

Contribution to the valorization of *Klila*, a traditional cheese from central Algeria.

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Abstract – The art of producing fermented dairy products has been passed down from generation to generation. The rich history of traditional Algerian food technology includes those abilities. Of Algeria's several traditional dairy products, *Klila* cheese appears to be the most manufactured and eaten. Typically, this traditional cheese is used for everyday home consumption; in addition, the people in the province have previously confirmed its medicinal benefits. *Klila* is a fresh or extra hard cheese made by heating, chopping, and sun-drying cow's milk curd, sheep's milk, or a combination of the two. A survey was conducted among 150 individuals in central Algeria's rural and urban areas, five samples were taken from different places in central Algeria (Birine, Djelfa, Massaad, Had Sahari, and Sidi Laadjal) for our physicochemical and microbiological study. This might account for the high acidity level seen at 84,64 °D and a pH of 4,5. The abundance of both native and contaminating bacteria was indicated by the load in TAMF, with an average of 1.64×10^3 CFU/g, total coliforms were found in only two samples. The average of 1.88×10^8 CFU/g was for molds and yeasts that was observed. However, none of the examined samples included *Salmonella*, *Clostridium*, Fecal Coliforms, or *Staphylococcus aureus*. The primary agents of lactic fermentation, lactic acid bacteria, have a presence rate of up to 5.75×10^6 CFU/g.

Keywords: Dairy Products, *Klila*, Valorization, Traditional Cheese, Central Algeria.

I. INTRODUCTION

Cheese has been a daily food for humans for over 10,000 years, along with dairy products [1]. This long-standing relationship is the outcome of animal herds and breeders coevolving in a particular setting. As a result, a solid tradition gradually emerged. It is currently a significant aspect of humanity that must be preserved [2],[3]. Several regional varieties of cheese are made in Algeria; these vary from location to location based on factors including dairy animals, sophisticated production processes, and cheese names. They are distinguished by unique organoleptic textures, aromas, and nutritional qualities that customers find very appealing. Nomadic cultures have occasionally utilized cheeses as "a sort of" medicinal medication to treat illnesses [4]. In the Maghreb region, *Klila* is the most widely eaten cheese from Algeria. While acknowledging that local consumption undoubtedly fluctuated over time, they suggest a

likely antiquity origin [5]. Even though their local names differ from place to place, certain identical cheeses are produced elsewhere in the world. For example, the Middle East and the Persian Gulf region both eat *Jameed* and *Arish-Kishk*, also known as *Trachanasen*. Ethiopia and Niger are the sources of *Ayib* and *Ahaggar*. Cheeses that resemble *Klila* are known as *Chhanna*, *Öröm*, *Pastillas De Leche*, or *Tikkamarin* in Asia [6].

Klila is regarded as a cheese produced traditionally in farmhouses. Local expertise undoubtedly adds to the unique qualities of the cheese, including its nutritional and sensory attributes. The nutritional value of *Klila* is especially intriguing when considering the human diet: the protein rate is high (Min: 29.88%–Max: 71.37%), while the concentrations of fat (Min: 9.54%–Max: 29.33%) and salt (Min: 0.33–Max: 1.70%) are relatively low. Lactose is fully digested due to the fermentation stage, and the curd's low moisture content (less than 10%) after draining shields the cheese from any further contaminations [6, 7]. The shelf life is up to two years [4, 7, 8]. People with metabolic illnesses like diabetes or high cholesterol are advised to consume *Klila*, particularly if it is prepared from goat milk that has been grazed on *Trigonella foenum-graecum* L, a fragrant plant also known as fenugreek or, locally, *el halba*.

