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Bacterial Quality of Informally Marketed Raw Milk in Kenitra City, Morocco

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Abstract: One hundred and twenty samples of raw milk were randomly collected from six dairies in different locations in Kenitra City (Morocco) from October 2010 to March 2011 and were subjected to evaluation. The study has shown that 119 samples were of poor merchantability and 24 samples of bad sanitary quality. Microbiological enumeration revealed that the counts of total mesophilic aerobic bacteria, $6.9x10^8$ cfu mL^{-1}; faecal coliforms, $4.2x10^7$ cfu mL^{-1} and Staphylococcus aureus, $1.4x10^5$ cfu mL^{-1}. *Salmonella* sp. were below detection level in all of the samples. *Listeria monocytogenes* was isolated from one sample. The same contamination degree between dairies and districts ($p>0.05$) was detected. A significant correlation was observed between total bacterial counts and faecal coliforms ($r = 0.51$; $p<0.001$) and also between total bacterial counts and temperature of storage ($r = -0.37$; $p<0.001$). The microbiological quality of raw milk sold in Kénitra city was judged marginal indicating the need for improved hygienic standards.

Key words: Raw milk, microbiological quality, Kenitra city

INTRODUCTION

Since 1975, the government has introduced incentive measures for the organization of milk collection by launching an extensive program of construction and equipment collection centers and making them available to farmers organized in cooperatives (Bourbouze, 2002). In these centers, milk is stored in refrigerated tanks before being transported to an industrial unit. However, alongside these centers, other channels emerged. This is especially evidenced in the work of collecting milk by hawkers directly from farmers constituting - about a quarter of national production - and selling it to local dairies "mahlabates", cafés (75%) or directly to consumers (25%) (Akesbi *et al*., 2007).

Collecting milk by peddling has expanded in recent years in the supply basins near major load centers. Its expansion has been strongly accentuated by demographic explosion, urbanization, rural exodus and economy liberalization (Padilla *et al*., 2004).

The government is losing control over this informal sector at the fiscal, social or sanitary levels. This sector poses not only an unfair competition for the organized subsector but also a public health threat (Oudin, 2006; Padilla *et al*., 2004).

In addition, short channels of the industry attract Urban Moroccan consumers seeking a fresh product "beldi", which is considered to have a better organoleptic quality. Moreover, milk consumption is less expensive than in the formal system. Thus, the informal sector remains a serious competitor of modern industries and organized sector.

Intact milk is a useful resource where breast-feeding is not possible, a valuable source of nutrition for growing children and a popular beverage or processed food for adults (Kumbhar *et al*., 2009). When discharged from udder a healthy cow, the milk is sterile; after a while it can be contaminated by outer microorganisms, but this count is low not exceeding tens and hundreds (Shojaei and Yadollahi, 2008). In some cases, infections can cause contamination and even make the milk not proper for use. It can conceal life-threatening hazards when it comes to gastroenteritis, diarrhea, typhoid, or bovine tuberculosis (Al-Khatib and Al-Mitwalli, 2009). It is commonly known that dairy products are perishable, namely raw products. This is a product at a higher risk when consumed in summer. Nevertheless, the risk is reduced or disappears in the cold season.

Milk quality is still evaluated in Morocco on the basis of physical and chemical tests such as milk density and fat content only while studies on milk quality involving hygienic and/or microbiological criteria at the farm level are relatively very few (Amhouri *et al*., 1998; Srairi *et al*., 2006). This lack of updated data on milk hygienic quality in Morocco may be harmful to the whole sector in comparison with other Maghreb countries (Tunisia for example) where this element represents a key figure factor for a sustainable dairy channel (Djemali and Kayouli, 2003). In fact, these considerations on raw milk hygienic quality and the questions they raise for the farmers and for the safety of the consumers are nowadays frequently investigated in other emerging dairy nations such as Iran or Malaysia (Chye *et al*., 2004; Ehsani *et al*., 2004).

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In order to monitor food safety, it is imperative that the microbiological quality of milk be determined. Therefore, the objective of this study is to estimate the bacteriological quality of raw milk sold in dairies of Kenitra City (northwest of Morocco), during the cold period of the year.

MATERIALS AND METHODS

Study site: Situated in the northwest of Morocco, Kenitra city is the economic capital of Gharb region. It is the fourth industrial city and the agricultural capital of the country. The climate in Kenitra is Mediterranean, with warm, dry summers and mild winters. The rainfalls in the region far exceed the national average.

The main vocation of Gharb region is agriculture. The region houses 163 milk collection centers. It covers a total area of 893 860 ha (about 1.2% of national territory). The milk sector represents the biggest contributor to revenues and the biggest job provider in agricultural holdings with its 157 000 dairy cows and its annual production of 280 000 tons. Milk is procured from rural and suburban areas, transported at ambient temperature to different marketing points of Kenitra city and sold as loose raw milk to consumers (Ouazzani *et al*., 2009).

