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INFLUENCE OF DIFFERENT GROWING CONDITIONS ON PRODUCTION, MILK COMPOSITION AND BODY CONDITION SCORE FOR ALPINA GOAT BREED

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Abstract: This paper presents the results of testing the impact of different farming systems on milk production, milk composition (milk fat, protein and dry matter without fat) and body condition score of Alpine breed goats in different growing systems during one production year. Control of the amount and chemical composition of milk included a total of 59 French Alpine goats at the age of 2-3 years (2-3 lactations), which are divided into two groups with approximate similar body weight. In the first group of goats a stable diet was applied. Goats had a sufficient amount of alfalfa hay available (ad libitum) and the addition of about 0.5 kg of concentrate that is administered twice a day. Goats in the second group in addition to 0.5 kg of alfalfa hay, received 0.25 kg of concentrate and in the period from April to October during the day stayed at the outlet and the surrounding pasture. Control of body weight of goats and body condition were performed once every two months from March to October, while the rate of body condition (BCS) was given score of 1-5. Somatic cell count and chemical quality of milk were controlled on a daily basis in the laboratory for raw milk AD Mlekara - Subotica on the device CombiFoss 6200 FC. Both groups of goats had a statistically significant increase in production of milk (about 45 l) and the average daily milk yield (of about 0.15 l) in the second compared with the third lactation ($p < 0.01$). It was also determined statistically significant effect of lactation on content of protein, dry matter without fat (DMwF) and the number of somatic cells in milk in both groups of goats. Body condition score of the analyzed groups of goats varied over time, and statistically significant differences were found in July ($p = 0.021$) and September ($p = 0.013$), where goats from the second group that remained at the pasture in the examined period had higher scores for BCS compared with the first group.

Key words: Alpina goat**,** nutrition, body condition score, somatic cell count, chemical composition of milk

Introduction

Milk from goats is of particular nutritional and economic importance in many parts of the world. Goat milk is primarily used for the production of traditional cheeses, yoghurt and ice-cream. The composition of milk is one of the major factors determining its value in the market. The nutritive value and technological properties of milk are largely influenced by its composition *(Morand-Fehr et al., 2007).* A number of animal (species, breed) or environmental (feeding regime, lactation stage, animal health and management) factors affect milk composition *(Chillard et al., 2003, Gorecki et al., 2004, Ataşoğlu et al., 2009).* Body condition is a very important factor in determining potential milk production. It is also a useful tool to help monitor adequate feeding and management.

Body condition score (BCS) is thus an estimation of muscle and fat development of an animal and is correlated with the direct measurement of backfat depth or the proportion of fat in the animal body providing a better estimate than body weight alone *(Sanson et al., 1993).* BCS is also a subjective way to evaluate the nutritional status of a flock and acts as a potential indicator for goat owners to increase the production efficiency in their flock *(Özder et al., 1995; Sejian et al., 2010).*

Goats with the score of body condition that is beyond the respective target ranges (from 0-2 and from 3.5-5) will produce less milk and meat with lower costs. Body condition score was successfully developed for dairy cattle, but applies equally to dairy goats (goats are graded on the scale from 1 to 5), and in fact are based on an estimate of the quantity of deposited fat. Today, there are many directions for feeding goats, which are based on NRC or similar official foreign tables for nutritional requirements and the composition of the meal (*NRC, 2007; AFRC, 1997; Sahli et al., 2004, Luo et al., 2004*). In combination with regular evaluation of body condition of goats in the growth and lactation, these tables for nutritional requirements should be adjusted upward or downward, in order to provide adequate nutrients under the given circumstances, with sufficient incentives to improve production and growth, or with sufficient tightness to prevent obesity and health risks (*Memiši and Žujović, 2010*). Such diet will correct the loss of production due to lack of nutrition and prevent the occurrence of the syndrome of fat goats (*Santucci et al., 1991*).

For this reason, the aim of this work is to show the influence of different farming systems (stable and stable-pasture) and nutrition on milk production, milk composition and body condition score of goats during lactation.

Materials and Methods

Description of the study location

Research was done on goat farm located in the vicinity of municipality of Subotica.

