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The influence of lactation stage on the milk constituents of Sahelian goats

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Abstract

Twelve lactating sahelian goats aged between 2 and 3 years and averaging 25kg body weight were selected from the herd at the University of Maiduguri Teaching and Research Farm, for a 19- week lactation study. The does were classified into early, mid, and late lactation stages and maintained daily on 1kg concentrate mixture per animal in addition to grazing on Gamba grass. Milk collected were analysed for total solids (TS), butterfat, protein, solids -not-fat (SNF), Ash and energy. The mean percentage values (M±SE) of colostrum were TS 14. 96 ± 0.41; buterfat 8.58±1.00; protein 5.64±0.31; ash 0.93±0.07; SNF 6.37±0.51; and energy 3.21±0.39 MJ/ kg. The overall mean values for mature milk were 13.18±0.27, 7.52±0.18, 4.81±0.14, 0.76±0.03, 5.66±0.16% and 2.79±0.12 MJ/ KG respectively for TS, fat, protein, ash SNF and energy. There was a gradual decline in the values of all the components of colostrum from day 1- 6 after kidding. Generally, colostrum constituents were higher in concentration than those of mature milk on the 7th day after parturition. The mature milk constituents were significantly affected (P < 0.05) by stage of lactation. These constituents tended to increase with advancing lactation. Milk constituents (especially Fat, protein and SNF), as evident from thus study could be manipulated through feeding.

Key Words: Sahelian goats, lactation stage, milk composition.

Introduction.

In Nigeria, cattle have been the traditional source of milk for human consumption. The indigenous cattle breeds have continued to dominate the traditional livestock subsector despite the fact that their genetic merit for milk production has consistently fallen far short of demand especially in the urban centres. The deficit has been met by importation of milk and milk products over the years.

There is a need to explore other sources of milk if the country is to attain self-sufficiency in dairy production and be able to satisfy the protein needs of a rapidly expanding population. With population of goats estimated at 40 million (F.O S. 1996) The country is better placed to realize significant contribution to the dairy industry from goats. Moreso, there is now a growing awareness of the unique differences between goat and cow milk for human nutrition and health (Parkash and Jenness, 1968; Devendra and Burns, 1970; Nuru, 1990). Goat milk is more easily digested than cow milk due to the fact that the fat is finer and more easily assimilated. In addition, goat milk is particularly rich in antibodies and low in bacterial count especially when freshly drawn (Belanger, 1975). It is partly due to these biomedical values that goat milk is usually prescribed in treatment of many human ailments(French,1970; Haenlein,1981). Goat milk varies in composition at different stages of location and this is of nutritional importance to the young goat. The composition of goat milk in

temperate countries has been extensively investigated and reviewed (Parkash and Jenness,1968; Jenness and Sloan,1970; Jenness,1980; Haelein,1981). With the exception of some studies on the milk production and composition of the Red Sokoto and the West African Dwarf breeds in Nigeria (Malau-Aduli and Anlade, 2001; Malau-Adule *et al*, 2000; James and Osinowo, 2000). It appears that little attention has been given to the evaluation of milk of other breeds.

The present study therefore reports on the chemical composition of the milk from Sahelian goats as influenced by stage of lactation.

Materials And methods

Animals and their management

Twelve Sahelian does, the Borno White variety of between 2 and 3 years old, averaging 25kg weight were selected from the goat unit of the University of Maiduguri Teaching and Research Farm for the lactation studies that lasted for a 19-week period. The animals were confined in individual pens and provided with fresh clean water and salt licks *ad libitum*. They were turned to pasture composed mainly of Gamba (Andropogon gayanus) from 08.00 GMT to 12.00 GMT daily. In addition to grazing, the does received 1kg concentrate mixture per head daily. The proximate compositions of the grazed forage and concentrate are as shown in Table 1.

Table 1 *Ingredients and nutrients compositions of the concentrate and grazed forage.*

Ingredients	percent	
	Concentrate	Gamba Grass
Wheat offal	77.0	
Cotton seed cake	15.5	
Molasses	5.0	
Dicalcium phosphate	1.0	
Salt	1.0	
*Premix	1.0	
Nutrient contents		
Dry matter (DM)	91.9	35.0
Crude protein	14.0	7.5
Crude fibre	18.0	29.5
Ether extract	4.0	1.5
Ash	5.7	6.8
N- free extract	58.3	54.7
Gross energy (MJ/g DM)	16.2	16.6

*To provide the following per kg:
Vit. A, 15000IU; Vit. D3, 1600IU; Vit. E, 11.0mg; Riboflavin, 9.0mg; Biotin, 0.25; Pantothenic acid, 11.0mg; Vit.K3, 3.0.mg; B2, 2.5mg; B6, 0.3mg; B12, 8.0mg; Nicotinic acid, 3.0mg; Fe, 5.0mg; Mn, 10.0mg; Zn 4.5mg; Co, 0.2mg; Se, 0.01mg

The goats were classified according to stage of lactation. Prior to kidding, each gravid doe was immediately confined to the kidding pen and fed gamba hay and after parturition, the kid(s) remained with the dam for a week before joining the herd. Weaning periods varied from 4 to 5 months.

