk coagulated with Jibben and citric acid. Coagulation takes place after one hour at 45°C. After coagulation and curd rest, the curds are cooked and drained slowly using a cloth.

The production diagram for traditional Jibben-coagulated cheeses is shown in figure 11.

=

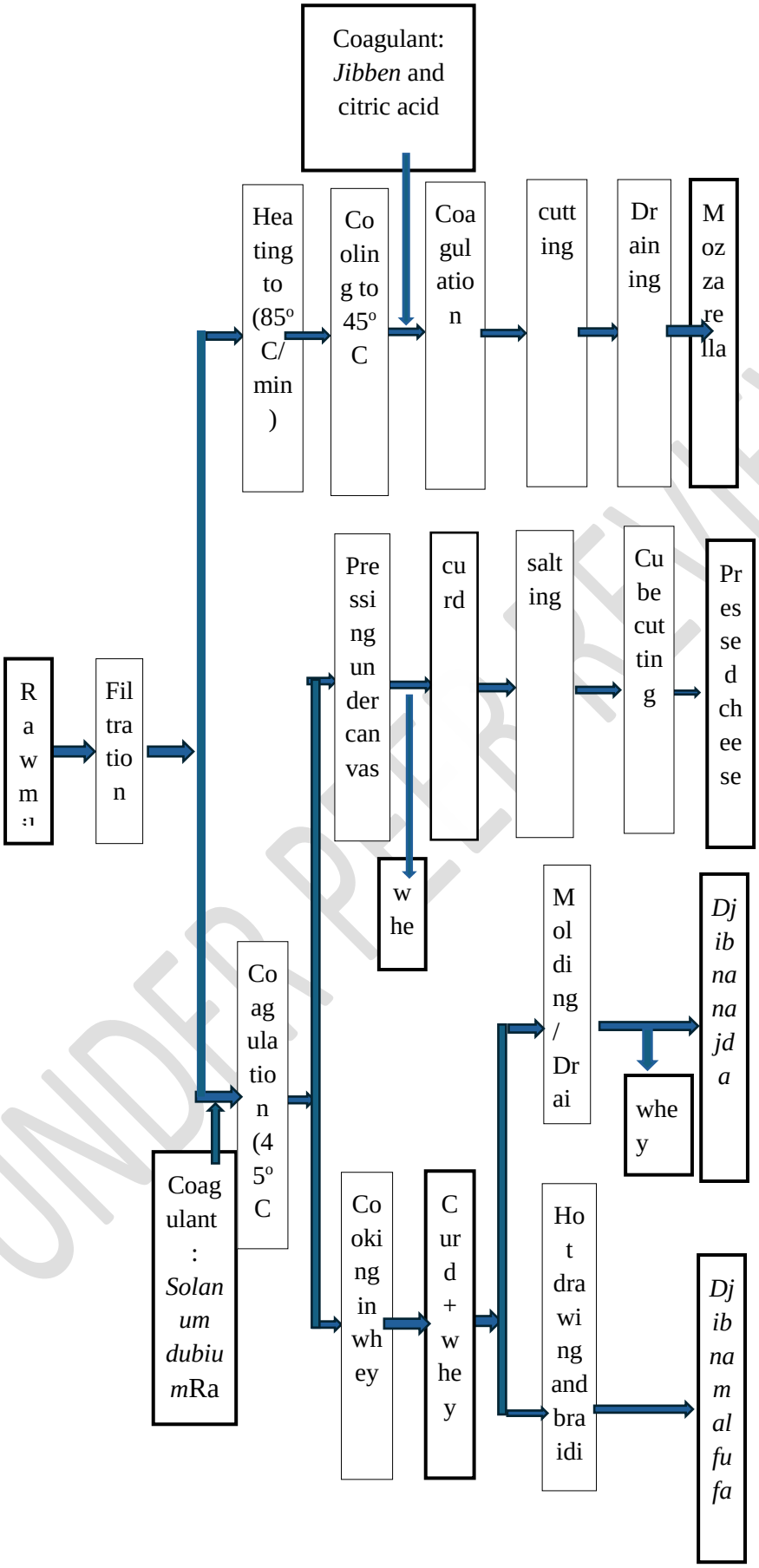

Figure 11: Production diagram for traditional cheeses coagulated with *Jibben*

III.1.2.1.2. Lactic curd cheeses

These cheeses are obtained by the spontaneous coagulation of milk by lactic bacteria indigenous to the milk. There are two types of cheese made using this technology: cheese whit, commonly known as DJIBNA BAIDA, and BOURSIN.

DJIBNA BAIDA is a fresh cheese. It is traditionally made by spontaneous coagulation of raw milk, followed by slow draining using a cloth without pressing. BOURSIN, on the other hand, is a pressed cheese obtained by pressing the curds. Figure 12 shows the production diagram for these types of cheese.

