The International Journal of Innovative Approaches in Agricultural Research
Volume 2 Issue 1, March 2018

Milk Quality and Food Practices in Dairy Cattle Farming in the Semi-arid Region of Setif

L.M. Mansour[1], K Cheniti[2] & K. Abbes[3]

Abstract: The purpose of this work was to bring out the diversity of milks produced in the semi-arid Algerian Setif area and link it to the practices of pastoralists mainly in the food sector. In 24 dairy farms, representing different feeding strategies, a breeding follow-up detailing the ways of driving cows was adopted. In parallel, a seasonal analysis of the physicochemical and microbiological characteristics of 144 mixed milk samples (6 samples per season /spring, summer/ and per farm during two passages) in 24 farms was carried out. Milk quality parameters were highly variable and generally satisfactory. The physicochemical composition of the milks could be described as average for the majority of the samples, and marked a remarkable normativity. The majority of the farm milk samples displayed average fat content compliant. It was below 35 g/l in only 21.52% of the samples and showed significant fluctuations during the summer season, ranging from 31 to 41.7 g/l. Seven farms had average contents of above 35g/l for both periods. Variations in the butter fat between the different farms could be explained by the production and eating behavior strategies adopted by each farm. The protein content recorded in both seasons appeared much more stable than the fat content of all the milk collected. The average protein level for the 24 farms was 34.21g/kg. However, 8.33% of the milk samples in spring and 12.5% of those collected in summer had levels considered insufficient (less than 33g/kg). The microbiological results were highly variable with average counts of total aerobic mesophilic microflora exceeding the maximum standard of 105 CFU/ml. Hygienic quality was a concern for all milk samples despite the variety of situations. The typology of milk samples allowed to describe the diversity in milk quality based on variations in the levels of useful materials and fluctuations in total microflora.

Keywords: *Dairy cattle, Raw milk, Diversity, Physicochemical quality, Hygienic quality, Typology.*

DOI: https://doi.org/10.29329/ijiaar.2018.133.5

[1] Department of Agronomy, Faculty Science of Nature and Life, Ferhat Abbes University, 19000, Algeria.

Correspondence: mlyndamaya@yahoo.fr

[2] Department of Agronomy, Faculty Science of Nature and Life, Ferhat Abbes University, 19000, Algeria.

[3] INRA. Algeria, Agrosystems Division of Eastern Regions, Sétif, Algeria.

INTRODUCTION

Milk is a biological food with obvious nutritional value (Faye and Loiseau, 2000). It is considered to be a major animal protein source with a vital role in human nutrition. Due to its high consumption by the Algerian population (more than 147 l /inhabitant/year in 2012), it is highly strategic (Makhlouf et al., 2015). National milk requirements are estimated at 4.5 billion liters, while national production covers only about 40%. Domestic supply is still largely assured by imports (18%) and 63% of the total food bill in 2014, the equivalent of $ 2.05 billion (Makhlouf and Montaigne, 2017).

The interest in the development of local milk production thus becomes a priority for the public authorities. Also, because the milk production in Algeria is 80% assured by the cattle herd (Kacimi El Hassani, 2013), the development of dairy cattle breeding thus constitutes an essential component of the dairy policy of the Ministry of Agriculture. However, in Algeria, this breeding continues to be subject of a set of constraints that hinder its growth.

The production system suffers from the limited technical level of the breeders, associated with the climatic and organizational obstacles. In addition to these aspects, the lack of water resources and land induces a low recourse to fodder crops, which explains the low productivity of livestock (Madani and Mouffok, 2008). Furthermore, the low specialization does not allow the often imported genetic material to express its potentialities.

The low hygienic and sanitary mastery combined with a faulty supply contribute to obtaining a product of average or poor quality which affects the conversion rates by the dairy factories (Aggad et al., 2009) and consequently the rate of integration of raw milk. Among the measures that can boost the development of the dairy sector, the improvement of the raw milk quality is an unavoidable necessity as long as it improves processing yields or milk availability. On the other hand, improving sanitary and nutritional quality strengthens food and safety. Many studies have been done on the factors of variation of milk production. However, little research links the overall quality of raw milks with all production conditions that is to say with all farming practices (Guetarni, 2006; Aggad et al., 2009).

This work aims to highlight the diversity of raw milks produced in the semi-arid Algerian zone defined by their physicochemical and hygienic composition and link them to farming practices. These practices will be analyzed in the general context of farm operation in order to identify the relationships between the milk types and farming systems.

Materials and methods

Sampling and laboratory analysis

Cow's milk samples (a total of 144) were collected from 24 farms located in the Daïr of Ain Arnet (6 samples per farm) and analyzed for physicochemical parameters (pH, fat content, milk protein) and hygienic characteristics (mesophilic total aerobic).

The farms selected corresponded to six production systems, representative of the diversity of the study area, particularly in terms of feeding practices (types of seasonal basic rations, type and duration of grazing, quantity and type of concentrate) (Mansour and Abbas, 2015).

The mixing milk from each farm was subjected to 6 analyzes during two passages - at the rate of 3 samples per season and per farm - the first carried out during the spring, the second during the summer. Controls began in March and ended at the end of August.

The collection of samples for the determination of the milk quality took place just after the morning milking and concerns exclusively the milk of mixture of this milking. The samples were refrigerated through a cooler to avoid the effect of ambient temperature during transport to the laboratory. Two samples of mixing milk from each farm were taken for each analysis: the first of 1 l, for physicochemical analyzes and the second of 90 ml for the determination of the hygienic quality. This required volume was taken by means of a ladle ignited by the alcohol to be burned to avoid any external contamination to the sample, then poured into 100 ml glass bottles previously sterilized. The milk samples were sent directly to the laboratory and the maximum time between sampling and analysis did not exceed 3 hours.

On each milk sample, we made 3 simultaneous determinations and we considered the arithmetic mean of the results. The physicochemical analyzes performed were as follows:

- **The pH,** measured by a digital pH meter type Tacussel;
- **The density** was measured by a Dornic thermo lactodensimeter set at a temperature of 20 °C;
- **The fat content** was evaluated according to the method of Gerber applied to the milk: 10 ml of concentrated sulfuric acid, followed by 11 ml of milk and 1 ml of amyl alcohol were put in a butyrometer. The butyrometer was capped, shaken 3 to 4 times until the casein was completely dissolved, and placed in the centrifuge at 1000-1200 rpm for 5 to 6 minutes. The fat content was read directly on the graduated branch of the inverted butyrometer (AFNOR, 1985).

- **Protein content**: the nitrogen determination in the various fractions was carried out according to the Kjeldahl method (AFNOR, 1977). A quantity of milk was mineralized with sulfuric acid in the presence of mercury oxide acting as a catalyst to convert the nitrogen of the organic compounds into ammonia nitrogen. Ammonia was liberated by the addition of caustic soda, distilled and collected in a solution of boric acid. The ammonia was then titrated with 0.1 N hydrochloric acid.
- **Titratable Acidity** (NaOH titration): it was titrated with sodium hydroxide solution (N/9) in the presence of 1% phenolphthalein as a colored indicator turning pink towards pH 8.4. This acidity was expressed in degree Dornic (decigram of lactic acid per liter). It is equal to the volume of NaOH consumed, multiplied by 10 (Gaursaude, 1985).
- **The total aerobic mesophilic** microflora (FMAT) was counted on a PCA agar (Institut Pasteur, Algeria) in bulk, following a series of 10-fold dilutions and after incubation in the oven for 24 hours at 30 °C. All colonies were enumerated and the results expressed in colony-forming units per ml of milk (CFU/ml) (Guiraud, 1998, Maury, 1987).

Data processing and statistical analysis

The statistical analyzes were carried out in two complementary stages:

Descriptive analysis for the calculation of means and standard deviations, maximum and minimum of the studied parameters. The comparison of the average milk quality parameters with respect to values considered normal by the Student's T test (Schwartz, 1992) on the one hand and between them, on the other hand, by the analysis of the one-way variance (Dagnelie, 1975).

