



**Phenotypic Correlations of Body Weight, Milk Yield with Udder and Teat Measurements in Three Nigerian Breeds of Sheep.**

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**Abstract**

*This study was conducted at the Livestock Teaching and Research Farm of the Department of Animal Science, University of Maiduguri, Borno State to determine the phenotypic correlations of body weight, milk yield with udder and teat measurements in three nigerian breeds of sheep. A total of 36 ewes, comprising of 12 each of Uda, Yankasa and Koroji breeds were used for the study which lasted for 18 months. The ewes aged two to three years were procured from Maiduguri cattle market and quarantined for two weeks. Each was replicated three times in a group of four animals per pen with a healthy matured ram of the selected breed for breeding purpose, the ewes were tagged for easy identification. Milk yield was measured daily using a measuring cylinder (in mls). The ewes were hand milked once daily between 7 and 9 am, till dry. Body weight, Udder and Teat dimensions were measured every two weeks using flexible rope, metre rule and tape from four days postpartum. The data collected were analyzed using the SPSS package version 21. The results showed that milk yield did not significantly correlate with ewe weight and most udder traits in all the breeds except udder volume ( $r = -0.281$ ) in Koroji breed and, left and right teat lengths ( $r = 0.46$ ,  $P < 0.05$ ) in Uda. The correlations between ewe weight and all the udder traits were mostly high and positive in Koroji and Uda breed except teat width. The wide inter individual variations in milk production, body live weight, udder and teat measurements in ewes identifies the impact of heavy and low body weight on sheep breed, milk production levels and related changes. Thus, milk yield is not a function of ewe weight and all the udder traits in all the breeds except udder volume in Koroji breed and, left and right teat length in Uda.*

**Keywords:** Parity, Milk, correlations, Body weight, Udder, Teat measurements, Sheep.

**Introduction**

In Nigeria there are generally four native breeds of sheep which are Balami, Uda, Yankasa and West African Dwarf (WAD). However, Koroji breed of sheep is predominantly found in Borno and Yobe states. They are mostly kept for meat, skin, and their potential for milk has not been harnessed in many parts of Nigeria. The variation in performance among breeds of sheep provides the possibility for selection of breeds best suited to various production objectives such as environment and management systems (Dikerson, 1978). The anatomy and morphology of the sheep (*Ovis aries L.*) udder is well known for many years due to many

scientific reports (Sagi and Morag, 1974; Carretero *et al.*, 1999 and Pulina *et al.*, 2009). The anatomical structure of mammary gland determines milk yield (Casu *et al.*, 2008 and Sadeghi *et al.*, 2013) and milking ability (Marnet and McKusick, 2001; Makovicky *et al.*, 2012). Animals that store a large proportion of milk in the gland cistern produce more milk, and are more able to tolerate extended milking intervals (Salama *et al.*, 2003, Ayadi *et al.*, 2009 and Castillo *et al.*, 2009). The udder characteristics are not the most important traits of the milking sheep but could have strong effects on milk yield and composition (Ugarte and Gabina, 2004). The improvement of udder traits could therefore be beneficial to milking

ability and animal health. Moreover, deep and well attached udders are highly correlated with milk production in sheep (Legarra and Ugarte, 2005., Altincekic and Koyuncu, 2011). The Knowledge of mammary morphological traits in meat breeds and their relationship with milk production should be of special interest for rearing ability and dairy potentiality and yield diversification of some breeds traditionally considered for meat purpose (De la Barra *et al.*, 2010).

James and Osinowo (2004) reported that changes in udder sizes of WAD, Red Sokoto and Sahel goats during lactation and their phenotypic relationship with daily milk yield and udder traits were found to be good indicators of milk yield. Furthermore, they reported that udder width (UW), udder circumference (UC), udder volume (UV), distance between the teats (DBT) and teat circumference (TC) could be used for predicting indirect response to milk production if genetic basis is established. Local sheep breeds in Nigeria have the potential to supply a significant portion of the milk deficit in the country because they exceed cattle in number in both rural and urban communities. This can be achieved by creating a data base on their milking potentials and identifying those factors that can influence their productivity. This study was conducted to determine the phenotypic correlations among body weight, milk yield and, udder and teat measurements in sheep.

