The Effects of Energy Intake During late Pregnancy on Lamb Birth Weights and Lactation of Nigerian Dwarf Sheep

I. F. ADU, E. A. OLALOKU and
V. A. OYENUGA
Department of Animal Science,
University of Ibadan

SUMMARY

EIGHTEEN Nigerian Dwarf ewe lambs about eight months of age and weighing between 15 and 20 kg were divided into three groups, A, B, and C, and fed diets supplying 75, 100 and 125% of the ARC energy standards (1965) from the 15th week of pregnancy through lactation. Mean daily intakes during the last seven weeks of pregnancy were: dry matter 569, 748 and 826g; digestible organic matter 260, 496 and 593; and calculated metabolizable energy 0.99, 1.81 and 2.16 Mcal for groups A, B and respectively. The daily intakes during lactation were: 660, 748 and 857g of dry matter; 287, 593 and 690g of digestible organic matter and 1.05, 2.16 and 2.51 Mcal of calculated metabolizable energy for groups A, B and C respectively.

Mean daily liveweight gains during the last seven weeks of pregnancy were 14.2, 99.0 and 90.0g and during lactation — 43.0, 7.9 and 10.4g for groups A, B and respectively, the differences being highly significant ($P < 0.01$). Mean birth weights of lambs were 1.18, 1.78 and 1.82kg for groups A, B and C respectively, the differences not being significant. Weight gains of lambs were highly significantly correlated with milk yield of their ewes.

During a 10-week lactation period the differences in milk yields were highly significant between groups, with average daily yields of 312, 480 and 533g, for A, B and C respectively. Peak yields were 481, 697 and 670 g for the respective groups between the second and thrid weeks of lactation. The mean values for milk composition were: fat, which remained relatively constant throughout lactation, 6.00, 6.36 and 6.40%; protein 4.82, 5.63 and 5.78%; lactose 4.15, 4.30 and 4.34%; total solids, which showed no definite trends during lactation, 15.98, 16.88 and 16.95%; and gross energy, which decreased with advancing lactation, 6.12, 6.18 and 6.38kcal/g for groups A, B and C respectively, the differences not being significant.

INTRODUCTION

A NUMBER of experiments reported in the literature have shown that good nutrition especially during the last 6 to 8 weeks of pregnancy affects not only the performance of the new-born lamb in post-natal life, but also the lactational performance of the ewes (Wallace, 1948; Thomson and Thomson, 1953; Guyer and Dyer, 1954; Treacher, 1970).

In view of the unique role of the Nigerian Dwarf sheep as a source of high quality meat in Nigeria, it is highly desirable to increase lamb production. Hence, it is considered necessary to intensify studies in the areas of nutrition during pregnancy to ensure high post-natal performance of the lambs.

The experiment reported here was therefore carried out to determine the effects of varying the energy intake on liveweight changes of the Nigerian Dwarf sheep during the last one-third of pregnancy, on the birth weight of the lambs and on the yield and composition of milk of the ewes.

EXPERIMENTAL METHODS

Animals

Eighteen Nigerian Dwarf ewes selected from the University of Ibadan flock were used in this study. The ewes were 7 and 8 months of age and weighed 10 and 20 kg. They were bred and randomly alloted to three groups of 6 ewes each, designated A, B and C.

The ewes were put in large pens by groups during the first 14 weeks of pregnancy after which they were housed in individual pens until 10 weeks after lambing.

Diets

During the first 14 weeks of pregnancy, the ewes were group-fed on a basal ration of *cynodon* offered ad libitum and supplemented with a concentrate mixture D fed at a rate calculated to supply total digestible nutrients (TDN) of 0.59kg (2.21 Mcal. ME.) and 76.8g of digestible crude protein (DCP) per animal per day. From the 15th week of pregnancy each group was placed on the experimental ration treatments as follows:

Group A — *Cynodon nlemfluensis* var *robustus* only at 75% of ARC (1965) standards;

Group B *Cynodon* plus concentrate mixture B at 100% of ARC (1965) standards;

Group C — *Cynodon* plus concentrate mixture C at 125% of ARC (1965) standards;

The rates of feeding for each group were designed to achieve equal levels of DCP but variations in the energy levels corresponding to 75, 100 and 125% of ARC (1965) energy standards for sheep gaining an average of 150g per day. Thus each ewe received approximately 78.0, 77.8 and 78.0g DCP per day in groups A, B and C respectively and calculated metabolizable energy (ME.) of 1.70, 2.25 and 2.81 Mcal. per day. Details of the rations fed are shown in Tables 1 and 2.

