MINERAL CHARACTERISTICS OF RAW GOAT MILK FROM THE REGION OF GOIÂNIA, BRAZIL.

M. J. Dias, C. A. Tanezini, W. T. D'Alessandro[1], A. B. C. de Oliveria, J. de M. Rocha, I. dos S. Pontes, A. L. de Carvalho and J. T. de Sousa

Physiology and Pharmacology Department of Federal Goias University
Campus II CNPq/Finep, Brazil

Summary

432 samples of raw goat milk were analyzed for sodium, calcium, potassium, chloride and ashes contents. The samples came from 16 pure breed goats, 2 to 4 years of age kept in semi-feedlots. They were basically fed soy bran, cotton bran, triturated Guandu hay and disintegrated corn with its straw and corncob (according to requirements for due preservation and production). The mean values found were: sodium, 45 ± 10.2 mg% (24.5-65.6 mg%); potassium, 206 ± 44.7 mg% (116.6-295 mg%); calcium, 111 ± 22 mg% (66.5-155.4 mg %); ashes, 0.82 ± 0.06% (0.68-0.95%); chloride, 235 ± 39 mg% (157-313 mg%). Results were related to: a) breed, the Brown and the Saanen revealed superior values for calcium and ashes, b) climate, which in the rain season led to higher contents of sodium, potassium and calcium when compared to the local dry season, c) time of lactation which increasingly affected the contents of calcium, sodium and ashes, and d) the time between milking, when higher concentration of chloride and ashes were mostly concentrated in the evening and calcium in the morning. These results have important implications in the handling and management of the goat herd.
(**Key Words**: Goat's Milk, Minera. Characteristics, Quality Control, Breed, Climate, Lactation Time)

Introduction

The mineral in milk represent the components that together with others chemical structures, guarantee the physical and chemical stability of the milk. Moreover they are important nutrients, as components of structural units, as enzymes activators as well as so lubilizing agents in water, for products of metabolism (Clement, et al., 1972). Calcium for example, is important for the formation of the dental and bone tissue, in the process that leads to blood coagulation and muscular contraction, and it acts in the secretion of some hormones, etc. Potassium and sodium are the main elements influencing the acid/base balance. Besides this, the minerals contribute to give the milk the necessary physiological osmotic pressure. They establish a poly-ionic system that, in balance, permits stability of casein in colloidal suspension. These minerals are also necessary for growing and reproduction. The present study was undertaken to obtain data on: The mean values and intervals of normal variation for the concentrations of sodium, potassium, calcium, chloride and ashes in 432 samples of raw goat milk, collected in the morning and afternoon, in the Goiania milky; the frequency distribution of the elements in the morning and afternoon samples; the mean concentrations of these minerals and how they are influenced by the animals breed, the time of lactation, the local climate and the interval of milking.

Materials and Methods

Materials

Sixteen goats of pure breed brown, Saanen and Anglo-nubian, of 2 to 4 years age were selected from the Samambaia creation, obtained from Veterinary Medicin School of the Federal University of Goias and from the cattle farm "Vale das Brisas", located in municipal district of Goiania-GO. The animals were identified by numbered colars for better control, and kept in semi-feedlots. A concentrate containing soy bran, cotton bran, triturated Guandu hay and disintegrated corn with its straw and corncob (MDPS);

[1]Address reprint requests to Dr. W. T. D'Alessandro. Physiology and Pharmacology Department of Federal Goias University, Campus II CNPq/ Finep, Brazil.
Received February 26, 1993
Accepted September 18, 1993

was used for the feeding. They were fed once a day according the requirements made for animal production and due preservation. Salt, water and procked grass were supplied to content. Besides this, they had clear access to grazing ground formed by: *A. gayanos, Braquiaria ruziziensis, stapf, Braquiaria humidicula*. The goats were vaccinated for aphtose fever and took vermifuge in the beginning of the experiment and, from then on, every 60 days. The samples were collected once a week, in the morning and afternoon, during 18 months. At every milking, data referring to time of lactation, animal breed, time of milking and season variations, such as temperature and air relative humidity, were registered. Immediately after collection the samples were individually packed in essay tubes, previously sterilized, kept in ice-boxes with triturated ice and taken to the Departament of Physiology of the biological Sciences Institute of the Federal University of Goias, where the samples were analyzed on the same day. The caprine had access to the pasture during part of the day and in the afternoon they were taken to the sheepfold and were kept in collective stalls. The installations characteristics of the place used for sampling is showed in table 1.

