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EVALUATION OF UDDER TRAITS AS INFLUENCED BY BODYWEIGHT AND REPRODUCTIVE STATUS OF RED SOKOTO GOATS IN A GUINEA SAVANNAH ENVIRONMENT

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ABSTRACT

A study was conducted to evaluate udder traits as influenced by liveweight and reproductive status of Red Sokoto goats in a guinea savanna environment. One hundred and thirty (130) Red Sokoto does were involved in the study. Effects of age, parity, lactation, pregnancy and liveweight on udder traits were determined. Age, parity, lactation and pregnancy had no significant ($P > 0.05$) effect on udder traits. Effect of liveweight was significant ($P < 0.05$) on all udder traits measured when used as covariate. Coefficients of regression for the effect of liveweight on udder traits were for udder length (UL), 0.39 ± 0.03 ; udder width (UW), 0.20 ± 0.03 ; udder circumference (UC), 0.55 ± 0.06 and udder volume (UV), 65.42 ± 6.42. Mean values of udder traits were adjusted to those of a 3 – 4 year old lactating doe. The adjusted values were for UL, 14.33 ± 0.25; UW, 10.17 ± 0.20; UC, 28.17 ± 0.46 cm and UV, 1007.21 cm^3. It was concluded that liveweight constituted a major determinant of udder size in Red Sokoto goats. This study also showed that although effects of age, parity, lactation and pregnancy on udder size were not significant, the udder size increased with age and parity; pregnant does had larger udder than non-pregnant ones, while lactating does also had larger udder than non-lactating ones.

Key words: Udder traits, Red Sokoto goats, bodyweight and reproductive status.

INTRODUCTION

The Nigerian goat population is estimated to be over 32.5 million (FDLPCS, 1991). Of this population Red Sokoto goats form the largest proportion (16.25 million). The Red Sokoto goat is one of the few well-defined breeds in Africa and is uniformly dark-red in colour. It is horned in both sexes and short-haired. It is relatively small but not dwarfed, weighing about 23-30 kg at maturity (Devendra and Burns, 1983). The Red Sokoto goat has good dairy potentials (Ehoche and Fajemisin, 1990), which have not been fully exploited. According to Ehoche and Buvanendran

(1983), the mean daily milk yield was 545 g. A lower value of 3.28 kg (i.e. 469 g) was earlier reported (Akinsoyinu *et al.*, 1982).

Considerable studies have been done to investigate the potentials of Nigerian goat breeds for milk production. However, they have been limited to the influence of dietary and health management on milk yield (Mba *et al.*, 1975; Akinsoyinu *et al.*, 1982; Ehoche, 1983 and Ehoche and Buvanendran, 1983) in Red Sokoto goats. An important aspect that has been neglected for investigation is the udder traits of the indigenous breed of goat.

Udder conformation may determine milk production ability of dairy goats and the risk of injury in range goats (Gall, 1980). Labussiere (1988) remarked that mammary morphology is one factor that determines aptitude for mechanical milking in sheep. According to Akpa *et al.* (1998) udder circumference and udder length averaged 27.9 ± 8.30 and 12.9 ± 4.3 cm respectively; and that udder and teat sizes increased with increasing age and parity.

Whereas udder traits have been widely reported for cow, sheep and some temperate breeds of goat (Labussiere, 1988; Montaldo and Martinez-Lozano, 1993 and Singh *et al.*, 1993), information on udder traits of Red Sokoto goats is scarce. The objective of this study therefore was to evaluate udder traits and the factors affecting them in Red Sokoto goats.

MATERIALS AND METHODS

Animals, management and study area

Data were collected on 130 RS goats from herds at the National Animal Production Research Institute (NAPRI), Shika, Zaria and from farmer's flocks in two neighbouring villages; in Giwa Local Government Area of Kaduna State. This area has been previously described by Osinowo *et al.* (1993). The region lies 640 m above sea level and falls within latitude 11°13'N and longitude 7°33'E. The climate is tropical and the vegetation is Northern Guinea Savanna. Mean rainfall is about 1,107 mm, stretching over 120-170 days, from April to early September. Mean annual temperature in this region is 24.4°C. The mean relative humidity during the dry and wet seasons is 21 and 72 % respectively.

The study was conducted between November 1997 and September 1998. The on-farm flocks were maintained under traditional system of management where animals grazed on natural pasture. They were also offered some supplements in form of household wastes. The flock at the National Animal Production Research Institute was kept under semi-intensive system of management. They were allowed to graze on improved pastures for 6-8 hours daily and were given 0.3-0.5 kg/day of concentrate supplement. They were kept in cross ventilated pens and had free access to water and mineral salt licks. Routine health management involved endo- and ectoparasite control.

