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COMPARATIVE EVALUATION OF THE CONSTITUENTS OF COLOSTRUM AND MILK OF THE WEST AFRICAN DWARF SHEEP AND GOAT REARED IN A HUMID TROPICAL ENVIRONMENT

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ABSTRACT
The colostrum and milk constituents of thirty small ruminants made up of fifteen each of the West African Dwarf (WAD) does and ewes were evaluated and compared in a 13-week study. The animals, which were grouped per stage of lactation, were maintained at the livestock unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike. Lactation length was 135 days. The animals grazed on improved pastures in addition to receiving 18.4% CP concentrate supplement formulated from maize, maize offals, soya cake and bone meal. The colostrums and milk samples were obtained weekly by hand and analyzed for total solids (TS), butterfat (BF), crude protein (CP), solids-not-fat (SNF), lactose, total ash (TA) and gross energy (GE).

Results indicated that days of lactation significantly ($P<0.05$) influenced the constituents of colostrums in both species with the exception of ash and lactose and, also SNF in goat. Between species, BF, CP and SNF contents of colostrums differed significantly ($P<0.05$). The relationship between BF and TS, CP and TS, and energy and TS in colostrums of both species were positive and significant ($P<0.01$). The values were r = 099, 0.99; 0.95, 0.83; and 0.94, 0.97 for sheep and goat respectively. Lactose and TS were significnat but negatively correlated in the colostrums of sheep ($P<0.05$), r = -0.63) and goat ($P<0.001$, r = -0.89). Significant and non-significant negative correlation's existed beween lactose and SNF contents of colostrums insheep ($P<00.01$, r = -0.87, and goat ($P<0.05$, r = -0.19) respectively.

Lactose stage did not influence ($P>0.05$) constituents in goat milk. In sheep milk however, TS were higher inmide and late lactation stages ($P<0.05$) than in the early stage. Beween species also, TS, BF and GE constituents of milk also differed ($P<0.05$). Highly significant ($P<0.001$) positive correlations existed between BF and TS (r = 0.81), energy and TS (r = 0.82), and energy and BF (r = 0.99) in goat milk. In sheep milk, the relationship between BF and TF, energy and TS and CP and SNF, were also positive (r = 0.93, 0.99, 0.92, 0.74) and highly significant ($P<0.0001$).

INTRODUCTION

Nigerian is essentially an agrarian society. Over 70% of its population is engaged in agriculture (Ukeje, 1998). Before now, agriculture used to be the bedrock of her economy, providing about 50% of the Gross National Product (Williams, 1978). Despite her major involvement in agriculture, Nigeria's teething problem has been with the feeding of her population estimated at over 100 million (FAO, 1990). A greater percentage of the populace are indigent and so can hardly afford quality nutrition that is available through consumption of meat, milk and milk products which provide anaimal proteins of high biological value. For instance, the British Medical Association (1950) recommended an average protein intake of 85.9 grams per day, out of which 51.9 grams and 34 grams must come from plant and animal sources respectively. Those figures are rarely obtainable in a tropcial Nigerian situation. FAO (1987) reported that an average Nigerian consumed 54 grams per day, 6.8 grams of which came from animal sources.

Milk and Milk products are essentially direct and indirect products derived from raising small and large ruminant animals.

The advantages of small ruminant production relative to large ruminant lies with their high prolificacy, short gestation period, and short generation interval and handling among other. This makes them preferable for rapid multiplication. The milk production potentials of the indigenous sheep and goat breeds in Nigeria are still under investigation. In fact, it is perceived among dairy scientists/milk producers (Walshe, *et al*, 1991) that the Nigerian sheep and goat breeds are poor milkers, yet these animals do not only suckle, but also wean their offspring successfully.

Colostrum is the first set of milk secretion from mammals 3 4 days post partum (Payne, 1990). It differs from the normal milk in contents.

It is naturally fortified with antibodies, which help to protect the young against disease and infection. Normal milk, which comes after colostrum, is also highly nutritive and helps to nourish the young. The post-natal life of an offspring would depend on the quantity and quality of colostrums and normal milk produced by the dam. The quantity and quality of colostrum and milk produced by the dam would in turn depend on the breed of animals, stage of lactation, nutritionof animal, species of animal and environmental factor. This study was therefore conducted to copare the constituents of colostrums and milk of WAD sheep and goats, maintained in a hot-humid environment.

