

## Physicochemical profile of colostrum from Bulgarian White Dairy breed goats - first day after birth

S. Stoycheva\*, L. Mondeshka

Agricultural Academy-Sofia, Research Institute of Mountain Stockbreeding and Agriculture, 281 Vasil Levski Str., 5600 Troyan, Bulgaria

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Colostrum is the first food that mammals receive immediately after birth. Its unique chemical composition and qualities distinguish it from milk and make it an indispensable source of nutrients and passive immunity for the newborns. The most intense changes in the composition and properties of colostrum are observed in the first twenty-four hours after birth, and by the fifth day its biochemical and physicochemical parameters reach values characteristic of milk. Both interspecies and interbreed differences in the colostrum composition have been found.

Bulgarian White Dairy breed (BWD) is the only goat breed created in Bulgaria. It was created in the Research Institute of Mountain Stockbreeding and Agriculture of Troyan (RIMSA), by crossbreeding of local white goats and Saanen bucks. It is perfectly adapted to the climatic conditions of Bulgaria.

The purpose of the present study was to observe the changes in the physicochemical parameters that occurred during the first twenty-four hours in the colostrum of goats of the Bulgarian White Dairy breed. The research work was conducted in the Meat and Milk Laboratory at the Research Institute of Mountain Stockbreeding and Agriculture of Troyan.

For the twenty-four-hour period of the study, a reliable decrease of the indicators was reported, such as protein (14.97-5.33%), total solids (26.47-15.71%), solid- non-fat (SNF) (20.46- 10.88%), density (1.0443-1.0356 g/ml<sup>3</sup>), acidity (35-20°T), milk fat (6.67-5.19%) and calcium (Ca) (0.240-0.145 mg%). In contrast, the lactose (2.99-4.19%) and pH (6.2-6.33) showed an increase in their values. The obtained results are within the optimal limits for this animal species and are the first reported for BWD breed.

**Keywords:** colostrum, goats, physicochemical parameters, Bulgarian White Dairy breed

### INTRODUCTION

Colostrum is the first food that mammals receive immediately after birth. Its unique chemical composition and qualities distinguish it from milk and make it an indispensable source of nutrients and passive immunity for the newborns. Both interspecies and interbreed differences in the colostrum composition have been found.

The most intense changes in the composition and properties of colostrum are observed in the first twenty-four hours after birth, and by the fifth day its biochemical and physicochemical parameters reach values characteristic of milk (Sánchez-Macías *et al.* [1]; Dimov *et al.* [2]). The changes that have occurred are a consequence of physiological processes that are most strongly influenced by factors such as health status, mother's diet, sequence of lactation [1], number of kids born (Knight and Peaker [3]), etc. Knowing the changes that occur during the colostrum and the entire lactation period and establishing milk quality criteria will guarantee a better quality

of the final products (Raynal-Ljutovac *et al.* [4]). According to Salem *et al.* [5], as the main nutritional component of colostrum and milk, milk proteins are essential, not only for the nutrition and growth of the offspring, but also in various technological aspects such as heat treatment, coagulation and rate of digestion.

Bulgarian White Dairy goat breed (BWD) was created in the RIMSA of Troyan, by crossbreeding of local white goats and Saanen bucks, it is the only breed of goats created in Bulgaria. Animals of this breed are perfectly adaptable to the climatic conditions of Bulgaria and represent the largest part of the goats raised in our country.

To date, in the available literature there is no information on the colostrum composition, milked on the first day after birth, in goats of BWD breed.

The purpose of the present study was to observe the changes in the physicochemical parameters that occurred during the first twenty-four hours in the colostrum of goats of the Bulgarian White Dairy breed.

\* To whom all correspondence should be sent:  
E-mail: s.e.stoycheva@abv.bg

## MATERIAL 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 in 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 goats of BWD breed during the period of kidding. The samples were milked at the first and twenty-fourth hour after birth, 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, of which milk fat, protein, lactose, solids, solid-not-fat 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/cm<sup>3</sup>. Active acidity (pH) was determined using a pH meter 3110 SET 2- Wissenschaftlich-Technische Werkstätten.

The statistical processing was done using JMP v.7 software package. The results were presented as means and standard deviations (SD). Means were compared through t-test.

## RESULTS AND DISCUSSION

Table 1 shows the chemical composition of colostrum at both time points of its obtaining.

