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Comparative Evaluation of Milk Yield and Compositions of West African Dwarf Goats Raised in the Village and University Environment

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Abstract: A total of 6 lactating does of the West African Dwarf (WAD) breed, in their first lactation stage and parity, were understudied in Michael Okpara University of Agriculture farm and in the village around the university campus for a period of 60 days.Total 3 animals in the university farm were fed cut-and-carry forages consisting mainly of Guinea grass (*Panicum maximum*) while the 3 in the village grazed available forages and house wastes. The two groups of lactating does were supplemented daily with a concentrate formulation of 14.3% CP. The animals were hand milked daily from 6-8 am and yield determined for each group. Samples of milk were analysed for Total Solids (TS), Butterfat (BF), Crude Protein (CP), Solids-Not-Fat (SNF), lactose, total ash and Gross Energy (GE). Milk productions of both groups were also corrected for fat (FCM). The results showed that goats kept in the university farm were higher in yield and milk constituents than does raised in the village except for lactose, SNF, protein and ash contents. Milk yield and FCM values for the university and village does were 122.0 ± 0.08; 137.4 ± 14.51 and 102.0 ± 0.03; 103.3 ± 18.80 g, respectively; the differences between the two means were highly significant ($p<0.001$). The butterfat (4.84 ± 0.80; $3.76 \pm 0.38\%$) and the energy contents (1.84 ± 0.35; 1.41 ± 0.41 MJ kg^{-1}) of both milks were also significantly different ($p<0.001$). The university does had higher butterfat and energy contents. The protein and lactose values, though similar ($p>0.05$) for both groups, were also 4.25 ± 0.32; 4.57 ± 0.34 and 4.37 ± 0.50; $4.34 \pm 0.50\%$ for the university and village does, respectively. High positive and significant correlation existed between BF and TS ($r = 0.82$; $p<0.001$); energy and BF ($r = 0.84$; $p<0.001$); and energy and TS ($r = 0.99$; $p<0.001$) in the university animals. In the village does, the relationship between energy and butterfat was also positive and highly significant ($r = 0.99$; $p<0.001$) but positive and non-significant between CP and TS ($r = 0.01$; $p>0.05$) and between lactose and TS ($r = 0.38$; $p>0.05$). Differences between the various milk constituents of the two groups of animals were minimal.

Key words: Comapritive, evaluation, milk yield, composition, dwarf goat, village and university environment

INTRODUCTION

Goat production plays an important role in the livelihood of rural populations in Nigeria. It contributes significantly to improved family nutrition and health and the sale of animals and their products helps stabilize household income. Goat husbandry is considered a form of security and source of independent income especially for rural households and subsistent farmers. The inescapable trends of increased urbanization, higher income and the ever increasing population have generated the greater demand for animal products (Bongaarts and Bruce, 1998; Delgado *et al*., 1999). Increased productivity from livestock is therefore, necessary to meet the increased demand for animal products, to alleviate poverty and to improve the livelihood of resource-poor farms (Garrett, 2000).

In Nigeria, the West African Dwarf goat (WAD), an indigenous small ruminant breed is kept principally for meat. Evidence of her milk production potential is also well documented (Nuru, 1985; Steele, 1996; Mason, 1996). Nutrition is one of the major constraints to WAD goat production. Results obtained for the breed on range (Olaloku, 1985) showed that remarkable improvement can be achieved under favorable or improved conditions of feeding and management (Nuru, 1985). The subsistent farmers who keep these animals in Nigeria raise them on range (Chidebelu and Ndjon, 1998). Owing to this, the animals are exposed to severe nutritional stress, especially during the dry months when fodder quantity and quality is low (Agishi, 1985). This affects production in this breed.

The dairy potential of WAD goat is presently unexploited. Any targeted approach to the improvement of WAD goat for milk production must first address the

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issue of nutrition. While genetic improvement of the breed's dairy profile would entail a protracted and systematic breeding effort to maximize inherent potentials, standardized nutrition would however, be required presently to realize the full dairy potential of the WAD goat. There is therefore need to supplement the nutrition of lactating WAD does with concentrate formulations to maximize milk yield and composition (Ahamefule and Ibeawuchi, 2005).