MATERIALS AND METHODS

Location of Study

The study was carried out at the livestock unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State of Nigeria. Umudike is located on 5°28 North and 7°31, East and lies at an latitude of 122m above sea level. It is situated in the tropical rainforest zone, which is characterized by an annual rainfall of about 2177mm. The relative humidity ranges from 50 to 95% Average monthly ambient temperature is 26°C with maximum and minimum of 32°C and 22°C respectively.

Livestock and their Management

Thirty lactating animals. (fifteen each of West African Dwarf (WAD) does and ewes) were used in this study. The animal were selected from among the flock reared in the University farm. They were fed daily with a sword of cut-and carry forages consisting mainly of *Panicum maximum* and other (*Stylosanthes gracilis, Asphilia africana, Tridax procumbens, Pennisetum pedicelatum, Centrosema puberscens, Calapogonium muconoides*). The animals were fed the cut forage at 0900 hours each morning using 3% body weight as baseline. Supplementary concentrate ration (18.4% CP. (Table 1) was also provided at the rate of 1 kig per lactating doe or ewe per day. Clean fresh water was also provided *ad litum* daily. They were also sprayed monthly against ectoparasites using piperazine, dewormed regularly with fenbenzole and vaccinated against major livestock diseases prevalent in the locality including *trypanosomiasis and pest des petit ruminants.*

Milk Sampling

A total of five WAD does or ewes were sampled at each stage of lactation (early, mid and late). Samples of colostrum were collected for six consecutive days from animals immediately after parturition. Thereafter milk samples were collected weekly. Samples were obtained by hand milking at 0800 hours on each sampling day, shortly before morning feeding. Four (4) milk samples were drawn per animal per stage of lactation. Lactation periods were based on 135 days for the does/ewes. Samples for early lacation in each species were drawn after the period of colostrum collection, that is, 6 days post-partum. The remaining lactation period for both species was equally delineated into three stages corresponding to 43 days per stage of lactation. Milk samples were bulked for each animal per stage of lactation. Fresh samples of colostruma nd milk were analysed for lactose concentration before storage in deep freezer (-5°C). Frozen colostrums and milk samples were allowed to thaw a room temperature before further analysis.

Analytical Procedure

The colostrums and milk samples were analysed for lactose, total solids, butterfat, crude protein N x 6.38), solids-not-fat, total ash and gross energy. Total solids were determined by dryng about 5g to a constant weight at 105°C for 24 hours. Lactose was estimed from fresh samples by the Marrier and Boult (1959) procedure. Butterfat was obtained by the Roese Gotlieb methods (AOAC, 1980). Milk protein N X 6.38) was determined by the semi-micro distillation method using Kjeldahl and Markhams apparatus.

Solids-not-fat was determined as the difference between total solids and butterfat, Milk energy, Y (MJ/kg), was computed usign the multiple regression equation,

$$Y = 0.386F + 0.205\,SNF - 0.236$$

(MAFF, 1975)

Where F and SNF represent percentages of fat and solids-not-fat respectively,

Proximate composition (Dry matter, crude protein, crude fibre, either extract, nitrogen-free-extract and ash) of the forage and concentrate diet were determined using AOAC)(1980) procedures.

Statistical Analysis

Data obtained in this study were subjected to analysis of variance appropriae for a completely Randomized Design (Steel and Torie, 1980). Correlation coefficients were calaculated between the various parameters obtained in both sheep and goat milk samples. Significant means were separated using Duncan's Multiple Range Test (Duncan, 1955)

Table 1: Ingredients and nutrients compositionof the concentrate and forage grazed

Ingredients	Percent	
	Concentrate	Forage grazed*
Maize	20.00	
Maize offals	40.00	
PKC	19.00	
Soya Cake	20.00	
Bone meal	0.75	
Common salt	0.25	
Nutrient composition (DM Basis)		
Dry matter (%)	92.10	82.00
Crude protein (%)	18.40	6.78
Crude fibre (%)	9.68	24.50
Ether Extract (%)	11.46	4.57
Nitrogen free extract (%)	47.68	40.00
Ash (%)	4.88	6.15
Gross energy (Mj/kg)	20.33	18.24

