

# PHYSICOCHEMICAL CHARACTERIZATION AND MICROBIOLOGICAL QUALITY ASSESSMENT OF 'KLILA': A TRADITIONAL DRIED HARD CHEESE, MADE FROM SMALL RUMINANT'S MILK (GOAT AND EWE) COLLECTED IN BIBANS AREAS (HIGHLANDS) NORTH EAST OF ALGERIA

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## ABSTRACT

*Klila* a traditional dried hard cheese, widely known and appreciated in all regions of Algeria, with a grainy texture, formulated with raw milk and/or *Lben*; a fermented acidified milk. The study aimed to valorize the Algerian traditional “*Klila*” cheese, and focused on twenty dried *Klila*'s samples, manufactured from goat's (10 samples) and sheep's (10 samples) fermented milk *L'ben*. Collected from various livestock farms in Bibans arid areas, Bordj Bou Arreridj province, North-Eastern of Algeria, during high lactation season March- April. The exploration of five physico-chemicals tests, gave value encircled between: pH (04- 04, 7), acidity in Dornic degree °D (22- 44°D), conductivity microsiemens/centimeter (0, 41- 02, 16 ms/cm), dry matter (25-48, 48%) and ash (0, 18- 0, 6%). Microbiological quality control By enumeration of nine bacterial groups allowed to estimating average total mesophilic aerobic flora (01.24 x10<sup>3</sup> cfu/g), fecal coliforms (08, 4 CFU/g), indologenes flora (0.32), faecal streptococci (21, 30 cfu/g). Samples hygiene level was acceptable; however, indigenous lactic flora, total fatty and proteins rates exploration are desirable.

**KEYWORDS:** Klila, Lben, Physicochemical, Microbiological

## INTRODUCTION

Algeria is classified as the second largest milk importing country in the world after China (Amellal 1995) and imports more than 60% of its milk's powder consumption. The average annual growth of the Algerian dairy market is estimated at more than 20% (Bekhouche 2011). In terms of area, Algeria is the first country in Africa, ranked nine in the world, with 2 281 741 Km<sup>2</sup> (Nedjraoui and Bédrani, 2008). However, more than 80% of this area is a desert suffering the pangs of recurrent drought. Individual consumption of milk and dairy products per year increased from 34L/Hab\*/Year in 1970 (Liter/Habitant/Year) to 95L/Hab/Year in 1995 and is estimated at 143L/Hab/Year in 2012 (Kacimi- El Hassani, 2013; Meribai et al., 2016). Algerian's local raw milk production covers only about 40% of the demand estimated at more than 04 billion liters, the latter being mainly of bovine species (Soukehal 2013). Traditional cheeses are sources of animal's proteins for the nutrition of nomadic populations, particularly in arid regions.

Fermented milks and traditional dairy products consumption reflects a long history, traditionally linked to the human farming activity, these dairy products manufactured by artisan processes, old, from the milk or mixture of milks from various species.

Several studies have focused the characterization of traditional cheese and their production process throughout the world as: *Liqvan* in Iran (Barouei et al., 2008), in Italy: traditional Mozzarella cheese (Morea et al., 1999); *Pecorino* cheese (Todaro et al., 2011); *Pasta Filata* cheese (Christian et al., 2010); Conciato Romano cheese (Caporaso et al., 2015); Italian traditional mountain cheese (Carafa et al., 2015); Indigenous brined cheese of the Philippines (Barraquio, 2006); *Kishka* very popular cheese in several middle East countries (Tamime and O'connor, 1995), Brined Cheeses from Middle East and Turkey (Toufeili and Özer, 2006); *feta* and other balkan cheese (Anifantakis and Moatsou, 2006); traditional *Kurdish* cheese (Milani et al., 2009); Egyptian Domiati cheese (El-Baradei et al., 2014); North African traditional brined cheeses (Abdelsalam and Benkerroum, 2006). There are a variety of traditional dairy products (cheeses, fermented milk, yogurt), their labels and old manufacturing processes differ from one area to another, these dairy products also differ in taste, consistency, depending on the source of milk (cow, goat, sheep and camel). Several works have characterized traditional Algerian dairy products, such as: *Shmen*; A traditional butter made from camel's milk in the South of Algeria (Kacem and Karem, 2006). *Raib* a curdled fermented milk (Mechai and Kirane, 2008). *Dhan* obtained at the end of the milk churning from various dairy species (Idoui et al., 2013; Guessas et al., 2012). *Lben* a fermented skimmed traditional milk; prepared by spontaneous acidification of raw cow's, ewe's or goat's milk, under the fermentative action of original lactic flora (Samet-Bali et al., 2010). From the long list of Algerian's traditional cheese, only *Djben* is well known (Hallel 2001).

