



An Analysis of the Milk Quality in Cameroon. A Study in Adamawa Region

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Authors' contributions

This work was carried out in collaboration between all authors. Author HCE designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author ETA managed the literature searches, analyses of the study performed the physico chemical and microbial analysis and author RN supervised the study. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: In order to assess the milk sector in Cameroon, the research and development sector is being questioned about the global quality of milk, as well as the specificity of the breeding context, since the milking activities are essentially based on rudimentary practices. The present work aims at shedding more light on the ongoing discussion on the quality of unpasteurized and fermented milk in the Adamawa region, by presenting the current practices and analysing the milk samples.

Place and Duration of Study: To achieve this, this study was carried out in Ngaoundéré in the Adamawa Region of Cameroon, between October 2011 and February 2012.

Methodology: Milk was supplied by 5 production units found around the town. A questionnaire aimed at describing the milking techniques was equally administered to the suppliers. Two series of 80 milk samples were collected on each site for physical, chemical (pH, dormic acidity, blue methylene test, density) and microbiological (total bacteria, salmonella, *streptococcus*, and coliforms) tests, in accordance with the standards.

Results: The main results show that the "Peulh" ethnic group represented by the "Mbororos" and the "Fulbe" hold the monopoly of the breeding sector in the Adamawa region. As concerns production techniques, 67 % of breeders carry their milk to the

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collecting centers within 12 to 15 minutes after milking. The quantity of milk collected by each breeder at the level of the collecting centers is 77 liters on average during the dry season, as opposed to 116 liters in the rainy season. These results also show that the udder and the collecting cans are critical points of milk quality. The precarious hygiene conditions of milking, conditioning and conservation illustrate these results, as confirmed by the microbiological tests which reveal that none of the samples are in conformity with the standards.

Conclusion: Finally, the milk production conditions in the Adamawa are not likely to ensure the quality of products put on sale. This study will help to better master the sector, by showing the contribution of hygiene in the milk production.

Keywords: Cameroon; Ngaoundéré; milk quality; milk quantity; milk sector in Cameroon.

1. INTRODUCTION

The Cameroon livestock is estimated at about 3.5 million cattle, 5 million sheep and goats found in the far North, North, Adamawa, West and North-West regions. With a more favorable environment, the Adamawa region is the main production and processing area of milk [1]. The average production of milk per cow is about 0.5 to 2 liters per day. With most farmers involved in stockbreeding, dominated by small-scale structures, the milk production is very much scattered. The low yield and low technological level of the milk production system, and the scattering nature of production structures, result in a diversity of origin and quality of the product. Considering the demand of actors involved in the system (dairy herd owners, processors, consumers), both in terms of product quantity and quality, in relation with the marketing value of the product, research and development actions are needed to fulfill conditions for the development of the milk sector in the country.

In order to assess the milk sector in Cameroon, the increase in the revenues of actors can be achieved through two main methods: increasing the volumes produced, either by raising the productivity per cow or the number of dairy cows, and improving the quality of milk. The technical, organizational and institutional problems related to the increase in milk production have been tackled by different development programs (PNVRA, GESEP, and SDDP). However, aspects related to the improvement of unpasteurized milk have not been given an equal attention. The research and development sector is questioned about the quality (physical, chemical, microbiological) of milk, as well as the specificity of the breeding context, since the milking activities are essentially based on rudimentary practices. The present work therefore aims at Shedding more light on the ongoing discussion on the quality of unpasteurized and fermented milk in the Adamawa region, by presenting the current practices and analyzing the results now available on the issue. Perspectives for the improvement of the milk quality are discussed, based on the existing situation and stake.

2. METHODOLOGY

2.1 Area of Study and Survey of the Milk Production System

This study was carried out at Ngaoundéré in the Adamawa Region of Cameroon (Fig. 1). The milk was supplied by 5 production units around the town. The collection of milk samples was done among cattle dairy herd owners, collecting agents, and Common Initiative Groups (CIG) of 5 villages (Tchabal Toll gate, Ngaoumokon, Dibi, Mbang Bouhari, Idool)

(Fig. 2 and Table 1). A questionnaire aimed at describing the milking techniques was equally administered to the suppliers.