TABLE 1

Composition of Concentrate Mixtures

Ingredients	*Concentrate mixture* *B*	*C*	*D*
	%	%	%
Maize	75	67.5	65
Decorticated groundnut cake	1	2.5	20
Palm kernel meal	2	12	15
Rice bran	12	10	—
Cane molasses	10	8	—
Mineral mixture [a]	5 kg per 50 kg of feed		
Calculated TDN (kg)	37.7	39.1	35.2
Calculated DCP (kg)	3.3	3.1	5.6

a "Microzone" — Crosfields International Limited (C23A)

The same experimental rations used from the 15th week of pregnancy were also used and fed at the same rates to the respective groups during lactation.

Management

The ewes were exercised for about one hour each day in large pens where they also had access to water. Group A

TABLE 2

Chemical Composition of the Feeds

Nutrient	*Cynodon*	*Concentrate mixture*		
		B	*C*	*D*
Dry matter, %	30.67	88.08	89.60	86.05
Crude protein, %	12.43	15.69	17.63	14.05
Crude fibre, %	36.15	6.07	6.63	5.80
Ether extract, %	2.85	3.70	4.15	4.20
Nitrogen-free-extract, %	40.98	71.94	68.64	61.80
Total ash, %	7.56	2.61	2.98	3.00
Organic matter, %	92.43	97.39	97.04	97.00
Gross energy, kcal/g	3.91	4.48	4.82	3.80

received their grass diet in three equal instalments at 07.30, 11.00 and 14.30hr. The concentrate feeds for groups B and C were fed at 07.30 hr. whilst the grass was fed in two equal instalments at 11.00 and 14.30hr. Water and mineral licks were made available to each ewe in their respective pens at all times. The feed intake was determined by the difference between the amount of feed offered and the amount left over. Each ewe was weighed weekly throughout the experimental period and the lambs were weighed a few hours (maximum 12 hours) after birth and weekly thereafter. By the 4th week of life, the lambs were divided into two rearing systems of suckling, and suckling plus creep feeding.

Estimation of Ewes' milk yield and composition

Milk yield was estimated once a week by the lamb suckling method. The lambs were allowed to suckle 3 times (for about one hour each time) at 08.30, 12.00 and 16.00hr. On the day for estimation with weighings before and after each suckling, the difference in weight was assumed to be the amount of milk produced per day.

The ewes were hand-milked on the 1st, 2nd, 4th and 6th days after lambing and weekly thereafter to collect colostrum and milk samples for chemical analysis. Milk fat was determined by the method described by Davis (1959); total solids by the methods of A.O.A.C. (1970); lactose by the method of Barnett and Tawab (1959); protein by the Macro-kjeldahl distillation method and the gross energy was determined by the use of the ballistic bomb calorimeter.

RESULTS

Feed intake during pregnancy

Table 3 shows the mean daily feed intake during the first 14 weeks of pregnancy. There were no significant differences in the mean daily feed intake between the treatment groups during this period. However, it was observed that feed intake increased until the 14th week of pregnancy after which it decreased as the pregnancy advanced.

