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MILK PRODUCTION TRAITS FROM ALPINE BREED OF GOATS IN CROATIA AND SLOVENIA

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Abstract

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The aim of the present research was to determine composition and test-day milk yield from Alpine goats in two countries, Croatia and Slovenia regarding the influence of milk production traits. Data was obtained from the Central database of Croatian Agricultural Agency and Central database for sheep and goats in Slovenia. Test-day milk yield (TDM), content of fat, protein and lactose, as dependent variables, were analysed with fixed statistical model (GLM procedure, SAS, 9.3) using parity, litter size, stage of lactation and season as fixed effects. The results from the present research showed significant influence of stage of lactation, parity, litter size and season on almost all investigated variables, between Croatian and Slovenian population of Alpine goats. Least square mean for TDM in goats from Slovenian population was lower, 1.04 kg, compared to Croatian goats, 1.11 kg. Higher percentage of goats (53.2%) from Croatian population were in 2nd to 4th parity, compared to Slovenian goats (49.6%), resulting in higher TDM. In Slovenian population of goats more records were analysed from mid-lactation, resulting in lower fat content (3.47%) compared to Croatian population (3.50%). In the present research more twins and triplets were in the Slovenian population of goats but results showed lower TDM in the same population. The reason for this may be due to later weaning in Slovenian producers that shortened the length of milking after weaning. Higher percentage of Croatian goats (94.47%) were kidding from December to March, compared to Slovenian (90.34%) goats, resulting in higher TDM and lower protein and lactose content in Croatian population. Content of protein and lactose were mainly following the standard lactation curve along with TDM. The results showed significant effect of parity, litter size, stage of lactation and season on TDM and milk composition in the goat farms of Croatia and Slovenia.

Key words: Alpine goats, milk, Croatia, Slovenia

List of abbreviations: F – content of fat in milk; L – content of lactose in milk; LS – litter size; LSM – least square means; P – protein content in milk; PR – parity of goats; S – season; STL – lactation stage; TDM – Test-day milk yield

Introduction

Goat production is an important part of the national economy in many countries, especially in the Mediterranean region of Europe (France, Italy, Greece, Albania and Spain) and in many places in Middle East and Asia. Moreover, goat milk and its products are an excellent source of food. According to the FAOSTAT (2013) the world's goat population increased approximately 67% between year 1991 and 2012, whereas, the number of cattle increased by 15%, and the number of sheep decreased by 1%. Production of goat's milk between year 1991 and 2012 (FAOSTAT, 2013) increased by around 79%, indicates the promising directions for future research of this sector. Therefore, any effort to encourage the production and scientific research in this area will be positive for the breeders, industry and for the quality of goat milk and their products.

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In last few years goat husbandry is more developed in Croatia and Slovenia as indicated by number of goats. In the year 2012, according to Croatian bureau of statistics 72 000 of goats were reared, and according to Statistical office of the Republic of Slovenia 26 351 of goats. In both countries Alpine breed is the largest population of goats, widespread mainly in North-west part of Croatia (Antunović et al., 2012), and flocks of Slovenian Alpine goat breed have a relatively even distribution throughout the country (Žan-Lotrič et al., 2013). In both countries official method of dairy recording is AT method, a measurement that may be applied at only one of the two daily milking, which is characterised according to ICAR (2012) as alternating monthly test. In dairy small ruminants, costs of the standard A4 milk recording design, expressed in production margin per animal, are too high compared to dairy cattle (Astruc and Barillet, 2004). Kompan et al. (2004) concluded that A4 method is being progressively replaced by two simplified designs for milk yield, AT or B4.

Numerous investigations proved a significant effect of parity, lactation length and litter size that constantly influence the amount and composition of goat milk. According to Carnicella et al. (2008), amount of milk significantly increases with the parity. Regarding the milk composition, Bhosale et al. (2009) observed gradually increase of protein, and fat percentage as lactation advanced, except lactose percentage in goat milk, from 1st to 4th parity.

The aim of the present study was to determine amount and composition of milk from Alpine goats in two countries, Croatia and Slovenia, regarding the effect of parity, litter size, stage of lactation and season.

