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The Relationship between Milk Constituents of Lactating Ewes and Linear Body Measurements of their Lambs

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Target Audience: Animal Scientists, Dairy Producers, Dairy Researchers

Abstract

The objective of this study was to evaluate the relationship between milk constituents of ewes and linear body measurements of their lambs maintained under a semi-intensive management system. Twenty-eight ewes comprising 10 Yankasa (YAN), 8 West African Dwarf (WAD) and 10 crossbred (YANxWAD) sheep with body weight range of 15-26 kg average age of 2½ years and lambs between 1 and 8 weeks were used for the study at the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State, Nigeria. Milk measurement commenced from a week post-partum to allow lambs have access to their dams' colostrum. The lambs were separated between 7 pm and 7 am from ewes which were then milked dry. The milk constituents determined were protein (PA), fat (FT), ash (AS) and lactose (LA). The linear body measurements of the lambs such as height at withers (HT), body length (BL), heart girth (HG), shoulder width (SW), tail length (TL), neck length (NL), neck circumference (NC), face length (FA), hind leg length (HL), foreleg length (FL), ear length (EA), head width (HW) and rump height (RH). The data were subjected to One-way analysis of variance (ANOVA), the means were separated using Duncan's multiple range test and Pearson correlation and Multiple stepwise regression parameters were estimated using SPSS. Fat and ash were similar for all ewes, while the milk protein and lactose content were affected by genotype. The mean weight (kg) of lambs of West African Dwarf, Yankasa and the West African Dwarf x Yankasa lambs were 4.46 ± 0.21, 5.41± 0.21 and 5.02 ± 0.21, respectively. There was significant effect (P<0.05) of genotype on height at withers, body length, foreleg length, hindleg length, facelength, earlength, tail length and rump height with the Yankasa lambs showing a consistently higher values in these body measurements than either the West African Dwarf and crossbred ewes. Dam's protein content was significantly correlated with lamb's heart girth (0.24; P<0.01) and neck length (0.20; P<0.05). Other parameters that were significantly correlated include dam's fat content and lamb's neck length (0.26; P<0.01) and face length (0.18; P<0.05). Dam's milk ash was significantly but negatively correlated with lamb's tail length (-0.22; P<0.05). Lamb's heart girth and neck length were superior to other linear body measurements in estimating protein and fat content of milk followed by foreleg length and heart girth, respectively while heart girth was superior in estimating lactose content. The best single measurement that can be used to predict ash content was tail length. Generally, accuracy of prediction of compositional traits was low (0.03-0.17), however, lamb's heart girth could be used in the selection of lactating ewe with high quality milk.

Keywords: Milk constituents, lactating ewes, body measurements, lamb

Description of Problem

Sheep milk is a unique product with high nutritional qualities containing more short chain fatty acids, protein, calcium and vitamins than cow's milk (1). The value of sheep milk in human nutrition has so far received very little attention and few information on sheep milk consumption are available (2, 3, 4). Linear body measurements have been used as tools for the characterization of breed, the evaluation of breed's performance, selection and for live weight prediction (5, 6, 7, 8). The accuracy of function used to predict milk yield or milk characteristic from live animal measurements is of immense financial benefit (9). The ability of the producer and buyers of livestock to relate live animals measurements to milk production and growth characteristics is essential for optimum production and value-based trading systems. This ability will also adequately reward livestock farmers rather than the middlemen that tend to gain more profit in livestock production especially in developing countries (10). Studies on the relationship between ewe milk production and body traits have been limited to udder dimensions, suckling behaviour and forage intake in adult sheep. However, the relationship between dam's milk parameters and lamb's linear body measurement is not known. Therefore, this study was designed to evaluate the relationship between milk constituents of ewes and linear body measurements of their lambs maintained under a semi-intensive management system.