During the last seven weeks of pregnancy, the mean daily intakes of dry matter and digestible organic matter were 569 and

TABLE 3

Mean Daily Feed intake and Weight gains during Pregnancy

	Treatment	groups	
	A	*B*	*C*
First 14 *weeks of pregnancy*			
Daily weight gain, g	58.7 ± 5.0	58.9 ± 3.7	59.3 ± 4.4
Dry matter intake			
g/day	806 ± 24.7	813 ± 23.9	855 ± 25.6
$g/W_{kg.}^{0.73}$	97.5	90.3	90.4
Digestible organic matter intake			
g/day	475 ± 20.1	479 ± 11.6	505 ± 26.4
$g/W_{kg}^{0.73}$	57.46	53.16	53.39
15*th week of pregnancy to lambing*			
Daily weight gain, g	14.2 ± 0.17	99.0 ± 14.20	90.0 ± 19.15
Dry matter intake			
g/day	569 ± 51.5	748 ± 26.5	826 ± 16.9
$g/W_{kg}^{0.73}$	67.85	71.83	79.84
Digestible organic matter intake			
g/day	259.8 ± 22.1	496 ± 8.7	593 ± 8.8
$g/W_{kg.}^{0.73}$	30.96	47.65	57.31

259g; 748 and 496g; 826 and 593g for the groups A, B and C respectively. Using Langland, Corbett, Mcdonald and Pullar's (1963) conversion figure (1g digestible organic matter = 3.64 kcal ME), the mean daily intake of metabolizable energy per ewe was calculated to be 0.99, 1.81 and 2.16 Mcal. for groups A, B and C respectively during the last seven weeks of pregnancy.

Liveweight changes during pregnancy

Table 3 also shows the mean daily liveweight gains of the ewes during pregnancy, which did not differ significantly between the three groups during the first 14 weeks of pregnancy. However, during the last seven weeks of pregnancy, group A showed consistently lower liveweight gains than groups B and C.

Lambing and lamb birth weights

All the lambs were born alive and none of them died during the experimental period. Of the births, 70% took place at night. The mean gestation periods were 154 (142-160) days; 146 (139-152) days; and 143 (139-148) days for groups A, B and C respectively. The mean birth weights of lambs are shown in table 4. There were no significant differences in the mean birth weights of lambs between the treatment groups. There was a highly significant ($P > .0.01$) correlation ($r = +0.83 + 0.08$) between the ewe's liveweight closest to lambing and the lamb's birth weight.

Feed intake during lactation

The mean daily intakes of dry matter and digestible organic matter during this period were 660 and 287g; 748 and 593g; 857 and 690g for groups A, B and C respectively. Using Langland's *et. al* (1963) conversion figure, the mean daily intakes of metabolizable energy during lactation were 1.05, 2.16 and 2.51 Mcal. per ewe

TABLE 4

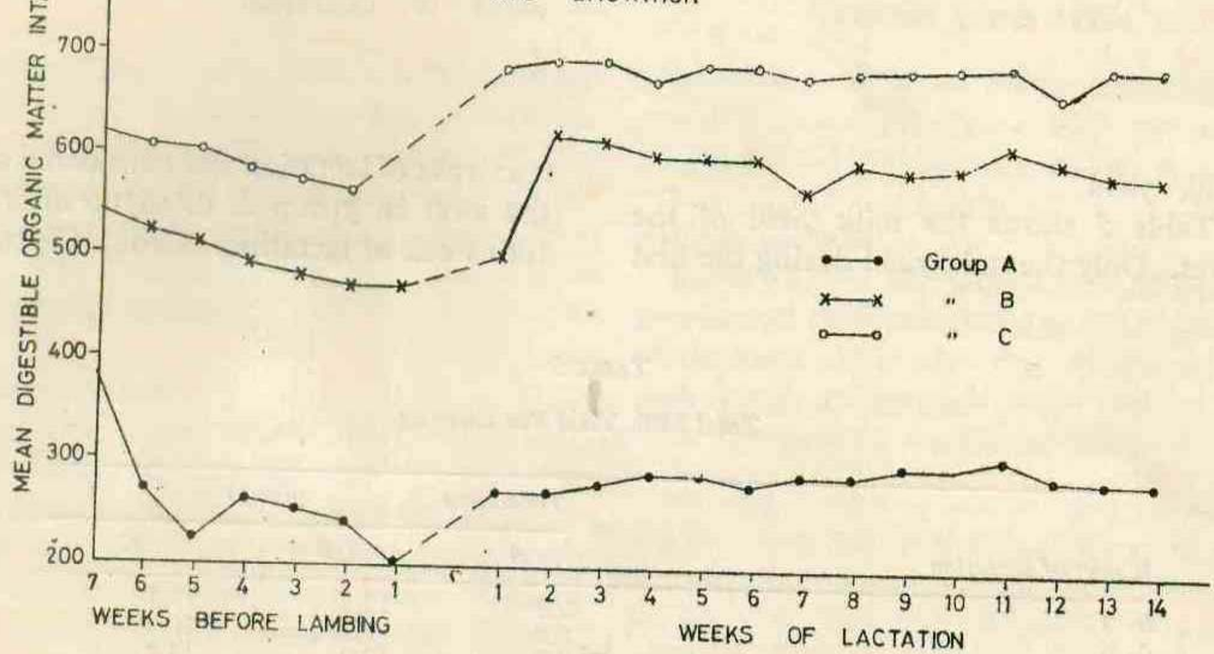
Mean Birth Weights and average daily weight gains of Lambs (g/day)

