



RESEARCH ARTICLE

MICROBIOLOGICAL QUALITY OF VARIOUS MILK MILES PRODUCED IN URBAN ENVIRONMENT IN NIGER

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ABSTRACT

Milk, a complete, easily perishable food is processed to increase its shelf life, often even at the household level. One of its by-products, the curd of large consumption in Niger, could be at the origin of certain infections. The objective of this study is to contribute to the improvement of the hygienic quality of curd produced in households and small milk production units of Niamey. 60 milk samples were collected including 30 raw and 30 curds. Thus, total aerobic mesophilic flora, total coliforms, *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* were determined. The results, presence of the total mesophilic aerobic flora in all samples ranging from $2.4 \cdot 10^8$ to 2.10^6 in the two types of milk; raw milk and curd were respectively 86.66% and 70% contaminated with total coliforms; 33.33% of raw milk samples are contaminated with salmonella and 16.66% contaminated with curdled milk. *Staphylococcus aureus* is present (80%) in raw milk and 13.33% in curd, *E. coli* (50%) in sour milk and (53.33%) in raw milk. *Lactobacilli* oscillate $2.36 \cdot 10^3$ to $3.33 \cdot 10^4$. Yeasts were enumerated in 53.33% of the raw milk and in 70% of the curd, the molds were present in 3.33% of the samples of the two types of milk. High levels of coliforms, *E. coli*, *Staphylococcus aureus* and *Salmonella* show that milk (curds and raw) products and sold in Niamey and its peripheries represent health risks for consumers and consequently for public health. Permanent support of producers to good production practices is essential to protect consumers from contamination.

INTRODUCTION

Even today, milk is an exclusive source of food for certain populations of all ages. In the same way, the milk of the animals replaces in many foci, the breast milk for the infant. Milk is used in a variety of other ways and it is when it combines with other foods in a combination diet that milk becomes very valuable. Thus, the complementarity relations that exist between milk and cereals are a well-established phenomenon: lactic proteins provide lysine, tryptophan and other amino acids thus improve the biological value of the proteins of the mixture (MADOUGOU, 2010). In the class of mammals, the first days of life are ensured exclusively by milk, which is the only food of the newborn. To play this role, milk should be a complete feed that contains most of the nutrients needed for the growing needs of the young. Milk is pretty much the only food that can balance most of a man's nutritional needs. We understand why at the dawn of civilization, the man used for his food the milk of large domestic animals (Madougou, 2010).

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In Niger, traditional peri-urban dairy farming systems are the work of ethnic groups (Fulani or Tuareg) who have ancestral dairy farming practice. These populations, originally transhumant, have gradually settled around cities to meet ever-increasing urban milk demand (Viasetal, 2003). These producers have settled around the city with 72% within 15 km and 28% beyond 15 km (SIM B, 2014). Milk is a valuable nutritious food that has a short shelf life and must be handled with care. Milk is very perishable because it is an excellent growth medium for microorganisms - particularly pathogenic bacteria - that can alter the product and cause disease in consumers. http://www.fao.org/agriculture/dairygateway/milk_processing/en/#.WJtw_6L-nIU viewed on 19/02/2017. In general, milk includes four types of important constituents, namely: lipids, consisting essentially of ordinary fats (triglycerides), proteins (casein, albumin and globulin), carbohydrates, essentially lactose, salts. But many other constituents are present in minimal amounts such as vitamins, enzymes, nucleotides, dissolved gases; don't have some great importance due to their biological activity. This composition varies according to different factors generally related to animals and the environment. (VIGNOLA, 2002) cited by CONTE, 2008.

