

# Comparative Study of Some Physicochemical Criteria of the Milk of Goats Raised in the Touggourt Region, Algeria

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**Abstract** The creation of the goat sector in Algeria and government subsidy have led to the appearance of specialized goat breeding systems and dairy production. Goat's milk is a popular food in the arid and semi-arid regions of Algeria. This food contributes effectively to balance and enrich the nutrition of the populations of these regions. The present study aim to contribute to the physicochemical characterization of goat milk from three breeds (Alpine, Arbia and the Cross breed) reared in the research station of Touggourt, by analyzing and comparing the physicochemical properties of these milks: pH, density, titratable acidity, fat, dry matter, non-fat dry matter and humidity content in various milk samples. A total of eighty-one samples of milk coming directly from the udders of goats of these three breeds (n=81) were collected in 2022. The samples are: (n1=60) from goats of the Alpine population, (n2= 9) from the Arbia breed and (n3 =12) from the cross breed. The parameters determined varied according to the day of sampling and the breed of goat from which the milk was obtained. The physicochemical quality of the milk varied from one breed to another. The Alpine goat showed a superiority in the Fat content ( $37.27 \pm 4.11$  g/l), in dry matter ( $115 \pm 1.17$  g/l) and in defatted dry extract ( $77.80 \pm 9.38$  g/l ), more over the Arbia breed marked a superiority in pH ( $6.75 \pm 0.04$ ), and humidity ( $90.46 \pm 0.10\%$ ), and the Cross breed in density ( $10.27 \pm 1.075$ ). and the Acidity ( $17.33 \pm 0.45$  °D). This allows us to conclude that breed has an effect on the physico-chemical parameters of milk.

**Keywords:** Algeria, goat, milk, physico-chemical characteristics

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## 1. Introduction

Algeria is known for its sheep breeding alongside goat breeding, the national number of which was 4 904 255 head in 2018 [1]. Also, goats show a great capacity to adapt to the harsh climatic conditions of the arid and semi-arid zones of the country. This feature allows them to live in areas inaccessible to other domestic animal species. Knowing that this breeding is practiced for its milk, its meat and its hair. Goat breeding represents nearly 15% of the total national herd. With a production of 42,000 tons of meat and 267.000 tons of milk [1].

In Algeria, this herd is very heterogeneous and made up of animals from the population of local breeds (the Arbia breed, the Kabyle breed, the Makatia breed and the M'Zabia breed), the population of imported breeds (Alpine breed and other ) and the mixed or cross bred population

(resulting from controlled or uncontrolled crossings of local breeds with imported breeds) [2].

From the point of view of these nutritional and digestive qualities, goat's milk has a first-rate value. It is less allergenic and undergoes lactic fermentation more slowly than that of cows. Also, it occupies a strategic place in the human diet due to its balanced composition of nutrients (proteins, carbohydrates and lipids) and its content of vitamins and minerals, especially dietary calcium [3]. The importance of milk is paramount because this product can be consumed fresh, pasteurized, sterilized or transformed into derivative products [4].

Goat breeding represents an income activity for the majority of families in semi-arid regions and a source of protein of animal origin to improve and balance the food intake in these localities. In order to contribute to the promotion of this activity and given the lack of data on goat's milk in this area, a study was carried out to characterize the physicochemical composition of the milk

of the three main breeds of goats in the area, the Alpine, the Arbia and the Cross breed. In the present study, we interested in studying the physicochemical characterization of the milk of three different breeds of goats raised in the same region of Touggourt, a town in southern of Algéria and under the same conditions. The three goat breeds object of our study are: the Arbia breed (Photo 1), the Alpine breed (Photo 2) and the cross breed (Photo 3).



Photo 1. The Arbia breed



Photo 2. The Alpine breed



Photo 3. The Cross breed

## 2. Material and Methods

The biological material used in this study is based on the milk of goats from three goat breeds (Alpine, Arbia and Cross) reared under the same conditions.

