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RESEARCH ARTICLE

PROCESSING OF RAW MILK INTO TRADITIONAL CHEESE IN DJERMAYA IN THE HADJER LAMIS REGION OF CHAD

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ABSTRACT

The objective of this study is to transform raw milk into traditional cheese in the Hadjer Lamis region in Chad.For eight analytical purposes (8) samples studied cheese and raw milk were collected. The milk was collected into sterile glass vials and shipped to the temperature of the ambient medium in the dark to a laboratory where the pH is measured using a pH-meter 370 by soaking in a beaker. The fat content (MG) and lactose respectively is determined by the infrared method (Farm Milk Analyser, 2001, Miris AB) and by spectrophotometry (AFNOR, 1993). Kjeldani method was used for determining the protein content. The density is measured using a thermo-lactodensimètre. The physicochemical analyzes show that the average fat content is 30,7g / l and the lactose concentration is 4359g / l .L'acidité is between 16.75 and 17.50%. Studied the milk protein has a value which is 29.69% and the water content on average 81.70% .For microbiological investigations, the samples 20 to 25 g weight were homogenized with peptone water 90 ml and then diluted with Ringer's solution. Diluted solutions were seeded in different culture media for the enumeration of total viable flora but also to assess the degree of contamination of the final products from unwanted germs that are total coliforms, Staphylococcus aureus, Salmonella and Listeria monocytogenes. Microbiological analysis showed a very satisfactory hygienic quality of cheese dry Djermaya justified by the total absence of coliforms and faecal streptococci and salmonella and staphylococci. These results showed that the cheese made in Djermaya is convenient and suitable for both rural and urban areas and a satisfactory quality in its dried form. Knowledge of the nutritional and sensory characteristics of this traditional cheese is certain pledge to promote this product.

INTRODUCTION

In Chad, milk processing is an activity mostly held by women. Fresh (raw) milk is processed as whole fermented milk (Rayeb), skimmed milk (Rouaba) and liquid butter (Dihin baggar). There are about 20 mini dairies scattered throughout the national territory and largely in the town of N'Djamena (capital of Chad), which transforms from imported powdered milk to various dairy products (Cheese, yoghurt, etc.) marketed and consumed (DESPA / ME, 2015). Chad is a country producing livestock and agriculture, but the national consumption of cow's milk and dairy products is now booming. In neighboring regions, characterized by poorly developed cattle breeding (PNDE, 2009). Milk, whether raw or processed, is an excellent culture medium for several microorganisms resulting in product deterioration or consumer infections / poisoning (Murinda *et al.,* 2004, Olivier *et al.,* 2005).

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In Benin, cheese remains the most widespread and widely consumed in rural and urban areas (Dossou *et al.,* 2006). In most African countries, there is a considerable increase in demand for animal proteins. The main contributors to this increase are population growth, invasive urbanization, rising incomes and changing dietary habits (Amellal, 1995). Milk from domestic ruminants is one of the most accessible sources of protein. It plays an important role not only in nutrition, but also in economic and socio-cultural terms (Kaci and Sassi, 2007). In rural villages and agglomerations, breeders produce milk in abundance during periods of high lactation. In the absence of means of preservation, they are sometimes obliged to throw away excess milk. The simplest method of conservation is to transform it into cheese (Bellakhdar, 2008). Traditional foods are part of the socio-cultural heritage of each people. The cheese has been made by man for centuries using traditional procedures. The processing of milk into products such as cheese has long been a traditional means of conservation (Arvanitoyannis, 2009). On the economic front, income from world trade in milk and milk products is almost

two-thirds that of cereals (Meyer and Denis, 1999). Thus the transformation of milk into cheese is an attractive alternative, as it increases its storage capacity, facilitates its handling and transport and improves the income from its production. The traditional cheese manufacturing technology of Djermaya in N'Djamena, Chad is still under the control of two families and its spread does not exceed the shelves of this region. The herd is estimated at 94 million head of which 24 million cattle 26.5 million sheep, 30.8 million goats, 64 million camels, 11 million equines, 28 million asins and 17 million pigs (RGE / ME, 2015).