## Materials and Methods

### Experimental Site

The study was conducted at the Livestock Teaching and Research Farm of the Department of Animal Science, University of Maiduguri, Borno State. Maiduguri is located within the Sahelian (semi-arid) region of West Africa. The area is situated on latitude 11.51° N and longitude 13.05° E at an average elevation of 354 m above sea level in the North Eastern part of Nigeria (NOAA, 2016). The region is characterized by three distinct seasons namely: Wet (June-September), dry

cold (October- January) and dry hot (February-May). The hottest season is between April and May, which is characterized with bright sunny day and the atmospheric temperature fluctuates between 40<sup>0</sup> and 45<sup>0</sup>C (Weather and climate.com, 2010-2020). During the rainy season, the temperature may drop to about 30<sup>0</sup>C or less. The peak of rainfall is in August where precipitation may exceed 198.6 mm while the relative humidity may reach up to about 45% in the wet season which drops to about 5-10% during the dry cold season (NOAA, 2016).

### Experimental Animals and Management

A total of 36 ewes and 3 rams, comprising 12 each of Uda, Yankasa and Koroji breeds were used for the study. The ewes, aged between two and three years (teeth dentition was used) were procured from Maiduguri cattle market and quarantined for two weeks during which they were monitored and observed for possible defects and abnormalities. They were dewormed with levamisole against helminths. Ectoparasite infestations were treated by administering Ivomectin® injection. The ewes were later separated and grouped into three according to breed as treatment in a complete randomized design. A healthy matured ram of each breed were included in each of the pens for breeding purpose. The ewes were tagged for easy identification and data collection.

### Data Collection

#### Milk yield

Ewes that parturited were milked daily commencing four days postpartum to give lambs access to sufficient colostrum. The ewes were hand milked once daily between 7 and 9 am, and measured daily using a measuring cylinder (in mls) till they dry. The nursing ewes were allowed to graze together with their lambs from 9 am to 12 noon and later separated till following morning.

#### Body weight and Udder Dimensions

Udder dimensions were measured every two weeks using flexible canvas tape, rope and

metre rule calibrated in centimeters from four days postpartum. The following variables were recorded;

- i. Udder length (UL): The distance between the base of udder attachment to the abdominal region and the point of teat protrusion from the udder.
- ii. Udder width (UW): The distance between the widest points of the udder
- iii. Udder circumference (UC): The distance (perimeter) round the widest point of the udder.
- iv. Udder volume (UV): This was obtained using James and Osinowo (2004) formula as:

$$\text{Udder volume (UV)} = \frac{4}{3} \pi r^3$$

$$\text{Where } r = \frac{UL+UW}{4}, \quad \pi = \frac{22}{7},$$

UL= udder length,  
UW= udder width

The teat measurements were as follows:

- i. Teat length (TL): The distance between teat tip and base of attachment to the udder
- ii. Teat width (TW): The distance between the widest points of the teats (middle)
- ii. Teat circumference (TC): The distance round the widest points of the teats.
- iv. Distance between teats (DBT): The distance between the tips of the teats.

### Statistical Analysis

Data collected during the study were analysed using the Pearson’s correlation sub route of the SPSS package (Version 21), to estimates correlation coefficients among the traits for each breeds. The experiment lasted for 19 months.

### Results and Discussion

**Table 1: Phenotypic Relationship Among Milk Yield, Ewe Weight and with Udder Measurements in Yankasa breed**

MY	WGT	UL	UW	UC	UV	LTL	RTL	TW	TC
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The phenotypic relationship among milk yield and ewe weight with udder and teat measurements are shown in Tables 1, 2 and 3 in Yankasa, Koroji and Uda breeds, respectively. The results show that milk yield did not significantly correlated with ewe weight and all the udder traits in all the breeds except with udder volume ( $r = -0.281$ ) in Koroji breed, left teat length ( $r = 0.46, P < 0.05$ ) and right teat length ( $r = 0.46, P < 0.05$ ) in Uda. The correlations between ewe weight and all the udder traits were mostly high and positive in Koroji and Uda breed except teat width. There was a positive and significant correlations between ewe weight and udder length ( $r = 0.308, P < 0.05$ ), udder circumference ( $r = 0.318, P < 0.05$ ), Udder volume ( $r = 0.269, P < 0.05$ ) and teat circumference ( $r = 0.464, P < 0.01$ ).

