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SHORT COMMUNICATION

GOAT MILK QUALITY IN THE LATE LACTATION

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Abstract

Improving application of goat milk in cheese production is an up-to-date issue in Latvia, therefore more information is needed about the chemical composition and renneting properties of goat milk during the lactation stages. The aim of the study was to analyse the goat milk in the late lactation. Milk fat, protein, lactose, dry matter, solids-non-fat and freezing point were measured by infrared spectroscopy (MilcoScan Mars^{TM}, Foss, Denmark). In total, 95 samples were tested, which represent four goat breeds: Latvian Native (n=44), Saanen (n=16), milking crosses XP (n=21) and crosses XX (n=14). All XX and XP goats had the first lactation, Latvian Native – 1.83 lactation, and Saanen goats – 5.3 lactation. All animals were kept in the same condition and received the same feed by feeding scheme. The bulk milk was also analysed (n=4) for understanding of an average chemical composition and its influence on cheese production. Fat to protein ratio was analysed in individual goat milk samples, as well as in bulk milk samples, and the average results were 0.91 and 1.15, respectively. Milk fat and protein content (%) was higher in XP goats' milk compare to Latvian Native, respectively 4.50 vs 4.75 and 3.91 vs 4.23. No significant differences were found between lactose content (%) in goat milk of the first, second and older lactations, respectively, 4.43, 4.43 and 4.23. Overall means for bulk milk fat, protein, lactose and solids-non-fat content were 4.95%, 4.28%, 4.41% and 8.90%.

Keywords: goat milk, late lactation, quality

Introduction

Goat milk is an excellent source of nutrients with high biological value proteins, essential fatty acids, high mineral bioavailability and vitamin content (Garciá et al., 2014; Park, 2009; Verruck et al., 2019). Also goat milk products, especially cheese, are considered a delicacy in many countries and its products have gained market size (Verruck et al., 2019).

Goat milk composition has substantial effect on cheese composition and yield. The goat milk varies considerably in composition, especially with the season as most of goat kids at about the same time in Latvia. Goat milk quality is a variable, as well as milk quality changes significantly influence cheese production.

One of most important quality indicators in goat milk is somatic cell count (SCC). In many countries already have some restrictions that SCC must not exceed 1 000 000 per 1 mL, but in Latvia we still produce milk with indefinite somatic cell count.

SCC influences many aspects as genetics, environment, husbandry conditions and animal health (Leitner et al., 2016).

The objective of this study was to analyse goat milk quality in the late lactation.

Materials and Methods

The study was carried out from October to December of 2018, the goat milk used in the study was collected at goat farm Ltd Licisi.

In total, 95 raw milk samples were tested which represent four goat breeds: Latvian Native (n=44), Saanen (n=16), milking crosses XP (n=21) and crosses XX (n=14). Crossed breeds goats had the first lactation, Latvian Native (LVK) average lactation 1.83, and Saanen goats (ZK) average lactation 5.3. Information about goats' characteristics was taken from the farm register but data on somatic cell count were obtained from milk data monitoring (Agricultural Data Centre Republic of Latvia, 2019).

The goats were divided according to the lactation stage in 3 groups: 1 – first lactation (n=55), 2 – second lactation (n=17), 3 – animals of third to seventh lactation (n=23).

Animals were kept in the same condition and fed by feeding scheme with hay, haylage, straw, bushes and twigs, grassland, barley flour or oats.

The goats were machine milked twice a day and milk yield recorded. Samples from morning milking were used for analyses. Samples were cooled and stored at 3±1 °C, and analysed on the same day of milking.

The bulk milk was analysed (n=4) for understanding an average milk chemical composition, as well as fat to protein ratio and its influence on the cheese production. Individual goat milk samples and bulk milk samples were analysed for fat, protein, lactose, dry matter, solids-non-fat and freezing point by infrared spectroscopy (MilcoScan Mars^{TM}, Foss, Denmark) and fat to protein ratio of individual goat milk and bulk milk was calculated.

Statistical data analyses were carried out using Microsoft Excel 2016 and Rstudio programmes.

Results and Discussion

Fluctuation of goat milk composition could be affected by breed, stage of lactation, and season. The results of different lactation stage goat milk composition in the late lactation are shown in Table 1. The lactation stage influenced milk yield, which significantly increased in the 2nd goat group and reached the highest amount in the 3rd group.

Analysing milk yield in the lactations, there were found significant differences between 1st and 2nd and between 1st and 3rd group ($p<0.05$, respectively $p=0.01$, $p=0.02$).

Table 1

Milk production indices and chemical composition in the late lactation goat

Group	1 (n=55)	2 (n=17)	3 (n=23)
Milk yield, kg	468±139^{b}	597±61^{a}	599±146^{a}
Fat content, %	4.31±1.12^{b}	3.67±0.37^{a}	3.51±1.07^{a}
Protein content, %	4.57±0.94^{b}	4.12±0.36^{a}	3.98±0.70^{a}
Fat to protein ratio	0.94±0.16^{b}	0.89±0.09^{a}	0.88±0.19^{a}
Lactose content, %	4.43±0.22^{a}	4.43±0.35^{ab}	4.23±0.59^{b}
Dry matter, %	13.46±2.11^{b}	12.11±0.76^{a}	11.55±2.10^{a}
Solids-non-fat, %	9.28±0.97^{b}	8.75±0.45^{a}	8.35±1.02^{a}
Freezing point, °C	-0.506±-0.037^{b}	-0.481±-0.037^{a}	-0.455±-0.064^{a}
SCC	992±864^{a}	915±660^{a}	1167±1168^{b}

SSC – somatic cell count.
Results indicated with the same letter in the lines do not differ significantly (p>0.05).

