Heterotic effect on body weight and morphometric traits of crossbred buck kids of Red Sokoto and West African Dwarf goats

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Abstract

This study was conducted to evaluate the effect of crossbreeding on body weight and morphometric traits of crossbred buck kids produced from a mating of Red Sokoto(RS) and West African Dwarf(WAD) goats in a humid tropical environment. Results showed that the main crossbred (RS x WAD) buck kids had significantly higher body weight at 20 weeks (8.98 ± 0.43kg) than the reciprocal (WAD X RS) individuals (8.22± 0.12kg) . The Red Sokoto (RS X RS) buck kids maintained overall superiority for body weight (10.48 ±0.49kg) and other morphometric traits namely; body length (72.62 ± 3.18cm), height-at-withers (54.62 ± 3.10cm) and heart girth (63.20 ± 2.41cm)than other genetic groups. Direct and percentage heterosis for body weight and the morphometric traits were positive for the RS x WAD buck kids except for body length which was negative. The reciprocal WAD x RS buck kids had negative values for all measured parameters indicating that the WAD sired buck kids showed no improvement for these body traits following crossbreeding. It was therefore concluded that rapid improvement in growth traits of WAD goats could be achieved by main crossbreeding involving mating of RS bucks with WAD does.

Key words: Red Sokoto and WAD goats, crossbreeding, heterosis, body weight, morphometric traits.

Introduction

Exploitation of heterosis is a major reason for crossbreeding in farm animals (Ibe, *et al*., 2005). Utilization of this phenomenon has led to the development of high quality meat and dairy-type animals. Usually characters that suffered reduction in inbred status are often restored or tend to be restored on crossing (Falconer, 1981). Crossbreeding therefore is one of the sure ways of achieving rapid genetic improvement in non-descript and unselected indigenous stocks within the shortest possible time (Jagdish, 2007). However, under experimental and field breeding conditions, not every crossbreeding effort produces desirable results. It is therefore important that an animal breeder knows what mating methods to employ and what breeding goals to accomplish (Dickerson, 1992). Geoff (1998) had noted that the most desirable form of heterosis is the better parent heterosis – a situation where the resulting progeny outperforms the superior parent. Although attaining this level of improvement is somewhat difficult, it still remains the target of most breeders and stockmen alike.

Development, multiplication and distribution of genetically improved meat-type goat in the tropical rainforest zone of South Eastern Nigeria where the menace of tse-tse fly infestation and trypanosomiasis infections have kept the level of small and large ruminant animal production low is desirable. Such laudable animal improvement plan demands that any 'new breed' of animals developed be fully assessed to confirm their suitability for production in the local environment as well other ecological zones before their multiplication and distribution. Utilization of local goat stocks like the West African Dwarf and the Red Sokoto goats in 'new breed' formation is appropriate especially

from the point of view of productive adaptability and use of local animal genetic resources (AnGr) in meeting local needs (FAO, 1984). This study therefore was undertaken to evaluate the growth performance of pure line and crossbred buck kids and the level of heterosis for body weight and some morphometric traits in main and reciprocal crossbred buck kids only.

Materials and methods

Location of study

This study was conducted at the goat Unit of Teaching and Research farm of Michael Okpara University of Agriculture, Umudike in Abia State, Nigeria. The University is located at longitude 7' 292 East and latitude 5' 212 North on an elevation of 120metres above sea level. Umudike falls within rainforest zone of South Eastern Nigeria, with an average annual rainfall of about 1220mm distributed over eight months (March to November) with its peak in June and July and a dry spell usually in August. It has a hot-humid climate with temperature ranges of 21-26^{o}C in wet season and 32-36^{o}C in the dry season.

Management of breeding stock

The breeding goat stock utilized for the study consisted of 18 matured Red Sokoto (RS) goats made up 2 bucks and 16 does; and 16 West African Dwarf (WAD) goats made up of 2 bucks and 14 does. The goats were maintained on a 25% concentrate and 75% fodder based rations daily. The stocks were housed in conventional dwarf walled house demarcated into pen units measuring 4m x 3m each. Periodic vaccinations against *Pest des petit ruminant* (PPR) disease was administered to them every 3 months. Deworming and delousing was carried out by administration of injectable Ivomectin subcutaneously to all the experimental animals.

