Microbiological And Physico-Chemical Characteristics Of Cow Milk For The Extraction Of Its Milk Fat For The New Products Production

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Abstract

The objective of this work is to extract the fat from milk for its use in the manufacture of a new product. For this, a survey of production and consumption of milk as well as the knowledge of it fat of milk was conducted on five areas in the district of Abidjan. The results revealed that foreigners were the most involved in the production and sale of milk, especially Malians (61.40%) and Burkinabe (28.60%). Most producers provide 5 to 15 liters of milk / day and a maximum of 6 liters of fat produced daily. In addition, the physicochemical analyzes revealed that the milk sold on the Yopougon market is less acidic (18.57 ± 0.30%) than the milk sold on the market of port-bouet (16.02 ± 0.29%) and milk collected in farmhouses of Abobo (15.34 ± 0.10%) and Songon (15.32 ± 0.01%). The quantities of protein recorded in the milk from of Abobo (3.71 ± 0.01%) and Songon (3.81 ± 0.02%) farms are higher than those from of milk sold in from Yopougon market (3.67±0.03%) and port-bouet (3.11±0.02%). In addition, the contamination rate of the milk samples is more pronounced in the samples sold in the port-bouet and Yopougon markets for respective values of 1.5 ± 1.2x10^6 cfu /mL and 4.1± 0.9x10^6 cfu/mL.

Keywords: *Microbiology quality, cow milk, milk fat, new products*

I. INTRODUCTION

Milk is the secretory product mammary glands of mammalian, such as the cow, goat and ewe, intended for the feeding of young borning animals [1]. It is an opaque aqueous fluid, white, slightly bluish, with a sweetish flavor and a pH (6.6 to 6.8) slightly acidic, close to neutral [2]. Dairy products contribute to the nutritional balance of the family, in both rural and urban areas especially for children's [1]. Important sources of protein, they contribute at about 14% protein intakes and 20% calories from animal products [3]. Local milk production is around 17% and accounts for 11% of total milk consumption in Côte d'Ivoire [4]. However, as much prized milk, as much it can dangerous, because just a small hygienic failure to be sources of many diseases such as indigestion, diarrhea, dysentery, hepatitis and brucellosis. Its composition and its physicochemical properties make it a favorable environment for the multiplication of microorganisms [5]. The main hazards are microbiological and physicochemical. They can occur before milking, at the time of milking, during transport or processing. Indeed, ignorance of hygiene rules and lack of personal hygiene, at the dairy as in the stables, have serious consequences for the microbiological quality of milk [6]. Therefore, the sanitary quality of raw milk is an important issue in Côte d'Ivoire, for both socioeconomic and health reasons. Many studies on the quality of cow milk were carried out in several countries, such as Maroc ([7], [8] - [9]) to control the microbiological quality of milk for human consumption. In Côte d'Ivoire, the studies on the milk local were conducted by [10] on the contamination of raw milk by the Bacillus cereus and by [11] on the microbial risk analysis of local raw milk. Thus, our work aims to determine the physicochemical and microbiological characteristics of milk for ensuring the safety of the consumer and for using its fat for making new products.

II. MATERIALS AND METHODS

A. *Sample Source and Sampling*

Material samples used in this study were constituted by types of milk: raw cow's milk collected from farmers and milk sold on the market in the Abidjan area. Thus, surveys were realized in five (5) sites: three (3) raw milk production sites and two (2) milk sale sites. A total 70 people were interviewed including, 20 in Abobo, 17 in Songon, 12 in Bingerville, 12 in Port-Bouet and 9 in Yopougon. The number of people chosen in each zone varies according to the density of people practicing in each locality. However, the microbiological and physicochemical analyzes were carried on a total of 62 samples taken in four (4) sites including two(2) production sites (Abobo, Songon) and two (2) sites of sale (Yopougon and Port-Bouet). In fact, 18 samples were taken in n'dotré (Abobo), 15 in the slaughterhouse (Port-Bouet), 17 in songon and 12 in market bagnon (Yopougon). Samples collection was done very early in the morning between 6 and 8 h. Then, the samples were packed stomacher papers and was put in an icehouse containing ice at a temperature of 4°C and transported until the laboratory. Once in the laboratory, a party of the samples were used for microbiological analyzes and the other for physicochemical analyzes.

