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Full Length Research Paper

Microbiological and Physico-chemical Proprieties of Raw Sheep Milk from Sardi Breed

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Fifty-four samples of raw sheep milk (morrocan Sardi breed) were collected in stables of 18 farms from different regions in Morocco and were analyzed for their microbiological and physico-chemical parameters. The temperature of raw milk just been collected from sheep is 36.9±0.2°C, its pH is 6.54±0.14 and titratable acidity is 23.1°D. The average freezing temperature is between -0.57°C and -0.56°C. Raw sheep milk had a variable charge of FMAT 4.5×10^3 to 9.4×10^7cfu/ml, 1.2×10^5cfu/ml of total coliforms and 2.10^4cfu/ml of fecal coliforms. However, all milks are free of Salmonella, Shigella, *Listeria monocytogenes* and Clostridia. The average fat content is 67.85±6.55 g/l. The dry matter content is between 153 and 183 g/l, while the ashes are from 6.9 to 8.7g/l. The lactose concentration varies between 34.5 and 45.34g/l and the calcium content is 1.84±0.06g/l. The results of this study indicate that the microbiological quality of raw sheep milk sampls from Sardi breed is below international standards. Low levels of coliforms and Escherichia coli as well as the total absence of Salmonella, Shigella and Clostridia indicate that milk is good, and reflect also the good production condition and the respect of good hygienic practices during milking.

Keywords: Sheep, Sardi breed, raw milk, physico-chemical characteristics, hygienic quality.

INTRODUCTION

Milk is a highly nutritious food for its richness in carbohydrates, fats, vitamins and minerals (Blowey and Edmondson 2000; Jones 1999). It is a major food taken by populations in arid and semi-arid regions of the world; it is often consumed raw or after processing.

In Morocco, milk and its derivatives are an important source of animal protein for the population. Thus, the individual consumption of milk and dairy products is highly

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different. On average, 81±32kg of milk consumed per person annually is distributed as follows: 36 kg (pasteurized drinking milk or UHT), 17kg (yoghurt), 11kg (unpasteurized milk), 8.9kg (cheese), 8kg (butter) and 0.1kg (leben-curd) (Srairi 2011). According to data from the Ministry of Agriculture and Maritime Fisheries (Sraïri et al., 2009; Sraïri and Karbab 2010), milk production does not cover the needs of citizens, which forces the state to allow the import milk as powder and its derivatives. The search for new sources of milk becomes increasingly essential.

Consumption of sheep milk dates back to thousands of years before Jesus Christ in the Middle East. A fresh sheep milk has all the vitamins and food supplements are highly appreciated (Baltadjieva et al., 1982).

Richer in protein and fat, sheep milk has a soft and slightly sweet taste. It has a dry matter content much higher than cow and goat milk and contains in double fold minerals such as calcium, phosphorus and magnesium and any of the vitamin B group (Baltadjieva et al., 1982). Sheep milk has an advantage for people with allergies or intolerances to cow milk. In addition, (particles of fat) of sheep milk are thinner and therefore more digestible than cow milk. It seems to be so perfect for older people or children that follow special diets (Verdier-Metz et al., 2009).

Of its biochemical composition, milk and its derivatives constitute a favorable environment to the growth of microorganisms specially pathogenic bacteria and fungi; this is why they have always been considered as one of the main causes of food poisoning (Mennane et al., 2007; Grant et al., 2002). Therefore, knowledge of the chemical and microbial composition of the milk is of special interest especially for farmers and processors of milk. The price of the latter is calculated based on the total number of bacteria that should be as low as possible (Verdier-Metz et al., 2009).

Production must therefore be strictly controlled, because of the potential risks it may pose to human health.

Very popular nationally, the Sardi breed occupies a special place in farming in Morocco. It especially dominates regions in the triangle formed by Beni Mellal, Khouribga and Settat (regions of Chaouia Ouardigha and Marrakech Tensift El Haouz). Its membership exceeds 2.1 million herds in 1998, representing 13% of total national herd (Transfert de 2007). Indeed, a study on Moroccan dairy sheep breeds showed that daily milk production of a Sardi sheep is higher compared to other breeds (Boujenane 1995). However, to our knowledge, a comprehensive study on the hygienic quality and chemical composition of sheep milk from Sardi breed has yet been the subject of scientific publication.

