Turkish Journal of Veterinary & Animal Sciences

Volume 29 | Number 3 Article 3

1-1-2005

Changes in Chemical and Mineral Contents of Awassi Ewes' Milk During Lactation

NURAY ŞAHAN

DİLEK SAY

ALİ KAÇAR

Turk J Vet Anim Sci
29 (2005) 589-593

Research Article

Changes in Chemical and Mineral Contents of Awassi Ewes' Milk During Lactation

Nuray ŞAHAN*, Dilek SAY, Ali KAÇAR
Department of Food Engineering, Faculty of Agriculture, Çukurova University, 01330 Balcalı, Adana - TURKEY

Received: 05.11.2002

Abstract: This study aimed to determine the chemical composition and mineral contents of Awassi ewes' milk during lactation. Morning milks of 150 Awassi ewes were taken once a week during 18 weeks of lactation. Mean values obtained from analyses of the ewes' milk samples were 17.54% ± 1.35 for dry matter; 6.61% ± 1.33 for fat; 10.93% ± 0.44 for non-fat dry matter; 5.68% ± 0.48 for protein; 4.34% ± 0.27 for lactose and 99.05 ± 11.63 kcal/100 g for energy value; 0.149% ± 0.008 for titratable acidity; 6.72 ± 0.42 for pH; and 1.0334 ± 0.001 g/cm^3 for specific gravity. The contents of calcium, phosphorus, potassium, magnesium and sodium of the samples were 395.2 ± 97.58 mg/100 g, 138.7 ± 22.38 mg/100 g, 119.9 ± 36.54 mg/100 g, 19.5 ± 1.65 mg/100 g, and 74.3 ± 11.75 mg/100 g, respectively. Results of the statistical analyses indicated significant lactational effects on the contents of dry matter, fat, and sodium ($P < 0.01$) and energy value, pH, titratable acidity, and specific gravity ($P < 0.05$).

Key Words: Awassi ewes' milk, lactation, chemical composition, minerals

Laktasyon Dönemi Boyunca İvesi Koyun Sütlerinin Kimyasal ve Mineral Madde İçeriğindeki Değişmeler

Özet: Bu çalışmanın amacı laktasyon dönemi boyunca Awassi koyun sütlerinin bileşim ve mineral içeriğinin belirlenmesidir. Laktasyon dönemindeki 150 İvesi koyunundan haftada bir kez olmak üzere 18 hafta boyunca sabah süt örnekleri alınmıştır. Analiz sonuçlarında koyun sütlerinin bileşimleri ortalama olarak; kurumadde % 17,54 ± 1,35, yağ % 6,61 ± 1,33, yağsız kurumadde % 10,93 ± 0,44, protein % 5,68 ± 0,48 , laktoz % 4,34 ± 0,27 ve enerji değeri 99,05 ± 11,69 kcal/100g, titrasyon asitliği % 0,149 ± 0,008, pH 6,72 ± 0,42 ve özgül ağırlık 1,0334 ± 0,001 g/cm^3'tür. İncelenen süt örneklerinin kalsiyum, fosfor, potasyum, magnezyum ve sodyum içerikleri sırayla 395,2 ± 97,58, 138,7 ± 22,38 119,9 ± 36,54, 19,5 ± 1,65 ve 74,3 ± 11,75 mg/100 g olarak belirlenmiştir. Yapılan istatistiksel analiz sonucu laktasyon döneminin koyun sütlerinin kurumadde, yağ, sodyum değerlerine ($P < 0,01$) ve enerji değeri, pH, titrasyon asitliği, özgül ağırlık değerlerine ($P < 0,05$) etkisi önemli çıkmıştır.

Anahtar Sözcükler: İvesi koyun sütü, laktasyon, kimyasal bileşim, mineraller

Introduction

Cows' milk comprises 85.34% of the milk produced throughout the world and goats' milk 2.22%, ewes' milk 1.42% and buffaloes' milk 10.79%. In Turkey, the percentages are as follows: cows' milk 88.56%, ewes' milk 8.13%, goats' milk 2.45% and buffaloes' milk 0.85%. After China and Italy, Turkey is the third leading country in the world in terms of the number of ewes and ewes' milk production, with 756,000 t (1).