B. *Biochemical analyzes*

The pH of 20 ml of milk solution was determined using a pH-meter (pH-meter P107, Consort, Bioblock Scientific, Illkirch, France). TTA was determined using the standard method described by [12]. Ten milliliters of milk solution were titrated with NaOH 01 N, using 1% phenolphthalein as indicator. The volume of aliquot used was recorded to determine the amount of acid in the sample. The titrable acidity was calculated as percentage of lactic acid [13]. The determinations were carried out in triplicates and the mean value recorded. The density was determined weighing 10 ml tap water and cow milk. The weighing of milk was done at the moment when the temperature of milk situated at 20°C. Finally, density of milk was calculated doing the ratio mass of milk on mass of water [14]. Protein content of cow milk was determined by method of Kjeldahl [15] where 17.6 ml of milk samples were put in the "matras" and were worn at mineralization at 400°C for 3h. After mineralization, 2ml of distilled water are added together with 20ml of soda solution at 36% (v/v). Colored indicator witch a mix to red methyl and bromocrésol green there is added and the all is carried at distillation until the final solution turn green. Finally, we dose this solution obtained with hydrochloric acid of concentration 0,1N until the solution turn pink. Protein content is determined by formula [16]: protein content = nitrogen content x 6, 38 (specific conversion factor for milk and derivatives).

C. *Microbial analysis*

For all determinations, 1ml of the samples was homogenized in a stomacher with 9 ml of sterile buffered peptone water (AES Laboratoire, Combourg, France). We obtain dilution 10^{-1} from which made decimal dilutions until 10^{-9}. The research of *Salmonella* in milk samples was achieved according to the procedure described in the global Salmonella surveillance and laboratory support project of the World Health Organization [17]. From each sample, 25ml was aseptically weighed and macerated in 225 ml of buffered peptone water (Oxoid) and incubated at 37°C for 24 h. A selective enrichment in Tetrathionate broth (Muller-Kauffmann) and Rappaport Vassiliadis soy peptone broth using 1 ml of previously incubated buffered peptone water was achieved at 37°C for 24 h, followed by a subcultivation on *Salmonella Shigella* agar incubation at 35°C for 24 to 48 h [18]. Enumeration of coliforms was carried out using plates of Violet Red Bile Lactose agar (VRBL, Merck 10660, Merck, and Darmstadt, Germany). The cultures were incubated for 48 h at 30°C for total coliforms. The eosin methylene blue agar (Becton Dickinson GmbH, Heidelberg, Germany) was used to particularly enumerate and isolate *E. coli*, which grows on the medium giving a distinctive metallic green sheen colony. Mesophilic aerophilic germs were enumerated on plates of plate count agar (PCA Oxoid Ltd, Basingstoke, UK) and incubated at 30°C for 2 days. The media and reagents were prepared as described by [19] and [20]. *Staphylococcus aureus* was isolated and enumerated according to the method described by [21]. A volume of 0.1 ml of each dilution was surface plated on Baird-Parker agar (BPA) containing egg yolk tellurite emulsion (Oxoid) and incubated at 37°C for 24 and 48 h. The total number of colonies, colonies with a typical morphology of *Staph. aureus* and colonies with different morphology to those of *Staph. aureus* were counted.

D. *Statistical analyzes*

Data were analyzed using Statistica (version 8.1) statistical software. Descriptive statistics, such as frequency distribution, mean and percentages were employed for the analysis. One way analyses of variance based on DUNCAN multiple tests with significant level α=0.05 were performed in order to compare data physicochemical and microbiological of samples milk and also to determine significant differences between them. The surveys cards and analyse of result of survey were developed from the software sphinx plus. Finally, the graphs were obtained from excel software version 2007.

