

UDDER AND TEAT TRAITS AS POSSIBLE SELECTION MARKERS FOR MILK YIELD IN LOCAL GOATS OF NIGERIA

D. ZAHRADDEEN, I. S. R. BUTSWAT and S. T. MBAP

(Received 4 July, 2007; Revision Accepted 30 August, 2007)

ABSTRACT

This study was carried out at the Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria (October, 2003 – May, 2006) to investigate the effects of some factors (breed, stage of gestation, body condition score and stage of lactation) on udder and teat traits with their relationships with partial daily milk yield (PDM) in goats. The goat breeds studied were Red Sokoto, Sahel and West African Dwarf. The traits studied included udder circumference (UC), udder length (UL), teat length (TL), teat height to ground (THG) and teat circumference (TC). The results showed that during pregnancy these traits were significantly ($P < 0.05$) larger in Sahel goat than in Red Sokoto and West African Dwarf does. There were also significant ($P < 0.05$) differences in these traits with respect to gestation stages; with a general increase as pregnancy advancing. However, during lactation the traits were superior ($P < 0.05$) in Sahel goat as compared to other two breeds. Conversely, these traits did not vary significantly with body condition score. There were also significant ($P < 0.001$) influence of lactation stage on udder and teat traits. For instance, UC, UL, TL and TC decreased markedly with advance in lactation while THG increased with increase in lactation. The correlations between PDM vs UL, PDM vs UC, PDM vs THG, PDM vs TC and PDM vs TL were 0.53, 0.74, - 0.34, 0.49 and 0.40 ($P < 0.01$) respectively. This study concludes that the Sahel goat does were more promising in terms of milk production potentials in this environment. However, the significant variations in the udder and teat traits in the three breeds and their high correlation coefficients implicated them as possible selection markers for milk improvement.

KEYWORDS: Breed, gestation, lactation, body condition score

INTRODUCTION

In Nigeria, the indigenous goats belong to three distinct breeds. The hardy, short-legged West African Dwarf restricted to high altitude areas and humid forest of the south, the relatively small-sized Red Sokoto found in the savannah zone and the long-legged Sahel found in the arid and sahel regions (Adu *et al.*, 1979).

The indigenous cattle have been the major source of domestic milk supply. Milk supply from other animals such as sheep, goats and camels is negligible (Ibeawuchi and Dalyop 1995). Goats in the country ranked second, followed by cattle, sheep, swine and rabbits, in population among domesticated animal species after chicken (FAO, 2006).

Information on udder traits in relation to milk production potentials of the goat species in the country were mostly confined to higher altitude and humid forest of the south (Agbede *et al.*, 1997; Amao, 1999; James and Osinowo, 2004a; 2004b) but there is paucity of literature in these traits in the savannah area of the country (Akpa *et al.*, 1998). A report shows that the savannah area alone has more than 60 % of the total goat population of Nigeria (Adalemo and Baba, 1993). However, this area is also the ecological niche of the Red Sokoto goats, the most predominate and widely distributed goat breed in Nigeria. Therefore, this study was designed to evaluate the performance of the three Nigerian breeds of goat with respect to the relationships of udder and teat traits with partial daily milk yield in Bauchi, a part of the sudan savannah ecological zone of Nigeria.

MATERIALS AND METHODS

Location and climate

Bauchi metropolis, the study area, is situated on latitude $10^{\circ} 17'$ north, longitude $8^{\circ} 49'$ east and at an altitude of 690.2 metres above sea level in the northern guinea savannah ecological zone of Nigeria (Kowal and Knabe, 1972). The annual rainfall is about 1016-1270mm. The mean monthly hours of sunshine is highest in December (300.3h) and lowest in August (150.1h). April is the hottest month with mean maximum and minimum temperatures of 30.1 and 13.7 °c

respectively. The mean relative humidity is highest in August (74.0%) and lowest in February (16.5%) (Butswat *et al.*, 2000).

