

STUDY ON THE PHYSICOCHEMICAL PROFILE OF COLOSTRUM FROM ANGLO-NUBIAN GOATS 24 HOURS AFTER PARTURITION

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Abstract

The specific properties of colostrum make it an indispensable source of nutrients and passive immunity for newborns. Feeding kids with colostrum within the first hours after parturition is extremely important for their health and survival. The composition of colostrum in different animal species is not the same. There is also a difference in terms of interbreeding. The present study aims to monitor the changes in the physicochemical parameters of colostrum from Anglo-Nubian (AN) goats that occurred within the first 24 hours after parturition. The study was conducted in the goat farm of the RIMSA, Troyan, Bulgaria, and a total of 40 colostrum samples were obtained from clinically healthy AN goats. For the studied period of 24 hours, a reliable decrease of the studied parameters was reported: protein (14.21-7.79%), total solids (24.02-20.84%), solid-not-fat (19.21-12.93%), density (1.045-10.354 g/ml³), acidity (32-21^oT) and Ca (0.254-0.1494 mg/%). In contrast, for the indicators, such as fat (5.32-8.37%), lactose (2.63-3.43%), and pH (6.24-6.31), an increase in the values was observed.

Key words: Anglo-Nubian breed, colostrum, goats, physicochemical indicators.

INTRODUCTION

Feeding colostrum within the first hours after parturition is especially significant for the health and survival of the kids. It is the first secretion that is released from the mother's udder after parturition (Agradi et al., 2023), different in appearance and content from usual milk, and it has a thicker consistency than milk, and is yellowish (Dimov et al., 1975, Kıvrak et al., 2012, Anitaş & Göncü, 2024,).

Changes in the composition and properties of colostrum are most significant during the first day after parturition (Sánchez-Macías et al., 2014). During the so-called "transition period", or in other words, the transition of colostrum into milk, changes are observed in its biochemical and physiological indicators (Arain et al., 2008; Övet, 2023).

Both interspecies and interbreed differences in the colostrum composition have been found. This question is reported by Koluman et al. (2019) (comparing cow, sheep, and goat colostrum), Anitaş et al. (2021) (in Awassi and Çukurova Meat Type Sheep Breeds), Kumar et al. (2014) (in Sannen x Beetal and Alpine x Beetal goats) and others.

König (1903) and Bergman & Turner (1936) cite Henry (1840), who first made studies on the goat colostrum composition. According to Arguello et al. (2006), the colostrum composition varies among goat breeds. Information on the quality of colostrum from Anglo-Nubian goats, and its physicochemical and immunological properties is limited.

This information would allow a more accurate assessment of proper suckling, health status, and to what extent the newborn has received passive immunity from the mother. That is why that paper is focused on the physicochemical profile of colostrum from Anglo-Nubian goats raised in Bulgaria, as well as its change within the first 24 hours after parturition.

The present study aims to observe the changes in the physicochemical parameters of colostrum from Anglo-Nubian (AN) goats that occurred within the first 24 hours after parturition.

MATERIALS AND METHODS

The study was conducted in the goat farm of the Experimental Base of the Research Institute of Mountain Stockbreeding and Agriculture of

Troyan, located on the foot-hill of the Central Balkan Mountain, at 380 m above sea level.

The colostrum analyzed for the present study was obtained from twenty clinically healthy Anglo-Nubian goats during the period of kidding. The samples were milked at the 1st and then at the 24th hour after parturition, as each of them was placed in an individual container of 200 ml and transported to the Meat and Milk Laboratory at the laboratory complex of RIMSA-Troyan.

The physicochemical analysis includes a total of nine indicators, such as milk fat, protein, lactose, solids, and solid-not-fat, which were analyzed on a MilkoScan FT 120 Foss Electric device, and the samples were previously tempered to 40°C in a water bath to homogenize them. The

obtained results are expressed in percentages (%).

Acidity and Calcium (Ca) were determined by standard titration methods.

Colostrum density was measured by weight method, at a sample temperature of 20°C, and reported in g/cm³.

