

YIELD AND COMPOSITION OF MILK AND THEIR RELATIONSHIP WITH PREWEANING LAMB GROWTH IN YANKASA EWES AND THEIR CROSSES WITH SIRES OF SUFFOLK X WENSELYDALE BREED

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ABSTRACT

Milk production in Yankasa ewes and their crosses with sires of Suffolk/Wenselydale breed was measured at weekly intervals following oxytocin administration. The influence of age and breed of dam on yield and composition were investigated and the relationships between milk yield, milk composition and lamb weight gain were determined. Daily milk production in Yankasa and crossbred ewes averaged 348.1 and 505.7g respectively. The mean fat and protein content over the entire lactation were 5.86 and 5.07% for Yankasa and 6.19 and 4.96% for crossbreds, respectively. Crossbred ewes produced significantly higher ( $P < 0.01$ ) milk than Yankasa at all stages of lactation. Age of the ewe had significant effect ( $P < .05$ ) on total milk yield but not on fat or protein content. The correlations between lamb weight gain and milk yield at various stages of lactation ranged from 0.51 to 0.66 and 0.62 to 0.71, respectively, for Yankasa and crossbred lambs. Sheep milking can make a significant contribution to rural daily production in Nigeria.

Keywords: milk yield, milk composition, lamb growth, Yankasa, suffolk x Wenselydale crosses.

INTRODUCTION

The sheep occupies an important place in Nigeria's rural livestock economy. A large number of rural households keep sheep as a ready source of income, as insurance against crop failure and as slaughter animals during ceremonies and religious feasts. The estimated 9.0 million sheep in the country contribute 11% of the meat supply from slaughter houses in the nation (Adu and Ngere, 1979).

The varied roles of the indigenous sheep has led to scanty information on their milk yield. Sheep milking is rarely practiced under the traditional extensive grazing system or semi-intensive and intensive systems of management.

However, the recent import restrictions and the reduction of government subsidy on imported dairy products has led to increased interest in sheep and goat milking to augment the domestic milk supply from cattle.

The Yankasa is the most widely distributed and most unmerous breed of sheep in Nigeria. The characteristics and distribution of the Yankasa breed have been described by Adu and Ngere (1979). They also reported that the preweaning growth rate of the Yankasa is slow with the result that the lambs are weaned at comparatively lighter weights. The poor preweaning performance of the Yankasa may partly be due to inadequate milk supply in the dam.

The objectives of this study were (1) to determine the milk yield and composition of the Yankasa ewes and their crosses with sires of Suffolk/Wenselydale breed and (2) to determine the relationship between milk production of the ewes and preweaning weight gain of their lambs.

MATERIALS AND METHODS

Animals and Management

The animals used in the study were maintained at the National Animal Production Research Institute, Shika, Zaria, located in Northern Nigeria. Animals were grazed on improved pasture during the wet season (May-September) while in the dry season (October - April) they were fed hay and concentrates made up of maize, Cottonseed cake and wheat offals.

Forty seven 3 - 4 years old ewes consisting of 25 Yankasa and 22 Yankasa X Suffolk/Wenselydale crosses were used. The crossbred ewes included in this study were 50% of Yankasa inheritance and 25% each of imported Suffolk and Wenselydale breed. All the ewes were nursing single lambs.

Lambing commenced in late November and continued until March. Within 12 hours of parturition, each ewe with her lamb were placed in a separated pen. The ewes were fed mixed hay

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(*Digitaria smutsii* predominanting) *as libitum*. In addition, each animal received 1/2 - 1/4 kg per day of concentrate mixture consisting of 60% maize, 20% cottonseed cake and 20% wheat of-fals. Mineralized salt block and fresh water were also made freely available to the animals. The lambs received similar food (*as libitum*).

#### Milking procedure

Milk yield was measured by hand milking following intrajugular injection of oxytocin. McCance (1959), Coombe (*et al*, (1960) and Doney *et al* found this method to be a more accurate estimate of milk production in sheep than the lamb - suckling weight differential method which has been widely used in the past to obtain yield estimate.