Sampling procedure: The study population in this research was the raw milk samples presented for sale at the dairies of Kénitra city. This study was carried out during October 2010 to March 2011, at ten weeks per season (total of 20 weeks). In this sectional study, sampling was done by selecting the shops with random cluster sampling from retails representing raw milk to customers. Three local dairies, from separate sections with different socioeconomic levels, in Saknia (northern region of the city) and Maâmora district (southern region of the city) were chosen randomly and one time per week, raw milk was collected (total samples 120 = 3*2*1*20). In parallel, the temperature of storage is taken.

Each sample was approximately 500 mL, not taken aseptically from the bulk milk container - placed at ambient temperature - into a sterile plastic bag. The milk collection was kept on ice during two-hour transportation and was analyzed immediately after arrival at the laboratory (Laboratory of Microbiology and Food Hygiene Department, National Institute of Hygiene of Rabat).

Microbiological analysis: The purpose of microbiological analysis is to identify the microorganisms responsible for the alteration of merchantability and/or health. In this study, the samples were examined for the most common microorganisms like Total Bacterial Counts (TBC), Faecal Coliforms (FC) and pathogens namely *Staphylococcus aureus*, *Salmonella sp* and *Listeria monocytogenes*.

Total Bacterial Counts (TBC) were obtained on Plate Count Agar (PCA) at 30±2°C for 48 hrs (Abd Elrahman *et al*., 2009; Houghtby *et al*., 1992) and Desoxycholate Lactose 1‰ agar (DL 1‰) was used to detect fecal coliforms at 44±0.5°C for 24 hrs (Mennane *et al*., 2007). To seek and count *S. aureus* Baird-Parker agar (BP) was used, at 36±2°C for 24 hrs (Aggad *et al*., 2010). Confirmation of the presence of *S. aureus* required coagulase test, hence the use of rabbit plasma. Then, typical black colonies on BP agar were counted.

Salmonella research was done on selective Hecktoen agar, at 36±2°C for 24 hrs (Afif *et al*., 2007). The presumptive colonies are sub-cultured on Kligler medium for diagnostic using API 20 E Test System.

Listeria was carried out on Palcam and Oxford Agar incubated at 36±2°C for 24 hrs to 5 days, according to the method of Food and Agriculture Organization[1] (Omer and Eltinay, 2008). Confirmation of the presence of *Listeria monocytogenes* was done in Tryptone Soja Yeast Extract Agar (TSAY) at 36±2°C for 18 h to 24 hrs. After checking with Gram test and Catalase Reaction, the isolate through biochemical identification via Api Listeria 18R gallery (Liofilchem).

Interpretation of results is made according to the Joint Order of the Minister of Agriculture and Rural Development, of the Minister of Health and of the Minister of Industry, Commerce and Tele-communications No. 624-04 of Safar 17, 1425 (April 8, 2004) relating to microbiological standards to be met by animal foodstuffs or food of animal origin (Table 1).

Statistical analysis: Data were analyzed by Epi-Info program version 3.3.2. (2002). Descriptive statistics were established to report the variability of the different parameters involved in the evaluation of the milk hygienic quality. Then, bacterial counts were transformed into logarithmic decimals and values equal to zero were converted to log 0.1. Log transformed counts of microbiological indicators data were analyzed using factorial analysis of variance and Student test for comparison of differences between means of microorganism's number with respect to different sources and general linear model. Correlation between different microbial indicators counted and between temperatures of storage was determined.

Table 1: Acceptability threshold of microorganisms sought in raw milk[a]

	TBC	FC	*S. aureus*	*Salmonella sp*	*L. monocytogenes*
	---------- (cfu 100mL^{-1}) ----------			(in 25mL)	(in 25mL)
Acceptability threshold	3.00x10^5	1.00x10^1	00	Absence	Absence

[a]Microbiological criteria according to the Order No. 624-04 of Safar 17, 1425 (April 8, 2004)

Table 2: Spatial distribution of three indicators in Kenitra city[b]