III. RESULTS AND DISCUSSION

In order to establish a new food based on cow's milk fat, a survey of milk production and consumption as well as knowledge of fat was conducted in Abidjan district. Similarly, the physico-chemical and microbiological parameters of cow's milk were analyzed in order to ensure the safety of the consumer. Surveys that were carried out in the farmhouses and sale markets of cow milk have given strong presence of foreigner community whose 28.60% of Burkinabe and 61.40% of Malians (Fig.1). This strong foreigner community present in breeding in Côte d'Ivoire is due to the fact that Ivoirians don't care livestock breeding, production and sale of milk. These Values are close to those found by [10] during a survey conducted on the production and sale of milk in district of Abidjan. Additional, most of the people practicing in milk activity are male whose rate is close to 90% (Fig.1). Most producers provide 5 to 15 liters of milk per day (Table 1) for a maximum of 6 liters of fat produced daily (Fig.2).

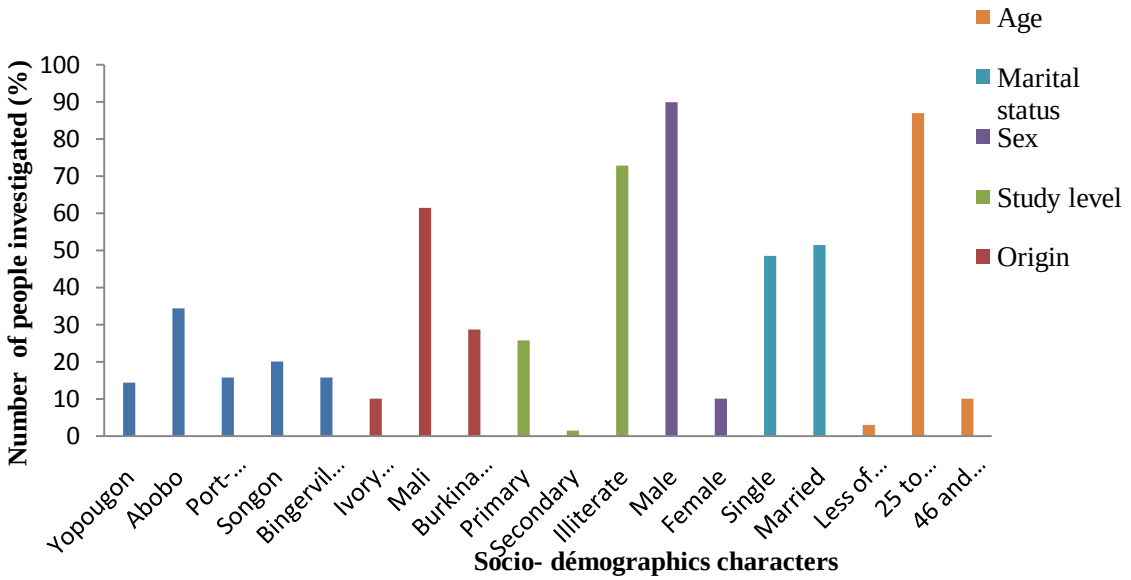

Fig 1: ***Sociodemographics characteristics of people inquired***

TABLE 1

Information concerning the production of cow milk

Parameters	Values	
	Number of people	Percentage (%)
People having dairy cows	56	80
People having not dairy cows	14	20
Number of dairy cows (5 to 20)	41	73.20
Number of dairy cows (20 to 50)	15	26. 80
Quantity of produce milk (5 to 15 L)	41	73. 20
Quantity of produce milk (15 to 40L)	15	26. 80

