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Effect of Ewe Weight gain During Pregnancy, Type of Birth, Sex and Ram Breed on Lamb Performance[1]

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ABSTRACT

In a crossbreeding study involving the mating of West African Dwarf (WAD), Yankasa, 1/2 Permer 1/2 WAD, and 1/2 Uda 1/2 WAD rams with WAD ewes, the crossbred rams were found to compete favourably with the purebreds in transmitting good qualities like heavier birth weights, higher twinning rates and faster growth rates. The 1/4 Uda 3/4 WAD and 1/2 Yankasa 1/2 WAD lambs were heaviest at birth. The straightbred WAD had the lowest birthweights while the 1/4 Permer 3/4 WAD lambs were intermediate, being not significantly ($P > 0.05$) different from any of the other groups. The Permer crosses grew at significantly lower rates to be lighter than the Yankasa and Uda crosses at 50 and 90 days, while the WAD were not significantly different from any of the other breed groups. At 180 days, the Uda crosses were significantly ($P < 0.05$) heavier than both the straightbred WAD and Permer crosses but not the Yankasa crosses. Single lambs were heavier at birth and also gained at faster rates to maintain the weight advantage at subsequent ages. Males were not significantly heavier than females at birth but grew faster to be heavier at 50, 90 and 180 days. Significant ($P < 0.01$) interaction effects were observed between ram breed, type of birth and sex of lamb.

COMPENDIO

En un estudio de cruzamientos realizados con carneros de dos razas: West African Dwarf (WAD) y Yankasa, y dos cruces: 1/2 Permer 1/2 WAD, y 1/2 UDA-1/2 WAD, con ovejas WAD, se encontró que los carneros resultantes de esos cruces compitieron favorablemente con los progenitores puros en cuanto a transmisión de algunas características ventajosas, como pesos mayores de las crías al nacer, tasas de nacimiento de gemelos más altas y tasas de crecimiento más altas. Las obejas 1/4 UDA-3/4 WAS y 1/2 Yankasa-1/2 Wad tuvieron pesos más altos al nacer más bajos en tanto que las 1/4 Permer 3/4 WAD fueron intermedias en este carácter no siendo significativamente diferentes ($P < 0.05$) de ninguno de los otros grupos. Los cruces Permer crecieron con tasas significativas más bajas siendo más livianas que los cruces Yankasa y UDA, a los 50 y 90 días, en tanto que los cruces WAD no fueron significativamente diferentes a los otros grupos de razas. A los 180 días, los cruces UDA fueron significativamente ($P < 0.05$) más pesados que los WAD puros y que los cruces Permer, pero no más que los cruces Yankasa. Las ovejas nacidas como vía única en el parto fueron más pesadas al nacer y también tuvieron tasas de ganancia de peso más altas manteniendo más ventaja en peso en edades posteriores. Al nacimiento, los carneros no fueron significativamente más pesados que las ovejas pero crecieron más rápidamente y fueron más pesados a los 50, 90 y 180 días, se observaron efectos significativos ($P < 0.01$) de interacción entre la raza del carnero padre, el tipo de parto (cría única o múltiple) y sexo de la cría con la tasa de crecimiento de las crías.

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INTRODUCTION

It has been recommended (26) that the weight of a pregnant animal should increase enough to offset the weight of the fetus, fetal fluids and placenta with a moderate additional increase in body weight of animals in average condition. Ensminger (10) had earlier indicated that temperate ewes should gain in weight during the entire period of pregnancy making a total gain of 6.8-9.1 kg for the period. Ewes should enter the nursing period with some reserve flesh, because the lactation requirements are more rigorous than those of the gestation period. Younis *et al.* (27) indicated that there are optimum levels in gain during pregnancy which will lead to high pre-weaning lamb performance. Chiboka (8) pointed out that the optimum levels of weight gain during pregnancy for WAD sheep have not been worked out.

Breed differences in liveweights and growth rates and the ability of superior breeds to transmit some of their desireable traits are too well-known to be overemphasised. The use of crossbred males in improvement programmes is only starting to gain ground in swine and beef production (14). This study was conducted to assess the amount of weight in excess of the results of conception (gain during pregnancy) gained by WAD ewes and how this is related to the performance of their lambs in the first 50 days of life. The study also sought to evaluate crossbred (F_1) rams as improved animals against one of their parent breeds (WAD) and pure Yankasa.