Active acidity or pH was determined using a pH meter 3110 SET 2- Wissenschaftlich Technische Werkstätten.

JMP v7 software package was used for the statistical processing of the results.

RESULTS AND DISCUSSIONS

Table 1 shows the chemical composition of colostrum at both time points it was obtained.

Table 1. Chemical composition of colostrum from AN goats within 24 h postpartum, %

Indicators (%)	1 h				24 h				Significance
	Mean	Under	Upper	SD	Mean	Under	Upper	SD	1 h x 24 h
Fat	5.32	4.53	6.11	0.27	8.37	7.58	9.16	0.48	***
Protein	14.21	12.8	15.61	0.88	7.79	6.39	9.2	0.43	***
Lactose	2.63	2.28	2.98	0.22	3.43	3.08	3.78	0.1	**
TS	24.02	22.27	25.78	1.1	20.84	19.08	22.59	0.54	*
SNF	19.21	17.69	20.74	0.98	12.93	11.41	14.46	0.41	***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Protein

Within the 24-hour postpartum period (Table 1), the amount of protein in the colostrum studied by us decreased by 6.42% ($p < 0.001$). The percentage decrease of this indicator is higher compared to what we found in the colostrum of Toggenburg goats (Mondeshka & Stoycheva, 2023), which is 3.81% ($p < 0.001$) and lower than what was found in the goat colostrum from Bulgarian White Dairy breed with 9.64% for the same period (Stoycheva & Mondeshka, 2023).

In Murciano-Granadina goats, Romero et al. (2013) found similar results to ours for protein, 13.64% at the 1st hour and 6.24% at the 24th hour postpartum, the difference between the two values (7.4%) is close to ours and confirms the trend to a significant decrease in the protein amount in the colostrum during the first day after parturition.

Anitaş et al. (2021) reported $18.60 \pm 0.31\%$ protein in the Awassi sheep colostrum and $10.90 \pm 3.16\%$ in the colostrum of Çukurova Meat Type Sheep Breed obtained at 16 h postpartum. Kessler et al. (2019) reported 16.36% protein in

the colostrum of Anglo-Nubian goats raised in Switzerland and Germany obtained within the first two hours after parturition.

The decrease in protein content in colostrum found in many breeds could be due to the large decrease in the number of immunoglobulins, leukocytes, lactoferrin, lysozyme, growth hormones, some amino acids, etc. within the 24 hours after parturition (Pellegrini et al., 1994; Rashid et al., 2012).

Lactose

Lactose is the main carbohydrate that newborns receive with colostrum. Also called milk sugar, it is a disaccharide found only in milk, milk products, and nowhere else in nature. Lactose has been found to stimulate the synthesis of B vitamins (Dimov et al., 1975). Lactose favors the intestinal absorption of calcium, magnesium, phosphorus, and vitamin D3 (Chilliard et al., 2003; Rashid et al., 2012). Kračmar et al. (2002) summarized the research of Hadjipanayiotou (1995) who compared milk and colostrum from sheep, goats, and cows and reported that the

amount of lactose increased sharply in samples taken consecutively during the colostrum period and remained relatively high throughout the transition and lactation period.

In the present study, an increase was observed in the milk sugar content in the colostrum from 2.63 to 3.43% ($p < 0.001$) within the studied 24-hour period (Table 1). The present finding is in agreement with many researchers, such as Kračmar et al. (2002) in Brown Short-haired breed goats; Sánchez-Macías et al. (2014) in Majorera goats; Rashid et al. (2012) in Beetal goats etc.

Fats

The percentage fat content of colostrum from Anglo-Nubian goats found in the present study was 5.32% at the 1st hour after parturition and 8.37% at the 24th hour (Table 1). Some publications present differences, which are determined by the breed, in the dynamics of this indicator within the first 24 hours after parturition. The fat and lactose in the colostrum are required by the newborn for heat production and the prevention of hypothermia (Keskin et al., 2007).