Mainly *Panicum maximum*

RESULT AND DISCUSSION

Colostrum

The mean constituents of sheep and goat colostrums are presented in Table 3. the butterfat, Crude protein and SNF values differed significantly (P<0.05) in the two species. Crude protein and SNF were superior in goat colostrums while BF was better in sheep colostrums. Also, in relation to normal milk Table 6, colostrums constituent in both species were appreciably higher in BF, CP and Ash, while being considerably lower on lactose and SNF. The TS of sheep colostrums was lower in concentration than the TS of normall milk. The composition of colostrums in the two ruminant species however approached normall milk values on days 6 (Table 2) following parturition. This observation is in agreement with the findings of Mba et al. (1997). Similar observation have also been reported by Akinsoyinu (1981) for catle in Nigeria and for temperature cattle (Rook, 1961). Colostrum components particularly TS, BF, SNF and CP significantly (P<0.05) devreased from day 1 to day 6 in both species (Table 2). Lactose, however, did not show any consistent trend.

The relationship between some colostrums of WAD sheep and WAD goat are summarized in Table 4.

The correlation between BF and Ts, CP and TS, and energy and TS were positively and high significant (P<0.001) in both species. The values were r = 0.99, 0.99; 0.83, 0.95; and 0.97, 0.94 for goat and sheep respectively. Energy and BF and CP and TS, wer also positively correlated inboth species. Lactose and TS and significant negative correlationin sheep (r = 0.89) and goat (=0.63, the significance level was however higher in sheep (P<0.0001) than ingoat (P<0.05). Lactose and SNF were also negatively correlated insheep (r = -0.19) and goat r = -0.87) in a significant (P<0.01) and non-significant (P>0.05) pattern respectively.

Milk.

The gross composition of milk of WAD sheep and goat at different stages of lactationis presented in Table 5. In sheep milk, TS average 15.30$\pm$0.86, 15.96$\pm$0.66 and 16.10$\pm$1.00 percent in early, mid and late lactations inthat order. The TS increased significantly (P<0.05) with advancing lactation post colosrum period. Ahamefule *et al* (2000) observed similar trend in the milk of WAD sheep, even though the diffeences were no significant (P>0.05).

Table2: Compositionof Sheep and Goat colostrums as affected by days after parturition

	Days after parturition						
Species Constituents	1	2	3	4	5	6	Mean+SD
SheepTS(%)	19.18^{a}	17.55^{b}	17.44^{b}	15.31^{c}	14.23^{c}	14.20^{c}	15.32+2.35
BF (%)	10.41^{a}	9.33^{ab}	9.28^{ab}	8.51^{c}	7.10^{c}	7.00^{c}	8.6+10.70
CP (%)	6.52^{a}	6.05^{b}	5.75^{b}	4.73^{c}	4.63^{c}	4.30^{c}	5.32 +0.76
SNF (%)	8.77^{a}	8.22^{ab}	8.16^{b}	6.80^{c}	7.13^{c}	7.20^{c}	7.71+0.49
Lactose (%)	1.15^{c}	1.17	1.14	1.46	1.53	1.68	1.40+0.25
Ash (%)	1.07	1.00	1.00	1.04	1.02	0.93	1.01+ 0.10
Energy (Mj/kg	3.96^{a}	3.54^{a}	3.51^{a}	3.18^{b}	2.65^{c}	2.61^{c}	3.24+ 0.64
GoatTS(%)	19.56^{a}	18.30^{a}	17.50^{ab}	16.47^{bc}	14.79^{cd}	13.68^{cd}	16.72+2.25
BF (%)	10.89^{a}	9.36^{a}	8.64^{bc}	7.06b^{cd}	6.43^{cd}	6.17^{d}	8.09+1.74
CP (%)	6.43^{a}	6.791^{a}	6.28^{a}	5.81^{b}	5.00^{b}	4.90^{c}	6.00 +0.86
SNF (%)	8.67	8.94	8.86	8.41	8.35	7.51	1.46+0.86
Lactose (%)	109	1.14	1.43	1.54	1.65	1.68	1.42+0.25
Ash (%)	1.12	1.10	1.03	1.04	0.99	0.93	1.04+ 0.27
Energy (Mj/kg	4.14^{a}	3.56^{a}	2.67^{c}	2.67^{c}	2.42^{c}	2.30^{c}	3.06+ 0.91

^{abcd} Means on the same row with different superscripts are significantly (P<0.05) different

TS = Total Solid, BF = Butterfat, CP = Crude protein, SNF = Solids-not-fat.