Eighty-one samples of milk came directly from the udders of goats of the three breeds (n=81) were collected in 2022. The samples were labeled according to their goat breed of origin. Milk from the Alpine breed (n=60), milk from the Arbia breed (n=9) and milk from the cross breed (n=12). Three types of goat milk were analyzed. The samples were taken by manual milking, respected certain aseptic conditions by cleaning the milk duct of the goats, threw the first jets of milk and used sterile glass bottles. The physicochemical parameters to be determined for the characterization of these milks are: The pH value characterizing the milk was read directly on a pH meter after immersion of its electrode in the milk. The density was expressed by the ratio of the masses of the same volume of milk and water at 20°C, it was measured using a lactodensimeter accompanied by a thermometer. Titratable acidity was expressed in Dornic degrees. The acidity titration was carried out with sodium hydroxide in the presence of phenolphthalein as a colored indicator

(NF 04-206). The fat content was determined by the acidobutyrometric method of Gerber and Vanglick (NF 04-210). The total dry extract was determined after the evaporation of the samples, 5 ml of the milk in the oven at a temperature of 105°C until a constant weight. The moisture content, expressed as a percentage of mass, represents the mass loss of milk when it was subjected to desiccation [5]. The defatted dry matter content is the mass expressed as g/l of the weight of the residue obtained after drying minus its fat content. The average values of the data obtained from several observations according to the tests were calculated and represented with the standard deviations using the Windows Excel software.

## 3. Results

### 3.1. pH

According to Remeuf et al. [6], the pH values of goat milk are between 6.45 and 6.90. The different pH measurements of goat milk samples from the three breeds of goats studied, measured at a temperature of 20°C, gave averages of this parameter of  $6.51 \pm 0.05$ ,  $6.75 \pm 0.04$  and  $6.45 \pm 0.06$  respectively for race; Alpine, Arbia and the Cross breed (Figure 1). Figure 1, shows that the average pH values of milk varied according to the breed of goat the milk came from. The highest average was recorded on the milk of goats of the Arbia breed ( $6.75 \pm 0.04$ ), followed by that of the Alpine breed ( $6.51 \pm 0.05$ ) then comes the average noted on the milk of goats of the Cross breed ( $6.45 \pm 0.06$ ). We note that all the pH values that was taken are in the neighborhood of neutrality.

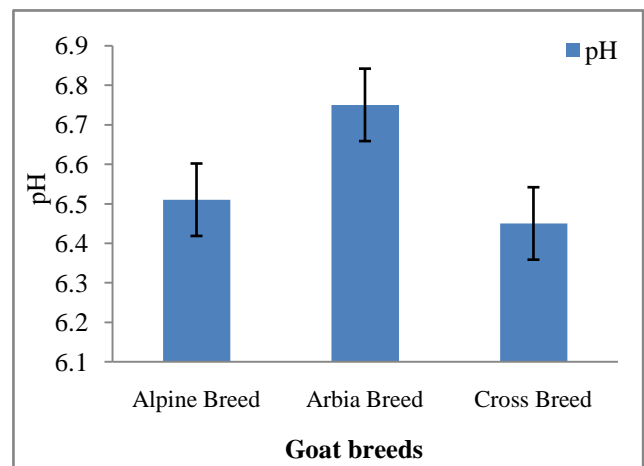
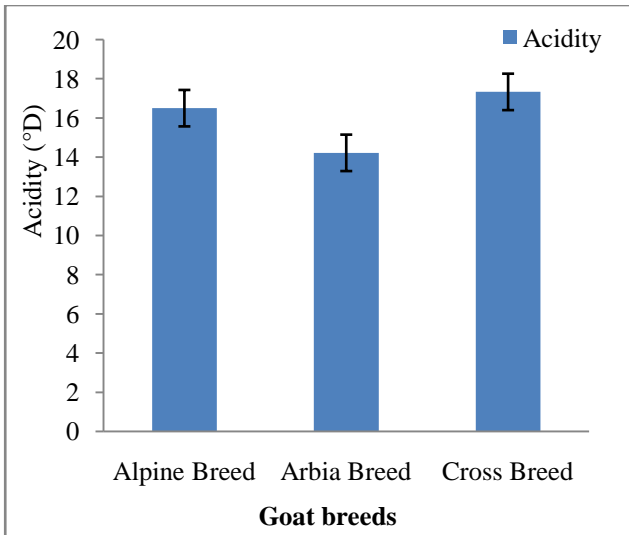