In domestic breeds of Romanian goats, Zaharia et al. (2011), investigated changes in fatty acid composition and cholesterol content of colostrum and followed the change in fat content from 0 to 7 days. The results published by the author's team, regarding the fat content, were obtained from samples taken for examination on 0 h - 4.20%; 6 h - 8.08%; 12 h - 5.14%; 24 h - 6.02%, and 48 h - 4.80%.

It is obvious that the results are quite dynamic and represent alternating increases and decreases in the percentage of lipids in the colostrum samples. Arguello et al. (2006) analyzed the effects of lactation sequence and number of kids born on the physicochemical parameters of colostrum from Majorera goats and found an increase in fat during the first day after parturition and a subsequent decrease until 132 hours after parturition. Marounek et al. (2012) examined colostrum from three-year-old White Shorthaired goats and found a decrease in fat from 5.67% at the 1st hour to 4.11% at the 24th hour.

Rashid et al. (2012) reported a much lower fat content in Beetal goats at the 1st day with 3.8%, followed by a continuous increase at the 2nd (4.5%) and 3rd day (5.2%). According to Dimov et al. (1975), the amount of fat in milk varies

depending on several factors, such as the lactation period, the season, and above all, nutrition - the type and ratio of forage used for animal feed.

The solid-not-fat (SNF)

In the present study, SNF of colostrum decreased by 6.28% ($p < 0.001$) at the 24th hour compared to the 1st hour after parturition (Table 1). The decrease is a logical consequence of the changes that occur when the other investigated colostrum indicators are changed. Proteins, lactose, and minerals make up the solid-not-fat. It is a relatively more constant quantity than total solids (Dimov et al., 1975).

The decrease mentioned above is a logical consequence of the dynamic changes occurring within the first hours after parturition, in the other physicochemical parameters of colostrum, since there is a certain dependence between the percentage content of SNF and proteins, lactose, and mineral substances. SNF is a relatively more constant quantity than total solids (Dimov et al., 1975).

Our findings correspond to the results of other authors on different goat breeds, such as Sánchez-Macías et al. (2014) for Majorera goats, Marounek et al. (2012) for White shorthaired goats, etc.

According to Prasad et al. (2002) the higher the solids content of the colostrum, the higher the density. Kračmar et al. (2005) and Hadjipanayiotou (1995) also described a higher content of total solids in colostrum immediately after parturition and a subsequent decrease. A decrease in colostrum density values within the first 24 hours after parturition was registered (Figure 1).

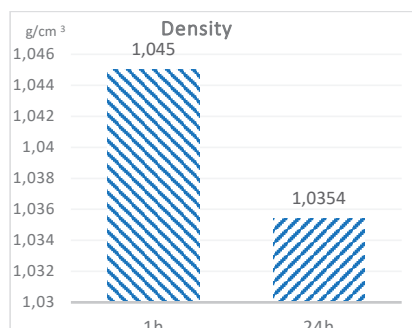


Figure 1. Mean density values (g/cm^3) of colostrum from AN goats at 1st h and 24th h after parturition

The **total solids** in the present study decreased from 24.02% at the 1st hour to 20.84% at the 24th hour after parturition (Table 1). Keskin et al. (2007) reported that the total solids content of colostrum of Damascus goats was the highest on the 1st day and decreased gradually until the 3rd day. The present data correspond to those presented by Romero et al., (2013) for Murciano-Granadina goats and Tórres Vilar et al. (2008) for Saanen goats.

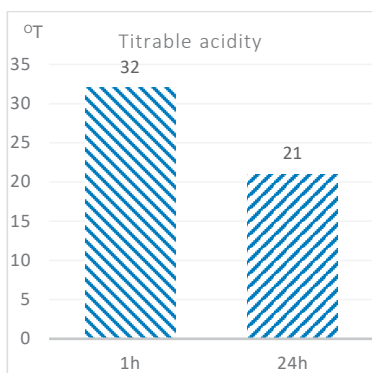


Figure 2. Mean values for the titratable acidity ($^{\circ}\text{T}$) of colostrum from AN goats at 1st h and 24th h after parturition

Titratable acidity is determined immediately after milking and indicates the presence of phosphates, citrates, proteins, and gases in milk. According to Dimov et al. (1975), it is influenced by nutrition, the health status of the animal, and the lactation period, as these factors probably also influence the colostrum composition (Tórres Vilar et al., 2008).