The exact origin of the transformation of milk into cheese is unclear, it is said that the cheese originated in South-West Asia and dates from about 8000 years (Gelais, 2002). The amended standard (FAO / WHO, 2002) defines cheese as a solid or semi-solid fresh or refined product obtained by coagulating milk through the action of rennet or other suitable coagulating agents and by draining. According to this definition, three main stages can be distinguished in the cheese manufacturing process: curdling, milk coagulation, draining and refining of the curd (Amoussou and Bawath, 1998). Despite the importance of the dairy sector in Chad, with 254,519 tons of milk per year, the number of dairies, not insignificant (25 according to the food industry union), suffers from a lack of expertise and remains at a family and Traditional for the majority (PNDE, 2009). Daily production is less than 5 tonnes for most of these companies and the level of hygiene and food safety of the final products remains to be discovered. Limited studies, carried out on the kishk and on the dairy sector in general (Dib. H *et al.,* 1998), indicate that this sector needs support in order to develop it and increase its competitiveness in the market. Salmonella caused foodborne illness due to the consumption of cheddar cheese in (Kansas, USA, 1976 and 1982 in Canada). E. coli also caused an epidemic in France due to the consumption of raw milk cheese in 1992-1993 (Doyle, 1989 and Decludt, 1996). The present study deals with processes for transforming raw milk into traditional cheese in Djermaya in the Hadjer Lamis region of Chad. Determination of the nutritional and sensory value as well as the physicochemical and microbiological characteristics of the finished product. The treatment and conservation aspect was not lost sight of.

MATERIALS AND METHODS

A - Processes for making Djermaya cheese

The production method of traditional cheese from Djermaya uses raw milk and a coagulant Solanum dubium (solanaceae) as raw materials.

Collection and transport of milk

The raw milk used is the main raw material in cheese making. The quantity of milk intended for the manufacture of cheese represents 30 to 70% of the daily quantity of the stroke. The processed milk comes from several camps of the nomadic herders. In plastic or aluminum containers of 30 to 50 liters transported on bicycles, motorcycles or taxi bushes

Milk Filtration

The dairy milk is immediately filtered in another canister previously sterilized with hot water and dried. For filtration, a plastic funnel and a clean, white filter cloth are used. The filtered milk is stored in the cans.

Preparation of Milk Coagulant

There are several traditional methods of extracting the coagulant Solanum dubium. The most common technique is to wash and peel the seeds, pound them in a mortar or grind them on a stone wheel. The ground material is then mixed with a small amount of fresh or hot milk. The mixture obtained is filtered in a sieve and then added to the milk which is on the flame. This extraction method is easy and fast. It avoids the green coloring that the leaves eaten by the animals give to the cheese.

Fig. 1. Solanum dubium coagulant seeds

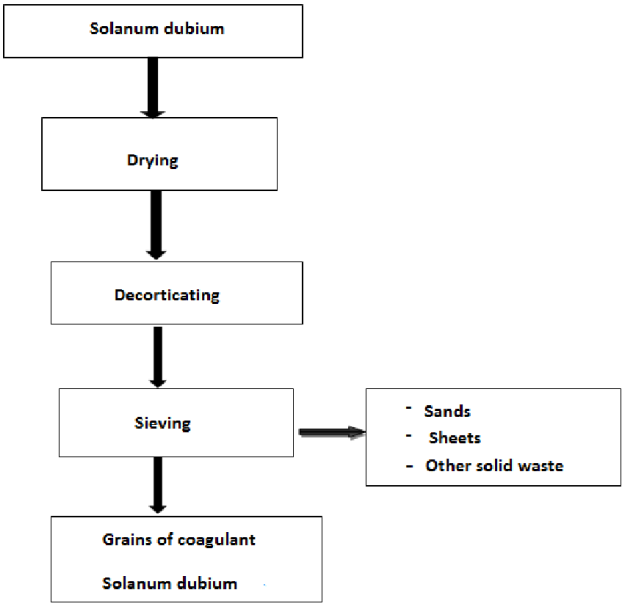

Fig. 2. Coagulant grain extraction technology diagram Solanum dubium

Manufacturing of cheese

The raw milk is heated slightly and coagulated with Solanum dubium. The coagulum obtained, drained and molded, is presented on the market in different shapes and sizes. The ingredients used in the preparation of Djermaya cheese are respectively the iodized salt which makes it possible to give a taste to the cheese and the panicles of sorghum (Sorghum vulgaris) used for the coloring of the cheese. The milk, after filtration, is preheated to about 60 ° C. for 5 minutes. Then the coagulant (Solanum dubium) is added. The milk and the coagulant are then cooked at about 95 ° C until the whey is

supernatant by the whey and heated for another three to five minutes before being drained in strainers. The cooking is stopped when the whey turns yellowish and transparent. The curd at the bottom of the pot rises to the surface and is broken into pieces. The manufacturing diagram for cheese production in Djermaya is summarized in Figure 2.