	Treatment groups		
	A	*B*	*C*
Birth weight, kg	1.18 ± 0.08	1.78 ± 0.06	1.82± 0.02
Suckled lambs			
0- 3 weeks of life	79.10	79.63	104.20
4- 6 " " "	53.33	57.62	61.90
7-10 " " "	20.35	27.14	40.35
0-10 " " "	47.85	57.42	66.00
Suckled plus creep-fed lambs			
0- 3 weeks of life	75.71	100.90	119.60
4- 6 " " "	102.80	90.01	68.58
7-10 " " "	81.06	88.20	86.68
0-10 " " "	86.00	92.57	83.30

in the groups A, B and C respectively. Figure 1 shows the digestible organic matter intake during the last seven weeks of pregnancy and lactation.

-12a-

FIG.1 MEAN DAILY DIGESTIBLE ORGANIC MATTER INTAKE DURING LATE PREGNANCY AND LACTATION

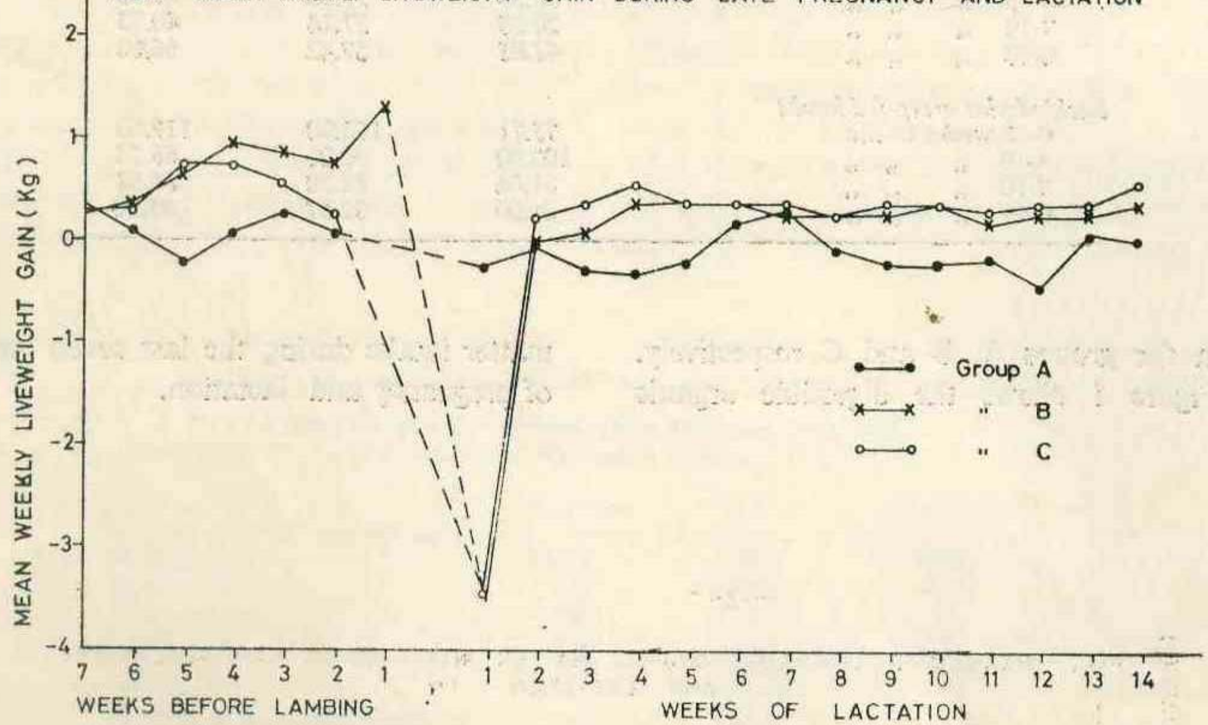


Liveweight changes during lactation

The mean daily liveweight gain was lowest for group A(-43.0g) as compared to groups B and C which had mean daily liveweight gains of 7.9 and 10.4g respectively; the differences between the three treatment groups being highly significant ($P<0.01$). Figure 2 shows the liveweight changes during the last seven weeks of pregnancy and lactation.

-12b-