Milk yield was measured at weekly intervals for 12 weeks. During milking, each ewe was injected in the jugular vein with 5 I.U. of oxytocin to stimulate milk "let down". She was then rapidly hand milked by two milkers until the udder was empty. This single dose of 5 I.U. of oxytocin was found to be adequate in emptying the udder of the sheep as judged by milk flow and udder palpation. After this initial milking the ewe was held away from her lamb for a period of 4-6 hours, followed by a second injection and milking. This time interval was agreement with the observation of McCance (1959) that milk synthesis over an interval of 4 to 6 hours after complete removal of milk from the udder was a reliable reflection of milk synthesis throughout the day. At the second milking, milk obtained from each animal was weighed and 25 ml sample was collected and frozen for analysis. The total yield for a 24 hour period was calculated in proportion to the time interval between initial and final milkings. Lamb weights were recorded at birth and on the days that milking was done.

Milk fat was determined by the Gerber method (British Standard 696, part II, 1969) and milk protein by the Kjeldhal method (A.O.A.C. 1975).

#### Statistical Analysis

The effects of age and breed of dam on cumulative milk yields to various stages of lactation and on fat and protein percentages were determined by least squares procedures (Hargvey 1960).

The relationships between part and whole lactation between milk yield, protein and fat percentages and between lamb weight gain and milk yield were determined by simple regression analysis. Fat and protein percentages were also added as independent variables to the model considering weight gain and milk yield.

#### RESULT AND DISCUSSION

The mean lactation curves calculated from the weekly milk yield data are illustrated in figure 1. For Yankasa ewes, daily milk yield increased to a maximum of 554g at approximately 2 weeks postpartum and then decreased steadily to the

TABLE 1: REGRESSION EQUATION BETWEEN PART (X) AND WHOLE LACTATION (Y)

Breed	Part record (weeks)	Regression equation	r*
Yankasa	2	$Y = 2.222 + 1.874X$	0.76
	4	$Y = 1.545 + 1.405X$	0.90
Cross-bred	2	$Y = 2.252 + 2.530X$	0.74
	4	$Y = 1.045 + 1.761X$	0.89

\*All significant at  $P < 0.01$ .

TABLE 2: ANALYSIS OF VARIANCE OF AGE BREED EFFECTS ON MILK YIELD AND COMPOSITION

	DF	Mean squares					
		<sup>a</sup> Milk 2	<sup>a</sup> Milk 4	<sup>a</sup> Milk 8	<sup>a</sup> Milk 12	Fat %	Protein %
Age of dam	1	0.13	1.31	4.89*	7.60*	0.02	0.25
Breed of dam	1	2.50**	10.61**	30.48**	41.66**	1.28*	0.13
Error	44	0.16	0.45	1.02	1.43	0.27	0.13
R <sup>2</sup>		0.27	0.38	0.44	0.46	0.10	0.06

\*,\*\*  $P < 0.05$  and  $P < 0.01$ , respectively

<sup>a</sup>Cumulative milk yield 2, 4, 8, or 12 weeks.

TABLE 3; PHENOTYPIC CORRELATIONS  
BETWEEN YIELD, FAT AND PROTEIN CONTENT

Breed		Milk Yield	Fat %
Yankasa	Fat %	0.212	
	Protein %	-0.321	0.430*
Crossbred	Fat %	-0.047	
	Protein %	0.003	0.173

12th week when production averaged only 224g/day. Similarly milk production of the crossbred ewes increased to a maximum of 813g at about 2 weeks postpartum and then declined gradually to 295g/day at the end of lactation. The milk yield values observed in this study are lower than the average lactation. The milk yield values observed in this study are lower than the average yield estimate of 603/day reported for West African ewes maintained in an intensive production system (Combellas, 1981).

The possibility of estimating total milk yield to 12 weeks of lactation from part production was investigated. Correlation coefficients were high for both Yankasa and crossbred ewes (Table 1) but the 4 weeks yield was a better predictor of total milk production than 2 weeks yield.