TABLE 1. CHARACTERISTICS OF THE STUDY LOCATION

Local	Mato grosso goiano
South latitude	16° 40' 22"
Longitude	49° 15' 29"
Altitude (m)	730
Average temperature (°C)	21
Humidity (%)	71.5
Pluviometric precipitation (mm)	1,487.2
Insolation/hours/year	2,645.7
Weather	Sub-tropical
Soil/fertility	Silica clayey/average

Sodium, Calcium and Potassium determination

Flame photometry was used in order to determine the above mentioned minerals. Aliquots of 0.4 ml were completed to 40 ml with deionized water and the read on the display, using standards solutions of zero (blank), 20 and 40 ppm of sodium, calcium and potassium. 1% lantanium oxide was added to calcium upon reading to eliminate any interference (Mussenden and Hiley, 1977).

Chloride determination

Chloride was determined, by means of the mercurimetric titulation technique. The present chloride ions together with mercuric ions from the titulating solution make up non-dissociated mercuric chloride. The ions from free mercuric will only appear after effective linkings with the chloride ions. We used diphenylbutazon as indicator, which, together with the remaining mercuric ions turn into a violet colour (Henry, J. T., 1964).

Ash determination

The amount of ashes was electronically determined by means of a Raphinometer TEC 3. As the equipment was duly calibrated, milk samples diluted in deionized water (1 : 20) were inserted in the sample cell. The double readings were registered after stabilizing the display (D 'Alessandro, W. T., et al., 1989)

Statistical analysis

The experimental outline was made through entirely casual blocks. Data were subjected to analysis of variance and the means averages were compared through the Tukey test. The significance level used in the experiment was 5% (Delio, 1975).

Results and Discussion

Mean values and variation intervals

Table 2 shows the mean values and the variation intervals of sodium, potassium, calcium, chlorides and ashes from the milk collected in the morning, in the afternoon and combined (morning + afternoon). The results are presented without reference to breed, lactation period and climate. Such values are useful to understand the regional patterns of fluid raw goat milk. They also contribute to the quality control of powder milk and to the improvement of the pertaining legislation. This paper allowed a tolerance of two standard-deviations above the mean to compensate for the occurrence of natural variations in the milk itself or in the equipment.

TABLE 2. MEAN VALUES AND VARIATION INTERVALS OF SODIUM, CALCIUM, POTASSIUM, CHLORIDE AND ASHES IN THE RAW CAPRINE MILK (%)

Milking period	Sodium (mg)	Calcium (mg)	Potassium (mg)	Chloride (mg)	Ashes (%)
Morning (n = 216)					
X	44	112	207	230	0.80
SD (±)	10	23	45	33	0.07
VI	24-64	65-118	118-296	160-300	0.65-0.94
Afternoon					
X	45	109	205	240	0.84
SD (±)	10	21	45	42	0.06
VI	24-66	67-151	116-294	151-320	0.70-0.50
Morning + afternoon (n = 432)					
X	45	111	206	235	0.82
SD (±)	10	22	45	39	0.06
VI	24-65	66-155	117-295	157-295	0.70-0.50

X = mean, SD = standard deviation, VI = variation interval, n = number of sample.

Morning and afternoon milk

Several authors state there is no difference between both milks(Shipe, 1959) while some others (Devendra, 1972) report that composition of the goat milk is quite variable depending on the milking lapse of time. As shown in table 2, where data were obtained from a long period of time, a statistical significant difference at level $p < 0.05$ for chloride and ashes was observed, which means that the afternoon milk has higher concentration of the components mentioned. For sodium and potassium, no significant difference was observed of the concentration in morning and afternoon milk. The results show a higher concentration of calcium in the morning ($p < 0.05$), which has implications on the production of and for the formation of consistent curdled milk. In addition, milk with low levels of calcium, like the ones subject to pasteurization and cold storage, may need an additional supplement of calcium (Silva, et al., 1990). Other factors such as drinking habits as well as temperature and humidity changes may be involved (Islabao, 1984).

