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CONTRIBUTION TO THE STUDY OF THE PHYSICOCHEMICAL CHARACTERISTICS OF BOVINE MILK IN THE TLEMCEN REGION

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Abstract

The objective of this work is to carry out a comparative study through the main factors (individual, breed, age and region) having a direct effect or by interaction on the physicochemical parameters of the milk produced by 3 types of cows, local (BLL), imported (BLI) and crossed (BLC) which are reared by the same extensive farming system in the western region of Algeria. A total of 88 dairy cows, 55 BLLs, 17 BLIs and 16 BLCs selected at the beginning of lactation were followed regularly for a period of three months (March to May). At the same time, milk samples are taken for each cow and then they are sent for analysis at the laboratory. The physicochemical parameters of milk analyzed as well as milk production showed a very varied degree of influence with respect to breed and age.

Key words: Local cattle, Cross-fed cattle, imported cattle, Cow's milk, physicochemical quality.

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Introduction

As early as the Neolithic, the domestication of the first herbivores began, men took for their personal consumption the milk secreted by female mammals. Different species have been used (Cauty and Perreau, 2009). Milk is an important source of all the basic nutrients required for mammals, including humans. Milk from various mammals such as cow, buffalo, goat, sheep, camel, etc. is used. for various nutritional purposes, for example to feed the youngest and to prepare certain nutritional products such as cream of milk, butter, yogurt, ghee, etc. The cow appeared about 8000 years ago in the Middle East, and quickly established itself as the dairy animal par excellence (Isabelle et al, 2009). Although milk is almost the only food that can balance most of a man is nutritional needs in a balanced way (Hamama, 1996). Because of its high nutrient content, milk represents 65.5% of animal protein, higher than meat 22.4% and eggs 12.1%. One gram of protein obtained from milk is eight times cheaper than the same amount obtained from meat (Amellal, 1995), which increases its consumption (Ferrah 2000, Dilmi 2008). Milk provides relatively fast income for small producers and is an important source of income. In Algeria, cattle breeding are an important indicator in the economy, as it is a source that covers part of the national requirements for animal protein and values the labor force employed in rural areas, but it is influenced by constrained multitudes that depend mainly on the environment, animal material and especially by state policy since independence (Mouffok, 2007). The various genetic improvement programs developed to increase milk production of the local cattle population have not achieved their objectives. Indeed, little information related to the lack of investigation in the field of knowledge of dairy parameters in this population and the poor organization of the sector was the cause. To our

knowledge, few studies on the physicochemical composition of the different types of milk marketed in Algeria have been reported. Therefore, in the present study, we have studied various physical parameters and chemical components of milk samples from cattle breeds of local origin with those of European origin and cross-processed by considering standards of the World Health Organization (WHO). We also tried to identify the problems related to the low production at the level of the different breedings in general and that of the breeding of the local breeds in particular. Thus, identify the positive and negative points for each type of bovine milk (European or local) based on a typological analysis using statistical software and an important asset for future investigations in improving milk production.

Materials and methods

Sampling

Our study was carried out in the highlands of the two wilayas of Tlemcen and Sidi Bel abbes, which is located in northwestern Algeria. The milk samples used come from cattle herds of the BLL atlas breed (Tlemcen region), the crossed cows (BLA) come from the region of Sidi Bel Abbés and the imported cows (BLM) are located at the ITElv of Sidi Bel Abbés (**Table 1**).

Table 1. Origin and date of sampling of samples of bovine milk analyzed.

Type of Milk	Breed	Number of samples	Sampling date	Region of collection
Cow milk	local	55	Avril 2016	Tlemcen
	cross	16	Avril 2016	Sidi Belabes
	imported	17	Avril 2016	Sidi Belabes

Fresh milk is processed manually from healthy cows at the stage of lactation. Then it is collected cleanly in bottles of 60 ml. Two bottles were used for each cow, which were then labeled and placed in a cold cooler at 4 ° C and sent to the milk analysis laboratory at the Sidi Bel Abbés ITElv, all precautionary measures have been taken into account during transport to the laboratory and their storage where they are analyzed (physicochemical analyzes).

Physico-chemical analyzes of collected milk

We used an Ekomilk® -ULTRA milk analyzer (Figure 01). This device uses new technologies as if the principle of ultrasound, this analyzer automaton measures, analyzes and prints data. The measured parameters are pH, density, freezing point, fat (MG), protein material (PM), fat-free dry extract (ESD), freezing point (TSE) and waterpercentage.

Figure 1. Ultrasonic Milk Feeder Analyzers (Ekomilk-ULTRA, USA) and Data Printer.