The influence of age and breed of the ewe on cumulative milk yield to 2, 4, 8 and 12 weeks of lactation are shown in Table 2. Age of the ewe did not influence 2 weeks and 4 weeks milk yields. However, there was significant evidence ( $P < .05$ ) for age of the ewe effect on 8 weeks and 12 weeks yields. The reports on the effect of age of ewe on milk yield are not consistent. Owen (1957) and Torres Hernandez and Hohenboken (1979) found little difference in milk yield between 3 and 4 year old ewes. Barnicoat *et al*

TABLE 4: MEAN LIVE WEIGHT OF LAMBS AT BIRTH AND VARIOUS STAGES OF LACTATION (kg  $\pm$  s.e.)

Age	Live weights	
	Yankasa	Crossbred
Birth	2.35 $\pm$ 0.45	3.17 $\pm$ 0.55
2 weeks	5.33 $\pm$ 1.41	6.65 $\pm$ 1.62
4 weeks	6.52 $\pm$ 1.78	8.27 $\pm$ 2.21
8 weeks	8.81 $\pm$ 2.06	11.12 $\pm$ 2.76
12 weeks	10.69 $\pm$ 2.61	13.47 $\pm$ 3.61

(1949) and Corbett (1979) found that age was an important factor in milk yield. Breed of the ewe had significant effect on milk yield. The crossbred ewes produced more milk ( $P < .01$ ) than Yankasa ewes at all stages of lactation. The coefficient of determination indicated that age and breed of the ewe accounted for 27-44% of the variation in milk yield.

The mean fat and protein contents over the entire lactation respectively were 5.86 and 5.07 for Yankasa and 6.19 and 4.96 for crossbred ewes. For both breeds percent fat declined in early lactation to minimum values between weeks 4 and 5 and then rose steadily to maximum values in weeks 11 and 12 (Figure 2). Protein % decreased rapidly to minimum values between 2nd and 3rd weeks of lactation and then increased gradually reaching peak values at the end of lactation. Corbett (1968) and Torres-Hernandez (1979) observed highest values of fat and protein at the beginning and end of lactation.

Fat and protein percentages were not influenced by age of the ewe (Table 2) but there was evidence of breed effect on percent fat ( $P < .05$ ). Crossbred ewes had higher percentage fat than the Yankasa. There was no significant difference ( $P < .05$ ) among breeds for percent protein. Slen *et al*, (1963) reported no significant difference among breeds for either percent fat or protein and concluded that the quantity of milk was the major factor influencing the weight gain of the lambs.

The relationships between milk yield, fat and protein percentages are shown in Table 3. In crossbred ewes the correlation between milk yield and percent fat was negative as in dairy cattle but smaller in magnitude. Percent fat was positively correlated with milk yield in Yankasa. Percent protein followed a reverse trend in crossbred and Yankasa ewes. The correlations between percent fat and protein was positive in both breeds.

The mean live weight of lambs at birth and cumulative lamb weight at various stages of lac-

TABLE 5: CORRELATION COEFFICIENTS BETWEEN LAMB WEIGHT GAIN AND EWE MILK YIELD AT DIFFERENT STAGES OF LACTATION.

State of lactation (weeks)	Correlation Coefficient	
	Yankasa	Crossbred
2	0.51**	0.62**
4	0.52**	0.58**
8	0.64**	0.60**
12	0.66**	0.71**

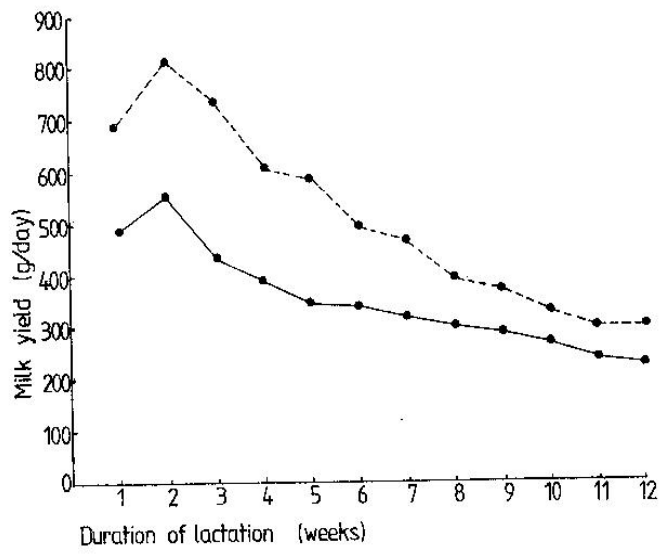


Figure 1. Daily milk yield during the course of lactation  
 — Yankasa ewes;  
 - - - Crossbred ewes