The main objective of this research, which is the first approach to the study of sheep milk in Morocco ,is to assess the hygienic and physico-chemical quality of raw sheep milk from Sardi breed collected from midsize stables of 5 regions in Morocco, namely : El Gharb Chrarda Beni Hssen (EL Mnasra), Rabat-Sale-Zemmour-Zair (Shoul, Zair and EL Gnzra), Casablanca (Oulad Hriz), Chaouia ouardigha (Benhmed, Bni Meskin) and Marrakech-Tensift-El Haouz (Marrakech, El Kelâa of Sraghna).

MATERIALS AND METHODS

Sampling

Analyzed samples are whole raw milks of small mix from 5 Sardi ewes, for each sample, in early lactation (1st, 2nd, and 3rd months of lactation). Ewes are aged from1to 3 years (a total of about 300 females were treated in this study, belonging to herds in 18 rural and suburban farms regions).

Ewes were randomly taken for milking. It was done manually in March 2014, in the morning, before the herds were released for grazing. The milk was collected in sterile bottles and transported in a cooler under a temperature of 4°C in the dark to the laboratory. All analyses were performed in duplicate for each sample; the values shown in the tables are averages of the results obtained for samples already mentioned for each region.

Microbiological Analysis

For each sample, 10ml of raw sheep milk was added into an Erlenmeyer flaskto90ml of sterile saline. Thus, a mother dilution of 10^{-1} was obtained, from which decimal dilutions of 10^{-7}were performed.

Total aerobic mesophilic flora (FMAT), a good indicator of contamination, is counted on PCA agar incubated for 48 h at 30°C.

Coliforms are sought on desoxycolate lactose agar (DL) incubated for 24 h at 37°Cfor total coliforms and 44°Cfor fecal coliforms. Fecal streptococci were enumerated on sodium azide after 48 h of incubation at 37°C. Staphylococci are enumerated on Baird Parker agar added to the egg yolk and of potassium tellurite; and then incubated for 48 h at 37°C.

For *Salmonella*, a pre-enrichment using selenite cysteine medium for 12 h at 37°C was done, followed by an enrichment using broth Tetrathionate for 24 h at 37°C. Then enumeration and isolation were performed on the medium SS (*Salmonella-Shigella*) after24 h of incubation at 37°C.

Sulphite-reducing clostridia are counted in the reinforced *Clostridium* Agar medium culture in tubes to promote anaerobic conditions, with heat treatment for 10 min at 80°C and also to activate the clostridia spores. They can persist in a latent form in milk, germinate when conditions are favorable and secret toxic substances. The tubes are

incubated for 48 h at 37°C. Only black colonies are counted.

Yeasts and molds were counted on Sabouraud dextrose medium at 4% and incubated for 5 days at 25°C. Lactic acid bacteria are enumerated on MRS agar medium (Man Rogosa Sharpe, Difco, Detroit, USA), M17 (Oxoid) and Eliker (Oxoid) and incubated for 48h at 30°C.

Physico-chemical Analysis

Physical Parameters

Temperature

Just after milking, the milk temperature is measured with a thermometer.

PH

One of the raw milk samples was taken to the laboratory. The pH was measured at 20°Cusinga pH meter Orion Type after calibration with Ph 7.00and 4.00 by soaking in a small volume milk collected in a beaker.

Titratable Acidity

This parameter is measured by titration with NaOH Dornic Soda N/9N in the presence of phenolphthalein and is expressed as percentage of lactic acid. A specific sample of 10ml of milk was placed in a100 ml beaker with 0.1mlof1% phenolphthalein in 95% alcohol. Dornic Soda (N/9) is added (in the burette) for it to turn pink. The pink color should persist for at least 10 seconds (GUIRAUD 1998).

Density

The density is measured using a thermo couple on the milk lacto densimeter kept standing. The idea is to immerse a hydrometer in a test tube filled with 100 ml milk sample. When stabilized, direct reading, gives us the result. The density is measured at 20°C.

Freezing Temperature

The freezer temperature was determined using an incubator/ freezer (BIO Firlabo).

Chemical Analysis

Dry Matter and Ash

We introduce in a pre-weighed capsule 10ml of milk using a volume tric pipette. Then it was placed in a set at 103±2°C for 3 h. After drying, the capsules were weighed and the difference between the two weights was multiplied by 100. Ash content, expressed in gram per liter of milk, was determined after drying at 550°C.