Draining and shaping the coagulum

After the coagulation, the curd formed is transferred with a ladle into plastic strainers placed on small bowls for the separation of the whey. The coagulum is shaped according to the type of mold used. The cheese thus obtained is a mole paste, moist (65 to 75%) and fragile.

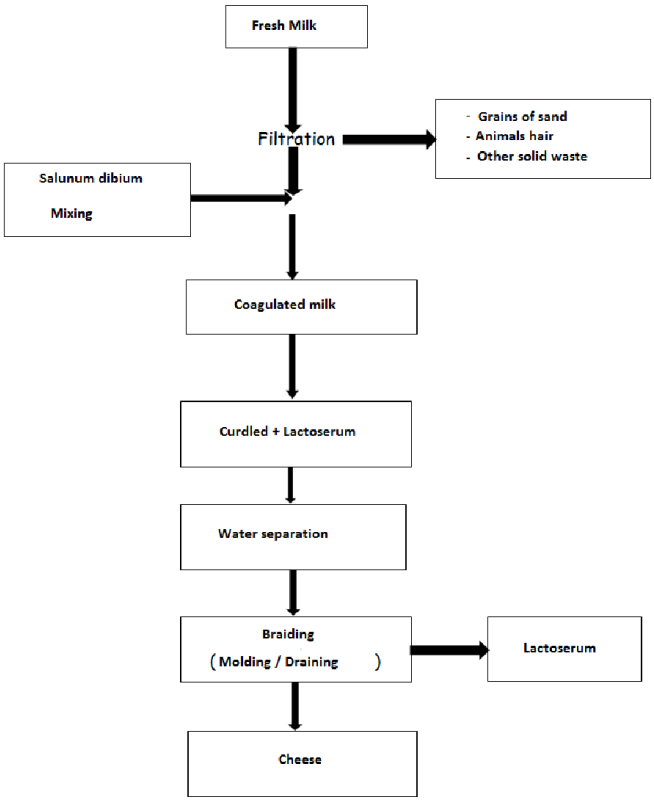

Fig. 3. Diagram of the production of traditional cheese in Djermaya

Treatment and preservation

When the cheese is not yet sold, it can be soaked in the whey where it keeps its moisture. At the end of this treatment, the dried cheeses can be kept for 45 days without any noticeable modification on the organoleptic level (Amoussou and Bawath, 1998)