We based on 11 parameters for the physical and chemical analysis, 7 parameters are measured directly by the automaton and the rest are either calculated, this is the case of the total dry matter (defatted dry

extract + fat) and the percentage of water (total dry matter - 100%) is the physiological parameters of the animal, it is the age of the cow and the amount of milk produced per day.

Statistical analysis methods

The results were expressed as mean ± standard deviation. The data were analyzed statistically using the Excel statistical program (for means, percentage, standard deviation) and XLSTAT (for Principal Component Analysis (PCA) and Hierarchical Ascending Classification (ACH). the physico-chemical composition of the milk (pH, density, freezing point, MG, MP, ESD, EST, and% water) of the breeds studied were compared by the smallest significant difference at the 5% degree of uncertainty (P <0.05) following one-way analysis of variance (Fisher's test).

Results and discussion

Physicochemical evaluation of constituents of cow's milk Analysis of the milk samples collected shows that the protein composition, fat, total solids and defatted solids content (**Table 2**) are below those reported by several authors (AFNOR, 1985 and Ghaoues, 2011), while data on physical properties, expressed by freezing point, density and pH, are generally close to those evoked by other researchers (Boutayeb, 2005). Our study shows that the factors causing variations in the composition of bovine milk analyzed are breed, region and age.

Table 2. Physicochemical Characterization of Bovine Milk of Local, Imported and Crossed Breeds

Variation factor	**Mean ± standard deviation**									
	N	**Dairy production**	**Protein (%)**	**MG (%)**	**EST (%)**	**Eau%**	**ESD (%)**	**PDC (-°C)**	**Density**	**pH**
Breeds			***	**	***	***	***	***	NS	NS
Local	55	3.73± 0.83	3.74± 0.58	2.97± 0.99	13.13± 1.54	86.79± 1.60	10.51± 2.68	0.665± 0.079	1028.09± 3.81	7.02± 0.22
Imported	17	17.41±1 .28	3.19± 0.07	3.49± 0.09	11.95± 0.26	88.05± 0.26	8.46± 0.25	0.553± 0.005	1029.4 ±0.82	6.99± 0.18
Crossed	16	8.03 ±0.74	3.14 ±0.03	3.47± 0.02	12.06± 0.06	87.94± 0.06	8.58± 0.06	0.555± 0.005	1028.26 ±0.52	7.03± 0.27
Regions (local)	55	NS	**	***	NS	NS	NS	***	***	NS
Beni senouss	20	3.62 ±0.8	4.04 ±0.42	2.35± 0.68	13.39± 1.09	86.59± 1.09	11.05± 0.75	0.711± 0.063	1026.6 ±2.99	7.01± 0.19
Elsahb	10	3.75± 0.67	3.76± 0.41	2.88± 0.48	12.83± 1.12	87.16± 1.12	9.94± 1.16	0.6575± 0.061	1031.22 ±3.86	6.95± 0.23
Telterni	14	3.78± 0.89	3.60± 0.67	3.64± 0.78	13.35± 1.86	86.35±2.0 6	11.12± 5	0.623± 0.073	1028.1 ±3.58	7.07± 0.23
Terni	8	3.50± 0.80	3.36± 0.44	3.85± 0.72	13.21± 1.62	86.85± 1.61	9.2± 0.98	0.596± 0.045	1027.2± 2.73	7± 0.23
Age classes (years)		NS	NS	*	NS	NS	NS	NS	NS	NS
[2-4]	56	7.07± 5.56	3.54± 0.47	3.05± 0.89	12.57± 1.23	87.41± 1.22	9.87± 2.73	0.619± 0.075	1028.17± 3.28	7.02± 0.21
[5-8]	32	7.29± 5.11	3.47± 0.62	3.35± 0.63	12.94± 1.47	86.94± 1.62	9.57± 1.35	0.617± 0.084	1028.7± 2.69	7± 0.23
Total	**88**	**7.15± 5.38**	**3.52± 0.54**	**3.16± 0.82**	**12.71± 1.34**	**87.25± 1.39**	**9.77± 2.33**	**0.619± 0.078**	**1028.4± 3.08**	**7.01± 0.22**

*MG: fat; EST: total dry extract; ESD: Defatted dry extract; PDC: freezing point; NS: not significant, *: P <0.05, **: P <0.01, ***: P <0.001*

Typology of milks

Principal component analysis is the statistical method to facilitate the explanation and interpretation of data (**Figure 2 and 3)**

The PCA performed on the 88 milk samples from the various herds of 3 cattle breeds (local, crossed and imported), accounts for 56.56% of the total variability (Figure 02).