After the procedure, women in some regions store the *Klila* cheese in bags made of goatskin known as *Mezwed* [6, 9]. The nomadic trading of the Saharan nomads, who predominated for millennia until recently, is suitable to this type of storage. These days, *Klila* is often kept in tulle bags or glass jars for storage. In Algeria, it is eaten either fresh or dried, depending on the area rural or urban [10, 11]. (Figure 1) shows the geographical boundaries of the locations where *Klila* is created. The Algerian areas of Guelma, Souk-Ahras, Oum El Bouaghi, Batna, and Khenchela [11]; Chellala and Souk Ahras [7] are among the "Wilayas" where *Klila* is made and consumed. Additionally, recent research showed that *Klila* was produced, eaten, or just known in Naâma (Ain sefra), Bordj Bou Arreridj, Djelfa and Tebessa [4, 12, 13].

Whether it is homegrown or purchased, *Klila* is often drunk once or twice a week in rural areas [2, 13]. The amount of cheese consumed locally has been dropping for many years, despite the compelling explanations [8]. There are several explanations for this, including the fact that milk output is drastically declining as cattle farming gains less significance. Not many cheese growers are opening up shop in the interim. Algerian consumption patterns and way of life have also evolved. These days, Algerians would rather purchase industrial goods from outside since they are easier to locate and prepare than regional handmade cuisine. *Klila* is more than just a regular cheese; it is a representation of the history of the people who have lived in the semi-arid and desert regions of southern Algeria. These areas have certain pedoclimatic characteristics, such as rocky or sandy soil, little xerophytic flora, less than 200 mm of annual rainfall, and extremely high temperatures, which can cause evapotranspiration into the atmosphere to be up to 150 % greater than rainfall. People in drylands depend on the land for their food and livelihoods, mainly through agriculture and pastoralism.

In dryland areas, climate change directly affects livelihoods, food and water security, land degradation, and biodiversity. Water, land, and vegetation are all significant factors in the conservation of these locations, but human resources more specifically, human knowledge and adaptability must also be taken into account by strengthening the environmental benefits and customs of the locals [14]. In order to preserve these areas' unique dietary composition and traditional practices, particularly with regard to the production of dairy products, the traditional products of these areas must be safeguarded and promoted. Numerous scholarly studies have been published in Algeria, indicating a growing interest in indigenous goods [6, 10, 15].

This study's main objective is to prove that *Klila* is a traditional cheese found in arid areas. Before suggesting a label for this traditional Algerian cheese in the future, this is an essential first step.