Table 3: Means of WAD Sheep and Goat Colostrum (Mean + SD)

Constituent	WAD Sheep	WAD Goat	Significant
TS(%)	15.32+2.35	16.72+2.25	ns
BF (%)	8.6+10.70	8.09+1.74	*
CP (%)	5.32 +0.76	6.00 +0.86	*
SNF (%)	7.71+0.49	1.46+0.86	*
Lactose (%)	1.40+0.25	1.42+0.25	ns
Ash (%)	1.01+ 0.10	1.04+ 0.27	ns
Energy (Mj/kg	3.24+ 0.64	3.06+ 0.91	ns

Ns = Not significant (P<0.05) SD = Standard deviation * = Significant (P<0.05)

Table 4:Correlation coefficients between colostrums constituents in WAD and Sheep and Goat

	Correlation Coefficient (r)	
Parameters	WAD Sheep	WAD Goat
BF&TS	0.99***	0.99***
CP&TS	0.95***	0.83***
Enger & TS	0.94***	0.97**
Lactose & TS	-0.63*	-0.89***
Enger & BF	0.68*	0.99***
CP & TS	0.91***	0.65*
Lactose & SNF	-0.87**	-0.19ns

* = Significant (P<0.05) ** = Highly Significant (P<0.01)

*** = Very highly significant (P<0.001) ns = Not significant (P>0.05)

In goat milk TS was slightly higher (P>0.05) in mid 14.98±0.66 than in early (14.90±1.04) or late 14.97±1.16 lactation. This observation is at variance with the report of Mba *et al* (1975) which showed higher TS concentration in early than in late lactation in goats. There was slight increase (P>0.05) in CP content of milk in both species with advancing lactation. The values were 4.07±0.44, 4.13±0.70, 4.18±0.44% for early, mid and late lactationsin the order in sheep. The corresponding values in goat milk were 4.26±0.34, 4.31±0.66 and 4.63±0.28%. Ahamefule *et al* (2000) have made similar observations. Meanwhile, the average CP values obtained for goat milk in this study (4.4±0.28) (Table 5) contrasts with the value (3.91%) reported by Mba *et al* (1975) for WAD goats. The disparity in values mayb e due to nutritional and climatic difference which may have influence milk constituents. Butterfat increased slightly (P>0.05) in sheep milk as lactation advanced. However, in goat milk, it increase with advancing lactation but declined in late lactation stage. In both species, the gross energy values of milk followed similar trend as BF. The values of SNF in sheep milk also increases as lactation progressed, it however declined in mid lactation before rising in late lactation in goat milk (Table 5)

Lactose concentration in milk did not show any pattern, declining from early (4.83±0.36%) to mid (4.72±0.36%) and rising again in the late (4.84±0.14%) lactation in sheep milk, while increasing from early (4.42±0.28%) to mid (4.61±0.60% and subsequently, declining in late (4.61±0.60%) lactation in goat milk.

The ash content of milk of both ruminant species declined genrally as lactation advanced. In this study, stage of lactation, had no significant effect)P>0.05) on the concentration of BF, GE, SNF, and ash in the milks of sheep and goat. This observation was corroborated by Ahamefule *et al*. (2002).

The mean milk constituents of sheep and goat are compared in Table 6. The TA of sheep milk (15.79±0.87%) was significantly higher (P<0.05) than the value for goat milk (14.95±0.90%). Agbede *at el*. (1997) observed a higher TS value in WAD goat milk than in WAD sheep milk. The observation of Ahamefule *et al*. (2000) however supports the present result. The BF content of sheep milk (5.97±14%) was superior (P<0.05) to the value for goat milk (5.11±0.80%). The present BF value is lower than the value *6.90%) reported by Akinsoyinu *et al* (1977) for same breed but compares favourable with the figure reported sheep milk had a high mean value (4.80±0.35%) of lactose that goat milk (4.57±0.35%).

These values were however not significantly different (P>0.05). Previous evidence (Jenness, 1980) indicates that the lactose content of sheep milk is higher than that of goat or cow milk. Goat milk is slightly higher (P>0.05) in percent total ash (0.95±0.14). this result is in line with what was reported earlier (Akinsoyinu, 1981; Bath *et al*; 1978; Henness 1980) but in contrast with the findings of Williams *et ai*. (1976) who reported higher total ash in sheep milk than in goat milk. The mean energy value of sheep milk was higher (P<0.05) than that of goat milk. A similar observation was reported by Mathewman (1995). The relationship between some constituents of WAD sheep and goat milks are summarised in Table 7.