Mating scheme

Pure line progenies were produced by pen mating of RS and WAD bucks to RS and WAD does in a ratio of 1:4 and 1:4, respectively. The main crossbred progenies were produced by mating RS buck to WAD does in the same ratio ; while the reciprocal progenies were obtained from mating of WAD buck to RS does in a ratio 1:3. Diagrammatically the mating scheme was as follows:

Pure line mating	-	RS x RS
	-	WAD x WAD
Main crossing	-	RS x WAD
Reciprocal crossing	-	WAD x RS

Management of Pure line and F_1 buck kids

A total of 38 buck kids were generated by the breeding stock in the following proportions: RS x RS (10), RS x WAD (9), WAD x RS (11) and WAD x WAD (8). These kids were allowed with their dams for 16 weeks before weaning. Each doe received a minimum of 300g concentrate ration + fresh fodder daily. Additional concentrate was supplied to each lactating doe based on the number of kids nursed. Kids were dewormed periodically using injectable Ivomectin while vaccination against PPR disease was done at 12 weeks of age.

Data Collection

Body weight (BWT) changes were recorded for the buck kids at birth and at 20 weeks of age using sensitive 20kg hanging scale while the animal is placed in perforated jute bag. The morphometric traits namely: body length, height-at-withers and heart girth were measured at 20 weeks of age. The body length (BL) was

measured as the distance from the external occipital protuberance to the base of the tail. Height-at-withers (HW) was measured as the distance from the withers to the base of the hoof while the animal stood erect , while the heart girth (HG) was taken as the circumference of the chest close to the foreleg. Measurements were carried out using a Tailor's tape in centimetres.

Experimental Design and Data Analysis

The design for the growth studies was a completely randomised design with genetic group as major factor of interest. Data on body weight and the morphometric traits were subjected to Analysis of Variance (ANOVA) techniques. Significant means were separated using Duncan's News multiple Range Test (Duncan, 1955). Direct and percentage heterosis was estimated using the linear contrast procedure as described by Dickerson (1992). The procedure is as follows:

Direct heterosis
= Mean of crossbred – Mean of pure breds ..... (1)

Percentage heterosis

$$= \frac{\text{Direct heterosis}}{\text{Mean of Pureline}} \times \frac{100}{1} \quad \text{..... (2)}$$

Results and Discussion

Growth performance

The growth performance of the four genetic groups as presented in Table 1 showed that mean birth weight was significantly highest (1.58 ±0.21kg) for the purebred Red Sokoto (RS x RS) buck kids. There was however, no statistical difference between average birth weight of the main crossbred (RS x WAD) and its reciprocal crossbred (WAD x RS) counterpart. This superior average birth weight of the RS x RS buck kids was expected since both parents were heavier than the West African Dwarf parents as was also reported by Gall (1996). The 20-week body weight of the various genetic groups showed marked differences in their development pattern compared to their birth weights. It was obvious that RS x RS buck kids maintained their superiority in body weight (10.46 ±0.49kg) over other genetic groups, however, the RS x WAD kids weighed significantly higher (8.98 ± 0.43kg) than the WAD x RS buck kids (8.22 ±0.12kg) and much higher than the WAD x WAD (7.55 ±0.30kg). This observation indicated that the main crossbred buck kids sired by the Red Sokoto bucks grew faster and attained higher body weight than the WAD sired reciprocal (WAD x RS) buck kids and the WAD x WAD individuals. This

Table 1: Mean body weight and morphometric traits of pure and crossbred Red Sokoto and West African Dwarf buck kids at birth and 20 weeks of age.