	Total Bacterial Counts (TBC)							
District	Dairy	N of samples	N positive (%)	N unsafe (%)	Min. (cfu mL^{-1})	Max. (cfu mL^{-1})	Mean (cfu mL^{-1})	SD (cfu mL^{-1})
Saknia	1	20	20 (100.0)	19 (95.0)	$7.0x10^5$	$2.2x10^9$	$5.3x10^8$	$6.8x10^8$
	2	20	20 (100.0)	20 (100.0)	$6.5x10^5$	$7.0x10^9$	$8.1x10^8$	$1.6x10^9$
	3	20	20 (100.0)	20 (100.0)	$2.7x10^5$	$3.9x10^9$	$6.0x10^8$	$1.1x10^9$
	Total	60	60 (100.0)	59 (98.3)	$2.7x10^5$	$7.0x10^9$	$6.5x10^8$	$1.2x10^9$
Maâmora	4	20	20 (100.0)	20 (100.0)	$5.5x10^5$	$6.2x10^9$	$1.2x10^9$	$1.8x10^9$
	5	20	20 (100.0)	20 (100.0)	$7.0x10^5$	$3.7x10^9$	$4.2x10^8$	$9.4x10^8$
	6	20	20 (100.0)	20 (100.0)	$2.3x10^7$	$1.8x10^9$	$5.9x10^8$	$5.6x10^8$
	Total	60	60 (100.0)	60 (100.0)	$5.5x10^5$	$6.2x10^9$	$7.4x10^8$	$1.2x10^9$
	Faecal Coliforms (FC)							
District	Dairy	N of samples	N positive (%)	N unsafe (%)	Min. (cfu mL^{-1})	Max. (cfu mL^{-1})	Mean (cfu mL^{-1})	SD (cfu mL^{-1})
Saknia	1	20	20 (100.0)	20 (100.0)	$1.5x10^4$	$1.6x10^8$	$2.7x10^7$	$4.8x10^7$
	2	20	19 (95.0)	19 (95.0)	0	$4.4x10^7$	$8.1x10^6$	$1.3x10^7$
	3	20	19 (95.0)	19 (95.0)	0	$1.7x10^9$	$1.1x10^8$	$3.8x10^8$
	Total	60	58 (96.7)	58 (96.7)	0	$1.7x10^9$	$4.7x10^7$	$2.2x10^8$
Maâmora	4	20	19 (95.0)	19 (95.0)	0	$4.7x10^8$	$4.2x10^7$	$1.0x10^8$
	5	20	19 (95.0)	19 (95.0)	0	$9.5x10^8$	$5.4x10^7$	$2.1x10^8$
	6	20	20 (100.0)	20 (100.0)	$2.0x10^4$	$9.5x10^7$	$1.5x10^7$	$2.2x10^7$
	Total	60	58 (96.7)	58 (96.7)	0	$9.5x10^8$	$3.7x10^7$	$1.4x10^8$
	Staphylococcus aureus							
District	Dairy	N of samples	N positive (%)	N unsafe (%)	Min. (cfu mL^{-1})	Max. (cfu mL^{-1})	Mean (cfu mL^{-1})	SD (cfu mL^{-1})
Saknia	1	20	4 (20.0)	4 (20.0)	0	$5.0x10^5$	$2.6x10^4$	$1.1x10^5$
	2	20	3 (15.0)	3 (15.0)	0	$5.0x10^5$	$2.7x10^4$	$1.1x10^5$
	3	20	3 (15.0)	3 (15.0)	0	$5.0x10^5$	$2.6x10^4$	$1.1x10^5$
	Total	60	10 (16.7)	10 (16.7)	0	$5.0x10^5$	$2.6x10^4$	$1.1x10^5$
Maâmora	4	20	7 (35.0)	7 (35.0)	0	$1.1x10^7$	$7.1x10^5$	$2.5x10^6$
	5	20	3 (15.0)	3 (15.0)	0	$1.0x10^4$	$1.1x10^3$	$2.8x10^3$
	6	20	3 (15.0)	3 (15.0)	0	$9.7x10^5$	$5.0x10^4$	$2.2x10^5$
	Total	60	13 (21.7)	13 (21.7)	0	$1.1x10^7$	$2.5x10^5$	$1.4x10^6$

[b]Table shows the mean values of microbiological characteristics of raw cow's milk in two districts (Saknia and Maâmora) of Kenitra city (northwest of Morocco) obtained during the cold season. Here, three indicators are evaluated; total bacterial counts, faecal coliforms and *Staphylococcus aureus* (pathogen form)

RESULTS

Global microbiological characteristics of raw milk: Among 120 raw milk samples analyzed, 119 (99.2%) are unsafe to drink for their poor merchantability, 116 (96.7%) for their fecal contamination and 24 (20.0%) for their sanitary quality. The mean values of microbiological results indicated that the cfu mL^{-1} of total aerobic mesophilic flora (TBC) and coliform counts were $6.9x10^8$ [$2.7x10^5$ - $7.0x10^9$] and $4.2x10^7$ [0-$1.7x10^9$] in raw milk samples, respectively. *Staphylococcus aureus* is found in 23 (19.2%) samples with an average bacterial density of 1.4 x 10^5 cfu mL^{-1} [0-1.1 x 10^7 cfu mL^{-1}], *Salmonella sp* is absent in all samples and *Listeria monocytogenes* is isolated from one. Listerias non-pathogenic to humans have also been identified because they were confounded with presumptive bacteria of *L. monocytogenes* during the analysis. Thus, *Listeria innocua* is observed in one sample, *Listeria grayi* in two others.

When comparing the average bacteria enumerated over acceptability thresholds, a significant difference was observed with TBC ($t = 6.25$; $p<0.001$) and FC ($t = 2.51$; $p<0.05$) except with *S. aureus* ($t = 1.49$; $p = 0.14$).

Three microbiological indicators evaluated in the two districts of Kenitra city: The microbiological quality of the raw milk in districts showed that dairies of Saknia district present a higher average level for faecal coliforms, lower average level for total aerobic flora and *S. aureus* than dairies in Maâmora district as shown in Table 2. Nevertheless, this difference is not significant for TBC ($t = 0.23$; $p = 0.81$), FC ($t = -0.41$; $p = 0.68$) and *S. aureus* ($t = -0.83$; $p = 0.41$). It is also not observed between dairies, together, for TBC ($F = 1.90$; $p = 0.10$), FC ($F = 0.62$; $p = 0.69$) and *S. aureus* ($F = 1.17$; $p = 0.33$). For the three indicators, the important Standard Deviations (SD) recorded reflect high variability of hygiene in milk path with respect to each dairy, as shown in the study of Aggad *et al.* (2010).