Procedure

Udder traits were measured in the morning between 6:00 a.m. and 12:00 noon before the animals were released for grazing. Traits measured were udder length (UL), udder width (UW), udder circumference (UC) and udder volume (UV). Others included teat length (TL), teat width (TW), teat circumference (TC), distance between teats (DT) and height of teat from the ground (HTG). Udder measurements were taken as already described by Montaldo and Maritinez – Lozano (1993). Udder volume was a derived variable computed as follows:

$$UV = \left(\frac{4}{3}\right)(\pi)\, r^3$$

where, UV = udder volume,

$$\pi = \frac{22}{7} \text{ and } r = \frac{(UL + UW)}{4}$$

Averages of the left and right teat dimensions were used. Distance between teats was measured between the tips of two functional teats. Height of teat from the ground was measured between the teat tip and the ground while the goat stood at the withers.

Age, parity and liveweight of the animals were determined. Age of the animals was determined by dentition (Sastry and Thomas, 1980; Saini *et al.*, 1993). Parity was determined mainly from formers records. A total of 12 goats constituted the farmers' flock from the two villages visited in Giwa Local Government Area. Liveweight of the

does was taken using a hanging scale with graduation in 0.1 kg.

The pregnancy status of the does was determined by abdominal palpation while lactation status was determined by milking. Based on these goats were categorized as pregnant or non-pregnant; lactating or non-lactating.

Statistical analyses

Analyses were done using Mixed Model Least-squares and Maximum Likelihood Computer Program (Harvey, 1990). A model was fitted for the effects of age, parity, pregnancy and lactation status on each udder trait and liveweight was included as covariate as follows:

$$Y_{ijklmn} = \mu + A_i + P_j + G_k + L_l + bW + E_{ijklmn}$$

where Y_{ijklmn} = The value of the trait of interest

μ = The overall mean for the trait of interest

A_i = The fixed effect of ith age group (i=1 to 4)

P_j = The fixed effect of the jth parity (j=1 to 5)

G_k = The fixed effect of the lth pregnancy status (l =1,2)

L_l = The fixed effect of the mth lactation status (l =1,2)

E_{ijklm} = Random error associated with each record.

b = Regression coefficient

W = Liveweight (Kg) used as covariate

Phenotypic correlations were also estimated using Systat Computer Package (Systat, 1992)

RESULTS AND DISCUSSION

The results of this investigation are presented in Tables 1 to 4. Table 1 shows the liveweights for the different age groups of the experimental does. Liveweight increased significantly ($P < 0.05$) with age. This is consistent with the earlier reports (Mazumder and Mazumder, 1983; Ruvuna *et al.*, 1988; Bhattacharya, 1989 and Katongole *et al.*, 1994) who reported that liveweight increased as goats advanced in age. This could be related to growth, which is characterized by cell multiplication and hence increase in body size.

Table 1: Liveweights for the different age groups of the experimental does

Age group (Yr)	No of obs.	Liveweight (kg) (least-squares means ± SE)
1 – 2	28	18.67 ± 1.43[a]
2 – 3	39	19.55 ± 1.09[a]
3 – 4	35	24.01 ± 0.95[b]
> 4	28	25.12 ± 1.96[b]

[abc]Means in the same column followed by different superscripts differ significantly ($P < 0.05$)

Least-squares means (±SD) for the effects of age, parity, lactation status, pregnancy status and liveweight on UL, UW, UC and UV in Red Sokoto goats are presented in Table 2. Age had no significant ($P > 0.05$) effect on UL, UW, UC and UV however, there was an increase in the udder traits with increasing age. Similarly, udder traits were not significantly ($P > 0.05$) influenced by parity, whereas, there was an increase in the traits with increasing parity. Although, lactating does had larger values for UL, UW, UC and UV than non-lactating ones, the differences were not significant ($P > 0.05$). Pregnant does also showed non-significantly larger udder size than the non-pregnant counterparts. Regression coefficients for the effects of liveweight on all the traits were significant ($P < 0.05$). The regression coefficients showed that 39% of UL, 20% of UW, 55% of UC and 65% of UV could be accounted for by liveweight. The observation that age, parity and lactation status had no significant ($P > 0.05$) effects on UL disagrees with the reports of Montaldo and Martinez-Lozano (1993) and Akpa *et al.* (1998). Probably this was due to different analytical models. Similar reason could be adduced for the non-significant effect of age, parity, lactation status and pregnancy status on UW, UC and UV. Recently, Akpa *et al.* (1998) reported that age, parity and lactation status had significant ($P < 0.05$) effects on UL and UC and