Experimental goats

The breeds of goat used for the study were the Red Sokoto (RS), Sahel (SG) and West African Dwarf (WAD). A total of 43 goats including two bucks per breed constituted the initial stock. The bucks were used for within-breed natural mating on the nulliparous does aged one-year. The composition of does at the beginning of the fertility trial was 15 RS, 12 SG and 10 WAD. The detailed descriptions of these breeds have been reported by Adu *et al.* (1979).

Goat management

The animals were managed semi-intensively. In the night, they were kept in cross-ventilated pens within the animal house but allowed to graze during the day within the University premises. They were supplemented with mineral licks and concentrate; a mixture of poultry litter, maize offal and rice bran in 1:2:1 ratio, which gave 89.9% dry matter, 8.4% ash, 18% crude protein, 1.1% ether extract and 13% crude fibre. At times they were also fed groundnut haulms. Routine health care practices such as vaccination/medication, ectoparasite control and deworming were also regularly carried out. Fresh drinking water was provided *ad libitum*.

Measurements of udder dimensions during pregnancy and lactation

The study was conducted at the Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria (October, 2003 to May, 2006). Data were collected during every trimester (0, 50, 100 and 150 days) of pregnancy, and weekly after kidding for 14 weeks commencing 4 days postpartum using a flexible graduated canvas tape. Udder dimensions were determined as per the procedures laid down by Agbede *et al.* (1997) and James and Osinowo (2004a; 2004b).

(i) Udder length (UL) was recorded as the distance between the base of udder attachment to the abdominal region and the point of teat protrusion from the udder.

- (ii) Udder circumference (UC) was measured as the distance (perimeter) round the widest point of the udder.
- (iii) Teat height to ground (THG) was taken as the distance between teat tips to the ground.
- (iv) Teat length (TL) was measured as the distance between teat tip and base of attachment to the udder.
- (v) Teat circumference (TC) was recorded as the distance round the widest points of the teats (middle).

Measurements of these traits together with the records of partial daily milk yield (PDM) were taken in the morning on the day of data collection before animals were turned out for grazing. Udder dimensions were classified based on breed, body condition score, stage of gestation and stage of lactation.

Data analysis

The data generated were subjected to analysis of variance and correlation using the General Linear Model (GLM) of SPSS (2001). Means were subsequently separated using Duncan's Multiple Range Test (DMRT) method described by Humburg (1977).

RESULTS AND DISCUSSION

Table 1 presents data on udder and teat traits during pregnancy. The udder and teat traits, UC, UL, TL, THG and TC were significantly ($P<0.001$) larger in SG than in RS and WAD does. Similarly, there were significant ($P<0.001$) differences in udder and teat traits among the gestation stages. In general, the udder and teat traits increased with advancing pregnancy.

Breed x gestation interaction had significant effect on UL, UC, TC and TL, whereas THG was not influenced by the interaction effect. Table 2 shows that there were significant correlations between most of the udder and teat traits. For instance, the correlations between UC vs UL, UL vs TC, UL vs TL, and TC vs TL of 0.86, 0.73, 0.67 and 0.95 respectively were high, positive and significant ($P<0.01$). The correlations between UL vs THG and UC vs THG (-0.37 and -0.24 respectively) though low and negative were also significant ($P < 0.05 - 0.01$).

Udder and teat traits in goats during lactation are depicted in Table 3. There were significant ($P<0.001$) differences in UC, UL, THG, TL and TC in the three breeds. The SG does had larger udder and teat traits than RS and WAD does. Udder and teat traits however did not vary significantly with body condition score. Furthermore, there was significant ($P<0.001$) influence of lactation stage on udder and teat traits. Udder and teat traits (UC, UL, TL and TC) decreased markedly with advance in lactation while THG increased with increase in lactation (Table 3).

There were significant ($P<0.001$) breed x week of lactation interaction with respect to UC, TL, TC and THG.