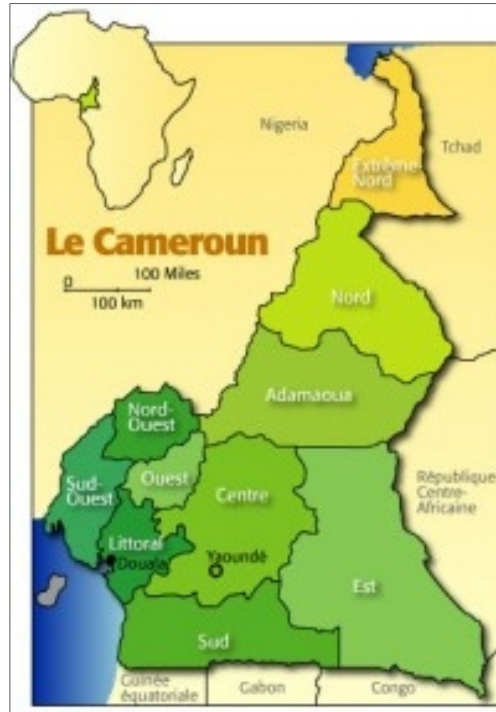


Fig. 1. map of Cameroon

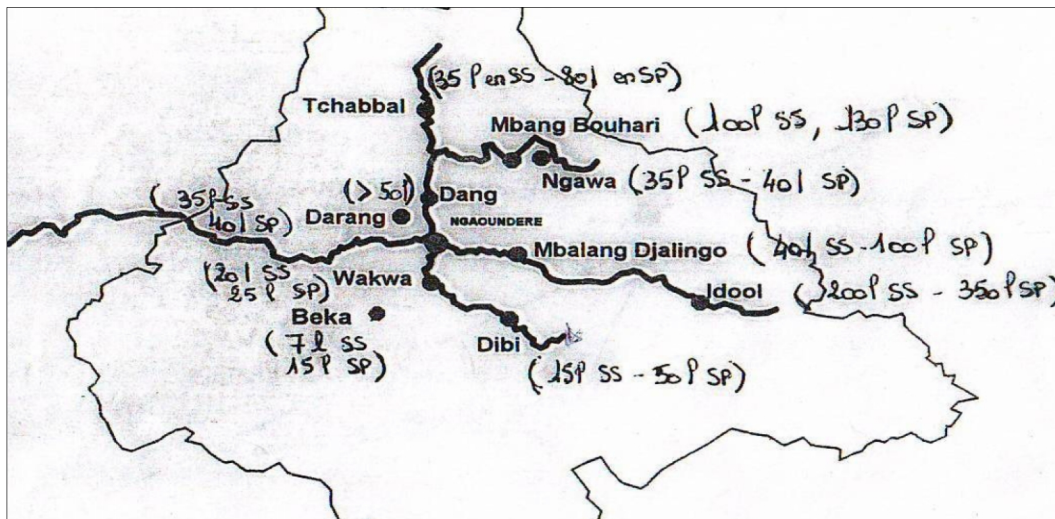


Fig. 2. Sampling site around Ngaoundere; l: liter; ss: dry season; sp: rainy season

The field survey was carried out through an interview based on the identification of sources of milk contamination, techniques used by dairy herd owners and on the assessment of their perception concerning milk hygiene and quality.

Table 1. Site of sampling of milk

| Site | Distance from Ngaoundéré |
|----------------|--------------------------|
| Tchabbal péage | 35 km |
| Ngaoumokon | 25 km |
| Dibi | 40 km |
| Mbang bouhari | 45 km |
| Idool | 67 km |

2.2 Analyses of Milk

2.2.1 Collection of milk

Four samples of 200 mL collected from each site were put into a sterilized flask, then placed in an ice-full bag and transported to the laboratory. This sampling was done at various stages: the cow udder, the milk churn of the dairy herd owners, milk churn for carrying milk to the factory in Ngaoundéré, milk churn for collecting milk once at the transformation unit in Ngaoundéré.

2.2.2 Physico-chemical and microbiological analyses

Physical, chemical (pH, dormic acidity, blue methylene test, density) and microbiological tests (total bacteria, salmonella, *streptococcus*, and coliforms) were done on the milk samples collected, in accordance with the standards, [2].