Influence of lactation time upon of minerals

Table 3 shows the mean values of the amounts of sodium, potassium, calcium and ashes in the milk from six Brown goats related to lactation time. Statistical analysis demonstrated significant differences ($p < 0.05$) as for lactation time. Increasing values were observed with lactation, in sodium, calcium and ash contents. Between previous and subsequent intervals, no significant difference in components was observed, except for potassium between the first (7-40 days) and the second (41-80) intervals ($p<0.05$). Sampaio (1984), and Le Jaquen, J. (1982) disclosed similar differences in other regions.

Influence of breed upon amount of minerals

240 samples from 16 pure heed of the Brown, Saanen and Anglo-nubian were analysed, all of them under the same feeding and handling conditions. The goats had lactation time between 40-160 day lactation periods and lived during the dry season in the region. The results, from 48 samples of each breed are presented in figures 1 to 4. As for sodium concentration there were no differences among the breeds. The Saanen and Brown breed samples did not show significant differences in the amount of potassium, however it was higher ($p < 0.05$) in the Anglo-nubian samples. There were differences in the amount of calcium in the Brown and Saanen samples as compared to the Anglo-nubian samples. The Brown and Saanen samples have a higher amount of ashes as compared to the Anglo-nubian samples. The values obtained in this research are quite similar to those previously found by Jenness (1980).

TABLE 3. INFLUENCE OF THE LACTATION TIME ON THE SODIUM, POTASSIUM, CALCIUM AND ASHES CONTENTS OF THE MILK FROM BROWN BREED (N = 60) (%)

Lactation time (days)	Sodium (mg)	Potassium (mg)	Calcium (mg)	Ashes (%)
7-40				
X	34	186	102	0.78
SD (±)	7.9	17.7	24	0.04
41-80				
X	38	205	100	0.80
SD (±)	5.7	19	17	0.02
81-120				
X	42	188	112	0.81
SD (±)	3.8	20	13	0.01
121-160				
X	41	203	122	0.81
SD (±)	5.2	27	17	0.02
More than 160				
X	54	194	136	0.81
SD (±)	7.9	20	20	0.02

X = mean, SD = standard deviation.

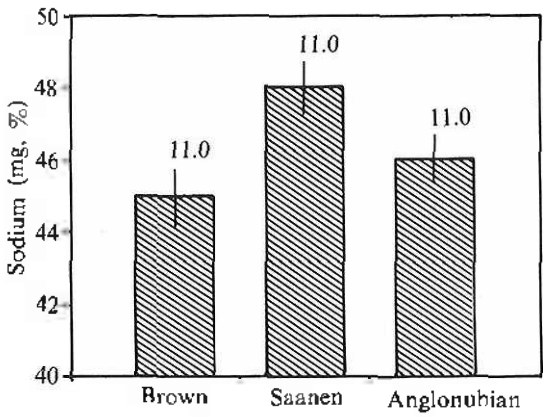

Figure 1. Effect of the breed on the sodium content of goat milk

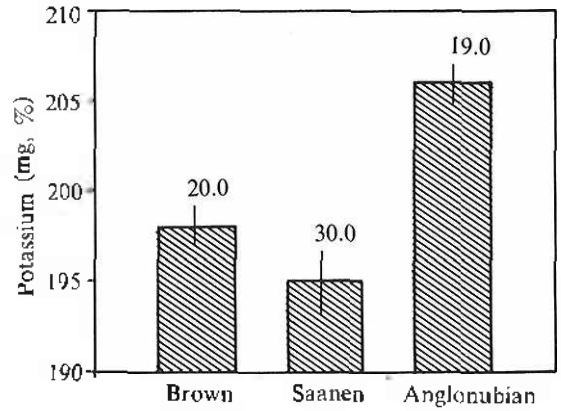

Figure 2. Effect of the breed on the potassium content of goat milk.

Influence of climate upon the amount of minerals

Figures 5-8, show higher percentages for potassium, sodium and calcium, during the wet season ($p < 0.05$). The highest decrease of calcium and sodium was observed from April to June and of potassium from April to August. These results were obtained from 160 samples collected in the wet season and 160 in the dry season (40 samples a month) from five pure origin animals of the Brown breed after 40-160 days of lactation and subjected to the same kind of feeding and handling. Therefore, the best raw material for production of milk by-products, such as cheese, would be the one collected in the summer, i. e., the wet season. Parkash and Jenness (1968), found higher amounts of ashes in the winter, the dry season. This study points out the importance of carrying out studies at regional levels in big countries like Brazil.