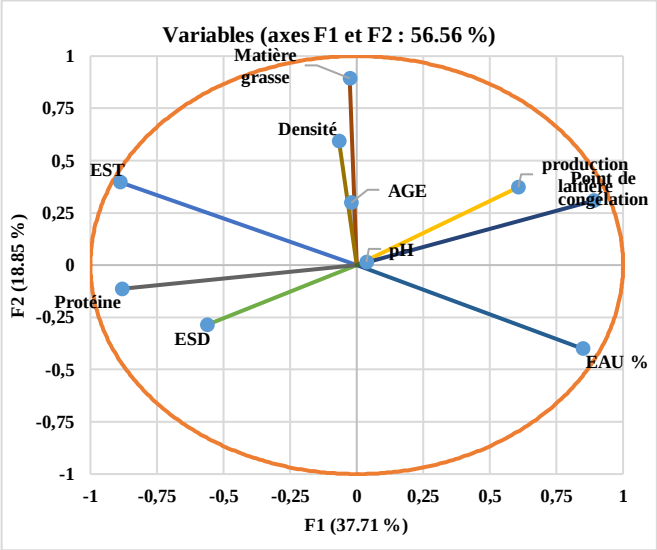

Figure 2. Correlation circle representing the active variables in the foreground of the PCA.

The first axis, explains 37.71% of the total variation, represents milks less rich in proteins, total dry and degreased extract. The second axis explains 18.85% of the total variation is represents fat-rich milks with significant densities.

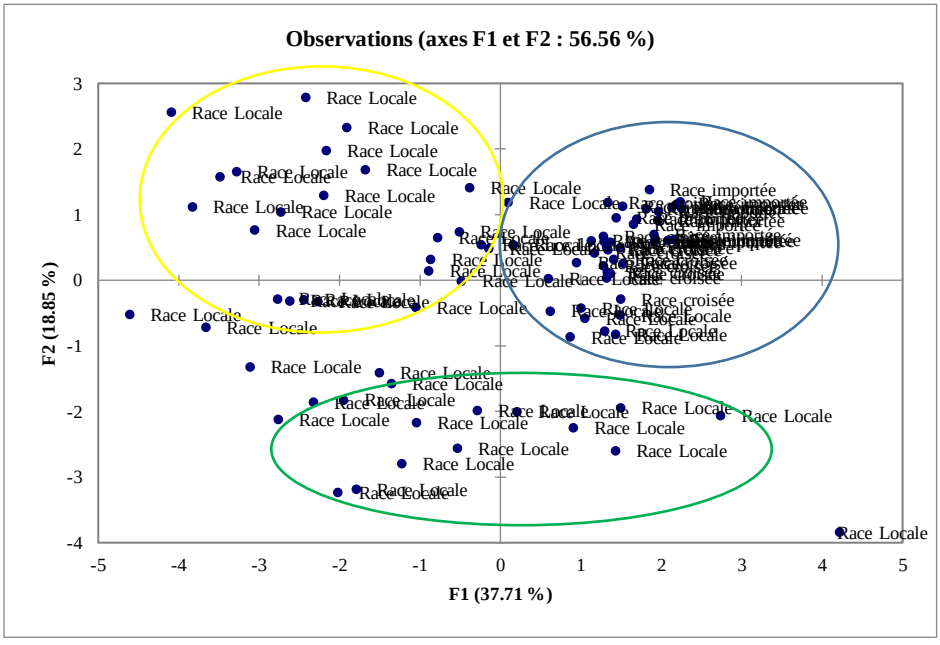

Figure 3. PCA representing the distribution of the bovine populations studied according to the parameters studied.

It seems clear from this distribution that the milk taken from the animals of the local population presents a very important diversity and is clearly individualized by contribution to the two other populations which are grouped is present a lesser diversity by contribution to the first population.

Hierarchical ascending classification (C.A.H)

The hierarchical classification (CAH) resulting from the PCA distinguished three classes of milk (Figures 04). The composition of these allows to distinguish; Milks rich in protein, fat, dry extract (total and defatted) and characterized by the lowest freezing point (milk of class 3), milk in low solids (total and defatted) (milk of class 2). Class 1 is characterized by a medium density, a low protein level and a pH that approximates neutrality, a medium MG content and the lowest EST. Finally, the class I contains intermediate values for all the parameters studied (**Table 3**).