L= liter

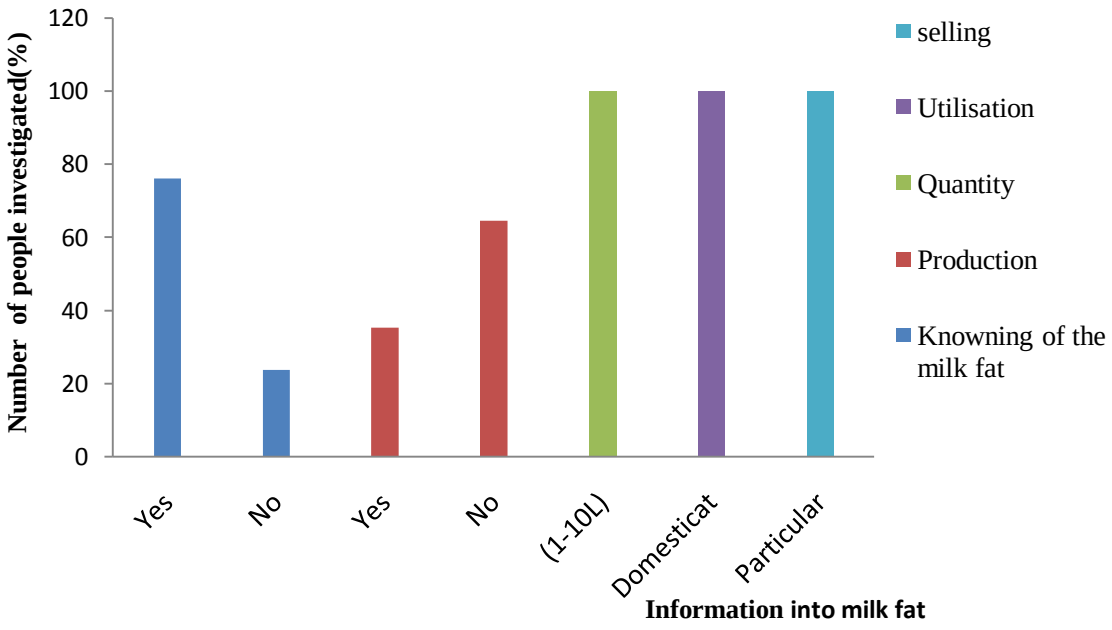

Fig 2: ***Production and selling of milk fat***

This was verified by [22]. This showed that a large number of people practices in sector of production, sale of milk or cattle farming are males. Physicochemical analyzes revealed a variation in acidity and pH for each sample analyzed (Table 2). In fact, pH of samples from of farmhouses (Songon and Abobo) are same while for milk from sale markets (Yopougon and Port-Bouet), pH vary and are different those from the farms. The milk sold on the Yopougon market is highest acidic (18.57 ± 0.30%) than the milk sold on the market of Port-bouet (16.02 ± 0.29%) and milk collected in farmhouses of Abobo (15.34 ± 0.10%) and Songon (15.32 ± 0.01%). The pH was 6.40±0.02 for the raw milks from farmhouses and varies to 6.28±0.01 to 6.35±0.02 for the milks sold on the markets (Table 2).

TABLE 2

***Physicochemical characteristics of different milk samples*.**

Paramèters Physico-chimicals	**Average values**			
	Sold milk on the market		raw milk of cow	
	Port-bouet	Yopougon	Abobo	Songon
Acidity (°D)	15.34±0. 10 [a]	18.57± 0,30[c]	16.02± 0,29[b]	15.32± 0.01[a]
Protein (%)	3.11±0.02[b]	3.81±0,02[c]	3.71±0,01[a]	3.67±0.03[a]
pH	6.28±0.01[b]	6.35±0,02[c]	6.40±0,02[a]	6.40±0.02[a]
Density	1.005±0.012[a]	1.024±0.015[b]	1.028±0.010[c]	1.031±0,010[d]

On a line, the average values assigned to the same letter are not significantly different at the 5% threshold

These values were in agreement with those found by [23] during a study conducted on the cow milk south in Togo but inferiors those to [8] during a study conducted on analyze of physicochemical parameters of raw milk of cow in Maroc. Indeed, this variation of pH and the acidity is certainly related to the variation of casein content, in mineral salts, in ions, number of free fatty acids and presence of lactic acid bacteria [24]. Concerning density, the values obtained for samples sold on the markets are inferiors to those milk samples from the farmhouses. These values vary from 1.005±0.012 to 1.024±0.015 for the milk sold on the market and from 1.028±0.010 to 1.031± for the raw milk. This variation of density