Milk contains few microorganisms when taken under good conditions from a healthy animal (less than 10³ germs / ml). It is essentially saprophytic germs of udders and ducts galactophores: micrococci but also lactic streptococci (Lactococcus and Lactobacillus). Raw milk is protected against bacteria by inhibiting substances called "Lactenins" but their action is of very short duration (about 1 hour) (GUIRAUD, 1998). Other microorganisms can be found in milk when it comes from a sick animal. They are generally pathogenic and dangerous from a health point of view (CONTE, 2008). The lactic microflora of milk is part of the normal flora of milk and is characterized by its ability to ferment lactose with the production of lactic acid and thus a lowering of pH. (ALAIS, 1984, CLAUDE and CHAMPAGNE, 1998). Products derived from milk processing are often prepared under questionable hygienic conditions. Few studies have been conducted on curdled milk in Niger. Indeed, this work puts a particular emphasis on the production of curd in some households and small dairy units in the city of Niamey (Niger). As curd is an important part of people's eating habits in Niamey, it is therefore necessary to evaluate the nutritional and microbiological quality of this foodstuff. The overall objective of this study is to contribute to improving the hygienic quality of curd produced in Niamey's households and small milk production units.

MATERIAL AND METHODS

Geographical location of the study area: The communes I, II, III, IV are all on the left bank of the Niger River while the commune V is on the right bank. Figure 1 illustrates the map of the five municipalities in the Niamey region, of which four municipalities are concerned by this study (I, II, IV and V).

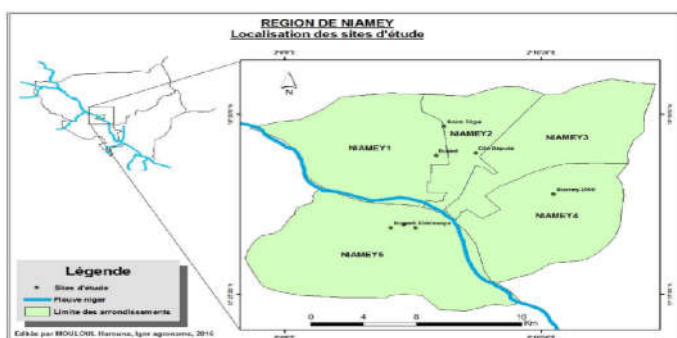


Figure 1. Map of the urban community of Niamey

Biological material

It consists of 60 milk samples, including 30 raw milk and 30 sour milk from the three communes.

Collection equipment

- a cooler + ice, for transporting samples of curds and raw milk under cold conditions;
- Sterile bags to collect the samples to be analyzed; a marker for the numbering of the samples;

MICROBIOLOGICAL ANALYSIS METHODS

Preparation of the stock solution and decimal dilutions: In this work, the following stages of analysis will be ideal for all microorganisms and for all products. In a flask containing 225

ml / 90 ml of buffered peptone water (EPT) or distilled water, 25 ml / 10 ml of the analyte is added. The whole is mixed using a sterile pipette. The mother solution thus obtained corresponds to a 1/10 dilution, ie D1 (10⁻¹). From D1, successive dilutions were carried out in test tubes each containing 9 ml of peptone water (PE). From D1 to 1/10 (225 ml of EPT + 25 ml of the product), 1 ml of the same pipette is withdrawn and transferred to a test tube containing 9 ml of EP. This gives a dilution to 1/100 ie D2 (10⁻²) and homogenized with another sterile pipette. From D2, the same operations are carried out in order to successively obtain dilutions at 10⁻³, 10⁻⁴, 10⁻⁵, 10⁻⁶, 10⁻⁷; 10⁻⁸ is D3, D4, D5, D6, D7, D8. The product or its decimal dilutions were used for the seeding of specific culture media for the purpose of isolation and numeration of the desired microorganisms. The incubation is done in boxes in the inverted position (lids at the bottom) to avoid the confluence of the superficial colonies because of the condensation water on the lid. On reading, the number found is multiplied by the dilution factor.

Enumeration of total aerobic mesophilic flora at 30 ° C

It is performed by mass counting on PCA (Plat Count Agar) media. The total flora count (mesophilic aerobic flora) was carried out according to the international standard ISO 4833, May 2003. The seeding is done in double test on the medium "Agar Plate Count Agar (PCA)" with 0.1 ml sample. The dishes are incubated in an oven set at 30 ° C for 72 h ± 3h.

