

COMPOSITIONAL CHANGES OF SAANEN X KİLİS GOATS' MILK DURING LACTATION

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Abstract

Milks of 220 Saanen x Kilis goats' were taken during 22 weeks of lactation. Chemical compositions, energy values and mineral contents of goats' milk samples were determined. As results of the goats' milk samples analyses, the mean values were determined as 12.12% for dry matter; 3.45% for fat; 3.81% for protein; 4.12% for lactose and 261.5 kJ/100g for energy value, 6.86 for pH, 6.71 SH for titratable acidity and 1.031 g/cm³ for specific gravity during lactation. The mineral contents of the samples were similarly found to be 220.5 mg/100g for calcium; 108.8 mg/100g for phosphorus; 153.5 mg/100g for potassium, 20.1 mg/100g for magnesium and 67.5 mg/100g for sodium. Results of the statistical analyses indicated significant lactational effects on the contents of total solids, fat, non-fat dry matter, protein, lactose, energy value, titratable acidity, pH, specific gravity ($P<0.01$) and sodium ($P<0.05$), but there was no similar effect on the contents of calcium, phosphorus, magnesium and potassium values of goats' milk ($P<0.05$).

Keywords: Goat milk, lactation, chemical, energy value, minerals

LAKTASYON DÖNEMİ BOYUNCA SAANEN X KİLİS KEÇİ SÜTÜ BİLEŞİMİNDEKİ DEĞİŞİMLER

Özet

Laktasyon dönemindeki 220 Saanen x Kilis keçilerinden haftada bir kez olmak üzere 22 hafta boyunca süt örnekleri alınmıştır. Keçi sütü örneklerinin kimyasal bileşimleri, enerji değerleri ve mineral içerikleri belirlenmiştir. Analiz sonuçlarında keçi sütlerinin bileşimleri ortalama olarak; kurumadde için %12.12, yağ için %3.45, protein için %3.81, laktoz için %4.12, enerji değeri için 261.5 kJ/100g, pH için 6.86, titrasyon asitliği için 6.71 SH ve özgül ağırlık için 1.031 g/cm³ olarak bulunmuştur. Aynı şekilde süt örneklerinin mineral madde içeriği; kalsiyum için 220.5 mg/100g, fosfor için 108.8 mg/100g, potasyum için 153.5 mg/100g, magnezyum için 20.1 mg/100g ve sodyum için 67.5 mg/100g olarak belirlenmiştir. Yapılan istatistiksel analiz sonucu laktasyon döneminin keçi sütlerinin kurumadde, yağ, yağsız kurumadde, protein, laktoz, enerji değerleri, asitlik, pH, özgül ağırlık ($P<0.01$) ve sodyum ($P<0.05$) değerlerine etkisinin önemli, kalsiyum, fosfor, magnezyum ve potasyum değerlerine etkisinin önemli olmadığı belirlenmiştir ($P>0.05$).

Anahtar Kelimeler: Keçi sütü, laktasyon, kimyasal, enerji değeri, mineraller

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INTRODUCTION

Of the milk Turkey produces annually, cow's milk makes up 91.47%, goat's milk 1.93%, sheep's milk 6.35% and buffalo's milk 0.25%. In the world, 12601944 tons of goat milk is produced per year and in this respect Turkey is the 13th leading country with its 237487 tons of goat milk production (1). Goat milk is of great importance for milk technology and nutrition. Goat milk is more digestible because of its small-sized globules, uniform protein and fat distribution. Modified goat milk can also be used in baby feeding (2). Goat milk provides a healthy and a balanced diet for the children who are allergic to cow milk, as the symptoms may disappear with goat milk consumption (3). As it is known, nutritional value of milk is closely related with its composition, which is highly affected by factors such as breed, feed, stage of lactation, season, etc. (3, 4). Particularly during lactation there are significant changes in the amount and composition of goat milk (5). Like cow milk, goat milk is an excellent source of calcium, phosphorus and potassium. It is also a good source of magnesium, sodium and iron (6-8).

One of the local breeds in Turkey is Kilis breed. Their total number is estimated to be around 60000 heads. The goats are known with high milk yield. Lactation milk yields of Kilis goat are 200-300 kg in lactation periods of 190-230 days (9). Saanen goat, originated in Switzerland, is one of the preferred dairy goats primarily because of their consistency in producing large quantities of milk in conjunction with their sturdiness, easy keepability and capacity to tolerate environmental changes. They produce 750 kg milk in their lactation period of 280 days. (10). For improving of goat population, Saanen breed was used as the improver breed and crossed with Kilis breed in Turkey (11).

