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Various Traditional Dairy Products in Africa and Algeria

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ABSTRACT

The aim of this study was to define various traditional dairy products most widely consumed in Africa and Algeria. In this study, we provided examples of these products along with their production and fermentation procedures. Fermented foods are the primary source of nutrition for rural and urban communities. In Algeria, cheese is still made in the traditional way at the family level. The Jben and Klila are the most popular traditional varieties and their manufacturing method is still in use to the present day. In conclusion, we sought to learn more about the traditional dairy products, tried to produce them industrially, and thus preserved this important indigenous wealth.

Keywords: *Milk; Products; Traditional dairy; Transformation*

Introduction

Milk, a rich nutritional food, is highly perishable. In countries with hot weather, milk is cooled immediately to prevent its microorganism growth, including bacteria. So, under normal conditions, the milk is cooled for a few hours. This explains the lack of raw milk on the market permanently. For this reason, people in these rural areas convert milk into several traditional products by fermentation. Thus, we can distinguish three products: cream, milk, and butter. In Mediterranean countries, goat farming is based on the joint use of mountain pasture, forage of plains, and by-products of agriculture.

Steps of processing and manufacturing these products are empirical and unhygienic. Therefore, consumers cannot rely on it daily and balk at buying them, although their taste is remarkable. Thus, it is important to consider milk processing conditions. In this regard, the producers are required to deliver healthy and trustworthy products at all stages of manufacturing (Semaan *et al.*, 2011). These products are an integral part of the Algerian heritage due to their economic and medical properties inherited from the ancient times. The products preserved in this way are guaranteed to stay longer. Therefore, we studied this issue to produce these

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dairy products in the factory to ensure a long and healthy retention period

Traditional dairy products in African

The processing techniques used in Africa often differ from the industrial patterns. While producing the traditional butter (dairy product), we get skimmed milk buttermilk as a by-product. Skim milk can be used immediately or can be turned into the skimmed milk powder. In producing cheese lactose and whey proteins are used and whey is obtained as a by-product. In the case of cheese, it is possible to leave the whole milk, and skim milk. Many forms of dairy products exist, including the types of products obtained by common biological processes.

Due to the lack of cold chain in Africa, the milk will be used in the form of curd or fermented milk in order to facilitate conservation in a context where the cold chain is rarely available. In this case, butter and buttermilk are directly obtained from fermented milk and not from raw milk. After clarification (by heating), the butter is transformed into butter oil. Buttermilk, after clotting, can be transformed into skinny cheese and whey. In the case of traditional transformation in Africa, butter is obtained directly at the base of acidified milk, not cream; buttermilk can be then used to produce thin cheese, which is sometimes dehydrated. The whey is consumed by the family or given to calves. The butter is often converted by clarification milled into butter oil. So, in both cases, the same milk can be used in manufacturing butter and cheese(Dossou *et al.*, 2006, Meyer and Duteurtre, 1998).

Traditional preparation

After the deal, women remove the amount of milk needed to provide food for the family and then put the rest of the milk in a tank specifically used to curl the milk. This process is done within 36 to 48 hours, depending on the seasons; meanwhile, the curd surface mounted and matures. As a result of this process, large quantities of raw milk are converted into different types of dairy products: fermented milk, cream, cheese, yogurt, butter, etc. However, an important part of the dairy products is embedded in food preparations of all kinds to enhance their flavor, texture, and nutritional quality or appearance. Farms pastoral or few farmers provide most of the African dairy production. Raw milk is rarely marketed. A wide variety of processes ensures the conservation of these products. Breeders produce fermented milk (often called "sour milk"), solid butter, and melted butter from lactic curdling and churning of the raw material. These traditional products are made from cow's milk, milk from small ruminants, or a mixture of both. They participate in a relatively large convenience store (sour milk, solid butter) or long distances (melted butter) (Duteurtre, 1998).