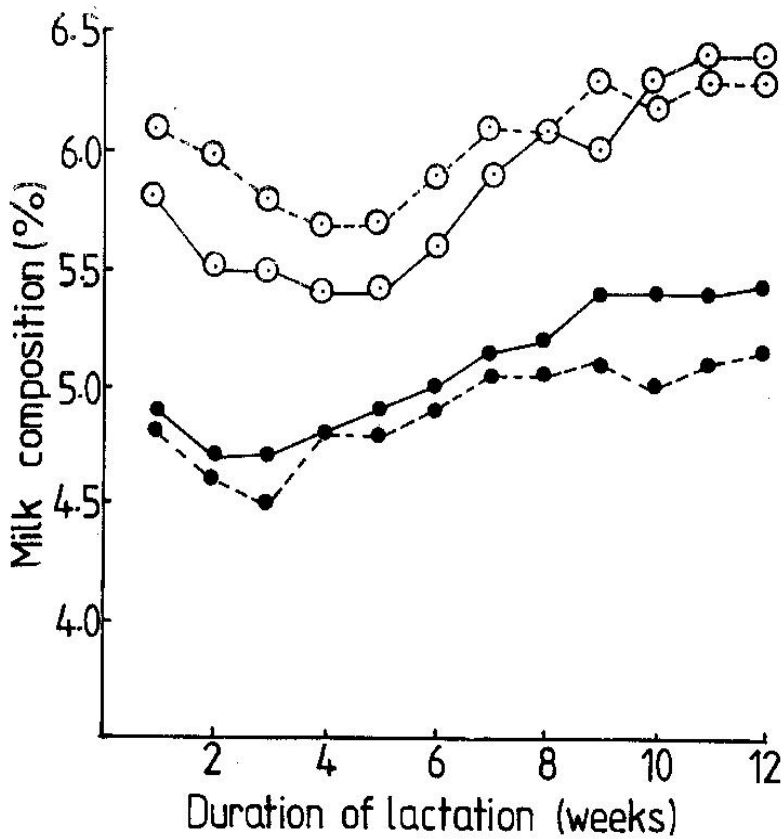


Figure 2. Fat and protein percentages during the course of lactation.  
 — Yankasa fat %  
 - - - Crossbred fat %,   
 — Yankasa protein %  
 - - - Crossbred protein %

TABLE 6: CORRELATION COEFFICIENTS BETWEEN LAMB WEIGHT GAIN AT 12 WEEKS AND TOTAL MILK YIELD AND MILK COMPOSITION (%)

Variables	Correlation Coefficient*	
	Yankasa	Crossbred
Milk yield	0.66	0.71
Milk yield + Fat %	0.68	0.71
Milk yield + Protein %	0.57	0.72
Milk yield + Fat + protein %	0.68	0.72

\* All significant at  $P < 0.01$ .

tation are presented in Table 4. The mean birth weight gain was also higher in the crossbred group, resulting in substantial differences in cumulative weight at various stages of lactation.

The relationship between ewe milk production and preweaning lamb growth rate was investigated separately for Yankasa and crossbred groups. Relationships were determined at different stages of lactation between lamb weight gain and cumulative milk yield (Table 5). In both breeds, correlation coefficients were large and significant ( $P < .01$ ) at all stages of lactation. Thus, in Yankasa and crossbred ewes, milk production of the dam accounted for 44 and 50% respectively, of the variation in lamb weight gain at 12 weeks. The high correlations obtained between lamb weight gain and milk yield during late lactations does correlations obtained between lamb weight gain and milk yield during late lactation does not agree with the results of Torres-Hernandez and Hohenboken (1980) and Coombe *et al.* (1960), where for both singles and twins, the highest correlations were observed in early lactation. However, high and positive correlation in studies by Peart (1968) and Owen (1957).

