Full Length Research

Effect of coat colour on morphological characteristics of Red Sokoto, Sahel and West African Dwarf goats

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ABSTRACT: The need to classify animals into breeds has necessitated the study of coat colour and its overall impact on livestock productivity. There exists paucity of information on the impact of coat colour on morphometrics of goats in Nigeria and this study was designed to fill that knowledge gap. Color morphological character was used to determine the relationship among Red Sokoto, Sahel and West Africa Dwarf at different ages (Less than one year, one to two years and above two years). 300 each of Red Sokoto, Sahel and WAD goats, with 150 males and females per breed and 100 across ages (<1year old, 1-2 years old and 2-3 years old) from Sokoto, Borno and Ogun state were sampled and were sorted into colour groups within breeds and different age groups and the effect of this on body measurements and body weight were evaluated. It was generally observed that coat colour influence varied with sexes and ages and moderately influenced many body mensuration traits with no definite pattern between breeds, ages and sex. Brown goats with white spots weighed heavier (body weight), grew taller (height at wither and stature) and had greater depth (D) and girth (HG); followed by white and brown, brown (B) and dark red (DR) coat coloured goats. The black with black spotted pigments had the least figures for production parameters on the average. It was concluded that although, coat colour appeared as a weak factor influencing body growth, it nevertheless, is a moderate factor that influences body morphometry.

Key words: Coat colour, body weight, morphological characteristics, Red Sokoto, Sahel, West African Dwarf goats.

INTRODUCTION

Coat colour is due to melanin deposits in the hair which comes in two basic types' eumelanin and phaeomelanin (Adalsteinsson et al., 1994; Sponenberg 1995). Eumelanin is usually black, but sometimes brown. It is the pigment responsible for black and brown areas on goats, or rarely for dusky blue colour (Adalsteinsson et al., 1994). Black wool has long been known to be due a recessive gene with heterozygotes for the recessive allele indistinguishable from the dominant homozygotes (Olfaz et al., 2011). Coat colour has been identified as one of the major factors that might affect the productivity of animal (Olfaz et al., 2011).

Coat colour genetics is an intricate and complicated subject, but if broken down to the details could be used to good advantage (Sponenberg, 2004). Studies have been carried out on coat types of small ruminants and the alleles responsible for pigmentation on the body measurable characters. An average of six coat types or coat colours have been reported in indigenous breeds (Peacock, 1996; Akpa et al., 1998). Also, several authors have postulated that goats could have a very vast array of coat colours which could range from black, red, white and brown; and each of these could be spotted, striped, blended shades or facial stripes (Sponenberg, 2004; Kine, 2005; Olfaz et al., 2011). Frequency of occurrence of coat colours might be environmentally influenced and enhanced genetically in all the cases cited by various authors (Peacock, 1996; Akpa et al., 1998). However, there has been no clear reports on the impact of coat pigmentation on morphometric indicators in recent literatures. Thus, this study attempts to evaluate the effect where available of coat colour on

Table 1. Effect of coat colour on body mensuration characteristics of Red Sokoto Does aged <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	*	ns	ns	*	*	*	ns	ns
BB	7.00±1.61	10.00± 0.84	20.50±2.67a	22.50±3.58	42.00±3.40	59.00±4.29a	68.00±5.59a	64.10±5.62^a	13.00±1.22	13.00±2.69
BR	6.72±0.43	10.04± 0.22	13.35±0.71b	21.48±0.95	41.89±0.91	52.46±1.14ab	54.96±1.49ab	57.15±1.50^{ab}	12.71±0.33	13.55±0.72
BW	5.79±0.93	10.83± 0.49	12.87±1.54b	26.58±2.06	42.75±1.96	52.67±2.47ab	41.17±3.22b	42.85±3.23^b	10.92±0.70	13.92±1.55
DR	5.43±1.14	10.75± 0.84	10.48±1.89b	23.30±2.26	38.63±2.40	52.75±3.03ab	50.00±3.94b	51.73±3.76^b	10.68±0.86	14.00±1.90
LB	5.29±0.76	10.09± 0.37	13.22±1.26b	23.89±1.68	42.47±1.60	49.44±2.02ab	54.39±2.63ab	56.49±2.64^{ab}	11.52±0.57	14.41±1.26
WW	4.00±2.27	11.00± 1.19	14.00±3.77b	20.40±5.05	46.00±4.80	44.00±6.05b	55.00±7.88ab	57.20±7.92^{ab}	10.00±1.72	12.00±3.79

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

morphometric traits of indigenous goats.