However, breed x body condition score and body condition score x week of lactation interactions were significant. Table 3 reveals significant ($P<0.01$) correlations between PDM and udder and teat traits. The correlations between PDM vs UL, PDM vs UC, PDM vs THG, PDM vs TC and PDM vs TL were 0.53, 0.74, -0.34, 0.49 and 0.40 ($P<0.01$) respectively. The correlations between most of the udder and teat traits studied were also significant, though some were negative. For instance, UL vs UC, UL vs THG, TC vs UL, UL vs TL, UC vs THG, UC vs TC and TC vs TL had correlation values of 0.80, -0.34, 0.51, 0.40, -0.28, 0.69 and 0.94 ($P<0.05$) respectively.

The Sahel goat had the largest udder and teat traits during pregnancy followed by Red Sokoto and lowest values were obtained in West African Dwarf does. This is consistent with the findings of James (2000) who reported significant breed effects on udder and teat traits in these three breeds in the humid environment. The larger udder and teat traits observed in Sahel goat does may also be attributed to its larger body conformation than the other two breeds. The marked increase in udder and teat traits with stage of gestation (0, 50, 100 and 150 days) in this study has similarly been observed in other breeds of goats elsewhere (James and Osinowo, 2004b). The increase in the traits with advance in gestation has been linked to endocrine control of pregnancy in preparation for parturition and lactation (Dijkstra *et al.*, 1997).

James (2000) reported that udder size in goats largely reflects milk production potential while cell population is a crucial determinant of milk yield as observed by Dijkstra *et al.* (1997). It has been reported that the positive relationships of udder traits and their high heritability values implicate them as possible selection markers for milk improvement (Akpa *et al.*, 1998).

During pregnancy the Sahel goat does had the largest udder and teat dimensions followed by Red Sokoto with lowest value in West African Dwarf does. This superiority was carried throughout lactation. These findings are similar to the reports of Agbede *et al.* (1997), James (2000) and James and Osinowo (2004a). The effect of stage of lactation (colostrum period, early, mid and end of lactation) on the overall udder and teat dimensions in goats was significant. This observation is in agreement with earlier reports by Agbede *et al.* (1997). Knight and Wilde (1993) attributed the changes in udder size of goats during lactation to extensive proliferation of cells in the mammary gland in early lactation (cells hyperplasia) and differentiation of mammary cells during declining lactation during which period the tissues remain constant but reduce toward the end of lactation (cell hypertrophy). Agbede *et al.* (1997) also observed that udder size and milk yield increased up to the fifth week post-partum. However, the successive decrease in udder dimensions when lactation advanced is mainly due to heavy demand on lactating animals as a result of intense suckling of kids or milking.

Table 1: Udder and teat traits (cm) in goats during pregnancy

Factor	n	Udder circumference	Udder length	Teat length	Teat height to ground	Teat circumference
Overall	105	28.75 ± 0.08	14.01 ± 0.07	3.23 ± 0.01	26.82 ± 0.09	5.79 ± 0.04
<i>Breed</i>		***	***	***	***	***
Red Sokoto	40	28.14 ± 0.13 ^b	13.08 ± 0.12 ^b	3.70 ± 0.02 ^a	25.45 ± 0.14 ^b	6.58 ± 0.07 ^b
Sahel goats	32	33.58 ± 0.15 ^a	16.70 ± 0.12 ^a	3.74 ± 0.02 ^a	29.90 ± 0.15 ^a	7.17 ± 0.08 ^a
West African Dwarf	33	24.53 ± 0.15 ^c	12.26 ± 0.12 ^c	2.27 ± 0.02 ^b	25.11 ± 0.15 ^b	3.63 ± 0.08 ^c
<i>Stage of gestation (day)</i>		***	***	***	***	***
0	27	25.67 ± 0.16 ^d	12.46 ± 0.13 ^d	2.91 ± 0.02 ^d	28.64 ± 0.17 ^a	4.84 ± 0.09 ^d
50	26	27.08 ± 0.17 ^c	13.58 ± 0.13 ^c	3.05 ± 0.02 ^c	27.62 ± 0.17 ^b	5.32 ± 0.09 ^c
100	26	28.62 ± 0.17 ^b	14.50 ± 0.13 ^b	3.27 ± 0.02 ^b	26.03 ± 0.17 ^c	6.05 ± 0.09 ^b
150	26	33.64 ± 0.17 ^a	15.50 ± 0.13 ^a	3.71 ± 0.02 ^a	24.99 ± 0.17 ^d	6.97 ± 0.09 ^a

*** $P<0.001$

^{a,b,c,d} Means in the same column within a subset having different superscripts are significantly different.

