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Evaluation of the Hygienic and Microbiological Quality of Raw Milk from Cows Intended For Consumption or Processing in the Town of Abéche in Chad.

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ABSTRACT

The objective of this study was to identify the sources of microbial contamination of was milk and to evaluate the degree of microbiological contamination of was milk, to isolate the suspected pathogenic germs in the milk consumed. A total of 30 farmers were surveyed simultaneously at the time of collecting 30 samples. The samples were immediately transferred to the laboratory for microbiological analysis. Pathogens were investigated according to standard microbiological methods. The analysis of was milk made in the laboratory of INSTA chowed that the load of FAMT was variable between 4, 00.10^4 cfu /ml to 7, 15.10^7 ufc /ml, those of CT and CF were included between 10^3 cfu / ml to 5,73.10^4 cfu /ml and staphylococcus aureus was between 1,36.10^2 cfu /ml to 4.5.10^3 cfu /ml. the microbiological quality of the raw milk samples according to FAMT, CT and CF were mostly unsatisfactory. The microbiological quality of the raw milk sample according to staphycocus aureus was mostly uncontaminated. In the light of these results, the improvement of the microbiological quality of milk based on the establishment of a quality policy, aimed at popularizing the application of good hygiene practices throughout the chain of milk production and veterinary monitoring could contribute to improving product quality.

Keywords

Quality, Raw milk, Hygiene, Abeche.

Introduction

The dairy sector plays an important social, territorial and economic role on a global scale [1]. Milk intended for human consumption is the integral product of the total and uninterrupted milking of a healthy, well-nourished and not overworked dairy female [2,3]. Like other Sahelian countries, Chad is a country with a dairy tradition. Milk and dairy products occupy a preponderant place in the food ration of Chadians, because they provide the largest share of proteins of animal origin. It is a very rich substrate providing humans with an almost complete food: proteins, carbohydrates, lipids, mineral salts, calcium and vitamins at concentrations satisfactory for growth and cell multiplication [4,5]. Local production of fresh milk is low and seasonal. In rural areas, it is largely self-consumed and is only available in quantities for processing during the rainy season. Due to this seasonality, a poorly operational collection circuit and precarious hygiene and storage conditions, this milk is very poorly processed and

marketed in urban areas [6]. According to the **FAO** [7], global milk production of all species has increased considerably over the decades, from 344 billion liters in 1961 to 827 billion liters in 2017. Individual milk consumption varies greatly from 'one country to another. In Africa, the estimate is around 40 to 45 liters of milk per capita per year, or half less than the world average, with significant differences between countries [8]. Africa's share of global consumption of dairy products has barely changed over the last two decades [8]. It amounts to 8% for fresh dairy products and skimmed milk powder and only 4% for butter and cheese. In Chad, according to the PASEP evaluation report, 2002 [9,10], individual consumption of milk produced is 100 liters per year for breeders and their families and 9 liters per year for city dwellers and farmers. In Abéché, the consumption of local milk has become part of eating habits. The Abeche population knows that fresh milk can be transformed into whole fermented milk (rayeb), fermented skimmed milk (rouaba) and liquid butter (dihinbaggar) [11]. The milking, processing and marketing of milk is an activity mainly owned by women. However, several risk factors for contamination of milk at different stages of its production may come into play. Contaminated, it can be a vector for the transmission of pathogenic germs to humans and can present a risk to human health [12]. It is in this context that our study aims to evaluate the hygienic and microbiological quality of raw milk from cows intended for consumption or processing in the town of Abéché.

Methodologies

Sampling Procedure and Milk Collection Equipment

The collection of samples was done using aseptic technique, to prevent the increase in the initial microbial load in the product collected during collection. A total of 30 samples of raw cow's milk were collected in 7 districts of the city of Abéché, namely: the districts (Alicher; Djatinie; Aldjazira; Dabanair; Digueri; Ardal-habayib). Thus, the samples were introduced into sterile bottles, labeled and placed in a cooler containing cold accumulators. The samples were quickly transported to the laboratory and then immediately submitted for microbiological analyses. And subsequently we used the different culture media (Plate Count Agar (PCA) for the enumeration of Total Mesophilic Aerobic Flora, Hektoen (HK) for salmonella, MacConkey Agar for the enumeration of total and thermotolerant coliforms, Muller Hinton for purification, Chapman for staphylococci; Sabouraud chloramphenicol for mushrooms), identification and enrichment techniques (Buffered Peptone Water (EPT) for dilution, Vassiliadis Soja Report Bouillon (RVS) for salmonella).

Biological Material

It consists essentially of raw milk collected by the owner from the various study sites.

Period and type of study

The study was carried out at the microbiological and chemical laboratory of the National Higher Institute of Science and Technology of Abéché (INSTA), in collaboration with the Laboratory of the Adam Barka University of Abéché. This is a prospective experimental study for quality control of isolated germs. This study was carried out from May to July 2022.

Investigation

A prospective survey was carried out in the peri-urban area of Abéché among sedentary breeders during sample collections. The aim of the survey is to obtain information on the education levels of breeders. In addition, it also targeted the work environment; staff hygiene; the materials used during milking; veterinary monitoring and transport. A total of 50 breeders were surveyed. The survey was carried out on the basis of a sheet which provides information on several parameters.