MATERIALS AND METHODS

The animals used for the study were sampled from Borno, Sokoto and Ogun States. These states were selected because they are locations having close to pure breeds of the goats. They were sampled from various abattoirs of the three states when brought for slaughter either by the owner or by the slaughter man. It is believed that all animals find their way into the abattoir from villages and local markets, where they are kept in small numbers by local farmers; they are raised under the extensive system of management. A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years.
   In these study, observed coat colours were classified as LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white and their various combinations. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age (Salako and Ngere, 2002). The following body morphometric characters were measured on each animal: Body Weight (BW), Age, Horn length (HL), Ear length (EL), Shoulder width (SW), Neck circumference (NC), Body length (BL), Withers height (WH), Heart girth (HG), Pouch girth (PG), Tail length (TL) (Salako and Ngere, 2002). Weights of the animals were taken using a spring balance and Walk-in weighing scale. Flexible measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by two assistants in such a way that their heads, necks, and chest were stretched almost in a straight line. Each measurement was taken at least three times and the mean recorded to the nearest centimeter or kilogram. Reference marks used for body measurements were done according to the method of Salako and Ngere (2002). Coat colour was visually appraised, animals were sorted into colour groups within breeds and different age groups and the effect of this on body measurement and body weight was evaluated using the general linear model (GLM) procedure of SAS (1990), means were separated using least square means.

RESULTS AND DISCUSSION

The effect of coat colour on body measurements in Red Sokoto does less than one year is shown in Table 1 and 2. In the doe, the effect of coat colour was significant (p<0.05) on SW, WH, HG and PG while non-significant (p>0.05) effect was observed in HL, EL, NC, BL, TL and BW. On the average, brown goats were superior in performance in all the studied traits among the does. EL, BL, TL and were significantly influenced (p<0.05) by coat colour, while HL, SW, NC, WH, HG, PG, and BW were not significantly (p>0.05) affected by the coat colour for the buck. No definite patterns of superiority were observed in the bucks except for the BR having the highest number of frequency (HG and WH) among the studied traits. Table 3 and 4 shows the effect of coat colour on body mensuration in Red Sokoto

Table 2. Effect of coat colour on body mensuration characteristics of Red Sokoto Bucks <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	*	ns	ns	*	ns	ns	ns	*	ns
BB	5.00±1.17	10.00±0.77a	16.00±2.40	20.55±3.01	38.00±2.63ab	51.00±4.14	57.05+5.57	59.20±5.64	11.00±1.48ab	10.00±2.11
BR	5.10±0.30	9.81±0.19ab	14.47±0.61	22.49±1.30	43.20±0.69ab	59.19±1.05	59.85±1.41	61.97±1.43	11.70±037ab	12.57±0.53
BW	5.38±0.83	9.78±0.54ab	11.75±0.70	25.00±2.13	39.35±1.86ab	51.63±2.90	49.00±3..93	50.85±1.41	11.18±1.04ab	12.63±1.49
DR	6.10±0.74	10.20±0.48a	12.00±1.51	17.00±1.90	39.70±1.66ab	52.10±2.61	51.60±3.51	53.74±3.55	10.80±0.93ab	14.32±1.33
LB	5.14±0.62	10.10±0.41a	12.86±1.28	23.86±1.60	40.16±1.40ab	50.07±2.20	56.29±2.97	58.13±3.00	13.29±0.78a	14.43±1.12
WW	5.00±1.65	8.00±1.08ab	14.00±3.39	24.80±4.25	46.00±3.71a	44.00±5.84	59.00±7.86	62.10±7.95	9.00±2.08b	10.00±2.97

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight. LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 3. Effect of coat colour on body mensuration characteristics of Red Sokoto Does aged 1 – 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	*	ns	*	ns	ns	ns	ns	ns	ns
LB	7.7±0.81	13.82±0.65a	13.67±0.74	25.82±0.99b	45.22±2.67	89.79±1.60	64.56±1.39	66.98±1.34	12.50±0.64	12.89±1.20
BR	7.14±0.41	11.92±0.33a	13.41±0.39	25.46±0.49b	53.42±1.35	57.59±0.81	63.48±0.70	65.72±0.68	12.22±0.33	14.36±0.60
BW	8.00±1.73	13.40±1.39a	13.00±1.57	24.00±2.06b	44.00±5.68	53.00±3.41	69.00±2.09	70.90±2.86	14.40±1.37	14.50±2.55
DR	5.33±1.41	12.33±1.13a	12.00±1.28	28.33±1.68b	47.67±4.63	51.50±2.78	62.67±2.41	64.83±2.33	11.67±1.12	11.002.03
WW	5.00 ±2.44	8.00±1.96b	15.00±2.22	42.00±2.90a	46.00 8.01	55.00±4.81	64.00±4.17	66.00±4.03	13.00±1.93	14.00±3.59

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

goats between one to two years. In the doe, the effect of coat colour was not significantly (p<0.05) affected by all the studied traits except for EL and NC (Table 3). On the average, BW goats were superior in performance in all these traits (HL, HG, PG, TL and BW) studied in the does. HG, PG and BW had significant (p<0.05) effect on coat colour while other studied traits were not significantly (p>0.05) influenced by coat colour for the bucks.