Table 3: The linear regression equations, determination coefficients and correlation coefficients of relations between different milk indicators and between these indicators and Ts in Kénitra city[c]

Linear regression analyze				
Relationship between parameters	Equation	COC (r)	COD (R^2)	p
TBC-FC	FC = 0.886 TBC - 0.832	0.51	0.263	<0.001
TBC-*S. aureus*	-	0.05	0.003	0.57
TBC-Ts	TBC = -0.108 Ts + 9.669	-0.37	0.137	<0.001
FC-*S. aureus*	-	0.09	0.009	0.31
FC-Ts	-	0.11	0.011	0.25
S. aureus-Ts	-	-0.06	0.004	0.50

[c]Table shows the relationship between different parameters evaluated. This study concerns all values, of total dairies because no variability has been reported (according to tests conducted). COC = Coefficient of correlation (r); COD = Coefficient of determination (R^2)

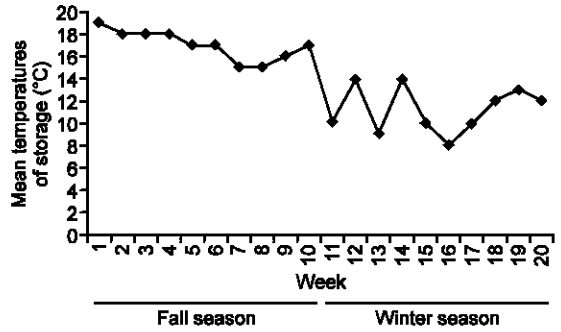

Fig. 1: Variation of mean temperatures of storage according to weeks, per season. Temperature of storage corresponds finally to the ambient room temperature. In fall, the temperature drops gradually and continues to decline in winter irregularly (presence of fluctuations)

Temperature of storage of raw milk sold in the different dairies of Kenitra city: In this study, the temperature of storage (Ts) is taken at the time of sampling, during the twenty weeks. Milk samples were collected at an average temperature of 14.1±3.4°C, with a minimum of 8.0°C at the sixteenth week and a maximum of 19.0°C at the first week (Fig. 1).

Relationship between the microbiological indicators and between these indicators and the temperature of storage of raw milk sold: In raw milk samples collected from the six local dairies, there was a negative low correlation between Ts and *S. aureus*. Positive low correlation is observed between TBC and *S. aureus*, between FC and *S. aureus* and between FC and Ts. However, a high significant correlation was estimated for the total bacterial counts when it was compared with temperature of storage and faecal coliforms, as shown in Table 3.

DISCUSSION

Generally, raw milk from a healthy cow contains a low microbial load (less than 1000 ml^{-1}), but this charge may increase up to 100 times or more when milk is left at room temperature (Richter *et al*., 1992). Moreover, in cold seasons, low temperatures delay the bacterial growth rate, but milk preserved into bars in cold water well can reach a temperature of 15°C, temperatures can allow bacterial growth, up to 15 times in 12 hrs; unlike storage temperature of milk (4 to 7°C), where growth is minimal (Calderon *et al*., 2006).

At the Gharb region, milk production suffers from the mismanagement of courses. The herds are in poor hygienic conditions (Ouazzani *et al*., 2009). Milk contaminated by high levels of spoilage bacteria usually becomes unsuitable for further processing since it does not meet the consumer's expectations in terms of health (nutritional value), safety (hygienic quality) and satisfaction (sensory attributes) (Nanu *et al*., 2007).

The results obtained during this work on the quality of raw milk in Kenitra, in the cold period of the year, indicate that milk samples collected are very unhygienic and of poor quality.

Total aerobic counts is a good indicator of general hygiene, permitting the appreciation of microbial pollution and the general quality of the product (Aggad *et al*., 2010). The number of bacteria in aseptically drawn milk was 10^2 - $9.2x10^4$ per mL, but infection occurred subsequently from the skin of animals, milkers hands, cow shed and milking utensils (Khan *et al*., 2008). The high contamination in raw milk samples indicated insufficient hygiene at milking (Aggad *et al*., 2010); during collection and transport or insufficient industrial treatment. Therefore, mixing of fresh milk with that of the day before leads to high bacterial growth (Abd Elrahman *et al*., 2009; Aggad *et al*., 2010). These germs ($6.9x10^8$ at mean (log 8.84)) [$2.7x10^5$ - $7.0x10^9$] were more superior than those reported in the East of Morocco by Afif *et al*. (2007), from other African countries such as Namibia by Bille *et al*. (2009), Sudan by Abd Elrahman *et al*. (2009), Zimbabwe by Mhone *et al*. (2011) and Algeria by Aggad *et al*. (2010) and Aggad *et al*. (2009), from Asian countries such as Malaysia by Chye *et al*. (2004), Bangladesh by Khan *et al*. (2008), Iran by Shojaei and Yadollahi (2008) and India by Lingathurai *et al*. (2009), as well as in Italy by Supino *et al*. (2004). The number of samples having less than $3x10^5$ cfu mL^{-1} was lower than that recorded by Bille *et al*. (2009).