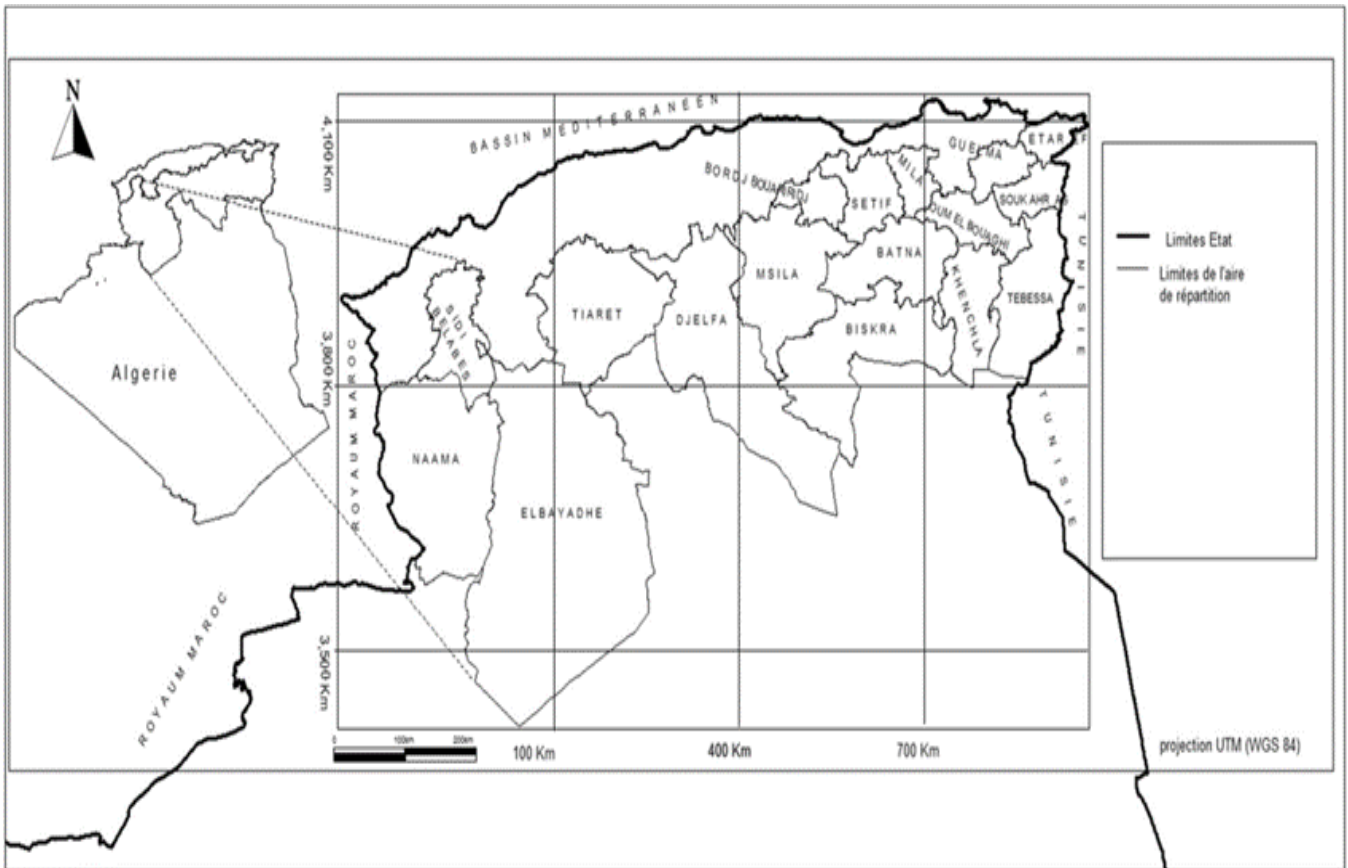


Fig. 1 Geographical delimitation of the *Klila* production.

II. MATERIAL & METHODS

Biological material used: The cheese of the *Klila* type: cheese samples were taken aseptically in sterile containers from five different sites in the cities of Birine (B), Djelfa (D), Massaad (M), Had Sahari (HS) and Sidi Laadjal (SL) in the Wilaya of Djelfa.

Sampling area: The middle region of northern Algeria is home to the Wilaya of Djelfa (*Figure 2*). The wilaya can continue to grow because of its centrality. It is an unquestionable crossing point and the ideal connection between the country's east and west as well as its north and south. The Wilaya of Djelfa is mostly a pastoral sheep farming region in Algeria due to the characteristics of its natural environment and the size of its land. [16].



Fig. 2 Location of the sampling area (<https://www.google.com/>).

1. The investigation: We surveyed 150 individuals of all ages in urban and rural environments in central Algeria, namely in several Djelfa districts (Birine, Djelfa, Massaad, Had Sahari, and Sidi Laadjal), in order to determine the product's social positioning. Men and women make up the target demographic; three age groups have been chosen for each category: under 35, between 35 and 60, and over 60. The

survey is split into two sections: the first piece asks questions about product knowledge and the production process, while the second section gathers data on product consumption.

2. Physicochemical analysis: All of the traditional *Klila* cheese samples under study were collected, sent straight to the laboratory in chilled containers (four degrees Celsius), and examined right away without being kept in storage. The pH of the cheese was measured using a conventional protocol [17]. The samples' titratable acidity was evaluated in triplicate, and the average results were given [18].

