



Milk Composition and Udder Measurements of Two Breed of Goat

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Abstract

The evaluation of udder measurement and milk composition of two breeds of goat were assessed. A total of one hundred and sixty goat were used for the study comprising of (80 Red Sokoto and 80 white Borno (does). Matured does were used, age ranges between 2-5 years of age and with average body weight of 20 - 35 kg. The udder characteristics were measured using flexible tape, venire caliper, and weight balance. The udder characteristics of each doe was measured postpartum and also during pregnancy. The body weight, udder and teat characteristics measurement were recorded include; Udder length (UL), Udder width (UW), Udder circumference (UC), and Udder volume (UV). Teat traits included Teat length (TL), Teat width (TW), Distance between teats (DBT), Teat to flow distance (TFD). Milk samples were analyzed for total solids % (TS), crude protein % (CP), butterfat %, solids-non-fat % (SNF), ash % and lactose %. All data generated were subjected to analysis of variance using SAS package version. The variation of milk composition of two breed of goats observed that breeds have a significant difference on crude protein % ($p < 0.05$) with higher value in Red Sokoto goat ($4.02 \pm 0.04\%$) followed by Borno white ($3.64 \pm 0.10\%$). The breed differences may be due to genetic variation, environmental differences and management practices. It was observed that there was significant difference ($P < 0.01$) in the values of udder length, udder width, udder Circumference and udder volume of the two breeds, with higher value in Red Sokoto as compare to Borno white with corresponding values of (12.32 ± 0.32 cm , 12.09 ± 0.15 , 3.82 ± 0.17 , and 3.48 ± 0.17) (10.58 ± 0.16 , 10.56 ± 0.12 , 3.48 ± 0.09 and 1.25 ± 0.54) respectively . Physiological variation of udder and teat measurement of two breed of goat observed that the body weight of pregnant red sokoto was higher than lactating red sokoto with the value of 26.07 ± 0.85 kg and 22.33 ± 1.55 kg , different trend were observed in Borno white pregnant and lactating does.

Keywords: Milk composition, Udder measurements, Breeds of Goats and Physiological variation

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1. Introduction

Goat production plays a very vital role in the livelihood of rural populations in Nigeria. It contributes significantly in improving family nutrition and health. Sales of animals and their products help to stabilize household income. Goat production, therefore, is considered as a form of food security and source of independent income for rural households and subsistent farmers [1]. One of the most important contributions of goat milk to human nutrition is the calcium and phosphate that it supplies. Goat milk contains about 1.2 g calcium and 1 g phosphate per liter these concentrations are similar to those in cow milk [2]. High buffering capacity of goat milk appears to be useful for treatment of gastric ulcers. Goat milk has been recommended as a substitute for patients allergic to cow milk. Between 40-100% of patients allergic to cow milk proteins can tolerate goat milk [3]. The udder is very important due to its physiological and conformational characteristics. Low and Adamu et al., 2025

pendulous udder are of little economic importance to dairy man, since they are more susceptible to injuries and they are more difficult to milk especially when milking machine is used [4]. Better knowledge of morphological udder trait variability should allow the identification of mammary traits most suitable for incorporation into selection programs for dairy goat breeds. In goat's udder characteristics, milk production and milking time/rate are traits with adequate genetic variation, which allow selection responses [5]. The need of improving goat milk should be used to augment animal protein intake [6]. The objective of this study was to evaluate udder measurement and the milk composition of two breeds of goat. The Red Sokoto and the Borno white goat in Maiduguri metropolitan council Area of Borno state.

2. Materials and Methods

2.1. Study Area

The study was conducted in Maiduguri, Borno state. Maiduguri is situated on latitude 11°05'N and longitude 13°00' E and at an altitude of 354m above sea level. The area falls within the Sahelian (semi-arid) region of West Africa which is noted for its great climatic and seasonal variation. It has very short period of rainfall about 3-4 months given 645.9 mm of precipitation per annum with a long dry season of about 8-9 months. The temperature could be as low as 200 °C during the dry cold season (October-January) and as high as 300 °C during the dry hot (February-May) season. Relative humidity is 5% in April and 60% in August; day length varies from 11-12 hours [7].

