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Contribution to the evaluation of the physicochemical quality of raw goat milk in the steppe region of Djelfa (Algeria): What risks on public health?

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Abstract— This research was conducted to study the key physicochemical parameters of raw goat milk samples taken from semi-intensive and extensive Sanine and Arbia breedings in the region of Djelfa as an Algerian steppe zone. Sixty three raw udder milk samples were taken from goat farms and analyzed.

The results showed that goat milk had $3.23 \pm 0.79\%$ fat (FT), $7.12 \pm 3.32\%$ non-fat dry matter (NFDM), $2.76 \pm 1.27\%$ protein (PR), $4.05 \pm 1.84\%$ lactose (LC) and a density (DS) of 1.0204 ± 0.0118 with a freezing point (FP) $-0.252 \pm 0.106 °C$ and a pH of 6.63 ± 0.13. Descriptive analysis of the milk temperature (TS) data revealed that its mean is $9.87 \pm 1.47 °C$. In addition, these temperatures have weak correlations with the seven physicochemical parameters of raw goat milk. Six correlations are negative [pH-TS ($r = -0.3431, R^2 = 0.1177$); FT-TS ($r = -0.4708, R^2 = 0.2216$); NFDM-TS ($r = -0.3212, R^2 = 0.1032$); PR-TS ($r = -0.3755, R^2 = 0.1410$); LC-TS ($r = -0.3748, R^2 = 0.1405$); DS-TS ($r = -0.3528, R^2 = 0.1245$)] and a correlation is positive [FP-TS ($r = 0.4167; R^2 = 0.1736$)]. In parallel, these temperatures in the majority of cases are greatly exceeded the values recommended by Algerian standards ($+ 6 °C$). These results reflect risks to the health of consumers. They require a control and popularization program for all stakeholders in the sector in order to improve the quality and quantity of the raw milk produced and minimize significant economic losses thereafter.

Keywords— Algeria, goat, pastoral region, raw milk, temperature.

I. INTRODUCTION

Milk is an important source of all the basic nutrients required for mammals, including humans. It is a complex colloidal dispersion containing fatty globules, casein micelles and whey protein in an aqueous solution of lactose, minerals and a few other minor compounds. Its physical properties are affected by several factors, including the composition and processing of milk [1].

Algerian consumption of milk has increased since independence. The lack of local production has forced the country to resort to massive imports of milk powder for several years. Admittedly, many efforts have been made by the various actors in the dairy sector, in particular the dairy policy based on the importation of improved breeds, but

the knowledge available on breeding systems and the constraints limiting the performances of the breeds [2].

Therefore, controlling the quality of milk production remains an important step to protect consumers and ensure that the controlled products are of acceptable quality and can be marketed profitably.

The main objective of this study was to determine the physicochemical indicators of raw goat's milk collected from the farms of an Algerian pastoral region (Djelfa) and to determine the temperature of the milk during physicochemical analyzes, in order to give an idea of the risk. consumption of milk without any heat treatment. Then, to study the influence or the relationship of this temperature on the physicochemical parameters. Finally, corrective measures will be proposed to improve the

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physicochemical quality of raw milk in production and marketing and to preserve the health of the consumer.

the introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. MATERIAL AND METHODS

2.1. Study area

The present study was carried out in the region of Djelfa. It is located in the central part of Algeria, the capital of the wilaya is 300 kilometers south of the capital. It lies between 2 ° and 5 ° East longitude and between 33 ° and 35 ° North latitude. It is bounded to the north by the wilayas of Médéa and Tissemsilt, to the east by the wilayas of M'Sila and Biskra, to the west by the wilayas of Laghouat and Tiaret and to the south by the wilayas of Ouargla, 'El Oued and Ghardaïa (Figure 1) [3].

Fig. 1. Geographical location of the Djelfa region [3].

2.2. Sampling and transport of samples

A total of 63 samples of raw goat's milk from udders were taken in flasks, correctly identified by significant codes, and sent to a cooler under the cold regime within a determined timeframe to the analysis laboratory at ZIANE Achour - Djelfa University (Faculty of Natural and Life Sciences).

The temperature of the milk was recorded at the time of the physicochemical analyzes.

2.3. Research and determination of physicochemical indicators of raw milk

As soon as the raw milk samples arrive at the laboratory, the pH is measured using a HANNA instruments type pH meter. The latter, according to the device's instructions, was first calibrated in calibration solutions.

The physicochemical quality parameters were determined by the LactoStar FUNKE GERBER type analyzer. These parameters are: fat (%), non-fat dry matter (%), protein (%), lactose (%), density and freezing point (° C).

After powering the analyzer and zero point calibration, the sample suction tube has been immersed in a jar with the milk to be analyzed, the measurements start and the result is simultaneously displayed. Between each sampling passage through the device, rinsing is mandatory.

The conditions for the temperature of raw milk determined in interministerial decree No. 85/1999, were used as a reference to estimate the risks of consuming raw goat milk without any treatment. It should be noted that the storage temperature for raw milk is + 6 ° C [4].

2.4. Statistical analysis

Average milk temperature and physicochemical indicators were used as the source of variation.

The correlation coefficients (r) were calculated between the physicochemical parameters and the temperature of the raw milk recorded during the physicochemical analysis.

Confidence intervals (CI) were calculated for each physicochemical indicator.

The calculations were made using Microsoft Office Excel® 2007 software.

III. RESULTS AND DISCUSSION

3.1. Results of measuring physicochemical parameters of individual raw goat milk

Overall, the results showed that goat milk had $3.23 \pm 0.79\%$ fat (FT), $7.12 \pm 3.32\%$ non-fat dry matter (NFDM), $2.76 \pm 1, 27\%$ protein (PR), $4.05 \pm 1.84\%$ lactose (LC) and a density (DS) of 1.0204 ± 0.0118 with a freezing point (FP) -0.252 ± 0.106 ° C and a pH of 6.63 ± 0.13 (Table 1).