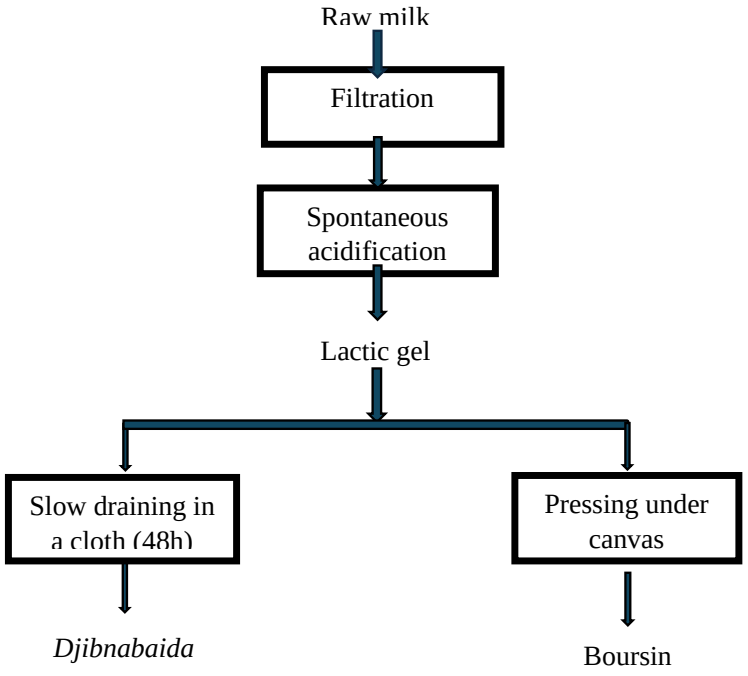

Figure 12: Production diagram for traditional lactic curd cheeses

III.1.2.1.3. Goat's cheese

The raw material used is raw goat's milk. Coagulation occurs spontaneously as a result of the natural (indigenous) lactic acid bacteria in raw milk. In some cases, industrial rennet is added to obtain a firmer paste.

The main cheese made using this technology is fromage frais (plain goat's cheese). Ingredients can be added to obtain several varieties of this cheese: peppered cheese, garlic cheese, herb cheese. The curds obtained after coagulation can be transferred to buchette-shaped molds to make BUCHE, which can be removed from the molds, cut and then aged in the open air to produce Crottin. Figure 13 illustrates the goat cheese production process.

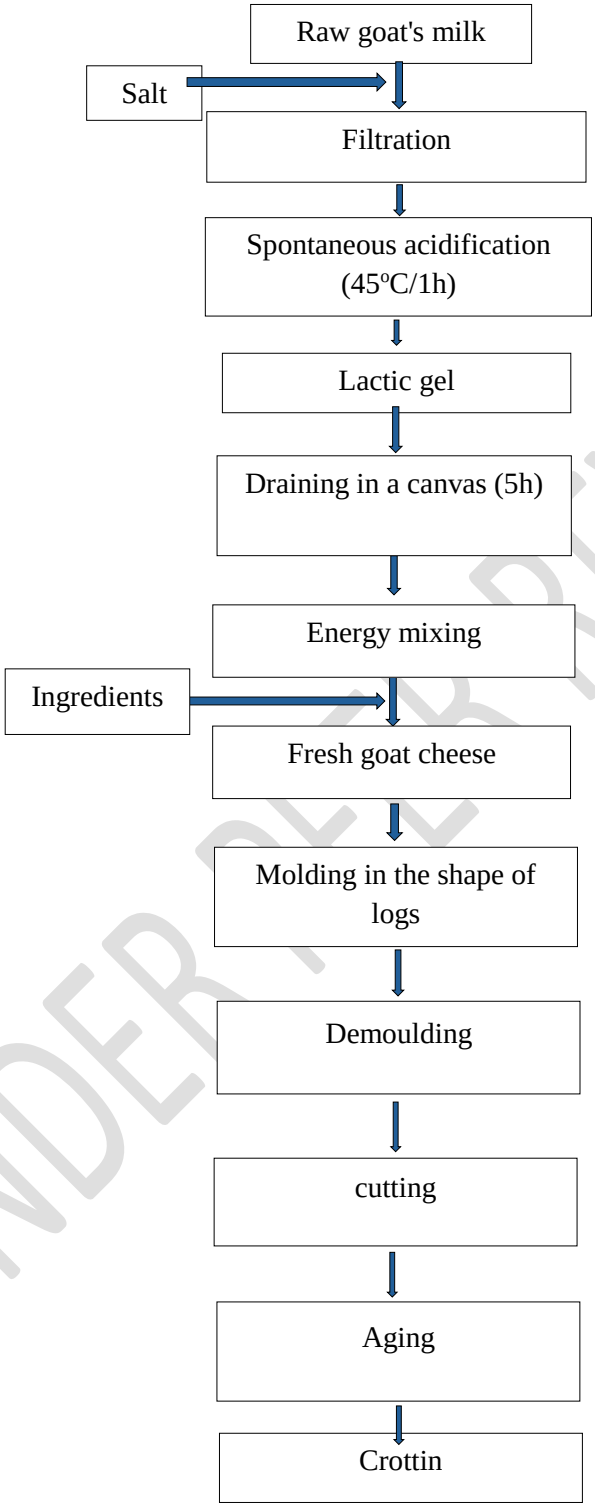

Figure 13: Goat cheese production diagram.