Table 2: Overall correlation matrix of udder and teat traits in goats during pregnancy

	1	2	3	4
1. Udder length (UL)				
2. Udder circumference(UC)	0.86**			
3. Teat height to ground(THG)	-0.37**	-0.24*		
4. Teat circumference(TC)	0.73**	0.78**	0.19NS	
5. Teat length(TL)	0.67**	0.75**	0.17NS	0.95**

NS = Not significant

* P<0.05; **P<0.001

Table 3: Udder and teat traits (cm) during lactation as influenced by breed, body condition score and stage of lactation

	n	Udder circumference	Udder length	Teat height to ground	Teat length	Teat circumference
Overall	142	29.21 ± 0.10	14.25 ± 0.19	21.83 ± 0.09	2.87 ± 0.01	3.40 ± 0.01
<i>Breed</i>		***	***	***	***	***
Red Sokoto	67	30.03 ± 0.17 ^b	14.13 ± 0.34 ^b	22.14 ± 0.15 ^b	2.90 ± 0.02 ^b	3.34 ± 0.03 ^b
Sahel goats	42	33.22 ± 0.16 ^a	16.07 ± 0.32 ^a	25.10 ± 0.14 ^a	3.69 ± 0.02 ^a	4.33 ± 0.03 ^a
West African Dwarf	33	24.25 ± 0.18 ^c	12.57 ± 0.36 ^c	18.18 ± 0.16 ^c	2.06 ± 0.02 ^c	2.52 ± 0.03 ^c
<i>Body condition score</i>		NS	NS	NS	NS	NS
2	76	29.34 ± 0.10	14.13 ± 0.20	21.80 ± 0.09	2.88 ± 0.01	3.37 ± 0.02
3	51	29.21 ± 0.15	14.25 ± 0.30	21.78 ± 0.13	2.90 ± 0.02	3.39 ± 0.02
4	15	29.09 ± 0.25	14.38 ± 0.47	21.90 ± 0.21	2.88 ± 0.30	3.42 ± 0.04
<i>Stage of lactation</i>		***	***	***	***	***
Colostrum ¹	37	33.96 ± 0.32 ^a	18.53 ± 0.62 ^a	18.10 ± 0.27 ^c	2.93 ± 0.04 ^{ab}	3.58 ± 0.05 ^a
Initial stage ²	37	31.77 ± 0.32 ^b	14.76 ± 0.62 ^b	19.59 ± 0.26 ^c	3.04 ± 0.03 ^a	3.66 ± 0.05 ^a
Mid lactation ³	34	27.49 ± 0.33 ^c	12.41 ± 0.66 ^c	23.57 ± 0.29 ^b	2.86 ± 0.04 ^{bc}	3.26 ± 0.05 ^b
End of lactation ⁴	32	23.73 ± 0.33 ^d	11.50 ± 0.67 ^d	25.90 ± 0.34 ^a	2.70 ± 0.05 ^c	3.04 ± 0.06 ^c

NS = Not significant ; *** P<0.001

^{a,b,c,d} Means in the same column in a subset having different superscripts are significantly different.

- 1 Measurements taken during the first three days of lactation
- 2 Measurements taken from 2nd to the 4th week of lactation
- 3 Measurements taken from 5th to the 9th week of lactation
- 4 Measurements taken from the 10th to the 14th week of lactation

Table 4: Overall correlation matrix of udder and teat traits and partial daily milk of goats during lactation

	1	2	3	4	5
1. Partial daily milk yield					
2. Udder length	0.53**				
3. Udder circumference	0.74**	0.80**			
4. Teat height to ground	-0.34**	-0.34**	-0.28**		
5. Teat circumference	0.49**	0.51**	0.69**	0.23**	
6. Teat length	0.40**	0.40**	0.59**	0.43**	0.94**

**P<0.01

CONCLUSION

Based on the udder and teat traits studied, the Sahel does were more promising than the other breeds (Red Sokoto and West African Dwarf) in terms of their milk production potentials. The Red Sokoto was also superior to West African dwarf goats in their milk yield potentials. However, the significant variations in the udder and teat traits in these breeds and their high correlation coefficients implicated them as possible selection markers for milk improvement.