Efforts were made in this study to supplement the diets of lactating WAD does, raised under two different management systems and environment, with concentrate formulations. The aim is to compare the yield and composition of milk of WAD goats reared intensively in the university farm with those reared extensively in the village environment.

MATERIALS AND METHODS

Environment of study: This study was conducted at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike. Umudike is geographically located in Abia state on latitude 05°29° north, longitude 33° east at altitude of 122 meters or 400 feet above sea level. It falls within the humid rain forest zone of West Africa, which is characterized by long duration of rainfall (April-October) and short period of dry season (November-March). Average rainfall is 2169.8mm in 148-155 rain days. Average temperature is 26°C with maximum of 32°C and minimum of 22°C. Relative humidity ranges from 50-95%.

Animals and management: A total of 6 lactating WAD does in their first lactation stage and parity were used in this study. Three of the does were randomly drawn from a group of animals raised at the Sheep and Goat unit of the Michael Okpara University of Agriculture Teaching and Research farm, Umudike. These animals were managed intensively-being fed cut-and-carry forages consisting mainly of *Panicum maximum* and others (*Centrosema pubescens*, *Emilia sanchifolia*, *Tridax procumbens*, *Urenia lobata* etc). They were also fed a supplement concentrate ration of 14.3% CP formulated from maize, groundnut cake, palm kernel cake, bone meal and common salt, at the rate of 1 kg per doe per day. Drinking water was also provided liberally. The contents and proximate compositions of the diets are given in Table 1.

Another set of 3 lactating does were also randomly selected from a band of goats in a local farm within the university environ. The animals' grazed natural pasture made up of grasses, leguminous and non-leguminous browse plants. In addition, the animals were each given 1 kg of concentrate supplement (Table 1) daily after grazing. The concentrate-feeding regimen lasted for 8 weeks; it was initiated on the last week of pregnancy and terminated after the 7th week of lactation.

Kid management: At birth, each kid had its umbilical cord cleansed with disinfectant and cut at a distance of about 2 cm away from the naval flap and a tincture of iodine added to aid healing and prevent entry of pathogens. Kid weights were recorded immediately after parturition using a 5 kg capacity sensitive top loading 'Salter' scale. The dates of kidding, parity and litter sizes and compositions for does were recorded. Thereafter, newborn kids were left to suckle their dams freely for the first 7days. Prior to each day's milking, kids were separated from their dams at 1800 h on the evening preceding the day of milking. Within this period of separation, kids were fed milk with the aid of feeding bottle. Dams were allowed to nurse their kids in the morning after milking and in the afternoon before separation at 1800 h daily.

Milk measurements: During milking, the two halves of the udder of lactating does were hand milked daily from 0600-0800 h. The quantity of milk harvested from a doe was measured using graduated glass cylinder (500 mL capacity) and weighed back to the nearest gram on a sensitive laboratory scale. The total amount of milk yielded per day was recorded as the morning daily yield of the doe. The daily milk yield was then estimated for each doe on the assumption that actual daily production of does can be met if the animals were milked twice a day. Thereafter, based on the concept of fixed milk yield responses to changing milking frequency the constant 0.6596 was used as a weighting factor on the morning milk yield. Each day's milk yield (S) was estimated as:

$$S = M + 0.6596\,M$$

Where M is the morning milk yield (Once-a-day milking).

Milk sampling: Lactation length for each doe was based on 135 days. Milk sampling was initiated post colostrums on the 8 th day post-partum and terminated on the 50th day post-partum, for each lactating doe. Sample from daily milk yield for each doe was analysed daily for lactose content before being bulked and analysed weekly for total solids, butterfat, crude protein, solids-not-fat, ash and energy. The bulked samples were often stored in a refrigerator (-5° C) until required for analysis. Average daily milk yield and compositions were also determined for each doe.