Although there are many studies on the changes of major constituents in goat milk during lactation, only little is known about nutritional value and mineral contents of goat milk. In this respect, this study aims to determine the nutritional value and mineral contents of goat milk. It also aims to determine the nutritional and mineral content changes during lactation period.

MATERIALS AND METHODS

For this study morning milk was collected from a herd, which consisted of 220 Saanen x Kilis goats in

Çukurova University, Faculty of Agriculture, Animal Husbandry Department during 22 weeks in 2006. After 22 weeks, the milking of goats was not sufficient for collecting. Saanen x Kilis goats produce 500-600 kg milk in their 150-220 days of lactation. When 60 days of kid feeding was eliminated from this period, goat milk could be collected during 155 days of lactation. Total population of them in Çukurova University farm is approximately 300-500 heads. After parturition, the animals were fed 600 g dairy feed which consists of 18% crude protein and 2600 kcal metabolisable energy in kg dry matter as addition to pasture during the study. Three milk samples were taken every week during the period and then analyzed.

In the samples, the level of dry matter was determined gravimetrically. The fat content was obtained using the Gerber method. Kjeldahl procedure was used for determination of protein and Lane Eynon procedure was used for determination of lactose. pH measurements were carried out using Beckman pH meter. Titratable acidity was determined according to alkali titration. Specific gravity was measured by lactometer (12, 13). The amounts of fat, protein and carbohydrate were multiplied by co-efficient and summed for energy content. To determine mineral content, milk samples were analyzed for Ca, K, Mg and Na by using PV9100 atomic absorption spectrophotometer and they were analyzed for P by using Varian DMS 1005 UV Visible Spectrophotometer (14). The results were statistically evaluated using analysis of variance (one-way ANOVA). The differences between the samples were determined by the test of LSD (15).

RESULTS AND DISCUSSION

Table 1 shows the composition of goats' milk analyzed during 22 weeks of lactation. As seen from Figure 1, average of dry matter value was stable during the early weeks of lactation and it started to decrease after the 6th week. Starting to increase after the 9th week, dry matter content had a higher value than that of early weeks of lactation ($P < 0.01$). During the last weeks of lactation, total solids value remained stable. Zahraddeen et al. (16) observed non-significant difference in total solid content of Nigeria goat milk during stage of lactation. Güler et al. (17) reported high values for dry matter for 10 Damascus goats and 8 German fawn x Hair goat

B-1 crossbreeds during lactation. When the results of this study are compared to results of the previous studies, it can be said that they are lower than the values reported by the researchers (4, 18). However, the values obtained in this study are higher than those observed by Merin et al (3) and Sawaya et al. (19). The highest non-fat dry matter value was obtained in the 19th week of lactation. The non-fat dry matter was affected during the lactation period. Kondyli et al. (20) reported similar observation for goat milk of 145 indigenous Greek breed. The non-fat dry matter value of Saanen x Kilis goats' was higher than that of white Polish goats (21) and Alpine and Saanen goats in lactation periods (22).

Table 1. Composition of goats' milk during 22 weeks of lactation

	Min	Mean ± S.D.	Max
Dry matter (%)	9.94	12.12±1.14	13.58
Fat (%)	2.00	3.45±0.92	4.50
Non-fat dry matter (%)	7.94	8.69±0.37	9.13
Protein (%)	3.30	3.81±0.30	4.52
Lactose (%)	3.45	4.12±0.38	4.72
Energy value (kJ/100g)	194.9	261.5±38.2	306.2
pH	6.70	6.86±0.09	6.96
Titrateable acidity (SH)	7.78	6.71±0.29	6.19
Specific gravity (g/cm ³)	1.030	1.031±0.01	1.033
Calcium (mg/100g)	118.0	220.5±59.52	299.0
Phosphorus (mg/100g)	58.0	108.8±21.52	133.0
Ca/P (mg/100g)	0.95	2.13±0.85	4.90
Magnesium (mg/100g)	16.0	20.1±2.48	27.0
Sodium (mg/100g)	55.0	67.5±7.55	87.0
Potassium (mg/100g)	124.0	153.5±19.21	192.0
Na/K (mg/100g)	0.33	0.45±0.07	0.61

