CORRELATIONS BETWEEN THE MAIN MILK COMPONENTS IN TURCANA SHEEP BREED

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Abstract

The purpose of the research was to determine the comparative content of fat, protein, lactose, total non-fat substances (SNF) and total dry matter (TDM) in raw sheep milk during the ascending phase and the plateau period of lactation. Based on the primary data, correlations were calculated in order to identify a single component form milk, which to be correlated closely with the main components of which the quality and yield of products processed from sheep's milk depends on. The study was performed on 54 ewes form the Turcana breed, reared in Timis and Caras-Severin counties. During the plateau phase of lactation the data registered the highest values, and the differences as compared to the ascending phase of lactation were significant ($p<0.05$) for all milk components, except the SNF. The correlations were significant and positive between SNF and fat and protein contents for each of the two phases, and per entire studied period ($r = +0.974$ and $r=+0.770$, respectively). SNF was negatively correlated only with fat content, while lactose was with all components except SNF, with which it was correlated weakly and positive. Based on the current results we recommend selection of dairy sheep for SNF or fat content.

Key words: sheep milk, chemical composition, correlations

INTRODUCTION

Sheep's milk and dairy derrived products are considered some of the most complex and valuable foods that provide a balanced nutritional support for human needs (Usturoi, 2007).

The chemical composition of sheep milk varies within certain limits from one individual to another, depending on animal dependent factors (genetic factors, health status, age, stage of lactation) and environmental factors (nutrition, rearing conditions, production system) (Padeanu, 2002; Pascal, 2015).

The genetic improvement of dairy sheep for incereased milk yields, had encountered some difficulties, more severe than in cows due to the diversification of the selection objectives and production of meat and/or wool, and to various environmental conditions. (Padeanu 2014; Javor et al., 2006).

Milk quality, on which on the quality of processed products depends, is being appreciated in breeding programs throughout the total solids

content, total solids non-fat, fat, protein, lactose and mineral salts (Sala, 2008). Significant phenotypic and genetic correlations between these characters helps the selection programs to include only one of them, who is strongly correlated with other characters of major economic importance. In principle, the effect of selection size (Δg) ratio decreases with the value of $1/\sqrt{n}$ where n is the number of characters taken in the selection (Dronca, 2007).

Phenotypic and genetic correlations between quantity and/or components of sheep milk were and are studied for each breed, to find a component very strongly and positively correlated with the other main components (protein, total solids, solids not fat, lactose). Studies by Barillet and Boichard (1987) done on 1487 Lacaune ewes, had showen that genetic correlation between milk production and fat content was positive, slightly negative or close to zero. In lactating Awassi sheep breed, it was found that the genetic correlation between the amount of milk and milk fat content was of low intensity and negative (Epstein, 1985). Other authors have confirmed the existence of negative and significant correlation between the quantity and quality of milk (Barillet and Boichard, 1987).

During a well balanced feeding with energy-protein ratio to dairy ewes for both maintainance and production, the correlation between the amount of fat and protein have high intensity and are positive (γ = + 0.4 to 0.7) and shows intense heritability (h^2 = 0.5-0.7) (Grosu and Oltenacu, 2005).

In the current study our aim was to determine correlations among the main components of sheep's milk, during the ascent and the plateau phases of lactation, in order to identify a single component correlated positively and intensively with all other components, to be used in selection objective for the Turcana sheep milk composition.

MATERIAL AND METHOD

The study was conducted in 2016 on 54 Turcana purebreed ewes, out of which 30 from the Research and Development Station for Sheep and Goats Caransebeş and 24 sheep of the same breed and age from the Didactic and Experimental Station Farm of the Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara.

For the two experimental groups of sheep, there were collected milk samples in containers of 100 ml, during the ascending and the plateau phases of lactation.

Milk samples were analyzed with a high resolution camera Milko Scan that operates on infrared radiation absorption to estimate milk components. It were determined the following chemical components: fat,

protein, lactose, total non-fat substances (SNF) and the total dry matter (TDM) (Voia and Padeanu 2013; Pascal, 2007).

