LINEAR MEASUREMENTS IN WEST AFRICAN DWARF (WAD) AND WAD X RED SOKOTO GOATS

OZOJE* M.O. AND HERBERT, U¹

Department of Animal Breeding and Genetics, University of Agriculture, Abeokuta, Ogun State

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ABSTRACT

Performance record of 76 West African Dwarf (WAD) and WAD X Red Sokoto (RS) kids were compared for efficiency of growth in skeletal dimensions. Genotype ($P < 0.01$) affected all the measurements studied. Halfbred kids were superior in all body parts from birth till 150 days of age. Maternal effect did not significantly contribute to better performance among the halfbred kids, although, its influence varied from 5 - 33% at different stages of growth in favour of the halfbreds. Season of birth ($P < 0.05$) affected all measurements studied at birth except shoulder width. However, at 90 days and 150 days of age, seasonal influence became significant ($P < 0.05$) on shoulder width and non significant for all other body measurements. At birth, kids born in the dry season (October-April) had superior body length, shoulder width and leg length, but those born in the rainy season had superior heart girth. Genotype X season interaction affected shoulder width significantly ($P < 0.01$) at birth, while sex and type of birth did not significantly influence body measurement at any age.

Keywords: Linear measurements, genotypes, preweaning growth, maternal effects, goats.

INTRODUCTION

Size, characterized by body weight at a given degree of maturity (Fitzhugh and Taylor, 1971), at a given body composition for a given sex, ignores possible important difference among endomorphic, mesomorphic and ectomorphic structures (Cartwright 1979). Similarly, body weight in characterization/evaluation of live animal performance is subject to short term changes

imposed by various natural processes of production such as, management system, pregnancy and seasonal changes. But linear measurement, apart from considering variation in endomorphic, mesomorphic and ectomorphic structure, it is less affected by management system, pregnancy and seasonal changes and therefore allows comparison of growth in different parts of the body (Russell, 1975). At maturity, linear measurements are essentially a constant reflecting heritable size of the skeleton (Jeffry and Berg, 1972).

Linear body measurements have been used severally to characterize breeds evaluate breed performance and predict liveweight gain. It is also being used to study the effect of crossbreeding and as a criterion for selecting replacement animals and evaluating breed controlled environments (Shrestha *et al.*, 1984, Searle *et al.* 1989a and b; Sharma *et al.*; 1977; Weiner and Hayter, 1974). In sheep, skeletal dimensions have been used to study the interactions between heredity and environment and had also been investigated as possible correlates of carcass composition (Wynn and Thwaites, 1981). The aim of this work therefore, is to evaluate the performance of West African Dwarf (WAD) and WAD x RS (Red Sokoto) goats over 150 days (using linear measurements) with the ultimate desire of exploiting the productive advantages of the Red Sokoto goats - a large, faster growing and early maturing meat producing breed (Upton, 1987; Ngere, 1983 and Ngere *et al.*, 1983)-in improving the meat potentials of the WAD goat.

MATERIALS AND METHODS

The data used in this study were extracted from an experiment conducted at the University of Ibadan Teaching and Research Farm between October 1988 and July, 1991. The University of Ibadan is located on latitude

¹ Present Address: Dept Animal Production, FUT, Owerri

7°27'N and on longitude 3° 55'E on an elevation of about 200m above sea level. It is under a lowland forest vegetation determined by the rainfall pattern of Ibadan controlled by two opposing winds dividing the year into two major seasons-the dry and the rainy seasons (Ebozoje 1992).

The experiment was designed to compare the performance of WAD and WAD X RS crosses using 26 does and 7 bucks of both WAD and RS breeds. The experiment spanned a period of 4 breeding cycles, each cycle producing varying numbers of kids ranging from 10-28. At the end experiment, a total of 76 kids from 48 kiddings were compared for growth potentials.

Management of Kids:

Kids were allowed to run and suckle their dams freely. In addition, fresh cow milk at the rate of 0.5 litter /head/day was made available to the kids as supplement until they were 30 day old. The kids were also fed 60g/head/day concentrates containing 14 percent protein and 2.8kcal of energy once a day as supplement to dam milk and legumes between 30-90 days of age.