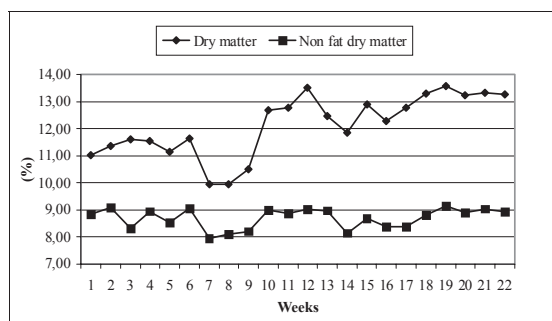


Figure 1. Dry Matter and non-fat matter in goats' milk during lactation

Fat, protein and lactose values in goat milk during lactation are presented in Figure 2. Fat content started to decrease after the 3rd week. The value started to rise in the 7th week and reached its maximum in the 12th week ($P < 0.01$). There were no significant changes in fat value during late lactation. The results found in this study are lower than the results found by other researchers for African dwarf goats (5) and 20 Maltese-local cross goats (18), white Polish goats (21). The mean value of fat found in this study is close to mean value reported by Voutsinas et al. (23) for Alpine goats and higher than mean value reported by Güler et al. (17) for Damascus goats and German fawn x Hair goat B-1 crossbreeds (3, 19). Brendehaug and Abrahamsen (24) found that fat content decreased over the first 4 months of lactation and increased during the mountain pasture period. A researcher determined that fat content was affected by breed, stage of lactation and season. Moreover, this value decreased as lactation progressed (16).

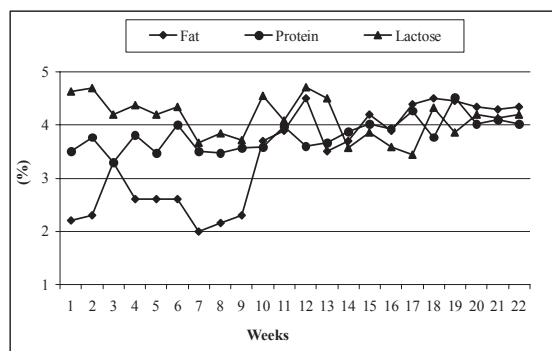


Figure 2. Fat, protein and lactose in goats' milk during lactation

Although protein content changed over the whole period of lactation, an increase in this value was only recorded during late lactation ($P < 0.01$). When the results of the study are compared to results of the previous study, it is found that they are lower than the value reported by Wuschko and Seifert (5) in 150 days of lactation period. However, the values obtained in this study were determined to be higher than the values reported by Gnan et al. (18) for 20 Maltese-local cross goats, Simos et al. (25) for 164 native Greek goats and Kudoka (21) for white Polish goats. Brendehaug and Abrahamsen (24) found that protein value decreased during the first 4 months and then increased until the end of lactation.

Zahraddeen et al. (16) reported that protein and lactose were significantly affected by breed, stage of lactation and their content decreased with advancing lactations.

Lactose value decreased slowly from the beginning until the 9th week of lactation. Although the value was high between the 10th and the 13th weeks, it started to decrease again ($P<0.01$) and remained stable during the last weeks of lactation. Wuschko and Seifert (5) and Brendehaug and Abrahamsen (24) reported similar observations. The average lactose value obtained in the study was lower than the values reported by Gnan et al. (18) for 20 Maltese-local cross goats, Simos et al. (25) for 164 animals in their 2nd and 3rd lactation of the native Greek goat, Mariani et al. (26) for 53 Alpine goats and 18 Alpine x Saanen goats, Voutsinas et al. (23) for Alpine goats and Kudеka (21) for white Polish goats and the same as value reported by Sawaya et al. (19) for Masri and Aardi goats of Saudi Arabia.

The energy value of goats' milk was minimum on the 7th week of lactation (see Figure 3). The values were low at the beginning but increased during lactation ($P<0.01$). Like other total solid constituents, energy value remained stable during the last weeks of lactation. Energy value changes as a result of the variations in the amount of the fat. The mean value is close to that found by Haenlein (4).

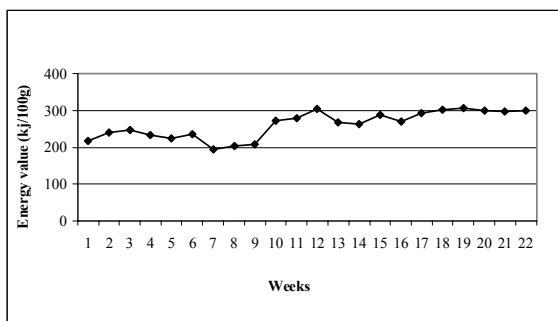


Figure 3. Energy value in goats' milk during lactation

pH and titratable acidity values in goats' milk are presented Figure 4. pH values rose consistently during lactation ($P<0.01$). This finding is in contrast to that of Zahraddeen et al. (16). Titratable acidity decreased during lactation in parallel to the changes in pH value ($P<0.01$). Mean values of titratable acidity were lower than those of Simos et al.'s reported (25) for native Greek goats during the period after weaning (mid Marc) until drying-off

(end of July). As seen in Figure 5 specific gravity decreased inconsistently during lactation period ($P<0.01$). Specific gravity decreases as a result of the variations in the amount of fat. This value is similar to those reported by Merin (3), Voutsinas et al. (23), El-Zayat et al. (27) and lower than the value reported by Kudеka (21).