No definite patterns of superiority were observed in the buck except for the BR having the highest number of frequency (HG and WH) among the studied traits. The effect of coat colour on body mensuration in different Red Sokoto goats above two years is shown in Table 5 and 6. In the doe, the effect of coat colour was significant (p<0.05) only on HL and other traits were not significantly (p>0.05) affected. No definite pattern was

observed among the superiority of the coat colours on the studied traits. NC and TL were significantly (p<0.05) influenced by coat colour while other studied traits were not significantly (p>0.05) influenced by the coat colour for the buck. No definite patterns of superiority were observed in the buck among the studied traits.

The effect of coat colour on body mensuration in Sahel goats of age less than one year is shown in

Table 4. Effect of coat colour on body mensuration characteristics of Red Sokoto Bucks aged 1 – 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	ns	ns	ns	*	*	ns	*
BR	7.16±0.39	11.86±0.51	13.55±0.65	25.79±1.03	50.69±1.79	55.47±1.44	63.32±1.10[a]	65.99±1.14[a]	13.20±.38	14.25±0.65[a]
DR	7.00±1.23	10.80±1.63	15.50±2.05	26.00±3.13	44.30±5.68	51.00±4.56	53.55±3.48[b]	55.80±3.61[b]	11.00±1.21	16.00±2.05[a]
LB	6.4910.35	12.09±0.47	13.09±0.59	27.09±0.94	43.79±1.63	52.37±1.31	61.97±1.00[a]	64.10±1.04[a]	12.76±0.35	13.29±0.59[ab]
BW	5.50±0.87	11.75±1.15	15.25±1.45	22.25±2.30	46.75±4.01	51.25±3.22	61.50±2.45[a]	63.58±2.55[a]	11.13±0.85	10.00±1.45[b]

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, ns =not significant.

Table 5. Effect of coat colour on body mensuration characteristics of Red Sokoto Does aged >2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
LB	8.08±0.71[a]	13.31±0.82	18.93±1.48	24.35±1.24	47.50±3.69	59.71±2.11	60.68±1.65	62.69±1.65	12.31±0.75	18.14±1.21
BR	7.88±0.41[a]	12.57±0.47	19.35±0.86	25.99±0.72	46.75±2.13	58.09±1.22	61.46±0.95	64.24±0.95	13.21±0.43	19.42±0.70
BW	7.25±0.71[a]	11.35±0.82	20.65±1.48	22.66±1.24	40.88±3.69	55.25±2.11	60.13±1.65	62.48±1.65	12.98±0.75	19.71±1.21
DR	6.91±0.71[ab]	12.01±0.82	20.41±1.48	24.55±1.24	40.73±3.69	59.81±2.11	60.75±1.65	63.31±1.65	13.98±0.75	18.38±1.21
WW	4.50±1.43[b]	11.00±1.65	21.50±2.97	26.00±2.50	52.00+7.40	59.00±4.24	57.00±3.30	59.15±3.30	11.50±1.50	18.00±2.43

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 7 and 8. In the doe, the effect of coat colour was not significant (p>0.05) for all the studied traits. On the average, brown goats were superior in performance for all the studied traits among the does. HL, EL and TL were significantly influenced (p<0.05) by coat colour, while all the remaining traits were not significantly (p>0.05) affected by the coat colour in the buck. Black and white showed the highest superiority for the bucks. Table 9 and 10 shows the effect of coat colour on body mensuration in different of Sahel goats between one to two years. In the doe, the effect of coat colour was significantly (p<0.05) influenced by EL, BL, WH and PG and the remaining studied traits were not significant (p>0.05). On the average, Black goats were superior in performance in all the stated traits. BL and WH had significant (p<0.05) effect on coat colour while other studied traits were not significantly (p>0.05) influenced by coat colour for the bucks. White goats showed the highest superiority in the bucks. The effect of coat colour on body mensuration in Sahel goats above two years is shown in Table 11 and 12. In the doe, the effect of coat colour was significant (p<0.05) only on NC and other traits were not significantly (p>0.05) affected. Black and white goats had the highest superiority of the coat colours on the studied traits. WH and HG were significantly (p<0.05) influenced by coat colour while other studied traits were not significantly (p>0.05)