Very highly positive and significant correlations existed between BF and TS (r = 0.81; P<0.001) and between BF and Energy (r = 0.99; (P<0.001) in goat milk, while CP and TS; Lactose and TS; CP and SNF, and Lactose and SNF had non-significant (P>0.05) positive correlations (r = 0.60; 0.14; 0.26; 0.55)

In sheep milk, highly significant (P<0.001) positive correlations existed between BF and TS (r = 0.92), Energy and TS (r = 0.92), Energy and BF (r = 0.99), while negative and non-significnat (P>0.05). Correlations existed between CP and TS (r = -0.30), and Lactose and TS (r = -0.14).

Positive and non-significant (P>0.05) relationship existed between Lactose and SNF (r = 0.04). Rai (198) reported that a decrease in lactose content of milk is associated with an increase in its TS content especially the protein.which explains the negative relationship between TS and lactose in the milks of both sheep and goat.

Table 5: Gross composition of sheep and goat milk at different stages of lactation(*)

Species	Constituents(%)	Lactation state		
		Early Day 6-49	Mid 49-92	Late 92-135
Sheep	TS	15.30± 0.86[b]	15.96 ±0.66[a]	16.10 ±1.00[a]
	BF	5.61 ±1.32	6.13 ±1.10	6.17 ±1.24
	CP	4.07± 0.44	4.13 ±0.70	4.18 ±0.44
	SNF	9.69± 0.48	9.83 ±0.86	9.93 ±0.58
	Lactose	4.83± 0.36	4.72 ±0.36	4.84 ±0.46
	Ash	1.02± 0.04	0.95 ±0.06	0.92 ±0.26
	Energy(Mj/kg	2.13± 0.05	2.15 ±0.52	2.31±0.42
Goat	TS	14.90 ±1.04	14.98 ±0.66	14.97 ±1.16
	BF	5.16 ±0.78	5.25 ±0.54	4.91 ±1.10
	CP	4.26 ±0.34	4.31 ±0.66	4.63 ±0.28
	SNF	9.75 ±0.32	9.73 ±0.48	10.07 ±0.28
	Lactose	4.42 ±0.28	4.64 ±0.14	4.61 ±0.60
	Ash	1.09 ±0.28	1.00 ±0.06	0.97 ±0.08
	Energy(Mj/kg	1.96 ±0.30	1.98 ±0.20	1.87 ±0.89

ab Means with unlik superscript on the same row differ significantly (P<0.05)

* Means ± SD

Ahamefule *et al.* (2002). Reported elsewhere (Payne, 1990; Henness, 1980) also showed that the BF of Sheep milk was superior to that of goat or cow milk. Mean CP values for sheep and goat milks were similar (P>0.05) This observation agrees with previous report (Ahamefule *et al.* 2000; Mba *et al.* 1975; Bath *et al.* 1978). The difference between the SNF content of sheep milk (9.82±0.48%) is small and the values are statistically similar (P>0.05).

Table 6: Average milk composition of WAD sheep and goat (Means ± SD

Constituent	WAD Sheep	WAD Goat	Significance
TS(%)	15.79± 0.87	14.95 ±0.90	*
BF (%)	5.97 ±1.14	5.11 ±0.80	*
CP (%)	4/13 ±0.38	4.30 ±0.28	ns
SNF (%)	9.82 ±0.48	9.84 ±0.42	ns
Lactose (%)	0.91 ±0.14	0.95 ±0.21	ns
Ash (%)	4.80 ±0.35	4.57 ±0.35	*
Energy (Mj/kg	2.27 ±0.42	1.94 ±0.31	

Table 7: Correlation coefficients between Milk constituents in WAD and Sheep and Goat

Parameters	Correlation coefficient(r)	
	WAD Sheep	WAD Goat
BF&TS	0.92***	0.81**
CP&TS	-0.30ns	0.61ns
Enger & TS	0.92***	0.82***
Lactose & TS	-0.14ns	-0.14ns
Enger & BF	0.99*	0.99***
CP & TS	0.74**	0.26ns
Lactose & SNF	-0.41ns	0.55ns

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