REFERENCES

Adalemo, I. A. and Baba, J. M., 1993. Nigeria: Giant in the tropics, 1:129, Gabumo Publishing Co. Limited, Lagos, Nigeria.pp:71-85

Adu, I.F., Buvanendran, V. and Lakpini, C. A. M., 1979. The reproductive performance of Red Sokoto goats in Nigeria. Journal of Agricultural Sciences (Camb), 93: 563-566.

Agbede, J.O., Ologun, A.G. and Alokun, J. A., 1997. Udder size and milk production potential of goats and sheep in the South West of Nigeria. Nigerian Journal of Animal Production , 24(2): 175-179.

Akpa, G.N., Duru, S., Dim, N. I., Alawa, J. P. and Jokthan, G. E., 1998. Sources of variation in udder traits of Red Sokoto goats. Proceedings of Silver Anniversary Conference of Nigerian Society of Animal Production, Abeokuta, Nigeria March 21-26.

Amao, O. A., 1999. Evaluation of udder traits in West African Dwarf and Red Sokoto goats. M. Agric. Dessertation, Department of Animal Production and Health, University of Agriculture, Abeokuta, Nigeria.

Butswat, I. S., Mbat, S.T. and Ayibatonye, G. A., 2000. Heat tolerance of sheep in Bauchi, Nigeria. Tropical Agriculture (Trinidad), 77(4): 265-268.

- Dijkstra, J., France, J., Dhanoë, M. S., Maas, J. A., Hanigan, M. D., Rook, A. J. and Beever, D. E., 1997. A model to describe growth patterns of the mammary gland during pregnancy and lactation. *Journal of Dairy Science*, 80:2340-2354
- FAO., 2006. Food and Agriculture Organisation. Quarterly Bulletin of Statistics. Rome, Italy. *Wttp: //fao. Org/statistics/Yearbook*: May 2006
- Humburg, M., 1977. *Statistical Analysis for Decision Making*. 2nd Edition, Harcourt Brace, New York, 801pp.
- Ibeawuchi, J. A. and Dalyop, D. M., 1995. Composition and quality of fresh cow milk offered for sale in parts of Plateau State of Nigeria. *Nigerian Journal of Animal Production*, 22(1): 81-84.
- James, I. J., 2000. Changes in udder traits of West African Dwarf, Red Sokoto and Sahel goats during pregnancy and lactation and their effects on partial daily milk yield. M.Agric Dissertation. Department of Animal Production and Health, University of Agriculture, Abeokuta, Nigeria.
- James, I. J. and Osinowo, A. O., 2004a. Changes in udder size and live weight of West African Dwarf, Red Sokoto and Sahel goats during lactation and their phenotypic relationship with partial daily milk yield. *Nigerian Journal of Animal Production*, 31(1): 119-129.
- James, I. J. and Osinowo, A.O., 2004b. Relationship between udder measurements during pregnancy and partial daily milk yield in goats. *Nigerian Journal of Animal Production*, 31(2): 252-262.
- Jefferies, B.C., 1961. Body condition scoring and its use in management. *Tasmanian Journal of Agriculture*, 32: 19-21
- Knight, C.H. and Wilde, C. J., 1993. Mammary cell changes during pregnancy and lactation. *Livestock Production Science*, 35: 3-19.
- Kowal, J. M. and Knabe, D.T., 1972. *Agroclimatological Atlas of the Northern States of Nigeria with explanatory notes*. Ahmadu Bello University Press, Zaira, Nigeria, 128p.