Table 6. Effect of coat colour on body mensuration characteristics of Red Sokoto Bucks aged >2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	*	ns	ns	ns	ns	*	ns
LB	7.64±0.48	11.73±0.40	20.95±1.24	23.83±0.74[ab]	45.81±2.63	58.75±1.66	60.25±1.13	62.77±1.12	11.59±0.45[ab]	19.23±0.98
WW	7.50±1.75	11.40±1.44	21.00±4.47	22.00±2.67[b]	40.00±9.48	58.00±5.98	59.00±4.09	61.40±4.03	10.00±1.62[b]	20.80±3.52
DR	7.35±0.71	11.95±0.59	21.72±1.82	26.55±1.09[a]	43.17±3.87	58.00±2.44	60.22±1.64	60.22±1.64	13.17±0.66[a]	19.27±1.44
BW	7.33±0.58	12.89±0.48	14.30±1.49	24.67±0.89[ab]	40.22±3.16	58.11±1.99	65.19±1.34	65.19±1.34	12.47±0.54[ab]	19.51±1.17
BR	6.81±0.38	11.54±0.31	21.03±0.98	24.60±0.58[ab]	49.95±2.07	58.40±1.31	63.47±0.88	63.47±0.88	12.84±0.35[a]	18.26±0.77

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 7. Effect of coat colour on body mensuration characteristics of Sahel Does aged <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	ns	Ns	Ns	ns	ns	ns	Ns
BR	8.00±2.34	11.80±1.70	23.00±3.05	26.00±3.59	42.00±7.28	56.00±9.98	49.00±3.32	51.00±2.29	11.00±2.29	20.00±3.93
WW	7.93±1.35	10.83±0.98	17.40±1.76	18.83±2.08	33.10±4.21	40.30±5.77	46.50±1.97	48.50±1.97	16.60±1.73	14.77±2.27
W/BR	7.59±0.63	12.56±0.45	18.43±0.82	21.89±0.96	38.07±1.95	51.47±0.89	51.47±0.89	53.63±0.91	12.19±0.61	12.67±1.05
B	7.44±0.88	11.33±0.64	18.00±1.15	21.81±1.35	35.43±2.75	49.21±1.25	49.21±1.25	51.79±1.28	11.14±0.86	12.51±1.48
B/W	6.90±0.48	10.08±0.35	18.00±0.62	20.89±0.73	34.48±1.49	49.81±0.68	49.81±0.68	52.15±0.69	11.61±0.47	14.00±0.80
BR	6.50±2.34	10.10±1.70	19.50±3.05	24.40±3.59	30.00±7.28	36.70±9.98	49.00±3.32	51.00±3.40	9.00±2.29	12.00±3.93

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

influenced by the coat colour for the buck. W/Br showed the highest superiority in all the studied coat colours.

The effect of coat colour on body mensuration in West African Dwarf goat less than one year is shown in Table 13 and 14. In the doe, the effect of coat colour was significant (p<0.05) on EL, BL, HG, PG and TL while non-significant (p>0.05) effect was in the remaining studied traits. On the average, BR/W goats had the most superior performance in all the studied traits among the does. HL, EL, SW, TL and BW were significantly influenced (p<0.05) by coat colour in the bucks. No definite patterns of superiority were observed in the bucks except for the black and brown having the highest number of frequency among the studied traits. Table 15 and 16 shows the effect of coat colour on body mensuration in different of West African Dwarf goat between one to two years. In the doe, the effect of coat colour was significantly (p<0.05) affected by all the studied traits except for EL, BL, BW and NC

Table 8. Effect of coat colour on body mensuration characteristics of Sahel bucks aged <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	*	*	ns	ns	ns	ns	ns	ns	*	ns
WW	8.10±1.06[a]	12.48±0.93	19.65±1.28	24.00±2..31	40.58±4.82	44.03±4.89	45.75±2.26	47.73±2.25	10.03±1.11[b]	14.50±1.84
B/W	7.74±0.57[ab]	11.35±0.50[ab]	19.48+0.68	24.47±1.24	38.99±2.58	47.50±2.61	46.63±1.21	48.44±1.20	13.00±0.59[a]	15.95±0.98
B	7.70±0.43[ab]	11.00±0.43[ab]	18.27±0.52	22.87±0.94	39.50±1.97	45.04±1.99	50.34±0.92	52.15±0.92	11.81±0.45[ab]	15.29±0.75
W/Br	5.80±0.75[b]	10.73±0.66[b]	17.65±0.90	22.76±1.64	40.44±3.41	45.74±3.46	51.35±1.59	51.35±1.59	11.48±0.78[ab]	12.91±1.30