The literature showed that fermented skimmed milks are named *Katch* (Wolof) or *Kossamkaadam* (Peul) in Senegal, the *Rouaba* (Arabic) or *Pendidam* (Peul) in Tchad, or the *Arera* (Amharic) in Ethiopia. The churning milk is known as the *M'bannick* (Wolof) in Senegal, and *Rayeb* (Arabic*)* to Tchad or the *Ergo* (Amaharic) in Ethiopia. The fermented cream is called *Fenè* (Bambara) in Mali or *Ketoungol* (Peul) in Senegal. In addition, the dishes based on the fermented milk are named *Degue* (millet porridge) in Mali, etc.

Some breeders in Niger, Mali, and Algerian South manufacture fresh dried cheese and dough, the Tchoukou, which is made based on the newborn ruminants stomach extract (abomasums), or a little pre-fermented milk (inoculums). The priest de Foucauld described manufacturing of this product in the Hoggar (Duteurtre *et al.*, 2003). This Touareg cheese basin is made in Sudan, the only area of sub-Saharan Africa in which the use of the abomasum is controlled in the traditional way for manufacturing cheese.

Indeed, other African traditional cheeses are the result of curdling the milk by plants, or by heating the fermented milk. In Benin, the leaves of *Calotropisprocera* are used for manufacturing *Peulh* cheese for more than 100 years. In Ethiopia, a granular white cheese, the *ayeb*, is made in a traditional way by heating fermented buttermilk (Duteurtre, 1998). Recently, a significant increase was observed in the demand for these traditional milk products in most southern countries. This development of animal products markets leads to

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fast and deep changes on farm systems (development of intensive systems, especially around urban areas) and marketing channels: increase of the retail part of the livestock products, use-increasing inputs, contractualization of sales, and development of the international trade (Duteurtre *et al.*, 2003). Consumed products are especially traditional products: fresh milk, fermented milk butter solid and liquid butter. However, there are more new and imported types of products on urban markets, such as milk powder, condensed milk, oil, butter, cheese, yogurt, butter, pasteurized, etc.

a. ***Traditional preparation in Benin:*** In Benin, the traditional production technology of *Peulh*cheese (waragashi) (**Figure 1**) occupies an important place in the artisanal processing of the fresh milk. The *Peulh* cheese method is used as the main raw cow's milk *Calotropisprocera* and the extract of *Sorghum vulgaris* panicle. Fresh cow's milk is slightly heated and coagulated using *Calotropisprocera*. The obtained coagulum was cooked, drained, cast, and then introduced to the market in different forms and size (Benyahia-Krid *et al.*, 2016, Dossou *et al.*, 2006). The ingredients used in the preparation of *Peulh* cheese are:

• Salt that gives a taste to the cheese;

• The panicles of *Sorghum vulgaris* (sorghum) used for coloring cheese.

• The potash used during cooking or treatment with sorghum panicle extract.

Potash allows setting of the red color and reduction of the cheese acidity. This requires 5 liters of fresh milk. The duration of manufacture depends on the quantity of milk and varies, usually, between 1 and 3 hours. Milk, after filtration is subject to a preheating at 60 °C for approximately 5 minutes. We added the coagulant (*Calotropisprocera*). Later, all more clotting milk undergoes a baking at 95 °C approximately until the formation of the curd supernatant by the whey. The whole remains on the heat for another three to five minutes before are drained in like sieves. Cooking is stopped when:

1.The whey becomes yellowish and transparent.

2.The curse or curd that lays at the bottom of the pot rises to the surface and is broken into pieces (Kees, 1996).

b.***Typical diagram of Peulh cheese making in Algeria:*** Five liters of raw cow's milk were filtered on gauze to eliminate the rough fragments and then heated at 60°C for five minutes. *Calotropisprocera* leaves (20 g/liter of milk) were triturated in a milk volume and then filtered through gauze (Figure 2). The filtrate is added to the whole milk (5 l) with increase of the heating temperature at 70°C for 10 minutes; where, the coagulation occurred and air followed by cooking the curd at 95°C for 4 minutes (Benyahia-Krid *et al.*, 2016).