Delicious cheese and yoghurt are produced from ewes' milk, and these products are usually preferred to the ones produced from cows' milk in Turkey. Thus, ewe raising is of great importance in Turkey. Similarly ewes' milk is also used for manufacturing cheese in some countries such as France, Italy and Greece (2,3).

Variations in the contents of ewes' milk are due to the differences among races and breeds. These genetic variations affect the composition of milk and thus the characteristics of the dairy products. Additionally, some factors such as lactation, season, feeding, psychological state and health of the animal cause variations in the composition of milk either at macro or micro level (4). Chemical composition of ewes' milk has been studied by some researchers (5,6). Ewes' milk has higher dry matter content than cows' and goats' milk (7). Particularly, ewes'

e-mail: nsahan@cu.edu.tr

milk has higher levels of protein, fat, minerals and vitamins (8-11). For example, the calcium, phosphorus, magnesium, riboflavin and vitamin C contents of ewes' milk are richer than those of cows' milk (7). Comprehensive information concerning the detailed analyses of the major constituents in ewe milk in the course of lactation is limited (3,12,13). Information on the content of minerals (11,14,15) and mineral contents of ewes' milk during lactation is still scarce in the literature (3,13). Mineral contents of Awassi ewes' milk are not found in the literature. Mineral constituents of various breed ewes' milk are given in Table 1.

One of the local breeds in Turkey is the Awassi breed. They produce about 181-202 kg milk between their 170^{th} and 200^{th} days of lactation. If appropriate conditions are provided, this amount may increase to 380 kg. When 60 days of lamb feeding is eliminated from this period, it can be said that ewe milk can be collected during 99 days of lactation.

This study was aimed to determine the composition and mineral contents of Awassi ewes' milk during lactation.

Materials and Methods

For the study, morning milks of Awassi ewes were collected from the Animal Husbandry Department of Agriculture Faculty of Çukurova University. Milk samples were taken from 150 ewes over 18 weeks. Dry matter, fat content, non-fat dry matter, protein content, lactose content, pH, titratable acidity and specific gravity of the samples were determined as described by Ling and AOAC (16,17).

After the percentages of fat, protein and carbohydrate were determined, the amounts were multiplied by co-efficient and summed for energy content (18). Milk samples were digested and then diluted in order to determine mineral content. Milk samples were analyzed for Ca, Mg, Na and K by using PV9100 atomic absorption spectrophotometer and they were analyzed for P by using Varian DMS 1005 UV Visible Spectrophotometer (19,20). Statistical analysis of the data was performed according to completely randomized. Comparison of the means of the samples was done by LSD test (21).

Results

Table 2 shows the chemical properties of ewes' milk samples during lactation Figures 1-6 show composition and mineral contents of Awassi ewes' milk during lactation. Changes in dry matter and fat content during lactation were statistically significant ($P < 0.01$). No significant change was observed in non-fat dry matter, protein or lactose values over the whole lactation period ($P > 0.05$). Significant changes were observed in energy values, pH, titratable acidity and specific gravity over the whole lactation period ($P < 0.05$). There were no significant changes in the amount of calcium, phosphorus, potassium or magnesium during lactation ($P > 0.05$). The changes in sodium value were significant ($P < 0.01$).

Discussion

The amount of dry matter changed only slightly during the first four weeks of lactation. However, the amount increased between the 4th and 6th weeks, and then decreased towards the end of the 8th week and then

Table 1. Mineral contents of ewes' milk (mg/100 g).

Reference	Breed	Ca	P	K	Mg	Na
3	Karagouniki	209.5	153.0	117.0	9.1	50.0
3	Serron	201.0	151.0	107.0	8.8	51.0
11	-	193.0	158.0	136.0	-	44.0
13	Boutsiko	214.2	148.0	116.5	14.8	49.7
14	Najdi	58.3	111.6	96.2	13.3	77.5
14	Nuaimi	88.6	121.5	89.1	13.6	84.1
15	Najdi	101.7	129.6	96.1	13.3	78.2
15	Australian 140.7	140.7	144.4	120.5	13.2	69.7
15	Najdi x Australian	140.5	127.1	118.0	13.6	69.8

Table 2. Composition and mineral contents of Awassi ewes' milk during 18 weeks of lactation.