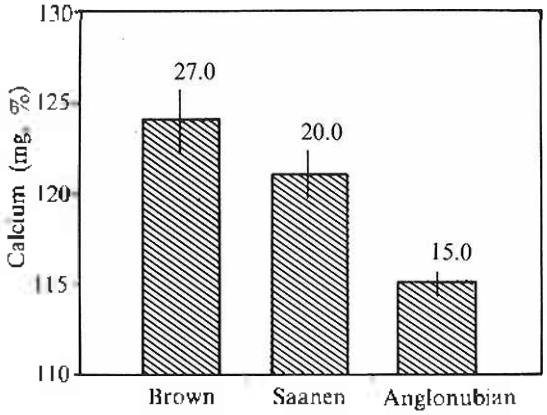

Figure 3. Effect of the breed on the calcium content of goat milk.

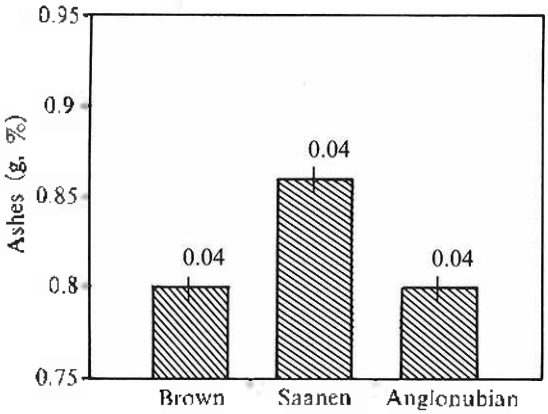

Figure 4. Effect of the breed on the ashes content of goat milk.

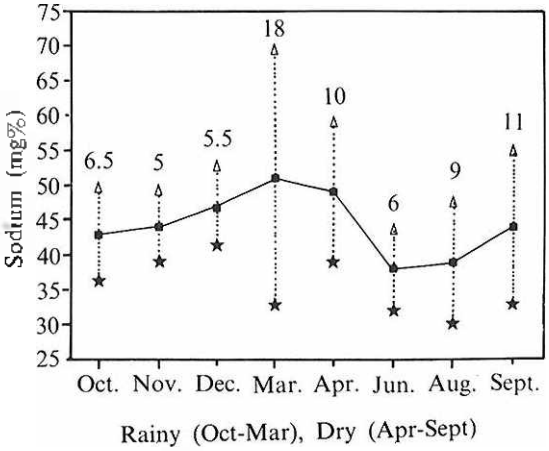

Figure 5. Sodium content of goat milk.

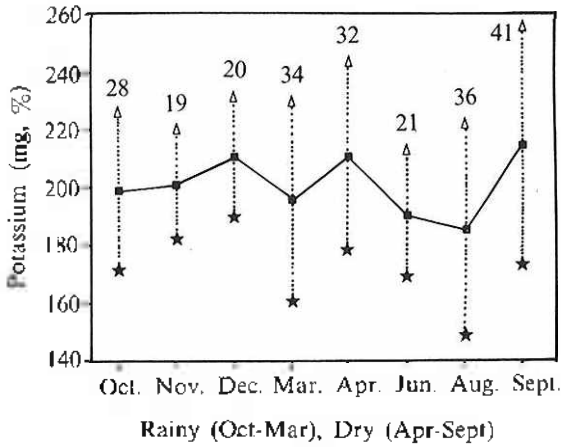

Figure 6. Potassium content of goat milk.

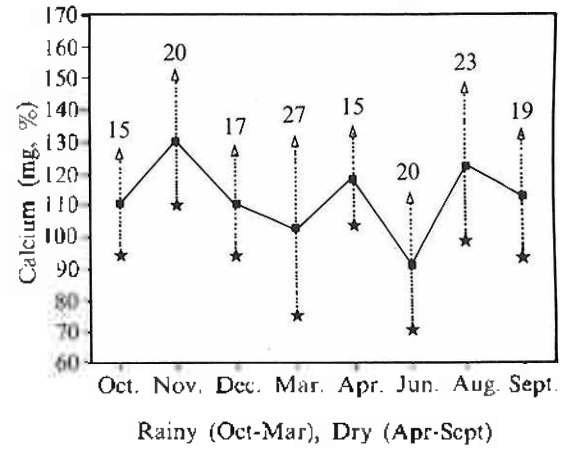

Figure 7. Calcium content of goat milk.