FIG.2 MEAN WEEKLY LIVEWEIGHT GAIN DURING LATE PREGNANCY AND LACTATION



Milk yield

Table 5 shows the milk yield of the ewes. Only the milk yield during the first ten weeks of lactation was considered since the ewes in group A dried up after the 10th week of lactation. Group C showed

TABLE 5

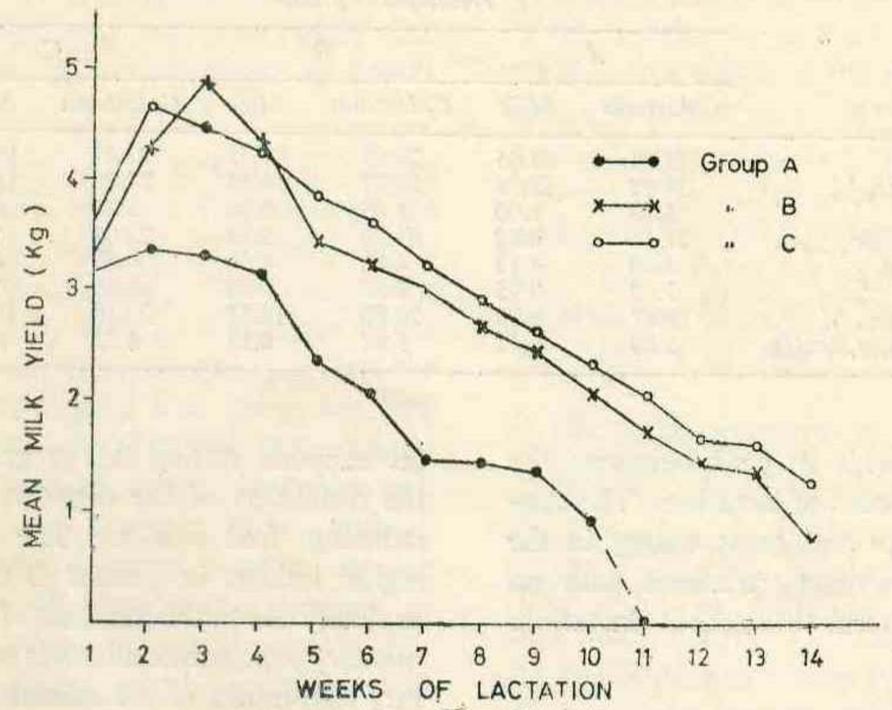
Total Milk Yield Per Ewe (kg)

	Treatment groups		
Weeks of lactation	*A*	*B*	*C*
0- 3	9.2	12.5	13.3
4- 6	8.8	9.2	10.8
7-10	3.8	12.0	13.2
0-10	21.8	33.6	37.6
Milk yield/day, g	321 ± 40.44	408 ± 47.50	533 ± 36.65
Peak yield/day, g	481	697	670
Week of peak yield	2nd	3rd	2nd

the highest milk yield, whilst milk yield was lowest in group A. Figure 3 shows the lactation curves of the ewes. There was a positive and significant ($P<0.05$)

-14a-

FIG.3 MEAN WEEKLY MILK YIELD OF EWES (LACTATION CURVES



correlation ($r = + 0.58 + 0.09$) between the ewe's liveweight closest to lambing and the total milk yield during the first 6 weeks of lactation, but the relation became weaker, and non-significant ($r = + 0.19 + 0.04$) during the 7th to 10th weeks of lactation.