Multi-variety analysis to link the quality of milks and breeding practices. Milk samples were grouped in class using a Principal Component Analysis (ACP) followed by a Hierarchical Classification (CAH). The software SPAD version 5.0, has been used for this.

Results

Main characteristics of the farms studied

Twenty-four farms were selected for quality monitoring reflecting the 6 groups previously identified (Mansour and Abbas, 2015) at the rate of 4 farms per group (Table 1). The management of livestock activities in these farms was the responsibility of farmers whose educational level and social status differed. Only the exploitation 6 of group 2 was led by two officials holding the diploma of agronomist engineer, while the other farmers (87.5%) were owner-breeders breeding from father to son and only two of them have agricultural training (farm 23 and 24 in group 6). The herds were composed on average of 9 to 32 dairy cows, mainly of Montbéliarde breed. Milk production per cow varied (from 3011.12 kg/year /cow to 3298.57 kg/year/cow).

Table 1. Distribution of dairy farms followed by group

Group	Holdings
Group 1 Dairy modules with acceptable feed integration on large cereals units	exp1 exp2 exp3 exp4
Group 2 Dairy modules with high fodder integration on very large cereal farms	exp5 exp6 exp7 exp8
Group 3 "Modules" milk-meat "with low fodder and grass integration on small cereal units	exp9 exp10 exp11 exp12
Group 4 Large modules "milk and meat" with herbal tendency on medium-sized cereal farms	exp13 exp14 exp15 exp16
Group 5 Module "meat" Aboveground on average grain farms	exp17 exp18 exp19 exp20
Group 6 "meat" modules Aboveground on small grain farms	exp21 exp22 exp23 exp24

The six groups monitored had average useful agricultural area (UAA) ranging from 14.33 ha (Group 6 farms) to 30.25 ha (Group 1 farms). Most of these usable areas were reserved by almost all farms for the cultivation of cereals, especially durum wheat and barley. In fact, 83.33% of the farms monitored devoted more than 50% of their agricultural area to this type of crop - up to more than 85% of the UAA. The average areas devoted to fodder crops were low in farms in Group 6 and 3, but larger in farms in Group 2. Thus the density of cows/hectare of fodder reached an average of 0.33 cow/ha with a maximum of 6 cow/ha on farms in Group 6 and a minimum of 1.95 cows/ha on farms in Group 2 (Table 2).

Cows were supplemented with dry fodder and concentrated feeds purchased or produced in farms. Dry forage in winter was similar to that of fall for the majority of farms (83%). Farms 15, 16, 21 and 22 increased the quantities of rations distributed in winter compared to that of autumn. During the fall and winter season, the basic ration was oat hay and/or mixed or non-straw meadow. The quantities of hay and straw distributed in these two seasons at farm level oscillated respectively between 6 kg (exploitation 3, 4 and 17) to 18.75 kg (exploitation 24) and between 4 kg (exploitation 21) to 10 kg (exploitations 3, 8, 11, 13, 14 and 16).

Apart from the three farms (15, 16 and 23), the composition of the basic ration was similar during the spring and summer seasons in all farms (87.5%). During its seasons, straw was the staple food in 54.16% of farms, with a quantity between 6 kg (farm 1) and 13 kg/d/cow. Hay was only used in 4 farms (5, 6, 7 and 8) with varying amounts of 8 kg to 10 kg/day/cow.

All farms completed their ration with concentrate. This supplementary food was procured with a frequency of 2 times per day with a quantity of between 5 kg and 13 kg. Only 20.83% of farms (1, 9, 10, 12 and 18) completed their ration with wheat bran. In the other farms, the breeders provided a concentrate composed of either a mixture of wheat bran, barley and maize crushed (54.16%), or a mixture of barley + bran + but + soya (29.16%) or a mixture of wheat bran, cracked barley and CMV (16.66%).

Table 3 summarizes the composition of the ration distributed on the farms studied during the different seasons. All farms that have been monitored did not graze in winter. Spring grazing was done twice a day on fallow in the morning and on natural grassland in the afternoon in 45.83% farms, while 41.66% of the farms grazed only on meadow. However, the rest, the farms 5 and 23 grazed only the fallow. In the summer, more than 50% of the farms grazed on the stubble in the morning and on the natural meadow in the afternoon.

Table 4 summarizes grazing practices in the different groups for milk quality.

Table 2. Structural characteristics and milk production performance in farms followed

	Exp.	**UAA**	**SF**	Meadow	Number of cows	Density of animals (cows/ ha of fodder)	SF/cows	Dairy yield (kg of milk / cow / year)
Group 1	**exp1**	55	12	5	15	6.66	0.8	2689.12
	exp2	28	3.34	3	8	1.53	0.41	3003.27
	exp3	25	4	5	15	0.65	0.26	3141.50
	exp4	13	8.5	1.5	10	1.17	0.85	3612.73
Group 2	**exp5**	56	26	2	48	1.84	0.54	2827.35
	exp6	873	36	60	66	1.83	0.54	3141.5
	exp7	73	13	45	8	5.07	1.62	3534.19
	exp8	48	10	5	8	1.5	1.25	3455.65
Group 3	**exp9**	25	1.5	1.5	8	4.5	0.18	3062.96
	exp10	10	3	2	13	2.66	0.23	2670.28
	exp11	18	2	3	15	8.66	0.13	3612.73
	exp12	25	3.5	1.5	10	2.85	0.35	3062.96
Group 4	**exp13**	20	3	7	8	3.33	0.37	3220.038
	exp14	15	3	1	12	8	0.25	3141.50
	exp15	15	6	9	17	2	0.35	3298.58
	exp16	20	1	4	25	13	0.04	3377.11
Group 5	**exp17**	20	9	5	13	0.88	0.69	2670.28
	exp18	30	0	10	10	3.4	0	3926.88
	exp19	12	2	6	10	7.5	0.2	3455.65
	exp20	16	1	3	9	4	0.11	3141.50
Group 6	**exp21**	6	1	1	8	1.5	0.12	2748.81
	exp22	7	2	1	9	1.41	0.22	2670.28
	exp23	30	1.5	3	10	1.15	0.15	3308.00
	exp24	75	30.03	12	46	2.6	0.65	3317.42

Exp: exploitation, UAA: Useful Agricultural Area, SF: Forage Area.

Table 3. Seasonal Composition (kg / day / cow) of rations in the farms followed

Groups	**Exp.**	Autumn			Winter			Spring			Summer		
		Hay	Straw	Conc.	Hay	Straw	Conc.	Hay	Straw	Conc.	Hay	Straw	Conc.
Group 1	**exp1**	15	0	13	15	0	13	0	13	13	0	13	13
	exp2	18.75	0	10	18.75	0	10	0	10	8	0	10	8
	exp3	6	10	11	6	10	11	0	6	5	0	6	5
	exp4	6	8	13	6	8	13	6	8	8	6	8	5
Group2	**exp5**	8	0	11	8	0	11	8	0	5	8	0	5
	exp6	8	0	11	8	0	11	8	0	5	8	0	5
	exp7	9	0	10	9	0	10	9	0	5	9	0	5
	exp8	10	0	11	10	0	11	10	0	6	10	0	6
Group 3	**exp9**	0	8	11	0	8	11	0	8	5	0	8	5
	exp10	0	8	11	0	8	11	0	6	11	0	6	11
	exp11	10	10	12	10	10	12	8	0	5	8	0	5
	exp12	0	8	11	0	8	11	0	8	5	0	8	5
Group 4	**exp13**	0	10	13	0	10	13	0	6	0	0	6	5
	exp14	0	10	8	0	10	8	0	6	0	0	6	5
	exp15	0	8	11	8	10	11	8	6	0	0	6	5
	exp16	8	10	10	10	12	10	8	6	0	0	6	5
Group 5	**exp17**	6	8	8	6	8	8	0	8	8	0	8	8
	exp18	10	6	8	10	6	8	10	6	0	10	6	3
	exp19	13	7	8	13	7	8	13	7	8	13	7	8
	exp20	10	9	12	10	9	12	8	9	6	8	9	8
Group 6	**exp21**	12	4	8	15	4	8	0	4	8	9	4	8
	exp22	11.25	5.25	8	13	6	8	0	10	8	10	6	8
	exp23	12.75	8	10	12.75	8	10	0	9	5	12.75	8	8
	exp24	18.75	8	10	18.75	8	10	13	6	5	13	8	8

Conc: Concentrate

Table 4. Overall grazing practice in groups followed for milk quality

Groups	Meadow	Fallow	Stubble
Group 1	++	++	+
Group 2	++	-	+
Group 3	+	-	+
Group 4	++	+	+
Group 5	+	+	+
Group 6	+	+	+

Overall quality of the mixing milk

The fat content of cow's milk varies from 35 to 45 g/l (Alais, 1984). The majority of farm milk samples showed consistent average fat content. The fat content was less than 35 g/l in only 21.52% of our samples. While, respectively, during the first pass and the second passage, 70.83% and 58.33% of the farms showed contents higher than 35 g/l (Figure 1). Only seven farms had average levels greater than 35 g/l for both passes.