	Min	Mean ± S.D.	Max
Dry matter (%)	15.69	17.54 ± 1.35	19.34
Fat (%)	4.10	6.61 ± 1.33	8.35
Non-fat dry matter (%)	10.25	10.93 ± 044	11.87
Protein (%)	5.00	5.68 ± 0.47	6.65
Lactose (%)	3.91	4.34 ± 027	4.85
Energy value (kcal/100 g)	79.96	99.05 ± 11.63	115.00
pH	6.21	6.72 ± 0.42	7.29
Titratable acidity (SH)	0.140	0.149 ± 0.008	0.164
Specific gravity (gcm^{-3})	1.0328	1.0334 ±0.001	1.0360
Calcium (mg/100 g)	165	395.2 9 ± 7.58	505
Phosphorus (mg/100 g)	95	138.7 2 ± 2.38	190
Potassium (mg/100 g)	90	119.9 ± 36.54	208
Magnesium (mg/100 g)	16	19.5 ± 1.65	23
Sodium (mg/100 g)	50	74.3 ± 11.75	91

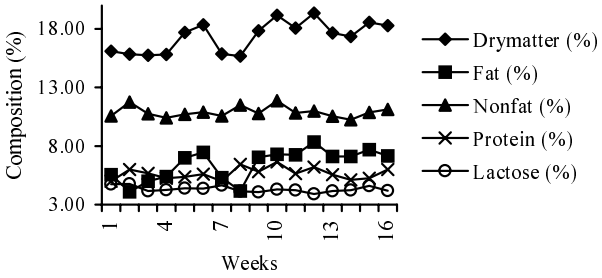

Figure 1. Composition of Awassi ewes' milk during lactation.

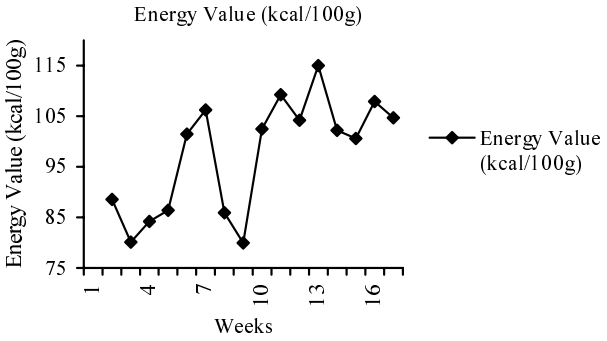

Figure 2. Energy value of Awassi ewes' milk during lactation.

rose disorderly until the end of lactation. Fat value in ewes' milk increased during the first six weeks and then decreased between the 7th and 9th weeks. The amount of fat increased starting from the 9th week until the final weeks of lactation. The concentration rose towards the end of lactation. Dry matter content of the samples tend to increase towards the end of the lactation period. Similar trend was observed for fat content obtained from Awassi ewes' milk during lactation. Dry matter and fat values were found to be significant and these values were dependent on the stage of lactation. Polychroniadov and Vafopoulov (3), Epstein (7), Konar et al. (12) and Voutsinas et al. (13) reported similar observations. Jelinek et al. claim that no significant change has been observed in the fat value (6).

The highest non-fat dry matter and protein values were obtained in the 10th week of lactation. The highest lactose value was obtained in the final week of lactation.

It was reported that non-fat dry matter (7) and lactose (6) were affected whereas protein was not affected by lactation period (6,7,12). Konar et al. reported that non-fat dry matter and lactose were affected during the lactation period (12).

Energy value during early lactation increased slowly after the 6th week, but started to decrease between the 7th and 8th weeks. After the 8th week, there was a fluctuation. However, the value remained stable until the end of lactation. Energy value changes as a result of the variations in the amount of the fat. While energy value in

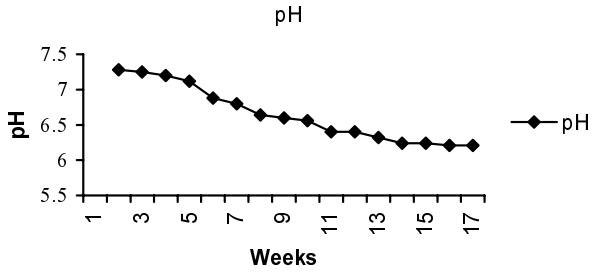

Figure 3. pH value of Awassi ewes' milk during lactation.

