

## GOAT MILK COMPOSITION VARIABILITY AFTER KID WEANING

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### Abstract

The aim of the research was to evaluate the variability of milk yield and composition for goats with different kid suckling periods. The research was carried out in 2011 and 2012 on a farm where goats of Latvian breed were reared. In both years goats kidded in February and March. Each group included 10 animals. In the first group the kids were weaned on the first day of kidding (A1), in the second – on the 30th day (A30) but in the third – on the 60th day (A60) after kidding. The amount of the milk yield was measured in five successive days after the kid weaning. Milk samples were analysed in an accredited milk laboratory. The highest milk yield was obtained from the goats when kids were weaned immediately after the birth, and samples were taken starting with the 6th day of lactation ( $2.10 \pm 0.05$  kg), but the lowest from the goats with suckling period of 60 days –  $1.68 \pm 0.03$  kg. The average milk fat and protein content of the goats from the group A1 ( $53.6 \pm 0.92$  and  $41.6 \pm 0.66$  g kg<sup>-1</sup>), was significantly higher than from the groups A30 and A60 ( $p < 0.05$ ). The average variability of milk yield proved to be from 4.9% in the group A1 to 10.5% in the group A30. The lowest fat content variability was observed for goats of the group A1 in both years – 8.9% and 10.7%, but the highest 20.5% in the group A60 in the first year. The highest variability of milk protein content was observed in the group A30 – 14.8%.

**Key words:** dairy goat, daily milk yield, fat and protein, variability.

### Introduction

In Latvia, goat breeding as a branch of agriculture started to develop in the 90s of the 20th century. Basically Latvian breed goats (Latvian local – LVK) are reared as dairy goats in all regions of Latvia. It constitutes up to 45% of the total number of dairy goats. The breed was developed at the end of the 19th century by crossbreeding local goats with Russian and Megrel breed bucks introduced in Latvia from Russia and the region of Vitebsk (Latvijas kazkopības biedrība, 2012) The most essential trait of LVK is high reproductivity – fertility 300 – 350% and kid rearing till the weaning age. Depending on feeding and keeping conditions an average milk yield of LVK goats is no less than 450 – 700 kg, with fat content 38.0 – 50.0 g kg<sup>-1</sup>, and protein content 30.0 – 35.0 g kg<sup>-1</sup> (Piliena and Jonkus, 2010).

The average milk yield from goats recorded in 2012 was 522 kg with the average fat content 3.81% and protein content 3.14%. An important problem in goat recording is a precise inventory and assessment of goat milk productivity, because it singles out the best animals for an aim oriented goat selection. Goat milk productivity recording in Latvia is not carried out uniformly because kid suckling periods vary from farm to farm. Traditionally it lasts till approx. the 60th day of lactation. Many European countries practise weaning some hours after kidding and kids are fed artificially. The first milk recording shows important variability of milk composition from goats with the suckling period to 2 months. Milk from individual goats with long suckling period in the first days of recording showed a very low milk fat content which does not comply with the International Committee for Animal Recording (ICAR) rules stating that the variability of milk composition should not decrease

lower than 20.0 – 90.0 g kg<sup>-1</sup>, but protein content 10.0 – 70.0 g kg<sup>-1</sup> (ICAR, 2012).

The aim of the research was to evaluate the variability of milk yield and milk composition for goats with different kid suckling periods.

### Materials and Methods

Productivity traits of Latvian breed goats were analysed in two year period: 2011 and 2012. 60 dairy goats were included in the research. They were divided into three groups, 10 animals in each. The average age of goats was 4.7 lactation, and there was no significant difference among the groups. In both years goats included in the research kidded in the period from the beginning of February to the end of March. In the first group the kids were weaned on the first day of birth (A1), in the second group – on the 30th day (A30) and in the third group – on the 60th day after birth (A60).