Udder length and udder width exhibited mostly high, positive and significant correlations with the other traits in Yankasa and Uda breeds except for teat width with udder length, udder width and udder length, udder width, respectively. Correlations between udder length and udder width and all other traits were generally high, positive and significantly correlated ( $P < 0.01$ ) in all the breeds.

Similarly, there was a positive and significant relationship between udder circumference and udder volume ( $P < 0.01$ ) with all the traits across the breeds except for teat width in Yankasa and Uda breeds. The right and left teat lengths were all positively correlated with the other traits except for teat width in Uda breed. Teat width was negatively correlated ( $r = -0.038$ ) with teat circumference in Yankasa breed. High, moderate and low positive correlations were observed between the udder and teat traits in all the breeds except for teat width in Yankasa and Uda breeds.

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<b>MY</b>	1	0.237	0.161	-0.092	0.063	-0.043	-0.018	0.066	-0.031	-0.001
<b>WGT</b>		1	0.308*	0.197	0.318*	0.269*	-0.081	0.068	-0.109	0.464**
<b>UL</b>			1	0.877**	0.892**	0.888**	0.461**	0.368**	0.209	0.561**
<b>UW</b>				1	0.933**	0.927**	0.594**	0.500**	0.154	0.649**
<b>UC</b>					1	0.894**	0.630**	0.600**	0.12	0.628**
<b>UV</b>						1	0.509**	0.409**	0.153	0.624**
<b>LTL</b>							1	0.918**	0.385**	0.385**
<b>RTL</b>								1	0.374**	0.363**
<b>TW</b>									1	-0.038
<b>TC</b>										1

\*Significant (P<0.05),\*\* Significant (P<0.01). Key: MY= Milk yield, WGT=Weight, UL=Udder length, UW= Udder width, UC= Udder circumference, UV= Udder volume, LTL= left Teat Length, RTL= Right Teat Length, TW= Teat width, TC= Teat circumference

**Table 2: Phenotypic Relationship Among Milk Yield, Ewe Weight Milk Yield with Udder Measurements in Koroji breed**

	<b>MY</b>	<b>WGT</b>	<b>UL</b>	<b>UW</b>	<b>UC</b>	<b>UV</b>	<b>LTL</b>	<b>RTL</b>	<b>TW</b>	<b>TC</b>
<b>MY</b>	1	0.093	-0.205	-0.254	-0.224	-0.281*	-0.173	-0.144	-0.160	-0.010
<b>WGT</b>		1	0.440*	0.316*	0.385*	0.271*	0.308*	0.416**	0.173	0.523**
<b>UL</b>			1	0.900**	0.829*	0.913**	0.756*	0.785*	0.637*	0.474**
<b>UW</b>				1	0.795*	0.952**	0.709*	0.783*	0.517**	0.322*
<b>UC</b>					1	0.888**	0.584*	0.636*	0.616*	0.596**
<b>UV</b>						1	0.732*	0.766*	0.600*	0.375**
<b>LTL</b>							1	0.948*	0.660*	0.388**
<b>RTL</b>								1	0.656*	0.473**
<b>TW</b>									1	0.550**
<b>TC</b>										1

\*Significant (P<0.05),\*\* Significant (P<0.01). Key: MY= Milk yield, WGT=Weight, UL=Udder length, UW= Udder width, UC= Udder circumference, UV= Udder volume, LTL= left Teat Length, RTL= Right Teat Length, TW= Teat width, TC= Teat circumfe

**Table 3: Phenotypic Relationship among Milk Yield, Ewe Weight with Udder Measurements in Uda breed**

	MY	WGT	UL	UW	UC	UV	LTL	RTL	TW	TC
MY	1	0.193	0.130	0.031	0.093	0.160	0.460*	0.460*	-0.108	-0.200
WGT		1	0.791**	0.856**	0.734**	0.776**	0.681**	0.687**	0.318	0.545**
UL			1	0.903**	0.914**	0.969**	0.628**	0.621**	0.304	0.605**
UW				1	0.906**	0.850**	0.530*	0.547**	0.303	0.589**
UC					1	0.833**	0.675**	0.676**	0.113	0.593**
UV						1	0.562**	0.543**	0.295	0.514*
LTL							1	0.987**	-0.131	0.511*
RTL								1	-0.100	0.522*