Research and enumeration of total forms of coli

Total coliforms were counted according to the international standard ISO 4832 (2006). Seeding is done on EMB agar (Eosin Blue Methylene). The dishes are incubated at 37 ° C for total coliforms and at 44 ° C for thermotolerant coliforms, in an oven for 24h ± 2h. Typical colonies are bright red to pinkish or purple because fermenting lactose and have a diameter of more than 0.5 mm.

Enumeration of fungal flora (Yeasts and molds)

The international standard ISO 7954 (1988) was used for the enumeration of yeasts and molds. Seeding was carried out with 0.1 ml of the sample on SABOURAUD agar with chloramphenicol in Petri dishes. The dishes are incubated at 25 ° C / 30 ° C. in an oven for 3, 4 or 5 days.

Research and enumeration of Staphylococcus aureus

This research is carried out according to standard NF-V08-057-1 (November 1994). Baird Parker (BP) is used as the culture medium, to which egg yolk with tellurite or Chapman medium is added. The dilutions used are 1 and 10⁻². Seeding is done on the surface with 0.1 ml by dilution on BP previously cast in Petri dishes and incubated in an oven + 37 ° C for 24 hours. Colonies of Staphylococcus aureus appear shiny black, curved and surrounded by an opaque white border and a lightened halo.

Search for Escherichiacoli

This study is based on four properties of E.coli: it is able to develop in a bile medium, it supports a temperature of 44 ° C, it ferments lactose by producing gas, it is indoligen.

Two tubes of bright green birch lactose broth (BLBVB) containing Durham bells were seeded with 1 ml of the product and incubated 48 hours at 37 ° C. The bright bile-green combination inhibits most enterobacteria. The fermentation of lactose which results in the appearance of gas in the bells of Durham signs the presence of coliforms. This gas release must be at least equal to one tenth of the volume of the bell so that the test can be considered as positive. At this stage, *E. coli* is identified by the Mackenzie test. The positive cultures are parallel transplanted on BLBVB and on indo-free EP, then incubated 48 hours at 44 ° C. The presence of *E. coli* confirmed in the only case where there is:

- Gaseous release in BLBVB's Durham bells,
- Indole production, revealed by the addition of Kovacs reagent.

The indole produced by *E. coli* gives, with the acyl alcohol contained in the Kovacs reagent, a coloration ranging from pink to red.

Salmonella search

For the detection of salmonella in milk, the following scheme was defined by EDEL and KAMPELMACHER (1969) and retained by National and International Standards:

Pre-enrichment (6-18 hours)

D1 suspension was incubated at 37 ° C for 24 hours. This phase aims to allow injured (stressed) bacteria to recover their stability. It is therefore necessary to push the selection even further.

Enrichment (in selective liquid media 24-48 hours)

At the end of these 24 hours, 10 ml of the pre - enrichment medium are removed and added to 100 ml of Na tetrathionate broth and brilliant green (MULLER- Kauffmann). Bright green inhibits Gram + hulls. Incubation is at 37 or 44 ° C for 24-48 hours.

This medium promotes salmonella growth, even in the presence of a competing polymicrobial population .The following broths can also be used:

- Selenite broth of Na (with or without Cystine and Novobiocine).
- RAPPAPORT-VASSILIADIS broth (rv10) with magnesium chloride or Malachite Green.

Isolation on solid selective media

It is carried out on solid selective media from selective liquid enrichment media. Incubation of the selective media is at 37 ° C for 24 to 48 hours. These media mainly contain selective agents (bile salts and colorants for example), sugars including lactose, salts to reveal the production of H₂ S and pH indicators. Bile salts also inhibit flora and accompany salmonella. The main media that can be used are: bright green agar, Hektoen agar, DCLS agar, XLD agar. Also suitable are SS agar, Mc CONKEY agar, Bismuth sulfite agar.