After the milk was fully coagulated, the whey-coagulum mixture was poured into a basket containing a cloth and sited in a test-tube to collect and to quantify the whey (Figure 1). The setup was conducted for the whey to filter through till it stopped dripping. The cloth was folded by putting the coagulum in it, which was then tied and the remaining whey was let out through the cloth until it dried to a constant weight for approximately 3 hours. The cheese was then removed into a sterile container and stored in the fridge at 4°C overnight or analyzed immediately (Benyahia-Krid *et al.*, 2016).

Traditional dairy products in Algeria

Traditionally, cow's milk was considered as a staple in many diets. It is a healthy drink since consumption is associated with quality of food. It provides a matrix easily accessible and rich in a variety of essential nutrients: minerals, vitamins and easy to digest proteins. Therefore, it is essential for all functions of the body (Steijns, 2008). Traditional Algerian dairy products, which have the commercial significance, include *Lben, Klila, Jben, Rayeb, Dhan, Zebda, Bouhezza, Takammarit*, etc. Figure 2 represents the main traditional Algerian preparations of these products.

Chemical and microbiological composition: The chemical composition of the traditional dairy products varies considerably between different localities, regions, and farms, mainly due to the

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variation in the chemical composition of milk during the lactation period (**Table 1**).

In recent years, traditionally fermented dairy products have been considerably developed thanks to the consumers' interest in organoleptic, nutritional, therapeutic, and even hygienic qualities. These fermented products result from fermentation by the dominant lactic acid bacteria *(Lactobacillus, Lactococcus,Leuconostoc*), accompanied by a slight fermentation in the presence of yeast (*Saccharomyces*), thanks to its rich and diverse composition (Lairini *et al.*, 2014). Table 2 presents the mean values of the total aerobic mesophilic flora count of the main traditional dairy products in Algeria.

In Algeria, cheese is always produced in a traditional way on a family scale. The *Jben* and *Klila* are the most popular traditional varieties and their manufacturing method is still in use to the present day. Intake of these products has increased in the steppe areas due to their pleasant organoleptic and nutritional properties caused by a native microflora. The role of this microflora in establishing the sensory characteristics of cheeses was reported by numerous studies on different technologies. Removal of the microflora of the milk (by heating, filtration, etc.) leads to a reduction in taste and differences in aromas of cheeses. Beyond the sensory interest that can make some cheeses, their inhibitory effect against pathogenic micro-organisms microbial populations has also been reported (Dahou *et al.*, 2015).

1. Traditional butter and buttermilk

1.1. Traditional butter (Zebda beldia: Butter is obtained by churning fresh milk, whole fermented milk, or cream. For the breeder, using fermented milk has several advantages; more specifically, it takes several days to accumulate milk and the products can be produced faster and more easily than with fresh milk. Furthermore, a higher percentage of milk fat can be extracted from fermented milk that results in a product probably more stable due to the presence of acid in butter (low pH) that neutralizes some pathogens (O'Connor and Tripathi, 1992).

So, small breeders use two containers, one to ferment and the other to barrater. Churn also is usually treated by aromatic plants. Before churning, the fermented milk, which is in the form of a curd is grounded by hand or homogenized with a wooden stirrer. The traditional method of making butter varies from one region to another. However, the aim is to agitate the milk until the granules of butter are formed. One frequent method is to suspend the churn (Chekoua) on a tripod and make it move back and forth (**Photo 1**).

During the churning process, agitation of milk releases the lipids from globules, after the liquid fat precipitates to give butter granules. The buttermilk is then removed and the butter granules are washed with cold water until uniform dough. However, this method of butter production has two major disadvantages: churning takes a long time, sometimes up to four hours; so, a large amount of fat is lost in buttermilk (Tantaoui-Elaraki *et al.*, 1983).