Milk Sampling:

Milk samples were obtained weekly from each doe after kidding except for the first 6 days when daily samples of colostrum were collected. About 10ml of milk or colostrum was obtained from each doe in plastic sample bottles and stored without preservatives in a deep freezer at $-5^{\circ}C$ until required for analysis.

Analytical procedures.
The colostrum and mature milk samples were analysed in triplicates for total solids, protein (N X 6.38), Fat, Solids-Not-Fat, total ash and energy. Total solids was determined by drying 5g sample to constant weight at 105°C for 24 hours. Fat was extracted by the Roese-Gottlieb cold extraction method (Pearson, 1977). Solids-not-fat was determined as the difference between total solids and fat. Crude protein and total ash were determined by the A.O.A.C. (1990) procedures. Milk energy (Y MJ/kg) was estimated using the multiple regression equation (MAFF, 1977);

$Y = 0.386F + 0.0205\ SNF - 0.2336$ where F and SNF are percentage values of fat and solids-not-fat. Statistical evaluations were made using the completely randomized design according to steel and Torrie (1980)

Results and discussion

The results obtained for the gross composition of colostrum from day 1-6 after parturition are summerised in Table 2.

Table 2 *Composition of Colostrum of Sahelian goats*

	Days After Kidding							
Components	1	2	3	4	5	6	Mean	SE
Total solids (%)	19.90	17.30	14.88	14.60	11.79	10.81	14.96	0.41
Fat (%)	12.40	10.70	7.80	7.80	6.20	6.60	8.58	1.00
Protein (NX6.38) (%)	6.30	6.09	6.08	6.02	4.98	4.39	5.64	0.31
Solid-not-fat (%)	7.50	7.11	7.05	6.80	5.58	4.20	6.37	0.51
Ash (%)	1.20	1.00	0.98	0.80	0.79	0.80	0.93	0.07
Energy (MJ/kg)	4.70	4.04	2.93	2.91	2.28	2.40	3.21	0.39

The mean values of total solids (TS), Fat, Protein, solids-not-fat (SNF), ash and energy were 14.96+0.41, 8.58+1.00, 5.64+0.31, 6.37+0.51, 0.93+0.07 and 3.21+0.39 MJ/kg respectively. There was a gradual decline in the percentage values of these constituents of colostrum from the first to the sixth day after kidding. The composition of colostrum approached that of mature milk on the seventh day of kidding. Several workers have reported similar trend in the composition of colostrum of goat(Mba *et al*; 1975; Akinsoyinu and Akinyele, (1979), cows (Rock, 1976; Akinsoyinu, 1981) and other species (Jenness and sloan, 1970).
The composition of mature milk with advancing lactation is presented in Table 3.

Table 3: *Components of mature milk of sahelian goats at different stages of lactation.*

LACTATION STAGE	WEEKS	TS	Components (%) FAT	Protein	Ash	SNF	Energy (MJ/Kg)
	2	10.71	5.71	4.43	0.60	5.00	2.07
EARLY	3	11.72	6.83	4.30	0.58	4.89	2.50
	4	11.24	6.40	4.26	0.56	4.84	2.33
	5	12.97	7.03	4.27	0.69	4.94	2.58
	6	11.29	7.47	5.10	0.70	5.80	2.75
	7	13.30	7.40	5.10	0.77	5.90	2.74
Mean		11.87[a]	6.81[a]	4.41[a]	0.65[a]	5.07[a]	2.49[a]
SE		0.36	0.23	0.41	0.03	0.17	2.11
	8	12.51	7.47	4.31	0.71	5.84	2.77
MID	9	12.80	7.38	4.72	0.70	5.42	2.73
	10	13.53	8.67	4.10	0.68	4.86	3.21
	11	13.74	8.44	4.48	0.80	5.30	3.13
	12	14.53	8.61	5.10	0.99	5.92	3.21
	13	14.26	8.51	4.97	0.80	5.77	3.16
Mean		13.56[b]	8.18[b]	4.61[a]	0.76[b]	3.32[b]	3.04[c]
SE		0.32	0.24	0.16	0.02	0.17	0.09
	14	13.60	7.33	5.45	0.80	6.27	2.72
LATE	15	13.66	7.14	5.72	0.80	6.52	2.66
	16	13.83	7.65	5.36	0.84	6.18	2.84
	17	14.37	8.08	5.36	0.94	6.29	3.01
	18	14.67	7.83	5.94	0.89	6.84	2.92
	19	15.50	7.37	6.14	0.98	7.13	2.75
Mean		14.303[b]	7.61[c]	5.56[b]	0.85[c]	6.42[b]	2.83[ab]
SE		0.19	0.14	0.14	0.03	0.16	0.05
Overall Mean		13.18	7.52	4.81	0.76	5.66	2.79
SE		0.27	0.18	0.41	0.03	0.16	0.12

*TS = Total solids; SNF = Solids-not-fat

[abc] Means in a column with different superscripts differ significantly($P<0.05$).