Analytical procedure: The milk samples were analysed for lactose, TS, BF, CP (N × 6.38), SNF, ash and gross energy. Total solids were determined by drying about 5g of milk sample to a constant weight at 105° C for 24 h. Lactose content was determined from fresh samples by the Marrier and Boulet (1959) procedure. Butterfat was obtained by the Roese- Gottlieb method (AOAC, 1980). Milk protein (N × 6.38) was determined by the Semi-micro distillation method using Kjeldahl and Markhamps apparatus. Solids-not-fat was determined as the difference between total solids and butterfat. Milk energy Y (MJ^{-1} kg) was computed using the multiple regression equation (MAFF, 1975):

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

Where F and SNF represent percentages of fat and solids-not-fat, respectively. Proximate compositions of the experimental diets were determined according to AOAC (1990) procedure. Fat corrected milk was determined using the equation (Maynard *et al*., 1979):

$$FCM = 0.4M + 15F$$

Where M and F are the milk and fat yield of milk (kg), respectively.

Statistical analysis: The data on milk yield and compositions of the 2 groups of does were analysed using chi-square. Means and averages of daily and weekly milk yield and compositions for the two treatment groups were computed; Student T-test was used to declare significance between means. Simple linear regression was used to determine the relationships between milk constituents.

RESULTS AND DISCUSSION

The content and the proximate composition of the experimental diet is given in Table 1. The crude protein (14.3%) and the energy (3.27 $Kcal^{-1}$ g) contents of the diet were adequate and within recommended values for lactating goats (Akinsoyinu, 1974; Mba *et al*., 1975).

The yield and composition of milk of goats reared in the University farm and the village environment is presented in Table 2. Average daily milk yield was significantly higher ($p<0.05$) for the university farm and values of 122 ±0.08 and 102 ± 0.01 g were recorded for the university and village farms, respectively. The corresponding fat corrected milk values for both groups were 137.4±14.51 and 103.3±18.80. The difference between the FCM yields was also highly significant ($p<0.001$). Meanwhile, the average daily milk yield obtained for the 2 WAD groups were much higher than the values of 25.0±0.05 and 47.57±15.3g reported, respectively by Ahamefule and Ibeawuchi (2005) and Akinsoyinu (1974) for same breed, but lower than 468.0±0.25 and 664±0.26 g recorded by Akpa *et al.* (2002), respectively for Red Sokoto goats, another indigenous goat breed found in Nigeria. Variations in milk production among goats of same breed and even

Table 1: The contents and proximate composition of the concentrate diet

Ingredients	% Composition
Maize	57
Palm kernel cake	35
Ground nut cake	5
Bone meal	2
Common salt	1
Total	100
Analysed compositions (%)	
Dry matter	89.40
Crude protein	14.3
Crude fibre	5.63
Ether extract	4.60
Nitrogen free extract	56.82
Ash	8.15
Energy ($Kcal\ g^{-1}$)	3.27

Table 2: Milk yield and composition of WAD goats reared in the University farm and village environment

Parameter	University farm	Village farm	Significance
Milk yield ($g\ d^{-1}$)	122.0±0.08^a	102.0±0.03^b	***
FCM (g)	137.4±14.51^a	103.3±18.80^b	***
Total solids (%)	14.77±0.65^a	13.55±0.24^b	***
Butter fat (%)	4.84±0.08^a	3.76±0.38^b	***
CP (N x 6.38)%	4.25± 0.32	4.31±0.05	ns
Solids-not-fat (%)	9.91± 0.34	9.97± 0.27	ns
Lactose (%)	4.57± 0.34	4.34± 0.60	ns
Ash (%)	0.94± 0.21	0.81±0.21	ns
Energy ($MJ\ kg^{-1}$)	1.84± 0.35^a	1.41± 0.41^b	***

ns = Not significant ($p>0.05$), *** = Very highly significant ($p<0.001$)

Table 3: Linear regression equation and correlation coefficient (r) between various milk constituents of WAD goats reared in the university and village environment

Group	Parameter X Y	Regression equation	SE	Correlation coefficient (r)	Significance
A		Y = 11.19 + 0.736X	0.11	0.82	***
B	BF vs TS	Y = 11.861 + 0.45X	0.15	0.48	*
A		Y = 8.34 + 1.51X	0.44	0.54	***
B	CP vs TS	Y = 12.93 + 0.15X	0.14	0.10	ns
A		Y = 11.17 + 1.95X	0.27	0.84	***
B	En vs TS	Y = 11.83 + 1.22X	0.38	0.50	***
A		Y = 14.37 + 0.09X	0.60	0.02	***
B	L vs TS	Y = 14.13 - 0.14X	0.12	0.11	ns
A		Y = 11.41 - 0.33X	0.30	0.11	ns
B	L vs SNF	Y = 11.08 - 0.30X	0.11	0.44	ns
A		Y = 0.02 + 2.62X	0.02	0.99	***
B	En vs BF	Y = 2.66X - 0.006	0.20	0.99	***
A		Y = 10.15 - 0.06X	0.34	0.03	ns
B	CP vs SNF	Y = 10.75 - 0.24X	0.15	0.38	ns
A		Y = 1.56X - 1.81	0.63	0.38	*
B	CP vs BF	Y = 2.18 + 0.39X	0.20	0.27	*