1.2.Traditional buttermilk (Jben): *Lben* (buttermilk) is a beverage prepared by spontaneous fermentation of raw milk until coagulation, followed by a slight wetting and churning, allowing a greater or lesser amount of fat to be collected in the form of butter (Zebda beldia). Its preparation has remained at the family or artisanal stage: the milk is left to itself in a goat skin churn (Chekoua) until its coagulation.

This is done at room temperature and lasts 24 to 48 hours depending on the season. The churning (Chekoua), which succeeds it, is carried out at either side, so that a manipulator must shake it vigorously with both hands (**Photo 1**) or in a jar. To this end, an instrument is used consisting of a long handle carrying on its lower end and two wooden discs of different diameters (**Photo 2.A**). In either case, this operation lasts 2 to 4 hours depending on the environmental conditions and the same procedure with the Kabyle churn (**Figure 2. B**).

At the end of the churning, a certain volume of water (about 10% of the volume of the milk) is generally added (hot or cold) depending on the ambient temperature. As a result, the temperature of

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the whole is brought to a level suitable for gathering Grains of butter. This is recovered, usually by hand, but some manufacturers filter the *Lben* on a canvas in order to collect as much butter (Tantaoui-Elaraki *et al.*, 1983).

Thus, the nutritional quality and quantity of *Lben* are produced after churning and separating the butter depending on the composition of the milk. This varies with the stage of lactation, diet, animal's health status, genetic factors, climatic conditions, and imported breeds, which contribute significantly to the production (Zeinhom *et al.*, 2016).

1.3. The traditional cheeses: In most African countries, a significant increase is observed in demand for animal protein. The main factors for this increase are population growth, invasive urbanization, rising incomes, and changing eating habits. The milk of domestic ruminants is one of the most accessible protein sources. It plays an important role not only in terms of nutrition, but also in the economic and socio-cultural (Kaci and Sassi, 2007).

In rural villages and agglomerations, breeders produce milk in abundance during the high lactation periods. In the absence of preservation means, people are sometimes obliged to throw away the excess milk. To avoid this, most of the production must be transformed since it is a rapidly perishable commodity. The simplest method of preservation is to turn it into cheese (Bellakhdar, 2008, Leksir and Chemmam, 2015). Milk is rich in protein, good quality, calcium, and vitamins; it is a food of high nutritional quality. Traditional foods are part of the socio - cultural heritage of people (Leksir and Chemmam, 2015). Among these foods, traditional cheeses are both a cultural and an economic resource; in this regard, different nations have various choices considering the characterization of cheese natural components and sensory diversity. Many varieties of cheese are known throughout the world. The cheese has been made by man for centuries using the traditional procedures. Processing milk into products, such as cheese, which has long been a traditional means of preserving.

1.3.1. The Klila

In the spring, milk comes from camels, sheep, and goats in the plains of Sahara.. Since we have no cheese tradition in this country, except in the mountainous regions, it is necessary to find ways to transform the milk. *Lben* (*whey*), *klila*, *butter beldi*, and various varieties of *S'men* are its derivatives. In this regard, the milk will be kept all the year. To dry it, the *klila* is crumbled over a clean cloth and placed in a shaded and airy place, which dries until complete dehydration. Once hard, *klila* pieces are stored and used in winter as a source of protein.

1.3.1.1. Manufacturing process

Klila defines the obtained product after curdling milk; the curd is then pressed lightly and can be consumed fresh or dry. This product was traded in the Sahara. Thus, *Klila* is defined as a hardened cheese obtained by completely dehydrating the curd obtained after moderate heating of the acidulated milk. The curd is churned to obtain an acidic drink: *Lben*which undergoes a moderate heat treatment to obtain the fresh *Klila* (**Figure 2**) (Leksir and Chemmam, 2015).

