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Changes in the Content of Bioactive Substances in Sheep's Milk Depending on the Lambing Date

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Abstract: The aim of the study was to investigate whether the season of lambing affects the content of bioactive compounds and nutritional value of sheep's milk during the lambs nursing period. Milk was sampled in two groups of Polish Mountain sheep, which lambed in December (G1) and in May (G2). In general, a higher contents of dry matter, protein, fat and lactose were found in milk of group G1. Analysis showed the higher ($P<0.05$) abundance of proline, lysine, isoleucine, aspartic acid, alanine, tyrosine, methionine and glutamic acid in group G2. Milk from group G2 contained more PUFA, especially CLA. In conclusion, the season of lambing affects the content of bioactive compounds and nutritional value of sheep's milk during the nursing period.

Keywords: sheep; lamb nursing; milk; bioactive substances; chemical composition.

Introduction

Sheep's milk is rich in bioactive substances that determine the proper development of a young organism (Flis and Molik, 2021). The basic chemical composition of sheep's milk expressed per 100 g of milk is: total dry matter 17.8%, fat 7.4%, protein 5.7%, lactose 4.8% and ash 0.9% (Alichanidis et al., 2016). Milk fat is one of the bioactive components of sheep's milk, and its content is much higher than in cow's or goat's milk (Moatsou and Sakkas, 2019). Sheep milk contains the highest amount of conjugated linoleic acid (CLA), omega-3 and omega-6 fatty acids (PUFA), which are crucial for the proper development of the body and have anti-cancer and anti-mutagenic properties (Flis and Molik, 2021; Molik et al., 2020). In addition, sheep's milk has a valuable composition of exogenous amino acids (lysine, histidine, valine) and amino acids characterized by the presence of sulfur (methionine, cysteine, taurine) (Mohapatra et al., 2019). An important component of sheep's milk proteins is proline. This endogenous amino acid plays a key role in the synthesis of arginine and initiates the process of protein synthesis, especially collagen. The aim of the research was to determine the effect of the season on the content of bioactive compounds in sheep's milk during the lamb nursing period.

Materials and methods

Forty Polish mountain sheep were used for the experiment - this is a breed representing reproduction seasonality. The animals had similar body weight (about 45±5 kg) and age (3rd or 4th lactation). Sheep were divided into two groups of 20 animals each. Mating after oestrus synchronization took place from 1 to 5 July (G1) and from 1 to 5 December (G2). Therefore, sheep from the G1 group lambed in December (group of short days), and those from the G2 group in May (group of long days). From the 5th month of pregnancy to the end of the experiment sheep received 1.0 kg of pelleted granulate complete feed and hay. The chemical composition was analyzed according to Budsławski (1971). The amino acid profile was analyzed by reversed-phase liquid 140 chromatography. Fatty acids were determined with gas chromatography according to Deman (1964). The amino acid profile was analyzed by reversed-phase liquid chromatography (ACCQ Tag analytical kit, Waters, USA). The chemical composition were analyzed by one-way analysis of variance of repeated measurements (ANOVA, Statistica; StatSoft, Inc., Tulsa, OK, USA).

Research results

The sheep's milk from G1 group contained significantly ($p < 0.01$) more dry matter and fat than the milk from G2 group (Tab 1). Significantly ($p < 0.05$) more protein and lactose was contained in the milk of sheep from the G1 group than the milk of sheep from the G2 group. (Tab 1).

Table 1. The influence of the lambing date on changes in the chemical composition of sheep's milk from the group 1 and group 2

Chemical compositions %	G1	SEM	G2	SEM	P-value
Dry matter	16.23	5.20	13.74	4.90	P<0.01
Protein	5.74	1.30	5.66	1.20	P<0.05
Fat	4.69	0.50	3.65	0.80	P<0.01
Lactose	4.82	0.70	4.50	0.80	P<0.05

The analysis of the content of exogenous amino acids in the tested milk samples showed significantly ($p < 0.05$) higher concentrations of proline, lysine, isoleucine and aspartic acid in the G2 group compared to the G1 group (Tab. 2). Also, the milk from G2 group contained also significantly ($p < 0.05$) more alanine, tyrosine, methionine and glutamic acid than the milk of ewes from the G1 group (Tab. 2).

Table 2. Selected exogenous amino acids contained in sheep's milk from group 1 and group 2.

Exogenous amino acids g/100g milk	G1	SEM	G2	SEM	P-value
Prolin	0.49	0.14	0.53	0.15	P<0.05
Lys	0.42	0.13	0.49	0.14	P<0.05
Ile	0.26	0.08	0.29	0.09	P<0.05
Asp	0.39	0.12	0.43	0.13	P<0.05
Ala	0.24	0.01	0.27	0.01	P<0.05
Tyr	0.18	0.06	0.21	0.06	P<0.05
Met	0.12	0.02	0.18	0.04	P<0.05
Glu	0.88	0.02	0.91	0.02	P<0.05

Significantly ($p < 0.05$), the most C18: 2 ($n = 6$) was contained in the milk of sheep from group G2 than in milk of sheep from G1 group (Tab. 3). Milk from G2 group contained significantly ($p \leq 0.01$) more CLA than milk from sheep from G1 group. In general, the milk of sheep rearing lambs during the long day period contained more polyunsaturated fatty acids than the milk of ewes from the G1 group.

Table 3. Content of polyunsaturated fatty acids in sheep's milk from the group 1 group 2.

Polyunsaturated fatty acids (PUFA) g/100 FA	G1	SEM	G2	SEM	P-value
C18: 2 (n=6)	1.95	0.01	2.23	0.02	P<0.05
C18: 3 (n=3)	0.64	0.01	0.70	0.01	P<0.05
C18: 3 (n=6)	0.09	0.01	0.11	0.01	P<0.05
CLA	0.03	0.01	1.12	0.01	P<0.01
Means – PUFA	0.67	0.02	1.05	0.02	P<0.01
Total – PUFA	2.71	0.06	5.20	0.07	P<0.01

The analysis of chemical composition showed that milk from sheep, which lambed under the conditions of a short day (G1) contained significantly more dry matter than milk from sheep, which lambed under the conditions of a long day (G2). Research by Simos et al. (1996) and earlier own research by Molik et al. (2020, 2011) also showed that sheep's milk with a higher dry matter content has more protein and fat (Molik et al., 2020, 2011; Simos et al.,1996). The protein levels recorded in the milk of sheep rearing lambs under short day conditions were similar to the results obtained in Manchega sheep (Elhadi et al., 2022). A lower concentration of PUFA, including CLA, was recorded in the milk of ewes lambed in December (G1 group). Previous studies by Molik et al. (2020) showed a higher CLA content in sheep's milk during the long day period (Molik et al., 2020). The high content of valuable bioactive substances in sheep's milk affects the dietary qualities of this milk and its products. For this reason, such parameters of the obtained milk may indicate worse pro-health and nutritional properties of milk.

Conclusions

The conducted research showed that in seasonal sheep, the content of bioactive substances and chemical composition of milk differs depending on the season on which the lambing occurs. Milk obtained from sheep that nursed their lambs during a short days season had less pro-health values than milk obtained from sheep nursing during a long days season. The observed increase in the nutritional value of milk during the long day may affect the correct development of lambs.

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