Experimental animals and treatments

Control of the yield, chemical composition of milk and somatic cells were covered by a total of 59 heads of French Alpine breed at age 2-3 years (2-3 lactations), which were divided into two groups, with an approximate similar body weight. In the first group of goats the stable diet was applied. Goats had free access to a sufficient amount of alfalfa hay (ad libitum) and the addition of about 0.5 kg of concentrate was administered twice during the day. Goats in the second group in addition to 0.5 kg of lucerne hay, received 0.25 kg of concentrate per day in the period from April to October while during the day they stayed at the outlet and the surrounding pasture. The botanical composition of the pasture was about two thirds of legumes (usually *Trifolium alestre, Trifolium montanum, Trifolium repens, Lotus corniculatus*, etc.). The blade of grass was very little represented (around one third - usually *Agrostis vulgaria, Festuca rubra, Alopecurus partenisis, Dactylis glomerata, Bromus moulgaria, Bromus mollis* etc.).The chemical composition of concentrate is shown in Table. 1. Calculation of nutritive value of concentrate mixture is made on the basis of recommendations by *Obračević (1990).*

Table 1. Chemical composition and nutritive parameters of concentrate mixture used in goat nutrition

F e e d	% in mixture
Corn	64,50
Wheat	12,00
Soybean meal (44%)	5,00
Sunflower meal (33%)	16,00
Di-calcium phosphate (16%P)	1,00
Premix	0,5
Salt, g	1,0
Nutritive Parameters	
Dry matter, % NEL MJ/kg CP/g	85.7 6,54 14,5

Animal feeding and management

Animals were given a two weeks adaptation period within which they were treated for internal parasites. External parasites were controlled through weekly spraying throughout the trial period using deltamethrin (decatix). Animals of second group were released to graze at 10:00 hours and returned in to pens by 17:00 hours. Concentrates were offered twice in a day; early in the morning before being released for grazing and in the evening at 17:00 hours after return from grazing. Free access was allowed to water and rock salt.

Milk production

The quantity of produced milk in all goats was determined on the 10th day after partus at the latest, all through to the end of lactation (dry off). Control of' milk production was performed on two occasions at equal time intervals (morning around 7 am and in the evening, about 7 pm), and in intervals of 28-32 days. The animals were in A control. Measuring the amount of milked milk was carried out in a graduated cylinder; with the lowest digit of 10 ml.

Milk samples (0.5 l/goat) for chemical composition were taken from each goat after mixing the yield from the evening and morning milking. Milk samples were collected in plastic containers and transferred to the laboratory immediately. They were kept in a refrigerator at 4 °C. The basic composition of milk samples was determined approximately 3-4 h after milking. Composition of milk (quantity of milk fat, proteins and fat free dry matter FFDM) was determined by the method of infra-red spectrophotometry using apparatus Milkoscan FT 6200, whereas the total somatic cell count (SCC) in milk was determined by fluoro-opto-electronic method on apparatus Fossomatic FC.

Body weight measurements

Initial body weights of goats were determined by two consecutive days of weighing and subsequent weights were taken every 60 days. All weights were taken before a day's morning offer of feeds. Average daily body weight gain was determined as a proportion of total weight change to the feeding period of 210 days. Body weight of goats and body condition scores were controlled once every two months starting from March until October, while the rate of body condition (BCS) was given grade of 1-5 (*Santucci et al., 1991*). Body condition score (BCS) was taken by an expert using a BCS scale of 1 (thin) to 5 (fat).

Statistical analysis

Statistical analysis of the data obtained was performed using Statistics 7 software (Statsoft, USA) on two factorial studies, where the first factor was group and the second lactation. Data are presented by groups (first and second groups of goats) and lactation (2 and 3 and the Total = Mean value of both lactation). From the statistical parameters shown is the mean value (X) and standard deviation (Sd).

Results and Discussion

Table 2 shows the mean value and variability of milk production, the contents of certain components in milk and the number of somatic cells in the experimental groups of goats.

Duration of lactation, milk production, average daily milk yield and milk composition did not differ significantly between the analysed groups of goats (Table 2.). Somatic cell count was slightly higher in the first than the second group, however, due to the high value of the standard deviation this is not a statistically significant difference between groups of goats in this parameter ($p = 0.063$).