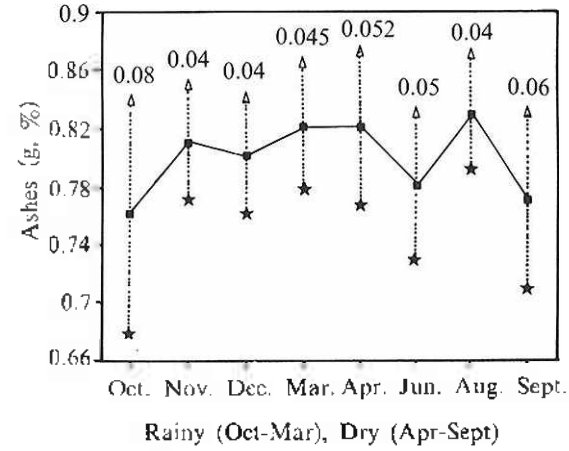

Figure 8. Ashes content of goat milk.

Chloride concentration

It has been observed that milking time has influence upon the quality of milk regarding its chloride contents. Rodrigues, et al. (1983) and Konrad, et al. (1969) relate the amount of Chloride and lactose in milk based on the following formula:

$$\frac{Cl\ \%}{\text{lactose}\ \%} \times 100$$

It is a standard wich represent a standard to the increase of chloride, according to the increase of the pathological process. In this way, one could get the value of 4,9 for ordinary milk. This procedure could also be followed to calculated the corresponding value of chronic and acute mastites in order to tell that the product comes from an animal with chronic mastitis. The physical and chemical characteristics of a certain region are also relevant once the proceeding leading to condemn the milk is based on calculations that establish the limit, existing between the physiological and pathological processes.

Literature Cited

D'Alessandro, W. T., C. A. Tanezini, A. L. Carvalho, M. B. S. Cerqueira, J. M. Rocha, F. M. A. Costa. 1989. Operational avaliation of the eletronic digital Raphinometer to measure the ashes content of cows milk. Cienc. Tecnol. Aliment. Campinas 9:1-106.

Delio, M. 1975. Statistics methods. Loyola Ed. Sao Paulo.

Devendra, C. 1972. The composition of milk of British Alpine and Anglonubian goats imported into Trinidad. J. Dairy Res. 39:381.

Henry, R. J. 1964. Clinical chemistry - Principle and technics. Hoeber Medical division, pp. 403-408.

Islabao, N. 1984. Nutrition of cows milk. Ed. Sagra, 2nd Ed. pp. 69-73.

Jenness, R. 1980. Composition and characteristics of Goat milk. Review J. Dairy Sci. 63(10):1605-1630.

Le Jaquen. 1982. J. The industrialization of goat's milk. Societe de presse et d'edition Ovine et caprine, 3rd Ed. Paris-France.

Mussenden, S. H., J. P. G. Hiley. 1977. Sodium and chloride in cow's drinking water and freezing point of milk. J. Dairy Sci. Champaign, 60:1554-1558.

Parkash, H., R. Jenness. 1968. The composition and characteristics of goat's milk. A review. Dairy Sci. Abstr. 30:67.

Rodrigues, R. S., E. C. Silva, T. J. P. Caetano, J. L. V. Abreu. 1983. Analitical inspection of the milk composition in Belo-Horizonte, Brazil. Arq. Bras. Med. Vet. Zoot. 35(5):731-6.

Sampaio, J. M. C., P. T. M. Cafezeiro, J. V. Assis, L. N. Sanches, T. N. M. Machado. 1984. Milk goats. EMATER-Brasilia-DF.

Konrad, V., L. Slanina, J. Balasek. 1969. Chlorides in cow milk and its importance in diagnosing disturbances of the milk glands. J. Folia Vet. Kosice. 8(1):67-74.