Faecal coliforms usually indicate recent faecal contamination, because these bacteria cannot survive apart from the intestine for a long time and their number

is generally proportional to pollution degree produced by feces (Aggad *et al*., 2010; Ravanis and Lewis, 1995). The presence of high numbers of coliforms in milk provides an index of hygienic standard used in the production of milk, as unclean udder and teats can contribute to the presence of coliforms from a variety of sources such as manure, soil, food, personnel and even water (Bille *et al*., 2009). When the faecal coliforms are numerous, they may lead to food poisonings (Aggad *et al*., 2010; Audigie *et al*., 1980). Serious pathogenic coliforms are *E. coli*, *Salmonella*, *Shigella* spp. and others (Bille *et al*., 2009). The mean level of faecal coliform counts per ml in our study ($4.2x10^7$ (log 7.62) [0 - $1.7x10^8$]) correlate with findings reported in Gharb region (Northwest of Morocco) by Ounine *et al*. (2004) but was higher than the results reported in the East of Morocco by Afif *et al*. (2007), also in Namibia by Bille *et al*. (2009), in Zimbabwe by Mhone *et al*. (2011) and in India by Lingathurai *et al*. (2009). So, coliforms were detected in 97% of the samples and the same result was observed in United States (Van Kessel *et al*., 2004). The group of *Salmonella* is characterized by a complete absence in all milk samples analyzed and for all dairies studied. This was also observed in Tadla area (East of Morocco) (Afif *et al*., 2008) and in Palestine (Al-Khatib and Al-Mitwalli, 2009). In Ethiopia, investigations conducted by Yilma *et al*. (2007) showed the occurrence of Salmonella in two raw milk samples. This pathogen was also found in samples of cleaning water and udder swabs during the wet season in this study.

Staphylococcus aureus is a major food borne pathogen due to its capability to produce a wide range of heat-stable enterotoxins (Peles *et al*., 2005). *S. aureus* can gain access to milk either by direct excretion from udders with clinical or subclinical staphylococcal mastitis or by contamination from the environment during handling and processing of raw milk (Donkor *et al*., 2007; Peles *et al*., 2005). When the udder is infected, *S. aureus* is excreted in the milk with large fluctuations in counts ranging from zero to 10^8 cfu mL^{-1} (Asperger and Zangerl, 2003). *S. aureus* is considered the third most important cause of disease in the world among the reported food borne illnesses (Asperger and Zangerl, 2003; Boerema *et al*., 2006). Milk and dairy foods have frequently been implicated in staphylococcal food poisoning and contaminated raw milk is often involved (De Buyser *et al*., 2001; Peles *et al*., 2005). *S. aureus* is potentially hazardous at $>10^4$ cfu/ml (Han *et al*., 2005). The results of analysis show that 11% of raw milk samples were within an in acceptable level. The average load of these bacteria was $1.4x10^5$ cfu mL^{-1} (log 5.15) [0 - $1.1x10^7$ cfu mL^{-1}]. This count correlates with findings reported in Zimbabwe by Mhone *et al*. (2011) but was higher than that reported by Afif *et al*. (2007), Jakobsen Aakre *et al*. (2011) and Lingathurai *et al*. (2009). However, the number of samples contaminated remains lower than that recorded in other surveys (Fook *et al*., 2004; Jakobsen Aakre *et al*., 2011).

Listeriosis is a sporadic disease which is often associated with the consumption of contaminated milk and dairy products (Aygun and Pehlivanlar, 2006; Oliver *et al*., 2005). The important characteristics of *Listeria spp*. contributing to food-borne transmission are the ability to grow at a low temperature (Rahimi *et al*., 2010). There was one contamination with *L. monocytogenes* in raw cow milk, which is recovered by Rahimi *et al*. (2010) in Iran and Jakobsen Aakre *et al*. (2011) in Norway too, less than that reported by Little *et al*. (2008) in United Kingdom. *Listeria innocua* is isolated from one sample. Rahimi *et al*. (2010) had found it in numerous samples. No species of *Listeria* was detected in another similar study (Lingathurai *et al*., 2009).

Thus, a great majority of milk samples had very high levels of contamination with total microorganisms and faecal coliforms, which may reach, respectively, 10^4 and 10^8 fold the international standards. Lower findings have been reported in previous studies dealing with milk hygienic quality in other regions of Morocco (Ounine *et al*., 2004; Srairi *et al*., 2006).