Fat

The fat content is determined by the acid-butyrometric Gerber's method (AFNOR standard NF V04-210). It consists of milk attacked by sulfuric acid and separated by centrifugation in the presence of alcohol isoamyl fat released. Milk proteins are dissolved by the sulfuric acid, are resistant to the action of concentrated sulfuric acid fat and are separated when hot by centrifugation, in the presence of isoamyl alcohol (3-methyl-1-butanol), which facilitates separation. We measure the volume from 65 to 70°C in a Butyrometer of Gerber (Granville and Desmet 1951).

Dosage Lactose

Lactose is expressed in gram per liter and is determined by the Bertrand method (Granville and Desmet 1951).

Determination of Calcium

The dosage of Calcium (Ca) is performed using atomic absorption spectrometer in the presence of lanthanum chloride (Sigma Chemical, St Louis USA)(Afnor, 1993).

RESULTS

Microbiological Analysis

The raw sheep milk analyzed contains a variable charge of FMAT, between 4.5 $\times 10^3$ to 9.4 $\times 10^7$cfu/ml (Table I), reflecting the variability of milking practices from one farm to another. The highest rate was observed in the samples that originated from El Kelâa of Sraghna. Indicators of general hygiene and fecal contamination, total and fecal coliforms are present at low or missing values in most samples. Their number does not exceed 1.2 $\times 10^5$ (CFU/ml) for total coliforms and 1.5 $\times 10^4$ for fecal coliforms.

The analysis revealed samples contaminated with streptococci. The average content varies from 1.1 $\times 10^2$CFU/ml with an average value of 0.4 $\times$ 10^3CFU/ml. *Staphylococci, Salmonella, Shigella* and *Clostridia* were totally absent in all samples.

The average charge of lactic bacteria is 8.1±1.33 $\times 10^5$CFU/ml, with fluctuations ranging from5.0 $\times 10^5$ to 9.5 $\times 10^5$ CFU/ml. The average yeast load is 1.2 $\times 10^4$ CFU/ml.

Table I. Microbiological analysis (cfu / ml) of raw sheep milk of samples tested

SAMPLES		FMAT	COLIFORMS		STREPTOCOCCI	YEASTS	LACTIC BACTERIA
			Total coliforms	Fecal coliforms			
Region of El Gharb	EL MNASRA	$4,5\ 10^3$	<10	<10	$0,5\ 10^2$	$2,6\ 10^3$	$7,9\ 10^5$
Region of Rabat-Sale-Zemmour Zair	Shoul	**$1,2\ 10^4$**	<10	<10	<10	$0,2\ 10^4$	$7,7\ 10^5$
	Zair	$2,3\ 10^4$	<10	<10	$0,1\ 10^2$	$2,3\ 10^4$	$8,3\ 10^5$
	El Gnzra	$7,4\ 10^4$	<10	<10	$0,3\ 10^2$	$1,3\ 10^3$	$9,5\ 10^5$
Region of grand Casablanca	Oulad Hriz	$5,3\ 10^6$	<10	<10	$1,1\ 10^2$	$1,1\ 10^4$	$9,2\ 10^5$
Region of Chaouia Ouardigha	Ben Hmed	$8,2\ 10^4$	<10	<10	$0,2\ 10^2$	$0,5\ 10^5$	$8,3\ 10^5$
	Beni Meskin	$6,1\ 10^5$	<10	<10	$0,1\ 10^2$	$2,8\ 10^3$	$8,7\ 10^5$
Region of Marrakech Tensift El Haouz	Marrakech	$6,4\ 10^7$	$1,2\ 10^5$	$1,5\ 10^4$	$3,6\ 10^2$	$3,7\ 10^4$	$9,0\ 10^5$
	El Kelâa of Sraghna	**$9,4\ 10^7$**	$1,2\ 10^5$	$2\ 10^4$	$4,1\ 10^2$	$7,4\ 10^4$	$5,0\ 10^5$

Physico-chemical Analysis

The results of the physico-chemical analysis are shown in Table II.

Temperatures measured immediately after milking are between 36.7and 37.1°C (Table II).The pH varies from 6.43to 6.65, with an average of 6.54. The value of titratable acidity is 23.1°D. Density measured at 20°C is between 1.032 and 1.037g/L, with a mean value of 1.034 g/L.

The average fat content is 67.45g/L. The average freezing temperature is -0.57°C. The solid content is between 153 and183 g/L, with an average of 168 g/L. The average concentration of lactose is 40.9g/L, where as the calcium content is1.84±0.06g/L.

