Effect Of Parity And Birth Type On Udder Characteristics And Milk Yield Of West African Dwarf Sheep

Adegoke, E.O. Ezekwe, A.G. Agaviezor, O.B.

Abstract: Twelve West African Dwarf (WAD) sheep, four in each of parities one, two and three were used to determine effect of parity and birth type on udder characteristics and milk yield during lactation and their phenotypic relationship. Udder length (UL), udder width (UW), udder circumference (UC), udder volume (UV), teat length (TL), teat width (TW), teat circumference (TC), distance between the teat (DBT) and teat height from the ground (THG) of sheep were measured weekly for the twelve weeks of lactation commencing from four days post partum. Result showed that, parity and birth type effects on udder characteristics and milk yield were highly significant (P < 0.01).Twin bearing ewes in the third parity had significantly highest values (cm) of 9.56±0.16, 9.75±0.16, 42.29±0.89, 2.05±0.11, 1.32±0.06, 3.42±0.15, 488.59±34.28, 7.26±0.07, 26.46±0.25 for UL, UW, UC, TL, TW, TC, UV, DBT and THG respectively while single bearing ewe in the first parity had the least values (cm) of 7.22±0.26, 8.26±0.21, 32.17±1.06, 1.22±0.05, 0.87±0.04, 2.33±0.11, 263.63±24.36, 6.23±0.07, 23.57±0.38 for UL, UW, UW, UC, TL, TW, TC, UV, DBT and THG respectively. The UL, TL, TC, TW, DBT and THG of single bearing ewes in the third parity had significantly higher values (cm) of 8.60±0.09, 1.73±0.11, 1.17±0.05, 3.20±0.11, 6.96±0.08, 25.49±0.28 than twin bearing ewes in the second parity with 8.05±0.23, 1.62±0.10, 1.07±0.04, 2.56±0.14, 6.66±0.10, 25.00±0.46 for same udder characteristics. Similarly, the parity and birth type effect on milk yield was highly significant (p< 0.01). Twin bearing ewes in the third parity had significantly (p 0.01) highest value (ml) of 249.09±14.85 per day, followed by single bearing ewes in the third parity with 208.08±14.64 ml per day while single bearing ewes in the third parity had the least milk production p of 124.54±8.79 per day. The correlation coefficient between udder dimensions and milk yield obtained were; 0.92, 0.79, 0.91, 0.92, 0.86, 0.88, 0.60, 0.08 and -0.24 for UL, UW, UC, TL, TW, TC, UV, DBT and THG respectively.

Keywords: Parity, birth type, udder, ewe, milk yield

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INTRODUCTION

The shortage of animal protein is a common problem facing many tropical countries including Nigeria (14). It was reported by **(**4) that the supply of animal protein for human consumption in Nigeria was below the demand. Despite the numerous advantages associated with the consumption of animal protein, the minimum intake recommended by (13) has not been met in most developing countries. McGee (19) reported that meat was assumed to be the only product from cow when it was domesticated, whereas other dietary products from cattle included milk and its products. Adewumi and Olorunsomo (3) pointed out that increasing demand for milk and its products in Nigeria had made it imperative to look for other sources of milk apart from cattle. According to the authors, local milk production has consistently fallen short of demand over the years, especially in urban centres leading to massive importation of milk and milk products. Continuous dependence on imported milk has led to increase in cost of milk thereby pushing these products beyond the reach of the average Nigerian. Hence, it is necessary to look for alternative sources of milk for local consumption. Local sheep breeds in Nigeria have potentials to supply a significant portion of the milk deficit in the country because sheep numbers far

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exceed cattle numbers in both rural and urban communities (23); (2). They are also more affordable to resource-poor families and produce more milk in relation to body size than cattle (20). The composition of different kinds of milk as reported by George (15) shows that the nutritional value of sheep milk with 19.30 % solids, 7 % fat, 5.98 % protein, 193 mg calcium, and 108 kcal is superior in quality to that of cow and goat with 12.01 % and12.97 % solids, 3.34 % and 4.14 % fat, 3.29 % and 3.56 % protein, 119 mg and 134 mg calcium and 69 kcal, respectively. There is therefore need to increase milk production from the sheep. Apart from dry season feeding which was reported to be a major constraint confronting ruminant production in Nigeria (6); (1), (10) reported that low genetic potential is also a prominent constraint to ruminant production. According to the authors most indigenous breeds of small ruminants in the tropics have not been selected for high productivity. The low genetic potential of WAD sheep and goat is often quoted as a major constraint to meat and milk production in Sub-Saharan Africa, hence the need for animal improvement programme.