MATERIALS AND METHODS

Data Collection

Ten West African Dwarf ewes were hand-mated to one each of selected WAD, Yankasa, 1/2 Permer 1/2 WAD and 1/2 Uda 1/2 WAD rams. Bred animals were kept in separate pens and examined for re-breeding, if they returned on heat, from day 17 to day 20 after the last breeding. The procedures followed for checking heat and ascertaining proper breeding were as described by Chiboka (8) and Tizikara and Chiboka (20). The weights of the ewes at breeding, prior to lambing (2-5 days) and at 50 days *post partum* were taken and, together with the weights of their lambs at birth and 50 days, were used to establish the relationship between ewe liveweight, gain during pregnancy and lamb daily gain. Fifteen more ewes were pasture-bred to each of Yankasa and WAD rams by allowing them to run together for 40 days. The ewe together with its lamb(s) would be introduced to a ram at 50 days, in an accelerated lambing programme.

All lambs were weaned by physical separation from their dams at 90 days so as to eliminate any maternal influences and allow a more realistic comparison of sire breed effects on lamb growth. Nursing ewes and their lambs were kept in small groups of 5-10 ewes, fed forages *ad libitum* and given concentrate supplements twice a day. Water was available *ad libitum*. Weaned lambs were, in addition to forages, fed on a concentrate ration containing approximately 16% crude protein (corn, 70%; groundnut cake, 18%; palm kernel meal, 10%; bone meal, 1%; agricare; 0.5%; salt, 0.5%) up to 180 days of age.

All animals were housed in barns designed to suit tropical humid conditions. These have an asbestos roofing, a service corridor running along its length and animal pens fitted with water and concentrate feed troughs and forage racks. All pens open to the paddocks so that animals are free to get into the barn or go to the pastures as they so wish. The long sides of the barn are built of wooden planks spaced about 10-20 cm apart up to 1 m from the concrete floor, the rest of the space being open. This allows free air circulation. A trough always water-filled runs along the whole perimeter of the barn to check ants and other crawling insects. The animals were inspected twice a week for ticks and their feet dipped in acaricide while the whole animal was dipped once a month and deworming done once every fortnight.

Data analysis

Ram breed, type of birth (twin or single) and sex of lamb (male or female) and their interaction effects on lamb weights and rates of gain were analysed in a 4 x 2 x 2 factorial design. significant differences between means were determined using Duncan's New Multiple Range Test. All statistical analyses and comparisons were done following the procedures described by Steel and Torrie (17).

RESULTS AND DISCUSSION

Live weights

Table 1 shows the mean squares from the analysis of variance of effects of sire breed, type of birth and sex on lamb weights. The mean weights are presented in Table 2. Sire breed, sex and type of birth effects were significant ($P < 0.01$) at all ages except those of sex at birth. Interaction effects were mainly significant ($P < 0.01$) at 50 days.

Table 3 shows that twin lambs born in either monozygotic or heterozygotic sets showed no significant ($P > 0.05$) differences in weights at birth, 90 and 180 days between the sexes. The monozygotic twins, however, tended to have higher birth weights than heterozygotic twins. Males born in heterozygotic sets

Table 1. Mean squares from the ANOVA of effects of sire breed, type of birth and sex on lamb weights.

	Birth		50 days		90 days		180 days	
Source of variation	d.f	MS	d.f	MS	d.f	MS	d.f	MS
Sire breed	3	1.35**	3	16.73**	3	15.61*	3	54.45**
Type of birth	1	6.42**	1	84.79**	1	86.29**	1	116.04**
Sex of lamb	1	0.27NS	1	169.45**	1	22.09*	1	61.34**
Breed x Type	3	0.65*	3	4.88NS	3	3.80NS	3	5.61NS
Breed x Sex	3	0.35NS	3	31.72**	3	12.09NS	3	11.41NS
Type x Sex	1	0.27NS	1	125.32**	1	1.65NS	1	6.16NS
Breed x Type x Sex	3	0.16NS	3	34.42**	3	12.71NS	3	6.19NS
Lambs (Error)	55	0.16	52	2.44	21	4.28	19	6.53

d.f – degrees of freedom; MS – Mean squares
* Significant at $P < 0.05$
** Significant at $P < 0.01$
NS Non-significant

Table 2. Means of lamb weights as affected by sire breed, type of birth and sex of lamb.