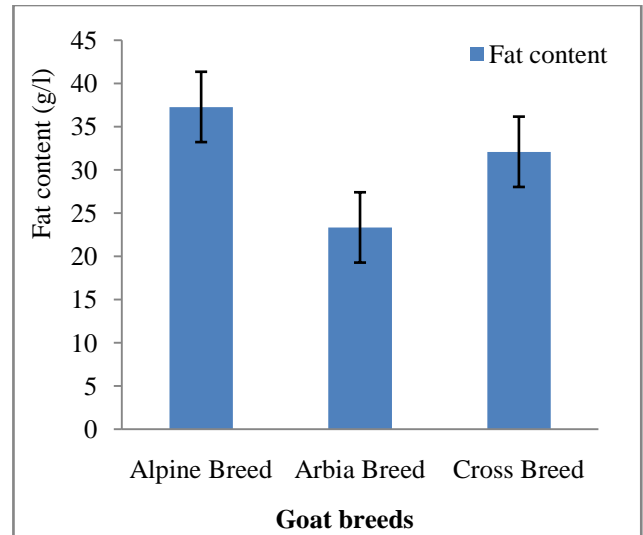
Figure 1. Variations in the pH of milk according to the breeds of goat (The values are presented with their mean  $\pm$  their standard deviation (n=81))

### 3.2. Titratable Acidity

Figure 2 shows that the average acidity values of the milk varied according to the breed of goat from which this milk came. The titratable acidity values of  $16.50 \pm 2.11$ ,  $14.22 \pm 0.77$  and  $17.33 \pm 0.45^\circ\text{D}$  were recorded on the milk of the Alpine, Arbia and Cross breeds respectively during our study. Alpine and Arbia breed milks are slightly acidic.



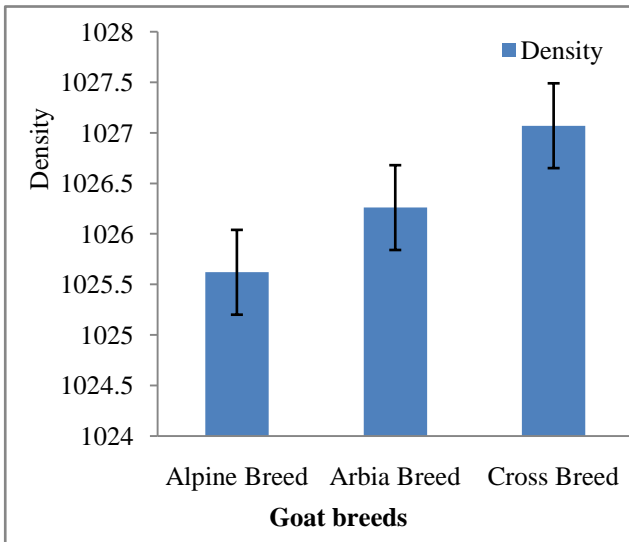
**Figure 2.** Variations in the acidity of milk according to the breeds of goat (The values are presented with their mean ± their standard deviation (n=81))



**Figure 4.** Variations in the fat content of milk according to the breeds of goat (The values are presented with their mean ± their standard deviation (n=81))