Materials and Methods

The study was conducted at the small ruminant unit, Department of Animal Science Teaching and Research farm, University of Nigeria, Nsukka, south-eastern Nigeria. Nsukka is located on longitude 6° 25' N and Latitude 7° 24' E (21) at an altitude of 430m above sea level (7). The climate is a typical humid tropical setting with a relative humidity range of 56.01-103.8%. Average diurnal minimum temperature ranges from 22^0 C- 24.7^0C, while the average maximum temperature ranges between 33^0C-35^oC (21); (12). Twelve West African Dwarf (WAD) ewes of different parities (1-3) with average weight of 18 kg were used for the study. The animals were dewormed with a levamisole product against helminths. Ectoparasitc infestations were controlled by bathing the animals with a solution of

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diazuntol[R]. They were also vaccinated against *Peste des Petis Ruminantes* (PPR) using PPR vaccine. The animals were managed semi-intensively. They were allowed to graze on mixed pasture comprising *Panicum maximum*, *Pennisetum purpureum* and *Centrocema pubescence* for six to eight hours daily, and were given 0.5kg per head of feed supplement consisting of wheat offal, dry brewer's grain, bone meal and common salt. Animals were housed in cross ventilated pens with slated floors. They were given access to water *ad libitum.* During gestation, udder dimensions were measured monthly using flexible canvas tape. Following parturition, udder dimensions were measured weekly for 12 weeks commencing from 4 days post partum .The following were the measurements taken;

1. Udder length (UL): The distance between the base of udder attachment to the abdominal region and the point of teat protrusion from the udder.
2. Udder width (UW): The distance between the widest points of the udder
3. Udder circumference (UC): The distance (perimeter) round the widest point of the udder.
4. Teat length (TL): The distance between teat tip and base of attachment to the udder
5. Teat width (TW): The distance between the widest points of the teats (middle)
6. Teat circumference (TC): The distance round the widest points of the teats.
7. Distance between teats (DBT): The distance between the tips of the teats.
8. Udder volume (UV): This was derived using the formula:
   $UV = 4/3\ \pi r^3$

Where $\pi = 22/7$

$r = \dfrac{UL+UW}{4}$ (17)

9. Teat height from ground (THG): The distance between teat tip and base of attachment to the udder.

All ewes were milked after udder dimensions had been taken. The milking frequency was once weekly for 12 weeks commencing from four days post partum. On the evening of the day preceding milking, the lambs were separated from their dams over night (12 hours) and the ewes were hand milked the following morning. The milk obtained was defined as the partial daily milk yield (PDM), which is a combination of milk off take and 12-hours milk yield. The PDM (in ml and g) was measured with a calibrated cylinder and electronic weighing scale. All measurements were taken in the morning on the days of data collection. The live weights of ewes were also measured and monitored concurrently with udder size and milk yield measurements on the days of data collection. Milk samples were taken from each ewe every week throughout the whole period of lactation.

Statistical analysis

The data generated was analysed using two ways analysis of variance (ANOVA) (Steel and Torrie, 1980), using the model

$Y_{ijk} = \mu + P_i + B_j + (PB)_{ij} + E_{ijk}$

Where:

Y_{ijk} = Observation of dependent variable k of the ith parity, j^{th} lambing

μ = The overall mean of all observation

P_i = Effect of ith parity (i =1-3)

B_j = Effect of jth Birth type (j = 1-2)

$(LB)_{IJ}$ = The interaction between parity and birth type

E_{ijk} = Random error

Significant means were separated by Duncan's multiple range tests using (23) statistical package.