Lamb growth

Table 4 also shows the average daily liveweight gains of the lambs on the two rearing systems. Groups B and C lambs on the two rearing systems consistently showed higher rates of gain than the group A lambs. Lamb growth was significantly ($P<0.05$) faster in the suckling plus creep feeding group than in the suckling group. Highly significant ($P<0.01$) correlation ($r = + 0.88, + 0.76, + 0.52$ and $+ 0.63$) were observed between the liveweight gains of lambs and the milk production of their ewes during the first 3 weeks of life, 4th to 6th weeks of life, 7th to 10th weeks of life and first 10 weeks of life respectively.

Milk composition

Table 6 shows the mean chemical composition of the colostrum and whole milk of the ewes. The colostrum showed very high values for protein when compared with the protein values of whole milk.

Groups B and C showed persistently higher values for total solids, fat, protein, lactose and gross energy components in the colostrum and whole milk than group A. However, the differences in these components between the treatment groups were statistically non-significant.

The fat content of the milk remained relatively constant throughout lactation, whilst the protein content of the milk

TABLE 6

Mean Chemical Composition of Colostrum and Whole Milk of the Nigerian Dwarf Sheep

	Treatment group					
	A		B		C	
Constituents	Colostrum	Milk	Colostrum	Milk	Colostrum	Milk
Water, %	76.03	83.45	70.63	83.75	73.47	83.77
Total solids, %	24.07	15.98	26.27	16.88	27.80	16.95
Fat, %	5.40	6.00	5.65	6.36	5.70	6.40
Crude protein, %	21.56	4.82	21.74	5.63	22.01	5.78
Lactose, %	4.40	4.15	4.60	4.30	4.45	4.34
Total ash, %	1.90	0.95	2.27	0.96	2.19	0.95
Solid-not-fat, %	19.67	9.98	20.62	10.52	22.10	10.55
Gross energy, kcal/g	5.80	6.12	5.97	6.18	6.25	6.39

appeared to reach its peak between the 2nd and 3rd weeks of lactation. The contents of lactose and gross energy in the milk showed minor variations with no particular pattern throughout lactation.

DISCUSSION

The results of this experiment have shown the type of response that may be expected from variations in the energy intake of Nigerian Dwarf sheep during late pregnancy and lactation. The performances of the Nigerian Dwarf ewe during these periods are generally comparable to those of other breeds reported elsewhere (Wallace, 1948; Barnicoat, Logan and Grant, 1949; Thomson and Thomson, 1953; Hadjipieris and Holmes, 1966; Treacher, 1970; Seth, Pandey and Roy, 1971).

The pattern of feed intake during early and late pregnancy reflected to some extent, the effect of the physiological state of the animal on its feedintake as earlier shown by Wallace (1948), and Gordon and Tribe (1951) who reported that a reduction in the volume of the abdominal cavity (as happens during late pregnancy) limits the distension of the digestive tract thus reducing feed intake. The consistently higher intakes in groups B and C were probably due to the influence of the supplementary concentrate mixtures on the voluntary feed intake of the animals in the two groups.

As would be expected, liveweight gains increased with advancing pregnancy. There was, however, a slight drop in liveweight in groups A and C during the last week of pregnancy. This drop in liveweight might be due, at least in part, to the cummulative result of the gradual reduction in feed intake during late pregnancy.

The gestation length of 143 to 154 days obtained in this study is in agreement with those reported for the Afrikander (Quinlan, Claassens and Bonsma, 1939) and the West Afrikan dwarf sheep (Kammlade, 1947; Williamson and Payne, 1965).

The birth weights recorded in this experiment are in line with those earlier reported by Hill (1966) and by Nwagbogu (1969) for lambs of the Nigerian dwarf sheep and further confirms that the Nigerian dwarf lambs are generally smaller at birth than the lambs of temperate breeds. The high relationship between the ewe's liveweight closest to lambing and birth weights of the lambs agrees with the findings of Hamada (1954), Spedding (1962); Datta, Sahani, Bhatnagar and Roy (1963), and Frederiksen, Price and Blackwell (1967).