Description of the study area

The study took place in the town of Abéché department of Ouara, provincial capital of Ouaddaï and located in the east of the country. It extends between 31°48'584" north latitude and 20°58'139" east longitude. It is located in a dry tropical zone of 9 months and a rainy season of 3 months. The regime of these two seasons is defined by the fluctuations between the dry air masses from the north (harmattan) and the humid maritime air masses from the southwest (the monsoon). The average annual rainfall is around 300mm. The average temperature in Abéché is around 28°C with a variation in the cold season (December to February) between 16 and 35°C and in the dry season (April and May) between 25 and 41°. So, it has seven municipal districts.

Preparation of culture media and diluents

The media and diluents will be prepared beforehand. The mass of the dehydrated media was weighed on a balance according to the instructions mentioned on the box. These media were then mixed with a quantity of distilled water and then brought to the boil with constant stirring with a magnetic stirrer. After sterilization in the autoclave at 121°C for 15 minutes with the exception of the Hektoen media, these media were cooled to between 45 to 50°C. A volume of 15 to 20 mL of medium was poured into previously sterilized Petri dishes. The germs sought were total mesophilic aerobic flora, total coliforms, thermotolerant coliforms, staphylococcus and salmonella.

Sample preparation

All the samples studied underwent preliminary treatment to obtain dilutions according to standard NF V08-010 (March 1996). 10ml of the sample was placed in a Stomacher bag to which 90ml of buffered peptone water (EPT) was added.

The contents of the Stomacher sachet were then homogenized and left to rest for around twenty minutes to ensure the revivification of the microorganisms. The solution thus obtained will constitute the mother suspension (10^{-1}). 1ml of this mother suspension was taken and added to 9ml of ETP contained in a test tube, which gives the dilution. 1ml 10^{-2} of the dilution 10^{-2} was added to 9ml of ETP contained in another test tube to carry out the dilution 10^{-3}. So on, we carry out the dilutions, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} etc.

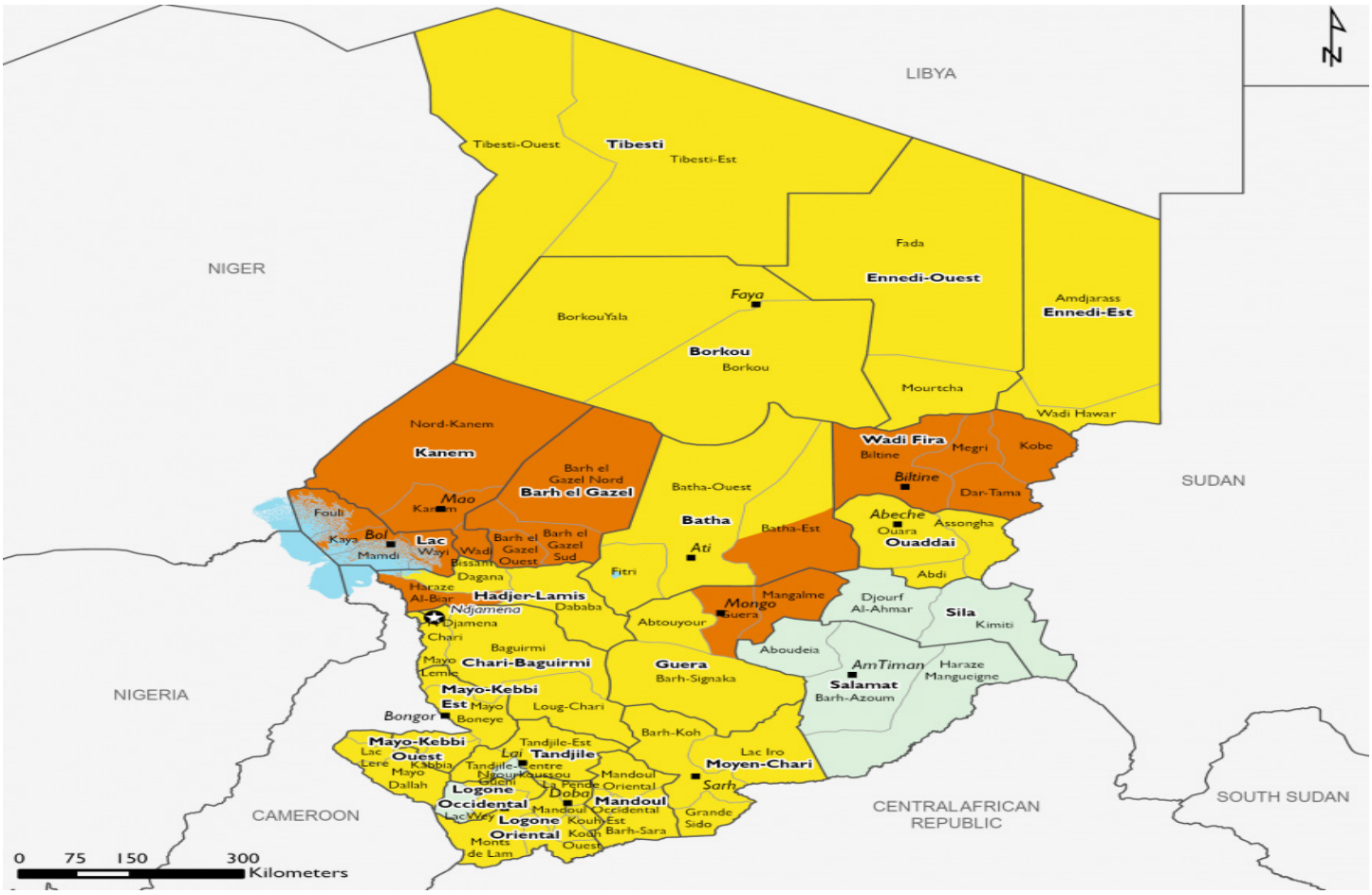

Figure 1 : Administrative map of Chad delimiting the cities
Source; fews.net (2022) [8]