Both groups of goats had significantly higher production of milk (about 45 liters) and average daily milk yield (about 0.15 l) in the second compared to the third lactation ($p < 0.01$). A statistically significant effect of lactation on protein content, dry matter without fat (DMwF) and somatic cell count of milk in both groups of goats. Milk fat content (MFC) was not significantly different ($p = 0.325$), although it was slightly higher in the third compared to the second lactation, in both groups of goats. For the parameters listed in Table 2., there were no significant interactions between groups of goats and lactation number ($p > 0.05$).

Table 2. Average values and variability of milk yield, chemical composition and somatic cell count

Variable/ Lactation in order		First group of goats		Second group of goats		group	lactation	group*lactation (interaction)
		X	Sd	X	Sd			
Duration of lactation	2.	241.40	20.27	254.50	14.45	0.241	0.074	0.225
	3.	258.00	19.40	257.77	12.86			
	Total	249.26	21.10	256.52	13.23			
Milk production	2.	337.44	25.23	354.10	18.37	0.650	0.000*	0.365
	3.	398.19	53.85	392.62	40.68			
	Total	366.22	50.78	377.94	38.45			
The average daily milk yield	2.	1.40	0.12	1.39	0.08	0.709	0.001*	0.912
	3.	1.54	0.12	1.52	0.11			
	Total	1.47	0.13	1.47	0.11			
Milk fat	2.	3.47	0.14	3.34	0.13	0.310	0.325	0.395
	3.	3.34	0.22	3.33	0.28			
	Total	3.41	0.19	3.33	0.23			
Protein	2.	3.02	0.10	2.98	0.12	0.463	0.001*	0.791
	3.	2.86	0.12	2.84	0.16			
	Total	2.95	0.13	2.89	0.15			
FFDM	2.	8.08	0.19	8.01	0.18	0.460	0.002*	0.641
	3.	7.86	0.12	7.85	0.18			
	Total	7.98	0.19	7.91	0.19			
SCC (000)	2.	1151.1	237.35	1017.2	169.52	0.063	0.013*	0.838
	3.	1370.7	262.80	1204.6	270.09			
	Total	1255.1	267.51	1133.2	250.04			

* ($p<0.01$); FFDM – fat free dry matter; SCC – somatic cell count

Compared to results obtained by other authors, duration of lactation in our research is similar to the level reported by *Gall (1980)* for duration of lactation in French Alpine breed from 200 to 300 days. Lower values were stated by *Pavliček et al., (2006)* in alpine goats reared in the private sector and whose lactation duration was from 201 to 203 days. Average daily milk yield determined in Alpine goats is lower than the values recorded in 30 goats (2.7 kg) of color improved breed (*Bernacka, 2006*), and Saanen goats (2.26 kg) in trials of Ataşoğlu et al. (2009). The total quantity of milk in both groups of goats is higher than the values measured in the two populations goats ((Montefalcone and Valfortorina goat) found by *Casamassima et al. (2007)* which amounted to 275 kg and 258 kg, throughout 180 days of lactation.

The average content of fat for the whole lactation was 3.38% and this value corresponded with data published by *Margetin and Milerski (2000)* but it was higher than that mentioned by *Zeng et al., (1997).* On the other hand, *Agnihotri et al., (2002)* found higher values of average fat content.

Milk protein and fat contents were lower to those found in the milk of Garganica, Maltese and Saanen goat *(AIA, 2005);* of color improved breed *(Bernacka, 2006);* Saanen and Alpine goats *(Marenjak et al., 2009).* The breed, level of milk production and stage of lactation, as well as reproductive cycle may influence the SCC in dairy goats *(Haenlein, 2002).*

Similar values in regard to somatic cell count in goat milk, depending on the order of lactation, were reported by *Raynal-Ljutovac et al., (2007). Kozačinski et al., (2002)* established in goat milk average SCC of $1.30x10^3$/ml and concluded that the limit for SCC in goat milk can be over $1.0x10^3$/ml, which is in accordance with results obtained in this study. Increased SCC in milk from dairy goat breeds reared in the USA is often, and above $1.0x10^3$/ml as stated by *Haenlein, (2002).* Similar values, even slightly higher for SCC, depending on the order of lactation are stated by *Pavliček et al., (2006)* in Alpine breed goats. The average number of SC ranged going from first to third lactation from 1.36 to $1.48x10^3$. Higher SCC in goat milk ($1.59x10^3$/ml) was also established by *Ying et al., (2002). Antunac et al., (1997)* stated that herds of dairy goats rarely have in the average milk sample SCC below one million.