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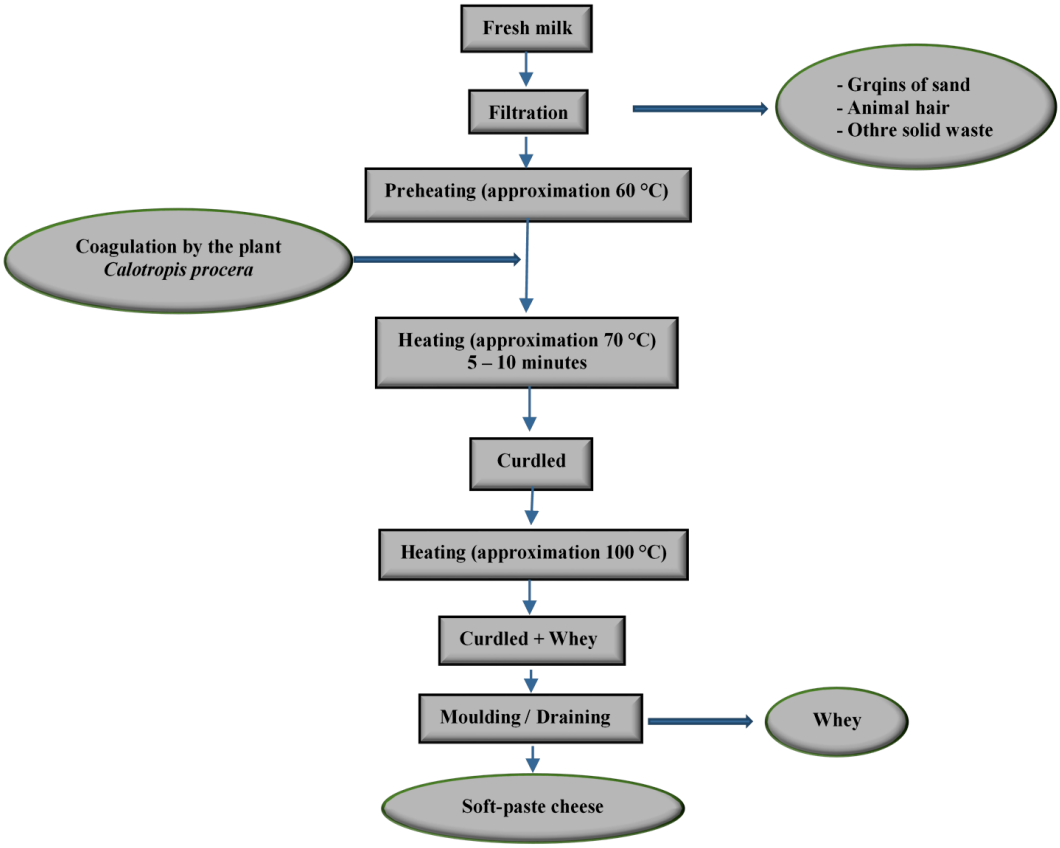

Figure 1. Typical diagram of *Peulh* cheese making (Dossou *et al.*, 2006)