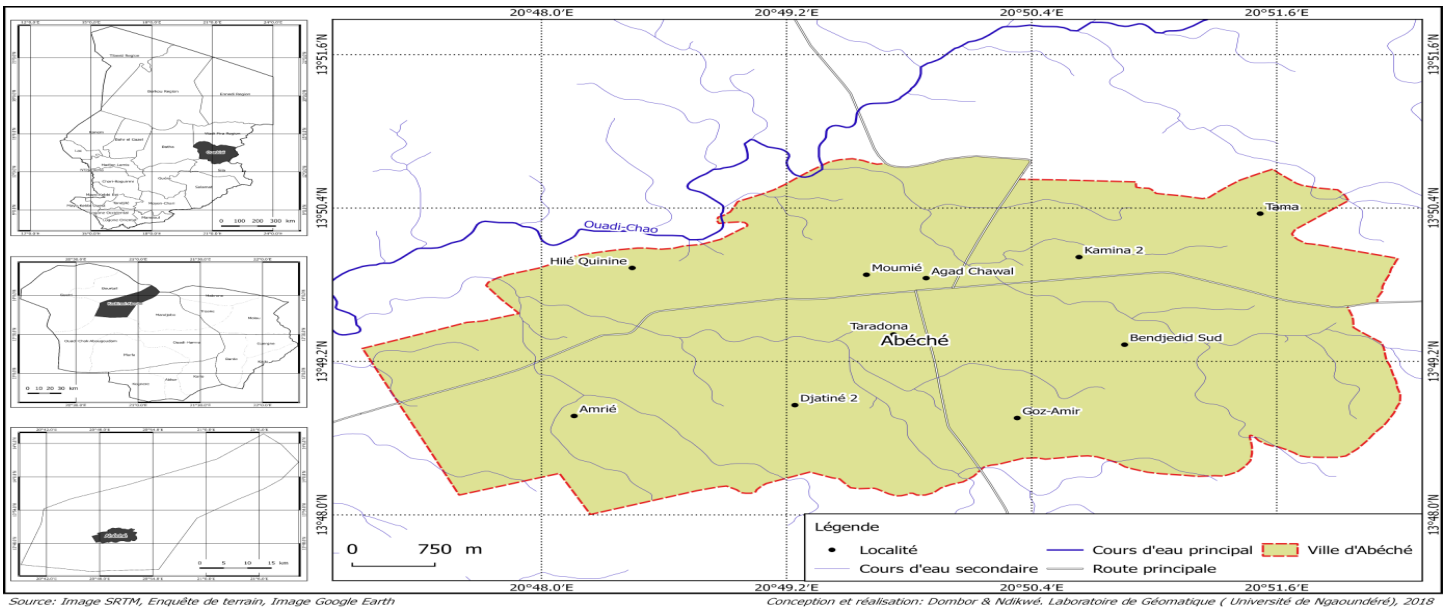

Figure 2: Administrative map of the town of Abéché
Source: www.retssa-ci.com [9].
The town of Abéché was chosen for its high consumption and processing of raw milk.

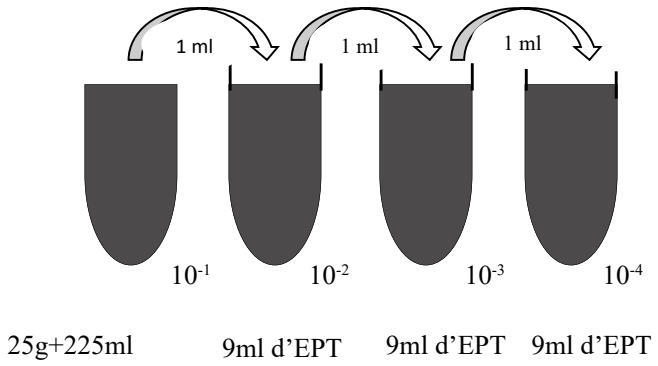

Figure 3: Sample preparation.

Contaminating flora

Thermotolerant coliforms

It refers to standard NF-V08-060 (March 1996). The culture medium used is MacConkey agar. 1ml of each dilution was taken and then introduced into a sterile Petri dish. 10 to 15ml of MacConkey previously prepared and brought back to 45°C are then poured into it. The inoculum and MacConkey were homogenized by rotating the Petri dish and then dried. After solidification a second layer was poured to prevent the development of possible surface contamination flora. Inoculated plates were incubated at 44°C for thermotolerant coliforms and 37°C for total coliforms.

Search and Enumeration of Presumed Pathogenic Staphylococci

This research was carried out according to standard NF-V08-057-1 (November 1994). Among the presumed pathogenic staphylococci, *Staphylococcus aureus* is sought. Chapman is used as a culture medium. Seeding on the surface with 0.1 ml by dilution on Chapman previously poured into Petri dishes were incubated in an oven at 37° C for 24 hours. The presence of *Staphylococcus aureus* was confirmed by catalase and coagulase tests.

