Performance of pure and crossbred progenies of Red Sokoto and West African Dwarf goats in the Rainforest Zone of South Eastern Nigeria.

[1]E. N. Nwachukwu, K. U. [2]Amaefule, F. O. [3]Ahamefule, S.C. [4]Akomas, T. U. [5]Nwabueze, U. A. U. [6]Onyebinama and O. O. [6]Ekumankama
[1]Department of Animal Breeding and Physiology, [2]Department of Animal Nutrition and Forage Sciences, [3]Department of Animal Production and Management, [4]College of Veterinary Medicine, [5]Department of food Processing and Analysis, [6]College of Agricultural Economics & Rural Sociology. Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria.
[1]Corresponding author; Email: ennwachuk@yahoo.com

Abstract

*This study is a report of part of a planned breeding programme to evaluate the performance of pure and crossbred progenies of Red Sokoto (RS) and West African Dwarf (WAD) goats in a rainforest zone of South Eastern Nigeria. A total of 56 kids produced by four breeding goat units consisting of pure Red Sokoto (RS x RS), pure West African Dwarf (WAD X WAD), main cross (RS x WAD), and reciprocal cross (WAD X RS) were used to investigate performance and cost benefit of producing progenies of these indigenous goats. The experimental design was a randomized complete block design with genetic group and sex as the factors of interest. Results showed that at birth, the male RS X RS kids weighed significantly (P<0.05) highest (1.84±0.23kg), followed by WAD X RS (1.43±0.14kg), RS X WAD (1.37±0.56kg) while the WAD X WAD kids had the lowest birth weight (1.15±0.39kg). However, the RS X WAD female kids, at birth weighed significantly highest (1.5±0.54kg), followed by the RS X RS (1.33±0.98kg), WAD X RS (1.31±0.17kg) and WAD X WAD (1.09±0.12kg).Body weight at 18 weeks was significantly higher for RS X RS (9.82±0.79kg) than the RS X WAD (8.34±0.85) which in turn was significantly higher than the WAD X RS (7.61±0.13kg) and WAD X WAD (7.51±0.61kg). The male and female kids of the RS X WAD had improved body weight and the linear body measurements namely, body length, height-at-withers and heart girth. This genetic group had a higher average daily gain (46.03 ± 1.41g/d) and better feed conversion ratio (5.38 ± 0.27) than the RS x WAD (*6.64 ± 0.18) and WAD x WAD (*7.02 ± 0.21). It also had the lowest cost of production (₦953.40=$6.60) and as such the highest gross margin (₦2,111.06 = $14.60) in 18 weeks. Individuals in this group appeared more promising hybrid goats for commercial meat goat production in the rainforest zone of South Eastern Nigeria.*

Key words: Red Sokoto and WAD goats, crossbreeding, linear body measurements, cost benefit, rainforest zone.

Introduction

Goats constitute a very important part of the rural economy in Nigeria, with more than 95% of the rural households keeping goats (Ukpabi, *et al.*, 2000; Otuma and Osakwe, 2008). As a multipurpose animal, goats provide meat, milk, hides and skin and manure. They rank next to cattle in income generation and their meat (chevon) is quite popular and well relished (Ladele, *et al.,* 1996; Hamayun, *et al., 2006*).

The need to develop productive and adaptive goat breed for the rainforest zone is desirable. Multiplication and distribution of such high quality hybrid goat definitely would increase small ruminant animal production and animal protein supply in South East and South-South Nigeria; where the level of livestock production is quite low. These geopolitical zones correspond to the agro-ecological area described as the rainforest zone where Tse-tse fly infestation and typanosomiasis infection are serious menace to livestock production. The use of

well adapted West African Dwarf (WAD) and highly productive indigenous Red Sokoto (RS) goat in 'new breed' formation is an appropriate breeding plan especially from the view point of utilizing local animal genetic resources (AnGR) in realizing local needs (Nwosu, 2005).