			Age of lamb, d							
Sire breed	Birth type	Sex		Birth		50		90		180
Overall	Single	M	(19)[1]	2.70 ± 0.47^{e}	(19)	10.11 ± 2.63^{c}	(11)	10.60 ± 2.08^{cd}	(10)	18.15 ± 3.30^{c}
		F	(18)	2.67 ± 0.36^{e}	(17)	8.18 ± 1.97^{b}	(14)	9.54 ± 2.46^{cd}	(14)	15.84 ± 3.22^{b}
	Twin	M	(12)	2.08 ± 0.39^{b}	(11)	7.59 ± 2.05^{b}	(5)	8.14 ± 2.19^{ac}	(4)	14.80 ± 2.64^{ab}
		F	(22)	2.05 ± 0.40^{b}	(21)	6.59 ± 2.05^{ab}	(7)	6.74 ± 0.95^{ab}	(7)	11.79 ± 2.22^{a}
WAD	Single	M	(6)	2.43 ± 0.42^{d}	(6)	7.15 ± 3.08^{b}	(2)	8.00 ± 0.00^{ac}	(2)	13.30 ± 0.99^{ab}
		F	(4)	2.33 ± 0.33^{cd}	(4)	7.05 ± 2.12^{b}	(2)	9.20 ± 1.70^{bd}	(2)	12.90 ± 0.14^{ab}
	Twin	M	(5)	1.88 ± 0.48^{a}	(4)	7.15 ± 1.01^{b}	(2)	9.80 ± 1.70^{cd}	(1)	16.60 ± 0.00^{bc}
		F	(13)	1.99 ± 0.42^{a}	(12)	6.62 ± 1.71^{b}	(2)	7.85 ± 0.35^{ac}	(2)	11.00 ± 2.26^{a}
Yankasa	Single	M	(9)	2.79 ± 0.42^{ef}	(9)	9.73 ± 1.89^{c}	(5)	11.28 ± 1.22^{cd}	(4)	18.88 ± 1.75^{c}
		F	(10)	2.69 ± 0.30^{e}	(9)	7.52 ± 1.85^{b}	(9)	8.71 ± 2.14^{bc}	(8)	14.84 ± 2.40^{b}
	Twin	M	(6)	2.17 ± 0.27^{bc}	(6)	8.27 ± 2.45^{b}	(2)	10.10 ± 2.83^{cd}	(2)	14.60 ± 3.96^{ab}
		F	(6)	2.17 ± 0.47^{bc}	(6)	7.55 ± 2.03^{b}	(2)	9.70 ± 0.00^{cd}	(2)	13.95 ± 3.32^{ab}
½ Permer ½ WAD	Single	M	(1)	3.50 ± 0.00^{g}	(1)	8.70 ± 0.00^{bc}	(1)	13.50 ± 0.00^{d}	(1)	22.00 ± 0.00^{c}
		F	(0)	–	(0)	–	(0)	–	(0)	–
	Twin	M	(1)	2.50 ± 0.00^{de}	(1)	5.30 ± 0.00^{a}	(1)	7.90 ± 0.00^{ac}	(1)	13.40 ± 0.00^{ab}
		F	(3)	2.07 ± 0.15^{b}	(3)	4.37 ± 0.20^{a}	(3)	5.70 ± 0.70^{a}	(3)	10.87 ± 0.42^{a}
½ Uda ½ WAD	Single	M	(3)	2.67 ± 0.50^{e}	(3)	11.70 ± 3.46^{c}	(3)	14.00 ± 2.50^{d}	(3)	19.13 ± 2.25^{c}
		F	(4)	2.98 ± 0.26^{f}	(4)	7.68 ± 0.52^{b}	(4)	11.78 ± 2.12^{d}	(4)	19.33 ± 2.60^{c}
				–		–		–		–
	Twin			(No twin births were obtained)						

WAD = West African Dwarf = M = Male; F = female.
a, b, c, d, e, f, g: Means within the same column bearing the same superscript are not significantly different at the 5% level

1 In parentheses, the number of observations.

also tended to have higher weights at 90 and 180 days than either heterozygotic or monozygotic females.

Breed differences in liveweights and other characteristics of Nigerian sheep have been described at length by Adu and Ngere (2). More importantly to be noted from this study is that these breed differences can be favourably transmitted by crossbred sires as efficiently as purebred sires. This conclusion is based on a comparison of the results in this study and those on crosses between WAD ewes and pure Uda and Permer rams reported in the literature (9, 18).