Materials and Methods

The present research data were obtained from the Central database of Croatian Agricultural Agency and Central database for sheep and goats in Slovenia. The total number of daily recordings accounted 159 348 samples from 9926 animals in Croatian and 2244 animals in Slovenian database presented in Table 1.

The litter size was grouped as single, and twins were associated with the higher litter size. According to similar number of milk samples, we estimated the influence of two seasons, the 1st was from December until April and the 2nd was from May until November. We associated months with small number (July, August, September, October and November) of samples to the 2nd season. The milk samples were grouped at 30 days interval based on the stage of lactation. We estimated lactation length as period from the kidding until the date of drying. In the data from some animals date of drying was unknown, then we calculated lactation length as period from date of kidding until the date of last dairy recording adding fifteen days, considering that last dairy recording was sampled 15 days before drying. The data were revised from illogically information also resulted in restricted lactation length up to 330 days. Frequency of records according to investigated effects is presented in Table 2.

Studied traits were: test-day milk yield (kg), content of fat (%), protein (%) and lactose (%) in every sample of milk collected with AT milk recording design. Descriptive statistics were estimated with MEANS procedure. Test-day milk yield (morning or evening), content of fat, protein and lactose were analysed with fixed statistical model (GLM procedure, SAS,

Table 1
Farm differences according to descriptive statistics and number of samples between two countries

Indicators	Country			
	Slovenia		Croatia	
	Mean	Sd	Mean	Sd
TDM, kg	1.12	0.59	1.13	0.51
P, %	3.11	0.52	3.10	0.48
F, %	3.34	0.85	3.43	0.84
L, %	4.36	0.30	4.17	0.25
Number of goats	2244		9926	
Number of farms	71		163	
The year of dairy recording	2004-2013		2007-2012	
Average lactation length (days)	243.74		271.20	
Total number of samples	37283		122065	

TDM-test-day milk yield, P-protein, F-fat, L-lactose

Table 2
Number of records determined under different effects

Effects	Number of records between countries			
	Slovenia		Croatia	
Parity	Frequency	Percentage, %	Frequency	Percentage, %
1st	6874	18.4	30054	24.6
2nd	6882	18.5	26670	21.9
3rd	6470	17.3	21880	17.9
4th	5184	13.8	16360	13.4
≥5th	11909	31.9	27101	22.2
Stage of lactation (days)				
0-30	1621	4.4	2000	1.6
31-60	3495	9.4	11237	9.2
61-90	4669	12.5	17993	14.7
91-120	5809	15.6	18110	14.8
121-150	5875	15.8	16135	13.2
151-180	5339	14.3	14114	11.6
181-210	4314	11.6	13457	11.0
211-240	3444	9.2	13349	10.9
>240	2717	7.3	15670	12.8
Litter size				
Single	1528	41.1	75857	62.1
Twins and triplets	21919	58.9	46208	37.9
Season				
I (December-April)	33681	90.3	115313	94.5
II (May-November)	3602	9.7	6752	5.5

9.3) using parity, litter size, stage of lactation and season as fixed effects. Least square means (LSM) of the investigated effects were estimated.

Results and Discussion

The results from the present research showed lower LSM for test-day milk yield (TDM) in goats from Slovenian (1.04 kg) population and lower content of fat but higher content of protein and lactose compared to Croatian (1.11 kg) population of goats, influenced significantly by parity, stage of lactation, litter size and season presented in Table 3.

The present research showed significant ($p < 0.001$) influence of parity on the TDM considering 53.2% of Croatian population of goats were in 2nd to 4th party, compared to 49.6% of Slovenian goats. It is well known, from the research by Carnicella et al. (2008) that the lowest amount of milk is in the 1st lactation, gradually increasing until 4th lactation similar observed by Bhosale et al. (2008) and Zahradden et al (2007). Mioč et al. (2008) observed significant influence of stage of lactation on the daily milk yield in Alpine goats resulting in the highest milk yield until the 90th day of lactation. It is evident from the Table 2 that milk from Croatian goats had more samples collected from 30th until 90th day of lactation where production was the highest.