Primary data were statistically analyzed using ANOVA 7 to estimate the averages and variability indices.

To calculate correlation between the components of sheep milk Spearman method was applied, more appropriate for a smaller number of samples, using the formula:

$$r = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Wherein: r = Spearman rank correlation

Σd^2 = The sum of squares of the differences between ranks

n = number of string values pair

RESULTS AND DISCUSSION

The study was conducted in two stages on Turcana breed ewes, which represent the main reared breed in Caras-Severin (94%) and Timis (98%) counties, as follows:

In the first set of experiments we determined the main components of milk from Turcana sheep in ascending lactation phase (early) and during the plateau phase. Based on the results on the main components of sheep milk (fat, protein, lactose, SNF, TDM), on which it depends to a great extent the quantity and quality of processed products, the averages and variability indices were calculated, data are presented in Table 1.

Table 1

The significance of differences for sheep milk chemical composition (%)

Trait	n	Ascending lactation	Plateau lactation	Differences	Significance
		x ± s	x ± s		
Fat	54	5.77 ± 1.39	8.48 ± 1.09	2.71	***
Protein		4.53 ± 0.31	5.39 ± 0.53	0.86	***
Lactose		4.92 ± 0.18	4.18 ± 0.56	0.74	***
SNF		10.48 ± 0.36	10.67 ± 0.39	0.19	ns
TDM		16.25 ± 1.35	19.15 ± 1.38	2.90	***

Analyzing the information in this table, it shows that in Turcana sheep reared in the Banat area, the fat percentage (5.77%) and protein (4.53%) or total dry matter (16.25%) in the ascending phase of lactation is significantly ($p < 0.05$) lower than during the plateau phase, where the values recorded were of 8.48% for fat, 5.39% for protein and 19.15% for the total dry matter.

Thus, the fat content during the plateau phase grew with 2.71 (46.9%), the protein with 0.86 (18.9%) and total dry matter with 2.90 (17, 8%), compared to the ascending phase.

Nonfat dry substance varied in very close (between 10.48% and 10.67%), with differences between periods of only 0.19 (1.8%), the diferences proven to be not significant ($p > 0.05$).

Lactose was the only component from sheep milk analyzed which has decreased significantly ($p<0.001$), by 0.74 (15.0%), from 4.92% during ascending lactation to 4.18% during the plateau phase.

Worldwide many authors have studied the composition of sheep milk in fat, protein and correlations between them.

In the milk from Merino sheep breed, Bencini and Purvis (1990) found at 9 weeks after lambing, a fat content of 8.48%, 4.85% protein and 19.70% TDM, much higher than our results obtained in Turcana ewes during the ascending phase of lactation.

Studies conducted in Europe on the main breeds of dairy sheep revealed that Improved Valkachian breed (Spanik, 1996; Oravcova, 2005) has the highest percentage of fat (8.70%) and protein (6.15%), followed by Tsigai sheep (8.72%; 5.97%) and Istrian Pramenka (7.23%, 5.65%) (Komprej, 2003) a breed simillar to Turcana.

Other authors report for the European dairy sheep breeds production values close to, however less than those found for the Turcana for fat content and protein, confirming once again that these breeds have high yields of milk but contain less fat and protein. Thus, the Assaf sheep breed (de la Fuente, 2006) newly formed has a fat content of 7.2% protein and 5.43%, followed by the breed Chios 6.60% and 5.80% (Ligda, 2002), Churra with 6.54% and 5.70% (Fuertes, 1998), Sarda 6.45% and 5.71% (Sanna, 1997) and East Friesian 5.81% and 4.98% (Hamann , 2004).

In the second stage were calculated the correlations between the analyzed sheep milk components, data are shown in Tables 2, 3 and 4.

During the ascending phase of lactation (Table 2) most intense significant ($p <0.001$) and positive correlation was between the total dry matter and fat content $r = + 0.916$.

A positive relationship, very intense and significant ($p <0.001$) was found between the protein and the amount of total total non-fat substances ($r = + 0.870$).