that udder and teat sizes increased with increasing age and parity in the same breed of goat. The significant coefficient of regression for the effect of liveweight (used as covariate) on udder traits is an indication that udder size in Red Sokoto goats is essentially a function of liveweight. This supports the earlier report of Ehoche and Buvanendran, (1983) that liveweight is the major factor influencing milk yield in RS goats. Mean values adjusted to those of 3-4 year-old lactating does are also shown in Table 2. One major merit of adjusting or standardizing the values for each trait is that at a given age, udder size and consequently milk yield potential of a lactating doe could be predicted for this breed. Least-squares means (±SD) for the effects of age, parity, lactating status, pregnancy status and liveweight on TL, TW, TC, DT and HTG in Red Sokoto goats are presented in Table 3.

Table 2: Least squares means (±SD) for the effects of age, parity, lactation status, pregnancy status and liveweight on UL, UW, UC, and UV in red sokoto goats

LSM Factor and subclasses	No. of obs.	UL (cm)	UW (cm)	UC (cm)	UV (cm^3)
OVERALL	130	13.67 ± 0.20	9.46 ± 0.16	26.44 ± 0.36	929.08 ± 38.62
AGE (Yrs)					
1 – 2	28	13.11 ± 0.85	8.54 ± 0.97	24.60 ± 2.11	901.30 ± 230.44
2 – 3	39	13.45 ± 0.56	9.52 ± 0.73	26.39 ± 1.03	907.83 ± 113.04
3 – 4	35	13.51 ± 0.62	9.63 ± 0.48	26.92 ± 1.20	912.82 ± 171.61
> 4	28	14.38 ± 1.15	9.94 ± 0.55	27.65 ± 1.57	939.31 ± 130.85
PARITY					
0	19	12.31 ± 0.97	8.71 ± 0.82	25.06 ± 1.79	786.73 ± 195.15
1	35	13.51 ± 1.19	9.14 ± 0.51	26.08 ± 1.25	885.02 ± 124.98
2	32	13.69 ± 0.62	9.41 ± 0.58	26.18 ± 1.09	927.18 ± 119.56
3	20	14.24 ± 0.68	9.44 ± 0.53	26.51 ± 1.14	979.44 ± 136.68
≥ 4	24	14.31 ± 0.59	10.34 ± 1.02	28.13 ± 2.20	998.20 ± 240.37
LACTATION STATUS					
Lactating	28	14.06 ± 0.40	9.49 ± 0.43	26.76 ± 0.94	927.37 ± 102.41
Non-lactating	102	13.16 ± 0.47	9.33 ± 0.32	26.06 ± 0.70	903.26 ± 76.31
PRENANCY STATUS					
Pregnant	99	14.09 ± 0.40	9.47 ± 0.34	26.58 ± 0.73	945.45 ± 80.06
Non-pregnant	31	13.14 ± 0.47	9.35 ± 0.40	26.20 ± 0.89	885.17 ± 95.06
LIVEWEIGHT (b)†		0.39 ± 0.03	0.20 ± 0.03	0.55 ± 0.06	65.42 6.41
ADJUSTED VALUE*	130	14.33 ± 0.25	10.17 ± 0.20	28.17 ± 0.46	1007.21 48.04

† Regression coefficient for each trait was significant ($P < 0.05$)

* Values adjusted to those of a 3 – 4 year-old, lactating doe

Teat dimensions were not significantly ($P > 0.05$) influenced by age, parity, lactation status and pregnancy status. Only liveweight (covariate) had significant effect on teat dimensions. However, TL, TW and TC increased with age. Distance between teats did not show a definite pattern with increasing age and parity while there was a decline in HTG with increasing age and parity. Whereas TW and TC increased with increasing parity, TL did not show a definite pattern with parity. Lactating does had larger teat dimensions than those of non-lactating counterparts. Teat dimensions were also larger for pregnant does than for the non-pregnant counterparts. Distance between teats (10.88 ± 0.25 cm) obtained in this study was smaller than the one reported for Saanen (15.97 ± 0.23 cm) a temperate breed (Horak and Gerza, 1969). This suggests that

probably the udder of Red Sokoto goats is smaller in size than that of Saanen. The decline in HTG with increasing age and parity indicates that as the animal increased in age and parity, udder size also increased and it grew downward. Mean values of HTG (both "overall" and "adjusted") for Red Sokoto goats appear high enough to prevent udder injury while foraging or grazing and to be accessible to kids for suckling. This could be an advantage in favour of Red Sokoto goats.