Materials and Methods

Twenty-eight ewes comprising 10 Yankasa (YAN), 8 West African Dwarf (WAD) and 10 crossbred (YANxWAD) sheep with body weight range of 15-26 kg average age of 2½ years and lambs between 1 and 8 weeks were used for the study at the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State, Nigeria. The animals were supplied with water and concentrate before grazing. Grazing was done between 10.00am and 2.30pm daily. The concentrate contained maize (15%), brewers dry grain (30%), wheat offal (20%), palm kernel cake (34%), salt (0.5%) and bone meal (0.5%) fed at 200-500 g/head per day. Milk measurement commenced from a week post-partum to allow lambs have access to their dams' colostrum. The lambs were separated between 7 pm and 7 am from ewes which were then milked dry. Each ewe was hand-milked weekly for 8 weeks and the milk samples were taken to laboratory and frozen for at 4^0C until required for analysis. The milk constituents determined were protein (PA), fat (FT), ash (AS) and lactose (LA). Milk samples were thawed and shaken before determining the proximate composition following the procedure of (11). Total solids were determined by drying a weighed amount of samples (approximately 10ml) to constant weight at 105^oC for 24 hours. Fat was determined by the Rose-Gottlieb method. Protein (N x 6.38) was determined with Markham's semi-microkjedahl apparatus. Total ash was determined when a known weight (approximately 5ml) was evaporated to dryness and ashed in a muffle furnace at 500-550°C for 48 hours. Lactose and energy constituents of colostrums and milk samples were estimated as follows:

Solid-not-fat (SNF) = Total solid — fat

Lactose= SNF- (%Protein + %Ash)

Energy (MJ/Kg) = 1.64 + 0.42 (%fat) (Economides. 1986).

Weight (WT) of lambs from the first to eight week of lactation was taken using a hanging scale of 0-100 kg graduation. Each animal was gently restrained while taking the measurements. The linear body measurements of the lambs such as height at withers (HT), body length (BL), heart girth (HG), shoulder width (SW), tail length (TL), neck length (NL), neck circumference (NC), face length (FA), hind leg length (HL), foreleg length (FL), ear length (EA), head width (HW) and rump height (RH) were taken as described by (12).

Statistical analysis

The data were subjected to One-way analysis of variance (ANOVA), the means were separated using Duncan's Multiple Range Test and Pearson correlation and Multiple Stepwise regression parameters were estimated using SPSS.

Results and Discussion

Results of the study indicated that fat and ash contents of milk were similar for three genotypes while the milk protein and lactose content were affected by genotype (Table 1). This is contrary to the findings of (13, 3, 4) who reported significant influence of genotype on ash content. The WAD ewes were significantly ($P<0.05$) superior in protein content. The high protein content in the WAD ewes milk may be due to the decreased milk volume. Similarly, other reports stated that the percentage of protein increases as lactation progresses which indicated a decrease in milk volume (14, 13). The average protein content observed in this study was lower while the lactose content was higher than that reported by (3). The average protein and ash content were comparable to that reported by (15) and (4). The average ash content was lower than that obtained by (16) and (4) but the protein content was higher than that of (3). The average fat content for the three genotypes was lower while the lactose content was higher than that of temperate and other tropical breeds (17, 3, 4). Fat content have been observed to range between 1.77 and 3.13% during partial weaning. The low fat and high lactose content may be due to fibre deficiency and energy surplus which is a common feature of lactating ewes in the tropics (18). The low fat content makes it safe for consumption for health reasons. The WAD ewes were significantly superior in protein content.

There was significant effect ($P<0.05$) of genotype on weight, height at withers, foreleg length, hindleg length, foreleg length, ear length, tail length, and rump height with the YAN lambs showing a consistently higher values than either the WAD and XBD ewes in these body traits (Table 2). The mean weight (kg) of WAD, YAN and XBD lambs were 4.46 ± 0.21, 5.41± 0.21 and 5.02 ± 0.21

respectively. This is higher than those reported for WAD and YAN sheep (3). The offsprings of the WAD breed with the highest value of milk protein and fat content recorded the lowest weight. The reason for this is difficult to explain. The crossbred lambs linear body measurements values were between the values for most of the traits measured for WAD and YAN values. The WAD ewes had the lowest linear body measurements. Dam's protein content was significantly correlated with heart girth (0.24; P<0.01) and neck length (0.20; P<0.05). Other parameters that were significantly correlated include dam's fat content and neck length (0.26; P<0.01) and lamb's face length (0.18; P<0.05) Table 3. This group of body traits (neck, withers, ribs, flanks, thighs and skin) sets apart generations of superior animals from their average contemporaries (19). Ash content was significantly but negatively (P<0.05) correlated with lamb's tail length (-0.22; P<0.05). Residual phenotypic correlations among lamb's linear body measurements were all positive except neck length. Among the linear body measurements, the most significant correlation existed between lamb's weight and heart girth (0.85; P<0.05) (Table 3). Body measurements were found to be strongly associated with body weight in sheep and among body measurements except neck circumference which was lowly correlated with weight. This is consistent with the findings of (20). A high, positive and significant correlation between chest girth and body weight and among body measurements has been reported in adult sheep (10).

