

PHYSICOCHEMICAL COMPOSITION, PROPERTIES, AND TECHNOLOGICAL CHARACTERISTICS OF SHEEP MILK FROM THE BULGARIAN DAIRY SYNTHETIC POPULATION

Neviana Stancheva¹, Nikolina Naydenova², Genoveva Staikova¹

¹Agricultural Institute, Blvd. Simeon Veliki 3, Shumen, 9700, R. Bulgaria

²Trakia University, Stara Zagora, R. Bulgaria

nevqna_68@abv.bg

A study on the physical and chemical composition, properties, and technological qualities of sheep milk was carried out. Subject of the study was the milk produced during the lactation period of ewes of the Bulgarian Dairy Synthetic Population bred on the farm of the Agricultural Institute – Shumen in 2008. The quality components and the physicochemical properties of the milk of the BDSP are in keeping with the standards of raw sheep milk indicating its pronounced suitability for processing dairy products. The established ratios among the components, representing the nutritive and technological quality of milk, are within the regulation standards.

Key words: dairy sheep; milk composition; technological properties; Bulgarian National Standard

ФИЗИЧКИ И ХЕМИСКИ СОСТАВ, СВОЈСТВА И ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА МЛЕКОТО ОД БУГАРСКАТА СИНТЕТИЧКА МЛЕЧНА ПОПУЛАЦИЈА ОВЦИ

Извршено е истражување на физичкиот и хемискиот состав, својствата и технолошкиот квалитет на овчо млеко. Предмет на истражување беше млекото добиено од бугарската синтетичка популација на овци одгледувани во Институтот за земјоделство во Шумен во 2008 година. Квалитетните состојки, како и физичките и хемиските својства на млекото од бугарската синтетичка популација овци, се во согласност со стандардите за сурово млеко, кои ја нагласуваат способноста за преработка во млечни производи. Одредените односи помеѓу состојките, кои го претставуваат хранливиот и технолошкиот квалитет на млекото, се во согласност со регулаторните стандарди.

Клучни зборови: млечни овци; состав на млеко; технолошки својства; бугарски национален стандард

1. INTRODUCTION

Studying the physicochemical characteristics and technological qualities of milk is distinctly essential for the profitable production of dairy products.

Lactic constituents – namely fat, protein, and somatic cells count – have been considered selection criteria in the process of creation of new sheep breeds and in the improvement of the existing ones (Barillet, 1985; Barillet et al., 1987, 2001).

In their studies on the composition, properties, and technological characteristics of the milk

of dairy sheep Djorbineva et al. (1995, 2002), Dimov (1995), Stancheva et al. (1997a,b), Boikovski et al. (2003, 2005a,b, 2006) Petrova and Nedelchev (2002), Raicheva et al. (2004) have established that milk fat was in the range from 6.08 to 8.37 %, total proteins – from 5.20 to 6.50 %, and lactose – from 4.11 to 5.04 %.

The phenotypic parameters of the productivity of the sheep from the Bulgarian Dairy Synthetic Population (BDSP) throughout the stages of the breed creation process have been studied by Hinkovski et al. (1984, 2008), Vitkov (1987), Tzvetanov (1989), Nedelchev et al. (2003), Raicheva et

al. (2003), Stancheva (2003). Studies of such nature are informative of the composition and properties of the milk of the BDSF which plays a major role in the domestic sheep breeding at present.

The aim of the present study is to estimate the physicochemical composition, properties, and technological qualities of the milk of the BDSF ewes as a source of high quality dairy products.

2. MATERIAL AND METHODS

The subject of the study was the milk produced during the lactation period of BDSF ewes bred on the farm of the Agricultural Institute – Shumen in 2008.

Lactation milk yield was established by the test-day recording under the instructions for the control of productive traits in dairy sheep. Bulk milk samples have been taken monthly during the morning milking after tank-mixing with the evening milk, in accordance to the regulations for milk sampling.

The physicochemical properties of the milk samples were analyzed at the research Dairy Laboratory, department of “Animal Breeding – Ruminants and Dairy Science”, Faculty of Agriculture, Trakia University, Stara Zagora. Natural sheep yoghurt was produced four times in laboratory conditions under an officially certified original technology. Samples for analysis were collected from the raw milk before pasteurization, 1 and 2 h after leaven introduction, and during the clotting process.

The raw milk was tested for solids not fat, total proteins, milk fat, and dry matter on the instrument MilkoScanTM 104 A/S (Foss Electric, Denmark), for specific gravity – according to BNS 1110-73, the titratable acidity – by the Torner’s procedure (BNS 1110-80), and the renneting ability – by BDS 659-74. The milk was pasteurized (95°C/30 min), cooled down to 45°C and cultivated with 1.5-%, 24-h yoghurt leaven.

The milk 1 and 2 h after leaven introduction, during clotting, at hour 24, and at day 10 of storage was analyzed for titratable acidity by the Torner’s procedure and qualified in accordance to BNS 12–82.

White brine cheese yield was calculated using empirical formulas (Chomakov et al., 2000).

All the data were analyzed using the statistical procedure described by Eftimov et al. (1972).

3. RESULTS AND DISCUSSION

The information about the lactation milk yield, composition, and properties is shown in Table 1.