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 9. Effect of coat colour on body mensuration characteristics of Sahel Does aged 1 – 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	*	ns	ns	*	*	ns	*	ns	ns
W/BR	10.63±0.79	13.40±0.85[ab]	23.18±1.05	24.71±1.06	56.64±2.56[a]	61.81±2.08[a]	59.25±2.09	61.79±2.08[b]	13.58±0.64	17.56±1.02
WW	10.25±1.72	14.25±1.2[ab]	23.10±1.49	23.50±1.50	54.75±3.62[ab]	65.00±2.95[ab]	59.75±2.96	62.53±2.96[ab]	12.25±0.91	20.00±1.45
B	9.55±0.56	15.78±0.60[a]	24.54±0.75	26.24±0.75	61.65±1.81[a]	64.65±1.47a	62.78±1.48	65.15±1.48[ab]	13.11±0.45	17.59±0.72
B/W	8.73±0.49	12.57±0.52[ab]	22.10±0.65	25.23±0.65	52.23±1.58[ab]	58.40±1.29[ab]	59.66±1.29	61.93±1.29[b]	13.95±0.40	16.40±0.63
B/Br	7.00±2.23	11.00±2.40[b]	21.00±2.98	21.30±2.99	44.00±7.24[b]	52.10±5.89[b]	69.00±5.91	72.00±5.91[b]	12.90±1.81	16.40±2.89

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weight, LB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

which were not significant (p>0.05). On the average, brown and white goats were superior in performance for the does. SW, WH and TL had significant (p<0.05) effect on coat colour while other studied traits were not significantly (p>0.05) influenced by coat colour for the bucks. No definite patterns of superiority were observed in the buck except for the BR/B having the highest number of frequency among the studied traits. The effect of coat colour on body mensuration in different of West African Dwarf goat above two years is shown in Table 17 and 18. In the doe, the effect of coat colour was not significant (p>0.05) on all the studied traits in the does. No definite pattern was observed among the superiority of the coat colours on the studied traits. Similar pattern was observed as in the does except that BW had significant (p<0.05) influence in the bucks. No definite patterns of superiority were observed in the buck among the studied traits.

The frequent occurrence of non-significant effect of morphometric traits in the population of the studied goats is an indication that coat colour might not be a good indicator in assessment of productive traits linked with coat colours. This agreed with the findings of Semakula et al. (2010) who reported that coat colour had no significant effect on the height at wither of small East African goat breeds of Uganda. Generally, Brown goats with white spots weighed heavier (body weight), grew taller

Table 10. Effect of coat colour on body mensuration characteristics of Sahel Bucks aged 1 to 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	ns	*	*	ns	ns	ns	ns
WW	9.82±1.26	14.60±1.20	24.74±1.20	25.60±1.10	57.60±2.31[a]	65.20±2.72[ab]	61.80±2.34	65.26±2.90	12.60±0.81	19.76±1.46
B/W	9.24 0.65	12.67±0.61	22.85±0.69	26.48±0.57	53.22±1.19[ab]	58.21±1.40	59.33±1.20	60.43±1.49	14.98±0.42	17.49±0.75
B	8.50±0.63	12.13±0.60	21.61±0.67	25.70±0.55	53.03±1.16[ab]	60.63±1.36[ab]	58.35±1.17	60.93±1.45	12.00±0.40	15.03±0.73
B/Br	7.02±1.26	14.00±1.20	23.22±1.34	24.86±1.10	56.60±2.31[b]	58.68±2.72b	66.40±2.34	69.04±2.90	13.06±0.81	18.78±1.46
W/Br	5.00±2.83	13. 00±2.68	24.00±3.00	25.00±2.41	45.00±5.17[a]	69.00±6.09[ab]	64.00±5.25	67.00±6.50	14.00±1.81	16.00±3.27

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 11. Effect of coat colour on body mensuration characteristics of Sahel Does aged >2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	*	ns	ns	ns	ns	ns	ns
B/W	10.60±0.89	13.13±0.74	25.29±0.84	24.31±1.28[b]	56.11±1.80	72.27±1.49	65.06±1.08	67.31±1.09	11.79±0.59	24.96±1.53
B	10.51±0.44	13.86±0.37	24.89±0.42	27.88±0.64[a]	59.13±0.90	70.07±0.76	64.50±0.54	66.88±0.35	12.92±0.30	23.26±0.77

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 12. Effect of coat colour on body mensuration characteristics of Sahel Bucks aged >2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
	Ns	Ns	ns	Ns	Ns	*	*	Ns	Ns	Ns
W/Br	11.50±1.29	13.50±1.06	25.00±1.58	27.00±2.02	58.00±2.42	62.00±1.93[a]	59.00±1.10[b]	62.00±2.83	13.80±1.08	19.00±2.66
B	10.97±0.42	13.67±0.35	24.94±0.52	26.79±0.66	57.26±0.91	71.62±0.63[b]	66.01±0.36[a]	67.24±0.93	12.66±0.35	25.43±0.88
B/W	9.82±0.86	13.44±0.70	24.76±1.05	25.66±1.34	53.26±1.85	73.78±1.28[b]	65.28±0.73[a]	67.87±1.87	13.67±0.72	24.11±1.77