	GENETIC GROUP			
PARAMETER	**RS X RS**	**RS X WAD**	**WAD X RS**	**WAD X WAD**
Av. birth wt (kg)	1.58 ±0.21^{a}	1.44±0.38^{ab}	1.37 ±0.11^{b}	1.18 ±0.10^{c}
Av. final body wt (kg)	10.46 ± 0.49^{a}	8.98 ±0.43^{b}	8.22 ±0.12^{c}	7.55 ± 303^{c}
Body Length (cm)	72.62 ± 3.18^{a}	68.24 ± 2.21^{b}	62.16 ± 1.19^{c}	62.02 ± 1.01^{c}
Height at withers (cm)	54.62 ± 2.28^{a}	48.24 ± 1.14^{ab}	46.43 ± 1.07^{b}	42.24 ± 1.02^{b}
Heart girth (cm)	63.20 ± 2.41^{a}	57.26 ± 2.92^{b}	51.30 ± 1.82^{c}	50.94^{d} ± 2.14^{b}

$^{a\,b\,c}$ Means on the same row bearing different superscripts are significantly different ($P<0.05$).

Table 2: Estimates of direct and percentage heterosis of 20 weeks old RS x WAD and WAD x RS buck kids

	RS x WAD		WAD x RS	
PARAMETER	**Direct Het.**	**Percentage Het.**	**Direct Het.**	**Percentage Het.**
Body weight (kg)	0.37	5.07	-3.34	-0.05
Body Length (cm)	-1.01	-1.74	-2.92	-5.02
Height at withers (cm)	0.49	1.11	-3.32	-7.54
Heart girth (cm)	0.77	1.62	-1.47	-3.09

finding is in agreement with the report of Esminger and Parker (1986) who noted that highly productive bucks mated to native does produced strong and rigorous offsprings than native bucks mated to exotic does. Hybrid vigour has been reported to be optimised in upgrading programmes involving genetically divergent goat breeds (Otoikhiam and Oyefia, 2010).

The morphometric traits namely; body length (BL), height-at-withers (HW) and heart girth (HG) as shown in Table 1 followed somewhat similar pattern as body weight in the various genetic groups except in the RS x WAD buck kids which had mid-way value between the RS x RS and WAD x RS individuals. This observation for the RS x WAD individuals confirmed obvious genetic improvement for these linear body parameters. Heart girth was significantly highest (63.20 ± 2.41cm) in the RS x RS buck kids followed by the RS x WAD (57.26 ± 2.92cm,) but there was no difference for this parameter in the WAD x RS (51.30 ± 1.8cm) and WAD x WAD (50.94 ± 2.14cm). This observation indicated that buck kids sired by the Red Sokoto bucks had better heart girth. Heart girth is a reliable indicator of live weight and body condition scores in small ruminant animals like sheep (Sulieman *et al.,* 1990) and goats (Ozoje and Herbert, 1997) and it is preferred to HW which reflects more of the animal's skeletal size and of course a poor correlate to body condition score (Jeffery and Berg, 1972).

Heterosis of growth traits

Results as presented in Table 2 showed that the RS x WAD buck kids had positive estimates of direct and percentage heterosis for body weight and other morphometric traits at 20 weeks of age as follows; BWT (0.37kg and 5.07%), HW (0.49cm and 1.11%) and HG (0.77cm and 1.62%) while values for body length were negative (-1.01cm -1.74%). Positive heterosis for body weight in crossbred goats at birth (Browning and Browning, 2011) and at weaning (Otoikhian and Oyefia, 2010) has been reported. Negative heterosis for body length in the RS x WAD genetic group is desirable since a good meat animal should not be lengthy but rather blocky.

The WAD x RS buck kids had negative estimates for direct and percentage heterosis for all the body traits considered as presented in Table 2. This showed that these individuals were obviously inferior to even the mid-parent value for the traits under consideration. This has serious implication in practical goat breeding and could mean that WAD bucks mated to RS does would not produce vigorous offspring

in an upgrading programme as observed in this study. Furthermore, the reciprocal crossbreeding arrangement which produced these WAD X RS individuals should be discountenanced in a goat improvement programme.

Conclusion

This study revealed that the main crossbred (RS x WAD) buck kids outperformed their reciprocal WAD x RS counterparts in 20 weeks body weight and morphometric traits, while the pure bred RS x RS bucks had overall superior performance for these traits. The effect of crossbreeding was strong on the main crossbred buck kids as reflected by positive estimates of direct and percentage heterosis for body weight and other growth traits except for body length which was negative. However, these parameters were all negative for the reciprocal WAD x RS buck kids showing that there were no obvious improvement for these traits following crossbreeding in these individuals.

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