The mean total solids (TS) showed consistent increase from early (11.87%) to late (14.03%) lactation. The mean value for mid-lactation was 13.56%. The differences in the lactation periods were significant ($p<0.05$). The total solids increased linearly from 12.51 to 14.53 percent in weeks 8 to 12 respectively, declining to 13.83 percent in week 16 before increasing again to 15.50 percent in the last week of lactation. The overall mean value (13.18±0.27%) is less than the values reported for the West African Dwarf (18.30%) and Red Sokoto (15.85%) goat milk (Mba *et al*, 1975). The present TS value is however, much higher than the values of 10.60% reported for saanen (Pilla et al., 1980) and 12.8% reported for saanen and Alphine goat milk (Varma and Chawla, 1984).

The mean butterfat content (%) of milk were 6.81±0.23 in early, 8.18±0.24 in mid and 7.61±0.14% in late lactation with an overall mean value of 7.52±0.18%. In an earlier study Mba et al (1975) recorded comparable values of

6.70, 7.78 and 7.26 butterfat in early, mid and late lactation, respectively in the West African Dwarf goat milk. The butterfat concentration in these two studies exhibited similar trend: rapid increase from early to mid-lactation and slight decline in late lactation. This observation is, however, at variance with the results of Flamant and Morand-Fehr (1982) which showed that butterfat was highest in early lactation, decreased quickly and increased again in late lactation. The differences could probably be due to breed effect, physiological condition of the animal, feed composition, methods and efficiency of chemical analysis. High concentrate low roughage diets have been reported to depress the butterfat level of milk (Kay, 1966; storry, 1970; Rook, 1976).

The present SNF values (Table 3) followed similar trend as those of total solids. The SNF content increased with advancing lactation attaining peak (7.13%) in the 19th week. However, the overall mean value (5.66+0.16%) is lesser than those reported in the literature (Mba *et al*, 1975; Quresh *et al*., 1981; Varma and Chawla, 1984; Boros *et al*., 1985). Breed differences in the SNF content of goat milk have been confirmed (Parkash and Jenness, 1968). Protein concentration in milk constitutes the main differences in SNF content. The mean milk protein content (Table 3) in early, mid and late lactation were 4.41±0.14, 4.61±0.16 and 5.56±14%, respectively. The overall mean value (4.81±0.15%) is comparable to the reported values of 4.60% for Red Sokoto and 4.71% for the West African Dwarf goat milk (Mba et al., 1975). The value is however, higher than those reported for goats elsewhere (Pilla *et al*., 1980; Quresh *et al*., 1981; Boros et al; 1985). The ash percentage representing the mineral content of the milk followed similar pattern as the TS throughout the lactation. Ash content was significantly influenced by lactation period. Total mineral content of milk attained maximum in late lactation which is contrary to the finding of Polychroniadou and Vafopoulou (1985) who reported maximum ash content in mid lactation among Greek sheep breeds. The overall ash value (0.76+ 0.03%) is comparable to those (0.72 and 0.77%) reported for Russian goats and sheep, respectively (Boros *et al*; 1975) and 0.78% for Indian goats (Quresh *et al*; 1981) The energy values (Table 3) were affected by stage of lactation, increasing significantly ($P<0.05$) in mid lactation before declining in late lactation. The mean values for early and late lactation were similar ($p>0.05$). The correlation coefficients(r) between fat and protein ($r = 0.158$), fat and energy ($r = 0.998$), SNF and protein ($r = 0.959$) and SNF and energy ($r = 0.279$) were computed. The correlations between fat and energy as well as SNF and protein were positive and significant ($P<0.01$). Highly significant correlation between fat and energy in the milk of the west African Dwarf goat and the Red Sokoto goat has been reported (Mba *et al*., 1975).

Conclusion

In conclusion, the data suggests that the milk of sahelian goats have constituents comparable to those of their counter parts elsewhere in Nigeria and other countries. The constituents of colostrum tended to decline progressively from the 1st to the 6th day after kidding and approached values of mature milk on the 7th day. Mature milk constituents were significantly influenced by stage of lactation.

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