The results of this study reveal that the contamination of raw milk is above standards in the two regions studied, the milk of dairies bears severe contamination. Only the level of TBC and FC had significant differences with standard Moroccan values. Therefore, these milks are unusable. According to US standards, each ml of raw milk must have TBC less than $10^5/3.10^5$ cfu mL^{-1} (Coast *et al*., 2004). Unfortunately, the mean of TBC of raw milk ($6.9x10^8$) is almost far greater than the US standard. Since the bacterial count of raw milk increases to higher than standard level, its protein, fat and lactose content will be degraded. It causes poor taste and bad smell and affects the stability of milk and its products (Shojaei and Yadollahi, 2008). Based on standards of raw milk, the coliform bacteria count in each ml must not be above 10 (based on the US regulations) and 5 (based on the EU regulations) (Hillerton and Berry, 2004; Lues *et al*., 2003; Shojaei and Yadollahi, 2008). According to Moroccan standards, a coliform count less than 10 cfu mL^{-1} is appropriate for raw milk transferring to further processing. Raw milk samples were contained in cfu mL^{-1} at mean $4.2x10^7$ in this study [0 - $1.7x10^9$]. Studies stated that a coliform count between 10^2 and 10^3 generally expresses poor milking hygiene and a coliform count greater than 10^3 depicts growth of bacteria as a result of milk handling equipment (Lues *et al*., 2003; Pamela Ruegg *et al*., 2002; Shojaei and Yadollahi, 2008).

Unlike rural areas, there are modern dairies in urban regions, located in residential neighborhoods or major boulevards that have a health certificate issued by the competent authorities concerning the cleanliness of premises, equipment production and conservation of products. Also, they are subject to regular checks on the premises and the quality of raw milk (Padilla *et al*., 2004). In our case, there is not a significant difference between the mean bacterial densities of the three

indicators in Saknia district and Maâmora district despite the difference in the socio-economic level of the two districts. The results showed a similarity in raw cow's milk quality between the two regions during the periods of investigation.

Recently, it has been shown that, in Morocco, the relationship between milk hygienic quality and milking practices is only valid for specific criteria linked to the environmental hygiene (faecal coliforms) and to the sanitary status of the udder (staphylococci). At the same time, it appears that there is no such steady relationship between milking practices and the total bacterial counts (Srairi *et al*., 2006). This could be explained by the important global microbial contamination of the majority of raw milk samples.

Otherwise, hand washing and udder cleaning before milking the cows seem to be ineffective in decreasing global milk microbial contamination because these operations are not properly executed. It was observed that very few farms use detergents during the cleaning operations of hands and udder before milking the cows. It was also noticed that less than 20% of the farms had access to disinfected tap water. In general, the water used comes from wells and is of doubtful hygienic quality (Srairi *et al*., 2006). This incomplete cleaning may further hinder the role of elementary hygiene practices as pointed out by Gran *et al*. (2002) in the context of smallholder farms in Zimbabwe.

Conclusion: The current situation is critical. It seems that there has not been any significant improvement in hygiene conditions at dairy farms level, in the last 20 years, despite the efforts made to increase milk productivity and to improve milk quality. Due to the universal standards, the raw milk of Kenitra dairies does not have proper quality for use by consumers, even in times of cold weather. These raw milks should be rejected and the dairy industry must refuse to use them in keeping with the EU regulations, according to Journal Official des Communautés Européennes[2].

REFERENCES

Abd Elrahman, S.M.A., A.M.M. Said Ahmad, I.E.M. El Zubeir, O.A.O. EL Owni and M.K.A. Ahmed, 2009. Microbiological and physicochemical properties of raw milk used for processing pasteurized milk in Blue Nile dairy company (Sudan). Aust. J. Basic Appl. Sci., 3: 3433-3437.

Afif, A., M. Faid and M. Najimi, 2007. Effects of breeding and hygienic practices on raw cow milk quality in Tadla area, Morocco. Livest. Res. Rural Dev., 19 (12).

Afif, A., M. Faid and M. Najimi, 2008. Qualité microbiologique du lait cru produit dans la région de Tadla au Maroc. Rev. Biol. Biotechnol., 7: 2-7.

Aggad, H., M. Bridja, B. Aek, M. Benaouali and A. Djebli, 2010. Some quality aspects of pasteurized milk in Algeria. World J. Dairy Food Sci., 5: 21-24.

Aggad, H., F. Mahouz, Y. Ahmed Ammar and M. Kihal, 2009. Evaluation of milk hygienic quality in Western Algeria. Rev. Med. Vet., 160: 590-595.

Akesbi, N., D. Benatya and N. El Aoufi, 2007. Implications structurelles de la libéralisation sur l'agriculture et le développement rural au Maroc. Première phase : synthèse nationale. RuralStruc Program.Washington, DC : Banque Mondiale ; Paris: Agence Française de Développement (AFD).

Al-Khatib, I.A. and S.M. Al-Mitwalli, 2009. Microbiological quality and sample collection policy for dairy products in Ramallah and Al-Bireh district, Palestine. East. Mediterr. Health J., 15: 709-716.

Amhouri, F., B. Saidi, A. Hamama and M. Zahar, 1998. Qualité microbiologique du lait cru. Cas de la région d'Errachidia. Actes Inst. Agron. Vet., 18: 31-35.

Asperger, H. and P. Zangerl, 2003. *Staphylococcus aureus*. In: Roginski, H., Fuquay, J.W., Fox, P.F. (Eds.), Encyclopedia of Dairy Sciences. Amsterdam, Boston, London, New York, Oxford, Paris, San Diego, San Francisco, Singapore, Sydney, Tokyo, pp: 2563-2569.

Audigie, C.I., J. Figarella and F. Zonszain, 1980. Biochemical analysis engineering. Publishing Doin éditeurs, Paris.