Identification

It is carried out from the enrichment medium in parallel on the bright green and phenol red agar (VBRP) and on the

deoxycholate citrate lactose sucrose (DCLS) medium. The culture is streaked on previously solidified media. The incubation is conducted at 37 ° C for 24 to 48 hours. On reading, the germs fermenting lactose turn the medium to yellow. *Salmonella* does not ferment lactose, their colonies will be smooth and red on VBRP and red or colorless (lactose - and saccharos e -) black center (H₂S + colonies) or not on DCLS. These indications of culture and color are in fact only a presumption. Thus a thorough search on Kligler's medium is carried out. The pellet is seeded by puncture, the slope streaks .*Salmonella* are - Glucose +, yellow pellet,

- Gas +: air bubbles in the pellet,
- -H₂ S + black ring between base and slope, black net along seeding line in base, lactose - and gives a red color on the seed slope.

For further clarification, confirmation can be continued by testing urea-indole, orthonitrophenyl, galactopyranoside (ONPG), lysine decarboxylase (LDC). The French Api 20 E system facilitates this identification. *Salmonella* are: indole -, urea - ONPG -, LDC +.

Lactobacillus Research

The enumeration of the lactic acid bacteria was carried out according to the ISO standard 21414 (1998). Seeding is carried out with 0.1 ml of the sample in Petri dishes containing agar ManRogosa and Sharp or MRS agar. The incubation of the dishes is carried out at 37 ° C in hermetically sealed anaerobic jars (Biolab) containing CO₂ generators (anaerocults) and placed in an oven for 72 to 96 hours.

Expression of Results

The formula for the expression of the results is the following:

$$N = \frac{\sum C}{V \times 1,1 \times d}$$

N = Number of microorganisms per gram or per milliliter of product, expressed as a number between 1.0 and 9.9 multiplied by 10^x (where x is the appropriate power of 10).

- ΣC is the sum of the colonies counted on the two boxes kept after two successive decimal dilutions, at least one of which contains at least 10 colonies.
- V is the volume of inoculum placed in each box, in milliliters.
- d is the dilution corresponding to the first dilution retained (d = 1 when the undiluted liquid sample is retained).

Nb: For technical reasons, the determination of lactobacilli was made in Ouaga (Burkina Faso), only twenty (20) samples of laurel were analyzed.

Data entry and analysis: The data collected were analyzed using one-way analysis of variance (ANOVA) at p = 0.05.

RESULTS AND DISCUSSION

Results and comments

Results of microbiological analyzes of raw milk: It is apparent from Table I that more than 50% of contaminated

samples by *Staphylococcus aureus* are off-specification, 33.33%, 46.66 and 30% are respectively contaminated by aerobic mesophilic floras total, *Escherichia coli*, and *Salmonella* are out of the ordinary.

associated with contamination of fecal origin and significance of testifying hygienic conditions deteriorated during milking, teat skin of improperly cleaned or during transport (Bachtarzi et al., 2015).

Table 1. Microbiological analysis results of raw milk by grouping

GR (cfu/ ml)	BORN	NEC	% EC	MGT / ml	MxGT/ ml	NEHN	% HN
FAMT	30	30	100	2,410 ⁴	8.2.10 ⁶	10	33.33
CT	30	26	86.66	<10	2,110 ⁴	0	0
E-coli	30	16	53.33	<10	1.40 ²	14	46.66
stp aureus	30	24	80	<10	1,610 ⁴	16	53.33
S	30	10	33.33	<10	10 ¹	9	30
yeasts	30	16	53.33	<10	1,410 ⁴	-	
molds	30	1	3.33	<10	4		

GR: Wanted Sprouts ; BORN: Number of samples; NEC: Number of samples; MGT: Minimum of found germs / ml; MxGT: maximum found germs / ml; NEHN: number of exceptional samples FAMT: Aerobic total mesophilic flora, CT: total coliform; E-coli: *Escherichia coli* Stp: *Staphylococcus*, S: *Salmonella*, E: *E-coli*: *Escherichia coli* ;Stp:*Staphylococcus* , S: *Salmonella* , E : sample, FAMT: aerobic flora, total mesophilic, CT : total coliform, S: salmonella, EchC: *Echerichiicola*, Ms: mold, Lb : *Lactobacillus*.