TS = Total Solids, BF = Butter Fat, L = Lactose, En = Energy, SNF = Solid-Not-fat, CP = Crude Protein, SE = Standard Error, *** = Very highly significant ($p<0.05$), * = Significant ($p<0.05$), ns = not significant ($p>0.05$), A = University reared does, B = Village reared does species may occur and this may arise due to management, season of study and plane of nutrition (Ibeawuchi and Dagut, 1996).

Total solids (%) was significantly higher ($p<0.05$) in the milk of does reared in the university farm than does raised in the village environment. Values obtained for both groups were comparable to 14.92±0.27% obtained for WAD goat (Ahamefule and Ibeawuchi, 2005) in a similar study, but also lower than 19.21±0.46% (Akinsoyinu, 1974) and 15.7 ± 0.14% recorded elsewhere for WAD and Red Sokoto goats, respectively. Differences in dietary planes and compositions have been reported to influence yield and compositions of milk even within animals of the same breed (Ibeawuchi, 1985).

The butterfat (%) and energy (MJ kg^{-1}) values of both groups also differed significantly ($p<0.05$). The does reared in the university farm had higher ($p<0.05$) butterfat and energy values relative to does reared extensively. This observation is in consonance with the findings of Olaloku (1985) that intensively reared ruminants produced milk of better quantity and quality than those reared extensively. Meanwhile, the average butterfat value of 4.30% obtained for both groups in this study is similar to that reported by Ahamefule *et al*. (2004) for WAD goats.

Solids-not-fat (%), lactose and ash contents (%) of the milk of both groups were similar ($p>0.05$) and in consonance with what has been reported for WAD goat (Ahamefule *et al*., 2004; Akinsoyinu, 1974; Ahamefule and Ibeawuchi, 2005). The protein contents of 4.25 and 4.37% obtained for both groups, respectively in this study are similar to the protein levels reported by Ibeawuchi *et al*. (2003) for Sahelian goats and Akinsoyinu for Red Sokoto goats, in Nigeria.

The mean lactose values obtained for the university (4.57±0.34%) and village (4.34±0.06%) farm also compared favorably to values reported (Ahamefule *et al*., 2004) in mature milk for WAD sheep.

The relationship between some constituents of milk of WAD goats reared in the university farm and village environment are summarized in Table 3. In the university does, very high significant positive correlation existed between BF and TS ($r = 0.82$; $p<0.001$); energy and BF ($r = 0.99$; $p<0.001$) and energy and TS ($r = 0.84$; $p<0.001$). The relationship between lactose and TS; lactose and SNF and CP and SNF were positive and non-significant ($p>0.05$). In the milk of village does, the relationship between energy and butterfat was positive and highly significant ($r = 0.99$; $p<0.001$), like in their university counterpart, while the correlation between CP and TS was not significant ($r = 0.01$; $p>0.05$). Lactose and TS were positively but non-significantly correlated ($r = 0.11$; $p>0.05$) and so were CP and SNF ($r = 0.38$; $p>0.05$). Rai (1980) reported that a decrease in lactose content of milk is associated with an increase in its content, especially protein. This observation runs contrary to what was obtained in this study where lactose and TS were positively correlated. Meanwhile, the relationships established in this study were similar to the observations made by Ahamefule and Ibeawuchi (2005) and Ahamefule *et al*. (2004).

CONCLUSION

There were minor differences in the yield and compositions of the milks of WAD does reared in the university and village environments even when both animal groups were supplemented equally. The low milk production reported for WAD on range can be improved through adequate nutrition and management. The dairy profile of the WAD goat can be exploited and improved for better performance.

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