During the research the milk yield (kg), the fat content (g kg<sup>-1</sup>) and protein content (g kg<sup>-1</sup>) were analysed as well as somatic cell count (thousand mL<sup>-1</sup>). Milk productivity and quality in all groups were recorded for five successive days after the kid weaning. After weaning the goats were milked twice a day. In the group A30 the check up was done on the 31st, 32nd, 33rd, 36th and 38th day, but in the group A60 – on the 61st, 62nd, 63rd, 66th. and 68th day of lactation. In the group A1 milk yield was measured starting from the 6th day of lactation when according to the rules of the International Committee for Animal Recording (ICAR) the milk recording is allowed. Also, for the goats of this group the milk check up was carried out for five days – on the 6th, 7th, 8th, 9th and 11th day of lactation. The milk yield was measured with electronic scales. The milk samples were analysed in Sigulda Artificial Insemination Station, where fat and

protein content was identified according to the method of ISO 9622:1999 with the device Milko-Skan 133. In winter, goats of all groups were kept in stables and fed on hay and haylage, but in summer they grazed in cultivated pastures. From the annual energy value 30.0% is concentrate, but grass is 70.0%. In dry matter there are 20% crude protein, and it includes 6.35 MJ kg<sup>-1</sup> neto energy for lactation (NEL). Every day the goats received 0.5 kg concentrate with 20% of the digestible protein.

The statistical analyses were performed using SPSS program package and MS EXCEL for Windows. Data in tables and figures are presented as the least square mean ± standard error of means. The coefficient of variation (CV) was used to describe the traits variability. The results were analyzed using two-factor analysis of variance to determine the factors year and the weaning group of the milk productivity traits. Statistical differences with *p*-values under 0.05 were considered as significant.

### Results and Discussion

The average milk yield from all the research groups of goats in a standard lactation in 2011 was 435 kg, milk fat content – 44.5 g kg<sup>-1</sup> un protein content – 32.0 g kg<sup>-1</sup>, but in 2012 the average milk yield was 431 kg, milk fat content – 45.8 g kg<sup>-1</sup> and protein content – 32.2 g kg<sup>-1</sup>, the average somatic cell count was 322 thousand mL<sup>-1</sup>.

To find out the variability of goat milk yield and composition, the average milk productivity traits were assessed in five successive days after kid weaning (Table 1).

In the period of research the highest 24 hour (daily) milk yield was obtained from the A1 group goats in 2011 – 2.52 kg, which was significantly higher than the yield from the groups A30 and A60, respectively – 1.82 and 1.65 kg. The next year the 24 hour (daily) milk yield was taken from goats when kids were weaned on the 60th day of suckling – 1.71 kg, but it was only 0.03 kg higher than from the A1 group goats. The 24 hour (daily) milk yield from the group A30 was significantly less – 1.51 kg (*p*<0.05).

The fat and protein content varied significantly among the groups in both years when the research was carried out. The highest milk fat content in both years was obtained from the goats when kids were weaned on the first day after birth and were fed artificially, 53.6 and 53.5g kg respectively, but the lowest milk fat content was obtained from the goats which had suckled kids for 60 days (30.2 and 27.6 g kg<sup>-1</sup>). The fat content characteristic for the breed (45.0 and 45.7 g kg<sup>-1</sup>) was obtained from the goats when kids were weaned on the 30th day of suckling. Similar tendency was observed for the variability of milk protein content among the research groups. The average milk protein content 43.2 and 40.7 g kg<sup>-1</sup> obtained from the group A1 was significantly higher than the milk protein content from A30 and A60. As the scientific data prove, goat milk yield grows till the second week of lactation. Provided that the feeding and keeping conditions are set correctly, the maximum milk yield is maintained till the 10th week of lactation (Bömkes, 2004). After that the milk yield gradually decreases by approx. 10% (Gall, 2011).