3. RESULTS AND DISCUSSION

3.1 Actors and Techniques of Milk Production in Adamawa Region

The “Peulh” ethnic group represented by the “Mbororos” and the “Fulbe” hold the monopoly of the breeding sector in the Adamwa region. The “Fulbe” represent 80 % of the surveyors. Their ages range between 20 and 55 years old, with a predominance of 20 to 40 years old (Fig. 3). More than half of the dairy herd owners (54 %) have at least attended primary school. This is an asset for this region characterized by one of the lowest rates of literacy in the country. This literacy rate is the reason why the Ministry of Livestock, Fisheries and Animal Industry and the National School of Agro-Industrial Sciences (ENSAI) of the University of Ngaoundéré, have offered training sessions on the breeding and hygiene techniques of milking. Generally, dairy herd owners associate in various ways (CIG¹, village associations).

¹ CIG : Common Initiative Group

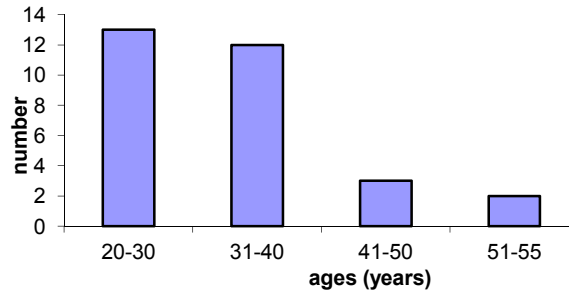


Fig. 3. Distribution of the farmers according to their age

As concerns production techniques, 67 % of dairy herd owners carry their milk to the collecting centres (CIG) within 12 to 15 minutes after milking. The quantity of milk collected by each dairy herd owner at the level of the CIG is 77 liters on average during the dry season, as opposed to 116 in the rainy season. The milk gathered, is then carried by public transport vehicles to the transformation units in Ngaoundéré.

The time spent in transporting milk is longer in the rainy season. Due to the bad states of roads and time spent to wait for transport vehicles, the lactoperoxydasis system (LPS) was introduced in this milk sector for a good conservation of milk. This system has been adopted only by 22 % of the actors because the milk transformers in Ngaoundéré are not keen on it. They believe that the LPS changes the taste of the milk and gives it a smell which consumers do not like. These results show that the production, preservation and transport methods go a long way to compromise the microbiological quality of milk. In fact, manual milking and the collection of milk in cans earlier used for fuel, increases the instances of contamination. From this, we realise that it is indispensable to assess the perception of the quality by the actors in the milk sector in order to better grasp the issue of quality.

3.2 Perception of the Quality of Milk by Actors

Whenever the quality is under discussion, especially concerning such a perishable product as milk, various subjective interpretations can be possible based on criteria selected for its definition according to individuals and their level of involvement within the sector. Hence, the quality of milk will tend to differ. The main criteria for milk quality at the level of the producer in Ngaoundéré are based on: the colour of the product, the duration of its preservation, and its purchasing value. The dairy herd owners generally recognise the influence of the cattle feeding, its state of health and the milking hygiene, among these criteria. The access of all these actors to training sessions on hygiene rules of milking is an evidence of this knowledge.

However, 54 % of trained dairy herd owners still have difficulties in putting the techniques learned into practice (Fig. 4). These difficulties particularly stem from the lack of adequate milking material and the inability of the actors to apply the simple hygiene rules (wearing gloves, cleaning the cow udder), they consider as waste of time. Consequently, about 46 % of these actors fail to apply the hygiene rules they have learnt, thereby compromising the milk quality.

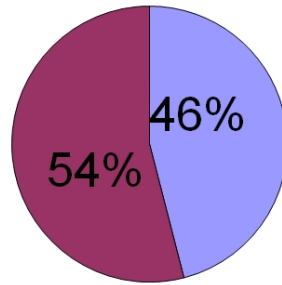


Fig. 4. Hygiene practice during milking: (■) apply; (■) does not apply

The diversity of criteria to appreciate the milk quality in Ngaoundéré town shows that it is a complex and multifaceted phenomenon, requiring the application of simple and repeated procedures in order to update the knowledge of the issue. Moreover, the consideration actors of the sector have about the quality is a pre - requisite for detecting the problems of the product. With the development of efficient and identifiable analytic methods, there are three groups of fundamental criteria to characterize the quality of milk; the physical, the chemical and the microbiological criteria.

3.3 Physical, Chemical and Microbiological Quality of Milk

At the physical and chemical level, the samples of milk analysed show a variable profile. The refrigerating temperature (4°C on average) which is an important parameter in the conservation of milk is not respected (Fig. 5). Once out of the udder, it is 32.5°C due to the inner temperature of the cow, but it rises to 35°C before falling again to 29°C (the average prevailing temperature) at the departure from the CIG, as well as, at the transformation unit. Milk thus, stays more than 5 hours under conditions that favour the development of microorganisms. These results clearly indicate the lack of the cold chain in that sector, a situation which compromises the stability and quality of milk, as confirmed by the pH and acidity values.