Table 2. Results of microbiological analyzes of curds by grouping

GR	BORN	NEC	% EC	MGT / ml	MXGT / ml	NEHN	% HN
FAMT	30	30	100	2,410 ⁴	8.2.10 ⁶	30	100
CT	30	21	70	<10	3.6.10 ⁴	21	70
E-coli	30	15	50	<10	4.10 ²	15	50
stp aureus	30	21	70	<10	1.4.10 ²	4	13.33
S	30	5	16.33	<10	3.10 ¹	5	16.66
yeasts	30	21	70	<10	1.6.10 ⁴	21	70
molds	30	1	3.33	<10	1.3.10 ¹	1	3.33
lactobacilli	20	20	100	2,36.10 ⁴	3.33.10 ⁵	0	100

GR: Wanted Sprouts; BORN: Number of samples; NEC: Number of samples; MGT: Minimum of found germs /ml; MxGT : maximum germs found / ml; NEHN: number of exceptional samples; FAMT: Aerobic total mesophilic flora, CT: total coliform; E-coli: *Escherichia coli* Stp: *Staphylococcus* , S: *Salmonella*

The microbiological analysis of curd (Tables II) shows that all the samples analyzed have a microbiological load above the standard for FAMT. 70% of samples contaminated with total coliforms and yeasts have a higher than normal load; 50%; 13.33%; 16.66% and 3.33% contaminated respectively by *E-coli*, *Staphylococcus salmonella* and mold are out of the ordinary.

DISCUSSION

Aerobic total mesophilic flora: Aerobic total mesophilic flora is considered as a general indicator of the overall quality of the dairy product. It reveals the conditions of production, more particularly the hygienic practices during milking. The enumeration of this total mesophilic aerobic flora for the 60 milk samples analyzed (raw and curd) showed that there is a significant contamination. The mean value of the raw milk MILT analyzed (1.33 10⁵ CFU / ml) is lower than that found in South-Togo by Seme.KPitala.W, Osseyi, G. E (2015) on Nutritional and Hygienic Quality of suckling cow milks (5.9 10⁵ CFU / ml), also inferior to the results obtained by Taybiet al.(2.15 10⁷ CFU / ml) (2014). For curdled milk the average value of FAMT is 2.17.10⁶ CFU / ml greater than normal (≤10⁴ CFU / ml), The search for indicator microorganisms of faecal contamination makes it possible to judge the hygienic state of a product such as milk. Even at low levels, they would testify to degraded hygienic conditions during milking, transport, or processing.

Total coliforms

Raw milk

The average value of total coliforms is 2.14110³CFU / ml. These levels of contamination exceed the current standards of 10³ CFU / ml. The presence of Cototal liformes is often

Our results are superior to those reported by Labiouiet alin 2009 who achieved an average of 2.0 10⁴CFU / ml, however they are lower than the counts (3.02 10⁵CFU / ml) found by Taybiet al, 2014 in Morocco.

Rotten milk: The average total coliform content in curd is 2.46 × 10³ corresponding to a contamination rate of 70%. Our results are similar to those of NAMEGNI (2006) who counted 84% of the total coliform-contaminated curd samples. On the other hand, our results are superior to those obtained by NJASSAP (2001) in Cameroon, which counted 57% of the samples which are contaminated.

Staphylococcus aureus: Our analysis revealed that 53.3% of raw milk and 13.33% curds contaminated par *Staphylococcus aureus*. The presence of staphylococci in milk may have two main origins, either as a result of primary contamination, due to the presence in a herd of *Staphylococcus aureus* mastitis, or it is a human contamination. Our results are similar to those obtained by HAMZA (1996) on the artisanal curd "Tarmamoun Adar" in Niger of which 18.18% of the samples were contaminated. NJASSAP (2007), found for the same type of study in Cameroon, a contamination rate of 37% by *Staphylococcus aureus* in raw milk, lower than our results.