Table 1

Lactation yield, composition, and properties of the studied sheep milk

Traits	\bar{x}	S	C	E
Lactation yield, l	104.24	26.806	25.175	1.681
<i>Composition, %</i>				
Fat	7.32	0.631	8.632	4.984
Total proteins	5.35	0.205	3.842	2.218
Lactose	4.25	0.095	2.224	1.284
Total solids	0.744	0.017	2.224	1.284
Solids non fat	10.63	0.236	2.224	1.284
Dry matter	17.94	0.844	4.705	2.715
<i>Properties</i>				
Specific gravity, Γ°	1.032	0.589	1.869	1.079
Titratable acidity, $^{\circ}\text{T}$	22.8	1.893	8.321	4.804
Freezing point, $^{\circ}\text{C}$	-0.587	0.009	1.553	0.897
Renneting ability, s	261.0	67.882	26.009	26.009
Energy, KJ	4481.94	291.274	6.499	3.752
<i>Ratios</i>				
Proteins / Fat	0.731	0.042	5.698	3.290
Proteins / Dry matter	0.298	0.005	1.838	1.061
Fat / Dry matter	0.408	0.016	4.042	2.333

The milk production for the studied lactation period is 104.24 litres, and the variability of the trait is high – C = 25.18%. The established values by Stancheva et al. (1997) for the Synthetic Dairy Cross-Breed (SDCB) (101.95 litres) are little lower, and by Stancheva (2003) for the BDSF (99.18 litres at first and 101.96 litres at second lactation). The lactic fat concentration herein is 7.3 %, commensurate with the results of Stancheva (2003) for the same population (7.4 %). The estimates for fat content in SDCB by Stancheva et al. (1997) are also of similar value. Compared to our results, Djorbineva et al. (1995, 2002) established little lower values in the Stara Zagora sheep and their crosses with the East Friesian breed (6.52 and 6.08 %), as well as in three different cross-breeds (6.76, 6.74 and 7.20 %).

The established results for the other milk constituents – total proteins (5.35 %), lactose (4.3 %), and solids (0.74 %) – are within the normal range for dairy-purpose sheep (Djorbineva et al., 1995, 2002; Boikovski et al., 2005).

The mean value of solids not fat, standard indicator in milk quality control, is 10.63 % meeting the standards for raw sheep milk to be processed to dairy products. Inconsiderably higher results concerning this trait have been reported by Boikovski et al. (2005) for the Newly Created Synthetic Population (10.86 %) and by Djorbineva et al. (2003) for three different cross-breeds (11.55 %).

The standard deviation, the coefficient of variation, and the accuracy exponent (E) for the different milk constituents have comparatively low values, which is indicative of its constant composition throughout lactation.

The freezing point is an indicator for detecting added water, solids, etc. in milk. It is a relatively constant characteristic ranging from -0.570 to -0.600°C for sheep milk. The established value of -0.587°C is within this range.

The titratable acidity and the renneting ability indicate that the milk of the BDSP ewes possesses good technological characteristics – renneting period up to 5 min. Our results about these traits are in keeping with those established by Stancheva (2003) for the same breed and by Djorbineva et al. (2002) for three dairy cross-breeds.

The established ratios among the components, representing the nutritive and technological quality of milk, are within the regulation standards for processing. Our results are similar to those reported by Stancheva et al. (1997a) and Djorbineva et al. (2002) for cross-bred sheep, and are negligibly lower than those cited by Boikovski et al. (2005) for the Newly Created Synthetic Population.

Acid formation is a main process of yoghurt fermentation and of basic importance for the quality of the product. The intensity of acid formation within the period from adding the leavening agent to the moment of coagulation is essential for the rheological properties of the coagulated mass, the syneresis, and the maintenance of product structure in storing conditions. The results about the dynamics of acid formation (Table 2) suggest that the milk of the BDSP ewes suits the requirements for high-quality production of leaven cultures as well as for processing high-quality dairy products.

Table 2

Technological properties of sheep milk of the Bulgarian Dairy Sheep Synthetic Population

Traits	\bar{x}	S	C	E
Initial titratable acidity, $^{\circ}\text{T}$	22.8	1.893	8.321	4.804
Acidity after 1 h curdling, $^{\circ}\text{T}$	24.8	2.217	8.959	5.172
Acidity after 2 h curdling, $^{\circ}\text{T}$	42.3	3.096	7.327	4.230
Acidity at coagulation, $^{\circ}\text{T}$	87.5	14.888	17.015	9.827
Coagulation time, min	172.0	15.895	9.242	5.336
<i>Titratable acidity of yoghurt</i>				
After 24 h, $^{\circ}\text{T}$	113.4	14.100	12.437	8.795
After 48 h, $^{\circ}\text{T}$	132.6	26.159	19.728	13.949
After 10 days, $^{\circ}\text{T}$	143.8	21.531	14.978	8.648
<i>White brine cheese parameters</i>				
Yield out of 100 l of milk, kg	22.747	1.011	4.442	2.565
Milk quantity for production of 1 kg, l	4.403	0.201	4.568	2.638
Yield out of 104 l of milk, kg	23.657	1.051	4.442	2.565

The mean yield of white brine cheese (22.474 kg out of 100 litres of milk) is higher than that reported by Stancheva (2003) and by Boikovski et al. (2005) for the Newly Created Synthetic Population. The results show that the lactation milk yield of 104.24 litres provides for the production of 23.657 kg of white brine cheese. The value of the coefficient of variation is low, representing the relatively constant composition of the BDSP ewes' milk.

4. CONCLUSIONS

The milk of the BDSP ewes is marked by very good quality characteristics. The established means for dry matter (17.94 %), solids not fat (10.63 %), lactic fat (7.32 %), total proteins (5.35 %), and lactose (4.25 %) meet the standards for raw sheep milk to be processed to dairy products.

The physicochemical properties – specific gravity (1.032°T), titratable acidity (22.8°T), renneting ability (261 s), and coagulation time (172 min) – show the good suitability of the milk for processing to dairy products.

The established ratios among the components, representing the nutritive and technological

quality of milk, are within the regulation standards.

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