In operation 2, 15 and 16 during the second period and to a lesser extent in operation 8 during the first pass, the milk fat content showed the greatest amplitude fluctuations, ranging from 31 at 39, from 32 to 39, from 31 to 38 and from 34 to 38.8 g/kg.

The milk fat content showed significant fluctuations during the summer season, ranging from 31 to 41.7 g/l. Farm 3 had the highest average fat content in both seasons (Table 5 and Table 6). Farms 8 and 16 had the lowest butterfat levels during the second pass and the first pass, respectively. This weakness could only be attributed to rationing errors since there was no dilution effect (annual milk yield in farms 8 and 16 is respectively 3455.65 and 3377.11 kg/cow/year).

The average protein content for the surveyed farms was 34.21g/kg, the maximum was 37.59 g/kg and the minimum - 30.63g/kg (Figure 2). However, 8.33% milk samples in the spring season and 12.5% milk samples collected in the summer season had a protein content of less than 33 g/l. In all the farms, the protein content showed acceptable average levels (35 g/l) indicating the effect of the massive and regular inputs of the concentrate. This observation is in agreement with the results of other studies showing that massive intakes of concentrates constitute a stabilizing factor of the protein content (Coulon and Remond, 1991; Srairi et al., 2005).

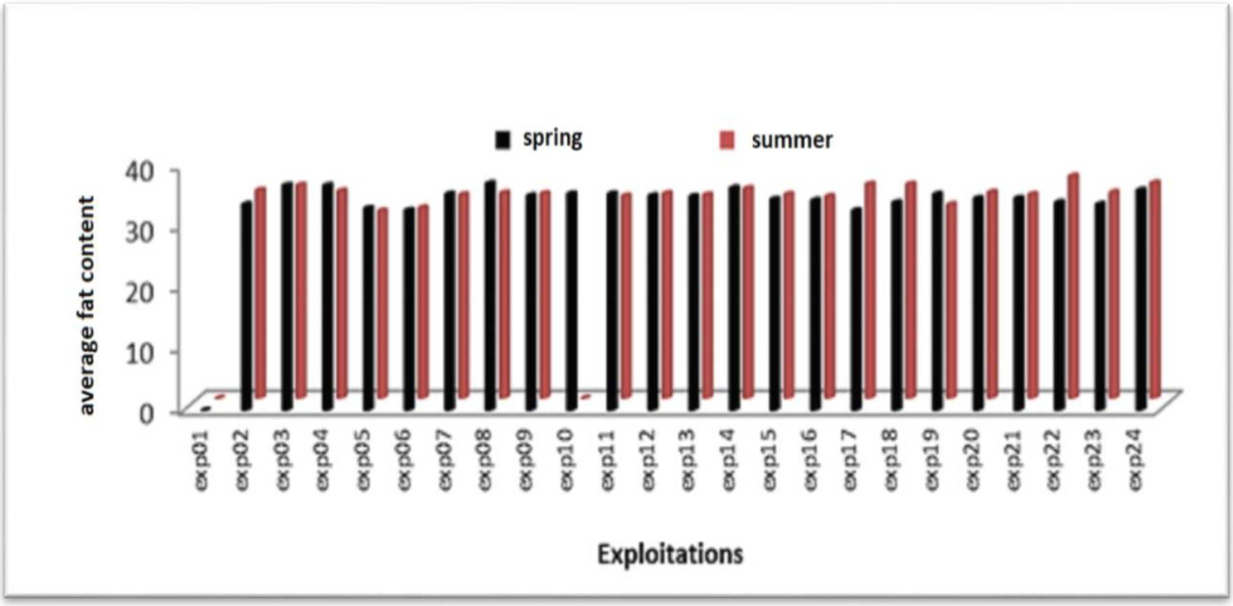

Figure 1. Variation in the average fat content mixing milk collected in two seasons

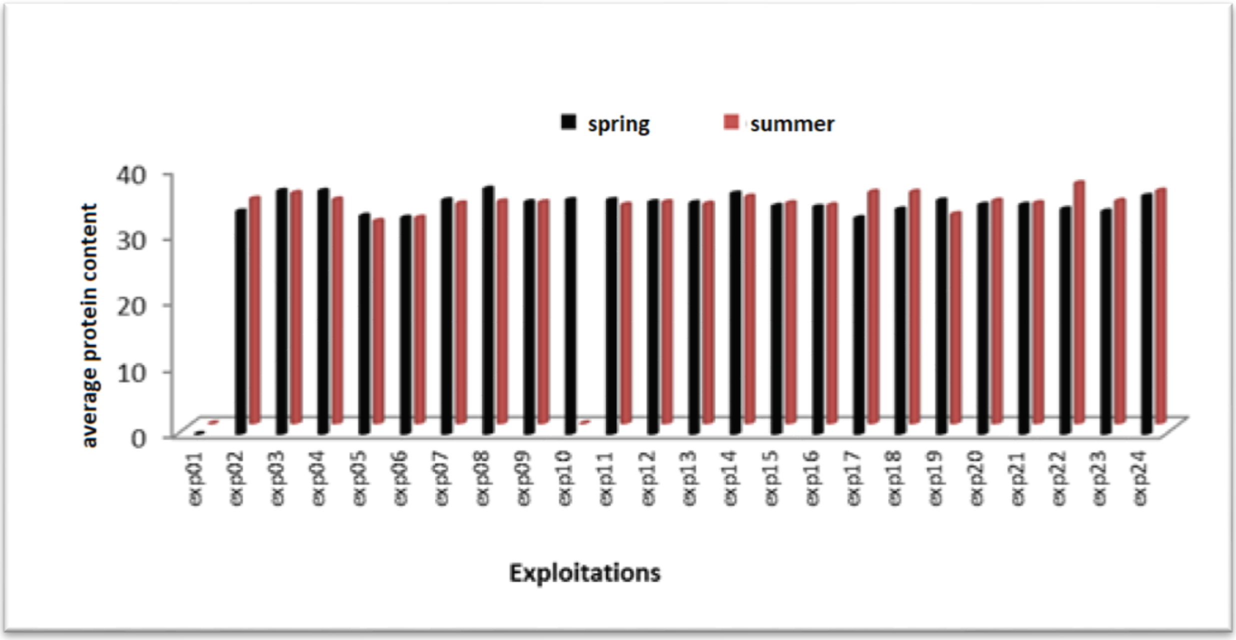

Figure 2. Variation of the average protein content of the mixture milk collected in the two seasons

The mixing milks of the farms monitored in the two passages had an acceptable mean pH (6.62 and 6.64 respectively in the first and second passages). In fact, fresh cow's milk has a pH between 6.6 and 6.8 (Luquet, 1985).

These values can be modified considerably by microbial infections. Acute forms lead to acidification and chronic forms to alkalization (Araba, 2006). This is an important parameter that determines the subsequent destination of the milk, that is, its processability. Indeed, low acidity has important effects on mineral equilibrium and stability of the colloidal casein suspension (Ramet, 1985; Alais and Linden, 2004).

The density recorded in all farm milks met the standards cited by Alais (1984) (1028-1033). The density of the milk is linked to its high dry matter content, if it is too high, which explains why the milk is skimmed (Luquet, 1985).