Table 3: Least squares means (±SD) for the effects of age, parity, lactation status, pregnancy status and liveweight on TL, TW, TC, DT and HTG in red sokoto goats

Factor and subclasses	LSM No. of obs.	TL (cm)	TW (cm)	TC (cm)	DT (cm)	HTG (cm)
OVERALL	130	3.08 ± 0.06	1.65 ± 0.03	4.52 ± 0.08	7.65 ± 0.13	25.54 ± 0.38
AGE (Yrs)						
1 – 2	28	2.96 ± 0.25	1.50 ± 0.20	4.15 ± 0.46	7.51 ± 0.57	28.66 ± 1.70
2 – 3	39	3.04 ± 0.34	1.65 ± 0.10	4.39 ± 0.26	7.95 ± 0.44	24.94 ± 0.83
3 – 4	35	3.11 ± 0.16	1.68 ± 0.11	4.45 ± 0.23	7.83 ± 0.38	24.50 ± 1.26
> 4	28	3.21 ± 0.19	1.70 ± 0.15	4.66 ± 0.35	7.40 ± 0.77	24.86 ± 0.96
PARITY						
0	19	2.76 ± 0.28	1.28 ± 0.17	3.40 ± 0.39	7.11 ± 0.65	27.73 ± 1.44
1	35	3.12 ± 0.18	1.51 ± 0.11	4.19 ± 0.25	7.99 ± 0.42	27.40 ± 0.92
2	32	2.95 ± 0.17	1.60 ± 0.10	4.47 ± 0.24	7.55 ± 0.40	27.83 ± 0.88
3	20	3.38 ± 0.20	1.87 ± 0.12	4.92 ± 0.28	7.48 ± 0.46	23.47 ± 1.01
≥ 4	24	3.17 ± 0.35	1.90 ± 0.21	5.09 ± 0.48	8.23 ± 0.80	22.07 ± 1.77
LACTATION STATUS						
Lactating	28	3.13 ± 0.15	1.65 ± 0.09	4.50 ± 0.15	8.13 ± 0.34	25.03 ± 0.59
Non-lactating	102	3.02 ± 0.11	1.61 ± 0.07	4.33 ± 0.21	7.37 ± 0.26	26.05 ± 0.56
PREGNANCY STATUS						
Pregnant	99	3.11 ± 0.12	1.70 ± 0.07	4.49 ± 0.16	7.97 ± 0.27	24.80 ± 0.59
Non-pregnant	31	3.05 ± 0.14	1.56 ± 0.08	4.34 ± 0.19	7.37 ± 0.32	26.28 ± 0.70
LIVEWEIGHT (b)†		0.07 ± 0.01	0.05 ± 0.01	0.09 ± 0.01	0.10 ± 0.02	– 0.13 ± 0.08
ADJUSTED VALUE*	130	3.12 ± 0.07	1.69 ± 0.05	4.55 ± 0.09	10.08 ± 0.28	26.05 ± 0.32

†Regression coefficient for each trait was significant ($P < 0.05$)
*Values adjusted to those of a 3 – 4 year-old, lactating doe.

Phenotypic correlations between udder traits in Red Sokoto goats are presented in Table 4.

Correlation coefficients between UL, UW, UC and UV were high, positive and highly significant ($P < 0.001$). trait combination and correlation coefficients suggested that any one of the traits could be effectively used to predict another for the goat breed. The choice of the breeder would thus depend on ease of measurement (Chineke, 2000). Besides, selection for large udder length would probably mean positive significant influence on udder width, udder circumference and consequently udder volume in Red Sokoto goats.

In conclusion, this study showed that liveweight (used as covariate) is the major factor influencing udder size in Red Sokoto goats. Although udder size increased with increasing age and parity, the increase was not significant. Lactating does had larger udder than non-lactating ones; similarly pregnant does had larger udder than their non-pregnant counterparts. However, the differences were not significant.

Table 4: Phenotypic correlations among udder traits in red sokoto goats

	UL	UW	UC	TL	TW	TC	DT	HTG	
UL									
UW	0.715**								
UC	0.798**	0.812**							
TL	0.422**	0.222	0.210						
TW	0.525**	0.321*	0.293	0.755**					
TC	0.476**	0.299*	0.279	0.747**	0.836**				
DT	0.572**	0.630**	0.600**	0.008	0.006	0.006			
HTG	-0.641**	-0.440**	-0.516**	-0.283	-0.347*	-0.426**	-0.388*		
UV	0.909**	0.887**	0.841**	0.311*	0.435**	0.383**	0.562**	-0.577**	

* P < 0.05; ** P < 0.001

UL = Udder length
UW = Udder width
UC = Udder circumference
TL = Teat length
TW = Teat width
TC = Teat circumference
DT = Distance between teats
HTG = Height of teat from the ground
UV = Udder volume

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