3. Microbiological analysis: The total aerobic mesophilic flora (TAMF) was isolated and counted using conventional microbiological techniques and medium, with decimal dilutions in physiological water. A sterile dropper was used to 1 ml of each dilution into each of the three Petri dishes. The Petri dishes were melted, cooled to between 40 and 45 °C, and then stirred before being incubated for a full day at 37 °C. The product's average CFU/g was assessed [19]. Furthermore, the technique of counting colonies to determine the quantity of coliform bacteria was applied. One milliliter is divided between two Petri plates using the decimal dilutions. VRB mold agar, which has been melted and chilled to 45 °C, contains agar and lactose, bile salts, purple crystal, and an indicator in each box. The above-prepared boxes are incubated for a full day at 35 °C. Following incubation, the reddish-purple colonies are tallied, and the following formula is used to determine the average value: $N = \Sigma c / (n_1 + 0.1 n_2) \times d$, (*c*: is the sum of the counted colonies; *n*₁ is the number of cans to be counted from the first dilution; *n*₂ is the number of cans to be counted from the second dilution; *d* is the dilution ratio corresponding to the first dilution used) [19]. In addition to adding egg yolk and tellurite to Baird-Parker Agar, the species of pathogenic and opportunistic bacteria, including *Staphylococcus* and coagulase-positive *Staphylococcus*, were enumerated. For a duration of 24 to 48 hours, the dishes were incubated at 37 °C. The dubious colonies were counted after they had grown. The colonies are divided into two categories: atypical (jet black to dark gray colonies, full margin without halo) and normal (smooth, convex, opaque zone throughout, entire border with a bright halo beyond it). [20]. To identify *Salmonella*, 225 milliliters of buffered peptone water were used to suspend 25 grams of cheese, which was then pre-enriched and incubated for 24 hours at 37 degrees Celsius. 10 ml of tetrathionate broth (selective enrichment) was added to 1 ml of pre-enrichment broth, and the mixture was incubated for 24 hours at 42 °C. Brilliant green agar (selected medium) and *Salmonella* and *Shigella* agar (SSA) were streaked with a full loop of tetrathionate broth, and the mixture was incubated for 24 hours at 37 °C. [21]. 10 g were extracted aseptically and homogenized for 5 minutes at a normal speed in 50 ml of 1% sterile peptone water to determine the quantity of molds and yeasts. [22]. Samples were spread out on Potato Dextrose Agar (PDA) after being diluted in series. After the agar has gelled, invert the flat box and incubate at 28 °C±1 °C for five days. If required, use a magnifying lens to see or identify the yeasts and molds that correlate to the various dilution rates. expressed as colony-forming units, or CFUs. Choose the box containing counts ranging from 10 to 150 CFU, then count the molds and yeasts, accordingly, based on how they seem. [23]. The lactic acid bacteria were counted using M17 and MRS agar at pH 6.2 and an incubation period of 24 to 48 hours. The techniques outlined by the International Dairy Federation (IDF) for the different LABs were followed to isolate the lactic acid bacteria through medium culture selectively. [24].

III. RESULTS

1. The investigation: According to the findings of the study, 93 out of the 150 persons surveyed in both urban and rural areas (62% of them) knew this cheese. This ratio demonstrates that this dairy product is well-known and a staple of traditional cuisine. According to 70,97% of respondents (66 individuals), it is mostly passed down through family memory; of them, 30,30% say grandparents are especially responsible (20 people). Ninety individuals in total ate it, particularly in its "fresh" state sixty percent (54 people) and after conservation forty percent (36 people). With 82.22 % (74 individuals) consuming it more than five times and 54.05% (40 people) consuming it more than ten times, the frequency of consumption is quite noteworthy. Typically, women use it in two ways: either fresh or preserved (dried) in the dough for traditional baked breads like *M'laoui* and *Kessra*, or in ready-made foods like *Berkoukes* and *Couscous*. Its consumption is substantially more common in rural than in urban settings, most likely

because raw materials for manufacture are readily available there. The most important ones have been condensed into a graphic (Figure 3). Whey and butter are two other byproducts of cheesemaking.