Escherichia coli: It was found in 50% in curd and 53.33% in raw milk, which is well above the standards. The lower rate in curd versus raw milk is thought to be due to the effect of acidity which significantly reduces the percentage of *E. Coli* (NDIAYE A., 1994). Contamination can be of faecal origin, cleaning with contaminated water or from a mastitis *Ecoli* (BACHTARZI et al, 2015). Its presence in a water or food suggests that there was during their preparation a lack of hygiene that led to defilement by feces. For NJASSAP (2007), the simple fact of finding *E. coli* in food, even in large numbers, is not enough to say that it is pathogenic. Some only

can be pathogenic for man and cause gastroenteritis. It is therefore important to make a typing for determining such are enteric,

Salmonella

Salmonellae were found in 10 samples of raw milk and 5 samples of curdled milk which corresponds respectively to 33.33% and 16.66%. This low level of salmonella in curdled milk maybe justified not only by the pasteurization used by some households before milk curdling but also by the high sensitivity of salmonella to acidic pH. Indeed, POUEME NRS, (2006) found that salmonella do not resist pHs between 4.6 and 4.8.

Lactobacillus

The analyzes gave important values of lactobacilli in curd ranging from 2.36×10^{10} to 3.33×10^5 (Table II). The number of lactobacilli of all samples is in accordance with the required standard ($> 10^8$). Nevertheless, our results are inferior to those found by BIATCHO (2006) with lactobacilli in the order of 10^8 seeds / g in artisanal curd.

Fungal flora: Yeast and mold

Yeasts are found in 53.33% of raw milk and in 70% of curd, mold is present in 3.33% of samples of raw milk and curd. According to DIENG (2001) molds are not impeded by acidity, sucrose and lactose residue el, which is a source of energy for them. The fungal flora comes from poor hygiene conditions during handling, sale and ambient air. Ineffective or incomplete pasteurization as well as a defection of the cold chain, as well as a bad closing of the boxes are all factors favorable to their development. Our results are similar to those obtained by Diallo (1995) who found for the same type of product, a contamination of 75% by the lev ures and 26% by the molds. The presence of certain microorganisms could be justified by the certain hygiene practices observed from milking to manufacturing. To wash the containers 51% of the respondents use simple water (tap or borehole) against 49% who use soap.

Conclusion

This study focused on the microbiological analysis of curd milk products in households and small dairy units in Niamey. The evaluation of the microbiological quality of the raw milk and the curd showed a presence of total mesophilic aerobic flora in all the samples of the two types of milk analyzed. High levels of total coliforms, E. coli, Staphylococcus aureus and Salmonella indicate somewhere that hygienic conditions are not or poorly met. As a result, the consumption of these products could pose a significant public health risk. It would therefore be important to continue studies in the same areas and to determine fecal coliforms and lactobacilli, and to broaden the scope of studies throughout the national territory to obtain a general overview of the quality of milk sold in Niamey, Niger.