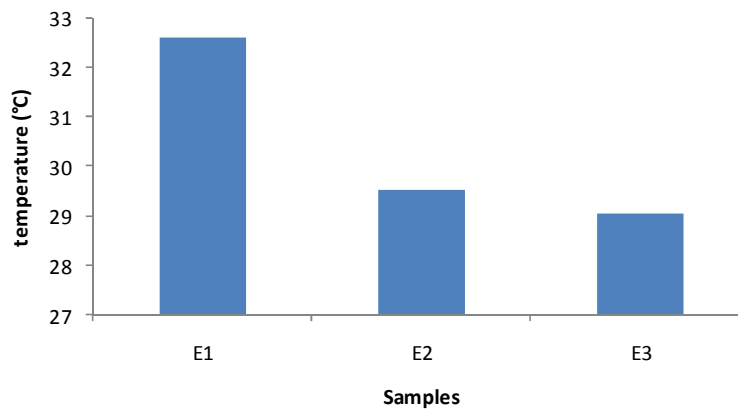


Fig. 5. Temperature of the milk; (E1): at the cow's udder; (E2): in the milk container at the CIG departure; (E3): in the milk container at the transformation unit

As regards the pH of milk once out of the udder, it conforms to the standard [3], whereas at the departure point of CIG it increases a little, hence indicating the beginning of proteolysis. While reaching the transformation unit, the pH drops drastically thereby revealing the instability of milk at prevailing temperature (Fig. 6). As for the acidity of milk which is an indicator of quality, it shows that milk immediately produced by the cow and from the CIG is of good quality, as opposed to that of the transformation unit (Fig. 7). At this level, the quantity of acid milk is 2.2 g/L, which indicates a microbial alteration.

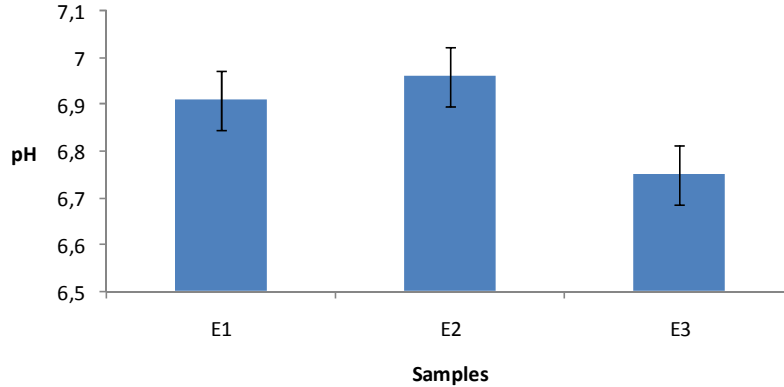


Fig. 6. pH of the milk; (E1): at the cow's udder; (E2): in the milk container at the CIG departure; (E3): in the milk container at the transformation unit

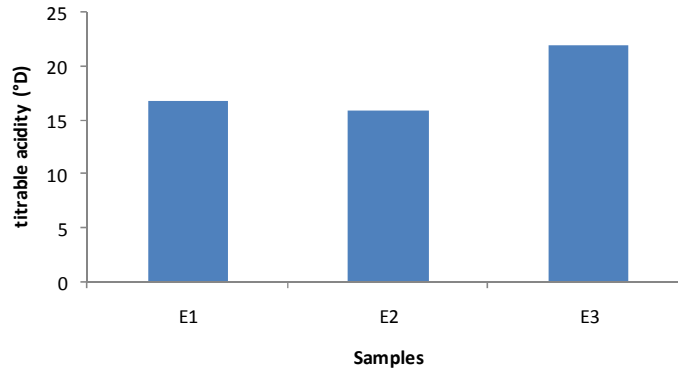


Fig. 7. Titratable acidity of the milk, (E1): at the cow's udder; (E2): in the milk container at the CIG departure; (E3): in the milk container at the transformation unit