Sex effect on birth weights is contradictory. Whereas this did not significantly (P > 0.05) affect birth weight in this study (Table 1), as was also reported by various researchers, as reviewed by Ademosun *et al* (1), significantly heavier birth weights for males than for females have more often been reported. Males were heavier than females in the 1/4 Permer 3/4 WAD twin lambs (Table 2); Ferguson (11) found female Yankasa lambs to be heavier (4.0 kg) than males (3.5 kg) and Martinez (15) has reported similar results with other breeds of sheep. The 1/4 Uda 3/4 WAD female lambs were heavier than males in this study (Table 2).

Type of birth, consistently, has been shown to affect birth weights, singles always being heavier than multiples. Martinez (15) reported that type of birth significantly affected weaning weights of WAD sheep but that reports on crossbreds were contradictory. He also found type of birth effects to have largely disappeared by the age of six months, although there was a tendency for triplets and twins to be lighter than singles. On the other hand, there are some reports (15) where type of birth had a significant effect on six-month weight, while sex of lamb did not have.

With regard to interpretation of the interaction effects observed (Tables 1 and 4), it is important to note that second-order interaction effects override first-order interaction effects, which also override main effects. Breed x type of birth effects on birth weights may be taken to mean that, although lambs of heavier sire breeds were heavier than those of lighter breeds, the weights of their twin and male lambs could have been limited by the ultimate body size of the ewes. By 50 days, these interaction effects imply inadequate supply of milk from the ewes. These interaction effects gradually disappeared as lambs became older and started depending more on feed than on milk.

Mrode (16), in a comprehensive review of the literature, asserted that birthweight and growth rate are definite breed characteristics with ranges of variation that are dependent on the size, weight, age, nutrition, parity, and physiological constitution of the dam. They are also dependent on prevailing environmental, climatic and seasonal conditions, genetic constitution of the sire and fetus and the sex of the newborn. A positive correlation exists between birth weight and subsequent weights; reports on genetic and phenotypic correlations (7, 16, 18) indicate that birth weights could be used to predict subsequent body weights. The presence of significant interaction effects between some of the factors that affect weights at birth, 50 and 90 days (pre-weaning period) and not at 180 days (Table 1) suggests a strong maternal effect. This may be linked to maternal uterine capacity (19, 21, 22) and the ability of the dam to provide adequate nutrition *in utero* and during the suckling period. Nevertheless, selection for body weight at early stages is bound to result in rapid improvement of the trait at subsequent ages because of the high correlations reported and the large variation observed, not only in lambs (Table 2) but also in older ewes (22). Much of this variation, however, is attributed to environmental influences, such as feeding, on the degree of fatness (6).

Table 3. Effect of litter composition at birth on lamb weights at birth, 90 and 180 days of age (kg).

Composition		Age of lamb, d				
		Birth		90		180
All males	(4)[1]	2.15 ± 0.13[a]	(0)	–	(0)	–
All females	(14)	2.16 ± 0.36[a]	(3)	6.50 ± 1.55[b]	(3)	0.53 ± 0.99[c]
Mixed Sex Males	(8)	2.04 ± 0.48[a]	(5)	8.54 ± 2.01[b]	(4)	14.80 ± 2.64[c]
Mixed Sex Females	(8)	1.85 ± 0.41[a]	(4)	5.93 ± 1.14[b]	(14)	12.73 ± 2.55[c]

a, b, c Means with the same superscript within the same column are not significantly different at the 5% level.

1 In parentheses, the number of observations

Table 4. Mean squares from the ANOVA of effects of sire breed, type of birth and sex on lamb rates of gain.

	0–50 days		0–90 days		90–180 days		0–180 days	
Source	df	MS	df	MS	df	MS	df	MS
Sire breed	3	5 818*	3	1 393NS	3	1 911**	3	1 876*
Type of birth	1	19 281**	1	7 104**	1	459NS	1	2 633*
Sex of Lamb	1	153 559**	1	5 365*	1	1 028*	1	1 714*
Breed x Type	3	19NS	3	3 413*	3	366NS	3	129NS
Breed x Sex	3	43 061**	3	3 198*	3	100NS	3	240NS
Type x Sex	1	139 112**	1	9 486**	1	185NS	1	194NS
Breed x Type x Sex	3	44 898**	3	9 319**	3	42NS	3	87NS
Lambs (Error)	52	1 601	21	1 601	21	861	19	439

df degrees of freedom: MS – Mean squares.