*Djben*: Algerian fresh cheese, (El Marnissi et al., 2013), unripened, prepared from raw milk (Ould abeid et al., 2013), consumed within 10 or 15 days after its preparation.

*Bouhazza*: A traditional cheese, refined, soft and spicy, unmolded, very widespread in Eastern Algerian's arid areas (Aissaoui- Zitoun et al., 2012; Marino et al., 2012).

*Michouna*: a fresh traditional cheese, made from the milk and *Lben* from cow or goat or the mixture milks of both species (Derouiche and Zidoune, 2015).

*Klila*: A traditional, fresh or dried cheese, prepared from "*Lben*", an acidified fermented milk from different species (cow, sheep, goat and camel) or a mixture of milks, its empirical manufacturing process is still in used, this latter is characterized by spontaneous fermentation of the original milk flora at room temperature, after coagulation and draining the product is consumed fresh (Mennane et al., 2007), or after drying for several weeks (Boubekri and Ohta 1996). In the latter case, the product is also used as an ingredient, after rehydration, in various culinary preparations. Few data are available on biochemical, microbiological and physicochemical characteristics of this dairy product. Similarly, the manufacturing process of *klila* cheese is poorly elucidated, this latter, seems different from one region to another. The archaic protocol, characterized by the absence of heat treatment of milk, use of non-sterilized instruments, non-disinfected work surfaces, unskilled personnel, filtration by non-sterile fabrics, product drying at air. There is proliferation of micro-organisms, thus the product escapes all hygienic quality control; constitutes a potential risk to health consumer.

Study aimed to characterize the physico-chemical and microbiological qualities for a total of twenty samples of traditional *Klila* cheese prepared from fermented milk *Lben*, from both species: goat and ewe, collected in various livestock farms in the province of Bordj Bou Arreridj Northeastern of Algeria

## MATERILS AND METHODS

A total of twenty four samples of hard dried *Klila* cheese, made from Goat's milk (10 samples) and sheep's milk (10 samples), were collected from extensive farms and Breeding centers, in different localities of Bibans arid areas, Bordj Bou Arreridj province, North-eastern of Algeria, during great lactation period: March- April 2015.

### Physicochemical Analyzes

Five tests: pH, Acidity in degree Dornic (°D), conductivity in microsiemens/centimeter (ms/cm), dry matter content (%) and ash rate (%).

### Statistical Tests

(Statistical data processing) Physico-chemical test's results were subjected to statistical processing (Program-ANOVA) Figure 1

### Microbiological Tests

Estimates (counts) of microbial average loads (count in colony forming unit /Gram of cheese), for nine microbials floras according to the protocols recommended by Joffin and Joffin (1993), Table 1 summarize protocols followed, culture media, enrichment medium and optimum incubation temperature used.

**Table 1: Microbiological Tests and Mediums Used**

Floras/count ufc/g	Medium used/ Label	Incubation/Time / Temperature°C
Eucaryotic Floras (Yeasts and Molds)	Saboraud Agar/Room temperature/IPA- Algeria	Five days at room temperatue
Procaryotaerobic mesophilic total Flora (F.T.A.M)	Plant Count Agar (PCA) at 30°C/Pronadisa- Spain	After 48H at 30 °C
Total Coliforms group- at 37 °C	Bile- lactose broth with -Durham Bell -37°C-Pronadisa- Spain	24H/ at 37 °C
Fecal and Indologic Coliform group at 44 °C	Bile lactose broth with Durham Bell/ at 44°C-Pronadisa- Spain	24H/ at 44 °C
Group D <i>Streptococci</i>	Rothe broth medium at 30 °C for Presumptive test Litsky broth for Confirmatory Test- Pronadisa Spain	24H/ at 30°C
Sulfitorreductor <i>Clostridium</i>	Agar liver meat/Na- Sulphite + Alum iron Fe- at 37 °C/ IPA Alger	24H/ 48H/ 72H at 30 °C
<i>Pseudomonas</i> sp	Citrimide-Agar medium/28°C- Idealab Algeria	24H/28 °C
<i>Salmonella</i> sp	Muller-kauffmann Broth /Hektoen agar/at 37°C Idealab-Algeria	24H/37 °C
<i>Staphylococcus</i> sp	Giolitti Cantoni Broth- Baird- Parker Agar/Ideal lab Algeria	24H/ 37 °C