DISCUSSION

The total aerobic mesophilic flora (FMAT), payment base for milk quality, is considered as a general indicator of the overall product quality. It reveals the conditions of production, particularly hygienic practices during milking.

The results obtained through this study indicate that samples of raw sheep milk analyzed are loaded with more microorganisms than cow and goat milk: 3.5×10^2 CFU/ml on the day of packing and3×10^4CFU/ml on the deadline for consumption, according to (Joffin and Joffin 1999). According to (Dacosta 2000) and (El-Shafie et al., 2008), sheep milk has high antibacterial properties that ensure cool conservation without immediate fermentation. This finding opposes the relatively high microbial load in the samples analyzed. In this sense, (Calvo and Olano 1992). reported that when milk is collected under appropriate hygienic conditions, the total flora does not exceed 10^3 to 10^4 CFU/ml. Indeed, 70% of sheep milk from Sardi breed collected did not exceed the European standards(500×10^3CFU/ml for raw milk intended for the manufacture of raw milk products, 1500×10^3CFU/ml for milk intended for heat treatment) laid down by Directive92/46 (Anonymous 1992). These results are similar to those found by several authors in various countries: Switzerland (Muehlerr et al., 2003; Zweifel et al., 2005). Spain (Gonzalo et al., 2006). North-eastern Greece (Alexopoulos et al., 2011), and Morocco (Bouazza et al., 2012). Noting that, in our case, the highest load was detected in samples of El Kelâ as of Sraghna. The importance of this high microbial contamination observed in sheep milk collected from Marrakech-Tensift-El Haouz is due to several factors:

Table II. Physico-chemical analysis of raw sheep milk of samples tested

Physical Parametrs		Milk after milking (°C)	pH	Acidity (%)	Density of whole milk at 20°C	fat (g/l)	Dry extract (g /l)	Freezing temperature (°C)	Lactose (g/l)	Calcium (g/l)
Region of Gharb	EL MNASRA	36,9	6,45	24,5	1,036	68,7	168	-0,56	42,43	1,87
Region of Rabat-Sale-Zemmour Zair	Shoul	36,9	**6,65**	22, 2	1,034	67,5	164	-0,57	40,9	1,86
	Zair	36,8	6,61	**21,1**	1,035	67,6	160	-0,57	38,5	1,80
	El Gnzra	36,9	6,59	22,1	1,034	66,6	154	**-0,57**	**34,5**	1,84
Region of Casablanca	Oulad Hriz	**36,7**	6,55	22,5	1,035	**61,3**	**153**	**-0,56**	37,45	1,88
Region of Chaouia Ouardigha	Ben Hmed	36,8	6,49	23,9	1,036	73,7	183	-0,57	43,27	1,89
	Bni Meskin	36,9	6,55	24,6	**1,037**	**74,4**	**185**	-0,57	**45,34**	**1,9**
Region of Marrakech Tensift El Haouz	Marrakech	36,9	**6,43**	**25**	1,033	65,8	181	-0,57	42,26	1,81
	El Kelâa of Sraghna	**37,1**	6,57	24,9	**1,032**	64,9	173	-0,57	39,40	**1,78**

hygiene during milking, transport conditions and favorable growth temperatures for microorganisms during their transport to the testing laboratory.

The search for indicators of fecal contamination from micro-organisms can be used to judge the hygienic condition of the product. Even at low levels, they also testify to the deterioration of hygienic conditions during milking or during transport. Levels of coliforms found are comparable to those reported by (Benalia et al., 2013):1.1 × $10^5$for total coliforms CFU/ml and 1.5 × $10^4$for fecal coliforms. Milk has low and normal microbial over all burdens, while milking technique is traditional. Coliforms seen only in the sheep milk collected from Marrakech-Tensift-El Haouz is due to trafficking and the distance to get to the laboratory. Despite this, the contents of coliforms (total, fecal) found are lower than those provided by (Gasmi-Boubaker et al., 2013).

The rate of streptococci is related to the health of the sheep, the hygienic conditions of trafficking, and possible contamination during enumeration. In fact, in our case, this rate does not exceed the values recommended by the Moroccan and international standards. The yeast load between1.3 × 10^3 and 0.5 × 10^5CFU/ml is normal and it will allow necessary fermentation to produce milk derivatives.

The raw sheep milks tested have a very good microbiological quality and hygienically, they are acceptable. The absence of salmonella, staphylococci and clostridia indicates a healthy sheep selected from stables and also a healthy trafficking (Hamama and Bayi 1991; Pollma and Sillerker 1984).