Table 1

The average goat milk productivity in research days

Group	Kidding Year	Milk yield kg day	Min	Max	Fat content, g kg <sup>-1</sup>	Min	Max	Protein content, g kg <sup>-1</sup>	Min	Max
A1	2011	2.52±0.02 <sup>a</sup>	2.3	2.9	53.6±0.92 <sup>a</sup>	36.3	63.5	42.4 ±1.41 <sup>a</sup>	33.0	60.3
	2012	1.68±0.04 <sup>A</sup>	1.0	2.4	53.5±1.61 <sup>A</sup>	38.2	72.4	40.7±0.81 <sup>A</sup>	30.1	35.1
	Average	2.10±0.05	1.0	2.9	53.6±0.90	38.2	72.4	41.6±0.66	30.1	60.3
A30	2011	1.82±0.05 <sup>b</sup>	1.3	2.7	42.0±1.16 <sup>b</sup>	20.4	54.0	36.2±0.88 <sup>b</sup>	25.3	49.3
	2012	1.51±0.02 <sup>B</sup>	1.1	1.9	45.7±1.50 <sup>B</sup>	18.8	75.6	38.0±0.64 <sup>B</sup>	30.9	50.3
	Average	1.66±0.33	1.1	2.7	43.9±0.91	18.8	75.6	37.1±0.56	25.3	50.3
A60	2011	1.65±0.45 <sup>c</sup>	1.1	1.6	30.2±0.97 <sup>c</sup>	16.3	44.4	28.0±0.82 <sup>c</sup>	21.0	41.8
	2012	1.71±0.03 <sup>A</sup>	1.2	2.2	27.6±0.43 <sup>C</sup>	21.2	34.6	30.2±0.29 <sup>C</sup>	23.4	34.0
	Average	1.68±0.03	1.1	2.2	28.8±0.54	16.3	44.4	29.1±0.44	21.0	41.8

<sup>a,b,c</sup> – differences between groups with different letter are significant in the year 2011 (*p*<0.05).

<sup>A,B,C</sup> – differences between groups with different capital letter are significant in the year 2012 (*p*<0.05).

The frequency of milking influences both milk productivity and quality. The scientists in Turkey found out that goats milked 4 times a day yield 2.05 kg milk with the fat content 29.5 g kg<sup>-1</sup>, protein content – 30.8 g kg<sup>-1</sup>, but goats milked 2 times a day yield 1.8 kg with fat content 30.8 g kg and protein content 31.9 g kg<sup>-1</sup>. By increasing frequency of milking, fat content got lower (Koyuncu and Pala, 2008). They also stated that the milk composition is influenced by machine milking (Cetin et al., 2010). Goats from research groups were milked twice a day at 7 a.m. and 5 p.m.

Another research showed that the productivity and quality of milk during the suckling period are influenced by the amount of fodder in 24 hours. If the amount of fodder is increased during the suckling period by 15%, milk yield among research groups was more than 116.2 kg in comparison with the check-up group, but if the amount was increased by 20%, the milk yield was more than 171.7 kg (Abdelhamid and Abdel-Khalek, 2012). Goats after kidding let kids suckle as often as they wanted for the first 4 weeks 6 – 8 times a day (Jensen, 2009; Rahmann, 2010).

Significant variability of milk yield and composition were observed for individual animals (Figure 1).

In all three groups there were goats with very low (daily) milk yield in 24 hours – only 1.0 kg or a little more than one kilogram (1.1 – 1.3 kg). The maximum yield (2.9 kg<sup>-1</sup>) in 2011 was obtained from the goat in

the group A1. The average variability of milk yield during the whole research period was from 4.9% in the group A1 to 10.5% in the group A30. The variability of fat and protein content during the research was higher than variability of milk yield. The observed minimum milk fat content was 16.3 g kg<sup>-1</sup> in the group A60, but maximum 75.6 g kg<sup>-1</sup> in the group A1. The variability of milk fat content assessment showed that the lowest values of coefficient of variation showed the group A1 in both years of research – 8.9% and 10.7%, but the highest coefficient of variation of milk fat content variability – 20.5% was observed in the group A60 in the first year of research. Permanently high variability of fat content was observed in the group A30 in both years (16.0 and 17.3%). The individual minimum variability of milk protein content was 21.0 g kg<sup>-1</sup> in the group A60 and the maximum – 60.3 g kg<sup>-1</sup> was observed in the group A1 in 2011. The highest variability of milk protein content from all the groups was noted in 2011 in the group A30 – 14.8%.