Enumeration of Total Mesophilic Aerobic Flora

The total mesophilic aerobic flora count was carried out according to the international standard ISO 4833 (2003). Also called "Total Flora" or very approximate number of germs found in food products. These microorganisms can, through their quantities, degrade the food, alter its marketability and cause digestive or allergic disorders in the consumer. The flora can be saprophytic or pathogenic, original or introduced during handling. The enumeration of total germs at 30°C remains the best method for estimating the safety index and quality of food in industrial control [10]. Standard enumeration agar or Plate Count Agar (PCA) was used for enumeration of total flora. It is generally used in a double layer because of its low selectivity to prevent the surface of the petri dish from being invaded by contaminating germs.

Operating mode

The dilutions 10^{-3} à 10^{-5}were used and the Petri dishes were inoculated at 37° for 24 h. One (1) ml of solution was taken aseptically from each dilution tube and introduced into the box, then 10 to 15 ml of PCA sterilized and kept supercooled at 45°C were poured into the box and homogenized by movements. Light circular movements with the hand, in one direction, then in the other. Incubation was carried out in an oven at 37°C for 24 to 48 hours. At the end of this period, the boxes were examined and the colonies counted according to the international standard ISO 4833 (2003).

Testing for Salmonella

- Pre-enrichment: 1 ml of milk was taken aseptically and introduced into 225 ml of sterile peptone water then incubated at 37°C for 24 hours;
- Enrichment: a volume of 1 ml of pre-enriched peptone water was inoculated into 9 ml of Rappaport-Vassiliadis Soya (RVS) broth in tubes. The tubes were then incubated at 37°C for 24 hours;
- Isolation: 1 ml of enriched Rapport- Vassiliadis Soja broth was taken and inoculated on Hektoen selective medium by the streak method using a sterile glass Pasteur pipette. The plates were incubated for 24 hours at 37°C;
- Identification: suspect colonies will be subcultured on MH agar medium for biochemical characterization.

Method of calculation and interpretation of results

After the incubation period specific to each germ, we will proceed to count all the colonies on two successive dilution boxes containing at least 10 and at most 300 colonies according to standard NF V 08-102: 1998. The number N of germs present in the analyzed sample is considered as a weight average and given by the following formula:

$$N = \frac{\sum colonies}{V*(n_1+0{,}1*n_2)*d_1}$$

N= Number of CFU/g; Σ= sum of colonies on interpretable plates, V= volume of suspension deposited for inoculation, d1= dilution rate corresponding to the first dilution retained, n1 = number of plates retained at the first dilution, n2 = number of plates retained at the second dilution

Microscopic identification: Grams stain

After 24 hours of incubation, the characteristic colonies grown on the different culture media were purified on MH agar for their biochemical characterizations.

It is a test that will distinguish Gram-positive and negative bacteria based on dyeing properties. Using a loop, we collected two (2) colonies for all samples at the level of total positive germs for preparation of the smear, in order to evaluate the bacterial flora of raw milk. On the same germs, we also carried out orientation tests (catalase and oxidase). Spreading colonies on the slide in thin smear and fixing (bacteria using flame).

Coloring

- The smear is covered with gentian violet and observed for one minute then rinsed with tap water;
- Cover again with Lugol for a minute and rinse with tap water;
- Bleach with 95° alcohol for one minute and rinse with tap water;
- Color again with fuchsin or safranin for 30 seconds to one

minute and rinse with tap water;
- We dry the slide, leaving it at room temperature;
- We examine under an optical microscope with objective 100 (immersion objective).
- Gram+ bacteria are colored purple (gentian violet), Gram- bacteria are colored pink (fuchsin). Bacteria appear in shell (cocci) or rod (bacillus).

Biochemical tests

- **Catalase**

Catalase is an oxidoreductase involved in the mechanism of resistance to bactericide. This test makes it possible to differentiate staphylococci from streptococci. From an isolation, a small quantity of bacterial culture is taken using a pasteur pipette, the colony is made to react in a drop of hydrogen peroxide (H_2O_2) placed on a slide.

- **Oxidase**

On a clean slide, an "OX" disk was placed and soaked with a drop of distilled water. Then, a portion of the colony to be studied was taken and spread on the disk using a sterile buttoned Pasteur pipette.

In the event of a positive result, a dark purple color immediately appears on the disc and then turns black.

Interpretation of the results

The assessment criteria used come from regulation 2073/2005/EC relating to dairy products and their derivatives. Interpretation of the results of the counts (total mesophilic aerobic flora, coliforms, Staphylococci aureus).

Table 1: Criteria for interpreting results.

m 3m M= 10m S=10 ^{3} m solid medium …… 10m M=30m S=10 ^{3} m liquid medium			
Satisfying	Acceptable if C/n<2/5	**Not satisfying**	**Not satisfying Toxic product**
	Unsatisfactory if C/n > 2/5		

Criteria for interpreting results on regulation 2073/2005/EC

Legend:

n: Represents the number of sample units that are randomly drawn from a batch and examined to meet the defined requirements.

m: the numerical value of "m" represents satisfactory concentrations of microorganisms. In a 3-class design, **m** is used to distinguish units of satisfactory quality from those of marginal quality.

M: (3-class plan only) represents unsatisfactory concentrations of microorganisms.