The average acidity of the milk collected in the two seasons varied from 16.16 to 18.67° D. The acidity of the milk can be an indicator of the quality of the milk at the time of delivery because it makes it possible to appreciate the quantity of acid produced by bacteria or possible frauds (Joffin and Joffin, 2004). Fresh milk has a titration acidity of 16 to 18° D. Preserved at room temperature, it acidifies spontaneously and gradually (Mathieu, 1998). Most of the samples (95.13%) taken in both seasons were compliant. Acidity and pH depend on casein content, mineral salts and ions (Alais, 1984), hygienic conditions during milking, total microbial flora and metabolic activity (Mathieu, 1998). The aerobic mesophilic flora always informs us about the hygienic quality of raw milk, it is considered as the determining factor of the shelf life of fresh milk (Guinot-Thomas et al., 1995). It is the most sought-after flora in microbiological analyzes.

In general, the total microbial load of the raw milk mixing of the farms followed was very important (on average 2.4 x 10^6 CFU/ml in the first passage and 3.2x 10^6 CFU/ml in the second passage). Several studies (Srairi and Hamama, 2006; Ghazi and al., 2010) as well as national regulations (JORA, 1998) agree that a load greater than 10^5 CFU/ml means a significant contamination. These counts are also greater than the maximum permissible loads by the two French and American regulations, which are respectively 5x10^5 CFU/ml and 3 x 10^5 CFU/ml (Alais, 1984). These high levels of contamination are closely dependent on the general hygiene conditions and the health status of the animal.

Table 5. Results of physicochemical analyzes of mixing milks collected in the spring

	pH	Density	Acidity ° D	Fat content	Protein content
Norms	**6.5-6.8[a]**	**1028-1034[b]**	**16-18[c]**	**35-45[b]**	**33-36[b]**
EXP 1	6.53±0.15	**1032.33±0.58**	18.33±0.58	34.66±0.57	**36.66±0.79**
EXP 2	6.6±0.2	**1028.33±0.57**	16.67±0.58	38.33±1.15	33.66±2.08
EXP 3	6.66±0.06	1029.33±0.58	16.16±0.28	39.1±0.95	36.77±1.30
EXP 4	6.59±0.041	1029.33±0.58	16.66±0.28	39.1±0.95	36.77±1.30
EXP 5	6.62±0.02	1029.33±0.58	16.33±0.28	38.83±1.75	33±1.005
EXP 6	6.59±0.03	1029.33±0.58	**16.16±0.28**	38.93±0.90	32.71±0.62
EXP 7	6.6±0.03	1029.33 ±0.58	16.5±0.87	38±1	35.37±1.19
EXP 8	6.57±0.03	1030.33±0.58	16.5±0.5	**36.6±2.42**	37.10±2.15
EXP 9	6.56±0.06	1028.66±0.57	16.67±2.08	37.13±1.20	35.08±1.12
EXP10	6.61±0.03	**1028.33±0.57**	16.33±0.57	37.7±0.65	**35.4±1.15**
EXP11	6.63±0.02	1028.66±0.57	16.5±0.5	36.06±0.51	35.39±0.84
EXP12	6.58±0.06	**1028.33±0.57**	17.67±0.58	37.13±1.20	35.08±1.12
EXP13	6.53±0.06	1028.66±0.57	16.83±0.76	37.96±0.95	34.96±0.94
EXP14	6.57±0.04	**1028.33±0.57**	17.67±0.58	38.86±0.85	36.37±1.59
EXP15	6.74±0.09	1028.66±0.57	18.33±0.57	34.33±2.30	34.5±1.5
EXP16	6.6±0.34	1029.33±0.57	17.66±0.57	34±1	34.33±1.52
EXP17	6.65±0.35	**1028.33±0.57**	17.67±0.58	37±1	32.66±2.51
EXP18	6.6±0.17	1029.67±0.58	17.66±0.57	36.66±2.08	33.96±1.70
EXP19	6.67±0.12	1029.33±0.58	17.67±0.58	35.66±1.52	35.33±0.57
EXP20	6.50±0.39	1030.67±0.58	17.66±0.57	33.66±0.57	34.66±2.88
EXP21	**6.6±0.43**	**1028.33±0.57**	17.67±0.58	38±1	34.66±4.50
EXP22	**6.8±0.1**	1030.33±0.58	18.16±0.28	37.66±1.52	34±1
EXP23	6.77±0.05	1029.66±0.57	17.33±0.57	34.66±1.15	33.66±1.15
EXP24	6.7±0.1	1030.33±0.58	17.33±0.58	37±2	36±2.64

[a] : Luquet (1985); [b] : Alais (1984); [c] : Mathieu (1998).

Table 6. Results of physico-chemical analyzes of mixing milk collected in summer

	pH	Density	Acidity ° D	Fat content	Protein content
Norms	**6.5-6.8[a]**	**1028-1034[b]**	**16-18[c]**	**35-45[b]**	**33-36[b]**
EXP 1	6.58±0.10	1029.33±0.58	17.67±0.58	37±2	**37.33±0.58**
EXP 2	**6.5±0.3**	1028.66±0.57	18±0.5	**36±3.60**	34±4.35
EXP 3	6.71±0.04	1028.66±0.57	16.67±0.76	40.76±0.86	34.84±1.76
EXP 4	6.71±0.04	**1028.33±0.57**	18±0.5	38.26±0.64	33.88±0.97
EXP 5	6.71±0.07	**1028.33±0.58**	17.33±0.29	38.93±1	30.63±0.54
EXP 6	6.7±0.02	1029.66±0.57	17.5±0.5	34.56±1.69	31.12±0.33
EXP 7	6.71±0.06	1029.33±0.58	17.83±0.76	34.13±1.80	33.28±0.7
EXP 8	6.71±0.07	1028.67±0.58	17.66±0.76	32.95±1.81	33.56±0.51
EXP 9	6.69±0.01	1028.66±0.58	17±0.87	34.33±1.15	33.46±0.4
EXP10	6.72±0.04	1029.66±0.57	18±0.5	33.23±1.66	**37.59±0.79**
EXP11	6.71±0.04	1029.33±0.58	17.5±0.5	34.63±0.40	33.08±0.38
EXP12	6.69±0.015	1029.66±0.57	17.17±0.76	33.5±1.80	33.46±0.4
EXP13	6.70±0.07	1030.33±0.58	17.33±0.58	33.96±1.55	32.91±0.73
EXP14	6.68±0.02	1029.66±0.57	17.5±0.5	35.16±1.04	33.24±0.31
EXP15	6.65±0.35	**1031±2.64**	17.66±0.57	**35.33±3.78**	33.33±0.57
EXP16	6.52±0.33	1029.66±1.15	17.83±0.29	**35±4**	33±1.73
EXP17	6.63±0.37	1029.66±0.57	17.66±0.57	35.5±0.5	35±3
EXP18	6.55±0.31	1028.33±0.57	17.7±0.26	36.33±1.15	35±2.64
EXP19	**6.73±0.20**	1029.33±0.58	17.33±0.58	37.33±1.52	31.66±1.52
EXP20	6.5±0.2	1028.66±0.57	17.83±0.29	37±1.73	33.66±1.15
EXP21	6.55±0.27	1029.66±0.57	17.5±0.5	34.66±0.57	33.33±1.52
EXP22	6.56±0.11	1030.67±0.58	17.66±0.57	38±1	36.33±3.05
EXP23	6.53±0.37	1029.33±0.58	**18.67±0.58**	39.33±1.52	33.66±1.15
EXP24	6.55±0.22	**1028.33±0.57**	17.67±0.58	38.3±1.12	35.2±1.05

[a] : Luquet (1985); [b] : Alais (1984); [c] : Mathieu (1998).

Overall quality of mixing milk and farming practices: towards the establishment of a type of raw milk

The first two factor axes of the PCA on milk quality data yieled 67.47% of the total variability (Figure 3). Axis 1 explains 40.92% of the total variation and is considered to represent the protein level, while axis 2 represents 26.55% of the total variation and is linked to the variables fat content and aerobic germs.