Analysing the total milk yield of a lactation from the research groups of goats, we found out that the milk yield in the first year in all groups was higher than in the second year although the difference was not statistically valid. The average milk yield obtained in a standard lactation significantly varied among the goat groups in both years of research. The highest milk yield was obtained from goats in the group A1 in both years – 455.6 kg and 455.3 kg ( $p < 0.05$ ; Table 2).

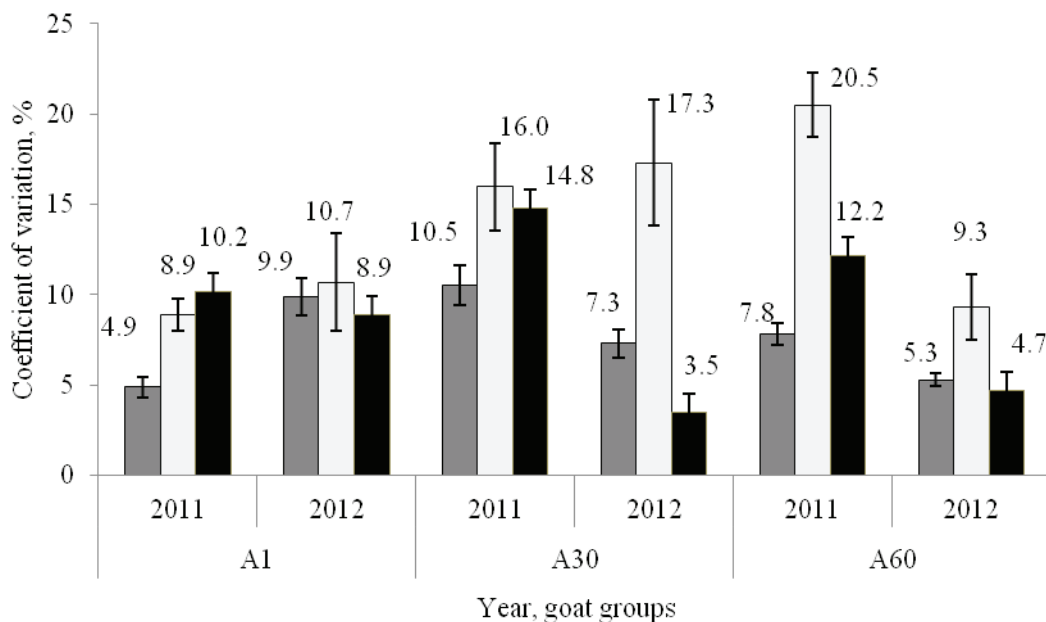


Figure 1. Daily milk productivity variability in goat groups.  
■ – Milk yield, □ – Fat content, ▨ – Protein content.

Table 2

**Average milk productivity in a standard lactation of goats research group**

Group	Kidding year	Milk yield, kg	Fat content, g kg <sup>-1</sup>	Protein content, g kg <sup>-1</sup>	SCC, thousand mL <sup>-1</sup>
A1	2011	455.6±2.91 <sup>a</sup>	44.1±0.61 <sup>a</sup>	31.9±0.22 <sup>a,b</sup>	366±25.75 <sup>a</sup>
	2012	455.3±2.23 <sup>A</sup>	47.4±0.70 <sup>A</sup>	32.7±0.21 <sup>A</sup>	266±31.30 <sup>A</sup>
	Average	455.5±1.82	45.7±0.52	32.3±0.11	316.5±20.78
A30	2011	443.4±4.12 <sup>b</sup>	46.5±0.70 <sup>b</sup>	32.4±0.33 <sup>a</sup>	325±31.88 <sup>b</sup>
	2012	434.7±1.58 <sup>B</sup>	45.0±0.51 <sup>B</sup>	31.7±0.16 <sup>B</sup>	157±14.48 <sup>B</sup>
	Average	439.0±2.23	45.8±0.42	32.1±0.22	241.4±19.34
A60	2011	406.6±7.51 <sup>c</sup>	42.8±0.61 <sup>c</sup>	31.7±0.24 <sup>b</sup>	493±83.48 <sup>c</sup>
	2012	405.5±5.92 <sup>C</sup>	44.9±0.62 <sup>B</sup>	32.0±0.17 <sup>B</sup>	272±28.96 <sup>C</sup>
	Average	406.0±4.75	43.9±0.44	31.9±0.11	382±45.33