### 3.3. Density

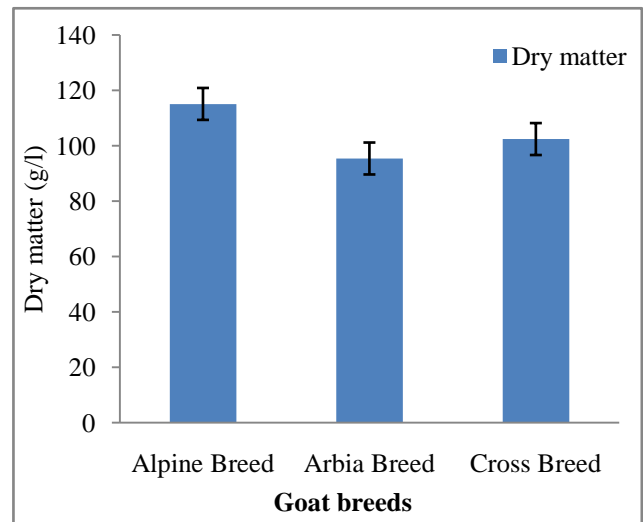
According to the FAO [7], the density of goat's milk is between 1027 and 1035. Our results were slightly lower than this range of values for the milk of goats of the Alpine (1025.62±0.00) and Arbia breeds (1026.26±0.46). While the milk of the Cross breed whose values were within the range indicated by this organization (1027.07±1.075) (Figure 3).



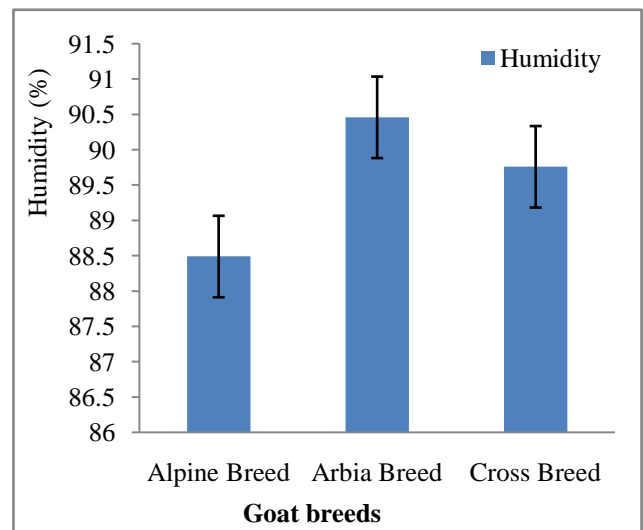
**Figure 3.** Variations in the density of milk according to the breeds of goat (The values are presented with their mean ± their standard deviation (n=81))

### 3.4. Fat Content

The recorded results showed that the average fat content of the milks analyzed varies according to the breed of goat of origin of this milk (Figure 4). The milk of the Alpine breed was the richest in fat matter with 37.27 ± 4.11 g/l followed by the milk of the cross breed with 32.08 ± 0.38 g/l and the milk poorest in this matter is that of the Arbia breed with 23.33 ± 0.33 g/l (Figure 4).



**Figure 5.** Variations in the dry matter of milk according to the breeds of goat (The values are presented with their mean ± their standard deviation (n=81))



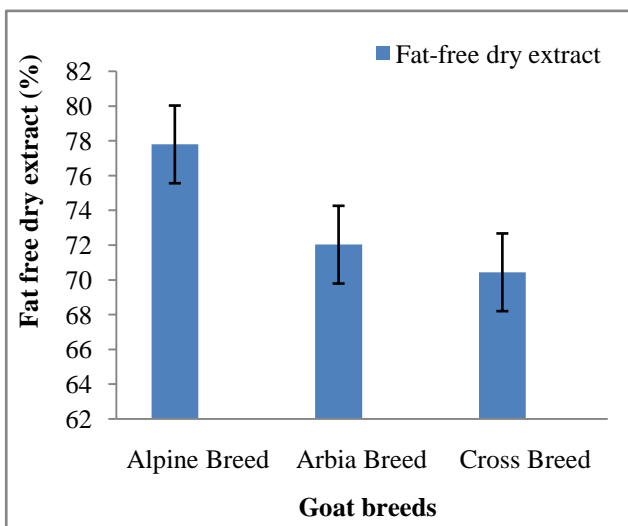
**Figure 6.** Variations in the humidity of milk according to the breeds of goat (The values are presented with their mean ± their standard deviation (n=81))