Aygun, O. and S. Pehlivanlar, 2006. *Listeria spp*. in the raw milk and dairy products in Antakya, Turkey. Food Control, 17: 676-679.

Bille, P.G., B.R. Haradoeb and N. Shigwedha, 2009. Evaluation of chemical and bacteriological quality of raw milk from neudamm dairy farm in Namibia. Afr. J. Food Agric. Nutr. Dev., 9: 1511-1523.

Boerema, J.A., R. Clemens and G. Brightwell, 2006. Evaluation of molecular methods to determine enterotoxigenic status and molecular genotype of bovine, ovine, human and food isolates of *Staphylococcus aureus*. Int. J. Food Microbiol., 107: 192-201.

Bourbouze, A., 2002. Les temps longs du développement: Patientes transformations des systèmes d'élevage au Maghreb. In: Dufumier, M. (Eds.), Un agronome dans son siècle. Actualité de René Dumont. Paris, pp: 95-107.

Calderon, A., F. García and G. Martinez, 2006. Indicadores de calidad de leches crudas en diferentes regiones de colombia. Rev. MVZ Córdoba, 11: 725-737.

Chye, F.Y., A. Abdullahb and M. Khan, 2004. Bacteriological quality and safety of raw milk in Malaysia. Food Microbiol., 21: 535-541.

Coast, D.A., D.J. Reinmann, N. Cook and P.L. Ruegg, 2004. The changing face of milk production, milk quality and milking technology in Brazil. Babcock Institute Discussion Paper No. 2004-2. The Babcock Institute for International Dairy Research and Development, University of Wisconsin-Madison, pp: 21.

De Buyser, M.L., B. Dufour, M. Maire and V. Lafarge, 2001. Implication of milk and milk products in food-borne diseases in France and in different industrialized countries. Int. J. Food Microbiol., 67: 1-17.

Djemali, M. and C. Kayouli, 2003. L'élevage laitier en Tunisie. In Djemali, M., Guellouz, M. (Eds.), Les filières lait en Méditerranée : enjeux pour un futur durable. Wageningen, pp: 98-105.

Donkor, E.S., K.G. Aning and J. Quaye, 2007. Bacterial contaminations of informally Marketed raw milk in Ghana. Ghana Med. J., 41: 58-61.

Ehsani, M.R., E. Azad, S. Dabirian and H.R. Shademani, 2004. Problems and needs of emerging dairy nations in ensuring safe milk and dairy products. In: IDF, FAO/OIE international symposium on dairy safety and hygiene (Eds.), A farm to table approach for emerging and developed dairy countries. Cape Town, pp: 27-32.

Fook, Y.C., A. Aminah and K.A. Mohd, 2004. Bacteriological quality and safety of raw milk in Malaysia. Food Microbiol., 21: 535-541.

Gran, H.M., A.N. Mutukumira, A. Wetlesen and J.A. Narvhus, 2002. Smallholder dairy processing in Zimbabwe: Hygienic practices during milking and the microbiological quality of the milk at the farm and on delivery. Food Control, 13: 41-47.

Han, B.Z., B. Sesenna, R.R. Beumer and M.J.R. Nout, 2005. Behaviour of *Staphylococcus aureus* during sufu production at laboratory scale. Food Control, 16: 243-247.

Hillerton, J.E. and E.A. Berry, 2004. Quality of the milk supply: European regulations versus practice. In: NMC 43rd Annual Meeting Proceedings (Eds.). Charlotte, NC, pp: 207-214.

Houghtby, G.A., L.J. Maturin and E.K. Koenig, 1992. Microbiological counts methods. In: Marshal, T.R. (Eds), Standard Methods for the Examination of Dairy Products. Washington, DC., pp: 213-246.

Jakobsen Aakre, R., R. Heggebø, E. Bekvik Sunde and M. Skjervheim, 2011. *Staphylococcus aureus* and *Listeria monocytogenes* in Norwegian raw milk cheese production. Food Microbiol., 28: 492-496.

Khan, M.T.G., M.A. Zinnah, M.P. Siddique, M.H.A. Rashid, M.A. Islam and K.A. Choudhury, 2008. Physical and microbial qualities of raw milk collected from bangladesh agricultural university dairy farm and the surrounding villages. Bangl. J. Vet. Med., 6: 217-221.

Kumbhar, S.B., J.S. Ghosh and S.P. Samudre, 2009. Microbiological analysis of pathogenic organisms in indigenous fermented milk products. Adv. J. Food Sci. Technol., 1: 35-38.

Lingathurai, S., P. Vellathurai, S. Ezil Vendan and A. Alwin Prem Anand, 2009. A comparative study on the microbiological and chemical composition of cow milk from different locations in Madurai, Tamil Nadu. In. J. Sci. Technol., 2: 51-54.

Little, C.L., J.R. Rhoades, S.K. Sagoo, J. Harris, M. Greenwood, V. Mithani, K. Grant and J. McLauchlin, 2008. Microbiological quality of retail cheese made from raw, thermized or pasteurized milk in the UK. Food Microbiol., 25: 304-312.

Lues, J.F.R., P. Venter and H. Van Der Westhuizen, 2003. Enumeration of potential microbiological hazards in milk from a marginal urban settlement in central South Africa. Food Microbiol., 20: 321-326.