* Significant at P < 0.05

** Significant at P < 0.01

NS Non-significant.

It was observed that although type of birth still had significant (P < 0.01) effects at 180 days (Table 1), actual differences in weights of twins and singles, in the pooled data (Table 2), were not significant. The rate of twinning has a great impact on ewe productivity, especially in areas where sheep are managed in small flocks and where feed supply is adequate all or most of the year (i.e., where survival of twins is sufficiently high so that twins mean more progeny that will reach market and breeding age). Fitzhugh and Bradford (12) have suggested the possibility of a major gene affecting variability in litter size. They suggest that an increase in variability in litter size could contribute to larger average litter sizes. Experimental results indicate that this could also be done through selection (24, 25).

The data on crossbred sheep also provide evidence of the ability of some breeds to transmit their high potential for prolificacy. Ewes which had twins had more total lamb mass at weaning (90 days) and 180 days than those with singles (Table 2). This meant higher productivity indices for the twinning ewes than those with singles. In other work (1, 10, 20), the Permer breed and its crosses have also displayed such a potential.

Rates of gain

Breed differences in rates of gain of indigenous Nigerian breeds, when compared together or with exotics and/or crosses, have been reported by several workers. The lack of significant (P > 0.05) sire breed effects on rates of gain during the suckling stage between 0 and 90 days (Table 4), agrees with the report of Martinez (15) on Barbados Blackbelly, West African, Criollo and Blackhead Persian sheep breeds. He also observed significant breed effects on average daily gain between 90 and 180 days similar to the results of the present study.

The effects of sex on the growth of ruminant livestock has been shown to be associated with differences in pituitary gland size and activity (5). Trenkle (23) also reported that somatotrophic hormone (STH) or growth hormone levels in serum were higher with lower fractional turnover rates in males than in females. This partly explains the higher growth rates observed with males than with females (Table 5). Baird *et al* (4) have suggested that genetic selection for body size in domestic animals could be associated with such factors as pituitary gland size and activity and STH levels.

Martinez (15) reported that type of birth had significant effects on average daily gain during the preweaning phase (0-90 days), but not during the next 90 days. In the present study, lambs born in multiple sets gained at slower rates than singles during the suckling period. Although type of birth had no effect on gain during the 90-day period after weaning, twins tended to gain more weight than singles. However, during the overall 180-day period, singles gained more than twins (Table 5). On the other hand, Gonzalez Stagharo (13) observed that twins gained weight at slower rates than singles between 0-30, 30-90 and 90-120 days.

Differences in growth rates between singles and twins are mainly due to the level of nutrition they are subjected to. During the preweaning period, this specifically refers to the ewes' milk-producing ability

Table 5. Means of lambs' rates of gain as affected by sire breeds, type of birth and sex of lamb, g/day.