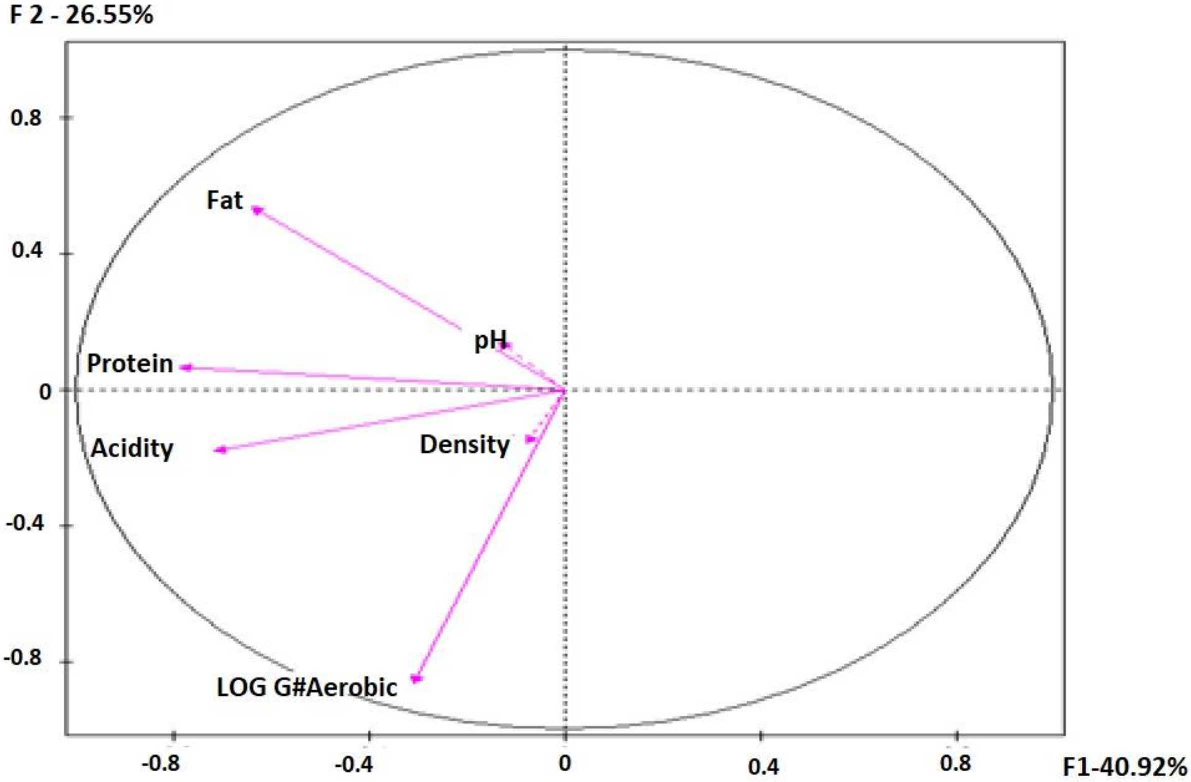

Figure 3. Distribution of milk quality variables on the F1 and F2 axes of the ACP

Classification has identified five distinct classes unequally distributed milk with distinct characteristics (Table 7 and Figure 4).

Table 7. Characteristics of the different classes of milk identified

	Class 1 (n=26)	**Class 2 (n=41)**	**Class 3 (n=22)**	**Class 4 (n=20)**	**Class 5 (n=35)**
pH	6.65±0.18	6.64±0.12	**6.71±0.11**	6.59±0.27	**6.56±0.11**
Density	**1029.61±1.29**	1029.12±0.74	1029.13±1.12	1029.3±0.97	1029.25±1.09
Acidity (°D)	17.75±0.66	17.14±0.62	**17.93±0.51**	17.73±0.52	**16.84**±0.92
Fat (g/l)	35.28±1.95	**38.37±1.30**	**37.55±1.56**	35.72±2.14	**34.73**±1.97
Protein (g/l)	34±1.77	34.17±1.44	**37.3±1.21**	**33.82±1.54**	**33.36±1.94**
FMAT (10^5CFU/ml)	7.01±3.6	7.58±5.65	12.86±17.55	**149.7±15.79**	**7.35±1.29**

n: number of samples**,** FMAT: total aerobic mesophilic flora. The results are expressed as mean ± standard deviation

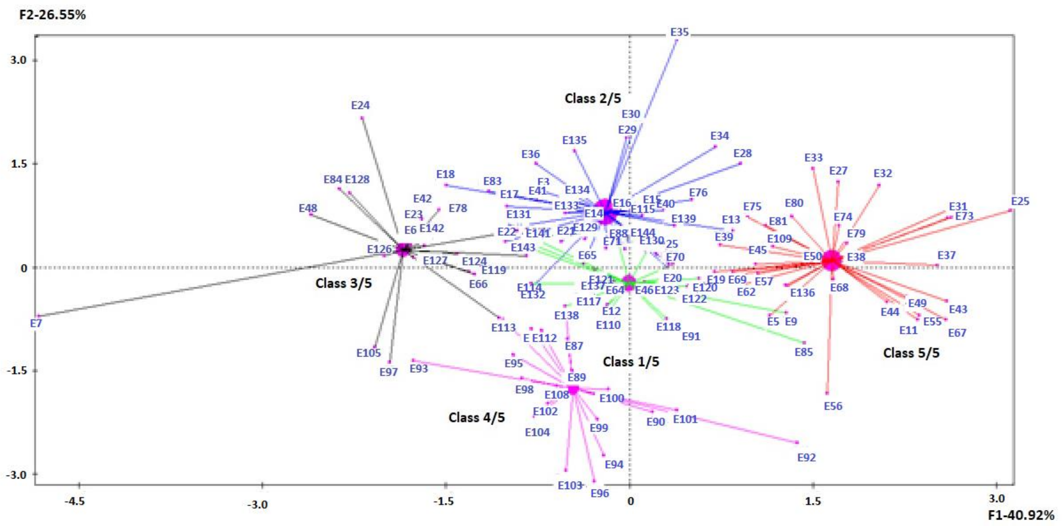

Figure 4. Different classes of milks identified in the study area

The discrimination of the five classes of milk in the study area has led us to look for the factors of variation that influence this distinction. For this purpose, six qualitative physicochemical variables (fat content, protein content, pH, acidity, density) and microbiological (total germ content) quality were retained. The results of the analysis were summarized in Table 8. The analysis of variance showed there are significant variations between classes and are mainly at fat and protein content, acidity, total germs.

Table 8. Results of the inter and intra class analysis of milks

Item	Sources of variation	df	Sum of squares	Average squares	F of Fisher	P
pH	intergroup	4	0.173	0.043	0.762	
	intragroup	139	7.896	0.057		
	Total	143	8.069			0.551
Density	intergroup	4	23.506	5.876	3.035	
	intragroup	139	269.154	1.936		0.020
	Total	143	292.660			
Acidity	intergroup	4	167.266	41.817	52.835	
	intragroup	139	110.013	0.791		**< 0.0001**
	Total	143	277.280			
Fat content	intergroup	4	435.177	108.794	40.343	
	intragroup	139	374.848	2.697		**< 0.0001**
	Total	143	810.025			
Protein content	intergroup	4	360.383	90.096	50.293	
	intragroup	139	249.005	1.791		
	Total	143	609.388			**< 0.0001**
Log FMAT	intergroup	4	27.639	6.910	43.834	
	intragroup	139	21.911	0.158		**< 0.0001**
	Total	143	49.550			

FMAT: total aerobic mesophilic flora

The classes of milk per farm could be described as follows:

Class 1 "class of milk with medium protein and fat content, and the lowest microbial load"

The first class contained 26 of the 144 milk samples (18.05%). They were characterized by medium protein (34 g/l) and fat (35.28 g/l), the highest density 1029.61, an average acidity equal to 17.75°D, associated with the lowest average aerobic count (7.01 x 10^5 CFU/ml).