M distinguishes units of marginal quality from those of unacceptable quality. If the value of a sampling unit is greater than **M**, the lot from which the sample comes is unsatisfactory.

C: represents the maximum permitted number of units sampled of marginal quality. If the number of marginal quality units is greater than **C**, the lot from which the sample came is unacceptable/ unsatisfactory.

The sampling plan is based on the European Commission guidance document.

❖ Results between **m** and **≤ 3m** were considered satisfactory.

❖ Results between **> 3m** and **≤ 10m** were considered acceptable. Results greater than **> 10m** were considered unsatisfactory

Table 2: Microbiological criteria relating to dairy products and its derivatives.

Designation	FAMT	CT and CTT	*S. aureus*
Satisfactory CFU/g	≤3.10 ^{6}	≤ 10 ^{3}	≤ 5.10 ^{2}
Acceptable CFU/g	9.10 ^{6}	3.10 ^{3}	15.10 ^{2}
Unsatisfactory CFU/g	3.10 ^{7}	10 ^{4}	5.10 ^{3}

Data processing

The data collected on the basis of the questionnaire and the results of the various analyzes were entered and processed using Microsoft WORD, EXCEL and XLSTAT, ANOVA software.

Results and Discussions

Survey Results

The results of the survey according to the characteristics were presented in Table 3.

Table 3: Proportion of breeders by gender.

Modality	Workforce	Percentage (%)
Man	20	40
Women	30	60
Total	50	100

Most of the breeders surveyed were women with a proportion of 60% while 40% were men.

Table 4: Proportion of breeders according to their level of education.

Modality Level Instruction	Workforce	Percentage (%)
Schooled	12	24
Unschooled	38	76
Total	50	100

The result of this survey showed that the majority of breeders were not educated (76%).

Table 5: proportion of breeders according to their age group.

Modality Age range	Workforce	Percentage (%)
[18; 45]	31	62
[45; 75]	19	38

Among the breeders surveyed, 62% were aged between 18 to 45 years while 38% were aged between 45 to 75 years.

Microbiological quality of milk

The sample enumeration of the districts of Alicher, Dabanair and Ardel -habayib is presented in Table 6.

Table 6: Count of germs in the 3 neighborhoods (Alicher, Dabanair and Ardel -habayib).

Neighborhood	FAMT	CT	CF	S aureus	Salmonella
Alicher _	2.16.10 ^{7}	2.15.10 ^{4}	1.14.10 ^{4}	27.09.10 ^{2}	Absence
	3.10 ^{5}	3.20.10 ^{4}	1.74.10 ^{3}	17.27.10 ^{2}	Absence
	4.10 ^{4}	1.75.10 ^{3}	≤ 10 ^{3}	4.25.10 ^{3}	Absence
	3.20.10 ^{7}	≤ 10 ^{3}	1.68.10 ^{3}	3.15.10 ^{3}	Absence
	7.15.10 ^{7}	2.25.10 ^{3}	≤ 10 ^{3}	1.36.10 ^{2}	Absence

Dabanair	3.50.10 ^{6}	1.25.10 ^{3}	1.18.10 ^{3}	0	Absence
	1.87.10 ^{7}	≤ 10 ^{3}	3.73.10 ^{4}	0	Absence
	1.95.10 ^{6}	1.35.10 ^{4}	4.64.10 ^{4}	0	Absence
	1.14.10 ^{5}	2.57.10 ^{3}	≤ 10 ^{3}	0	Absence
	2.20.10 ^{7}	≤ 10 ^{3}	1.45.10 ^{3}	0	Absence
Ardelhabayib	9.50.10 ^{5}	1.15.10 ^{3}	3.10.10 ^{4}	0	Absence
	2.57.10 ^{7}	2.23.10 ^{3}	≤ 10 ^{3}	0	Absence
	1.80.10 ^{7}	2.05.10 ^{4}	4.91.10 ^{4}	0	Absence
	2.00.10 ^{7}	≤ 10 ^{3}	5.45.10 ^{3}	2.20.10 ^{3}	Absence
	1.02.10 ^{7}	1.61.10 ^{4}	2.64.10 ^{4}	0	Absence

FMAT: total aerobic mesophilic flora; **CT**: total coliforms; **CF**: fecal coliforms; **Staph *aureus***: *Staphylococcus aureus.*

The raw milks examined in the districts of the city of Abéché (AL-ICHER, DABANAIR and ARDAL-HABAYIB) contain a variable load of FMAT, located between 4.00.10 ^{4} cfu/ml to 7.15.10 ^{7} cfu/ml. Regarding total coliforms, their loads vary between 10 ^{3} cfu / ml to 3.20.10 ^{4} cfu /ml, and fecal coliforms, 10 ^{3} cfu /ml to 4.91.10 ^{4} cfu/ml. The enumeration of *Staphylococcus aureus* gave a value between 1.36.10 ^{2} cfu/ml to 4.25.10 ^{3} cfu /ml.

Table 7: Count of germs in the 3 neighborhoods (Djatinie, Digueri and Aldjazira).