Sire breed	Birth type	Sex	Age of lamb, d							
				0–50		0–90		90–180		0–180
Overall	Single	M	(19)[1]	143.6 ± 31 8de	(11)	86.9 ± 19 2^{b}	(10)	84 3 ± 18 2de	(10)	85.8 ± 17.0^{bc}
		F	(17)	115.5 ± 35 4^{cd}	(14)	76 0 ± 25 8^{b}	(14)	70 0 ± 17 7^{bc}	(14)	73.0 ± 16 7^{bc}
	Twin	M	(11)	93.4 ± 33 9^{ac}	(5)	65 1 ± 25 3^{ab}	(4)	69 7 ± 11 8^{bc}	(4)	69.2 ± 16 2^{ac}
		F	(21)	82.0 ± 32.1^{ab}	(7)	41.3 ± 10.8^{a}	(7)	67.1 ± 26.4^{bc}	(7)	54.2 ± 13.2^{a}
WAD	Single	M	(6)	150 5 ± 63 5de	(2)	61 7 ± 00 8^{ab}	(2)	58.9 ± 11 0^{ab}	(2)	60 3 ± 5 9^{ab}
		F	(4)	156.3 ± 38 2^{e}	(2)	77 2 ± 30 9^{b}	(2)	41.1 ± 17.3^{a}	(2)	59.2 ± 1 2^{ab}
	Twin	M	(4)	102.3 ± 19.2^{ac}	(2)	72 8 ± 30 6^{ab}	(1)	62.2 ± 0.0^{ac}	(1)	78 3 ± 0.0^{bc}
		F	(12)	92.3 ± 32.1^{ac}	(2)	48.3 ± 19.6^{a}	(2)	51.7 ± 5.5^{ab}	(2)	50.0 ± 12.6^{a}
Yankasa	Single	M	(9)	138 9 ± 35 2de	(5)	93 8 ± 14.8^{b}	(4)	83.6 ± 15.2^{ce}-	(4)	90 0 ± 10.5^{bc}
		F	(9)	96 1 ± 34 8^{ac}	(8)	64 9 ± 23 7^{ab}	(8)	70 4 ± 8 8^{bd}	(8)	67 6 ± 12.8^{ac}
	Twin	M	(6)	122 0 ± 50 8^{ce}	(2)	60 0 ± 5.7^{ab}	(2)	77 8 ± 12 6^{be}	(2)	68.9 ± 25.1^{ac}
		F	(6)	107.7 ± 36.0^{bc}	(2)	35.6 ± 6.3^{a}	(2)	97.2 ± 36.9^{e}	(2)	66.4 ± 21.6^{ac}
½ Permer ½ WAD	Single	M	(1)	104.0 ± 0 0^{ac}	(1)	111 1 ± 0.0^{b}	(1)	94 4 ± 0 0de	(1)	102.8 ± 0 0^{c}
		F	(0)	–	(0)	–	(0)	–	(0)	–
		M	(1)	56.0 ± 0.0^{a}	(1)	60.0 ± 0.0^{ab}	(1)	61.1 ± 0 0^{ac}	(1)	60.6 ± 0.0^{ab}
		Fx	(3)	46.0 ± 4.0^{a}	(3)	40.4 ± 7.0^{a}	(3)	57.7 ± 10.5^{ab}	(3)	48.9 ± 1.7^{a}
½ Uda ½ WAD	Single	M	(3)	181.0 ± 65.1^{e}	(3)	84 1 ± 22.5^{b}	(3)	98 9 ± 8 4^{e}	(3)	91 5 ± 15 4^{c}
		F	(3)	94 0 ± 5 9^{ac}	(4)	97.8 ± 23 7^{b}	(4)	83 6 ± 16 6^{ec}	(4)	90.7 ± 14.3
	Twin	M	(No twin births were obtained)							
		F								

a, b, c, d, e: All means within the same column bearing the same superscripts are not significantly different at the 5% level

1 In parentheses, the number of observations.

as affected by number of lambs suckled and the vigour of the individual lambs as earlier observed (21, 22) During the post-weaning period, management and quality and quantity of feed are more important Based on the results reported herein, maternal influences during the pre-weaning period are suggested in view of significance ($P < 0.05$) of all interaction effects during the first 90 days of the lambs' growth (Table 4). These effects were not significant between 90 and 180 days of age.

Several workers (8, 10, 26, 27) have pointed out the importance of weight gain during pregnancy on the performance of a dam and its offspring Weight gain during pregnancy has been reported to lead to higher milk yields (3) Younis *et al* (26) have indicated that there are optimum levels in pregnancy weight gains which will lead to high pre-weaning lamb performance; they found ewes carrying twins to be more efficient (65%) in lamb production than those carrying singles (59%) in the utilization of body gain during pregnancy. This was determined from correlation studies between body gain and growth performance of newly born lambs up to 30 days; after this time, they expected no further influences of the type of pregnancy (twin or single) on the utilization of body weight.

In the present experiment, lamb daily gain (LDG) showed a negative and non-significant relationship with gain during pregnancy ($r = -0.155$, $P > 0.05$) and with both ewe liveweight and gain during pregnancy ($R = 0.314$, $P > 0.05$). Earlier results (19) however, gave the impression that ewes which either lost weight or gained more than 10 kg were not able to support growth rates as fast as those that gained up to 10 kg. This implies that those which lost weight possibly had insufficient reserves at lambing to support adequate milk production, just like those that gained more than 10 kg which must have utilized the available nutrients for body gain during gestation Body gains of 5 kg, on the average, seemed reasonable for WAD ewes, if they were to support the fastest rates of gains of their lambs

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