Mennane, Z., M. Faid, M. Lagzouli, M. Ouhssine, M. Elyachioui, E. Berny, M. Ennouali and K. Khedid, 2007. Physico-chemical, microbial and sensory characterisation of Moroccan Klila. Middle East J. Sci. Res., 2: 93-97.

Mhone, T.A., G. Matope and P.T. Saidi, 2011. Aerobic bacterial, coliform, *Escherichia coli* and *Staphylococcus aureus* counts of raw and processed milk from selected smallholder dairy farms of Zimbabwe. Int. J. Food Microbiol., 151: 223-228.

Nanu, E., C. Latha, B. Sunil, M. Prejit Thomas and K.V. Venon, 2007. Quality assurance and public health safety of raw milk at the production point. Am. J. Food Technol., 2: 145-152.

Oliver, S.P., B.M. Jayarao and R.A. Almeida, 2005. Food-borne pathogens in milk and the dairy farm environment: Food safety and public health implications. Foodborne Pathog. Dis., 2: 115-129.

Omer, R.H. and A.H. Eltinay, 2008. Microbial quality of camel's raw milk in central and southern regions of United Arab Emirates. Emirates J. Food Agric., 20: 76-83.

Ouazzani, N., Z. Guessousse and M. Ouhssine, 2009. Qualité physicochimique et microbiologique du lait cru dans la région du Gharb. Actes du Congrès international "Biotechnologie Microbienne au service du Développement" (MICROBIOD) Marrakech (MAROC), MICROBIONA Edition. pp: 273. CA - 190-191.

Oudin, E., 2006. Analyse et propositions d'améliorations du fonctionnement de coopératives de collecte laitière au Maroc: Approche par les systèmes d'information. Mémoire de fin d'études. Institut National Agronomique de Paris-Grignon. DAA Agronomie - Environnement. pp: 115.

Ounine, K., A. Rhoutaisse and N.E. El Haloui, 2004. Caractérisation bactériologique du lait cru produit dans les étables de la région du Gharb. Al Awamia, 109-110: 187-204.

Padilla, M., M. Frem, E. Godart, S. Haddad and D. Tanriverdi, 2004. Contribution du secteur informel à l'approvisionnement en produits laitiers des villes méditerranéennes: Le cas de la Tunisie, du Maroc, du Liban et de la Turquie. Cah. Agric., 13: 79-84.

Pamela Ruegg, L.D.V.M., M.P.V.M. Douglas and J. Reinemann, 2002. Milk quality and mastitis tests. Bovine Pr., 36: 41-45.

Peles, F., M. Wagner, L. Varga, I. Hein, P. Rieck, K. Gutser, P. Kereszturi, G. Kardos, I. Turcsanyi, B. Beri and A. Szabo, 2005. Coagulase-positive staphylococci and *Staphylococcus aureus* in food products marketed in Italy. Int. J. Food Microbiol., 98: 73-79.

Rahimi, E., M. Ameri and H. Momtaz, 2010. Prevalence and antimicrobial resistance of *Listeria* species isolated from milk and dairy products in Iran. Food Control, 21: 1448-1452.

Ravanis, S. and M.J. Lewis, 1995. Observations on the effect of raw milk quality on the keeping quality of pasteurized milk. Lett. Appl. Microbiol., 20: 164-167.

Richter, R.L., R.A. Ledford and S.C. Murphy, 1992. Milk and milk products. In Vanderzant, C., Splittstoesser, D.F. (Eds.), Compendium of Methods for the Microbiological Examination of Foods. Washington, DC, pp: 837-838.

Shojaei, Z.A. and A. Yadollahi, 2008. Physicochemical and microbiological quality of raw, pasteurized and UHT milks in shops. Asian J. Sci. Res., 1: 532-538.

Srairi, M.T., J. Moudnib, L. Rahho and A. Hamama, 2006. How do milking conditions affect the hygienic quality of raw milk? Case study from Moroccan dairy farms. Livest. Res. Rural Dev., 18 (7).

Supino, M.T., M. Gallo, G. Capo, C. Morena, G. Durnate and G. Galiero, 2004. Buffalo milk produced in the province of salerno: Evaluation of sanitary and product parameters *Bubalus bubalis*. CAB Abs., 10: 22-26.

Van Kessel, J.S., J.S. Karns, L. Gorski, B.J. McCluskey and M.L. Perdue, 2004. Prevalence of *Salmonellae*, *Listeria monocytogenes* and fecal coliforms in bulk tank milk on US dairies. J. Dairy Sci., 87: 2822-2830.

Yilma, Z., B. Faye and G. Loiseau, 2007. Occurrence and distribution of species of *Enterobacteriaceae* in selected Ethiopian traditional dairy products: A contribution to epidemiology. Food Control, 18: 1397-1404.

[1]Andrews, W. Manual of food quality control, 4. rev. 1: microbiological analysis. FAO Food and Nutrition Paper. 1992; No. 14/4(Rev.1).
[2]Journal Officiel des Communautés Européennes (1992). Directive 92/46/CEE du conseil du 16 juin, Bruxelles, L268/17.