Neighborhood	FAMT	CT	CF	S aureus	Salmonella
Djatinie	2.23.10^{6}	9.36.10^{4}	2.10.10^{4}	0	Absence
	4.41.10^{5}	1.75.10^{3}	1.01.10^{3}	0	Absence
	1.64.10^{7}	2.55.10^{3}	≤ 10^{3}	0	Absence
	1.86.10^{7}	3.01.10^{3}	1.11.10^{3}	0	Absence
	2.59.10^{5}	4.45.10^{4}	3.18.10^{4}	0	Absence
Digueri	1.27.10^{6}	3.41.10^{4}	5.73.10^{4}	3.05.10^{2}	Absence
	1.55.10^{5}	2.14.10^{4}	4.55.10^{4}	19.10^{2}	Absence
	2.09.10^{7}	1.70.10^{3}	2.10.10^{3}	4.5.10^{3}	Absence
	6.86.10^{7}	2.05.10^{4}	≤ 10^{3}	3.75.10^{3}	Absence
	1.75.10^{5}	3.75.10^{3}	1.35.10^{3}	4.09.10^{3}	Absence
Aljazira	2.32.10^{6}	4.50.10^{4}	1.95.10^{4}	0	Absence
	1.83.10^{7}	2.40.10^{3}	1.36.10^{4}	0	Absence
	2.29.10^{7}	≤ 10^{3}	2.68.10^{4}	0	Absence
	1.45.10^{5}	3.25.10^{4}	1.77.10^{3}	0	Absence
	1.73.10^{5}	2.23.10^{3}	1.68.10^{3}	0	Absence

FMAT: total aerobic mesophilic flora; **CT**: total coliforms; **CF**: fecal coliforms; **Staph *aureus***: *Staphylococcus aureus.*

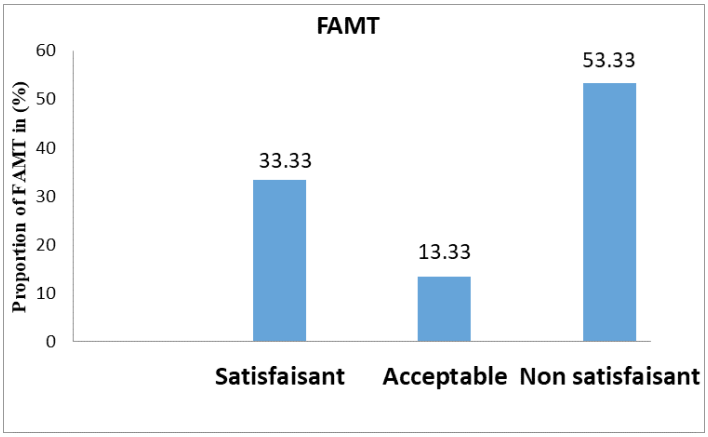

Figure 4 : Microbiological quality according to the level of contamination by FAMT

Analysis of raw milk from Djatinie, Digueri and Aldjazira contain a variable load of FMAT, located between 1.45.10 ^{5} cfu/ml to 6.86.10 ^{7} cfu/ml. For total coliforms the bacterial load varies between 10 ^{3} cfu/ml to 9.36.10 ^{4} cfu /ml and fecal coliforms 10 ^{3} cfu /ml at 5.73.10 ^{4} cfu/ml; on the other hand, the enumeration of *Staphylococcus aureus* gave a value between 4.5.10 ^{3} cfu/ml to 4.09.10 ^{3} cfu/ml.

It appears from this figure that 53.33 % of our samples are unsatisfactory for FAMT compared to only 38.33 % satisfied. Figure 5 the level of contamination according to total coliforms.

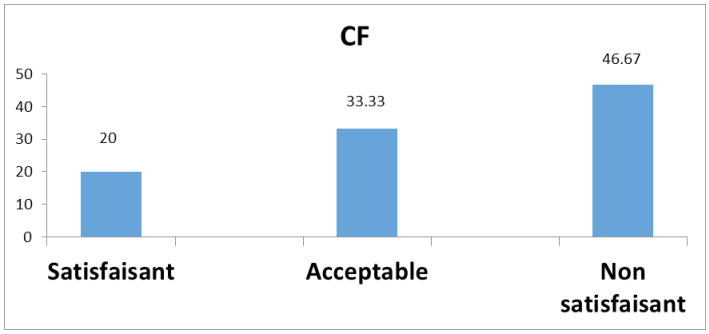

Figure 5: Contamination level for total coliforms.

Regarding total coliforms, the majority of our milk samples taken were unsatisfactory with a proportion of 46.66 % while 16.66 % were satisfactory and 36.66 % acceptable.
The level of contamination according to fecal coliforms is presented in Figure 6.

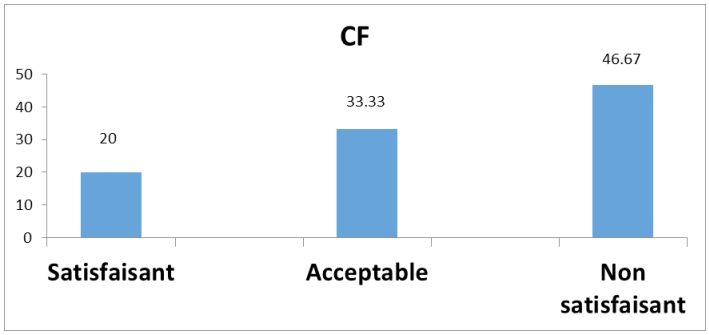

Figure 6: Level of contamination of fecal coliforms.

For fecal coliforms, the majority of milk samples taken were unsatisfactory with a proportion of 46.66% compared to 20% satisfactory and acceptable 33.33%.

Figure 7 illustrates the level of contamination of the samples for all Staphylococcus aureus.