2.2. Experimental Animals

Two breeds of goat were used for the study (Borno White and Red Sokoto goat). A hundred and sixty goats were used comprising of (80 Borno White and 80 Red Sokoto goats) does were selected at the Maiduguri abattoir and cattle market (Kasuwan shanu). The animals were brought from different parts of the state for sale and slaughter. Matured does were used for the study, the age ranges between 2-5 years of age, and with average body weight of 20-35 kg.

2.3. Data Collection

2.3.1. Udder Measurements

The animals were restrained in a standing position or recumbent position depending on the parameter to be taken. The udder characteristics of each doe was measured postpartum and also during pregnancy. The Udder characteristics were measured using flexible tape, venire caliper, meter rule and weighing balance. As described by (James *et al*, 2000). The body weight, udder and teat characteristics measurements were recoded include; Udder length (UL), Udder width (UW), Udder circumference (UC), and Udder volume (UV). Teat traits included Teat length (TL), Teat width (TW), Distance between teats (DBT), Teat to flow distance (TFD).

- (i) Body weight cm (BW) was obtained by placing them on the weighing balance and the weight was obtained in kg.
- (ii) Udder length cm (UL); these was measured from the base of udder attachment to the abdominal region.
- (iii) Udder width cm (UW); this was measured from the above of the teat at rear of udder.
- (iv) Udder circumference cm (UC); these was measured as the widest point of the udder around it.
- (v) Teat length cm (TL); these was measured as the distance from the upper part of the teat, where it hangs perpendicularly from the Udder to the tip of the teat.
- (vi) Teat width cm (TW); these was taken in the middle of the teat.
- (vii) Distance between teats cm (DBT); these was measured as the distance between the bases of the two teat.
- (viii) Teat to flow distance cm (TFD); this was measured as the distance between teat tips to the ground.

2.4. Milk Sample Collection

2.4.1. Milk Samples

Before the collection the collector hand was sanitized with isopropyl alcohol 70 % ethanol and sterilized gloves were used during collection of the samples to avoid contamination. Milk samples (100ml) were collected in sterile tubes directly from the udder. Milk a sample was collected from 10 does per breed postpartum by hand milking procedure to determine the milk composition of the two breeds of goat. Milk samples immediately being transferred to an ice box before taken for milk quality laboratory analysis. Milk quality was analyzed for fat %, protein %, lactose %, solids non solid fat %, and vitamins %. The samples were taken to Adamawa State University, Mubi. Department of animal production (Nutrition Laboratory) for analysis.

2.5. Determination of milk

Milk samples was analyzed for total solids % (TS), crude protein % (CP), butterfat %, solids-non-fat % (SNF), ash % and lactose % . Total solid % (TS) was obtained by drying about 5.0 g milk sample to a constant weight at 105 °C for 24 hours. Butterfat % was estimated by the Rose Gottlieb method as described by the procedure. Milk protein (N x 6.38) was determined using the semi-micro distillation method using Kjeldahl and Markham's apparatus. Ash content was obtained by drying and ashing a weighed milk sample (10ml) to a constant weight at 550 °C for 48 hours. Lactose content was determined from fresh samples using standard procedure. The difference between TS % and butter fat gives the SNF. The pH of milk samples was determined using a pH meter (Pocket sized, pH-107 ROHS). Milk samples were assessed for bacteriological quality using the Standard plate count, Methylene blue dye reduction test and direct microscopic count. In Standard plate count, colonies of bacteria were counted after incubation of a diluted milk sample in a petri-dish containing a standard agar at 37 °C for 48 hours. One ml (1) of diluted solution of methylene blue dye was added to 10 ml of milk in a test tube; this was set in incubator at 37.6 °C and examined at 2 minutes intervals for color change. The Direct microscopic count carried out using 0.01 ml of milk sample spread uniformly over a ruled area of 1-2cm on a glass slide. This examined under oil immersion objective previously calibrated to determine area of field.