Data Preparation and Analysis:

Basic information of genotype, type of birth, sex, sire and dam were kept on each kid in addition to linear measurement record at 30, 60, 90, 120 and 150 days. Linear measurements record taken include; body length (BL) heart girth (HG), shoulder width (SW) and leg length (LL). Measurements were taken with the aid of a measuring tape and ruler as described by Searle *et al.* (1989a),

Analytical Model:

All measurements taken at birth 90 days and 150 days of age were analysed using the following model. The effects of breed, season, sex and the type of birth on all parameters measured were also estimated using the least squares procedures for unequal subclass number (SAS, 1990).

$$Y_{ijklm} = U + B_i + S_j + D_k + T_l + BD_{ik} + ST_{jl} + E_{ijklm}$$

Y_{ijklm} = the observation of the dependent variable on the M^{th} kid of the i^{th} breed of the j^{th} Sex of Kid of the K^{th} season of birth and of the l^{th} type of birth.

U = Population constant for all record

B_j = effect of the i^{th} genotype, $i = 1, 2$ (WAD and WAD X RS)

S_j = effect of the j^{th} Sex of kid; $j = 1, 2$ (Male, female)

D_k = effect of the k season of birth, $k = 1, 2$ (dry, rainy season)

T_l = effect of the l^{th} type of birth, $l = 1, 2$ (Single, multiple birth)

BD_{ik} = effect due to the interaction between breed and season.

ST_{jl} = effect due to the interaction between sex and type of birth.

E_{ijklm} = random error normally and independently distributed with 0 mean and variance S^2 .

All effects except the error term were considered fixed. Estimated of least squares means for all the parameters studied at various ages were also computed.

Maternal Effects:

The following attempts were made to reduce the influence of milk on the preweaning performance of the kids used in this study:

1. Direct and reciprocal crossing
2. Fresh milk supplementation twice daily (9a.m. and 1.30 p.m) between birth and 30 days of age.
3. Between 30-90 days all surviving kids were given concentrates containing 14% protein and 11.70MJ energy.

At the end of the experiment an estimate of total maternal effect calculated by the method of Dickerson (1969) and Alanda *et al.* (1980) was deducted from the performance of crossbred kids and tested for significant different along-side purebred data.

Total maternal effect was defined as the sum of the maternal and grand maternal effect of genotype i and j .

$$\text{Total maternal effects (TMi or j)} = \sum_{j=1}^n gm + gm^1 = (B_{ji} - B_{ij})$$

$$j = 1$$

$$j \neq i$$

$$j = \text{Red Sokoto}$$

$$i = \text{WAD}$$

$$gm = \text{maternal effect (direct)}$$

$$gm^1 = \text{grand maternal effect}$$

$$n = \text{number of genotypes}$$

$$B = \text{genotype of kids}$$

$$B_{ji} = \text{least square means for the genotype class with } j$$

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as the dam

B_{ij} = least square means for the genotype class with j as the dam

Genetic effect equal total variations minus total maternal effects.

The following assumptions were implied in this model:

1. Deviation from the population mean by any class was assumed to be due to genetic and or maternal environmental effects.
2. The mean of the additive, maternal and grand maternal effects equals zero.
3. The population means was equal to the mean of the purebreds.

RESULTS

The estimated square means for genotype, sex, season and type of birth by age for body length, heart girth, shoulder width and leg length are presented in Tables 1-3. Examination of all first order interactions involving genotypes, sex, season and the type

of birth showed that only genotype X season significantly affected ($P < 0.05$) shoulder width at birth. Halfbreds born in the dry season were wider in shoulders than purebreds born in the rainy season (9.6cm vs 8.6cm). Purebreds born in the rainy season had wider shoulders than the halfbreds born in the same season. Generally, halfbreds were superior in shoulder width.

There was a steady significant increase in each of the measurements studied from birth until kids were 150 days old (Tables 1-3). The regression equations estimated for each of the measures are $Y = 25.91 + 0.11 X$ for body length (BL), $Y = 9.80 + 0.05 X$ for shoulder width (SW), $Y = 28.53 + 0.13 X$ for heart girth (HG), and $Y = 19.67 + 0.09X$ for leg length (LL). These increases calculated as a percentage of their sizes at birth were 63.9% for body length (BL), 73% for heart girth (HG), 70% for shoulder width (SW) and 62.8% for leg length (LL)

TABLE 1: LEAST SQUARES MEANS AND STANDARD ERRORS FOR LINEAR MEASUREMENTS(CM) TAKEN AT BIRTH.