Analyzes showed that the majority of milk samples taken were 70 % satisfactory compared to 10 % acceptable.
The overall contamination rate of the samples analyzed is recorded in the table below.

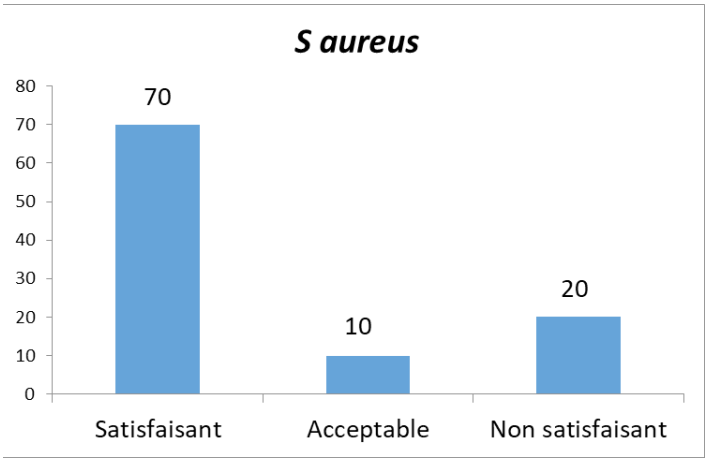

Figure 7: Level of contamination of pathogenic germs S. aureus.

Table 8: Overall contamination level rate.

Bacteria Standards	FAMT	CT	CF	S aureus
Minimum	$4.00.10^{4}$	10^{3}	10^{3}	$1.36.10^{2}$
Average	$1.23.10^{7}$	$1.42.10^{4}$	$1.41.10^{4}$	$2.61.10^{3}$
Maximum	$7.15.10^{7}$	$9.36.10^{4}$	$5.73.10^{4}$	$4.50.10^{3}$

The maximum rate of mesophilic aerobic flora for the 30 samples analyzed was $7.15.10^{7}$ with an average of $1.23.10^{7}$. Regarding total coliforms, the maximum rate was $9.36.10^{4}$ with an average of $1.42.10^{4}$. For fecal coliforms, the maximum rate was $5.73.10^{4}$ with an average of $1.41.10^{4}$. Finally, the maximum level of *Staphylococcus aureus* present in the milk analyzed was $4.50.10^{3}$ with an average of $2.61.10^{3}$.

Discussion

Breeders profile

The study noted that most of the respondents were women with a proportion of 60% compared to only 40% of men. Our results are superior to those obtained by [13], he reported that 36.17% of producers were women compared to 63.83% of men. This difference could be explained by the fact that, culturally, milk milking is mainly carried out by women. The majority of surveys in our study were unschooled. Our results are consistent with those obtained by Gagara [14,15], (76%). The conformity of our results could be explained by the fact that most breeders only want their children to take care of breeding activities rather than sending them to school. The level of lack of education among producers can lead to ignorance of the rules of hygiene practice. Among the producers surveyed, 62% are aged between 18 to 45 years while 38% are aged between 45 to 75 years. Our results are consistent with those reported by Brahim (2021) [13,16], that 60% of producers were in the range of 18 to 45 years old, while 40% of producers were 45 years old and older. However, the minimum age was 18 years old while the maximum age was 50. All the producers surveyed are sedentary people who supply the town of Abéché with milk. They are agropastoralists and run small businesses using raw milk as raw material to transform it into dairy products.

Microbiological quality of milk

The raw milk examined in the districts of the city of Abéché (AL-ICHER, DABANAIR and ARDAL-HABAYIB**)** contains a variable load of FMAT, located between $4.00.10^{4}$ cfu /ml to $7.15.10^{7}$ cfu/ml. Our values are higher than those found in Algeria by Hamiroune [17], whose variable FMAT load is located between $6.5.10^{5}$ cfu /ml to $8.1.\ 10^{5}$ cfu /ml. This difference could be explained by a lack of hygiene during milking and the unsanitary environment. Regarding total coliforms, the loads vary between 10^{3} cfu /ml to $3.20.10^{4}$ cfu /ml. Our results are lower than those obtained by Hamiroune [17], whose variable coliform load is located between $2.4.10^{4}$ cfu /ml to $6.2.\ 10^{4}$ cfu /ml. The existence of total coliforms does not necessarily indicate direct fecal contamination of milk, but it is considered an indicator of poor hygiene and sanitation practices during milking and post-handling. Fecal coliforms have a value between 10^{3} cfu/ml to $4.91.10^{4}$ cfu/ml. Our values are different from those reported by Azzi (2018) and [18,19], $6.8.10^{3}$ cfu/ml to $2.3.10^{6}$ cfu/ml. These germs could come from the water used during milking, either to wash the container used to collect the milk, or to dilute the milk in order to increase their income. The enumeration of *Staphylococcus aureus* gave a value between $1.36.10^{2}$ cfu/ml to $4.25.10^{3}$ cfu /ml. Our values found are higher than those mentioned by Hicham [20,21], they obtained during their study the load of between $1.2.\ 10^{2}$ to $0.6.\ 10^{3}$ cfu /ml with an average value of $0.4.10^{3}$ cfu/ml. The presence of *Staphylococcus aureus* in milk could be explained either by direct excretion from the udders of animals suffering from mastitis or by the instability of the environment during the handling and processing of raw milk. Analysis of raw milk from the Djatinie neighborhoods, Digueri and Aldjazira contain a variable load of FMAT, located between $1.45.10^{5}$ cfu/ml to $6.86.10^{7}$ cfu/ml. Our values are higher than that mentioned by Hicham [20], who found $2.6.10^{6}$ cfu/ml to $12.0.10^{6}$ cfu/ml, with an average of $6.38.10^{6}$ cfu/ml. The FAMT load in all samples analyzed exceeds the microbiological criteria applicable to milk. This contamination is undoubtedly linked to the lack of hygiene during milking and to infection of the cow's udders. For total coliforms the bacterial load varies between 10^{3} cfu/ml to $9.36.\ 10^{4}$ cfu /ml and fecal coliforms 10^{3} cfu /ml to $5.73.10^{4}$ cfu/ml. Our values are slightly higher than those reported by Maïwore [21]**,** that 0 to $5.76 \pm 0.76.\ 10^{4}$ cfu/ml in Cameroon. The heavy contamination of raw cow milk samples by coliforms could be due to a hygienic failure: either during milking of the product, which would be the case for packaged dairy products, or during exposure of the product to bad weather. Atmospheric and teat hands. For *Staphylococcus aureus* the value obtained is between $4.5.10^{3}$ cfu/ml to $4.09.10^{3}$ cfu/ml. Our values are higher than those found by d outoum [11], he reported values between $1.2.10^{2}$ to $0.6\ 10^{3}$ cfu /ml with an average value of $0.4.10^{3}$ cfu /ml. The presence of *Staphylococcus aureus* could be due to the hygienic state of the handler, to hand washing before, during and after milking.