### 3.5. Dry Matter Content and Moisture Rate

The total dry matter content obtained after evaporation of water from the milk is expressed in g/l or in percentage [8]. The dry matter and moisture content respectively were ( $115.07 \pm 10.27$  g/l and  $88.49 \pm 1.02\%$ ), ( $95.37 \pm 1.05$  g/l and  $90.46 \pm 0.10\%$ ) and ( $102.39 \pm 7.12$  g/l and  $89.76 \pm 0.72\%$ ) noted on goat milks: Alpine, Arbia and the Cross breed (Figure 5 and Figure 6). This showed a variability of these two parameters according to the goat breed. Milk from the Alpine breed showed the highest total dry matter content (Figure 5). While that of the Arbia breed was the most diluted (Figure 6).

### 3.6. Fat-free Dry Extract

The fat free dry extract of milk varied according to the breed of goat from which it came. The highest average was recorded on milk from animals of the Alpine breed ( $77.80 \pm 9.39$  g/l) followed by that of the Arbia breed ( $72.02 \pm 0.75$  g/l) and the lowest average was recorded on milk from goats of the cross breed ( $70.44 \pm 6.97$  g/l) (Figure 7).



**Figure 7.** Variations in the fat free dry extract of milk according to the breeds of goat (The values are presented with their mean  $\pm$  their standard deviation (n=81))

## 4. Discussion

The pH values recorded on the studied milks were included in the interval which characterizes a normal and stable milk according to Vignola et al. [9]. The pH values of the milk obtained from the Arbia breed were close to those measured by Gaddour et al. [10] (6.77, 6.68 and 6.74) on goat milk collected in arid regions in Tunisia. And the values for this parameter recorded on the milk of goats of the Alpine and Cross breeds were lower than those announced by Aissaoui et al. [11] on the milk of three goat breeds Alpine, Arbia and Cross breed (6.88, 6.68 and 6.83 respectively), the milk of goats in Turkey (6.68) and of the Draa breed in Morocco (6.64) reported respectively by Kesenkas et al. [12] and Noutfia et al. [13]. The pH values recorded were all close to neutrality (between  $6.75 \pm 0.04$  and  $6.45 \pm 0.06$ ) very slight

variations according to the goat breed were noted for this parameter.

According to some studies, the pH of goat's milk takes on different values depending on the goat breed. It is 6.59 for the Girgentana [14], 6.41 for the Sangamneri [15], 6.27 for the Kabyle goat [16], 7.1 for the Alpine [17] and 6.71 for the Saanen [18]. This variance can be explained by breeding system undertaken and the specific food of each area [19].

According to the FAO [7], the titratable acidity of goat's milk is between 14-18°D. Our results fell within this range. They are lower than those reported by Gaddour et al. [10] in Tinusia (22°D, 20°D and 19°D). Aissaoui et al. [11], announced values of 12.55, 17.39 and 14.8°D on milk from goat breeds: Alpine, Arbia and Cross breed respectively. The values of this parameter recorded on the milk of the goat breeds studied were clearly lower than those measured by Amroun and Zerrouki [16] on Kabyle goat milk (20.98°D).

The titratable acidity showed great variability according to goat breed in the different studies that have been carried out on goat milk. Noutfia et al. [13] noted an acidity for Draa and Alpine milk of 17.7°D and 13.5°D respectively in Morocco.

According to Mukhekar et al. [15], Dornic acidity was 12.85°D for Sangamneri goat's milk, while Boumendjel et al. [17] have reported a value of 18.88°D for Alpine. This difference may be due to the amount of lactic acid in each milk.

Rafiq et al. [20], have announced that the Dornic acidity varied according to the breed, it is generally low in the order of 12°D for goat's milk. The acidity of milk is relatively steady, but its increase is an index of abnormal milk [9,21].

