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Milk yield of West African Dwarf sheep as affected by udder stimulation, stage of lactation and parity

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Abstract

This study was conducted to investigate the milk yield of West African Dwarf sheep as affected by udder stimulation, stage of lactation and parity. The study involves 12 matured lactating ewes weighing between 16 and 24 kg live weights in a semi intensive system of management. For udder stimulation, the animals were divided into 2 groups; 6 animals were stimulated by massaging, cleaning and drying the udder for 2 minutes before milking while the other 6 were not stimulated, the udder were just milked. Stage of lactation was divided into 4; early, mid, late, and very late respectively with 3weeks interval for all the animals. 4 animals were on first parity while 8 animals were on second parity. The animals were allowed to graze on an established paddock consisting of Stylosanthes hamata, Panicum maximum, Pennisetum purpureum etc. for 5 hours and then supplemented with concentrate (17% CP at 5% body weight). Each quarter of the udder was hand milked unilaterally twice per week at 8.00am for 12 weeks. The result of the study showed that daily milk yield in each of the quarter of the udder (left and right) was not significantly (P>0.05) different. Udder stimulation and stage of lactation had significant (P<0.05) effect on daily milk yield while parity and mammary gland position (left and right) did not significantly affect daily milk yield. The interaction between udder stimulation and stage of lactation as well as interaction between udder stimulation and parity had significant (P<0.05) effect on daily milk yield in WAD sheep. Therefore it is recommended that sheep udder be stimulated at late and very late stages of lactation to enhance milk production.

Key words: WAD sheep, milk yield, stimulation, lactation

Introduction

Milk yield is dependent on the amount of secretory tissue and the rate of milk secretion. It is a function of the sensory activities, number of mammary epithelial cells, and size of cistern, breed and the physiological state of the lactating animal (Capuco, 2002). The quality and quantity of sheep milk is of utmost importance as it affects the physiological and growth rate of the offspring in terms of live weight gain, adaptability, resistant ability and general health condition. Several factors affects milk yield in sheep. They include nutrition, stage of lactation, parity, live weight, milking frequency, age at first lambing, litter size, breed and disease. Sheep respond to multiple suckling by increasing their yield and this response depends on the number of lambs suckled and not the number born. This could be attributed to the stimulation intensity which increases as the number of lambs suckled increases (Ehoche and Buvanendran, 1983; Preston, 1989 and Zygoyiannis, 1994).). Udder stimulation involves, the neurohormonal reflex which culminates in the contraction of the myoepithelial cells surrounding the alveoli by the action of oxytocin liberated from the pituitary gland (Jorge and Marbis, 2003). The milk ejection reflex can be elicited in sheep by a number of stimuli which include sight of young and suckling, washing and massaging the udder, entering milking parlour, sounds associated with milking operations, distention or stimulation of reproductive tract and injection of oxytocin. As the stimulation intensity increases, milk yield also increased. This showed that variable amount of milk are ejected from the alveoli based on the kind of stimulus supplied and the duration of application (Bruckmaier and Schams, 1994). The stimulation procedure includes cleaning of the teats, drawing some control milk and giving massage to the teat, all done before milking unit is attached. The biological significance of the stimulation phase is to evoke ejection reflex. It has been reported that the time it takes from the start of teat stimulation until the onset of milk ejection is about 1-2 minutes (Bruckmaier and Schams 1994). The efficiency of milk removal is dependent on the availability of hormones required to stimulate the movement of milk from the small galactophores for extraction. The milk has been compelled from the alveoli by the pressure applied on the alveoli wall by myoepithelial muscle cell. Those cells simultaneously contract, but the efficiency of milk ejection will only be effective if their contractions are synchronized, which can only be achieved if they are stimulated by neuropituitary hormones, oxytocin (Manet and Labussiere, 1994).

Several milking experiments have been performed to investigate the importance of stimulation, and different types of mechanical stimulation have been tested. Bruckmaier and Blum (1997) reported that stimulation of the udder facilitated the milk ejection reflex. In a complete lactation experiment it was found that manually stimulated cows increased milk production by nearly 30 % and the lactation period was prolonged (Bruckmaier and Blum, 1997). The type of tactile stimulation influenced the milking related release of hormones. During hand milking the release of both oxytocin and prolactin was significantly higher compared to machine milking. Tactile teat stimulation can be considered as the most efficient for stimulation of milk ejection (Bruckmaier and Blum, 1997).. However, actual observations indicate that milk ejection might occur without the tactile teat stimulation but rather stimulation of other senses. It has been indicated that the milk ejection reflex is activated by visual or auditory stimuli of the young (Upton, 1987).