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 13. Effect of coat colour on body mensuration characteristics of West African Dwarf Does aged <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	*	ns	ns	*	N\ns	*	*	*	Ns
BR/W	6.38±1.12	10.00±0.49[a]	11.00±1.55	23.25±	48.63±2.73[a]	46.75±4.05	49.55±2.60[a]	50.58±2.59[a]	9.75±0.64[b]	11.10±0.80
BR/B	6.00±2.24	9.00±0.98[a]	15.00±3.10	23.00±4.12	44.00±5.45[a]	55.00±8.10	38.00±5.18[b]	39.20±5.17[b]	9.80±1.28[b]	9.00±1.59
R	6.00±2.24	10.00±0.98[a]	12.00±3.10	23.00±4.12	47.00±5.45[a]	45.00±8.10	48.00±5.18[ab]	49.20±5.17[ab]	10.00±1.28[b]	11.20±1.59
B	5.61±0.56	9.88±0.25[a]	13.74±0.78	24.90±1.03	42.89±1.36[ab]	51.13±2.03	51.88±1.30[a]	53.03±1.29[a]	10.26±0.32[b]	10.79±0.40
BR	4.94±0.75	9.50±0.33[a]	11.99±1.03	20.33±1.37	38.61±1.82[ab]	46±30±2.70	46.78±1.73[ab]	48.21±1.72[ab]	10.14±0.43[b]	10.34±0.53
B/N	4.82±0.62	9.44±0.27[a]	12.54±0.86	24.29±1.14	42.15±1.51[ab]	47.15±2.24	51.39±1.43[a]	52.77±1.43[a]	10.32±0.35[b]	10.07±0.44
B/.BR	4.80±1.00	9.30±0.44[a]	13.00±1.30	23.30±1.84	40.60±2.43[ab]	43.60±3.63	19.60±2.31[a]	50.94±2.31[a]	9.60±0.57[b]	10.20±0.71
BR/.N	2.50±2.24	6.00±0.98[b]	11.00±3.10	21.00±4.12	32.00±5.45[b]	44.00±8.10	56.00±5.18[a]	57.10±5.17[a]	13.90±1.28[a]	10.00±1.59

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 14. Effect of coat colour on body mensuration characteristics of West African Dwarf Bucks aged <1 year.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	*	*	*	ns	ns	ns	ns	ns	*	*
B/.BR	8.00±1.91[a]	11.50±1.22[a]	10.00±3.28[b]	25.00±4.34	44.00±5.35	51.00±7.80	51.00±5.38	53.00±5.24	6.00±1.37[b]	12.50±1.49[a]
BR	6.80±0.78[ab]	9.45±0.50[ab]	10.35±1.34[b]	23.42±1.77	42.20±2.18	51.00±3.18	51.00±2.20	52.30±2.14	10.40±0.56[a]	9.52±0.61[b]
B/W	5.22±0.51[ab]	9.61±0.33ab	13.19±0.88[ab]	24.86±1.16	41.67±1.43	46.92±2.09	50.49±1.44	51.44±1.40	10.75±0.37[a]	10.48±0.40[ab]
BR/B	5.17±1.10[ab]	9.67±0.71[ab]	17.50±1.90a	22.33±2.51	41.00±3.09	46.33±4.51	52.33±3.11	53.50±3.03	10.33±0.79[a]	11.33±0.86[ab]
B	4.50±0.44[b]	9.27±0.28[b]	12.86±0.75[ab]	25.24±0.99	41.37±1.23	48.68±1.79	48.00±1.23	49.34±1.20	10.34±0.31[a]	10.83±0.34[ab]
BR/W	4.33±1.10[b]	9.00±0.71[b]	13.67±1.90[ab]	22.33±2.51	44.37±3.09	49.67±4.51	50.67±3.11	51.80±3.03	9.00±0.79[a]	11.20±0.86[ab]
R	3.50±0.96[b]	9.50±0.61[ab]	13.75±1.64[ab]	23.50±2.17	39.50±2.68	42.88±3.90	49.75±2.69	51.63±2.62	10.25±0.69[a]	10.48±0.75[ab]

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

(height at wither and stature) and had greater depth (BD) and girth (HG); followed by white and brown, brown (B) and dark red (DR) coat coloured goats.

The black with black spotted pigments had the least figures for production parameters on the average and this was in agreement with the

findings of Olfaz et al. (2011) that dark colored animal are more susceptible to climatic stress while light colored one are susceptible to sunburn as coat