Previous studies have showed that the density depends on the richness of the milk in dissolved and suspended elements as well as the fat content. It is also variable depending on the temperature. The density of goat's milk is between 1026 and 1042 [22]. Our results fall within this range. The density of freshly extracted milk from the udder was unstable and tends to increase over time. Our results for this parameter were lower than those announced by Aissaoui et al. [11], whose values were 1032.36 (Arbia) and 1029.09 (Alpine), and to the results noted by Noutfia et al. [23] on Draa goat milk (1031). The density values obtained from the Cross breed were comparable to those of milk from the Alpine breed in Morocco (1028) [23]. According to Luquet [24], the density of milk varied according to its dry matter content, and was inversely proportional to the fat content.

The fat content of milk of the Alpine and Cross breed were higher than those noted by Gaddour et al. [10] on goat's milk in Tunisia (28.66 g/l). While Aissaoui et al. [11] announced higher rates of 43.55 g/l (Alpine) and 57.4 g/l (Cross breed), as well as those of Turkish goat's milk (48 g) reported by Kesenkas et al. [12]. Our results noted on the milk of Alpine and Cross breeds are getting closer to those reported by Arroum et al. [25] on Kabyle goat's milk (36.25 g/l).

The breed influences the fat content of goat's milk [26]. Different values of this parameter have been noted, the Girgentana goat is characterized by a fat content of 3.93% [14]. African, Nguni and Boer goat breeds have fat levels

of 3.98% and 2.91% respectively [27]. In India, Sangamneri milk has a rate of 5.24% [15]. In Europe, Alpine milk is characterized by a rate of 4.4% [17].

Several studies have reported that breed has an impact on the physicochemical characteristics of milk [28,29], especially on its fat content [30]. Milk production can also affect its composition as milk production decreases, nutritional components increase [19,31].

According to St-Gelais et al. [32] the fat content of goat's milk is related to rearing conditions, feeding, stage of lactation and breed.

Our dry matter results were lower than those reported by Gaddour et al. [10] for goat milk in Tunisia (Arbia: 130.43, Alpine: 127.64, and Cross breed: 139.6 g/l).

The values of this parameter recorded by previous studies have shown great variability. Lopez et al. [33] and Zeng et al. [34] noted values of 9.9% and 2.7% respectively for the Alpine breed. However, those reported for local goat milk from northern Morocco of the Murciana-Granadina breeds and the local breed from the island of Tenerife are 13.3%, 13.2% and 13.8% respectively [35].

However, Mukhekar et al. [15] estimated a dry matter content of 0.75% in Sangamneri goat milk. Kljajevic et al. [18] reported levels of around 0.62% in milk from the Saanen breed.

The variation of the dry fraction can be explained by the quality of the feeding in each area which varies seasonally [37,38].

Water is the main constituent of milk. It represents 90% with some variations. The humidity levels recorded in our study were higher than those measured on goat's milk in Jijel (80.05%) by Boubezari [36].

Overall, the variations observed in the values of the physicochemical parameters of the milk of these three breeds goat studied can be linked to several factors, the feed, the age of the goats, the effect of the climatic conditions and the milk production. According to Jenness, [39], the milk from breeds with low milk yield is more concentrated in fat and dry matter. This may also explain the variations noted between the standard values and those observed by other studies.

## 5. Conclusion

The results obtained during this study showed that the acidity, the fat content and the dry matter of the three milks varied according to the goat breed. While the pH, the density, and the humidity, do not showed large differences in the values recorded for these milks.

These analyzes also showed that there were variations in the physico-chemical composition of milk depending on the breed. The milk of the Alpine goat breed was the richest in dry matter, Fat-free dry extract and in Fat content. The milk of the Cross breed was the most acidic. While Arbia breed milk proved to be the most diluted.

The results of this study confirmed that the goat breed (Alpine, Arbia and Cross) animal source of milk had an effect on the most physicochemical characteristics.

Igoat breeding in semi-arid areas has been marginalized and remains the family scale. Although its milk production

covers the nutritional needs of the population in these regions. In this context, it is necessary to improve the quality of this foodstuff by feeding goat livestock, genetic selection of high-performance breeds, and health monitoring of these animals.

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