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Coat pigmentation effects in West African Dwarf goats: live weights and body dimensions

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Abstract

The effect of coat pigmentation on live weight and various body measurements (body length, shoulder width, head width, leg length, neck girth, heart girth, abdominal girth, heart depth and height at withers) of the West African Dwarf (WAD) goats were studied. Coat pigmentation significantly ($P<0.05$) affected live weight with the white and or tan (A^{wt}) goats weighing the most (26.30 kg on the average). Body weight at maturity increased with decrease in pigmentation intensity. Although coat pigmentation had no significant effect on all the body dimensions studied except leg length, it was observed that the white and or tan goats had the largest frame size on the average followed by the brown (B^{bl}) goats. They however, had shorter legs when compared with either the brown or black goats. Frame size also increased with decrease in coat pigmentation intensity. Selection for large frame size and heavy weight at maturity on the basis of coat colour would therefore favour the white goats and those with low pigmentation intensity, where size and market price are the determinant factors.

Keywords: *Coat colour, body dimensions, live weight, frame size*

Introduction

Coat pigmentation in beef cattle has a high repeatability rate and a heritability estimate of 0.53 (Schleger, 1962). Its inheritance in sheep and goats is majorly controlled by alleles on three loci (A, B, and S), although genes on the extension locus (E) tend to modify the effects of these alleles (Adalsteinsson *et al.* 1994).

In tropical environments with high ambient temperatures and intensive solar radiation, coat colour influences radiant heat loss exerting its effects on body weight and other productive adaptability factors in livestock species (Ódubote, 1994; Peters *et al.*, 1982). Finch and Western, (1977) and Seigfried and Hofmeyr, (1979) showed that darker animals among the indigenous cattle of Kenya and Transkei absorbed more solar radiation, drank more water, lost less weight during drought and gained faster thereafter than the lighter-coloured ones. Similar results were reported by Schleger (1962). Odubote (1994) studied the influence of coat colour on body weight in West African dwarf goats and reported that body weight increased with decrease in the degree of pigmentation. However, Peters *et al.* (1982), though reported non significant effect of coat colour in cattle, but claimed that darker animals tended to be heavier at maturity.

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Schleger (1962) found no indication of a higher heat load in the darker animals as evident from their body temperature. The aim of this work was to study the influence of coat pigmentation on body weights at absolute maturity and linear body measurements of the West African dwarf (WAD) goats.

Materials and methods

770 absolute weight at maturity and body measurement records of West African dwarf (WAD) goats in the rural areas of Ogun State taken twice in different seasons were used in this study. These extensively managed goats were housed at night and allowed to freely roam about in the daytime feeding on grasses, browse plants and kitchen wastes.

All the animals used were classified into four groups according to their coat colours and colour combinations, using the codes and allelic classifications of Adalsteinsson *et al.* (1994). These groups ranged from black (E^d, A^a & B^+ alleles) to brown (B^{bl} allele), white and or tan (A^{wt} allele), and spotted or white patched areas on pigmented background (S^{sp})) respectively.

Data collected on each animal and used in this study included coat colour, live weight in the dry and rainy seasons and body measurements such as body length, heart girth, abdominal girth, heart depth, shoulder width, height at withers, neck girth, leg length and head width. All measurements were taken with the aid of a measuring tape and a ruler as described by Searle *et al.*, (1989) and Weiner and Hayter (1974) as follows:

body length the distance from the anterior point of the shoulder (tuberosity of the humerus) to the posterior extremity of the pin bone (tuber ischii)

leg length from the proximal extremity of the olecranon process to the mid lateral point of the coronet.

heart depth the dorso-ventral distance between the most dorsal point of the wither and the ventral surface of the sternum.

heart girth the circumference of the chest.

shoulder width the distance between the lateral tuberosities of the humeri.

abdominal girth the circumference of the abdomen (non-pregnant does as much as could be detected were used)

neck girth the circumference of the neck.

height at withers the distance between the most dorsal point of the withers and the ground level.

head width maximum width at the supra-orbital processes.

Statistical analyses

The effect of coat pigmentation on all the parameters studied was analysed by the Harvey's (1990) mixed-model least-squares analysis procedures. These parameters included weight at maturity and the body measurement traits stated above. Preliminary analyses showed that the effect of seasons and all first order interaction were not significant. This was not surprising any way since weight records were taken in both rainy and dry seasons and the means were used. The model used had the coat pigmentation as the only independent variable. Where significant differences were observed, differences between means were tested using the Duncan's multiple range test procedures outlined in the Harvey's statistical package.

Results and discussion

Live weight

Size is characterised by body weight at a given degree of maturity (Fitzhugh and Taylor, 1971). At maturity, when growth has seized, size in respect of body weight is essentially a constant varying only with the natural processes of production such as management

practices/systems, seasonal changes and pregnancy/kiddings. Therefore, under the same management system and seasonal manipulation as was the case in this study, weight differences would only be accounted for by the variation in additive genetic differences in the same breed. In this study, coat pigmentation effect on matured body weight of the West African dwarf goats was significant ($P<0.05$) favouring the white goats (Table 1). While the white goats weighed 26.30 kg on the average, the brown and black goats weighed 23.40 kg and 22.24 kg respectively (Table 1). The lighter the coat colour the heavier the mean live weight; that is, live weight decreases with increase in pigmentation intensity. Similar results were reported by Odubote (1994) at weaning and at one year of age. However, Finch and Western (1977) and Siegfried and Hofmeyr (1979) reported a contrary result among the Kenyan and Transkei cattle breeds. Although Peters *et al.* (1982) reported a non-significant effect of coat colour on the body weights of cows, they noted that the darker animals tended to be heavier than the lighter coloured ones. In our earlier study on the productivity of the WAD goats (Ebozoje and Ikeobi, 1998), we noted that weaning weight was found to increase with increase in coat pigmentation intensity. This is however, not surprising when compared with the results of this study, since slow growing/maturing animals are usually more matured, weighing more at maturity (Smith *et al.* 1976a and b). But faster maturing ones attain puberty and market weight at a relatively younger age than the slow growing/maturing ones (Fitzhugh and Taylor, 1971, Smith *et al.* 1976a, Smith *et al.* 1976b and Stobart *et al.* 1986).