RESULTS

Table 2: Physicochemical Tests Results

Samples/ Animals	Physicochemical Tests					
	Samples*	pH	Acidity* (°D)	Cond.*	Drymatter(%)	Ash (%)
Klila from sheep's fermented milk Lben (Br*)	Br 01	04,6**	26	02,2*	32,96	0,30
	Br 02	04,1	42	1,7	26,48	0,26
	Br 03	04,5	24*	2,16*	37,56	0,60**
	Br 04	04,2	36	0,71	34,62	0,47
	Br 05	04,4	33	0,82	25,74	0,31
	Br 06	04,0*	44*	1,20	25,00*	0,30
	Br 07	04,4	38	0,90	48,48**	0,25
	Br 08	04,6	27	1,29	33,00	0,18*
	Br 09	04,3	39	0,70*	27,22	0,43
	Br 10	04,1	41	0,80	36,45	0,34
Average (M)	M	04,32	35	1,25	32,75	0,34
Klila from goat's fermented milk Lben (Ch*)	Ch01	04,6	23	0,42*	36,68	0,58**
	Ch02	04,7**	23	1,28**	38,75	0,25
	Ch03	04,5	24	1,01	28,32	0,46
	Ch04	04,6	23	0,70	35,56	0,20*
	Ch05	04,6	23	0,83	36,61	0,32
	Ch06	04,5	24	0,74	40,09	0,40
	Ch07	4,7**	21	0,77	32,00	0,26
	Ch08	4,6	24	1,22	41,29**	0,42
	Ch09	4,7**	20	0,97	33,05	0,21
	Ch10	4,2*	26**	0,70	30,14*	0,44
Average (M)	M	4,57	23,1	0,86	35,25	0,35

Cond: Acidity in °D: Dornic degree- Conductivity - Ash% -DM: dry matter %: \* Br: Klila cheese from ewe's fermented milk lben- \*Ch: Klila cheese from goat's milk-( \*):Minimum value- (\*\*): Maximum value

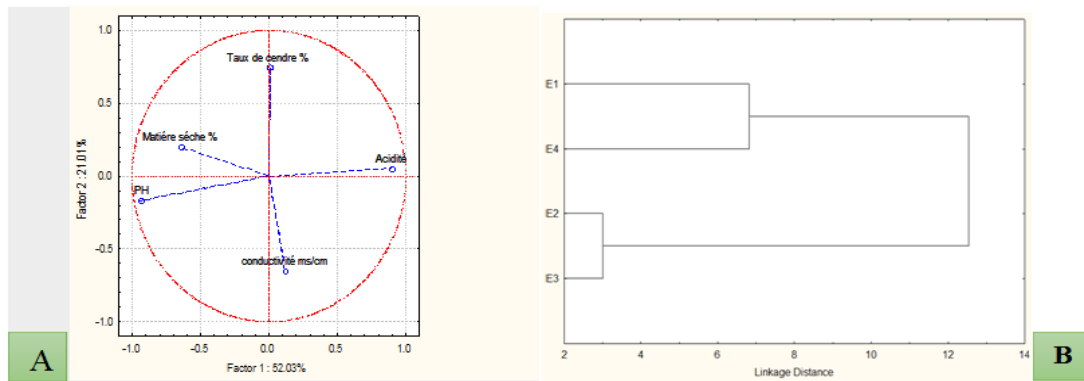


Figure 1

DISCUSSIONS

pH and titratable acidity (°D):For all samples (table 1), pH values were ranged between 04(Br 06 sample) and 04.7 (Ch 02 sample), with average of 04.47, are closed to those recorded by several authors for the Algerian traditional Klila : Boubekri and Ohtha, (1996): 04,29 and 04,71; Leksir and Chemam, (2015): 04.35 and 04.99. Guettouache and Gueassas, (2015): 04.29 and 04.71. Low pH sample's, can be explained by it's manufacture process marked by the use of Lben: a traditional fermented milk, with low pH around 04.24 (Boubekri et al., 1984). Our results corroborate those reported by Boubekri and Otha, (1996), which recorded pH values of Algerian (dried for a month) klila between: 04.29 and 04.71.