could be related the dry matter content of milk and also water addition. According to [25] any milk whose density isn't between 1.028 and 1.035 is a milk poor in dry matters. It means that water has been added to our milk samples. Yet, the quantities of protein recorded in the milk from of Abobo (3.71 ± 0.01%) and Songon (3.81 ± 0.02%) farms are higher than those from of milk sold in from Yopougon market (3.67±0.03%) and port-bouet (3.11±0.02%). This variation in the protein content of milk is related to its fatty content as well as to the breed of the cow [23]. As for the microbiological analyzes, an absence of salmonella in all the milk samples analyzed was observed. However, an abundance of mesophilic aerobic germs such as *Staphylococcus aureus*, coliform and *E. coli* in the milk samples analyzed has been observed (Table 3).

TABLE 3

Microbiological analyzes of different samples

Germs	Average values (cfu/ ml)				
	Sold milk on the market		raw milk of cow		
	Port-bouet	Yopougon	Abobo	Songon	norms AFNOR (1985 ; 1994)
E. coli	$0.4 \pm 3.6x10^{5\,d}$	$1.8 \pm 0.9x10^{4\,c}$	$1.7 \pm 0.8x10^{4\,b}$	$1.5 \pm 0.6x10^{4\,a}$	Abs in 0.1 ml
FAMT	$1.5 \pm 1.2x10^{6\,c}$	$4.1. \pm 0.9x10^{6\,d}$	$5.9 \pm 1.2x10^{4\,a}$	$9.6 \pm 1.8x10^{5\,b}$	$5.0.10^{4}$
Staphylococcus aureus	$1.8 \pm 2.4x10^{5\,d}$	$1.3 \pm 3.2x10^{5\,c}$	$1.4 \pm 0.9x10^{3\,a}$	$9.3 \pm 2.3x10^{4\,b}$	-10^{2}
Salmonella	Abs	Abs	Abs	Abs	Abs in 25 g
Coliformes	$1.0 \pm 3.0x10^{5\,b}$	$1.2 \pm 5.2x10^{6\,d}$	$7.0 \pm 1.9x10^{4\,a}$	$1.9 \pm 3.1x10^{5\,c}$	$-2.0x10^{5}$

On a line, the average values assigned to the same letter are not significantly different at the 5% threshold.

(Abs= absence) , FAMT: Total mesophilic aerophilic flora

The presence of such micro-organisms in the milk samples could be due the production process, the production environment, the material of production, the product handling during stokage or extraction. Nevertheless, the microbial load of milk samples from farmhouses is lower than those from markets. Thus, for mesophilic aerophilic germs, the values found for samples from the Songon ($9.6 \pm 1.8x10^{5}$ cfu/ mL) and Abobo ($5.9 \pm 1.2x10^{4}$ cfu/ mL) production areas are lower than those from the markets of Port-Bouet ($1.5 \pm 1.2x10^{6}$ cfu / mL) and Yopougon ($4.1 \pm 0.9x10^{6}$ cfu / mL). These values are lower than those obtained by ([7], [9]) during a study on the quality of cow milk in the regions of Maroc. In fact, the presence of mesophilic aerophilic germs made it possible to have an idea about the hygienic quality of milk. Likewise, the values found for coliforms are lower for milk samples from Songon farmhouses ($1.9 \pm 3.1x10^{5}$ cfu/ mL) and Abobo ($7.0 \pm 1.9x10^{4}$ cfu/ mL) that those sold on Yopougon ($1.2 \pm 5.2x10^{6}$ cfu/ mL) and Port-Bouet ($1.0 \pm 3.0x10^{5}$ cfu/ mL) markets. As to Escherichia coli, the values differ from one zone to another, that is, the charges found in farm milk Songon ($1.5 \pm 0.6x10^{4}$ cfu/ mL) and Abobo ($1.7 \pm 0.8x10^{4}$ cfu/mL) samples were ower than that those of markets(Yopougon ($1.8 \pm 0.9x10^{4}$ cfu/ mL) and Port-bouet ($0.4 \pm 3.6x10^{5}$ cfu/ mL). This high contamination of the different samples by coliforms and *Escherichia coli* gives us an idea of the origin of the contamination of cow milk. Indeed, the presence of *E. coli* and coliforms in a food product automatically tells us that this contamination is recent and especially of faecal origin. Concerning to *Staphylococcus aureus*, the values found for samples from Songon farmhouses ($9.3 \pm 2.3x10^{4}$ cfu / mL) and Abobo ($1.4 \pm 0.9x10^{3}$ cfu/ mL) were lower than those from markets of Port-Bouet ($1.8 \pm 2.4x10^{5}$ cfu/ mL) and Yopougon ($1.3 \pm 3.2x10^{5}$ cfu/ mL). In general, according to [9] the lack of mastery of good hygiene practices namely the lack of maintenance of cattle pastures, the lack of cleanliness of the means used for the conditioning and the storage of the milk as well as the body hygiene could be at the base of the contamination of the milk by the various microorganisms.