**Table 1.** Chemical composition of colostrum from BWD goats in the period of 24h *postpartum*.

Indicators, %	1h		24 h		Sig.
	Mean	SD	Mean	SD	
Fat	6.67	2.16	5.19	1.75	*
Protein	14.97	2.23	5.33	1.48	***
Lactose	2.99	0.62	4.19	0.33	***
TS	26.47	4.02	15.71	2.73	***
SNF	20.46	2.07	10.88	1.26	***

\* p < 0.5; \*\*\* p < 0.001

### Protein

During the first twenty-four hours after birth (Table 1), the protein content in the colostrum decreased by 9.64% (p < 0.001). According to Arguello *et al.* [6], when the amount of colostrum or milk increases, the total protein content decreases, and this is most pronounced in dairy breeds such as the Bulgarian White Dairy goat. The values we report are a consequence of this physiological

process and correspond to what has been described in studies in different breeds (Keskin *et al.* [7]; Moreno-Indias *et al.* [8]; Romero *et al.* [9]; Hodulová *et al.* [10]; Soloshenko *et al.* [11], Paramasivam *et al.* [12]). Kosum *et al.* [13] found in Saanen goats a decrease by 4.46% in the protein amount in the colostrum in the first 24 hours. For Majorera goats, [6] reported a reliable decrease in total protein during the first two days after birth. Again, in Majorera goats that gave birth to twins, [1] found that protein decreased by 45% in the 48-h period after birth. The high amount of protein during the first hours after birth is explained by the higher content of immunoglobulins, leukocytes, lactoferrin, lysozyme, growth hormones, some amino acids, etc. (Pellegrini *et al.* [14]; Rashid *et al.* [15]). Rachman *et al.* [16] reported a drastic drop in lactoferrin levels in the first 48 hours after birth in three goat breeds in Indonesia.

### Lactose

Lactose is the main carbohydrate that the newborns receive with colostrum. It is absorbed faster than fat [6]. In the present study, an increase was observed in the milk sugar content in the colostrum of BWD goats by 1.2% (p < 0.001) for the studied twenty-four-hour period (Table 1). That corresponds to the results obtained in the study on the colostrum of various goat breeds, in Majorera goats [1, 6], in Murciano-Granadina goats [9], etc.

[15] studied the colostrum composition of Beetal goats and found that when passing into milk, the lactose amount increased from 2.93% on the first day to 3.8% on the second day and 4.4% on the third day. Lactose favors the intestinal absorption of calcium, magnesium, phosphorus and vitamin D3 (Chilliard *et al.* [15, 17]). According to Olechnowicz and Sobek [9, 18], lactose concentration follows the pattern of milk production, as it increases immediately after birth, it reaches a peak and then decreases.

### Total solids

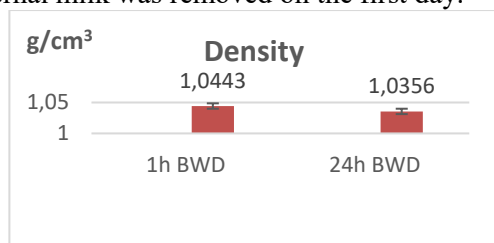
The content of the total solids in the colostrum obtained at the first hour after birth was 10.76% (p < 0.001) more than the same obtained at the 24th hour (Table 1). The present findings correspond with the results of [10] in Czech White Shorthair goats, the authors reported a 10% decrease in colostrum total solids, as well as Elmaz *et al.* [19] in Honamli goats. [9] reported the highest total solids values for Murciano-Granadina goats in the first hour after birth and a decrease of 10% up to the 24th hour. Hadjipanayiotou [7, 20] reported that the total solids content of colostrum of Damascus goats was the

highest on the first day and decreased gradually until the third day.

The solid-not-fat (SNF) includes protein, lactose and minerals and is a relatively more constant quantity than total solids [2]. In the present study, SNF of colostrum decreased by 9.28% ( $p < 0.001$ ) at the twenty-fourth hour compared to the first hour after birth (Table 1). The decrease in values in the present study is in agreement with that reported for other goat breeds. Marounek *et al.* [21] reported for the colostrum of White shorthaired goats, SNF of 16.03% at the first hour and 13.24% at the 24th hour. In Majorera goats, [1] found a decrease in the percentage of solid-not-fat from 13.87% after birth to 10.90% 24 hours later.

#### Fats

For the colostrum in the present study, a slight decrease in the percentage of fat content of 1.48%, ( $p > 0.5$ ) was reported (Table 1). In Saanen goats, [13] reported a decrease in fat content from 8.27% to 6.76% in the first 24 hours, where as it was up to 5.79% at the 48th hour. A similar decrease in the amount of fat in colostrum during the first 24 hours after birth was also reported by [19] in goats of Honamli breed, by [10] in Czech White Shorthairs and Kráčmar *et al.* [22] in Brown Short-haired breed. In contrast to the present study, [6] found an increase in fat in the colostrum at 24 hours after birth, and this contradiction could be explained by the fact that all cisternal milk was removed on the first day.



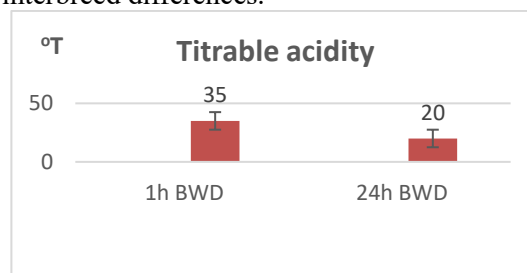
**Figure 1.** Mean density values ( $\text{g}/\text{cm}^3$ ) of colostrum from BWD goats at the 1st h and 24th h after birth.