Body condition score of the analyzed groups of goats varied over time, and statistically significant differences were found during July ($p = 0.021$) and September ($p = 0.013$), where goats from the second group had higher scores for BCS compared to the first (Table 3).

Table 3. Average values and variability of body weight and body condition of goats

Traits / Lactation in order		First group of goats		Second group of goats		group	lactation	group*lactation (interaction)
		X	Sd	X	Sd			
March BCS	2.	2.06	0.18	2.03	0.09	0.600	0.042*	0.199
	3.	1.90	0.15	1.99	0.16			
	Total	1.98	0.18	2.00	0.13			
March Body weight	2.	46.47	2.66	47.40	2.19	0.688	0.003*	0.601
	3.	50.12	3.23	50.00	3.71			
	Total	48.20	3.42	49.01	3.41			
May BCS	2.	2.16	0.17	2.14	0.05	0.181	0.023*	0.061
	3.	1.99	0.13	2.12	0.11			
	Total	2.08	0.17	2.13	0.09			
May Body weight	2.	48.69	2.97	49.49	2.53	0.221	0.113*	0.599
	3.	49.91	3.73	51.89	4.08			
	Total	49.27	3.31	50.98	3.69			
July BCS	2.	2.22	0.11	2.22	0.09	0.021*	0.181	0.023*
	3.	2.09	0.12	2.25	0.10			
	Total	2.16	0.13	2.24	0.10			
July Body weight	2.	49.69	2.80	50.58	3.76	0.247	0.058	0.737
	3.	51.40	3.42	53.00	3.23			
	Total	50.50	3.14	52.08	3.56			
September. BCS	2.	2.29	0.10	2.27	0.09	0.013*	0.131	0.003*
	3.	2.15	0.10	2.32	0.09			
	Total	2.22	0.12	2.30	0.09			
September. Body weight	2.	50.13	3.52	50.03	3.53	0.566	0.007*	0.509
	3.	52.77	3.60	54.25	4.02			
	Total	51.38	3.71	52.64	4.30			

* ($p<0.01$); (BCS) Body condition score

Body weight was not significantly different between groups of goats during the test period. Lactation had a significant effect on the difference in body condition in examined goats. Statistically significant differences were observed between the second and third lactation during months of March and May, while during the period September, lactation significantly affected only the body weight of the animals ($p = 0.007$).

The interaction of two factors analyzed (groups and lactation) is not significantly different in body weight of goats (Table 3.). For the BCS there was a statistically significant interaction of the first order for the month of July ($p = 0.023$) and September ($p = 0.003$), whereas during months of March and May, this trend has not been determined.

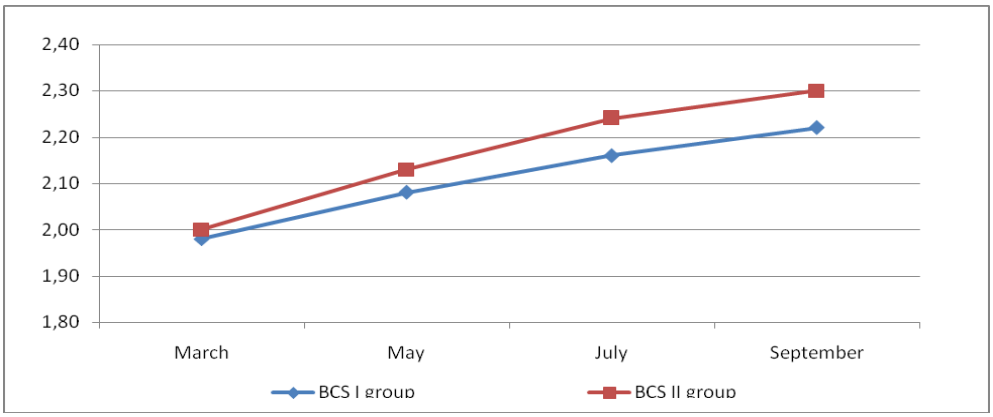

Figure 1. Changes in body condition during the lactating period in goat experimental groups