Results and discussion

Table 1 shows the proximate composition (g/100gDM) of supplemental diet fed WAD Sheep. The result obtained on the study of udder characteristics during lactation showed that udder characteristics of WAD sheep during lactation were influenced by the birth type and parity. Twin bearing ewes' udders were more developed than that of single bearing ewes (Table 2). This finding is in consonance with the finding of (5) who reported that twin-bearing ewes had bigger udders than single bearing ewes at Days -10 and -3 of pregnancy and the full and empty udders were bigger in twin bearing compared with single bearing ewes. This result also is in agreement with the report of (8) and (25) that ewes bearing multiple foetuses have higher placental weight and higher serum progesterone and more placental lactogen hormones during pregnancy. Consequently their mammary glands are better developed during pregnancy and at parturition. This could be attributed to the fact that the mammary glands are suckled more frequently by twins than by one lamb. Similarly, ewes in the first parity had least udder development and growth, followed by ewes in second parity while those in third parity had the most developed udder during lactation. Twin bearing ewes in third parity had highest values for all udder characteristics while single bearing ewes in the first parity had the least values for all udder characteristics (Tables 2 - 4). Stanton *et al*, (26) observed the same effect in dairy cows and suggested that this pattern could be due to the fact that the body and mammary gland of young animals are still developing during the first lactation. The result obtained from the study on milk yield revealed that Milk yield of ewes in the third parity was significantly higher than those of ewes in the first and second parities (Table 5), while those of ewes in the second parity were also significantly higher than that of ewes in the first parity. Therefore, milk yield increased with increase in parity number. This result is in consonance with the findings of *(*9) who reported highest milk yield for ewes in third parity, followed by ewes in second parity and the least by those in first parity. The milk yield of twin bearing ewes was significantly higher than the milk yield of single bearing ewes. This result supports the findings of (8) and (25) that ewes bearing multiple foetuses have higher placental weight and higher serum progesterone and more placental lactogen hormones during pregnancy. The higher average serum progesterone levels during pregnancy means that mammary glands are better developed at parturition as can be seen from the greater number of mammary cells and their increased synthetic activity (18). Table 5 shows the variation in milk yield. The observed higher milk yield in twin bearing ewes could be attributed to the fact that the mammary glands were suckled more frequently by twins than by one lamb. This result is also in consonance with the findings of *(*9) who reported highest milk yield for ewes that lambed twins than those that lambed single lamb in Valle del Belice dairy ewes. The milk yield when at the peak in this study was 249.09 ml, this

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value is slightly higher than 216.7 ml obtained by (3) at the peak during the first lactation in WAD sheep but lower than 320 ml reported by the authors during the second lactation. It was also observed in this experiment that the milk production was more persistent in ewes in the first parity. This result corroborates the findings of (16), who observed the same effect in sheep. The authors suggested that this pattern could be due to the fact that the body and mammary gland of young animals is still developing during the first part of lactation. There was high significant correlation between udder characteristics (except THG and DBT) and average milk yield (Table 6). Correlation coefficients of milk yield and udder characteristics obtained were; 0.92, 0.79, 0.91, 0.92, 0.86, 0.88, 0.60, 0.08 and -0.24 for UL, UW, UC, TL, TW, TC, UV, DBT, and THG respectively. This is in consonance with the findings of (11) and James and Osinowo (17) who reported positive correlations between udder characteristics of goats. This suggests that udder characteristics are good indicators of milk yield requiring further investigation as genetic markers. The negative relationship that exists between THG and milk yield showed that there is inverse relationship between them. Therefore, when the milk yield increases, THG decreases.

Conclusion

Udder characteristics of twin bearing ewes were higher in values than those of single bearing ewes. Consequently, their udder characteristics were more developed than those of single bearing ewes. Udder characteristics increased in values and continued to develop up to 3rd parity (i.e.) mammary growth and development increased with parity number. The udder characteristics (UL, UW, UC, TL, TW, TC, UV, DBT and THG) of ewes were positively and significantly correlated with partial daily milk yield thus indicating that they could be used for predicting indirect response to milk production if genetic basis is established. Since teat length (TL) ranges from 1.22 cm to 2.05 cm and teat circumference (TC) ranges from 2.33 cm to 3.42 cm during lactation, milking machine to be used in WAD sheep dairy farm should be constructed with set of cups that can accommodate teat length ranging from 1.22 cm to 2.05 cm and teat circumference ranging from 2.33 cm to 3.42 cm.

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Table 1: *Proximate composition (g/100gDM) of supplemental diet fed WAD Sheep*

Diet Components	Proportion (%)
Dry matter	91.65
Crude protein	17.05
Crude fibre	3.5
Ether extract	3.1
Ash	6.15
Nitrogen free extract	61.85
Energy	1,456 kcal

Table 2: *Least square means (cm) showing the effect of parity and birth type on udder characteristics of WAD Sheep during lactation (UL, UW and UC)*

PARITY Birth Type	Parity									
	1			2			3			
	UL	UW	UC	UL	UW	UC	UL	UW	UC	N
1	7.22 ± 0.26^f	8.26 ± 0.21^e	32.17 ± 1.06^f	7.72 ± 0.19^d	8.27 ± 0.24^e	35.06 ± 0.73^d	8.60 ± 0.09^b	8.55 ± 0.09^c	35.91 ± 1.13^c	24
2	7.44 ± 0.28^e	8.43 ± 0.21^d	32.95 ± 1.06^e	8.05 ± 0.23^c	8.76 ± 0.23^b	36.52 ± 0.89^b	9.56 ± 0.16^a	9.75 ± 0.16^a	42.29 ± 0.89^a	24
Mean	7.33 ± 0.27	8.35 ± 0.21	32.56 ± 1.06	7.89 ± 0.21	8.52 ± 0.24	35.79 ± 0.81	9.08 ± 0.13	9.15 ± 0.13	39.10 ± 1.01	