2.6. Statistical analysis

All data generated subjected to analysis of variance using SAS package version 2000. Significant difference was obtained and difference b/w mean separated using Duncan's multiple range. Pearson correlation will be used to determine relationship b/w udder characteristics and body weight.

3. Results and discussion

3.1. Variation of milk composition of two breed of goats

Table 1 presents the variation of milk composition of two breed of goat. It was observed that the crude protein % was significantly ($P < 0.05$) affected by breed. The crude protein was higher in Red Sokoto Goat with the value of ($4.02 \pm 0.04\%$) as compared to Borno White goat ($3.64 \pm 0.10\%$). The value obtained above was higher than the value investigated by Zahraddeen *et al*. [9] who obtained the value for Red sokoto goat as ($3.84 \pm 0.03\%$) followed by Borno White goat ($3.45 \pm 0.03\%$). The breed differences may be due to genetic variation, environmental differences and

management practices. The variation in fat % content was not significantly affected by breed though Red Sokoto goat had the higher value than the Borno white goat with their corresponding values of $(352 \pm 0.22\%)$ and $(3.32 \pm 0.15\%)$ respectively. But this finding was not in line with the findings of Haenlein, [2] who recorded a significant difference in the fat % content. The mean percentage fat content of Red Sokoto, Borno white, and West African dwarf goats obtained by Haenlein, [2] were higher than the value obtained by [8]. Egbowon *et al.* (12) also observed that milk fat % was higher in dual purpose breeds such as Red Sokoto and West African dwarf goats than those selected for milk production alone such as the Saanen.

This was not in line with the finding of Zahraddeen *et al.* [9] who observed that ash content was not affected by breed. Table 2 presents the effect of breed on udder measurement of two breeds of goat. It was observed that there were significant difference ($P < 0.001$). In the values of Udder length, Udder width, Udder Circumference and Udder Volume of the two breeds. With a higher value in Red Sokoto compare to $(12.32 \pm 0.32, 12.09 \pm 0.15, 3.82 \pm 0.17, \text{ and } 3.48 \pm 0.17)$ Borno white have the lower value as $(10.58 \pm 0.16, 10.56 \pm 0.12, 3.48 \pm 0.09 \text{ and } 1.25 \pm 0.54)$. This finding were not in agreement with those recorded previously by Dijkstra *et al* [10]. Who's result shows that these traits were significantly ($P < 0.05$) larger in Borno white goat than in Red Sokoto. Such differences between breeds of goats have been reported earlier by [8]. This difference may be due to the ecological nature, management practice system and genetic characteristics of goats' breeds.

The udder measurement values of the Teat length (TL), Teat width (TW) and Number of teat (NT) of the Red Sokoto is significantly ($P < 0.001$) lower as $(2.26 \pm 0.12, 1.53 \pm 0.12 \text{ and } 2.54 \pm 0.08)$ compared to White borno with $(3.33 \pm 0.06, 2.27 \pm 0.06 \text{ and } 2.62 \pm 0.04)$. This result is in line with that of [8]. Such differences between the two breeds might be due mainly to the differences in genetic make-up of the two breeds. Distance between Teats (DBT) and Teat to Flow Distance (TFD) measurement values of the Red Sokoto

are slightly higher $(4.07 \pm 0.19 \text{ and } 31.02 \pm 0.57)$ than that of the White Borno $(4.06 \pm 0.10 \text{ and } 30.91 \pm 0.29)$ respectively. This finding are similar to that of [9]. Such difference are usually due to the ecological nature, management and genetic difference of the animals. Moreover, Red Sokoto and White borno goats reared on semi-arid rangeland of the northern Nigeria have some effects on the characteristic's mention with our finding and most of the related correlated finding indicated that these effect are more on red sokoto than white borno. There for Red Sokoto goats effect on udder measurement is most pronounce than the white borno Goats.