Table 1 Milk constituents of West African Dwarf, Yankasa and the crossbred dams

Constituents (%)	WAD	Yankasa	WAD xYankasa	Overall mean (pooled)
Protein	6.06 ± 0.20^{a}	5.16 ± 0.23^{b}	5.02 ± 0.21^{b}	5.41 ± 0.12
Fat	2.18 ± 0.12	2.00 ± 0.15	1.92 ± 0.13	2.03 ± 0.08
Ash	0.87 ± 0.06	0.71 ± 0.07	0.76 ± 0.06	0.76 ± 0.06
Lactose	6.86 ± 0.53^{b}	8.85 ± 0.06^{a}	7.90 ± 0.51^{ab}	7.88 ± 0.33

[abc] Different superscripts indicate significant difference along the rows

Results of stepwise regression analysis are presented in Table 3. Heart girth was superior to other body measurements in estimating milk protein in lactating ewes with a low coefficient of determination of 6%. This was followed by fore leg length. The inclusion of fore leg length added 0.07 to the improvement of protein content in lactating ewes. Neck length (7%), tail length (5%) and heart girth (3%) were the best predictor of fat, ash and lactose content in the three genotypes. It is obvious that the best single measurement that can be used to predict milk component is heart girth. Heart girth has been associated with live weight and is more environmentally sensitive as it responds to environmental components such as feed and management (21).

Table 2 Lamb's weight (kg) and body measurements (cm) of three breeds of sheep

Body traits	WAD	Yankasa	WAD xYankasa	Overall mean (pooled)
Weight	4.64 ± 0.21^{b}	5.41 ± 0.21^{a}	5.02 ± 0.21^{ab}	5.02 ± 0.12
Height at withers	39.38 ± 0.56^{c}	43.91 ± 0.56^{a}	41.80 ± 0.56^{b}	41.70 ± 0.32
Body length	31.78 ± 0.59^{b}	33.59 ± 0.59^{a}	31.83 ± 0.59^{b}	32.40 ± 0.34
Neck length	14.12 ± 0.36	14.57 ± 0.36	14.67 ± 0.36	14.45 ± 0.21
Neck circumference	21.13 ± 0.57	21.02 ± 0.57	19.94 ± 0.57	20.69 ± 0.33
Heart girth	41.02 ± 0.63	42.51 ± 0.63	41.31 ± 0.63	41.61 ± 0.36
Foreleg length	26.94 ± 0.34^{c}	30.12 ± 0.34^{a}	28.40 ± 0.34^{b}	28.45 ± 0.20
Hind length	31.08 ± 0.50^{b}	33.44 ± 0.50^{a}	33.34 ± 0.50^{a}	32.62 ± 0.29
Face length	12.36 ± 0.25^{b}	12.94 ± 0.25^{ab}	13.22 ± 0.25^{a}	12.84 ± 0.14
Ear length	8.64 ± 0.14^{b}	9.46 ± 0.14^{a}	9.05 ± 0.14^{b}	9.05 ± 0.08
Head width	7.51 ± 0.14	7.68 ± 1.14	7.44 ± 1.41	7.54 ± 0.08
Shoulder width	10.95 ± 0.30	10.97 ± 0.30	10.30 ± 0.30	10.74 ± 0.18
Tail length	17.27 ± 0.46^{c}	21.77 ± 0.46^{a}	19.13 ± 0.46^{b}	19.39 ± 0.26
Rump height	40.74 ± 0.59^{c}	45.38 ± 0.59^{a}	43.64 ± 0.59^{b}	43.26 ± 0.34

^{abc} Different superscripts indicate significant difference along the rows

Table 3. Multiple stepwise regression equations relating dam's milk composition, lamb's weight and body measurements

Milk constituent	Regression equation	R	R^2
Protein	4.870 + 0.105HG – 0.128FL	0.362	0.131
Fat	1.870 + 0.088 NL – 0.092 HG + 0.061BL + 0.074 FA	0.409	0.167
Ash	1.185 – 0.022 TL	0.220	0.050
Lactose	19.510 – 0.383 HG + 0.894WT	0.280	0.079

HG= Heart girth, FL=Foreleg length; NL=Neck length; BL=Body length; FA=Facelength, TL=Tail length; WT=Weight

Conclusion and Application

1 The West African Dwarf ewes were significantly superior in protein content.

2 Lamb's heart girth could be used in the selection of lactating ewe with high quality milk.

References

1 Alfa-Laval, A.B. (1980). *Dairy Handbook*. Alfa-Laval A.B. Publishing Company. Sweden.

2 Akinsoyinu, A.O., Mba, A.U. and Olubajo, F.O. (1977). Studies on milk yield and composition of the West African Dwarf goat in Nigeria. *Journal of Dairy Science.* 44: 57 – 62.