The higher intakes of nutrients during lactation also reflected the effect of the physiological state of the animal on its voluntary feed intake. The demand for milk, especially during the first few weeks after parturition, presumably increases the energy requirements and hence the feed intake of the ewes (Wallace, 1948; Thomson and Thomson, 1953; Hadjipieris and Holmes, 1966; Treacher, 1970). Indeed, the digestible organic matter intakes recorded in this experiment remained at their peak during the first 4 weeks of lactation, a period which coincides with peak milk production.

As would be expected, liveweight gains were generally low during lactation. The marked loss in body weight in group A might be due to the reduction in feed intake resulting from the quality of roughage give to the ewes in this group.

The lamb suckling technique used in this study to estimate the milk yield of ewes might be inaccurate since the milk yield would be affected by the vigour and capacity of the lamb to withdraw milk- (Owen, 1957). The milk yield in the Nigerrian dwarf ewes is comparatively lower than those recorded for the temperate breeds of sheep in Australia, U.K. and U.S.A. by Wallace (1948), Barnicoat *et al* (1949), Thomson and Thomson (1953), Burris and Baugus (1955) during a 10or 14 week lactation. However, the mean daily milk yields of the Nigerian Dwarf ewes are in fair agreement with those recorded for Cheviot ewes on a low plane of nutrition during pregnancy and lactation (Thomson and Thomson, 1953) and Corriedale x Bikaneri in Pradesh (Seth *et al*, 1971). The shape of the lactation curves obtained in this study is generally similar to those reported by Barnicoat *et al* (1949), Owen (1957), Acharya and Bawa (1971) and Seth *et al* (1971). These workers have also reported that the peak yield occured between the 2nd and 3rd weeks of lactation as recorded in this study.

The high relationship between the weight gains of lambs and the milk production of their ewes observed in this study agrees with the earlier reports of Wallace (1948); Owen (1957); Acharya and Bawa, (1971). Also, similar trend of decline in the association between the two characteristics has also been observed by Barnicoat *et al* (1949), Burris and Baugus (1955), Achaya and Bawa (1971). The decline in association between milk production of ewes and the growth of her lambs would probably be due to the decline in her milk yield and the increasing ability of lambs to digest supplementary feeds.

The relationship between the liveweight of the ewe closest to lambing and their milk yield, as well as the tendency of the relationship to weaken with advancing lactation confirm the earlier findings of Owen (1957).

The estimated milk composition in this study may not represent the actual quality of the milk, especially with regards to its fat content, as hand-milking is not an efficient method of complete evacuation of the udder. The consistently better quality milk from groups B and C as compared to their counterparts in group A confirmed the adverse effect of underfeeding during pregnancy and lactation on milk quality as earlier reported by Barnicoat *et al*, (1949), Hadjipieris and Holmes (1966) and Treacher (1970).

The pattern of crude protein content in milk found in this study agrees with that of Kon and Cowie (1961), but it conflicts with the reports of Hadjipieris, Jones, Wimble and Holmes (1966) who found that in Leicester X Cheriot ewes, the crude protein of milk decline during the first 3-4 weeks of lactation before a continuous rise till the 10th week of lactation. Also, the patterns of the fat, lactose, total solids and gross energy contents in milk found in this study do not seem to agree with those earlier reported by Wallace (1948), Hadjipieris *et al* (1966) and Treacher (1970) in the Border-Leicester X Cheriot and Scottish Half-bred ewes.

It can be concluded from the results of this stall-feeding experiment that the adequate feeding imposed during late pregnancy and lactation substantially improved the performance of the Nigerian Dwarf ewes, measured in terms of lamb birth weight and milk production.

REFERENCES

ACHARYA, R. M. and BAWA, S. J. S. 1971. Milk production of ewes and its relationship with preweaning growth of lambs. *Ind. J. Anim. Sci.* **41**, 572–576.

A. O. A. C. 1970. Official Methods of Analysis of the Association of Official Analytical Chemists. (11th Edition) Association of Official Analytical Chemists, Washington, D. C.