The overall mean weight of 24.41 kg recorded in this study fell within the range reported in literatures. ILCA (1982) noted that at maturity the WAD goats weighed between 20 and 25 kg measuring about 50cm in height, while Ngere *et al.* (1983) reported that the WAD goats vary considerably in size weighing between 22 and 26 kg at maturity.

Linear body measurements

At maturity, linear measurements are essentially a constant reflecting heritable size of the skeleton (Jeffrey and Berg, 1972). Skeletal growth and muscular development are interconnected according to Searle *et al.* (1989). Skeletal dimensions especially shoulder width, heart girth and height at withers are good indicators of live weight and condition score. They tended to be highly correlated with dressing percentage and grade reflecting their association with condition score (Jeffrey and Berg, 1972). The effect of coat pigmentation on linear body measurements studied was found not to be significant except on leg length ($P<0.05$). Black goats had the longest legs followed by the brown goats and then the white goats. From Table 2, it is obvious that as leg length increases, height at withers decreases, representing a negative relationship between both (Table 3). This was however not expected. While leg length increased with increase in coat pigmentation intensity, height at withers decreased with increase in coat pigmentation intensity. Generally, body dimensions increased with decrease in pigmentation intensity in all the other linear body measurements studied except for body length and shoulder width though, the effects of coat colour on these measurement were not significant. Therefore, selection on the basis of frame size at maturity would favour the white and or tan goats especially where size and market price are the determining factors.

From Table 2, it could be seen that the heart girth values are higher among the white goats, and according to Searle *et al.* (1989), heart girth reflects the physiological status of an animal. It acts as a good indicator of live weight and condition. The white goats with the heaviest live weight in this study also had the largest heart girth. The composition and energy value of live weight and hence body composition according to Searle *et al.* (1989) are influenced by actual and potential frame size. This is probably the reason behind the advantages of the white goats in absolute live weight.

Table 1 *Coat pigmentation effect on the live weight of the West African Dwarf goats*

Variables	No. of obs.	Live weight (Kg)	S.E.
Overall mean	770	22.41	0.72
Coat Colour			
Black/Chocolate brown	233	22.24[b]	0.64
Brown	139	23.40[b]	0.57
White/tan	98	26.30[a]	0.78
Spotted	300	24.88[ab]	0.86

Column means with the same letters are not significantly different (P>0.05)

Table 2 *Coat pigmentation effect on the linear body measurements (CM) of West African Dwarf goats*

Variables	No. of obs.	BL	SW	HTW	LL	NG	HW	AG	HG	HD
Overall mean	770	53.49 ± 0.41	13.84 ± 0.51	43.87 ± 0.39	28.96 ± 0.31	26.41 ± 0.41	11.22 ± 0.94	65.30 ± 0.87	44.92 ± 0.35	24.51 ± 0.29
Coat colour										
Black/chocolate brown	233	53.69	13.94	43.74	29.45[a]	26.19	11.18	63.80	44.16	24.32
Brown	139	53.30	13.92	43.88	29.21[a]	26.64	11.19	65.21	45.02	24.35
White/tan	98	52.86	13.46	44.30	27.25[a]	26.71	11.43	69.23	46.64	25.41
Spotted	300	53.38	14.14	43.16	28.35[ab]	26.06	11.23	63.45	44.22	24.57
Average s.e.		0.51	0.47	0.59	0.41	0.48	0.74	0.77	0.55	0.31
Test of sign.	ns	ns	ns	ns	*	ns	ns	ns	ns	Ns

[ns] not significant

*column means with different letters are significantly different at P<0.05.

Table 3 *Pearson's correlation coefficients between linear body measurements in West African Dwarf goats*

	1	2	3	4	5	6	7	8	9
BL									
SW	0.57	-							
HTW	0.44	0.51	-						
LL	0.31	0.11	-0.32	-					
NG	0.11	0.71	0.21	0.11	-				
HW	0.01	0.17	0.11	0.18	0.51	-			
AG	-0.05	-.47	-0.11	0.31	0.31	0.41	-		
HG	0.01	0.71	0.31	0.27	0.41	0.31	0.51	-	
ND	0.11	0.31	0.11	0.11	0.21	0.41	0.24	0.17	-

In conclusion, Brown *et al.* (1973) stated that body measurements in addition to body weight give a more complete description of an animal than the conventional method of weighing and grading. From the results of this study, the white goats were heavier and also had the largest frame size. Actual size (absolute weight and frame size) increased with decrease in coat pigmentation intensity. So selection for increased body size at maturity would favour the white colour goats and the lighter-coloured ones where emphasis is placed on matured body weight and frame size in the West African Dwarf goats

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