Class 2 "milks with the highest fat content, a low average protein count and a low germ count"

The second class contained 41 milk samples collected (28.47%). Its main characteristics were the highest fat content 38.37 g/l, the lowest acidity 17.14°D, the lowest density 1029.12 and average protein content 34.17 g/l. The samples of this class were characterized by a means of counting aerobic germs (7.58x10^5 CFU/ml)

Class 3 "milks with the highest protein level, a high fat content and a high number of total germs"

The third class included 22 milk samples collected (15.27%). It wss characterized by milks having high fat content 37.55 g/l, the highest protein level (37.3 g/l), the highest acidity17.93 °D, a high count of aerobic germs 12.86 x 10^5CFU/ml and the highest pH (6.71).

Class 4 "milks with low protein, average fat content and highest total germ number"

Twenty milk samples were part of this class (i.e. 13.88% of milk analyzed). They were distinguished by a low protein level (below the standard of 34 g/l), an average fat content slightly higher than the standard of milk, 35 g/l, associated with highest aerobic counting14.96 x10^6 CFU/ml.

Class 5 "milks with the lowest protein and butyrous content and low total germ load"

The fifth class had thirty-five samples or 24.30% of the milk collected. Milk samples of this class were characterized by unsatisfactory protein and butyral levels and the lowest, respectively 33.46 g/l and 34.73 g/l, acidity (16.84°D) and pH (6.56) the lowest, average density of 1029.25, associated with low aerobic count (7.35x10^5 CFU/ml).

The analysis of the distribution of the different classes of milk per farm (Table 9) clearly revealed that apart from exploitation 3, none of the farms studied produce, throughout the seasons, milk of the same quality belonging to the same class. In fact, only the acceptable forage-integrated group 1 farm 3 with a significant pasture area relative to the data of the study area, can produce milk throughout the seasons with the highest fat content (100%) - milks of class 2.

Table 9. Distribution of milk samples collected by class and farm

		Class 1	Class 2	Class 3	Class 4	Class 5
Group 1	**exp 1**	**4**	1	1	0	0
	exp2	3	0	3	0	0
	exp3	0	**6**	0	0	0
	exp4	0	3	3	0	0
Group 2	**exp5**	0	5	0	0	1
	exp6	0	5	0	0	1
	exp7	0	3	1	0	2
	exp8	1	2	2	0	1
Group 3	**exp9**	0	0	1	0	5
	exp10	0	0	1	0	5
	exp11	2	0	1	0	3
	exp12	0	0	1	0	5
Group 4	**exp13**	0	2	1	0	3
	exp14	0	2	1	1	2
	exp15	0	2	1	1	2
	exp16	2	0	0	**4**	0
Group 5	**exp17**	1	0	0	**5**	0
	exp18	0	0	1	**5**	0
	exp19	2	1	1	2	0
	exp20	3	2	1	0	0
Group 6	**exp21**	3	1	1	0	1
	exp22	1	3	0	0	2
	exp23	2	2	0	1	1
	exp24	2	1	1	1	1
	Total	**26**	**41**	**22**	**20**	**35**

Discussion

This study was carried out under the conditions of cattle breeding of the Daïra de Ain-Arnet. It made it possible to quantify the variability of herd characteristics and also to establish a summary characterization of the actual quality of the milk produced.

The results of physicochemical quality follow-up analyzes of 140 samples of raw milk produced in the semi-arid zone revealed an average quality of raw milk. The parameters were very variable and overall satisfactory. As a whole, the physicochemical composition of the milks could be described as average for the majority of the samples, and marked a remarkable normativity.

The majority of the milk samples in the six groups had consistent average fat content. Milk samples from farms in Group 01 showed the highest average fat content in both periods. The farms in this group invested in fodder which explains the high fat of their samples. In fact, the fat content seems to be the most variable, following its very strong correlation with the forage content, the nature of the fibers and concentrates used in rations for dairy cows (Hoden et al., 1988).

Variations in the butterfat between different farms are explained by the production and feeding behavior strategies adopted for each farm. In fact, milk fat consists mainly of volatile fatty acids that are formed from the carbohydrates of fodder (cellulose) and fermentable carbohydrates (starch). As a result, the higher the ration's fibre content, the higher the acetic acid production and the milk content (Stoll, 2002).

Some farms aim for maximum milk production by reducing concentrate expenditure and increasing the use of dry fodder (exploitation 3.4 and 5), which may be favorable for the fat content (fat content greater than 38 g/l). Whereas farms 1 and 10 are more particularly focused on a maximum yield without considerations of the expenses generated by the use of high quantities of concentrate, which may explain the high protein content of their milk sample (protein content greater than 35 g/l).

On average, the fat content was slightly lower than that observed by Bassabasi et al. in 2013 on spring collection samples (0.92 g/l) and (2.41g/l) from that observed by Bony et al. (2005) in Reunion. However, the average value of 72 raw milk samples from five farms recorded by Srairi et al. in 2005 in Morocco is slightly lower than that observed in our study (4.39 g /l).

With the exception of milk from farms 2 and 17, the protein content recorded in both seasons appeared to be much more stable than the fat content of all the milk collected. The protein content, during the two passages, was slightly higher than that obtained for raw milks on the island of Réunion (31 g/l) (Bony et al., 2005) and Morocco (31.31 g/l). (Bassabasi et al., 2013).

One of the commonly-used variation factors in explaining changes in the protein content of milk is the proportion of the concentrate in the diet. Indeed, the incorporation of a large amount of concentrate (> 10 kg/cow/day) in the ration of cows of farm 10 and 1 has led to an increase in the protein content of milk (> 35 g/l). Unlike farm 05, where the energy supply was insufficient (<6 kg/cow/d). This explains the inferiority of the protein content compared to the standard (33-36 g/l) cited by Alais in 1984.

In general, the average density of fresh milk mixes in both seasons was relatively low (1029). As the wettability hypothesis is discarded, it is possible to attribute this significant decrease to the presence of fat with a density of less than 1 (0.93 to 20°D) (Goursaude, 1985).

The majority of the analyzed milk samples had a consistent acidity and were in the range of 16 to 18°D. The titration acidity is the sum of 4 reactions. The first three represent the natural acidity of milk (acidity due to casein, mineral salts and phosphates) and the last is related to the acidity due to lactic acid and other acids from the microbial degradation of lactose and possibly lipids in the process of alteration.

The microbiological results were highly variable with average counts of total aerobic mesophilic flora exceeding the maximum standard of 10^5 CFU/ml. This results in poor hygiene control either during milking or in the overall environment of livestock buildings.

The averages recorded were relatively lower compared to those reported by Karimuribo et al. (2005) in Tanzania (10^7 CFU/ml). The enumeration values were also higher than those obtained for raw milk mixtures collected in France (Desmasures et al., 1997; Michelle et al., 2001), in Denmark (Aagaard et al., 1998) or on American farms (Hogan et al., 1988) in probable relation with more rigorous hygienic conditions. Milk collected in good conditions from a healthy animal, contains little microorganism and is protected against bacteria by inhibiting substances of very short duration (Guiraud and Rose, 2004).

According to the study conducted by Ameur et al. (2011) in the region of Freha (Algeria), raw milk collected has a very high microbial contamination rate (between 10^5 and 10^7 CFU/ml), detrimental both to the transformation in the dairy industry to public health. Our counts were in this contamination interval, they were superior to the results reported by Aggad et al. (2009) in western Algeria where the average level of contamination is close to $83x10^4$ CFU/ml with raw milk samples taken from tank reception. This is explained by a lower degree of cumulative contamination from production to the arrival of milk at the dairy. However, they agree with those found in Morocco by Affif et al. (2008), Labioui et al. (2009), Mennane (2007), Srairi et al. (2005) and enumerated in Mali by Bonfoh et al. (2002).

The multidimensional statistical analyzes made it possible to characterize the milk samples according to the two main groups of variables reflecting the quality of the milk in the semi-arid region of Sétif- the contents of useful materials and the general hygiene.