Fig. 4. traditional cheese made in Djermaya

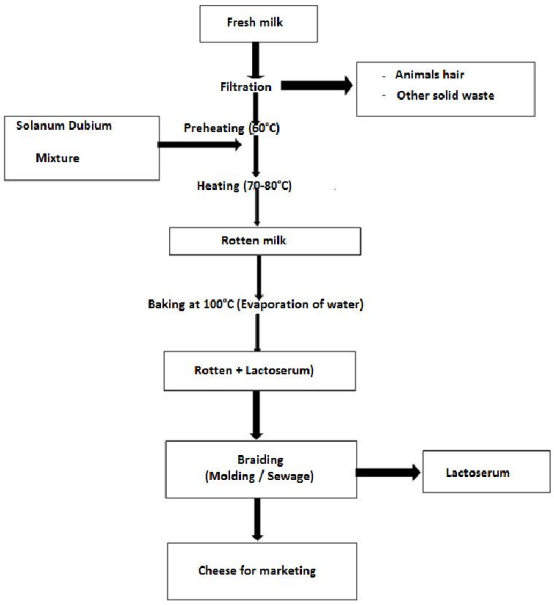

Fig. 5. Process for converting raw milk into cheese in Hadjer Lamis

B - Physico-chemical and microbiological analyzes

Physico-chemical analysis of raw milk

The samples analyzed are raw milks of the cows. On 7 cans from different farms containing milks of cows for manual milking in the early morning, four (4) were selected. Immediately after milking, the temperature is measured with a thermometer. Milk was taken from sterile glass bottles and transported at ambient temperatures in the dark to the laboratory where pH was measured using a pH meter (370 pH Meter Jenway, European Union) By soaking in the sample in a beaker. The fat content (MG) and the lactose content are determined by the infrared method (Farm Milk Analyzer, 2001, Miris AB, Sweden) and by spectrophotometry (AFNOR, 1993). The Kjeldani method was used to determine the protein level. The density is measured using a thermo-lactodensimeter and corrected at 20 ° C. by the following formula:

Density corrected = Density read + 0.2 (Milk temperature - 20 ° C)

The titratable acidity is measured by titration with 1N NaOH in the presence of phenophthalein and is expressed as a percentage of lactic acid (AFNOR, 1980).

Physico-chemical and microbiological analyzes of eight cheese samples

Of the eight (8) samples of the cheese studied, titratable acidity, dry matter content were measured by methods (AFNOR, 1980). Moisture was determined by the method described by IUPAC, (1979). Five grammes of sample were removed and dried at 105 ° C. until constant mass for 24 hours. Total Mesophilic Aerobic Flora (FTAM) was counted on Liofilchem flat plate agar (PCA), Ref 610040, ISO 4833, Italy) and the pH was measured using a 370 pH-meter. All samples Were analyzed three times in succession. For microbiological investigations, samples of 20 to 25 g of mass were homogenized with 90 ml peptone water and then diluted with Ringer's solution. The diluted solutions were seeded in different culture media for the counting of the total mesophilic

flora but also for evaluating the degree of contamination of the end products by the undesirable germs, namely the total coliforms, Staphylococcus aureus, Salmonella and Listeria monocytogenes. For each desired bacterium, the culture medium used, the duration and the temperature of incubation were also recorded. Microbiological analyzes shall be carried out within a period not exceeding 48 hours following collection. The number of bacteria will be multiplied by 1.1 (Lubin, 1998). The microbiological criteria chosen for the interpretation of the results take into account the guidelines of (LIBNOR, 2003).

RESULTS AND DISCUSSION

Our research has shown us that raw milk processors are far from applying the basic principles of good hygiene and production practices. In the age of globalization, where we are interested in certifying management systems in the area of food safety, cheese producers are faced with serious problems such as: Lack of hygiene, Environmental conditions around farms, lack of disinfection and quality of water in the environment and especially quality assurance is not regularly followed. For producers, the determining factor in the quality of a dairy product is mainly organoleptic Dib *et al.* (2008). Lebanese cheese varieties are prepared using traditional simple methods.

moisture content of the cheese studied, which varies from 7.75 to 9.1%, constitutes an extra- Is very rich in dry matter (91.5%) and has a pH of about 4.6 which proves a true protection against alterations due to undesirable microorganisms. The average fat content is 30.7 g / l and the lactose concentration is 4359 g / l. The acidity varies between 16.75 and 17.50%. The milk studied has a protein value of 29.69% and an average water content of 81.70% (Table 2). The 7.75% to 9.13% moisture content of the cheese studied constitutes an extra-hard cheese very rich in dry matter (91.5%) and has a pH of about 4.6 which constitutes a true Protection against alterations due to undesirable microorganisms. The total aerobic mesophilic flora count values did not exceed 9.80 x 103 (cfu / g); this may be justified by the moderate heating applied to the fresh milk for the separation of the whey. These results are comparable to those obtained by Kora (2005), which vary between 80.73 and 87.58% for the water content and 25.67 to 31.51% for the proteins. The microbiological analyzes showed a very satisfactory hygienic quality of the dry Djermaya cheese justified by the total absence of fecal coliforms and streptococci as well as salmonella and staphylococci. According to LIBNOR, (2003), the number of tolerated pathogenic colonies should be zero for salmonella and Listeria and less than 100 cfu / g for total coliforms and for Staphylococcus aureus. In terms of research and enumeration