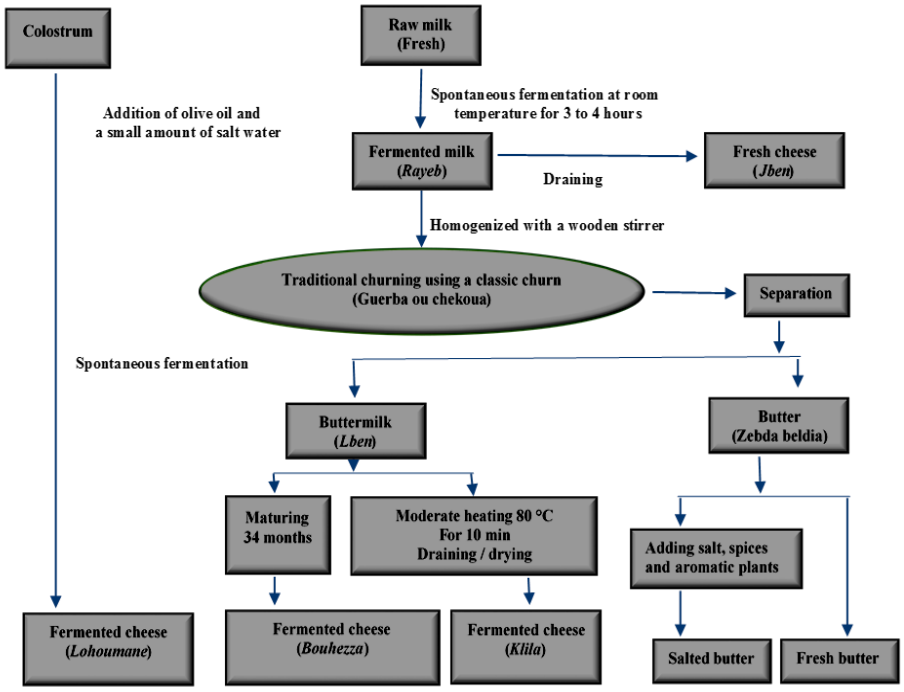

Figure 2. Diagram of processing some Algerian traditional dairy products (Mourad and Bettache, 2019).

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Table 1. Average value of the physicochemical parameters (g / 100 g); main traditional dairy products in Algeria (Bendimerad, 2013)

Parameters	Average values			
	Lben	***Bouhezza***	***Klila***	***Smen***
Humidity (%)	90.80	64.24	12.53	14.00
pH	4.20	04.00	04.71	-
Acidity (° D)	60.00	20.80	42.24	-
NaCl	0.08	03.00	00.51	01.50
Lactose	2014	-	-	01.20
Fat	0.20	30.20	13.84	81.00
Protein	01.93	-	53.86	03.20

Table 2. Average value of total mesophilic aerobic flora (FMAT) counts (cfu / g) of the main traditional dairy products in Algeria

Dairy products	(FMAT)	References
Rawmilk	02.30 x 10^7	(Yabrir, 2017)
Beurre (S1)	04.10 x 10^6	(Mourad *et al.*)
Beurre (S2)	02.30 x 10^6	
Beurre (S3)	01.30 x 10	
Shmen (S1)	02.76 x 10^3	(Mourad and Nour-Eddine, 2006)
Shmen(S2)	3.52 x 10^3	
Shmen (S3)	3.88 x 10^3	
Bouhezza (S1)	04.72 x 10^4	(Hamama, 2017)
Bouhezza (S1)	08.45 x 10^8	
Jben (S1)	01.20 x 10^6	(Mourad *et al.*, 2015)
Jben (S1)	01.30 x 10^6	
Jben (S1)	14.00 x 10^6	
Klila (S1)	01.39 x 10^3	(Leksir and Chemmam, 2015)
Klila (S2)	09.80 x 10^3	
Klila (S3)	03.37 x 10^3	
Lben	09.80 x 10^3	

S: Sample

Photo 1. Guerba or Chekoua, El-Malha (Algeria)

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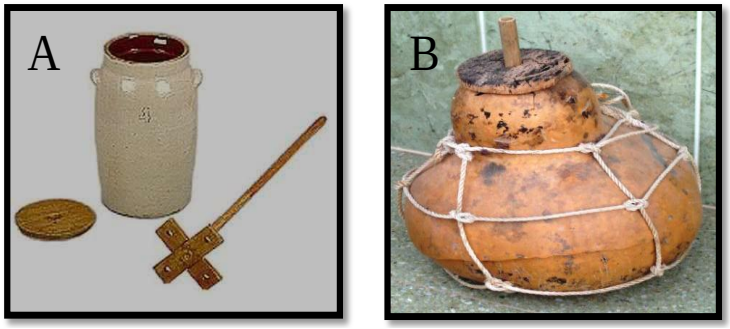

Photo 2. A (Jarre wooden) (http://www.genealogie.com/page-15-t887169-p59.html), B (Calebasse, ChurmKabyle) (http://aitali-ouharzoune-retour-aux-sources.vip-article256.html).

Authors' contribution

Guetouache Mourad and Guessas Bettache drafted and prepared the manuscript. All authors had equal roles in collecting data as well as designing and conducting the study.

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Conflict of interest

There is no conflict of interest in this study.

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