Class 1 is that of samples with average levels of useful material (fat content and protein content), having a moderate hygienic quality compared to other samples ($7.01x10^5$ CFU /ml), having the highest density 1029.61 and average acidity equal to 17.75 °D. This class mainly includes milk samples collected from farms in group 6 (30.76% of samples), group 5 (23.07% of samples) and group 01 (26.92% of samples). Groups 5 and 6 are modules outside soils, characterized by fairly limited pasture land but distributing rations of bases without any negligible straw (> 39% of the basic ration). The introduction of a high proportion of straw in the basic ration causes the increase of the fibrosity which can induce at a high butyric rate.

However, cereal straw is a food that is low in soluble sugars, nitrogen, minerals and vitamins. It is a cumbersome fodder and little digestible. It is therefore necessary to have an appropriate complementation to optimize this forage, to allow its digestion and the functioning of the rumen, and finally to ensure the needs of animals. The consumption of high quantities of concentrate in these farms also made it possible to produce milk with average but satisfactory protein levels.

Group 1 farmers' production of 26.92% of class 1 milks is due not only to the introduction of straw at an average rate of 37% in the basic ration of cows but also to their investment in fodder and provision of important grazing surfaces.

Class 2 contains milk samples with the highest butterfat levels and consists mainly of samples of the 02 group farms characterized by a high degree of forage integration with a good basal ration distribution.

Fodders contribute to the increase of milk fatty acids thanks to microorganisms that ferment cellulose and hemicellulose in acetates and butyrates, precursors in the manufacture of milk fat. These fodder, the main source of fiber, are important for the maintenance of a high butyrous rate milk (Sutton, 1989).

Class 3 contains milks with the most favorable characteristics: high levels of fat content and protein content. This class mainly includes milk from Group 1 farms (31.81%). The production of milk with the most favorable levels of useful matter is undoubtedly due to the good feeding practices within this group: satisfactory share of forage in the diet, significant pasture area and an average complementation of concentrate.

The milks of this class are distinguished mainly by the highest protein level and therefore come mainly from breeding (group 01) practicing a medium supplementation in the highest concentration. This is consistent with the work of Coulon et al. (1998) and Bony et al. (2005) arguing that the highest protein levels are generally related to the highest energy intakes. However, these samples have the disadvantage of being very charged with total germs (on average 1.28×10^{6} CFU/ml). This may be the consequence of poor general hygiene, mainly that of the environment (livestock building). Hygiene is a practice that limits microbial teat contamination (Agabriel et al., 1995). This is an important element in a breeding to maintain animal health, product quality and to reduce the cost of breeding.

Hygiene problems are mainly increased by breeders because of:

- lack of milk storage (refrigeration) at 4 ° C prior to collection except in farms 5 and 6 of group
- lack of appropriate means of transport for milk to the farmer.

- milking conditions at the farm level (no milking parlor).

Class 4 consists mainly of milk samples from farms in group 5 (60% of milk collected), having a priori the least favorable characteristics (low protein content and the highest count in total germs). The small portion of forage in the rationing of animals in these groups may be at the origin of the low butyrous rate of these samples. The valorization of the use of concentrate is not reached in this group.

Class 5 mainly includes milk samples collected from farms in group 03 (51.42%). These milk samples are characterized by the lowest protein and butyrous content. Farms in this group are characterized by low forage and grass integration that may be responsible for the low fat content.

Concentrate recovery is optimal in Group 1 farms, resulting in 29.16% of the highest grade milk samples in the third class. The high level of fodder integration in Group 2 farms has resulted in over 60% of their milks having the highest butterfat content in the second class. The fifth class is dominated by milk samples from farms in the third group. These milk samples are characterized by levels below the standard for fat content. The poor forage and grass integration can be at the origin of the weakness of this physicochemical parameter. Group 5 farmers can not produce milk with high protein levels (60% of their milk samples are in the fourth class). Farmers in Group 6, despite their small pasture area, produce more than 70% of the milk samples with satisfactory physicochemical parameters.

Examination of all the characteristics of milk shows that it does not currently exist in the ideal class study area, which combines both high levels of useful matter and good health value. Similarly, the examination of the average farm values, their evolution over the two seasons and the distribution of the milk produced by each farm in the different classes clearly shows that with the exception of farm 3, no of the farms studied produced milk of the same quality throughout the seasons: among the 144 milk samples analyzed, none had at the same time the highest butyrous and protein content with a satisfactory microbial load (<105 CFU/ ml).

The distribution of milk samples in the different classes confirms the irregular quality of the milk produced in the different groups. We also note that a significant proportion of breeders produce milk with very high fat content (28.47% of milk samples are class 2), but fail to produce milk with a high protein content (only 15.27% of the milk samples collected belong to the third class).

Three classes of milk receive special attention: on the one hand, classes 1 and 2 having the most favorable characteristics (satisfactory fat and protein content) associated with the lowest count of total germs. On the other hand, the class 5 which, unlike low-fat, low protein milk combined with a low count of total germs.

- Apart from class 1, there are percentages close to milk samples taken in the spring season and in the summer season, the other classes have an unequal constitution of milks collected in both seasons:

- Class 2 contains 70.73% of the milk collected in the spring,
- Class 3 contains mainly milk in the summer (77.27%),
- Class 4 includes 60% of milk collected in summer,
- almost all the samples taken in class 5 are taken in summer (91.42% of the samples in the class).

The analysis of the distribution of milk samples collected by season in the different classes shows that the majority of milks collected in the spring season have the highest butterfat levels (constituting the major part of the samples in class 2), the production of milks with the highest protein levels is observed in the summer season (+ 70% of samples in class 3), while the microbial load of whole milk milks increases significantly during the summer season (60% of milk of class 4).

The typology of the milk samples made it possible to provide a descriptive framework of the variety of variations that milk can undergo in a breeding environment based on variations in the levels of useful materials and fluctuations in total flora that reflect the general hygiene and storage conditions and also confirms the direct consequences of farming practices (lack of rationing, poor basic ration, feed "with concentrate", overall hygiene in livestock buildings) on the quality of the milk.

The distribution of milk samples in the different classes confirms the irregular quality of the milk produced on the farms. While it is therefore difficult, from these results of this study, to rank the specific effect of each dietary practice, we can nevertheless think that dietary factors in the broadest sense play a predominant role, at least for classes 2 and 3.

Conclusion

This work allowed to establish a summary characterization of the reality of the situation of the overall quality of the milk under the conditions of current cattle breeding of the semi-arid region of Setif. The physicochemical composition of the milk analyzed was satisfactory for all the parameters studied. However, a high total mesophilic flora load characterized all the samples analyzed.

As far as quality is concerned, these results are very important, considering that our work has opened up a fairly new but important field for a greater professionalization of the sector and an improvement in milk collection rates.

Indeed, although the average quality is acceptable, we noted a very interesting variability for the implementation of a program of improvement of physicochemical parameters and their stability between seasons. Of course, at this level there is only one quality food that can ensure quality milk. The development of irrigated and dry forage crops, silage as well as the improvement of rationing by the diversification and improvement of the quality of the resources constituting the basic rations, on the one hand and the use of concentrates little expensive and adequate (compound, balanced), on the other hand, are the guarantors of a nutritionally good quality milk.

In terms of microbiological quality, the situation seems more worrying despite the diversity of situations. It goes without saying that livestock modernization remains to be a leitmotif of development programs. This modernization must be based on the rehabilitation of livestock facilities that are still too old (buildings, equipment, utensils, vats). It must also cover the training component, which is very important to instill in breeders but also to the various agents of the sector the necessary actions to produce and accompany this noble and highly perishable product.

Finally, this work has shown the way for a long-term research program to take place in order to strengthen the results obtained and especially to deepen them in the framework of an observatory allowing a rigorous and individual follow-up (individual performance control). This program could then best guide the development policies of the milk sector.

REFERENCES

Aagaard, K., L. Jepsen and H. Andersen (1998). Raw milk quality in Denmark. Scand, Dairy Inform, 3, 22-24.

Afif, A., M. Faid and M. Najimi (2008). Microbiological quality of raw milk produced in the Tadla region of Morocco. Reviews in Biology and Biotechnology. BioAlliance Canada-Morocco, 7, 2-7.