The lowest percentages of constituents observed in the milk of goats from previous lactations are caused by the effect of dilution, i.e., goats produced more milk, directly reflecting on composition and decreasing their concentration in the milk (Kala and Prakash, 1990). Although milk fat and protein content are inversely proportional with milk yield (Pavliček et al., 2006) results from our research showed higher content of fat, but lower content of protein and lactose in Croatian population of goats that had higher amount of milk. In the case of fat, it may be due to feeding cause content of fat and protein in milk are influenced by feeding the most (Toledo-Alonzo et al., 2003). Ploumi et al. (1998) found significant effect of season on the fat percentage but it wasn`t

Table 3
Variance analysis results of TDM (kg) and milk composition

Indicator	Country				Effects (Significance)				Model R^2
	Slovenia		Croatia						
	N	LSM	N	LSM	STL	PR	LS	S	
TDM, kg	37248	1.04	122006	1.11	***	***	***	***	0.19
P, %	36762	3.21	122016	3.15	***	***	**	***	0.29
F, %	36740	3.47	121972	3.50	***	***	***	***	0.13
L, %	36738	4.37	122045	4.19	***	***	NS	***	0.22

TDM-test-day milk yield, P-protein, F-fat, L-lactose, STL-stage of lactation, PR-parity, LS-litter size, S-season; *P<0.05, **P<0.01, ***P<0.001, NS-not significant; R^2-coefficient of determination.

consistent, similarly observed by our research. In Slovenian population of goats more records were analysed from mid-lactation, resulting in lower fat content (3.47%) compared to Croatian population (3.50%). The lowest content of milk fat observed by Mestawet et al. (2012) was in the mid stage of lactation, whereas the highest fat content was recorded at the end of lactation, as in the present research, that is typical for a standard lactation in accordance with Park (2007) and Strzalkowska et al. (2009).

In the present research more twins and triplets were in the Slovenian population of goats but the results showed lower average TDM in the same population. Carnicella et al., (2008) observed significant ($p < 0.001$) influence of litter size on the milk yield of goats which means higher amount of milk in goats that had more twins but did not influenced milk composition. Opposite situation in our research, regarding to TDM may be due to later weaning in Slovenian producers that shortened lactation length (243.74 days) during which sampling was carried out, resulting in lower amount of milk compared to lactation length (271.20 days) in Croatian population, which was longer for approximately one month. The higher TDM was expected in goats with twins compared to goats with singles, but the opposite trend was observed in research by Králícková et al. (2013). Olechnowicz and Sobek (2008) found no significant influence of litter size on daily milk yield and the number of weaned kids did not affect production levels.

Season had significant ($p < 0.001$) influence on all parameters including TDM and milk composition. In the research by Zoa-Mboe et al. (1996) for all parities, milk yields increased from December kidding to a maximum after February kidding, and then decreased to summer. Also, maximum kidding take place between January and February, with most goats around peak milk production by February-March. Similar results with the peak milk production in February are determined in the present research. Higher percentage of Croatian goats, 94.47%, were kidding from December to March, compared to Slovenian, 90.34% of goats, resulting in higher amount of TDM and lower amount of protein and lactose and higher fat content in Croatian population. Addass et al. (2013) observed that fat content of goat milk is higher in wet seasons, which is also determined in the present study. Similar results were obtained by Sevi et al. (2004) in ewes´ milk. Zoa-Mboe et al. (1996) found negative effect of kidding in later seasons (April-November) on milk yield and composition in Anglo-Nubian, Chamoisee and Saanen goats in Belgium.

Conclusion

Stage of lactation, parity, litter size and season of kidding influenced almost all investigated parameters. In Croatian population of Alpine goats, higher test-day milk yield and content of fat, but lower content of protein and lactose were observed. The same goats were mostly kidding in season from December until March and were in 2nd to 4th lactation when production is the highest, resulting in more milk, compared to Slovenian population of goats. Content of protein and lactose were mainly following the standard lactation curve along with the test-day milk yield.

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