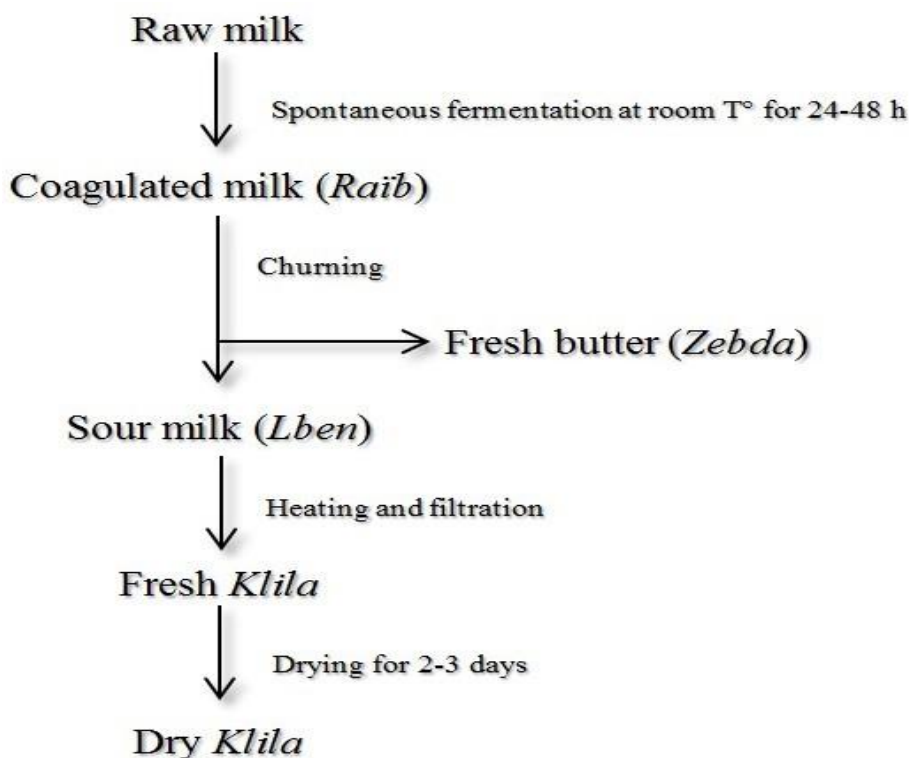


Fig. 3 Traditional cheese-making diagram *Klila*.

2. Physicochemical analysis: The results of the physicochemical analysis have been presented in Table 1. Where the pH range for traditional cheese *Klila* was from 4.35 to 4.57 with an average of 4.5, the titratable conventional cheese acidity samples varied from values as low as 76.29 °D to values as high as 92.51 °D, the average titratable acidity value was 84.64 °D.

Table 1. pH and acidity of the samples of the traditional cheese (*Klila*).

	Sampling					
	S1 (B)	S2 (D)	S3 (M)	S4 (HS)	S5 (SL)	M
pH	4,48	4,35	4,55	4,57	4,55	4,50
Acidity	89,40	92,51	82,51	76,29	82,51	84,64

S: Samples, M: Mean.

3. Microbiological analysis: The average of the results obtained has a significant microbial load in terms of TAMF, Total coliforms, yeasts and molds, and the absence of *Staphylococcus aureus*, *Clostridium*, Fecal coliforms and *Salmonella*. The results of microbiological properties of traditional cheese *Klila* are presented in Table 2. The total number of the total aerobic mesophilic flora (TAMF) varied from 1.03×10^3 CFU/g and 3.37×10^3 CFU/g with an average of 1.64×10^3 CFU/g. The number of total coliforms were found in only two samples; the average number of total coliform bacteria was 1.3×10^4 CFU/g. The total number of yeasts and Molds varied from 1.2×10^8 CFU/g and 2.4×10^8 CFU/g with an average of 1.88×10^8 CFU/g. Fecal Coliforms and pathogenic bacteria *Staphylococcus aureus*, *Salmonella*, and *Clostridium* were not detected. Lactic acid bacteria have a presence rate of up to 10^6 CFU/g.

Table 2. Results of the microbiological analysis (CFU/g) of the samples from the *Klila*.