Stage of lactation is an important factor for milk yield and fat percentage but not for protein (Ehoche and Buvanendran, 1983). Stage of lactation had a significant effect on daily milk yield in sheep (Ochoa-Cordero *et al*., 2002; Kralickova *et al*., 2012). The sensitivity of the reflex seems to decline as lactation progresses. The effect of parity and age of ewe on milk yield can be masked by differences in management, seasonal availability of quality feed, diseases and other environmental factors (Devendra and Burns 1983; Said and Al-Jaryan, 1992). The latter authors reported that pre-weaning yield and pre-weaning total milk yield increase with age until when it declined. Effect of parity and age of ewe on milk yield is also dependent on the management, availability of quantity of feed and diseases. It is observed that milk yield increase from first lactation to the third lactation with no significant difference between third lactation and fifth lactation. (Sangare and Pandey, 2000).

Nigerian sheep are potential dual purpose breeds, being meat and milk producers. Sheep are considered the most important in the small ruminant sector in Nigeria as they come second after goat (33 million), goat, 52 million and cattle, 16 million (NPFS, 2012). Local sheep breeds in Nigeria have the potential to supply a significant portion of the milk deficit in the country because sheep numbers far exceed cattle in both rural and urban communities (Adewumi, 2005). They are also more affordable to resource-poor families and produce more milk in relation to body size than cattle (Nuru, 1998). There are four main breeds of sheep in Nigeria namely; Yankassa, Balami, Ouda and West African Dwarf (WAD). These breeds are adapted to specific geographical regions and have developed adaptation through natural selection. The WAD is physiologically adapted to arid regions and is found in considerable number in the Sub Arid region of Nigeria. Ears are long and drooping or carried horizontally. Height at withers is usually about 60 cm. Twin births are very common but three and four also occurs. They are present in all humid Africa from the Southern Sudan to the West Coast of Sudan. They are about 38% of the estimated sheep in the West African humid zone. The order of population and importance in Nigeria are Yankassa (60%), WAD, 20%, Ouda, 10% and Balami, 10% (Osinowo, 1992). Therefore, the objective of this study is to investigate the daily milk yield in WAD sheep as affected by udder stimulation, stage of lactation and parity.

Materials and Methods

The experiment was conducted at the sheep unit of the University of Agriculture, Abeokuta, Teaching and Research Farm Directorate (TREFAD) Ogun State, Nigeria. The farm is located in a humid tropical zone in South Western Nigeria with minimum and maximum temperature of 20.66°C and 35.48°C respectively. It is located within latitude 7° 13' 49.46"N and longitude 3° 26'11.98"E. (Google Earth, 2006). The altitude is 76 meters above sea level.

Twelve lactating ewes of WAD breed in parities 1(4 animals) and 2 (8 animals) were used for the experiment. Stage of lactation (lactation period) for all animals were divided into 4; early, mid, late, and very late respectively with 3weeks interval. The udder of the animals in group A (6 animals) were stimulated by cleaning, drying and massaging the udder for 2 minutes. Therefore addition of both sides was recorded as milk yield for the day in gramme. The udder of the animals in group B (6 animals) were not stimulated, they were just milked. All the animals lambed between October and November 2010, during the dry season. The animals were kept under semi- intensive system, fed on concentrate (17% CP: Table 1) at 5 % body weight and allowed to graze in an established paddock for the period of 5 hours per day throughout the 12 weeks of the experiment. They were housed in open sided pens with a wooden slated floor, raised a little above the ground. The animals grazed on all types of grasses and legumes found in the area, such as *Panicum maximum, Pennisetum purpureum, Tridax procumbens,* and *Stylosanthes hamata.* Water was given *ad libitum.*

The animals were restricted at the milking stand after which their udder (left and right) were hand milked unilaterally once in a day and twice a week for a period of 12 weeks and recorded. The data recorded was analyzed, using Systat (1992) with the statistical model:

$Y_{ijk} = A_i + B_j + C_k + AB_{ij} + AC_{ik} + BC_{jk} + DW + MD + E_{ijk}$

Where:
Y_{ijk} = Trait of interest
A_i = Fixed effect of ith udder stimulation (i = 1-2)
B_j = Fixed effect of jth stage of lactation (j = 1-4)
C_k = Fixed effect of kth parity (k=1-2)
AB_{ij} = Interaction between ith udder stimulation and jth stage of lactation
AC_{ik} = Interaction between ith udder stimulation and kth parity
BC_{jk} = Interaction between jth stage of lactation and kth parity
DW = Dam live weight as co-variate
MD = Milking days
E_{ijk} =Random error.