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REFERENCES

- ADAMOU, A., 2005. Migration path of cit adins and housing problem in Niamey. DEA thesis, Faculty of Human Sciences UAM (Niger). 149p.
- AFNOR - Milk - Determination of fat content - Gravimetric method (reference method). NF EN ISO 1211, December 2001, 21 p.
- AFNOR (French Association of Normalization) - Milk. Determination of the dry matter. NF VO4 207, In AFNOR (Ed.), Compendium of French Standards. Milk and dairy products. Methods of analysis. Paris: French standardization, 1980, p. 33-34.
- Aggad H, F MAHOUZ, AHMED AMMAR Y, Kihal million. 2009. Evaluation of the Anonyme : http://www.fao.org/agriculture/dairy-gateway/transformation-du-lait/en/#.WJtw_6L-nIU accessed on 19/02/2017
- Anonymous : <http://web04.univlorraine.fr/ENSAIA/marie/web/ntic/pages/2010/baroth.html>. Accessed the 18/02/2017
- Anonymous : <http://www.memoireonline.com/04/14/8819/Intert-de-fabrication-de-fromage-analogue.html> accessed on 19/02/2017.
- APESS., 2014. Assessment of public support for livestock farming in Niger from Maputo 12p
- Baroth. 2010. The main microorganisms of raw milk. Available on:
- BEN AMOR K, CORNELIEUS C, MAHJOUR A and THONART PH, 1998.
- BENSALAH A. 2010th. Contribution to the evaluation of the physico-chemical and bacteriological quality of raw and diagnostic milk of brucellosis and mastitis in the region of
- BOURGEOIS C, MESCLE JF and ZUCAM., 1990. Microbiology Food; Microbiological aspect of food safety and quality. Paris; Lavoisier: Techniques and Documentation. 422p
- Cheikh Anta Diop Dakar, Inter-State School of Science and Veterinary Medicine, 93p
- CUN. Memory ITA4 (PA), Faculty of Economics, Niamey, Niger, 65p
- DIATTA O., 2005. Study of the quality of artisanal quail milks manufactured by the GIE of Nguekokh breeders: Faculty of Science and Technology EISMV (Senegal). 44p
- DUBOIS., 1982. Inhibition of some Pathogenic Bacteria and Totally Pathogenic Pot by Streptococcus lactis, Streptococcus thermophilus, Lactobacillus Acidophilus and Lactobacillus helveticus. 62p
- European standards (Official Journal of the French Republic, January 19, 1980) Paris.
- FALL CL, 1997. Study of raw milk frauds: Wetting and skimming, thesis, University
- FAO. 2017. Milk and milk products in human nutrition available at <http://www.fao.org/docrep/t4280f/t4280f00.htm>. France, 17p.
- FREDOT E., 2009. Food and nutritional basics of dietetics. ed. Lavoisier 17p.
- GABRIEL S., 1986. Contribution to the study of the microbiological quality of coarse milk milks in the Dakar region, Thesis. Med. Vet of Dakar 144p.
- General Census of Agriculture and Livestock, 2006
- GHAOUES S., 2011. Evaluation of the physicochemical and organoleptic quality of five brands of partly skimmed reconstituted milk marketed in eastern Algeria. Memory Magister in Food Science Option: Food Technology INATAA University MENTOURI - Constantine 123p.