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

4 Adewumi, O.O. Alokan, J.A. and Ologun, A.G. (2005). Milk yield, chemical constituents and stage of lactation in sheep. *Proceeding of the 10th Annual Conference of Animal Science Association of Nigeria.* University of Ado-Ekiti, Ekiti State, Nigeria. September, 12th-15th. Pg 240-241.

5 Chineke, C.A. (2001). Interrelationships existing between body weight and egg production traits in Olympia Black layers. *Nigerian Journal for Animal Production.* 28:1-8.

6 Salako, A.E. and Ngere, L.O. (2002). Application of multi-factorial discriminant analysis in the morphometric structure differentiation of West African Dwarf (WAD) and Yankasa sheep in south West Nigerian. Nigeria. *Journal of Animal Production.* 29:163-167.

7 Adewumi, O.O., Alokan, J.A. and Ologun, A.G. (2003). The relationship between some body measurements and milk yield of lactating ewes. *Journal of Agriculture, Forestry and Fisheries.*4:44-48.

8 Adewumi, O.O., Ologun, A.G. and Alokan, J.A. (2006). Phenotypic variation and correlation among milk yield and physical body characteristics of Yankasa and Yankasa X WAD ewes. *African Journal of Science.* 5:39-43.

9 Sakult, H. and Boylan, W.J. (1992) Lactation curves for several US sheep breeds. *Journal of Animal Production*. 54 :229-233.

10 Afolayan, R.A., Adeyinka, I.A. and Lakpini, C.A.M. (2006). Prediction of live-weight from objective live-dimensional traits in Yankasa sheep. Proceedings of the 31st Annual Conference of the Nigerian Society for Animal Production (NSAP). Bayero University, Kano. March 12th – 15th. Pg 9-11.

11 Association of Analytical Chemists (1990). Official Methods of Analysis. Association of Analytical Chemist.

12 Adewumi, O.O. Chineke, C.A., Alokan, J.A., James, I.J. and Akinola, O.A. (2011). The effects of genotype and week of lactation on milk yield, udder dimensions and linear body measurements of non-dairy ewes. *Nigerian Journal of Animal Production* 38: 9-17.

13 Rami, T., Kridli, Abdullah Y. Abdullah, Moh'd Momani Shaker and Nawzat M. Al-Smadi (2006). Reproductive performance and milk yield in Awassi ewes following crossbreeding. doi:10.1016/j.smallrumres.2006.05.007

14 Sevi, A. M. Albenzio, R. Marino, A. Santillo and A. Muscio (2004). Effect of lambing season and stage of lactation on ewe milk quality, *Small Ruminant. Research* 51: 251–259.

15 Malau-Aduli,A.E.O and Anlade, Y.R. (2001). Variations and correlation in the composition of bovine, ovine and caprine milk. *Proceeding of the 26th Annual Conference of Animal Science Association of Nigeria,* pp: 7-9.

16 Ibeawuchi, T.O. Ahamefule and I.A. Ringim (2003). The influence of lactation stage on the milk constituents of Sahelian goats. *Nigerian Journal of Animal Production.* 30:259-264.

17 Simos, E.N., E.M. Nikolaou, P.E. Zoiopoulos (1996). Yield, composition and certain physiocochemical characteristics of milk of Epirus mountain sheep breed. *Small Ruminant Research* 1996: 67-74.

18 Alphonsus, C., Akpa, G.N., Barje, P.P., Nwagu, B.I. Orunmuyi, M. Agubosi, O.C.P. and Mukasa, C (2012). The variation of milk fat-protein ratio within the first 120 day lactation of Friesian x Bunaji cows. *Proceedings of the 31st Annual Conference of the Nigerian Society for Animal Production (NSAP).* University of Agriculture, Makurdi, Nigeria 37: 80-83.

19 Stultz, J. (1980) Dairy Character Defined. *Journal of Dairy Science.*, 63:1925-1937.

20 Ibeawuchi, T.O. Ahamefule and I.A. Ringim (2003). The influence of lactation stage on the milk constituents of Sahelian goats. *Nigerian Journal of Animal Production.* 30:259-264.

21 Salako A.E (2004). Maturity rate of some morphometric traits in the West African Dwarf Sheep of Nigeria. *Tropical Journal of Animal Science* 7(1): 51-55.