III.1.2.2. Distribution and sale of artisanal cheeses

Cheeses are generally sold in supermarkets, large restaurants and patisseries, as well as by home delivery. Customers for this product are mainly European expatriates and people with a culinary background.

particular. A kilo of cheese is sold at 6,000 FCF. The following table shows the prices of various cheeses sold in N'Djamena.

Table 2: Prices of cheeses sold in N'Djamena.

Type of cheese	Quantity	Price
Djibna malfoufa	1000kg	6000 FCF
Djibna malfoufa	500g	3000 FCF
Djibna malfoufa	120g	2500 FCF
Djibna malfoufa	200g	2000 FCF
Djibna baida	800g	2500 FCF
Djibna baida	120g	1000 FCF
Goat's log	200g	1500 FCF
Goat's log	120	2500 FCF
Bursin	100g	1000f FCF

III.1.3. Consumer preference for cheese and dairy products in the city of N'Djamena

III.1.3.1 Consumption of dairy products

We surveyed a total of 237 consumers in 84 households. The survey covered 30 districts in the 10 communes of the city of Ndjamena. 86.9% of the heads of households surveyed were male, compared with 13.1% female. 24.5% were civil servants, 29.1% shopkeepers, 10.5% students, 5.1% housewives and 30.8% had other occupations. The results showed that 197 (83%) of those surveyed regularly consumed milk and/or dairy products. (Figure 14).

The product preferred by consumers is powdered milk 58.60%, followed by curdled milk (Rouaba) 51.50%, then clarified butter (Dihin Bagar) and yoghurt each with a rate of 11%, fresh milk 9.10%, fermented milk (Rayb) 8.40%, imported condensed milk 5.10%, solid butter (Zibdé) and local cheese each with a rate of 4.60%. The least appreciated product is imported cheese 3% (Figure 15). 61.11% of cheese consumers prefer local cheese, versus 38.89% for imported cheese.

by its coagulant property. The practice of transforming milk into cheese is empirical in these rural environments. It is generally made by young shepherds of both sexes during grazing for their own consumption. None of the respondents confirmed that they marketed this product. At present, this practice is threatened with extinction. For this reason, no respondent under the age of 25 replied that they had ever made cheese; in fact, it is people in this age group who used to make cheese. On the other hand, all respondents aged 45 or over replied that they had made cheese, confirming the existence of this practice in the past. Furthermore, the level of knowledge of the Jibben plant itself is reduced when young people are surveyed, but increases among older people.