Table 15. Effect of coat colour on body mensuration characteristics of West African Dwarf Does aged 1 to 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	*	ns	*	*	ns	*	ns	ns	ns	*
BR/W	14.00±1.89[a]	13.00±1.60	16.00±3.25[ab]	28.00±1.78[ab]	42.00±6.88	55.00±7.28[ab]	53.00±6.68	54.00±7.24	13.00±2.05	24.00±3.52[a]
B/W	7.16±0.84[b]	11.68±0.91	10.20±1.45[b]	23.58±0.79[c]	50.30±3.07	54.46±3.25[ab]	63.66±2.98	65.18±3.23	12.40±0.92	13.62±1.57[c]
R	7.00±1.09[b]	11.67±0.92	15.67±1.88[ab]	25.33±1.03[bc]	54.33±3.98	60.33±4.21[a]	57.00±3.86	58.43±4.18	10.67±1.18	16.00±2.03[ab]
B	6.98±0.45[b]	11.00±0.38	14.25±0.77[ab]	23.24±0.42[c]	53.14±1.62	52.48±1.72[ab]	60.71±1.58	61.98±1.71	10.33±0.48	16.08±0.83[bc]
B/.BR	5.90±1.34[b]	11.20±1.13	15.50±2.30[ab]	25.45±1.26[bc]	51.25±4.88	55.90±5.16[ab]	60.20±4.74	61.55±5.13	10.85±1.45	21.05±2.50[ab]
WW	5.83±1.09[b]	10.10±0.92	13.17±1.88[ab]	24.97±1.05[bc]	51.87±3.98	52.77±4.21[ab]	60.47±3.86	61.70±4.18	9.97±1.18	13.77±2.03[c]
BR/W	5.29±07[b]	11.36±0.60	16.57±1.23[a]	28.77±0.61[a]	53.71±2.60	49.07±2.75[ab]	60.44±2.52	61.73±2.73	11.93±0.77	14.53±1.33[c]
BR	4.75±0.67[b]	11.63±0.57	13.38±1.15[ab]	24.38±0.63[c]	51.63±2.43	51.13±2.57[ab]	61.70±2.36	65.50±2.56	11.13±0.72	13.94±1.24[c]
BR/B	3.67±1.09[b]	11.00±0.92	14.00±1.88[ab]	24.60±1.03[c]	44.00±3.98	44.73±4.21[b]	62.20±3.86	64.00±4.18	10.03±1.18	15.43±2.03[bc]

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 16. Effect of coat colour on body mensuration characteristics of West African Dwarf Bucks aged 1 – 2 years.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	*	ns	ns	**	ns	ns	*	ns
BR/.B	7.00±2.08	10.00±1.64	21.00±3.43[a]	28.00±3.33	47.00±6.02	55.00±8.49[a]	53.00±6.53	54.20±7.00	14.00±1.82[a]	19.00±3.63
BR	6.73±0.54	11.26±0.42	15.95±0.87[abc]	24.58±0.86	50.89±1.56	54.62±2.19[ab]	57.10±1.69	58.44±1.81	12.48±0.47[ab]	11.63±0.94
B/W	6.43±0.69	10.55±0.55	16.59±1.14[abc]	26.28±1.11	50.70±2.01	47.45±2.83[ab]	57.83±2.18	59.82±2.33	11.55±0.61[ab]	15.31±1.21
BR/B	5.83±1.20	9.67±0.95	17.67±1.98[ab]	21.90±1.22	47.67±3.48	47.33±4.91[ab]	56.10±3.77	57.10±4.05	10.67±1.05[ab]	20.67±2.70
R	5.50±1.48	10.00±1.16	11.00±2.43[c]	27.50±2.36	50.50±4.27	38.50±6.02[b]	51.50±4.63	52.60±4.96	11.00±1.29[ab]	18.20±2.57
BR/W	4.88±0.85	11.58±0.67	13.83±1.40bc	25.63±1.36	43.38±2.46	47.33±3.49[ab]	53.67±2.67	54.73±2.86	10.17±0.79**b**	16.92±1.48
B	4.53±0.66	10.33±0.52	15.13±1.09[abc]	25.77±1.05	52.25±1.91	49.33±2.69[ab]	59.67±0.07	61.23±2.22	11.93±0.58[ab]	17.29±1.15
WW	4.33±1.20	9.27±0.95	14.13±1.98[abc]	26.00±1.92	43.33±3.48	49.33±4.98[ab]	58.33±3.77	60.47±4.05	12.10±1.05[ab]	15.67±2.10
BR/.W	4.00±1.48	11.00±0.16	16.00±2.43[abc]	24.00±2.36	43.00±4.27	43.50±6.22[ab]	49.45±4.63	50.30±4.96	10.50±1.29[b]	19.00±2.57