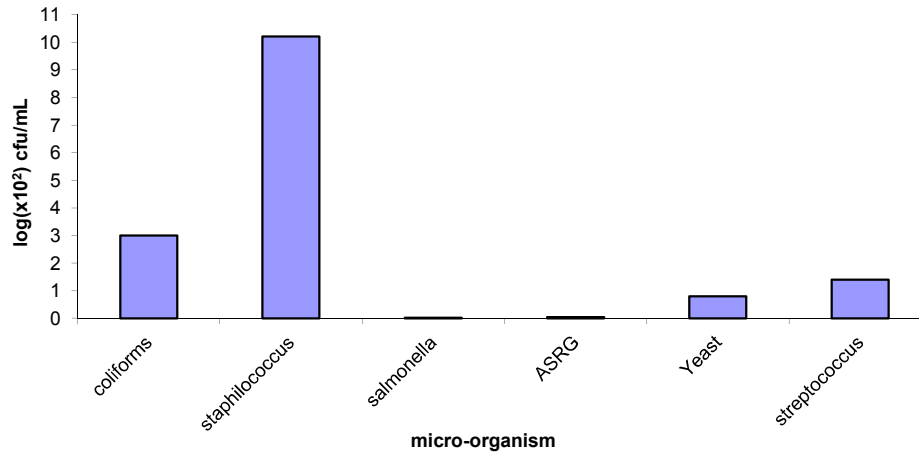


Fig. 8. Microbiological quality of milk leaving the cow's udder
 ASRG: aerobic sulfite reductors bacteria

These results show that the udder and the collecting cans are critical points of milk quality. The precarious hygiene conditions of milking, conditioning and conservation illustrate these results, as confirmed by the microbiological results. No sample conforms to standards [4].

The identification of bacteria responsible for this alteration shows the presence of *staphylococcus*, coliforms and *streptococcus*, *salmonella*, mould and anaerobic sulfite reductors bacteria (Fig. 8). In general, milk is less contaminated once out of the udder whatever the germ being sought, the microbial contamination increases gradually following the transfer of milk in the milk churns and reaches its maximum in the cans at their arrival at the transformation unit. This result suggests the contribution of the milk churns and the temperature during the transport aggravated by the conservation conditions on the bad hygienic quality of the milk. A microbial contamination higher than Log (4.0) (cfu/mL) of aerobic mesophilic bacteria indicates unhygienic conditions at the farm. The high contamination and mould can be influenced by the duration of the product, as well as by the cans and conservation methods. The higher level of contamination by these bacteria is equally a sign of considerable external contamination and of unhygienic condition of utensils. The importance of *staphylococcus aureus* in the milk may originate from this unhygienic situation. Considering the hygienic quality of cans used in the sector and the lack of the cold chain, the milk contamination becomes a serious public health problem, especially with the presence of *staphylococcus aureus* and *salmonella*, which causes food toxi-infection. If the hygienic conditions during milking and conservation appear as the main cause of alteration, it suffices to suspect the state of health of cattle. In this regard, 17 % of cows at Idool, the main producing area, and 5 % of those in Dibi, showed sub clinical signs of udder related diseases. However, it has not been possible to ascertain if the sick cows had been milked.

The introduction of pasteurization otherwise known as the simple boiling of milk should be coupled with the putting in place of starter that can be used locally [5,6,7]. The use of the lactoperoxidase system [8] in order to increase the conservation of fresh milk at the prevailing temperature will be efficient, provided the hygienic conditions are respected. Yet, a sound analysis of the critical points of contamination and the putting in place of less expensive simple techniques at the local level will contribute to improve milk hygiene. Similarly, the sensitization and information actions on the potential risks concerning

consumers appear as indispensable. Besides, helping producers to organise as well as put in place a collecting system “collecting centers”, with milk technology, can contribute to improve the milk quality.

4. CONCLUSION

The milk production conditions in the Adamawa are not likely to ensure the quality of products put on sale. These constraints are due to the difficulties faced by dairy herd owners in applying good production and hygienic techniques learnt during the training sessions, quite often organized in the region. It is quite clear that the methods of milk consumption after boiling significantly contribute to reduce the microbial contamination. Apart from this form of fresh milk consumption, the other forms have to do with transformed milk. The difficulty to apply hygienic principles during milking illustrates the necessity to review the training process, which lays more emphasis on a sensitization approach, with little illustration on the risks inherent to unhygienic practices. The present results are a first step of a complete epidemiological study, which takes into account the microbiological quality, the cattle related infections (brucellosis, tuberculosis), the udder borne infections and the research of antibiotics and pesticides at the national level. This will help to better master the sector, by showing the contribution of hygiene in the milk production.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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