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Table 1. Distribution of the physicochemical quality parameters of raw goat milk

pH: potential hydrogen; NFDM: non-fat dry matter ; SD: Standard deviation; CI (95%) : Confidence interval at 95%.

Indicators	Extreme values		Mean ± SD	CI (95%)
	Min	Max		
pH	6.25	7.08	6.63±0.13	[6.60; 6.66]
Fat (%)	1.20	5.99	3.23±0.79	[-1.14; 7.60]
NFDM (%)	0.27	13.37	7.12±3.32	[0.77; 13.47]
Protéine (%)	0.07	5.11	2.76±1.27	[-1.29; 6.81]
Lactose (%)	0.09	7.46	4.05±1.84	[-0.82; 8.92]
Density	0.9957	1.0424	1.0204±0.01118	[1.0175; 1.0233]
Freezing point (°C)	-0.491	-0.04	-0.252±0.106	[-0.278; -0.226]
Temperature (°C)	6.30	12.6	9.87±1.47	[9.51; 10.23]

These results can be explained, in particular, that goats are reared in extensive or semi-intensive mode and feed on natural vegetation preferring anything that is suspended and far from the ground, and may not receive additional food for the improved milk production.

In addition, density and freezing point are indicators of wetting of raw milk especially or level of points of sale.

According to Parcuel et al. [5], wetting is linked to the failure to use milking or refrigeration equipment.

3.2. Relationship between physicochemical indicators and the temperature of raw goat milk

The temperature of raw goat milk recorded at the time of physicochemical analyzes, in the majority of cases is greatly exceeded the values recommended by Algerian standards (+ 6 ° C). They are included between a minimum of 6.3 ° C and 12.3 ° C, with an average of 9.87 ± 1.47 ° C.

In addition, the majority of samples the temperatures greatly exceeded the temperature of 10 ° C. This temperature is considered to be a threshold at which the *S. aureus* bacteria can begin to produce the enterotoxin responsible for the disease [6].

The descriptive analysis of the data on the temperature of this foodstuff revealed that, these temperatures at the time of the physicochemical analyzes have weak correlations with the seven physicochemical parameters of raw goat milk. Six correlations are negative [pH-TS (r = -0.3431, R^2 = 0.1177); FT-TS (r = -0.4708, R^2 = 0.2216); NFDM-TS (r = -0.3212, R^2 = 0.1032); PR-TS (r = -0.3755, R^2 = 0.1410); LC-TS (r = -0.3748, R^2 = 0.1405); DS-TS (r = -0.3528, R^2 = 0.1245)] and a correlation is positive [FP-TS (r = 0.4167; R^2 = 0.1736)] (Table 2).

The results obtained can be explained by the fact that the temperature has a negative influence on six physicochemical parameters (pH, DS, NFDM, PR, LC, FT), ie, when the temperature increases, it degrades the previously mentioned indicators.

Table 2. Correlation between physicochemical indicators and the temperature of raw goat milk

pH: potential hydrogen; FT: fat; NFDR: non-fat dry matter; PR: protein; LC: lactose; DS: density; FP: freezing point; TS: temperature; r: Correlation coefficient; R^2: Coefficient of determination.

Relationship between parameters	r	R^2
pH-TS	-0.3431	0.1177
FT-TS	-0.4708	0.2216
NFDM-TS	-0.3212	0.1032
PR-TS	-0.3755	0.1410
LC-TS	-0.3748	0.1405
DS-TS	-0.3528	0.1245
FP-TS	0.4167	0.1736

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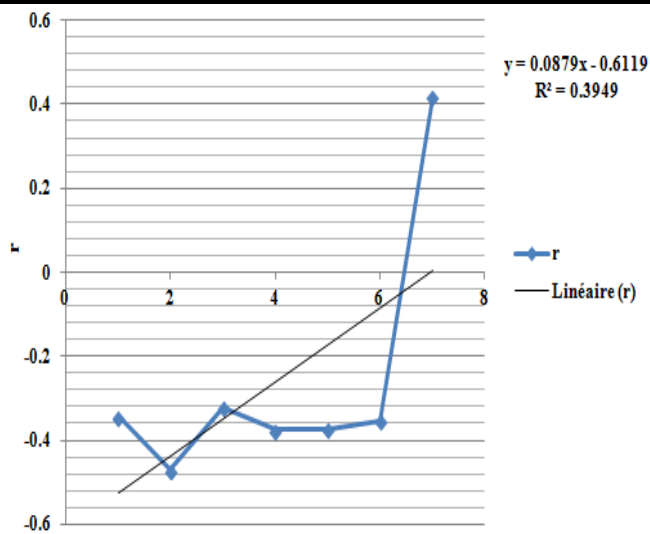$y = 0.0879x - 0.6119$
$R^2 = 0.3949$

Fig. 2. Distribution of values of relationships between physicochemical parameters and temperature

IV. CONCLUSION

This work confirms the importance of controlling the physicochemical quality of raw goat milk by evaluating the parameters required on farms and also at points of sale, in order to correct any nutritional insufficiency and to detect all frauds in the points of sale.

At the same time, in the majority of cases, the results obtained make it possible to discover that the temperature of the milk at the time of the physicochemical analyzes are exceeded the values recommended by the Algerian standard, which constitutes a risk to the health of consumers in the event of non-treatment of raw milk.

These results reflect risks to the health of consumers. They require a control and extension program for all actors in the sector in order to improve the quality and quantity of the raw milk produced and to minimize significant economic losses thereafter.

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