We found values of 32°T at the 1st hour after parturition and 21°T at the 24th hour (Figure 2). In previous studies, we found 35°T at the 1st hour after parturition and 20°T in the 24th h in Bulgarian White Dairy goats (Stoycheva & Mondeshka, 2023) and values of 25°T at the 1st hour after parturition and 21°T in the 24th h in Toggenburg goats (Mondeshka & Stoycheva, 2023). Torres Vilar et al. (2008) reported acidity of 46.1°D at the 1st hour and 25.1°D at the 24th hour in Saanen goats, which was higher than what we found, but the trend was similar.

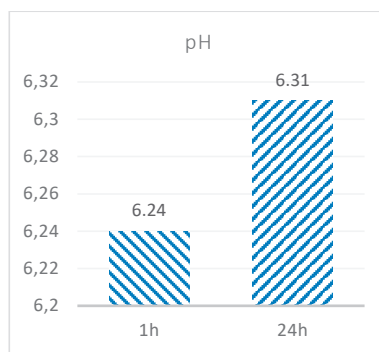


Figure 3. Mean pH values of colostrum from AN goats at 1st h and 24th h after parturition

The values of active acidity (**pH**) of the colostrum we studied increased from 6.24 at the 1st hour to 6.31, 24 hours later (Figure 3).

In Murciano-Granadina goats, Romero et al. (2013) reported values for this indicator from 6.38 at the 1st hour to 6.58 in the 24th h. Similar results to ours were also reported by Tórres Vilar et al. (2008) in Saanen goats and Sánchez-Macías et al. (2014) in Majorera goats. Some authors consider that the change of active acidity is influenced by the number of lactations of the goat (Tórres Vilar et al., 2008, Romero et al., 2012), whereas others do not find such a dependence (Argüello et al., 2006).

At the 1st hour after parturition, we found Ca content of 0.254 (mg%), in the colostrum obtained from Anglo-Nubian goats, as the value of this indicator was 0.194 (mg%) at the 24th hour (Figure 4).

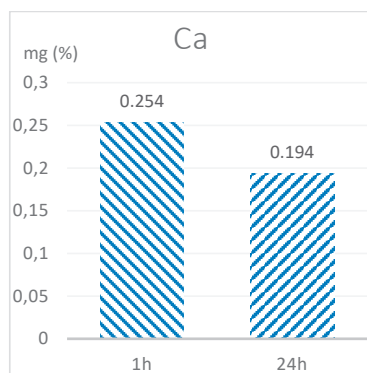


Figure 4. Average Ca values (mg/%) of colostrum from AN goats at 1st h and 24th hour after parturition

The calcium content in fresh goat's milk is found in the ionic, molecular, and colloidal-dispersed state. Its amount in milk is relatively constant. The increased or decreased content of calcium in milk depends on the health of the animals, the lactation period, and their nutrition (Dimov et al., 1975; Pecka-Kielb et al., 2018). Hamed et al. (2023) reported a decrease in the amount of Ca when the colostrum transits into milk for Baladi goats, from 511.695 ± 0.22 to 27.924 ± 0.21 mg/100 g.

CONCLUSIONS

In conclusion, the present study showed the change in the colostrum composition obtained from Anglo-Nubian goats within the first 24 hours after parturition, which is within the optimal limits for this type of animal.

A reliable increase in the values of fat, lactose, and pH, and a decrease in the values of protein, total solids, solid-not-fat, density, acidity, and Ca were found.

The results of the present study could be used as a basis for interbreed differentiation and criteria for determining the main quality characteristics of colostrum from Anglo-Nubian goats at the 1st day after parturition, which is decisive for the survival of the newborns and their normal development.

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