PH tells of the milk freshness precisely. The average pH values of raw sheep milk from Sardi breed analyzed range between 6.43and 6.6. These values found in this study are similar to those reported by some authors such as (Delacroix-Buchet and Marie 1994) and (Baltadjieva et al., 1982) on sheep milk from French Lacaune breed and Plovdiv regions in Bulgaria and Ioannina in Greece. Indeed, compared to human and cow milk, sheep milk is slightly acidic. In this context, Labioui (2009) evaluated the pH of raw cow milk in the region of El Gharb and gave average values of 6.70±0.15.These values are lower than those found by (Mathieu 1998), for ten samples of cow milk collected under traditional milking conditions. The highest value is marked in samples that originated from Shoul (6.65) in the Region of Rabat Sale while the lowest value is recorded in the samples collected in Marrakech (6.43). The pH also depends on the presence of casein, phosphoric anions and citric acid.

Titrable acidity values are high compared to those of cow milk (Bennacir 1980). The average of 23.1°D remains never the less in the range of 21 to 24°D of fresh milk. This parameter is low in samples from Rabat-Sale and higher in those from Marrakech stables. Acidity depends mainly on the casein content, minerals and ions (Alais 1984); it also depends on hygienic conditions during milking, total microbial flora and its metabolic activity (Mathieu 1998) and on handling of milk.

The average density values(1.032 to 1.037 g/L)are similar to those reported by (Baltadjieva et al., 1982). (1.033 to 1.038 g/L). For cons, the sheep milk density

(1.028 to 1.034 g/L) appears to be higher than that of raw cow milk (Mathieu 1998). The average of the highest density is observed in Chaouia Ouardigha Region. However, this parameter depends on the dry matter content, fat content, the increase in temperature and food availability. (Baltadjieva et al., 1982), also reported that during lactation, density and acidity of milk fluctuate slightly by region (Baltadjieva et al., 1982).

Sheep milk is richer than cow and goat milk. In our case, the average dry matter content is in the order of168 g/L against only 121.7g/L for cow milk (Labioui et al., 2005), while the ashes about 6.9 and 8.7g/L. The value of the dry extract is in the range of international standards, depending on climatic and dietary factors.

On average, sheep milk contains 61 to 75g/L of fat. This content is confirmed in this study and seems higher compared to cow milk (31.45 g/L), according to Labioui (Labioui et al., 2005). The higher fat content of sheep milk is noted in the samples collected in Ben Hmed and Bni Meskin from Chaouia Ouardigha Region, while the lowest fat content is marked in samples collected in Oulad Hriz from Casablanca Region. In fact, the variability of the fat content also depends on factors such as weather conditions, lactation stage and power supply (Seboussi et al., 2010).

From the results compiled in Table II, the average lactose content of the raw sheep milk from Sardi breed varies between 34.5 and 45.34g/L. These levels appear lower than those of cow milk(49.00 g/L) (Mathieu 1998; Labioui et al., 2005). Lactose, the main sugar found in milk and substrate of lactic fermentation for lactic acid bacteria ,is in the normal range for raw milk(40 to 50g/L).The high lactose content of the sheep milk is observed in Chaouia Ouardigha Region (Beni Meskin), while the lowest value is recorded in Rabat-Sale Zair Region (El Gnzra). The lactose content seems to depend mainly on the breed type, the stage of lactation and hydration status (Yagil and Etzion 1980).

The calcium content in sheep milk (1.78to 1.9 g/L) is similar to that reported by (Baltadjieva et al., 1982), (1.86 to 1.94 g/L). Generally, it is also greater than that of cow milk (0.8 to 1g/L). The higher mineral content is observed in samples from Chaouia Ouardigha (1.9g/L), while the lowest value is recorded for samples collected from El Kelâa of Sraghna (1.78g/L).

CONCLUSION

Traditional milking done in 18 farms allowed us to obtain sheep milk from Sardi breed of good bacteriological quality and which is also high in fat, carbohydrates and calcium. It is used for the production of organic raw milk products of good taste: lbens, yoghurt, fresh cheese, etc.