3.2. Physiological variation of udder and teat measurement on two breed of goat

Table 3 presents the physiological variation of udder and teat measurement of two breed of goat (Red Sokoto and Borno white). It was observed that the body weight of pregnant red sokoto is higher as compared to lactating red sokoto with the value of $26.07 \pm 0.85 \text{ kg}$ and $22.33 \pm 1.55 \text{ kg}$, different trend were observed in Borno white pregnant and lactating does. This may be as a result of increment on the Body weight of the pregnant Red sokoto due to the weight of the fetus and water birth the doe carries before parturition Alkass and Merkhan (13). The udder length (UL) was affected by both pregnant and lactation stage in all the breeds while udder width (UW) was significantly affected only in red Sokoto goats between two stages. Borno white goat was significantly affected in udder volume in all the stages. Were a higher values where obtain during pregnancy, the white borno does has lager udder and teat dimension than red sokoto does. This superiority carried out during lactation. This findings are similar with reports of James [8] who also observed that effect of stage of lactation on overall udder and teat dimension in goat significantly affected [8]. However, successive decrease in udder dimensions during lactation is as a result of intense suckling of kids or milking [11].

Table 1. Variation of milk composition of two breed of goats

Breeds	Protein%	Fat %	Lactose %	Ash%	Casein%	Total solid%
Borno white	3.64 ± 0.10^b	3.32 ± 0.15^{ns}	3.16 ± 0.06^b	0.40 ± 0.06^a	2.43 ± 0.11^{ns}	0.52 ± 0.31^{ns}
Red Sokoto	4.02 ± 0.04^a	352 ± 0.22^{ns}	4.19 ± 0.03^a	0.38 ± 0.01^b	2.51 ± 0.18^{ns}	0.52 ± 0.31^{ns}

Table 2. Effect of Breeds on Udder Measurement of two Breed of Goats

Parameters	Red-Sokoto	Borno - white
UL (cm)	12.32 ± 0.32^a	10.58 ± 0.16^b
UW (cm)	12.09 ± 0.15^a	10.56 ± 0.12^b
UC (cm)	3.82 ± 0.17^a	3.48 ± 0.09^b
UV (m ³)	3.48 ± 0.17^a	1.25 ± 0.54^b
TL (cm)	2.26 ± 0.12^b	3.33 ± 0.06^a
TW (cm)	1.53 ± 0.12^b	2.27 ± 0.06^a
DBT (cm)	4.07 ± 0.19^{ns}	4.06 ± 0.10^{ns}
TFD (cm)	31.02 ± 0.57^b	30.91 ± 0.29^a

Means on the same column followed by different letters differ significantly (A, B, C, = $P < 0.01$; a, b, = $P < 0.05$). UL= udder length, UW= udder width, UC= udder circumference, UV= udder volume, TL= teat length, TW= teat width, DBT= distance between teat, TFD= teat to flow distance.

Table 3. Physiological variation of udder and teat measurement of two breed of goat