- GOUTTAYA.A., 2013. Study of the microbiological quality of camel milk collected locally in mid-lactation, Master thesis, Faculty of Sciences of Nature and Life and Sciences of the Earth and Universe, UKMO 70p .
- GUIRAUD J P., 1998. Food Microbiology. Dunod , 89 -95p
- GUY VAN V. 2003. Support to small milk producers in the urban community of Niamey: external evaluation mission, study report, VSF
- Hygienic quality of milk in western Algeria, 160 (12) 590-595
- I Maazou, 2001. Framework document for the revival of the culturing sect. MRA. Final report. 61 p.
- Identification of the lactic flora of traditional Tunisian fermented milk (lben) and evaluation of flavoring compounds. Microb - Hyg -Alim vol 10 p27
- ISSA, O., 2016 .Contribution of ' Chukou ' cheese to the food and nutritional security of pastoral and agropastoral households in Niger: the case of the urban district of Filingue. Master Memory (CILSS) 58p.
- JEANTET ROMAIN, THOMA CR OGUENNEC MICHEL MAHAUT, STONE
- KONTE.M, 1999. Milk and dairy products intensive production systems development in West Africa, ISRA / LNERV 25p study report
- LAMONTAGNE M, 2002: Fermented dairy products, In Science and milk technology; milk processing - Canada: international polytechnic presses - 600p
- LUQUET FM and CORRIEU G, 2005: Lactic and probiotic bacteria .Edition Tec 8c Doc, Lavoisier. Paris 307p.
- MARICHATOU H., HAROUNA K., HENRI KM AND VIAS G., 2005. Synthesis on dairy dairies in Niger. 37 p.
- MATHIEU J., 1998. Initiation to the physicochemistry of milk. Technological Guides of LPNs. Edition Lavoisier Tec and Doc, Paris. 214 p
- MOUNA O., 2009 . Biodiversity of lactic acid bacteria in raw milk and its "ben" and " Jben " derivatives of Moroccan origin PhD Thesis, MOHAMMED V-AGDAL University - Faculty of Sciences Rabat, Order No. 2475, 132p
- MOUNKEILA A., 2005 . Preliminary characterization of peri-urban dairy farms of the
- MOUSSA A M., 2005. Preliminary characterization of the peri-urban dairy farms of CUN. Thesis dissertation IAT / FA, UAM / Niamey, 70p
- MOUSSA M., 2010. Influence of food supplementation (brewer's dough and association of wheat-cotton cake) on the milk production of Azawak cows raised at the kirkissoye dairy cooperative (CLIK) Agricultural Engineering Engineer's Brief UAM 46p.
- NDIAYE M., 1991. Contributed to the comparative study of the microbiological quality of raw milks, curds and powdered milk marketed in the Dakar region. Thesis: Med. Vet., Dakar; 17
- NGASSAM TC., 2007. Contribution to the study of the microbiological characteristics of artisanal fermented milks in Senegal: case of the Niayes zone. Thesis: Med. Vet, Dakar, 109p
- NJASSAP NGABET H., (2001). Contribution to the study of the microbiological quality of fermented milk "kossam" marketing in the streets of Yaounde (Cameroon) Thesis: Med. Vét de Dakar 72p
- OUNINE K., RHOUTAISSE A., EL HALOUI NE, 2004. "Bacteriological characterization of raw milk produced in barns in the Gharb region", Al Awamia, no. 109-110, p. 187204.
- OUSMANE.MD, 2011. Characterization of the value hatred of milk and milk products of the producer case of the commune V of Niamey, Memory DESS / UAM 81p
- ROISSART H., LUQUET FM; 1994. Lactic bacteria, fundamental and technological aspects. Uriage, France, Lorica in 2 vols., P. 118-119
- SCHUCK, GERARD BBRULE (2008). Dairy products. 2^e Edition Lavoisier Paris. 181p
- SOULARD F., 1994. Dairy farming in Niger: a technical-economic study of two improved livestock systems. Thesis dissertation . I .ST, Overseas 67p
- SOULEYMANE M B., 2008: Hygiene and health of milk in the Hamdalaye dairy basin.
- Statistics Directorate SIM Livestock., 2014. Atlas on Breeding in Niger. 137p
- STOLL .W. 2002: Feeding of dairy cows and composition of milk. 4p. Document tel acc essible at www.rapportieux.ch
- TAYBI NO, ARFAOUI A., FADHI M., 2014 . Evaluation of the microbiological quality of raw milk in the Gharb region, Morocco. International Journal of Innovation and Scientific Research ISSN 2351-8014 Vol. 9 No. 2 Sep. 2014, pp. 487-493 © 2014 Innovative Space of Scientific Research Journals <http://www.ijisr.issr-journals.org/>
- TCHAMBA.NC , 2007. Characterization of the milk flora of artisan fermented milk in Senegal: case of the Niayes zone, Thesis, Inter-State School of Veterinary Science and Medicine 109p.
- Thesis dissertation ITA / FA, UAM / Niamey 31p
- Tlemcen in Algeria .Master's thesis in Agronomy University Abu BekrBelkaid 63p.
- UEMOA, 2013. Study on the formulation of the detailed action program for the development of the milk sector in the WAEMU zone. Annex 6: Report Niger. 53p.
- VIAS FRANCK SG, MARICHATOU H., KORE H., 2005. Synthesis on dairy sectors in Niger. Launch workshop on "Dairy Policies". Dakar, Senegal, Eismv, 45p.