Variations between regions are important, as they denote a lack of compliance with good manufacturing practices at the trafficking and transport of raw milk. Pasteurization is important and requires the combination of temperature and time. Disinfecting equipment and hygienic milking immediately followed by refrigeration of milk reduce contamination. Timeliness and more rigorous control of the market for veterinary products would reduce the rate of residues. The presence of pathogenic bacteria and residues should be examined with a view to analyzing the risk to consumers. The concerted action of the various actors in the sector, combined with their incentives could improve the quality needs.

Ultimately, this study also shows the effect of variations between morrocan regions, and the difference between the performances of grazing dairy sheep cannot be attributed to the nature of the operation in the strict sense, but depends essentially on modifying the nutrient in take observed during this period. The causes of these changes (especially the intake and/or the nutritional value of grazed grass) as well as director indirect effects of non-food factors (climatic or social) from one region on the performance of the animals need to be confirmed.

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REFERENCES

AFNOR (1993). Contrôle de la qualité des produits alimentaires : lait et produits laitiers : analyses physicochimiques. Paris La Défense, 4e éd., 581 p.

Alais C (1984). La micelle de caséine et la coagulation du lait. In Science du lait : Principes des techniques laitières. Paris : Ed. Sepaic,4e ed., 723-764, 1984

Alexopoulos A, Tzatzimakis G, Bezirtzoglou E, Plessas S, Stavropoulou E, Sinapis E (2011). Microbiological quality and related factors of sheep milk produced in farms of NE Greece. Anaerobe, 17(6), pp. 276 - 279, 2011.

Anonymous (1992). « Directive 92/46/CEE du Conseil du 16 juin 1992 arrêtant les règles sanitaires pour la production et la mise sur le marché de lait cru, de lait traité thermiquement et de produits à base de lait, Luxembourg, 1992.

Baltadjieva M, Veinoglou B, Kandarakis J, Edgaryan M, Stamenova V (1982). La composition du lait de brebis de la région de Plovdiv en Bulgarie et de Ioannina en Grèce. Le Lait, 62, pp. 55-66, 1982.

Benalia Y, Ahcène H, Mostefaoui A, Iaoun A, Titouche Y, Iabiad M, Magtouf L, Mati A (2013). Qualité microbiologique du lait cru ovin collecte dans la steppe centrale de l'algérie. Afrique Science 09(2), pp. 86 – 92, 2013.