Variables	No. of obs	Body Length	Heart Girth	Shoulder Width	Leg Length
Overall Aver. s.e.	76	25.76 0.23	27.15 0.23	9.64 0.18	18.42 0.21
Breed					
WAD	45	24.95	26.71	9.16	17.23
WAD X RS	31	26.62	28.03	10.09	19.56
Av. s.e.		0.23	0.24	0.18	0.20
Sign F. Test		***	***	**	***
Sex					
Male	38	25.65	27.32	9.72	18.32
Female	38	25.90	27.42	9.53	18.48
Av. s.e.		0.25	0.24	0.19	0.20
Sign F. Test		n.s	n.s	n.s	n.s
Season					
Dry	55	26.21	26.70	9.81	18.82
Rainy	21	25.34	28.04	9.44	17.98
Av. s.e.		0.24	0.35	0.18	0.30
Sign F. Test		*	*	n.s.	*
Birth Type					
Single	34	25.72	27.54	9.51	18.47
Multiple	42	28.83	27.20	9.74	18.33
Av. s.e.		0.24	0.24	0.19	0.20
Sign F. Test		n.s	n.s	n.s	n.s

*** $P < 0.001$

** $P < 0.01$;

* $P < 0.05$;

n.s. not significant

TABLE 2: LEAST SQUARES MEANS AND STANDARD ERRORS FOR LINEAR MEASUREMENT (CM) AT 90 DAYS OF AGE.

Variables	No. of. obs.	Body Length	Heart Girth	Shoulder Width	Leg Length
Overall	61	38.97 0.38	43.79 0.53	14.71 0.19	28.71 0.34
Breed					
WAD	35	37.40	40.95	14.47	26.24
WAD X RS	26	38.91	44.96	15.40	32.67
Aver. s.e.		0.38	0.52	0.20	0.34
Sign. F. Test		**	**	**	***
Sex					
Male	34	38.31	42.92	15.18	29.38
Female	27	38.00	42.98	14.70	29.53
Aver. s.e.		0.40	0.53	0.20	0.35
Sign F. Test		n.s	n.s	n.s	n.s
Season					
Dry	43	38.19	42.13	12.52	28.98
Rainy	18	28.11	44.34	15.36	29.94
Aver. s.e.		0.38	0.75	0.20	0.37
Sign. F. Test.		n.s	n.s	n.s	n.s
Birth Type					
Single	32	38.36	43.20	15.10	29.84
Multiple	29	37.95	42.71	14.78	29.06
Aver. s.e.		0.38	0.53	0.20	0.35
Sign F. Test		n.s	n.s.	n.s.	n.s.

** P < 0.01;

***P < 0.001;

n.s not significant

Genotype significantly ($P < 0.01$) affected each of the linear measurements examined at birth, 90 days and 150 days. Halfbred were superior to purebreds in all body parts at all stages of growth. Sex did not significantly affect any of the measurements studied either at birth or at any other age up to when kids were weaned (Table 1-3). Season significantly ($P < 0.05$) affected BL, HG and LL ($P < 0.01$) at birth. At 90 days and 150 days, seasonal effects became significant ($P < 0.01$) for SW and non-significant on HG and BL. Kids born in the dry season (October - April) had superior BL (26.21cm vs 25.34cm) SW (9.81cm versus 9.44cm) and LL (18.82cm vs 17.98cm) at birth as compared to kids born in the rainy season. However, kids born in the rainy season had superior HG (28cm versus 26.7cm) at birth. At 90 and 150 days, these difference became negligible and non-significant except for LL (Tables 1-3). Type of birth had no significant effect on all the measurement

studied. Maternal environmental effect at birth, 90 and 150 days for all measurements considered except BL at 150 days and HG at 90 days were not significant. Maternal effect accounted for between 9.96% and 15.3% of total variations of all measurements at birth, 5.48% - 33% at 90 days and 8.13-33% at 150 days.