Microbiological Analysis	S1(B)	S2(D)	S3(M)	S4(HS)	S5(SL)	M	Norme
TAMF x 10 ³	1.39	1.12	3.37	1.30	1.03	1.64	10 ⁵ /g
Coliforms x 10 ⁴	1.2	1.4	0	0	0	1.3	10/g
Yeasts and Molds x 10 ⁸	2.3	2.4	1.2	1.4	2.1	1.88	10 ² /g
<i>Staphylococcus aureus</i>	Abs	Abs	Abs	Abs	Abs	Abs	0/1g
<i>Salmonella</i> (1g)	Abs	Abs	Abs	Abs	Abs	Abs	0/1g
<i>Clostridium & Fecal Coliforms</i>	Abs	Abs	Abs	Abs	Abs	Abs	----
LAB x 10 ⁶	7.03	8.45	5.05	3.65	4.56	5.75	----

S: Samples, M: Mean, Abs: Absence, LAB: Lactic acid bacteria.

VI. DISCUSSION

1. The investigation has shown that this cheese is known, manufactured, preserved, and consumed in rural and urban areas. For each parameter, the highest rates were recorded in rural areas compared to urban areas and among older people over 60 years of age, compared to adults and young people under 35 years of age [25]. describes the *Klila* as being the product obtained after curdling the milk; the curd is then pressed lightly; it was consumed fresh or dry. This product was the object of trade in the Sahara. Nomadic tribes sold it or bartered it on the markets of the Tellian region. In his book describing the Saharan nomads, [26] described the dietetics of travelers of yesteryear, talking about the diets of nomads; we find the use of high-calorie foods, easy to preserve, available and occupying small volumes to reduce the crowding of walkers and riders. He defined *Klila* as being a cured cheese obtained by completely dehydrating the curd obtained after moderate heating of the sour milk. This process has also been described by [27]; the curdled milk is churned to obtain an acidic drink: the Lben which undergoes a moderate heat treatment to obtain the fresh *Klila*. During the conduct of the survey, we collected information regarding the manufacturing process of this traditional cheese, and overall, the manufacturing process is the same in all areas of the survey.

2. Physicochemical analysis: The pH values are similar to those found by [28]. The acidity values are almost identical to those reported by [29] and [30]. A great variability observed for traditional Algerian cheeses and even based on limited data reflects the conventional dairy typicity transformations in each region, this requires a characterization of these traditional dairy products by respecting the specificity of each cheese including the *Klila* in the steppe regions.

3. Microbiological analysis:

The results indicate a possibility of general contamination and a lack of hygiene, which requires corrective measures to reduce the microbial load and improve the safety and quality of the cheese. Many common enteric pathogens such as *Salmonella*, *Escherichia coli* O157: H7, and *Campylobacter* are transported in the intestinal tract of ruminants, including domestic animals used in dairy production, for example, cows, sheep, and goats. Effective cleaning procedures can reduce the risk [31], consumer requirements for traditional fermented milk products are generally increased due to their proven gastronomic quality and their positive effects on human health. However, the tightening of legislation on food safety is reflected in less flexibility of production, homogeneity of food production, and a loss of food diversity and traditional specificity. Therefore, the preparation of well-defined functional autochthonous sourdough cultures for the production of traditional cheeses under controlled conditions, using standardized traditional technology, is crucial [32]. According to the results obtained, in this research, the counts total coliform bacteria, and yeasts and molds present in traditional cheese *Klila* were higher than the upper limits given by the European Commission (EC) [33]. It is not surprising to obtain high microbiological contents in cheese with artisanal manufacturing methods due to the use of unpasteurized milk [34].

V. CONCLUSION

According to study data, *Klila* cheese is well-known, produced, preserved, and eaten throughout the investigated area's rural and urban areas. When comparing rural to metropolitan locations and individuals over 60 to adults and young people under 35, the greatest rates were found for each parameter among the former group. Microbiological and physicochemical studies have demonstrated that the dehydrated cheese is of a good quality. When the pH is at 4.5, it truly protects against changes brought on by unwanted microbes. The traditional *Klila* cheese's characterization serves as both the foundation for a method aimed at preserving and protecting its unique qualities and a means of comprehending the processes that define its typicity. It is of some interest to learn about the nutritive and sensory properties of this classic cheese. With the help of this first strategy, we were able to broaden the scope of our research to market this product.

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