Table 2

Correlations between the main components of sheep milk during the ascending phase of lactation

Trait	Fat	Protein	Lactose	SNF

TDM	0.916***	0.315	-0.516*	0.143
SNF	-0.178	**0.870*** **	0.383	-
Lactose	-0.603**	-0.043	-	
Protein	0.003	-		
Fat	-			

During the plateau phase of lactation (Table 3), the amount of fat was also positively and intense correlated at a significance of p <0.001, with the total dry matter (r = + 0.946), followed by moderate significant correlations (p <0.001) between the amount of fat and the amount of protein (r = + 0.674) or the amount of protein and total solids (r = + 0.626).

Table 3

Correlations between the main components of sheep milk in the plateau phase

Trait	Fat	Protein	Lactose	SNF
TDM	**0.946*** **	**0.626*** **	- 0.281	0.783***
SNF	0.589***	0.490**	0.041	-
Lactose	- 0.448**	- 0.787***	-	
Protein	**0.674*** **	-		
Fat	-			

On cumulated data from both periods of lactation (Table 4) finding show the same link in meaning but with different intensities.

Table 4

Correlations between the main sheep milk components during total lactation

Trait	Fat	Protein	Lactose	SNF
TDM	**0.974*** **	**0.770*** **	-0.734***	0.489***
SNF	-0.336*	0.581***	0.072	-
Lactose	-0.790***	-0.795***	-	
Protein	**0.738*** **	-		
Fat	-			

Per whole lactation, it was positively correlated to the amount of fat (r = + 0.974) and the total amount of dry matter.

Very intense and significant positive correlations (p <0.001) were also recorded between: the amount of protein and the amount of dry matter (r = 0.770) and between the amount of fat and the amount of protein (r = 0.738). The amount of lactose was, however, negatively correlated, intensive and significantly (p <0.001) with the amount of fat (r = - 0.790), the amount of protein (r = - 0.795) and the amount of total solids (r = - 0.734).

Bencini and Purvis (1990) examined the correlations between the components of milk, and found that milk fat content is strongly correlated with TDM (r = + 0.89) and moderately with protein content (r = 0.26) and total production milk lactation and is negatively correlated (p <0.01) with

the percentage of protein (r = -0.27) and insignificantly with the percentage of fat.

At first lactation of the Lacaune breed ewes, the authors Barillet and Boichard 1987 reported a very intense positive correlation (r = 0.8) between the milk fat content and protein. In Turcana breed, the correlation between the same components was r = 0.738, very close compared to the value of the reports for the Lacaune breed.

In the Improved Valachian breed, the phenotypic correlation between milk fat content and protein was also positive (r = + 0.331) but moderate. Correlations between lactation milk yield and fat content (r = - 0.211) and protein content (r = - 0.169) were negative but weaker in intensity (Oravcova et al., 2007).

These data suggest that in Turcana sheep breed, the total amount of dry matter and / or amount of fat in 100 ml of milk can be a single criterion of selection for the components of milk taking into account the effect of selection decreases with increasing number of characters under selection. At the same time based on the content of sheep's milk in total solids can be estimated the specific consumption of sheep milk per kg processed product.

CONCLUSIONS

During the plateau lactation stage, the sheep milk content for fat, protein and TDM (8.48%, 5.01% and 19.15%) was significantly ($p < 0.001$) higher compared to the ascending phase of lactation (fat 5 77% protein, 4.53%; 16.25% TDM).

In the ascending phase of lactation, the most positive correlations and significant ($p < 0.001$) were between the components of sheep milk were found between TDM and fat content (r = + 0.916) or protein (r = + 0.870).

During the plateau phase of lactation milk components had a positive and significant correlations ($p < 0.001$) same as in the ascending phase (r = + 0.946 + 0.626 = r, respectively).

For the total lactation, TDM was found to be positively correlated and significantly ($p < 0.001$) with fat (r = + 0.974), protein (r = + 0.770) and SNF (r = + 0.489) contents.

In Turcana sheep breed ewes, during the two phases of lactation and total lactation, total dry matter (TDM) from raw milk is positively correlated with the amount of fat component, thus it migh be chosen as a single criterion in selecting sheep for dairy production.

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