Figure 1 presents the decrease in colostrum density values for the first 24 hours after birth. According to [9], colostrum density drops sharply around the 12th hour after birth and continues to decline more smoothly until the 156th hour. For the Murciano-Granadina goat breed, the author reported a decrease from 1.0528 to 1.0303  $\text{g}/\text{cm}^3$  at 156th hour, as colostrum density was 1.0377  $\text{g}/\text{cm}^3$  at the 24th hour, which coincides with the present findings. Tôrres Vilar *et al.* [23] in Saanen goats in Brazil, under similar climatic conditions to Bulgarian, reported a decrease from 1.0530 at the first hour to 1.0280  $\text{g}/\text{cm}^3$  at the 24th hour.

There is a direct interconnection between the colostrum density, the change in the amount of fat

and the milk composition, i.e. the higher the content of solids of the colostrum, the higher the density (Prasad *et al.* [24]).

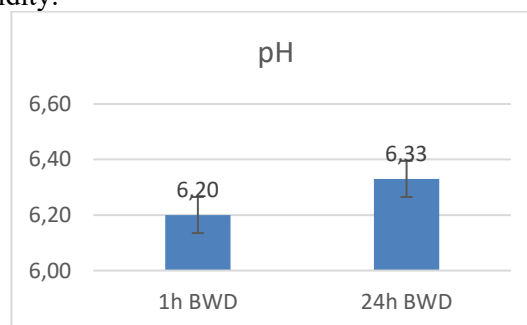
We found values of 35°T at the first hour after birth and 20°T at 24th h for the titratable acidity of BWD goat colostrum (Fig. 2) The present finding is in agreement with [9] for Murciano-Granadina goats and [23] for Saanen goats and although our results are slightly lower, the trend towards a decrease in acidity is the same and we attribute the differences to interbreed differences.



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

Titratable acidity is determined immediately after milking and indicates the presence of phosphates, citrates, proteins and gases in the milk. In the milk of different species of animals, it varies within narrow limits, as in goat's milk, it is around 15-16°T. The primary acidity depends on the animal's health condition, nutrition and the lactation period, at the beginning of lactation, colostrum has a very high acid degree, then it enters the above limits and by the end of the lactation period it falls below 15°T [2].

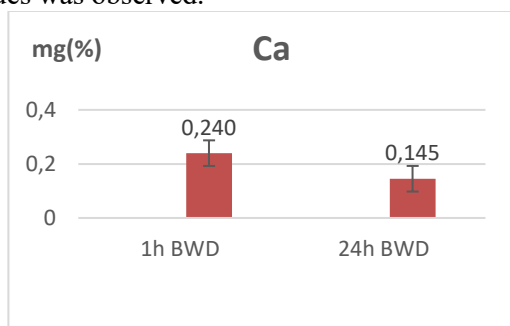
[23] reported a very high correlation between colostrum protein content and titratable acidity ( $r = 0.9$ ) and confirmed the theory of Mariani *et al.* [25] that lower percent protein results in lower titratable acidity.



**Figure 3.** Mean pH values of colostrum from BWD goats at 1st h and 24th h after birth.

The active acidity (pH) of milk decreases more slowly than the titratable one, which is due to the buffering properties of milk, which are determined by the content of protein substances and salts [2]. In the present study, a slight increase was observed in average pH values from 6.2 at the first hour to 6.3

twenty-four hours later (Fig. 3). [23] reported pH 6.40 in colostrum at the first hour and pH 6.68 at the 24th hour for Majorera goat breed. In a similar study, [9] indicated a slight increase in the first twenty-four hours from pH 6.58 to pH 6.62. Similar to the data published by [1], again no significant variation in values was observed.



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

The amount of Ca (Fig. 4) in colostrum from BWD goats at the first hour after birth was 0.239 mg/%, and at the twenty-fourth hour it was 0.145 mg/%. 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 [2].

#### CONCLUSIONS

The composition of colostrum from goats of BWD breed changes significantly during the first 24 hours after birth. A reliable decrease in the indicators was found: protein-(14.97-5.33%), total solids (26.47-15.71%), SNF (20.46-10.88%), density (1.0443-1.0356g/cm<sup>3</sup>), acidity-(35-20°T), milk fat (6.67-5.19%) and calcium (Ca)-(0.240-0.145mg/%). In contrast, the lactose (2.99-4.19%) and pH (6.2-6.33) indicators showed an increase in values.

The obtained results are within the optimal limits for this animal species and are the first reported for BWD breed. Future research in this direction will enrich the knowledge about the composition and properties of colostrum from the most widely spread goat breed in Bulgaria and will benefit farmers.

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