DISCUSSION

Halfbred kids were superior to purebred West African Dwarf kids in all body parts at all stages of growth studied. This was expected since breed combinations promote high growth which is in turn associated with increase in mature body size (Jeffery and Bergy, 1972). Although, the performance of the halfbred progeny relative to the pure purebreds in all linear measurement traits observed in this study, were lower than that reported by Djubrilou-Oumara (1986) on purebred Red Sokoto kids, their performance

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TABLE 3: LEAST SQUARES MEANS AND STANDARD ERRORS FOR LINEAR MEASUREMENTS (CM) AT 150 DAYS OF AGE

Variables	No. of obs.	Body Length	Heart Girth	Shouder Width	Leg Length
Overall	58	42.22	46.97	16.47	29.98
Aver. s.e		0.33	0.50	0.23	0.34
Breed					
WAD	33	41.20	44.98	16.07	27.28
WAD X RS	25	43.91	49.38	17.41	33.80
Aver. s.e.		0.33	0.48	0.23	0.34
Sign. F. Test		***	***	***	***
Sex					
Male	33	42.81	47.43	16.88	30.49
Female	25	42.30	46.93	16.60	30.59
Aver. s.e.		0.35	0.49	0.25	0.35
Sign. F. Test		n.s	n.s	n.s	n.s
Season					
Dry	41	42.17	46.45	16.23	30.30
Rainy	17	42.93	47.50	17.25	30.93
Aver. s.e		0.32	0.69	0.24	0.49
Sign. F. Test		n.s	n.s	n.s	n.s
Birth Type					
Single	32	42.81	47.21	16.90	30.70
Multiple	26	42.30	47.10	16.58	30.39
Aver. s.e		0.33	0.49	0.24	0.35
Sign. F. Test.		n.s	n.s	n.s	n.s

**P < 0.001

***P < 0.01

n.s not significant.

was a significant improvement on the performance of WAD goats consistently reported in literature (Ngere, 1983; and Opong, 1987). Weiner and Hayter (1974) and Searle *et al.* (1989a&b) reported similar findings in crossbreeding experiments involving sheep. They also noted that breeds did not rank in the same order of size for all body parts. Similar observation among the breeds of goats used in this study revealed that the Red Sokoto is superior to the WAD, At maturity the WAD goat weighs between 20-25kg, measures between 40-50cm in height and 55-70cm in length at wither. The Red Sokoto goat on the other hand, weighs between 30-33kg at maturity and measures between 75-90cm in height at wither and 90-100cm in length (Ngere *et al.* 1983; Wilson 1982).

Height at wither at any age, according to Jeffery and Berg (1972) reflects animals skeletal size, while shoulder width, pounce

girth and heart girth reflect body conditions. Sulieman *et al.* (1990) however, noted that heart girth reflects an animal's physiological status. Heart girth, pounce girth and shoulder width are better indicators of liveweight and condition scores than height at wither. They are all highly associated with grade and dressing percentage reflecting their associations with condition scores (Jeffery and Berg, 1972).

In general, each measurement studied increased with increase in age in both genotypes. These increases from birth to 150days, calculated as a percentage of their values at birth, were at different rates. This observation agreed with the report of Russell (1975) that body measurements differ in their rates of maturing.

At birth, kids born in the dry season were superior in body length, shoulder width and leg length, while kids born in the rainy season were superior in heart girth. The superiority

of kids born in the dry season could be associated with maternal nutritional status at conception since dam's weight changes 90 days prepartum highly affected kids body size at birth (Jeffery and Berg, 1972). Individual nutritional differences might also have contributed to growth difference in various body parts studied as was also observed by Searle *et al.* (1989a). Allden (1968), found that at 150 days of age, Merino sheep subjected to contrasting nutritional regimes differed in all aspects of body size. He therefore, concluded that the shape of an animal may be altered to a minor extent by food restriction so that bone occurs at the expense of other tissues, (Allden, 1970).

Sex effect on body measurements was not significant in this study which contradicted the reported of Sharma *et al.* (1977) on Muzaffarnagrl breed of sheep and their crosses with corriedale sheep. The type of birth, like sex, did not significantly affect dimensions in all measurements studied, which confirms the report of Shrestha *et al.* (1984) on sheep at six month of age, but contradicted the observations of Cassard *et al.* (1956), who reported that singles were larger than twins in heart girth and body length. The lack of significance of type of birth on body measurements in this study may have been due to the management practice where kids were on milk supplementation from birth to 30 days of age. The lack of significant effects of most of the interactions on body measurements in this study is consistent with the reports of Shrestha *et al.* (1984) and Dominique *et al.* (1981).

In conclusion, the superiority exhibited by the halfbred kids in general performance would likely be carried on to latter ages leading to a better performance in the long run and heavier market weights and size. Therefore, the Red Sokoto breed of goat could conveniently be used to upgrade and improve the meat potentials of the West African dwarf goat, taking into account that body frame influences muscle development in addition to the growth of other tissues and total body composition.

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