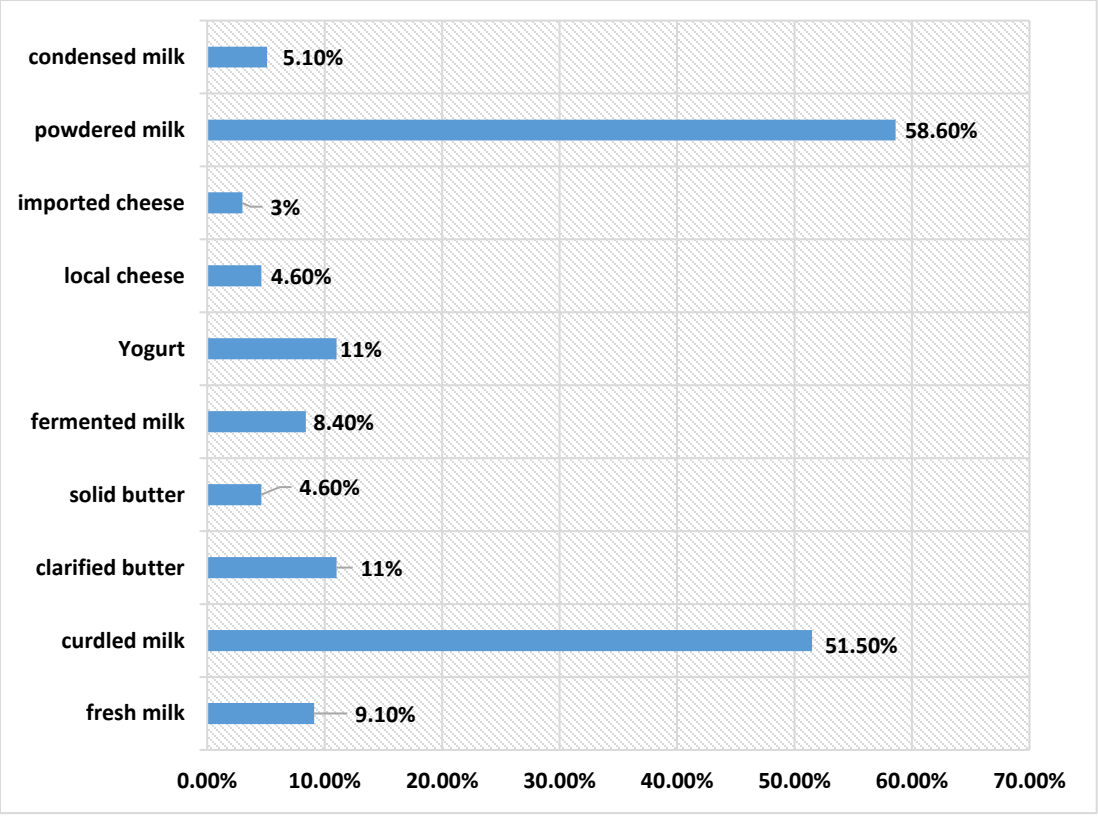

Figure 14: Preference for milk and/or dairy products

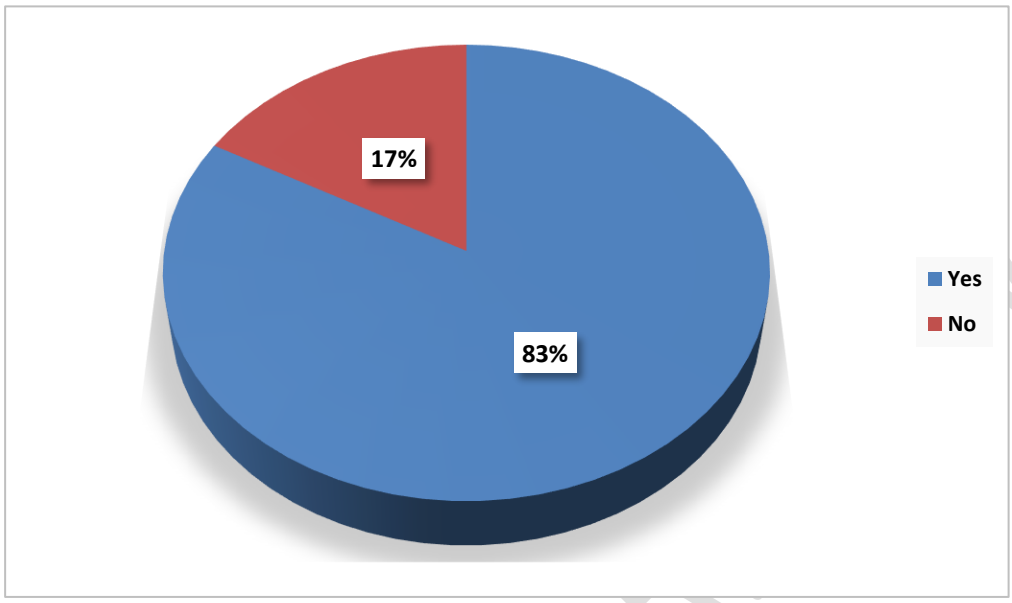

Figure 15: Consumer preference for milk and dairy products

III.1.3.2. Cheese consumption

Survey data show that consumer preference for local cheese is influenced by the socio-professional status of the head of household. 9.59% of consumers whose head of household's socio-professional status is classified as (other) regularly consume local cheese, 5.17% of civil servants and 4% of students. No cheese consumers were identified in the categories headed by housewives or shopkeepers (Figure 16).

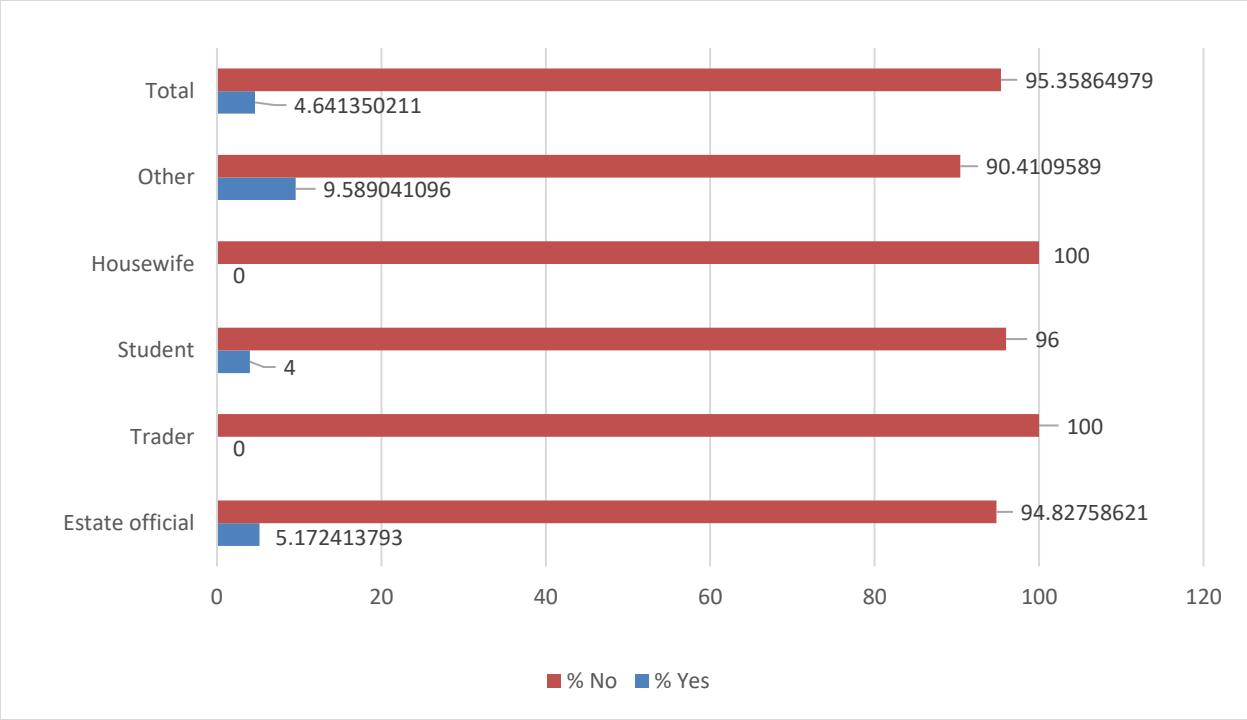

Figure 16: Socioprofessional status of head of household and consumption of local cheese