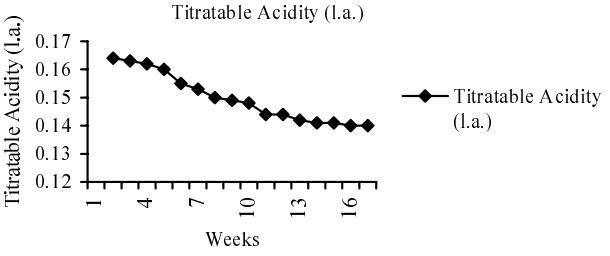

Figure 4. Titratable acidity of Awassi ewes' milk during lactation.

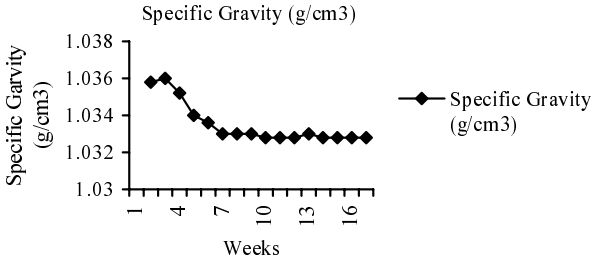

Figure 5. Specific gravity of Awassi ewes' milk during lactation.

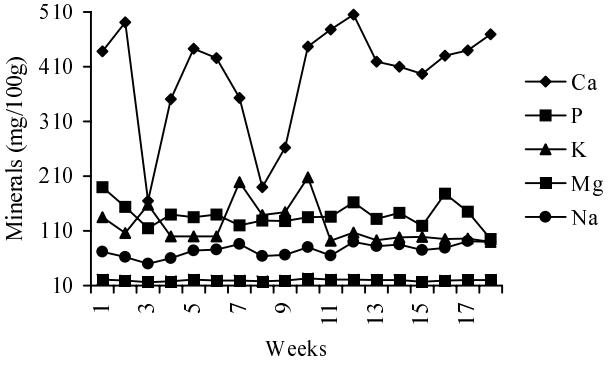

Figure 6. Mineral contents of Awassi ewes' milk during lactation.

ewes' milk increased, pH, titratable acidity and specific gravity in Awassi ewes' milk decreased.

pH of ewes' milk changed consistently during lactation. pH value decreased slowly to the end of lactation. Konar et al. (12) and Voutsinas et al. (13) reported different observations.

Titratable acidity of ewes' milk decreased during lactation, and reached its lowest value in the final week of lactation. Acidity changes as a result of the variations in the amount of protein. It is well known that the proteins contribute to the natural acidity of milk. Researchers have reported that titratable acidity changes in the lactation period (5,12,13).

During the first six weeks, there was a significant decrease in the specific gravity of ewes' milk. However, it was observed that it remained stable until the end of lactation. Specific gravity decreases as a result of the variations in the amount of fat. Voutsinas et al. (13) reported similar results but Konar et al. (12) reported different observations in the values of specific gravity.

The ewes' milk studied was an excellent source of calcium, phosphorus and potassium. Calcium was not significantly varied during lactation and its fluctuation pattern was not clear. Average calcium value in ewes' milk samples of this study was higher than the values reported by previous researchers (3,7,11,13,15). Polychroniadov and Vafopoulov (3) reported similar results but Voutsinas et al. (13) reported different observations. The phosphorus value decreased during lactation. Phosphorus value was higher than the values reported by Sawaya et al. (14) and Mehaia (15), lower than the values reported by Polychroniadov and Vafopoulov (3), Yücecan (11), and Voutsinas et al. (13). Potassium content decreased throughout lactation. Potassium value was similar to those values reported by Polychroniadov and Vafopoulov (3), Voutsinas et al. (13), and Mehaia (15). It was different from those values reported by Yücecan (11) and Sawaya et al. (14). Magnesium content did not follow a definite pattern of variation during lactation. Polychroniadov and Vafopoulov (3) and Voutsinas et al. (13) reported different results. Magnesium value was lower than the values reported by Polychroniadov and Vafopoulov (3), Voutsinas et al. (13), Sawaya et al. (14), and Mehaia (15). Sodium content was slightly increased with the stage of lactation. Voutsinas et al. (13) reported

similar observations. This finding is in contrast to that of Polychroniadov and Vafopoulov (3). The average value of sodium found in this study was similar to the results reported by Sawaya et al. (14).