Parameters	RS-P	RS-L	WB-P	WB-L
BW (cm)	26.07 ± 0.85 ^a	22.33 ± 1.55 ^b	24.06 ± 0.64 ^{ns}	24.14 ± 0.62 ^{ns}
UL (cm)	12.36 ± 0.31 ^b	12.72 ± 0.42 ^a	10.45 ± 0.23 ^b	10.71 ± 0.23 ^a
UW (cm)	12.25 ± 0.24 ^a	11.93 ± 0.44 ^b	10.60 ± 0.18 ^{ns}	10.53 ± 0.17 ^{ns}
UC (cm)	3.53 ± 0.17 ^{ns}	3.43 ± 0.31 ^{ns}	3.87 ± 0.13 ^{ns}	3.77 ± 0.13 ^{ns}
UV (m ³)	0.98 ± 1.04 ^{ns}	0.93 ± 1.89 ^{ns}	1.72 ± 0.78 ^a	0.77 ± 0.76 ^b
TL (cm)	2.40 ± 0.12 ^a	2.12 ± 0.22 ^b	3.35 ± 0.09 ^{ns}	3.30 ± 0.09 ^{ns}
TW (cm)	1.45 ± 0.12 ^b	1.61 ± 0.22 ^a	2.27 ± 0.09 ^{ns}	2.28 ± 0.09 ^{ns}
TFD (cm)	30.02 ± 0.55 ^b	32.02 ± 1.01 ^a	30.67 ± 0.14 ^b	31.14 ± 0.14 ^a
DBT (cm)	3.91 ± 0.19 ^b	4.22 ± 0.33 ^a	4.10 ± 0.14 ^a	4.03 ± 0.14 ^b

Means on the same column followed by different letters differ significantly (A, B, C, = P < 0.01; a, b, = P < 0.05). UL= udder length, UW= udder width, UC= udder circumference, UV= udder volume, TL= teat length, TW= teat width, DBT= distance between teat, TFD= teat to flow distance.

4. Conclusions

The variation of milk composition of two breed of goats observed that breeds have a significant difference on crude protein % (p < 0.05) with higher value in Red Sokoto goat (4.02 ± 0.04%) followed by Borno white (3.64 ± 0.10%). The breed differences may be due to genetic variation, environmental differences and management practices.

References

- [1] K. El-Hassan, E.-A. El-Abid, A. Nikhaila. (2009). A study on some non-genetic factors and their impact on some reproductive traits of Sudanese Nubian goats. *International Journal of Dairy Science*. 4: 152-158.
- [2] G.F. Haenlein. (2002). Composition of goat milk and factors affecting it. *Small Rumi Res*. 51: 155-63.
- [3] S. Roy, V. Vadodaria. (2006). Goat milk and its importance. *Indian Dairyman* 58: 65-69.
- [4] M. Mamabolo, E. Webb, Goat production survey-fundamental aspects to model goat production systems in Southern Africa. Case study–Agricultural commission-Witfor. In 2005.
- [5] J. Agbede, A. Ologun, J. Alokun. (1997). Udder size and milk production potentials of goats and sheep in the south west of Nigeria. *Nigerian Journal of Animal Production*. 24(1): 175-179.
- [6] B. Harris, R.L. Richter, S. Vernlund. (1996). Dairy goat production guide. University of Florida Cooperative Extension Service, Institute of Food and ...: pp.
- [7] A. Raji, U. Oke, S. Ibe. (2013). Influence of age and sex on productive traits of rabbit in tropics. *Journal of Animal Genetics*. 8: 122-128.
- [8] I. James, O. Osinowo. (2004). Changes in udder size and liveweight 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.
- [9] D. Zahraddeen, I. Butswat, S. Mbap. (2007). Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. *Livestock Research for Rural Development*. 19(11): 166.
- [10] J. Dijkstra, J. France, M. Dhanoa, J. Maas, M. Hanigan, A. Rook, D. Beever. (1997). A model to describe growth patterns of the mammary gland during pregnancy and lactation. *Journal of dairy science*. 80(10): 2340-2354.
- [11] D. Zahraddeen, I. Butswat, S. Mbap. (2009). A note on factors influencing milk yield of local goats under semi-intensive system in Sudan savannah ecological zone of Nigeria. *Parity*. 1: 442.
- [12] B. F. Egbowon, Osinowo, O.A., Biobaku, W.O. and Dipeolu, M. A. (2007). Effect of breed, age, season on milk secretion rate of WAD and Sokoto red goat. *ASSET series A 7(1)*; 13- 17.
- [13] J.E. Alkass, K.Y. Merkhan (2011). Milk production of black and Meriz goats raised under farm production system. *Res Opin Anim J. Vet Sci*. 1: 708-713.