Microbiological quality according to the level of contamination

The results show us that among the 30 milk samples taken, 53.33 % of our samples are unsatisfactory by the FAMT. Our results were consistent with those obtained by Maïwore [22], in Cameroon. He mentioned that more than 50 % of the samples

taken have unsatisfactory microbial quality. Contamination of raw milk samples would reflect non-compliance with hygienic practice. Regarding total coliforms, the majority of milk samples taken were unsatisfactory with a proportion of 46.66 % compared to 16.66 % satisfactory and 36.66 % acceptable. Our results are superior to those obtained by Brahim [13,23], he reported that 45 % of our samples were unsatisfactory compared to 10% satisfactory and 35% acceptable. This difference could be explained by the fact that most of our producers worked in an unhealthy environment, which led to some contamination of our samples. Regarding fecal coliforms, the majority of milk samples taken were unsatisfactory with a proportion of 46.66% while the qualities were satisfactory 20% and acceptable 33.33%. Our results are superior to those of Brahim [13,24], he reported that 35% of these samples were unsatisfactory compared to 25% satisfactory and 40% acceptable. The presence of coliforms in certain samples could be explained by exogenous contamination of the teats of fecal origin. The analyzes showed an absence of *Staphylococcus aureus germs* in 63.44 % samples compared to 36.66 % . Our results differed from those obtained by Yasmine [25] in Algeria, showing a total absence in the samples analyzed.

The overall contamination rate of milk samples analyzed from all 6 districts

30 samples analyzed was 7.15.10.7 cfu / ml with an average of 1.23.10.7. Our results are superior to those obtained in Algeria by Hamiroune [17,26], whose maximum rate was $8.1.10^5$ with an average of $7.2.10^5$. These results could be explained by the fact that the work was carried out in a different environment and also over a different period. Regarding total coliforms, the maximum rate was $9.36.10^4$ with an average of 1.42.10 4. Our results were lower than those obtained in Algeria by Kheira [27,28] whose maximum level of total coliforms is $1.3.10^5$. For fecal coliforms the maximum rate of $5.73.10^4$ was found with an average of $1.41.10^4$. Our results are lower than those obtained in Algeria by Hamiroune (2014) [17], whose maximum rate was $6.2.10^4$ with an average of $4.6.10^4$. Finally, the maximum level of *Staphylococcus aureus* present in the milk analyzed was $4.50.10^3$ with an average of $2.61.10^3$. Our results are lower than those obtained in Algeria by Kheir [27,29], of which the maximum rate of *Staphylococcus aureus* is $1.7.10^3$. This could be explained by the fact that our results were produced in the dry season where contamination conditions are lower.

Conclusion

This study, which aims to evaluate the hygienic and microbiological quality of raw cow's milk, allowed us to determine that the cattle breeders in the town of Abéché were predominantly women with an age between 18 to 45 years. These breeders were mostly unschooled with a proportion of 75%. Analyzes of raw milk carried out in the INSTA laboratory showed us that the FAMT load was variable between $4.00.10^4$ cfu /ml at $7.15.10^7$ cfu /ml; those of CT and CF were between 10^3 cfu /ml to $5.73.10^4$ cfu /ml and *staphylococcus aureus* was located between $1.36.10^2$ cfu /ml to $4.5.10^3$ cfu /ml. The microbiological quality of raw milk samples based on FAMT, CT and CF was mostly unsatisfactory. The microbiological quality of raw milk samples based on *staphylococcus aureus* was mostly uncontaminated. Investigations into the evaluation of the microbiological and hygienic quality of raw milk from cows made it possible to determine the microbiological quality of raw milk, the contamination rate and the hygiene of milking and collection. Therefore, it would be appropriate to carry out an additional study on improving the hygiene of raw milk milking.

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