Different results may be due to various feeding programs of the ewes, the milking procedures, breeding or climate.

This study showed that the contents of dry matter, fat and energy value in ewes' milk increased during lactation. However, pH, titratable acidity and specific gravity contents decreased. Sodium contents obtained in this study were found to be higher in the last weeks of lactation than those in the early weeks.

Acknowledgements

The financial support is provided by the University Research Board of the Cukurova University of Turkey is gratefully acknowledged (ZF – 1999 – 26).

References

1. FAO.: http://www.fao.org agricultural database production. 1999.
2. Metin, M.: Süt Teknolojisi I. Bölüm. Sütün Bileşimi ve İşlenmesi. Ege Üniversitesi Mühendislik Fakültesi Yayınları No: 33, İzmir. 1996.
3. Polychroniadov, A., Vafopoulov, A.: Variations of major mineral constituents of ewe milk during lactation. J. Dairy Sci., 1985; 68: 147-150.
4. Haenlein, G.F.W.: Nutritional value of dairy products of ewe and goat milk. Int. Dairy Fed., 1996; 159-178.
5. Tietze, M., Majewski, T.: Chemical composition and sanitary value of cow and sheep milk. Int. Dairy Fed., 1997; special issue 9702: 303-307.
6. Jelinek, P., Gajdusek, S., Illek, J., Helanova, I., Hlusek, J.: Changes in composition and characteristics of ewe milk during lactation. Zivocisna Vyroba, 1990; 35: 803-815.
7. Epstein, H.: The Awassi Sheep with Special Reference to the Improved Dairy Type. Food and Agriculture Organization of the United Nations. Rome. 1985.
8. Alichanidis, N., Polychroniadou, A.: Special features of dairy products from ewe and goat milk from the pysicochemical and organoleptic point of view. Production and Utilization of Ewe and Goat Milk. Proceeding of the IDF/Greet National Committe of IDF/CIRVAL Seminer, Greece, 19-21 October, 1995.
9. Yalçın, B.C.: Sheep and Goats in Turkey, FAO Animal Production and Health Paper. Rome Food and Agriculture Organization of the United N. 1986; 168.
10. Özcan, L. : Küçükbaş Hayvan Yetiştirme II. Çukurova Üniversitesi Ziraat Fakültesi Ders Kitabı No: 106, Adana. 1997.
11. Yücecan, S.: Sütün beslenmemizdeki yeri ve önemi. Gıda San. Derg.,. 1992; 6: 13-16.
12. Konar, A., Akın, M.S., Şahan, N., Güven, M.: Laktasyon döneminde ivesi koyun sütü bileşimindeki değişmeler. Turk. J. Agriculture Forestry Sci., 1991; 15: 958-967.
13. Voutsinas, L.P., Delegiannis, C., Katsiari, M.C., Pappas, C.: Chemical composition of Boutsiko ewe milk during lactation. J. Dairy Res.. 1988; 43: 766-771.
14. Sawaya, W.N., Khalil, J.K., Al-Shalhat, A.F., Al-Mohammad, M.M.: Mineral and vitamin contents of sheep milk. Milchwissenschaft, 1985; 40: 81-83.
15. Mehaia, M.A.: A study of mineral contents in milk of Najdi and Australian (Border Leicester x Merino) ewes and their crosses, J. Dairyi. Food. Home Sci., 1994; 13: 146-150.
16. Ling, R.L.: Dairy Chemistry 1, Chapman & Hall Ltd., London. 1963.
17. A.O.A.C.: Official Methods of Analysis of the Association of Official Agricultural Chemist., P. O. Box: 540, Washington D. C. 1970.
18. Yöney, Z.: Süt ve Mamülleri. Ankara Üniversitesi Ziraat Fakültesi Yayınları 421 Ders Kitabı 148, Ankara. 1973.
19. Kosikowski, F.V., Kindstedt, P.S.: Improved complexametric determination of calcium in cheese. J. Dairy Sci., 1985; 68: 806-809.
20. A.O.A.C.: Calcium in Animal Feed. Assosiation of Official Analytical Chemistry Vol: 1 Arlington, Virginia 85 202201 U.S.A. 1990.
21. Steel, R.G.D, Torrie, J.H.: Principles and Procedures of Statistics. McGraw Hill Book Co., Inc., New York. 1980.