Table 2

Milk composition and production indices in different goat breeds milk at late lactation

Group	LVK (n=44)	ZK (n=16)	XP (n=21)	XX (n=14)
Milk yield, kg	550±123^{a}	635±135^{b}	797±130^{c}	410±136^{d}
Fat content, %	3.91±1.12^{a}	3.34±0.92^{c}	4.50±0.42^{b}	4.29±1.16^{ab}
Protein content, %	4.23±0.68^{b}	3.81±0.49^{c}	4.75±0.13^{a}	4.73±1.23^{a}
Fat to protein ratio	1.08±0.18^{ab}	1.05±0.15^{a}	1.10±0.13^{b}	1.14±0.18^{c}
Lactose content, %	4.39±0.29^{a}	4.20±0.68^{a}	4.40±0.23^{a}	4.55±0.20^{a}
Dry matter, %	12.54±1.96^{b}	11.11±1.95^{c}	13.9±0.94^{a}	13.59±2.43^{ab}
Solids-non-fat, %	8.86±0.76^{b}	8.09±1.00^{c}	9.49±0.73^{a}	9.47±1.20^{a}
Freezing point, °C	-0.485±-0.042^{a}	-0.445±-0.072	-0.520±-0.019^{b}	-0.507±-0.027^{ab}
SCC	1147±981^{b}	906±1128^{a}	453±501^{c}	999±768^{a}
Average lactation	1.83	5.3	1.0	1.0

LVK – Latvian Native goat breed, ZK – Saanen goat breed, XP – milking crosses, XX – crosses, SCC – somatic cell count.
Results indicated with the same letter in the lines do not differ significantly (p>0.05).

The noticeable difference in milk yield was not found between 2nd and 3rd group (p>0.05, p=0.98). Latvian researchers Piliena and Jonkus (2012) have established that milk yield rises till third lactation and with fourth lactation it decreases. Stage of lactation is one of the many factors that influence milk composition and its technological properties especially fat to protein ratio. Goetsch et al. (2011) established that it is negative practice to elongate the lactation stage.

In most cases, goat milk is not standardized prior cheese production, which influences fat content in dry matter as well as cheese yield, too. Protein and fat content determines the yield of cheese, but ratio of fat to protein mainly determines the fat content in dry matter, as well as affects syneresis and water content in the cheese. The ratio of fat to protein in milk decreased with the lactation stage (Table 1). Protein and fat content was lower in 2nd and 3rd group goat milk. The content of lactose in milk decreased throughout the lactation stage, and also lactose content was lower in 3rd group goat milk. Somatic cell count was higher in 1st and 3rd group goat milk. Stage of lactation also influenced SCC count in goat milk. High milk production amount was associated with lower total solids concentration, particularly fat and protein content in milk.

The study results indicated that analysed milk samples could be considered of high quality in relation to SCC, reaching the parameters established in many European countries – 1 000 000 per 1 mL. The individual goat milk samples with SCC above one million per 1 mL were lower in 1st and 2nd lactation stage. This may be due to the fact that the goat milk yield decreases with the advance of lactation and consequently increases SCC.

The results of different breeds' goat milk composition in the late lactation are shown in Table 2.

The significant differences were established among the breeds in fat content (p<0.05). There were no significant differences between LVK and XX; XP and XX, respectively p>0.05 (p=0.24; p=0.63).

The goat breed influenced the milk yield, which was significantly higher for XP and ZK goats compared to LVK and XX. Protein and fat content was higher in XP goat milk. Estonian researchers (Tatar et al., 2015) established the lower average fat and protein content in spring and summer season (April-June) milk, but higher average fat and protein content in October-December and in July-September milk. Chávez-Servín et al. (2018) and Steinshamn et al. (2014) concluded that the variability of goat milk and its product composition is affected by the grazing season.

The bulk milk chemical composition are shown in Table 3.

Table 3

Bulk milk composition

Sample	Average	Min	Max
Fat content, %	4.95	4.21	5.53
Protein content, %	4.28	4.11	4.44
Fat to protein ratio	1.15	1.02	1.25
Lactose content, %	4.41	4.24	4.60
Dr y matter, %	13.79	12.64	14.83
Solids-non-fat, %	8.90	8.64	9.24

The information on the influence of bulk milk composition of late lactation goats can help cheesemakers to better understand the effect on milk suitability for cheesemaking and cheese quality.

It is known that sheep and goat milk normally have higher SCC than cows milk. SCC has been used as an indicator to detect mastitis in cows and it should be adapted for goat milk, too (Stuhr et al., 2013). Milk with a low SCC and bacterial count is the base for having healthy animals and good hygienic practice at the farm (Skeie, 2014). Goat breeders should remember that SCC is also an indicator of goat subclinical mastitis (Bagnicka et al., 2011). To establish the acceptable limits for SCC in goat milk, it is necessary to evaluate the average value as its variation through lactation.

Conclusions

The stage of lactation influences lactose, protein, fat content and SCC count in goat milk.

The analysed goat milk varied considerably in composition, especially in the late lactation. Milking crosses had shown the higher milk yield and lower SCC in the late lactation milk.

To establish the acceptable limits for SCC in goat milk, it is necessary to evaluate the average value as its variation through lactation.

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