IV. CONCLUSION

Aim of this study was to know quality of raw milk of cow and cow milk sold on the market in district of Abidjan. In this way, at the end of this study, we have observed a contamination all the samples raw of milk and milk sold on the market by FAMT (total aérophilic mésophilic flora), *Escherichia coli*, *Staphylococcus aureus* and coliforms with a higher microbial load observed at level the milk samples from markets compared to those of farmhouse. However, these different values obtained in general are superiors at the international norms concerning microbiological quality of raw milk. Moreover, for physicochemical parameters, an abnormal density was observed for the milk samples sold on the market compared at the raw milk samples from the farmhouses. Finally, we estimate that microbiologic quality of cow milk in district of Abidjan whether it's at the farmhouses or markets level is still problematic. Therefore, it would be necessary to reduce the microbial load filtering and pasteurizing the milk before consuming.

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SURVEY PLUG

I. Identity

1. Locus of survey

◯ 1. Yopougon ◯ 2.Abobo ◯ 3. Port Bouet

◯ 4. Bingerville ◯ 5.Songon ◯ 6. Other to specify

2. Genus

◯ 1. Male ◯ 2. Female

3. What age group do you belong to?

◯ 1. Less than 25 years ◯ 2. 25 to 45 years

◯ 3. 45 to 60 years ◯ 4. More than 60 years

4. Which country are you from?

◯ 1. Ivory coast ◯ 2.Mali ◯ 3.Burkina Faso

◯ 4. Guinea ◯ 5.Niger ◯ 6. Other to specify

5. What is your level of study?

◯ 1. Primary ◯ 2. Secondary ◯ 3.Superior

◯ 4. Neither

6. What is your marital status?

◯ 1. Single ◯ 2.Married ◯ 3.Widower

◯ 4. Divorced ◯ 5. Other to specify

II. Milk and Milk fat

7. Do you have dairy cows?

◯ 1. Yes ◯ 2.No

The question is only relevant if cow=" Yes"

8. How many milk fat cows do you have?

◯ 1. (5 to 20) ◯ 2. (21 to 50) ◯ 3. Other to specify

9. What quantity of milk do you produce by day? (L= liter)

◯ 1. (5 to 15L) ◯ 2. (15 to 40L) ◯ 3. Other to specify

10. You get to sell the amount of milk you take by day?

◯ 1. Yes ◯ 2. No

The question is only relevant if quantity of milk =" Yes"

11. What do you do with what was not sold the same day?

◯ 1. Versed ◯ 2. Kept for the next day ◯ 3.Other to specify

12. Do you know milk fat?

◯ 1. Oui ◯ 2.Non

The question is only relevant if milk fat = "Yes"

13. Do you produce milk fat?

◯ 1. Oui ◯ 2.Non

The question is only relevant if production = "Yes"

14. What quantity of milk fat do you produce by day?

◯ 1. (1 to 10L) ◯ 2. (10 to 20L) ◯ 3. Other to specify

15. Who do you sell this milk fat?

◯ 1. Particular ◯ 2.Society ◯ 3.Other to specify

16. How are you using this milk fat?

◯ 1. Domestic use ◯ 2. Butter making

◯ 3. Cheese making ◯ 4.Other to specify

Several answers can be ticked