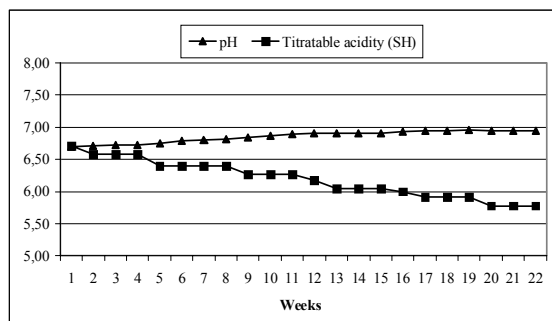


Figure 4. pH and titratable acidity in goats' milk during lactation

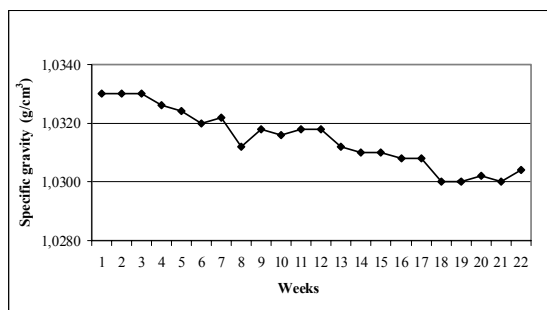


Figure 5. Specific gravity in goats' milk during lactation

The changes in calcium, phosphorus, potassium and magnesium values of goats' milk during lactation were not found statistically significant ($P>0.05$). When compared to other studies, the content of calcium recorded in this study is higher than the values reported by the researchers (4, 6, 23, 25, 27, 28). Some researchers have mentioned that phosphorus, potassium, sodium, calcium and magnesium increase during lactation (29). Some researchers found out that there occurs a simultaneous decrease in calcium content (25). However, other researchers reported that these minerals (Na, K, Ca and Mg) remain stable during lactation (5). Antunac et al. (22) reported that significantly higher contents of calcium and phosphorus were determined at the beginning of lactation in comparison with the middle of lactation. Whereas in one study, it was reported that phosphorus concentration was higher at the beginning of lactation (30), in another

reported study, phosphorus content was low at the beginning and increased by 3.4% during lactation (29). Researchers stated that the amount of potassium was at higher level during mid lactation (30). During lactation, magnesium content slightly increased (29).

Significant change was observed in sodium content during lactation ($P < 0.05$). As seen from Figure 6, sodium was highest in 2nd week and then became equal to its initial value towards the end of lactation. The mean value for sodium content was found higher than the values reported by Gnan et al. (18) for native Libya goat, Simos et al. (25) for native Greek goat, Voutsinas et al. (23) for Alpine goat. It was reported that the amount of sodium increased during lactation period (7, 29).

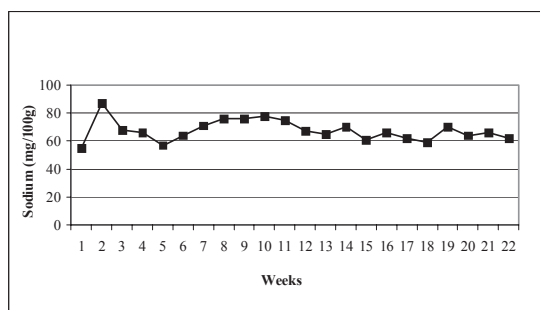


Figure 6. Sodium in goats' milk during Lactation

The profile of Ca/P and Na/K ratios were obtained at stages of lactation. The mean values of these ratios were higher than the values reported by Kondyli et al. (20) for goat milk of the indigenous Greek breed. Voutsinas et al. (23) founded significant changes in Ca/P and Na/K ratios in the milk between lactation stages.

CONCLUSIONS

This study showed that fat, protein, energy value and pH content in goats' milk increased during lactation periods. However, lactose, titratable acidity and specific gravity decreased during lactation. Calcium, phosphorus, potassium and magnesium values did not vary. However, sodium value varied during lactation.

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