III.1.3.3. Reasons for refusing to eat cheese

The result shows that 51% of respondents do not consume cheese because of its unavailability, 33% because of its high price.4% of consumers surveyed refuse to consume cheese because of its unpleasant taste, 2% because of its disgusting taste. Digestive reasons were cited by 2% of consumers (Figure 17).

The reasons for refusing to eat cheese are significantly influenced by age (P value 0.005); the unpleasant taste and flavor of cheese are raised by the youngest people (< to 22 years), while the problems of price and unavailability of cheese are raised much more by older people (> to 21 years). (Figure18)

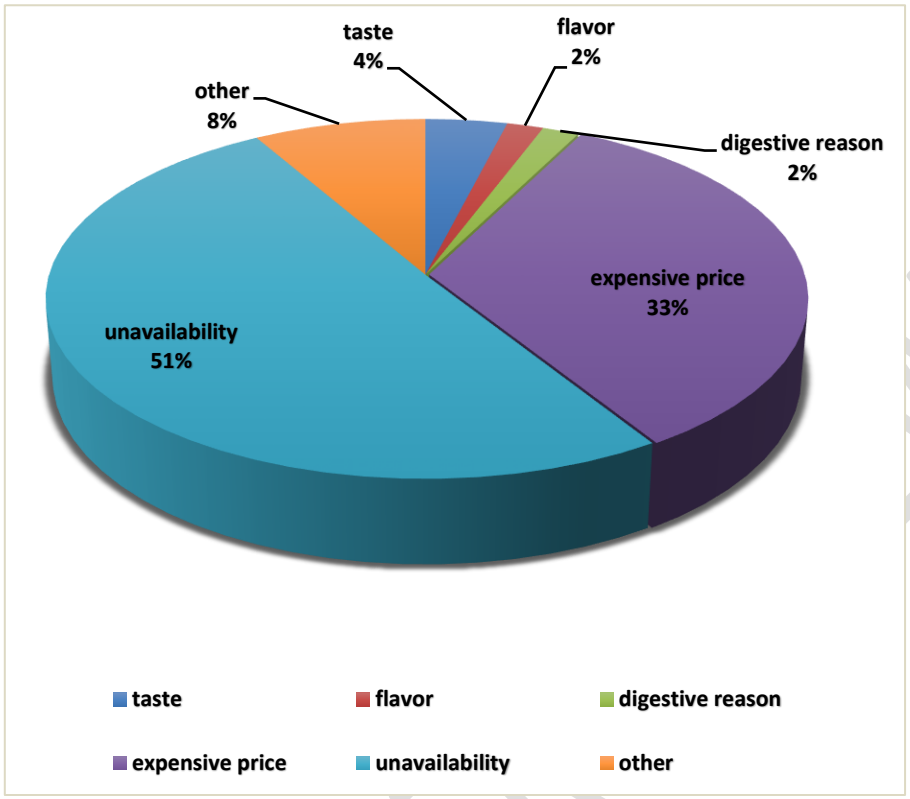

Figure 17: Causes of refusal to consume cheese

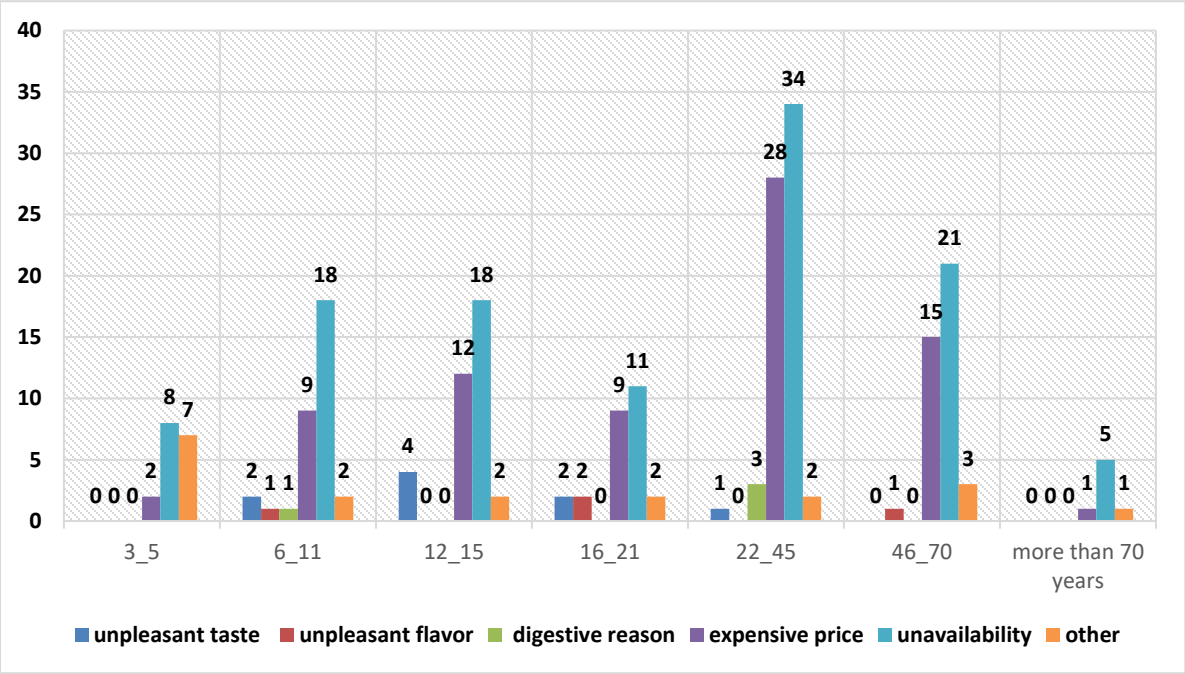

Figure 18: Causes of refusal to consume cheese according to age

III.1.3.4. Frequency of cheese consumption

The frequency of cheese consumption is very low: 0.8% of respondents regularly consume cheese every week, and 3.4% consume it every month. Most respondents (73.4%) are occasional consumers (Figure19).

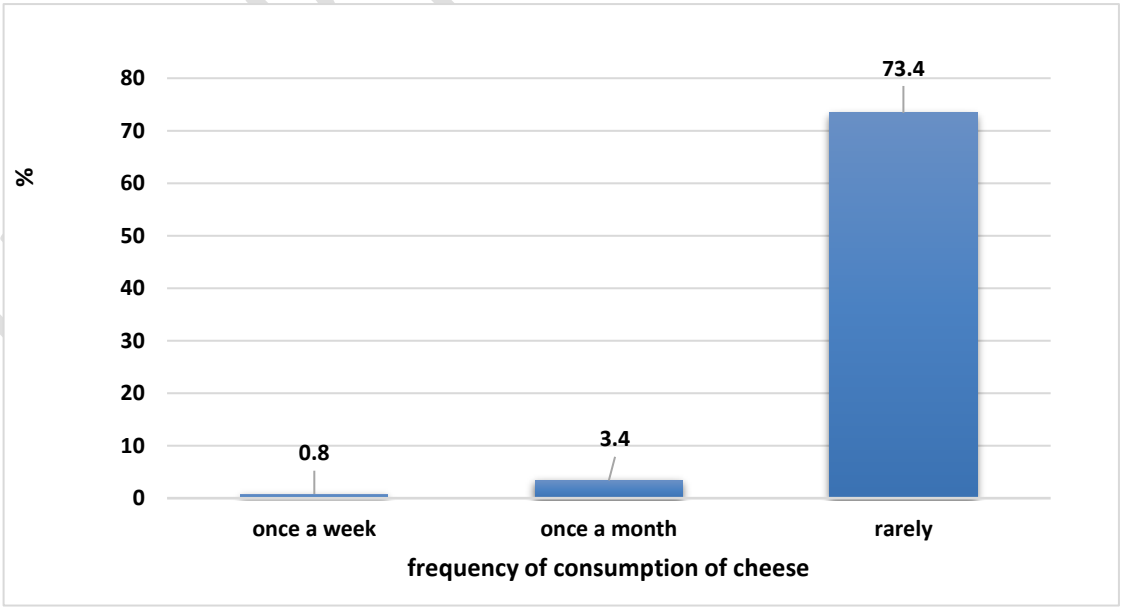

Figure 19: Cheese consumption frequencies

III.2. DISCUSSION

Cheese-making in rural areas

In the Sahelian zone of Chad, butter (Zibdé) is the main milk-processing product in rural areas. This product is obtained by spontaneous fermentation of fresh milk, followed by manual churning to produce quail milk (Rouaba) as a processing by-product. The churning technique is carried out exclusively by women, who share the same processing technique. Corniaux et *al*., 2005 and Ossibi et *al*., 2023 assert that milking, processing and selling milk are among the tasks assigned to women in pastoral households. Milk and its by-products are used by these women as a means of subsistence and integration into the market and society (Ossibi et *al*., 2023).

Our results show that the milk curdling technique is well known to pastoralists in eastern Chad, who use ripe, dried Jibben fruit to coagulate milk and make an artisanal cheese called Djibna baida. The *Jibben* plant (*Solanum dubium Fresen*) is a wild herb belonging to the Solanaceae family. It grows widely in the Sahelian zones of Chad. This plant is well known in eastern Chad.

by its coagulant property, the practice of transforming milk into cheese is empirical in these rural environments. It is generally made by young shepherds of both sexes during grazing for their own consumption. None of the respondents confirmed that they marketed this product. At present, this practice is threatened with extinction. For this reason, no respondent under the age of 25 replied that they had ever made cheese; in fact, it is people in this age group who used to make cheese. On the other hand, all respondents aged 45 or over replied that they had made cheese, confirming the existence of this practice in the past. Furthermore, the level of knowledge of the Jibben plant itself is reduced when young people are surveyed, but increases among older people.