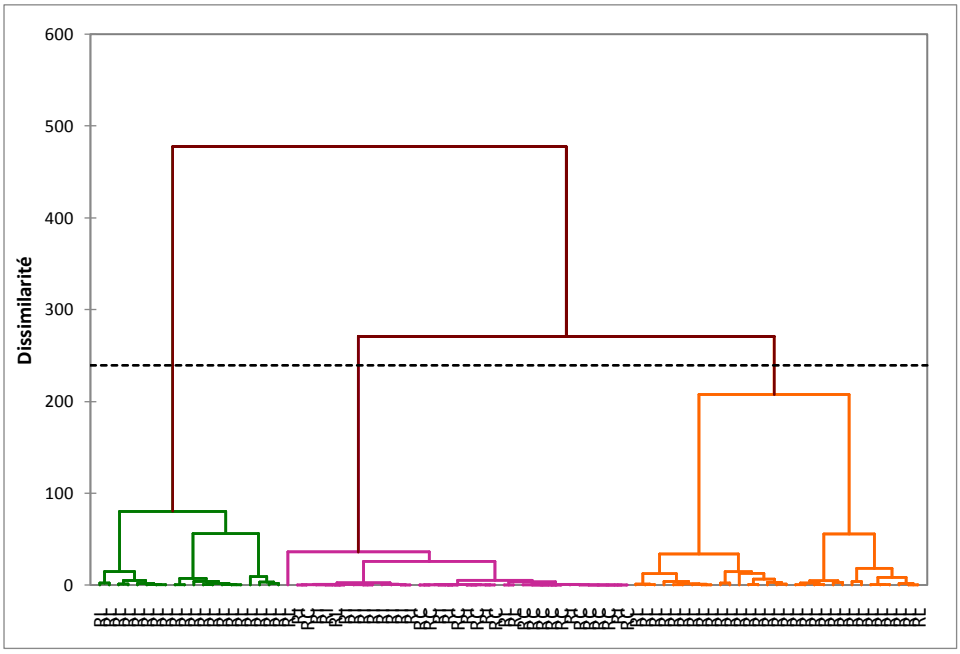

Figure 4. Dendrogram resulting from the classification of 88 milk samples.

Table 3. Characterization of three milk classes studied.

Classes	1	2	3
Numbers	37	20	31
EST	11,952	12,434	13,791
ESD	8,352	9,937	10,534
WATER %	88,048	87,593	86,063
Fat	3,454	2,471	3,259
Protein	3,178	3,639	3,857
Density	1028,773	1024,200	1030,635
Point of freezing	-0,557	-0,650	-0,671
pH	7,003	7,020	7,035

Correlation between variables

The correlation coefficients between the variables (Table 04) are between -0.95 and 0.71. This means that the variables are negatively and positively correlated with each other. There is an interdependence between the measurements. A strong positive correlation between dry matter and fat content, dry matter and protein content, freezing point and milk yield. A strong and significant negative correlation between dry matter and moisture content, freezing point and dry matter content and protein level. The rest of the

correlation values show a weak link between the variables, these correlations are not significant.

Table 04: Relationship between physicochemical parameters of milk (correlation matrix (Pearson (n)).

Variables	Age	Milk yield	EST	ESD	Water %	Fat	Protein	Density	Point of freezing	Ph
Age	**1**									
Milk production	0.02	**1**								
EST	0.10	**-0.37**	**1**							
ESD	-0.11	**-0.36**	**0.33**	**1**						
Water %	-0.11	**0.37**	**-0.95**	**-0.31**	**1**					
Fat	0.15	**0.22**	**0.40**	-0.12	**-0.36**	**1**				
Protein	-0.04	**-0.42**	**0.71**	**0.40**	**-0.60**	-0.11	**1**			
Density	-0.02	0.17	0.17	-0.06	-0.17	**0.33**	0.07	**1**		
Point of freezing	0.01	**0.53**	**-0.66**	**-0.46**	**0.60**	**0.34**	**-0.89**	0.05	**1**	
Ph	0.08	-0.03	0.0020	-0.11	0.01	-0.05	-0.03	0.02	0.01	**1**

Values in bold are different from 0 to a level of significance alpha = 0.05

Conclusion

The physicochemical parameters of the milk analyzed as well as the milk production showed a very varied degree of influence with regard to the breed, the region and the age. For example, the breed has a positive or very significant effect on the majority of the parameters measured with milk production except density and pH. In addition, no significant difference is observed for these parameters as to the age of the animals; however, the fat varies with the age of the animal. The analysis of the results shows that the milk fat of local cows is similar to the milk value of imported cows. We also observed individual variations, both in the local population and in the imported and cross-pollinated populations.

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