[a-f] Means in the same column having different superscript differ significantly ($p<0.001$)

Table 3: *Least square means (cm) showing the effect of parity and birth type on udder characteristics of WAD Sheep during lactation (TL, TW and TC)*

Birth Type	Parity									
	1			2			3			
	TL	TW	TC	TL	TW	TC	TL	TW	TC	N
1	1.22 ± 0.05^f	0.87 ± 0.04^e	2.33 ± 0.11^e	1.52 ± 0.10^d	0.99 ± 0.03^d	2.54 ± 0.14^{cd}	1.73 ± 0.11^b	1.17 ± 0.05^b	3.20 ± 0.11^b	24
2	1.35 ± 0.05^e	0.99 ± 0.04^d	2.48 ± 0.13^d	1.62 ± 0.10^c	1.07 ± 0.04^b	2.56 ± 0.14^c	2.05 ± 0.11^a	1.32 ± 0.06^a	3.42 ± 0.15^a	24
Mean	1.29 ± 0.05	0.93 ± 0.04	2.41 ± 0.12	1.57 ± 0.10	1.03 ± 0.04	2.55 ± 0.14	1.89 ± 0.11	1.25 ± 0.06	3.31 ± 0.13	

[a-f] Means in the same column having different superscript differ significantly ($p<0.001$)
See material and methods for key to codes

Table 4: *Least square means (cm) showing the effect of parity and birth type on udder characteristics of WAD Sheep during lactation (UV, DBT and THG)*

Birth Type	Parity									
	1			2			3			
	UV	DBT	THG	UV	DBT	THG	UV	DBT	THG	N
1	263.63 ± 24.36^e	6.23 ± 0.07^f	23.57 ± 0.38^e	296.07 ± 24.14^{cd}	6.47 ± 0.09^d	24.90 ± 0.47^c	312.13 ± 25.19^{bc}	6.96 ± 0.08^b	25.49 ± 0.28^b	24
2	280.16 ± 26.63^{de}	6.33 ± 0.07^e	23.83 ± 0.31^d	323.99 ± 28.16^b	6.66 ± 0.10^c	25.00 ± 0.46^c	488.59 ± 34.28^a	7.26 ± 0.07^a	26.46 ± 0.25^a	24
Mean	271.89 ± 25.50	6.28 ± 0.07	23.70 ± 0.35	310.03 ± 26.15	6.57 ± 0.10	24.96 ± 0.47	400.36 ± 29.74	7.11 ± 0.08	25.98 ± 0.27	

[a-f] Means in the same column having different superscript differ significantly (p<0.001)
See material and methods for key to codes

Table 5: *Least square means (ml) showing the effect of parity and birth type on milk yield*

Birth Type	Parity						N
	1		2		3		
	Milk yield (ml)		Milk yield (ml)		Milk yield (ml)		
1	124.54 ± 8.79^f	(127.22 g)	150.20 ± 10.59^d	(152.51 g)	208.80 ± 14.64^b	(212.52 g)	24
2	128.30 ± 8.71^e	(130.50 g)	164.16 ± 11.89^c	(167.79 g)	249.09 ± 14.85^a	(254.13 g)	24
Mean	126.42 ± 8.75		157.18 ± 11.24		228.95 ± 14.75		

[a-f] Means in the same column having different superscript differ significantly (p<0.001)

Table 6: *Phenotypic correlation between udder characteristics and milk yield of WAD Sheep*

	MY	UL	UW	UC	TL	TW	TC	UV	DBT	THG
MY	1.00	0.92***	0.79***	0.91***	0.92***	0.86***	0.88***	0.60***	0.08	-0.24
UL		1.00	0.81***	0.91***	0.89***	0.88***	0.87***	0.92***	0.14	-0.34
UW			1.00	0.89***	0.91***	0.85***	0.88***	0.69***	0.18	-0.49
UC				1.00	0.88***	0.82***	0.89***	0.66***	0.11	-0.36
TL					1.00	0.86***	0.85***	0.63***	0.18	-0.34
TW						1.00	0.87***	0.66***	0.12	-0.25
TC							1.00	0.71***	0.17	-0.43
UV								1.00	0.28	-0.71
DBT									1.00	-0.31

*** P < 0.001
See material and methods for key to codes