\*Significant ( $P < 0.05$ ), \*\* Significant ( $P < 0.01$ ). Key: MY= Milk yield, WGT=Weight, UL=Udder length, UW= Udder width, UC= Udder circumference, UV= Udder volume, LTL= left Teat Length, RTL= Right Teat Length, TW= Teat width, TC= Teat circumference

The correlation between milk yield with all the udder traits in all the breeds were not significant except for udder volume which was negative and low ( $r = -0.281$ ,  $P < 0.05$ ) in Koroji breed. However, the relationship between milk yield and both teat length and width were positive and significant ( $P < 0.05$ ) ( $r = 0.460$  and  $0.460$  respectively) in Uda. Similar results were reported by Fernandez *et al.* (1995) that milk yield effect rarely had significant relationship with teat measurements. Whereas, Maria *et al.* (2011) reported that mammary traits that showed significant linear correlations with milk yield were udder circumference ( $r = 0.40$ ) and udder width ( $r = 0.22$ ). The rest of the morphological traits were not affected by breed factor, despite milk yield differences between Chilota and Suffolk Down sheep. Similarly Darwin *et al.* (2020) observed that udder width, teat width and teat length were not correlated with milk yield in Pelibuey ewes. Emediato, *et al.* (2008) reported positive correlations between milk yield and udder circumference, udder depth and udder width ( $r = 0.74$ ,  $0.75$  and  $0.62$ , respectively) in Bergamasca ewes. Ayadi *et al.* (2011) evaluated mammary morphology and milk production in Sicilian Sarde dairy sheep milk yield and reported a positive and significant correlations with udder volume and udder length.

The values of the analyzed morphological traits in the present study for all the three breeds in relation to milk yield were below the values reported for West African Dwarf sheep (Adegoke *et al.*, 2015), polish Merino and polish Lowland sheep (Krystyna, 1993) and Awassi breed (Inguez *et al.*, 2009). Small teats could make difficult ewe milkability, although a teat size increase can be expected by milk yield selection. There is a need to continually strive to improve the economically important traits of milk yield and udder conformation in order to produce sheep with better milking performance and reduced milking labor costs in the future. This is because shape and size of the udder and teat have been shown to be related to milk yield and milk flow rate in dairy sheep (Darwin *et al.*, 2020). Most of the Udder measurements considered are good predictors of performance in other breeds such as Lacauna sheep (Labussiere, 1988), Chois (Mavrogenis and Papachristoforou, 1990), East Fresian (Mckusick *et al.*, 1999), Bergamasca sheep (Emediator *et al.*, 2008), Zelazna sheep (Charon 1990) and Churra ewes (Fernandez *et al.*, 1995).

The high, positive and significant correlation between the udder circumference and width ( $r = 0.79$ ,  $0.97$  and  $0.93$ ) in Koroji, Uda and Yankasa respectively, are similar with the findings of Inguez *et al.* (2009) and Fernandez *et al.* (1995) in Awassi and Churra ewes



respectively. Udder morphological measurements, their relationships with milk production traits and their usefulness for genetic improvement have been reported in different sheep breeds (Iniguez *et al.*, 2009 and Pourlis, 2020). Most of the correlations coefficients were not large enough to be useful as a phenotypic predictor of milk yield, however right teat length and left teat length as well as udder volume were statistically important in Uda and Koroji respectively, and considered good predictors. Similarly Iniguez *et al.* (2009) reported that udder circumference and teat width has been shown to be significantly correlated with total milk yield and are considered good predictors of performance in several sheep breeds. Consequently Casu *et al.* (2008), Altincekic and Koyuncu, (2011) and Legarra and Ugarte (2005) had also reported that improvement of udder traits are beneficial to milking ability

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and animal health as deep and well attached udders are highly correlated with milk production in sheep.

## Conclusion

Milk yield is not a function of ewe weight and all the udder traits in all the breeds except udder volume in Koroji breed, left and right teat length in Uda. Ewe's body weight is a measure of all udder measurements except teat width in Koroji and Uda breeds whereas in Yankasa breed udder length, udder circumference, udder volume and teat circumference were positively correlated with ewe body weight. Therefore, body weight and udder characteristics are not the most important traits of the milking sheep but could have strong effects on milk yield and composition.

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