Cheese factories in the urban and peri-urban areas of N'Djamena

In N'Djamena, the technique of processing milk into cheese was first introduced by European missionaries and Lebanese-Syrian traders for their own consumption. The first artisanal cheese factory (the Zina cheese factory) was set up in 1964, based on Lebanese-Syrian know-how. This assertion is similar to that of Duteurtre (2003), who states that artisanal cheese dairies in Africa

had been set up since the 1970s, based on imported know-how: convents or monasteries, French, Dutch, Swiss or mixed-race private individuals, former employees of Italians or Libano-Syrians. Corniaux et *al*., 2005 pointed out that in Mali, these processing units are small-scale, run by European entrepreneurs and missionaries, as well as by Lebanese-Syrian traders, and are designed to add value to milk from peri-urban farms, but above all to the "bush milk" marketed by local pastoralists or agro-pastoralists. (Koussou *et al.* 2008) cited eight (08) cheese dairies created between (1964 and 2004): La fromagerie Zina in 1964, Fatime Sossal in (1969), Al-houda in (1988), Durand in (1997), Batoul sossal in (2001), Mahamat Kourloukou in (2001), Faki ali in (2004), Al- wahid in (2004) and the Bakara cheese dairy. The development of artisanal cheese dairies continued in the 2000s, thanks to growing urban demand for this type of product, which is highly prized by consumers.

Cow's milk cheese, coagulated by Jibben, is the most widespread and widely consumed cheese in N'Djamena. It comes in several forms: Djibna malfoufa, Djibna baida, Djibna nadjda and Mozzarella. among the cheeses produced in Chad are local cheeses such as Djibna baida, cheeses of african origin such as wagashi from benin, and cheeses of european origin such as Mozzarella, Boursin and Buche from goats.

Consumer preference for cheese and dairy products in the city of N'Djamena

Imported powdered milk and curdled milk (Rouaba) are the two main products preferred by respondents. Koussou and Grimaud (2009) found that powdered and curdled milk are consumed by over 90% of households in N'Djamena. Niafo en (2005), in Mali, showed that powdered milk is consumed by 90% of households. Preference for cheese is very low. This preference is slightly higher for local cheese than for imported cheese. Unlike in Senegal, (Niang et *al* 2023) state that 75% of cheese consumers prefer imported cheeses. Cheese is considered a luxury product in Chad. It is generally sold in supermarkets, large restaurants and patisseries, and the majority of people surveyed (51%) do not have access to this product because of its unavailability and (33%) because of its high price. The regular consumers we were able to identify are in households whose heads are grouped in the (other) category, and government employees. The (other) category includes private sector employees, contractors and other tradespeople. No consumers in households headed by shopkeepers or householders were identified as cheese consumers. Most respondents (73.4%) are occasional consumers who rarely eat cheese. This low level of

consumption can be explained by dietary habits, where cheese is not often present in culinary preparations, and above all by low purchasing power. What's more, cheese is unaffordable for many households.

Conclusion

The technique of transforming milk into cheese is well known in Chad. Jibben fruits are used as the main coagulant in milk coagulation and cheese-making, as well as for other peasant uses during transhumance. This know-how is empirical in the rural world. It is inherited from generation to generation. However, this cultural heritage is threatened by the abandonment of this practice by the new generation in rural areas. In urban and peri-urban areas, small-scale enterprises. The cheese industry has been built on imported know-how. Despite changing dietary habits and population growth in urban areas, cheese consumption remains low compared to other dairy products. This is due to the high price and low market presence of cheese. It is imperative to popularize this artisanal technology by organizing training courses for associations involved in the processing of our local products, in certain regions of the country, in order to participate in changing the nutritional and socio-economic status of our populations.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3

References

1. Aboudou Kowiou., Chérif Alidou., Sènan Vodouhe-Egueh., Alice Gougbe-Semako., Ginette Tadagbé Sagbohan: Technological suitability of two coagulants (Calotropaine and Papaine) for the production of Peuhl cheese produced in Benin.Afrique SCIENCE .(2021). 19(6):122 – 132.

2. Aboudou, K., Alidou, C., Vodouhe-Egueh, S., Gougbe-Semako, A., & Sagbohan, G. T. :Technological suitability of two coagulants (Calotropaine and Papaine) for the production of Peuhl cheese produced in Benin. ;Afrique SCIENCE. ; (2021)19(6):122 – 132.

3. Aïsso, R. C. B., Aïssi, M. V., Youssao, A. K. I., & Soumanou, M. M.: Physicochemical characteristics of Peulh cheese produced under optimal coagulation conditions from the milk of two breeds of cows from Benin. ; Nature & Technologie. B- Agronomic and Biological Sciences. (2016);14: 37 – 43.

4. Chatellier V.:The dairy planet and the place of West Africa in the consumption, production and trade of dairy products, Inra. Dakar. (2019).

5. Corniaux C., Duteurtre G., Dieye P.N., Poccard-Chapuis R. Mini-dairies as a model for organizing dairy sectors in West Africa: successes and limitations. Journal of Livestock and Veterinary Medicine of Tropical Countries, (2005) 58: 237-243.