Results

The summary of the analyses of results of milk yield of WAD sheep as affected by udder stimulation, stage of lactation and parity is shown in Table 2. The result showed that udder stimulation (P<0.05) and stage of lactation (P<0.001) had significant effect on daily milk yield (DMY) while parity had no significant effect on DMY. Though the animals were unilaterally milked, the summary of analyses of the results showed that DMY in the right udder was higher than DMY in the left udder but without any significant difference. The result of interaction between udder stimulation and stage of lactation is shown in Table 3. The trend revealed that animals whose udders were not stimulated at early and mid stages of lactation (Table 3) had significantly (P<0.05) increased milk yield (147.48; 105.61 g) compared to animals whose udders were stimulated (98.73; 100.81 g). At late and very late stages of lactation however, the difference in the yield between stimulated and not stimulated reduced drastically (Fig. 1) such that at very late stage of lactation, stimulated udders produced yield (84.24 g) higher than not stimulated udders (76.98 g) but this was not however significant (P>0.05).

The results showed that parity had no significant on DMY. The result of the interaction between stage of lactation and parity was also not significant. The results of interaction between udder stimulation and parity was however, significant (P<0.001). Animals in parity 2 produced milk that was significantly (P<0.001) higher than animals in parity 1 for animals whose udders were not stimulated. For animals whose udders were stimulated however, animals in parity 1 produced DMY that was significantly higher than animals in parity 2. The trend revealed that the differences in the yield between parity 1 and parity 2 were higher at the early and mid stages of lactation. As lactation progresses

Table 1. Composition (%) of the concentrate fed to the animal

Ingredients	(%)
Maize	5.00
Dry brewers grain	35.00
Palm kernel cake	18.00
Wheat offal	40.00
Bone meal	1.00
Common salt	1.00
Total	100.00
Calculated analysis	
Crude protein	16.84
Crude fibre	12.66
Ether extracts	4.25
Calcium	0.52
Available phosphorus	0.34
Metabolizable energy (kcal/kg)	2004.20

Table 2. Least square means of milk yield of WAD sheep as affected by udder stimulation, stage of lactation and parity

Sources of variation	Subclass	No. of observation	Least square means (g)
Udder positioning	Left udder	288	48.04±1.60
	Right udder	288	45.60±1.60
Udder Stimulation	Stimulated	144	86.30±3.67^{b}
	Not stimulated	144	98.12±3.62^{a}
Stage of Lactation	Early	72	123.10±10.24^{a}
	Mid	72	103.21±5.83^{a}
	Late	72	61.91±6.08^{b}
	Very late	72	80.61±9.80^{ab}
Parity	One	96	87.92±4.76
	Two	192	96.50±3.16

Means with superscript on the same column are significantly different (P<0.05)

however, the differences became smaller and almost at par at very late stage of lactation. Another trend observed was that animals in parity 1 significantly (P<0.001) responded better to udder stimulation when compared to animals in parity 2 (Fig. 2). This response enabled animals in parity 1 that had their udder stimulated to produce more milk compared to animals in parity 2. When their udders were not stimulated however, animals in parity 2 produced more milk than animals in parity 1.

Discussion

The result of the study showed that udder stimulation significantly affected milk yield in WAD sheep. The effect of udder stimulation on DMY was not significant at early, mid and late stages of lactation but affect milk yield at very late stage of lactation. This report was similar to the report by (Linzel and Peaker, 1971) who

Table 3: Least square means of milk yield of WAD sheep (interaction) as affected by udder stimulation, stage of lactation and parity

Sources of variation	Subclass	No. of observation	Stage of lactation (g)			
			Early	Mid	Late	Very late
Udder stimulation	Stimulated	36	98.73±11.48^{bc}	100.81±7.67^{b}	61.43±7.73^{c}	84.24±11.34^{b}
	Not stimulated	36	147.48±11.20^{a}	105.61±7.52^{b}	62.40±7.85^{c}	76.98±10.55^{b}
Parities	One	24	112.13±12.19	100.28±8.99	54.75±9.32	84.53±11.49
	Two	48	134.08±10.91	106.14±6.71	69.08±6.71	76.69±10.91

Means with superscript on the same column are significantly different (P<0.05)

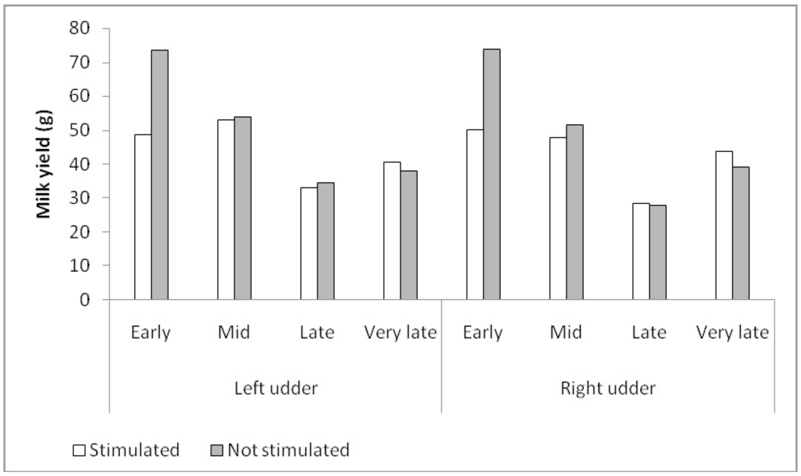

Fig.1. Effects of udder stimulation and stage of lactation on milk yield in WAD sheep