Bennacir M (1980). Contribution à l'étude de la qualité chimique et bactériologique des laits des centres de collecte du Gharb. Thèse 3eCycle IAV, pp. 72-75 (215 f) 1980.
Blowey R, Edmondson P (2000). Mastitis control in dairy herds: an illustrated practical guide. Farming Press, Tonbridge, pp. 134-138, 2000.
Bouazza F, Hassikou R, Ohmani F, Hmmamouchi J, Ennadir J, Qasmaoui A, Mennane Z, Chrof R, Khedid K (2012). African Journal of Microbiology Research, 6 (11), 2768p, 2012.
Boujenane I (1995). Convention N° 4332 DE/DPA/SAG relative à l'analyse des données de contrôle de performance. MAMVA-IAV, Rabat, 1995.
Calvo MM, Olano A (1992). Review: thermal treatment of goat's milk .Rev Esp Ciens Tecnol aliment, 32, pp. 139-152, 1992.
DACOSTA Y (2000). La bio-protection des aliments. L'antagonisme microbien au service de la sécurité et de la qualité microbiologique. Ed: Technique et documentation, 2000.
Delacroix-Buchet A, Marie C (1994). Comparaison des variants A et C de la caseine B des laits de vaches tarentaises en fabrication de fromage de type beaufort .I. aptitudes fromagères et rendements en frais, Lait 74, pp. 343-360, 1994.
El-Shafie HA, Ibrahim N, ABD El-Sabour H, Mostafa YA (2008). Purification and characterization of bacteriocin produced by isolated strain of Lactococcus lactis. Journal of Applied Sciences Research, 4(11), pp. 1315-1321, 2008.
Gasmi-Boubaker A, Mosquera-Losada MR, Boubaker B (2013). In vitro fermentation of diets incorporating carob pulp using inoculum from rabbit caecum.South African Journal of Animal Science, 43 (No. 1), 2013.
Gonzalo CJA, Carriedo E, Beneitez MT, Jua´rez LF, De La Fuente F (2006). San Primitivo,Bulk Tank Total Bacterial Count in Dairy Sheep:Factors of Variation and Relationship with Somatic Cell CountJ. Dairy Sci. 89, pp. 549–552,2006.
Grant IR, Hitchings EI, Mac Cartney A, Ferguson F, Rowe MT (2002). Effect of commercial high-scale high-temperature short-time pasteurization on the viability of Mycobacterium paratuberculosis in naturally infected cows' milk. Appl. Environ. Microbiol. 68, pp. 602-607, 2002.
Granville A, Desmet F (1951). Détermination de la teneur en matière grasse des fromages, au moyen du butyromètre Gerber. Le Lait 31, 308, pp. 501-505, 1951.
GUIRAUD JP (1998). Microbiologie alimentaire, microbiologie des principaux produits laitiers. Edition DUNOD, Paris, 651, 1998.
Hamama A, Bayi M (1991). Composition and microbiological profile of two Moroccan traditional dairy products : raib andjben. J. Soc. Dairy Teehnol. 44, pp. 118 -120, 1991.
Joffin C, Joffin JN (1999). Microbiologie alimentaire. Collection biologie et technique. 5ème édition, 11p. 1999.
Jones GM (1999). On-farm tests for drug residues in milk. Milk Quality and Milking Management, Department of Dairy Science, Virginia Tech., pp. 401-404, 1999.
Labioui H, Elmoualdi L, El Yachioui M, Ouhssine M (2005). Sélection de souches de bactéries lactiques antibactériennes. - Bull.Soc. Pharm. Bordeaux, 144(3-4), pp. 237-250, 2005.
Mathieu J (1998). Initiation à la physicochimie du lait. Paris : Lavoisier, « Tec et Doc », 220p, 1998.
Mennane Z, Ouhssine M, Khedid K, EL Yachioui M (2007). Hygienic quality of raw cow's milk feeding from domestic waste in tow regions in Morocco. International Journal of Agriculture and biology 9,pp. 46-48, 2007.
Muehlerr JE, Zweifel C, Corti S, Blanco JE, Stephan R (2003). Microbiological quality of raw goat's and ewe's bulk-tank milk in Switzerland. J. Dairy Sci.,86(12), pp. 3849-3856, 2003.
Pollma L, Sillerker JH (1984). Salmonella. In Compendium of methods for the microbiological examination of foods. American Public Health Association, 2nd ed., p. 237-245 (914 p.), 1984.
Seboussi R, Faye B, Alhadrami G, Askar M, Ibrahim W, Mahjoub B, Hassan K, Moustafa T, Elkhouly A (2010). Selenium Distribution in Camel Blood and Organs After Different Level of Dietary Selenium Supplementation. Biological Trace Element Research January, Volume 133, Issue 1, pp. 34-50, 2010.
Siboukeur O (2007). Etude du lait camelin collecté localement : caractéristiques physico-chimiques et microbiologiques; aptitudes à la coagulation. Thèse de Doctorat, Institut National Agronomique El-Harrach-Alger, pp. 27, 38, 71, 86, 87, 2007.
Sraïri MT, Karbab A (2010). Consommation de lait et de produits laitiers dans la ville de Rabat (Maroc) : effets des facteurs socio-économiques, Tropicultura; 28, pp. 211-216, 2010.
Sraïri MT, Rjafallah M, Kuper M, Le Gal PY (2009). Water productivity through dual purpose (milk and meat) herds in the Tadla irrigation scheme, Morocco.˙Irrigation and Drainage Supplement: Irrigation Management in North Africa.Volume 58, Issue Supplement 3, pp. S334–S345, 2009.
Srairi MT (2011). *Dairy development in Morocco*. Food and Agriculture Organization of The United Nations (FAO) , Rome, 2011.
Transfert de Technologie en Agriculteur, La race ovine Sardi: Ses performances en race pure et en croisement, Bulletin Mensuel de Liaison et d'Information du PNTTA. N 149, 2007.
Verdier-Metz I, Michel V, Delbès C, Montel MC (2009). Do milking practices influence the bacterial diversity of raw milk? Food Microbiol., 26,305-310, 2009.
Yagil R, Etzion Z (1980). Effect of drought condition on the quality of camel milk. Journal of Dairy Research, Volume 47; Issue 02, pp. 159-166, 1980.
Zarkadas M, Scott F, Salminen J, Ham Pong A (1999). Etiquetage des aliments allergènes courants au Canada - Revue de la littérature. Canadian Journal of allergy and clinical immunology;4(3), pp. 118-141, 1999.
Zweifel C, Muehlerr JE, Ring M, Stephan R (2005). Small Ruminant Research, pp. 58-63, 2005.