Table 1. Physico-chemical analyzes of the four raw milk samples

Sample	Milk temperature after milking (° C)	pH	Fat matter (g/l)	Lactose (g/l)	Water content (%)	Densitéy (g/cm^3)	Protein (%)	Acidity (%)
1	36,92	6,71	31,31	44,74	81,50	1,030	32,45	17,20
2	37,15	6,50	29,54	45,40	83,15	1,029	30,32	16,75
3	37,56	6,58	32,53	42,75	79,60	1,035	28,50	16,80
4	36,83	6,65	29,52	41,50	82,57	1,032	27,52	17,50
Average	37,075	6,61	30,70	43,59	81,70	1,031	29,69	17,06

Table 2. Results of the physicochemical and microbiological parameters of the cheese

Sample	Dry matter (%)	Rate Of moisture (%)	PH	Titratable acidity (%)	Enumeration (FTAM)
1	91,21	8,79	4,48	35,60	$1,39\ 10^3$
2	91,43	8,57	4,35	46,5	$1,12\ 10^3$
3	93,03	7,75	4,99	38,6	$3,37\ 10^3$
4	90,87	9,13	4,57	43,0	$1,30\ 10^3$
5	91,64	8,36	4,55	54,2	$1,03\ 10^3$
6	91,43	8,57	4,66	46,0	$6,70\ 10^3$
7	91,41	8,59	4,65	44,3	$8,10\ 10^3$
8	90,98	9,02	4,52	38,6	$9,80\ 10^3$
Average	91,50	8,59	4,60	43,35	$4,10\ 10^3$

Table 3. Search for bacteria, incubation condition and culture medium

Type of bacteria	Incubation température (°C)	Incubation time (hours)	Culture Center
Total Flore	37	48	Nutrient Agar
Salmonella	37	24	SS
Total califorms	37	48	Mc Conkey
Staphylococcus aureus	37	48	Chapman
Listeria monocytogenes	37	48	Palcam

The coagulant obtained is drained under pressure to produce the cheese. According to the producer, for the manufacture of one kilogram of cheese, five to six kilograms of raw milk are required. According to the results of Kees (1996), it takes about 5 liters of fresh milk to obtain 1 kg of cheese. The duration of manufacture depends on the quantity of milk to be treated and varies between 1 and 3 hours of the time. The results of the physicochemical analyzes of the four raw milk samples of the cows presented in Table 1 show that the

of the total aerobic mesophilic flora, we obtained a range of colonies of varying sizes (small, medium) of different colors (white, yellow, transparent) and circular in shape. Similar results have been obtained in Lebanese cheeses such as Baladi, Akkawi and Double Cream and Halloum. These cheeses lacked Staphylococcus aureus, samples from these regions were free from salmonella Dib.H et al. (2008). Sources of contamination of dairy products are linked to lack of hygiene throughout the production cycle. Non-control of transport and

storage conditions could also be responsible for high levels of pathogenic bacteria in dairy products Araujo *et al.* (2002). The titratable acid values are slightly higher than those found by Bennacir (1980). The mean of 17.06, however, remains in the range of 15-17.5% of fresh milk. The average fat content of 30.7 g / l is consistent with the 28.5 to 32.5 g / l range proposed by AFNOR (2001) and is not far from the results obtained by Hicham Labioui *et al.* (2009) and the lactose concentration which is 43.59 g / l on average are lower than those of the milk studied by Mathieu (1998) and which is 49.00 g / l but corroborates the results of Hicham Labioui *et al.* (2009), ie 43.51 g / l. The cow's milk products studied have a relatively acceptable microbiological quality from the hygienic point of view. The absence of Salmonella Hamama et al (1991), Pollma *et al.* (1984) of Staphylococci indicate good cow health and good milking hygiene. However, it is highly desirable to establish a policy of quality assurance and popularization of good practices and safety throughout the cheese production chain.

Conclusion

The results showed that the cheese manufactured in Djermaya is practical and adapted both in rural and urban areas in the area studied. The microbiological and physico-chemical analyzes showed a satisfactory quality of the cheese in its dehydrated form. A pH close to 4.60 constitutes a true protection against the alterations due to the undesirable microorganisms. The characterization of traditional cheese from Djermaya is the starting point of an approach whose objective is the conservation and protection of its specific characteristics; It is also a means of understanding the mechanisms that determine its typicity in its genus. The knowledge of the nutritional and sensorial characteristics of this traditional cheese is of interest. This first approach allowed us to broaden our investigations to other areas to promote this product.

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