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 17. Effect of coat colour on body mensuration characteristics of West African Dwarf Does >2 years of age.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
B/W	8.31±0.76	12.44±0.83	15. 56±0.98	28.83±0.94	44.21±2.20	47.49±2.33	68.08±1.66	69.74±2.39	11.76±0.59	18.56±0.73
BR/B	8.00±1.52	11.15±1.67	19.00±1.96	27.00±1.89	43.00±4.41	50.50±467	68.35±3.34	70.05±4.80	12.25±1.18	19.50±1.47
B	7.57±0.47	11.03±0.51	14.50±0.60	27.63±0.58	44.59±1.36	46.68±1.44	68.00±1.03	68.11±1.48	11.75±0.36	19.29±0.45
WW	6.83±1.24	10.83±1.36	15.33±1.60	27.00±1.54	47.67±3.59	46.17±3.80	71.67±2.72	73.50±3.91	12.50±0.96	19.67±1.20
BR	6.26±0.76	11.24±0.83	14.56±0.98	26.43±0.94	39.75±3.80	44.91±2.33	69.90±1.66	70.93±2.39	11.51±0.59	18.60±0.73
BR/W	6.25±1.08	11.25±1.18	14.25±1.39	28.58±1.33	45.93±3.11	46.93±3.29	68.43±2.36	70.33±3.39	12.68±0.83	17.70±1.04
R	6.07±1.24	10.60±1.36	16.00±160	28.33±1.54	42.53±3.59	44.93±3.80	72.67±2.72	74.70±3.91	11.73±0.96	21.17±1.20
BR/W	6.00±2.15	8.50±2.35	14.00±2.77	26.00±2.66	41.10±6.22	47.20±6.58	70.00±4.71	72.40±6.77	11.00±1.66	20.00±2.07

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

Table 18. Effect of coat colour on body mensuration characteristics of West African Dwarf Bucks >2 years of age.

Coat Colour	Body mensuration characteristics									
	HL	EL	SW	NC	BL	WH	HG	PG	TL	LBW
Total	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
B/Br	9.50±1.55	11.10±1.09	13.50±2.20	28.25±2.09	48.50±3.54	46.00±4.20	65.50±2.82	67.55±5.70	11.65±1.06	17.90±1.19[bc]
B/BR	9.00±2.18	12.30±1.54	18.00±3.10	31.00±2.87	37.90±4.99	49.00±5.92	71.00±3.98	72.30±8.04	12.70±1.49	19.60±1.68[abc]
R	7.50±2.18	10.90±1.09	15.00±2.20	28.55±2.04	42.50±3.54	47.00±4.20	66.90±2.82	63.50±5.70	12.00±1.06	16.50±1.19[c]
BR/	7.41±0.73	11.40±1.54	14.00±3.10	27.80±2.87	40.00±4.99	47.00±5.92	63.00±3.98	65.10±8.04	10.00±1.49	21.80±1.68[ab]
B/W	7.41±0.73	11.38±0.51	15.66±1.03	27. 00±0.96	44.34±1.66	40.91±1.97	71.83±1.33	69.28±2.68	11.38±0.50	20.78±0.54[abc]
BR	7.11±0.82	9.37±0.58	14.86±1.17	27.29±1.08	43.71±1.88	45.93±2.23	67.31±1.50	69.26±3.03	11.50±0.56	19.17±0.63[abc]
BR/W	6.53±1.26	12.00±0.89	15.00±1.79	26.33±1.66	45.13±2.88	46.33±3.42	70.10±2.30	71.90±4.65	11.33±0.86	20.33±0.97[abc]
B	6.21±0.49	11.23±0.34	15.20±0.69	26.35±0.64	42.54±1.12	43.91±1.32	68.30±0.89	70.62±1.80	12.79±0.33	19.27±038[abc]
BR/B	5.75±1.09	10.33±0.77	17.25±1.55	26.50±1.44	41.58±2.50	48.45±2.96	68.25±1.99	70.40±4.02	12.70±0.75	18.75±0.84[abc]
BL(s)	5.00±2.18	9.70±1.54	19.00±3.10	30.00±2.87	49.00±4.99	48.50±5.92	68.00±3.98	69.40±8.04	11.00±1.49	22.00±1.68[a]

*=P<0.05; a,b = means within the same column with different superscripts differ significantly (P<0.05); N= number of observations; HL = horn length, EL = ear length, SW = shoulder width, NC = neck circumference, BL = body length, WH = wither height, HG = heart girth, PG = pouch girth, TL = tail length, LBW = Live body weightLB = light brown, BR = brown, BW = black and white, DR = dark red, WW = white, ns =not significant.

color is related to the amount of heat absorbed from solar radiation. Akpa et al. (1998) reported that brown and light brown goats were predominantly heavier in body weight and higher in height at wither than other colour pigmented types. The observation of significant variations in certain morphometric measures is at variance with the report of Olfaz et al. (2011) that there was no significant effect of coat color factor on milk production and kid growth in Turkish hair goat. Also review by Kine (2005) showed that dark-coloured animals of various livestock species grow faster in the tropics and subtropics and survival and growth are less in lighter coloured animals, which seem to have increased milk yield (Kine, 2005). Oke and Ogbonnaya (2011) however reported insignificant differences in live weight and heart girth among different colour groups even though black sheep had the highest values for these traits.

Conclusion

Coat colour moderately influenced body morphometric measures and its effect varied between breeds, gender and ages of Nigerian indigenous goats.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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