Analysis were also conducted to determine whether milk composition added information for predicting lamb weight gain to that milk composition added information for predicting lamb weight gain to that from milk production alone. The correlation coefficients when protein and fat percentages were added to regression model that included only milk yield are shown separately for Yankasa and crossbred ewes (Table 6). the addition of protein had little effect on the precision in Yankasa (.66 vs .67) and in crossbreds (.71 vs .72). Inclusion of fat added

little value to the correlation in Yankasa lambs (.66 vs .68) but not in crossbred lambs (.71 for both models). Thus, for both Yankasa and crossbred lambs, addition of fat or protein or both was no more effective in explaining variation in lamb weight gain than milk production alone. In goats, addition of fat resulted in an increase in the coefficient from .57 to .76 in twin kids but not in singles (Ehoiche and Buvanendran, 1983). In conclusion the results of this study show that milk yields of West African Yankasa ewes are lower than those of Yankasa X Suffolk/Wensleydale ewes. Stage of lactation is an important variable for milk yield, and percent fat and protein. Milk production of the ewe is a major factor influencing preweaning lamb weight gain. Milk fat and protein are not important variables affecting lamb weight gain. In view of their large population, sheep milking can make a significant contribution to rural dairy production in Nigeria.

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#### REFERENCES

- ADU, I. F. and NGERE, L. O. 1979. The indigenous sheep of Nigeria. *World Rev. Anim. Prod.* 15L 51 - 62
- A.O.A.C., 1975. *Official Methods of Analysis*, 12th edition. Association of Official Analytical Chemists, Washington, D.C.
- BARNICOAT, C. R., LOGAN, A. G. and GRANI, A. I. (1949). Milk secretion studies with New Zealand Romney ewes. Part I and II. *J. Agric. Sci. Camb.* 39: 44 - 56.
- BRITISH STANDARD 696 PART II, 1969. Gerber method for the determination of fat in milk and milk products. British Standards Institute, London.
- COMBELLAS, J. B., DE, 1981. Milk yield of West African X Dorset Horn ewes in first lactation. *Dairy Sci. Abstr.* 43: 5666.
- COOMBE, J. B., WARDROP, I. O. and TRIBE, D. E., 1960. A study of milk production of the grazing ewe with emphasis on the experimental technique employed. *J. Agric. Sci. Camb.* 54: 353 - 359.

- CORBETT, J. L., 1968. Variation in the yield and composition of milk of grazing merino ewes. *Austr. J. Agric Res.* 19: 283 - 294.
- DONEY, J. M., PEART, J. N. SMITH, W. F. and LOUDA F., 1979. A consideration of the techniques for estimation of milk yield by suckled sheep and a comparison of estimates obtained by two methods in relation to the effect of breed, level of production and stage of lactation. *J. Agric Sci. Camb.* 92: 123 - 132.
- EHOCHÉ, O. W. and BUVANENDRAN, V., 1983. The yield and composition of milk and preweaning growth rate of Red Sokoto goats in Nigeria. *World Rev. Anim. Prod.* 19 (2): 19 - 24.
- HARVEY, W. B., 1960. Least square analysis of data with unequal subclass numbers. United States Department of Agriculture. ARS 20-8 (Mimeo).
- McCANCE, I., 1959. The determination of milk yield in the Merino ewe. *Austr. J. Agric, Res.* 10: 839 - 853.
- OWEN, J. B., 1957. A study of the lactation and growth of hill sheep in their native environment and under lowland conditions. *J. Agric. Sci. Camb.* 48: 378 - 411.
- PEART, J. N., 1968. Lactation studies with Blackface ewes and their lambs. *J. Agric. Sci. Camb.* 70: 87 - 94.
- PEART, J. N., R. A. and DONALDSON, E., 1979. The yield and composition of the milk of Finish landrace x Blankface ewes. 1. Ewes and lambs maintained indoors. *J. Agric. Sci.* 43: 16 - 20
- TORRES-HERNANDEZ G. and HOHENBOKEN, W., 1979. Genetic and environmental effects on milk production, milk composition and mastitis incidence in crossbred ewes. *J. Anim. Sci.* 49: 410 - 417.
- TORRES-HERNANDEZ G. and HOHENBOKEN, W., 1980. Relationships between ewe milk production and composition and preweaning lamb weight gain. *J. Anim. Sci.* 50: 597 - 603.