On the other hand, *Klila's* acidic pH, seem results from fermentative activity of *Klila's* original lactic floras, (Tamime and O'conner 1995, Abdelsalam and Benkerroum 2006, Pogagic et al., 2013; Kongo and Malcata, 2016). In this regard, Mennane et al., (2007); Rhiat et al., (2011; 2013): had recorded low pH values: 03.8 to 04.7; 03.8 to 04.7 and 03.89 to 04.26 respectively. In addition, pH values for our samples, seem close to those for traditional fresh traditional cheese: *Bouhezza* (pH: 04.6) (Aissoui-Zitoun et al., 2012). Boubekri and Ohta, (1996): for two *Klila* samples, collected in various Algerian's Eastern areas (K<sub>1</sub> Sétif and K<sub>3</sub> Batna) and dried for four weeks, noted that *Enterococcus faecalis* and *Enterococcus faecium* species followed by *Lactobacillus* sp species dominate the K<sub>1</sub> sample while *Pediococcus* sp species followed by *Leuconostoc* sp dominate the K<sub>3</sub> sample. However Leksir and Chemmam, (2015): for eight *Klila's* samples made from cow's, goat's and ewe's milk, collected from different localities in three Easterns provinces of Algeria (Guelma, Souk Ahrass and Oum El Bouagui): recorded pH values between 04,35 and 04,99, while titratable acidity values were between 24.3°D and 54°D, moisture levels were ranged between: 07% and 09,13% and the dry matter between: 90,87% and 90,98%. For the Algerian traditional fresh cheese *Djben*: made from ewe's, goat's and cow's milk pH values were: 04,57; 04,81 and 04,62 respectively (Dahou et al., 2015). For five *Klila* samples, collected in various rural areas in Djelfa province-South of Algeria, authors recorded pH values ranged from 03.8 to 04.8 (Guettouache and Guessas, 2015). Although, for same sample's acidity in Dornic degree (°D) varied between: 68°D and 91°D, with average of 79.4°D: Authors noted for this cheese ecosystem dominate species *Lactobacillus* sp: with *Lactobacillus fermentum* 21.97%, *Lactobacillus plantarum* 18.94%, *Lactobacillus casei* 18.18% respectively. However, Menane et al., (2007): for 23 fresh *Klila's* samples collected in Morocco, pH values recorded were ranged between 04.7 and 03.8. For our *klila* sample's, titratable acidity values varies from 21°D to 44°D with average: 27,46 °D. Results closed those recorded by Leksir and Chemmam, (2015): 24,3°D and 54°D, much lower than results reported by Guettouache and Guessas, (2015): 68°D and 91°D. Several *klila's* studies in Marrocco: Hamama (1989); Mennane et al., (2007) and Rhiat et al., (2011; 2013) reported higher titratable acidity values: 99°D, 73°D and 97°D respectively. pH and titratable acidity (in Dornic degree) variations value's between *klila's* samples could be explain by: the difference in milk composition, sampling conditions, dried duration (drying time) process steep, storage conditions. However, titratable acidity reflects lactate concentration, this latter result from lactose fermentative metabolism by original lactic flora associated with *Klila* cheese (Kongo and Malcata, 2016). The Dornic degree (°D): is the expression of developed acidity, by lactose conversion to lactic acid: a degree Dornic (°D) corresponds to 0.1 lactic acid in one milk liter (Chamba and Prost, 1989).

Conductivity: for the all *klila's* samples values varied from 0.41 to 02.16 sm/cm, with the mean of 0.97 ms/cm. According to Mabrook and Petty (2003), conductivity is sample's ions content (mainly chloride, phosphate and sodium) which appear to be present at very low levels in our *Klila's* samples. Dry matter rates: varied between 25% and 48.48% with average of 35.37%. These results were lower than those reported for *Klila* by Leksir and Chemmam, (2015): 90.87% and 90.98%; Mennane et al., (2007): 35, 4; Derouiche and Zidoun 2015: 45.5%. However, for Moroccan *klila* cheese average value dry matter rate was: 28.14%. Ash: composed mainly of minerals from raw materials (milk) as calcium, phosphorus, potassium, chlorine, sodium, and magnesium. The *klila's* samples ash rate values varied from 0.18% to 0.6% with average of 0.33% and are much lower in comparison with the value recorded for traditional Moroccan *klila* (0.62%) (Mennane et al., 2007). Microbiological analyzes: The bacterial counts flora, especially those indicative of contamination (faecal coliforms, indol floras and group D streptococci), recorded at low levels (within the norms), with pathogenic and toxinogenic species absence (*Salmonella* sp and *Staphylococcus* sp), reflects hygienic level of milks used sampling, material, manufacturing and environment drying.

## CONCLUSIONS

Physico-chemical tests showed a hard cheese with acidic pH, high lactate rate, dry matter content average of (35.37%) and an average ash rate of (0.33%). The microbiological analyzes revealed an acceptable hygienic level. However, indigenous lactic flora, total fatty and proteins rates exploration are desirable. In our knowledge, this is the first characterization of Algerian traditional cheese *Klila*, made from small ruminant's (ewe's and goat's milk) in Algeria.

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