AFNOR (1977). Determination of nitrogen for the purpose of calculating the crude protein content. AFNOR Edition, Paris, France.

AFNOR (1985). Quality control of dairy products - physical and chemical analyses, 3rd edition (publishing): 107-121-125-167-251 (321 pages).

Agabriel, C., J. B. Coulon, G. Brunschwig, C. Sibra and C. Nafidi (1995). Relationship between the quality of milk delivered and the characteristics of the farms INRA Prod. Anim., 8, 251-258.

Aggad, H., F. Mahouz, Y. Ahmed Ammar and M. Kihal (2009). Evaluation of the hygienic quality of milk in western Algeria. Med. Vet. Rev., 160 (12), 590-595.

Alais, C. and G. Linden (2004). Food biochemistry. 5th Edition Masson (Paris), 520 p., 162-164.

Alais, C. (1984). Milk science. Principles of dairy techniques. 3rd edition, Advertising edition France.

Ameur, A., K. Rahal and A. Bouyoucef (2011). Evaluation of the cleaning of refrigeration tanks on dairy farms in the Freha region (Algeria). Nature & Technology, 6, 80-84.

Araba, A. (2006). Feeding of the dairy cow. Technology transfer in agriculture. Bulletin produced at the agronomic and veterinary institute Hassan II, Rabat. N°136.

Bassbasi, M., A, Hirri and A. Oussama (2013). Physico-chemical characterization of raw milk in the Tadla-Kelaa region of Morocco: Application of the exploratory analysis. Int. J. Innov. Appl. Stud., 2 (4) 512-517.

Bonfoh, B., A. Fané, N. A. Traoré, Z. Coulibaly, C. F. Simbé, O. Alfaroukh, J. Nicolet, Z. Farah and J. Zinsstag (2002). Microbiological quality of milk and dairy products sold in the hot season in the Bamako district of Mali. Bioterre, Rev. Inter.Sci. of life and earth, N ° special acts of the international symposium, center Switzerland. University Publishing of Ivory Coast, pp: 242-250

Bony, J., V. Contamin, M. Gousseff, J. Metais, E. Tillard, X. Juanes, V. Decruyenaere and J. B. Coulon (2005). Factors of variation of milk composition in Réunion. INRA Prod. Anim., 18, 255-263.

Coulon, J., C. Hurtaud, R. Romond and R. Verite (1998). Factor of variation of the proportion of casein in cow's milk proteins. INRA Prod. Animal., 1, 299-310.

Coulon, J. P. and B. Remond (1991). Responses of cow's milk production and composition to changes in nutrient intake. INRA Prod.Anim., 4, 49-56.

Dagnelie, P. (1975). Theory and statistical methods. Edition: Flammarion, 378,113-135.

Desmasures, N., F. Bazin and M. Guéguen (1997). Microbiological composition of raw milk in the Camembert region of Normandy, J. Appl. Microbiol., 83, 53-58.

Faye, B. and G. Loiseau (2000). Sources of contamination in dairy value chains and example of quality approaches in: Food safety management in developing countries, CIRAD-FAO edition, 1-5.

Gaursaude, J. (1985). Composition and physico-chemical property of milk. In: Milk and milk products, sheep cow, goat. Vol.1, Milk from the udder to the dairy, Luquet, F.M., Edition INRA, pp. 520-530.

Ghazi, K., B. Guessas, A. Niar and K.I. Louacini (2010). Hygienic quality of cow milk, in various bovine breeds of Tiaret Area (Algeria). Asian J. Anim. Vet. Adv., 5(8), 592-596.

Guetarni, D. (2006). Strategy for improving quality and quantity of raw milk in Algeria. Proc. Scientific days on dairy production. Tiaret, Algeria, pp: 26-43.

Guiraud, J. (1998). Food Microbiology, DUNOD Edition, 79-102.

Guiraud, J. P. and J. P. Rose (2004). Practice of food microbiology standards AFNOR, 300p.

Hoden, A., J. B. Coulon and P. Faverdin (1988). Feeding cattle, sheep and goats. In: Jarrige, R. (Ed.), INRA, Paris, France, 135-158.

Hogan, J. S., K. H. Hoblet, K. L. Smith, D. A. Todhunter, P. S. Schoenberger, W.D. Hueston, D. E. Pritchard, G. L. Bowman, L. E. Heider and B. L. Brockett (1988). Bacterial and somatic cell counts in bulk tank milk from nine well managed herds. J. Food Prot., 51, 930-934.

Joffin, C. and J. N. Joffin (1999). Food microbiology. Collection biology and technique 5th edition, 174.

JORA (1998). INTERIM Ministerial Order of 25 January 1998 (JORA) on the microbiological specifications of certain foods. Department of Commerce. JORA No. 35, 1998, Algeria.

Kacimi El Hassani, S. (2013). Food dependence in Algeria: import of milk powder versus local production, what evolution? Mediterr. J. Soc. Sci., 4 (11), 152-158.

Karimuribo, E. D., L. J. Kusiluka, R. H. Mdegela, A. M. Kapaga, C. Sindato and D.M. Kambarage (2005). Studies on mastitis, milk quality and health risks associated with consumption of mil from pastoral herds in Dodoma and Morogoro regions, Tanzania. J. Vet. Sci., 6, 213–221.

Labioui, H., L. Elmoualdi, A. Benzakour, El Yachioui, E. Berny and M. Ouhssine (2009). Physicochemical and microbiological study of raw milks. Bull. Soc. Pharm. Bordeaux, 148, 7-16.

Luquet, F. M. (1985). Milk and dairy products (cow, ewe, goat). Volume 1: Milks from the udder to the dairy. Technical and documentation Lavoisier, 217-261

Madani, T. and C. Mouffok (2008). Dairy production and breeding performance of Montbéliarde cows in the Algerian semi-arid region. Elev Review. Med.Vet. Country Trop., 61 (2), 97-107.

Makhlouf, M., E. Montaigne and A. Tessa (2015). Algerian dairy policy: between food security and differential support for consumption. New Medit.,1, 12-23.

Makhlouf, M., E. Etienne Montaigne (2017). Impact of the new Algerian dairy policy on the viability of dairy farms. New Medit, 1, 2-10.

Mansour, L. M. and K. Abbas (2015). Typology of feeding strategies for dairy cattle in the semi-arid region of Sétif. Livest. Res. Rural Dev., 27, http://www.lrrd.org/lrrd27/5/abba27085.html.

Mathieu, J. (1998). Initiation to the physicochemistry of milk. Technological Guides of LPNs. Edition Lavoisier Tec and Doc, Paris, 220 p.

Maury, M. (1987). Medias and laboratory reagents. Microbiol. Immunol. Pasteur Diagnosis, pp: 727.

Mennane, Z., M. Ouhssine, K. Khedid and M. Elyachioui (2007). Hygienic quality of raw cow's milk feeding from waste in two regions in Morocco. Int. J. Agric. Biol., 9, 46-48.

Michelle, V., A. Hauwuy and J. F. Chamba (2001). The microbial flora of raw cow milks: diversity and influence of the conditions of production. Milk, 81, 575-592.

Ramet, J. P. (1985). The cheese dairy and the cheese varieties of the Mediterranean basin. FAO Animal Production and Health Study, 48.

Schwartz, D. (1992). Statistical methods for use by physicians and biologists. Flammarion Edition, Paris, 306 p.

Srairi, M. T., I. Hasni Alaoui, A. Hamama and B. Faye (2005). Relationship between breeding practice and overall quality of cow's milk in suburban barns in Morocco. Med. Rev. Vet., 156, 155-162.

Srairi, M. T. and A. Hamama (2006). Overall quality of raw cow milk in Morocco concept, state of play and prospects for improvement. Technology transfer in agriculture. Bulletin made at the agronomic and veterinary institute Hassan II. Rabat, N 137.

Stoll, W. (2002). Feeding of the dairy cow and composition of the milk. Federal Research Station for Animal Production. http/www.admin.ch/sar/2ap. N°8.

Sutton, J. D. (1989). Altering milk composition by feeding. J. Dairy Sci., 72, 2801-2814.