6. Corniaux C., Niafo Y., Poccard-chapuis R., Consumption of milk and dairy products in households in Ségou (Mali). Montpellier, France, Cirad. (2005) 21p.

7. Duteurtre G.: Exogenous standards and local traditions: The problem of quality in African dairy sectors Agricultures (2004) 13 (1),91-98

8. Duteurtre G.:African dairy products under the test of liberalization: Dairy traditions in danger, a heritage to be valued. 3rd international meeting on milk as a vector of development. Dakar, Senegal.HAL Id: cirad-00472073 https://hal.science/cirad (2019) -00472073

9. Duteurtre G., Corniaux C., Coutonnet J.P.: Declining consumption of dairy products in sub-Saharan Africa: myth or reality? Renc. Search Ruminants: (2003) 323-326.

10. El kholy A. M.,: The use of artichoke (Cynara scolymus, L.) extracts for the production of Tallaga cheese. International Journal of Food and Nutritional Sciences, (2015) 4, 34-41.

11. El Owni O. A., Kheir, S. O., Abdallah, M. O.: Extraction and characterization of Solanum dubium (Gibbain) Fruit Extract. Australian Journal of Basic and Applied Sciences, (2011) 5 (9): 213-218, 2011 ISSN 1991-8178.

12. Faye B., Et alery V.: The challenges of animal production in southern countries INRA, Animal Production (2001 14 (1): 313.

13. Koussou and Grimaud.,: Local livestock farming in the face of market changes in Africa. Organizational changes and technical innovations in milk supply chains in the city of N'Djamena, Chad. African savannas in development: innovating to last, Garoua, Cameroon. (2009) 9 p. cirad-00472073.

14. Koussou M. O., Grimaud P., & Mopate, L. Y.,: Assessment of the physicochemical and hygienic quality of bush milk and local dairy products marketed in dairy bars in N'Djamena, Chad. Revue d'élevage et de médecine vétérinaire des pays tropicaux, (2007) 60(1-4), 45-49.

15. Ministry of Livestock and Animal Resources (MERA). National Livestock Development Plan (PNDE 2009-2016), summary document, Action Plan, Chad, 2008. 84p.

16. Ministry of Finance and Budget. 2018-2021. Macroeconomic and budgetary framework report, Chad, 46p.

17. Mohamed I. T., Hassan R., Kabbachi A., Mohamed H., Abdelwahab H.: Evaluation of Acute Toxicity of Solanum dubium seeds Aqueous Extract in Rats. American Journal of Research Communicatio, (2016). 4 (11): 64-72.

18. Mohamed R., Hicham L., Abdelhak D., Mahjoub M. Comparative bacteriological study of marketed Moroccan fresh cheeses (Mahalbats) and cheeses made in the laboratory. (2011). Afrique Science 07 (3): 108-112.

19. Niang I., Ndiaye M. A., Diop A., & Ayessou N., Goat milk: production and cheese consumption in Senegal. Rev. Mar. Sci. Agron. Vét. (2023). ; 11(3): 335-339.

20. Nouani A., Dako E., Morsil A., Belhamiche N., Belbraout S., Bellal, M. M. & Dadi A., : Characterization of the purified coagulant extracts derived from artichoke flowers (Cynara scolymus) and from the Fig tree latex (Ficus carica) in light of their use in the manufacture of traditional cheeses in Algeria. Journal of Food Technology, (2009) 7, 020-029.

21. Ossebi, Walter, Aliou Diouf Mballo, Daouda Dao, Malik OROU Seko, Djiby Dia, and Bassirou Bonfoh. : "Social Relations and Economic Influence in the Local Milk Value Chain in Senegal." Moroccan Journal of Agronomic and Veterinary Sciences(2023) 11(2):175-84.

22. Ouedraogo, Souleymane, Etienne Sodre, K. I. Savadogo, Lassina Sanou, and V. M. C. Bougouma. : "Production performance of peri-urban and urban dairy farms in the commune of Fada N'Gourma in Burkina Faso." Rev. and Moroccan Journal of Agronomic and Veterinary Sciences 2023. 11(3):351-59. doi: 10.5281/zenodo.8287468.

23. Sana E. O. K., El owni O. A. O., & Abdalla M. O. M.: Comparison of quality of Sudanese white cheese (Gibna Bayda) manufactured with Solanum dubium fruit extract and rennet. Pakistan Journal of Nutrition.; (2011) 10:106-1

24. Sanni, A. L., Onilude, A. A., Momoh, M. O. (1999). International Journal of Food Science and Technology, 34 : 325-333.

25. Sessou P, Farougou S, Azokpota P, Youssao I, Yehounou B, Ahounou S, Sohounhloue DCK. : Inventory and analysis of endogenous conservation practices of argahi, a traditional cheese produced in Benin. International Journal of Biological and Chemical Sciences, (2013) 7(3): 938-952.

26. Talib MA, Abubakar MM, Jideani IA, &Hassan A,: Use of Jiben Seeds Extract to Manufacture Soft White Cheese. American Journal of Applied Sciences 6(4) : (2009) 551–554, 2009 ISSN 1546–9239.