<sup>a,b,c</sup> – differences between groups with different letter are significant in the year 2011 (p<0.05).

<sup>A,B,C</sup> – differences between groups with different capital letter are significant in the year 2012 (p<0.05).

The goat milk fat content in 2011 significantly varied among the research groups. The highest average fat content in 2012 was 47.4 g kg<sup>-1</sup>, and it significantly exceeded the average fat content characteristic for the population of LVK goats. Also, the milk protein content – 32.7 g kg<sup>-1</sup> – was significantly higher for this group of goats. The same can be stated about the average somatic cell count among the groups. In 2012, the milk had higher quality, because the average somatic cell count was significantly lower (156 to 272 thousand mL<sup>-1</sup>) than in 2011 (325 to 493 thousand mL<sup>-1</sup>).

A group of scientists in Croatia has found out that Saanen breed goats which had the shortest period of kid suckling – 32 days – during a lactation produced the highest milk yield – 724.40 kg. Also, the average day yield is the highest for these goats – 2.76 kg, and they produced the most milk fat and protein kilograms (20.16 and 18.64 kg respectively). Alpine goats had the longest kid suckling period – 51 day as well as the longest lactation – 259 days. They had the highest milk fat content in a lactation – 35.5 g kg<sup>-1</sup>, but the highest milk protein content was obtained from German Improved White (VBD) goats – 32.3 g kg<sup>-1</sup>, which had 45 day long kid suckling period (Mioč et al., 2007).

During our research LVK breed goats in a standard lactation, which according to ICAR is from 240 to 305 days long, had lower average milk yield (405.5 to 455.6 kg), but significantly higher milk fat content

(42.8 to 47.4 g kg<sup>-1</sup>) and similar milk protein content (31.7 to 32.7 g kg<sup>-1</sup>) as in Croatia, because high milk yield is a characteristic trait for Saanen goats.

### Conclusions

The highest (daily) 24 hour milk yield was obtained from goats when kids were weaned after the birth, and milk samples were taken starting from the 6th day of lactation – 2.10 ± 0.05 kg, but the lowest – from goats with the kid suckling period of 60 days – 1.68 ± 0.03 kg

A1 group goats showed significantly higher average milk fat content – 53.6 ± 0.92 g kg<sup>-1</sup>, whereas the group A30 – 43.9 ± 0.91 g kg<sup>-1</sup>, and A60 – 28.8 ± 0.54 g kg<sup>-1</sup>.

Significantly higher average milk protein content was obtained from the group A1 goats 41.6 ± 0.66 g kg<sup>-1</sup>, from the group A30 – 37.1 ± 0.56 g kg<sup>-1</sup> and from the group A60 – 29.1 ± 0.44 g kg<sup>-1</sup> (p<0.05).

The variability of milk yield ranged from 4.9% in the group A1 to 10.5% in the group A30.

The lowest goat milk fat content variability (8.9%) was observed in the group A1, while the highest (20.5%) in the group A60. The highest milk protein variability (12.2%) had the group A60, while the lowest (3.5%) – goats from the A30 group.

Significantly higher average milk yield in a standard lactation was obtained from the first group of research goats – 455.6 ± 1.82 kg, but the lowest – from the group three goats – 406.1 ± 4.76 kg (p<0.05).

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