Ataşoğlu et al., (2009) have found in twenty one (2-4 years old) lactating Saanen goats grown in a semi-intensive system in which the nutrition of goats was based mainly on grazing on a woody and herbaceous pasture with the supplementation of mixed concentrate and vetch hay, body condition score differed (*P*=0.0021) among the sampling periods from April (2.64) to October (2.91). The authors note that body weight of goats was not affected (P = 0.1599) by sampling period. *Antunović et al. (2009)* found in the 30 French Alpine goats grown in the organic production during early lactation period (in the first 30 days) the BCS value to be 2.7 (from 2.2 to 3.5).

Conclusion

Based on test results for different cultivation systems on milk production, milk composition (milk fat content, protein and dry matter without fat) and body condition score of Alpine breed goats during one production year, it could be drawn the following conclusions:

- Length of lactation, milk production, average daily milk yield and milk composition did not differ significantly between the analyzed groups of goats ($p > 0.05$). The number of somatic cells in milk was slightly higher in the first group than the second, but without statistical significance. It was found a statistically significant effect of lactation on the content of protein, fat solids and somatic cell count of milk goats in both groups ($p < 0.01$).
- Body weight of the animals was not significantly different between the experimental groups of goats during the year. Lactation had a significant effect ($p < 0.01$) on difference in body condition of examined goats.

The interaction of two analyzed factors (groups and lactation) is not significantly different in body weight of goats. Body condition score of the analyzed group of goats varied over time, and statistically significant differences ($p < 0.01$) were found during July ($p = 0.021$) and September months ($p = 0.013$), where goats of the second group remained at the pasture, had higher BCS scores compared with the first group.

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Uticaj različitih sistema uzgoja na proizvodnju, sastav mleka i ocenu telesne kondicije koza alpina rase

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Rezime

U ovom radu prikazani su rezultati ispitivanja uticaja različitih sistema uzgoja na proizvodnju, sastav mleka (sadržaj mlečne masti, proteina i suve materije bez masti) i ocenu telesne kondicije koza rase Alpina u različitim sistemima uzgoja u toku jedne proizvodne godine. Kontrolom količine i hemijskog sastava mleka bilo je obuhvaćeno ukupno 59 koza francuske alpine u starosti 2-3 godine (2-3 laktacija), koje su podeljene u dve grupe sa približnom telesnom masom. Kod prve grupe koza primenjivan je stajski način ishrane. Koze su na raspolaganju imale dovoljnu količinu lucerkinog sena (ad libidum) kao i dodatak oko 0.5 kg koncentrata koji je davan u dva navrata u toku dana. Koze druge grupe su pored 0.5 kg lucerkinog sena, dobijale 0.25 kg koncentrata i u periodu od Aprila do Oktobra meseca su u toku dana boravile na ispustu i okolnom pašnjaku.

Kontrola telesne mase koza i ocena telesne kondicije kontrolisane su jednom u dva meseca počev od marta do oktobra meseca, pri čemu je pri oceni TK davana ocena od 1-5. Broj somatskih ćelija kao i hemijski kvalitet mleka, kontrolisan je svakodnevno u laboratoriji za sirovo mleko AD “Mlekare“ – Subotica na aparatu CombiFoss 6200 FC.

Obe grupe koza imale su statistički značajno veću proizvodnju mleka (za oko 45 l) i prosečnu dnevnu mlečnost (za oko 0.15 l) u drugoj u poređenju sa trećom laktacijom ($p<0.01$). Utvrđen je i statistički značajan uticaj laktacije na sadržaj proteina, suve materije bez masti (SMbM) i broja somatskih ćelija u mleku kod obe grupe koza. Ocena telesne kondicije analiziranih grupa koza varirala je tokom vremena, a statistički značajne razlike utvrđene su tokom jula ($p=0.021$) i septembra meseca ($p=0.013$), gde su koze druge grupe koje su u ispitivanom periodu boravile na pašnjaku, imale više ocene BCS u poređenju sa prvom.

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