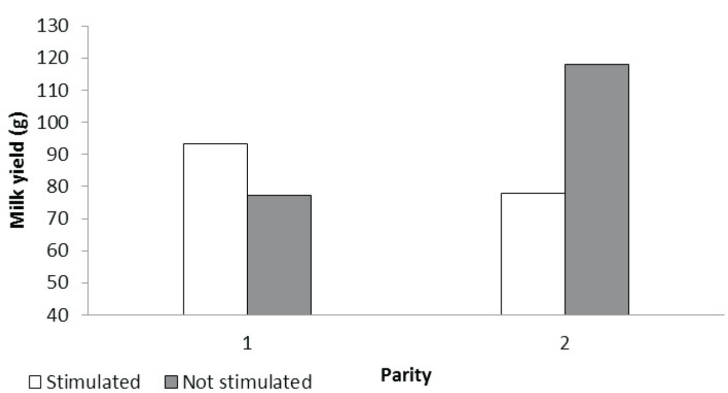

Fig. 2. Effects of udder stimulation and parity on milk yield in WAD sheep

revealed that massaging the mammary gland of sheep had no effect on milk yield. The authors noted that mammary gland responds to milk withdrawal rather than to actual process of milking or suckling. Hurley (2003) reported that no measurable increase in oxytocin in blood after stimulations was seen in 38% of goat and 32% of cows studied. Bemji and Adebiyi (2006) also reported that udder stimulation had no significant effect on daily milk yield in WAD goats. Stage of lactation significantly affected DMY in WAD sheep. The interaction of udder stimulation and stage of lactation was also significant. This observation was similar to the findings of several authors (Tancin *et al*., 2006; Jilek *et al*., 2006: Kuchtik *et al*, 2008: Goetsch *et al*, 2011: Kralickova *et al*., 2012) who also reported significant influence caused by stage of lactation in sheep and goat. There was a significant reduction in DMY from early to mid and to late stages of lactation in the non-stimulated udders. Stimulted udders however, started lower at early stage of lactation, increased slightly at mid stage of lactation, decline at late stage of lactation and slightly increase at very late stage of lactation. These results could be due to reduction in the quantity of milk stored in the teat cistern as the stage of lactation progresses (teat cistern is known to store a low quantity of milk due to a reduction in the number of secreting milk cell with proceeding lactation stage recorded by (Chamberlain, 1989). It could also be due to reduced number of functioning alveoli cell of the mammary gland with advancing lactation stage. This report support that of Oddy and Toussaint (1984), who reported that milk yield decrease with advancing lactation stage. This also falls in line with the report of Knight and Wilde (1993) who reported that mammary cell multiplied during gestation, increase in size during early lactation and die during declining lactation. Declining milk yield as lactation progresses could also be attributed both to loss of secretory tissue and a fall in rate of secretion per cell.

Effect of parity was not significant on DMY but the interaction with udder stimulation was highly significant. This observation was similar to the findings of Pokorna *et al*., (2010), Kralickova *et al*., (2012) and Williams *et al*., (2012) who reported a non-significant effect of parity on DMY. The non-significance of parity in this study could be as a result of the closeness of the parities of the animals (parities 1 and 2) and the number of animals used. Animals in parity one whose udders were stimulated produced significantly higher DMY compared to animals in parity two. This could probably be due to a positive response to tactile stimulation of the udder resulting in more oxytocin release to cause more milk ejection. In non-stimulated udder, second parity animals produced more milk which was significantly higher than first parity counterpart. This could have resulted from an increase in the number of functioning alveoli cells in the second parity ewes resulting in higher volume of milk secreted as compared to the younger ones. This result supports the findings of (Chamberlain, 1989), who reported that older animals has higher milk yield than younger ones

Conclusions

There was no significant difference between the left and right udder of WAD sheep unilaterally milked. Udder stimulation affects DMY in WAD sheep especially at very late stage of lactation. Animals in parity one whose udder were stimulated produced more milk than their counterparts in parity two. Stage of lactation significantly affects DMY in WAD sheep as well as its interaction with udder stimulation. Animals with closely related parity produced DMY with no significant difference.

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