BARNICOAT, C. R., LOGAN, A. G. and GRANT, A. I. 1949. Milk secretion studies with New Zealand Rommey ewes. Parts I–IV. *J. Agric. Sci.* **39**, 44–55; 237–248.

BARNETT, J. A. and TAWAB, A. G. 1957. Rapid method for the determination of lactose in milk and cheese. *J. Sci. Fd. Agric.* **8**, 437–441.

BURRIS, M. J. and BAUGUS, C. A. 1955. Milk consumption and growth of suckling lambs. *J. Anim. Sci.* **14**, 186–191.

DATTA, I. C., SAHANIM K. L., BHATNAGAR, R. K. and ROY, A. 1963. Studies on certain aspects of sheep and goat husbandry. Birth weights, liveweight growth and rearing lambs and kids. *Ind. J. Vet. Sci. and Anim. Husb.* 33, 71–77.

DAVIS, J. G. 1959. Milk secretion. The laboratory control of milk (2nd Edition). Dairy Industries, London.

FREDERIKSEN, K. R., PRICE, D. A. and BLACKWELL, R. I. 1967. Environmental factors affecting rate and efficiency of gain and other traits in Rambouillet lambs. *J. Anim. Sci.* **26**, 667–673.

GORDON, J. G. and TRIBE, D. E. 1951. The self-selection of diet by pregnant ewes. *M. Agric. Sci. Camb.* **41**, 187–190.

GUYER, P. W. and DYER, A. J. 1954. Study of factors affecting sheep productivity. *Miss Agric. Expt. Stat. Res. Bull. No.* 558.

HADJIPIERIS, G. and HOLMES, W. 1966. Studies on feed intake and feed utilization by sheep. 1. The voluntary intake of dry, pregnant and lactating ewes. *J. Agric. Sci.* **66**, 217-223.

HADJIPIERIS, G., JONES, J. G. W., WIMBLE, R. H. and HOLMES, W. 1966. II. The utilization of feed by ewes. *J. Agric. Sci.* **66**, 341-349.

HAMADA, M. K. O. 1954. A study of birth weights in British mutton breeds. *Anim. Brd. Abstr.* 23, 49.

KAMMLADE W. G. 1947. Sheep Science. J. B. LILLINCOTT Co. Chicago, Philadelphia and New York.

KON, S. K. and COWIE, A. T. 1961. Milk: the mammary gland and its secretions. Vol. II. Academic Press, New York and London.

LANGLAND, J. P., CORBETT, J. L., MCDONALD, I. and PULLAR, J. D. 1963. Estimation of the energy required for maintenance by adult sheep. (Housed and Grazing Sheep). *Anim. Prod.* 5, 1–16.

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.* **48,** 387-412.

QUINLAN, J., CLAASSENS, C.C. and BONSMA, H.C. 1939. Observations on the gestation period of Ronderib-Afrikander sheep. Onderstepoort. J. Vet. Sci. and *Anim., Ind.* **12,** 251-257.

SETH, O.N. PANDEY, M.D. and ROY, A. 1971. Effect of season of lambing and breed on the milk secreting capacity of ewes. *Ind. J. Anim. Sci.* **41,** 577-580.

SPEDDING, C.R.W. 1962. Modern trends in animal health and husbandry. The agricultural ecology of sheep grazing. *Brit. Vet. J* **118** 461-491.

THOMSON, W. and THOMSON, A.M. 1953. Effect of diet on milk yield of the ewe and growth of her lamb. *Brit. J. Nutr.* **7,** 263-274.

TREACHER, T.T. 1970. Effect of nutrition in late pregnancy on subsequent milk production in ewes. *Anim. Prod.* **12,** 23-36.

WALLACE, L.R. 1948. The growth of lambs before and after birth in relation to the level of nutrition. *J. Agric. Sci.* **38,** 93-153, 242-302, 367-401.

WILLIAMSON, G., and PAYNE, J.A. 1965. An Introduction to Animal Husbandry in the Tropics. (2nd Edition) Longmans, Green and Co. Ltd., London.