It is a common knowledge that not every mating scheme yields satisfactory result (Lamb, *et al.,* 1992). To overcome some suspected growth and reproductive problems associated with crossbreeding in goats e.g. low birth weight, poor kids survival rate, insufficient milk supply to the young and dystocia (Malik *et al;* 1980); mating of unproductive local males to improved productive females has been suggested in sheep (Dickerson, 1992). Mating of WAD goats with Red Sokoto breed has been carried out to determine growth and reproductive potentials of the offsprings (Taiwo, *et al.,* 2005). Result of that study revealed that present breeding plan would be feasible and beneficial. The objective of this study was therefore, to evaluate growth performance and cost benefit of producing pure and crossbred lines of meat goats in a rainforest zone of Nigeria.

Materials and methods

Location of study

This study was conducted at the goat Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The study area lies within the rainforest zone of South East Nigeria with a bimodal rainfall pattern. Total annual rainfall ranges from 1700 – 2100mm with a temperature range of 27° – 38°C during the dry season (November – April) and 18° – 26°C during the rainy season (May – October). This agro-ecological zone is a warm-wet humid tropical environment.

Management of breeding stock

A total of 34 mature goats with an average age of 10 months and consisting of 16 West African Dwarf (WAD) and 18 Red Sokoto (RS) goats constituted the breeding stock. They were housed in a conventional dwarf walled pen structured house. The sex ratio was 1:8 for the WAD and 3:6 for the RS. The animals were quarantined for 28 days during which vaccination against *pest des petit ruminant (PPR)* disease was administered.

The breeding stock was maintained on a daily feed allowance of 25% concentrate ration and 75% fresh fodder made up of *Panicum maximum* and a mixture of other browse plants. The composition of the

Table 1: Percentage Composition of concentrate ration fed to breeding goats

Feed Ingredients	Percentage
Maize offal	50.00
Wheat offal	6.50
Palm kernel cake	39.00
Bone meal	2.00
Periwinkle	1.00
Minerals	
– vitamin premix	0.25
Salt	1.25
Total	100
% Crude protein (%)	13.9
ME (kcal/kg)	2980

concentrate ration fed to breeding WAD and RS goats is shown in Table 1.

Mating Scheme

Mating schemes adopted to generate progenies for the study were pure line, main cross and reciprocal crossing as shown below:

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

Management of pure and crossbred kids

A total of 56 kids were produced by the breeding stock. Kids were allowed with their dams in nursing pens for 4 months before weaning. Apart from a feeding allowance of 300g/doe/day, additional 150g/kid/day was added for the number of kids each doe nursed. Protection against ecto- and endo-parasites among kids was achieved using injectable Ivomectin administered subcutaneously, while vaccination against *PPR* disease was carried out at 3 months of age.

Data collection

Data collected on pure and crossbred kids were weekly body weight changes, body length, heart girth and height-at-withers in both sexes as well as scrotal circumference in the buck kids only. The body length was measured as the distance from the pole of the animal to the base of the tail. Heart girth was taken as the circumference of the chest close to the forelegs, while height-at-withers was measured as the distance from the withers to the base of the hoof while the animal stood erect on a platform. The scrotal length was taken as the distance from the base of the scrotum to the tip of the scrotal sac, while the scrotal circumference was measured as the region of largest scrotal expansion. All linear body measurements were taken with a tailor's tape in centimeters.

Cost-benefit of raising each genetic group was computed based on feed consumed, other variable costs and prevailing market price of life goats in the area. Average daily gain (ADG) and feed conversion ratio (FCR) of the various breeding groups were also computed.

Experimental design and data analysis

The experimental design was randomized complete block design with genetic group and sex as factors of interest.

$$Y_{ijk} = u + G_i + S_j + e_{ijk}$$

Where Y_{ijk} = j^{th} individual in the i^{th} genetic group

U = Overall mean

G_i = Effect of the i^{th} genetic group (i = 1,--,4)

S_{ij} = Effect of the j^{th} sex (1,2) in the i^{th} genetic group

e_{jik} = Random error assumed to be independently identical and normally distributed with zero mean and constant variance.

Means and their associated standard deviations were computed for the measured parameters. Significant means were separated using Duncan's New Multiple Range Test (Duncan,1955).

Results and Discussion

The performance of male and female progenies of pure and crossbred Red Sokoto and West African dwarf goats are presented in Tables 2 and 3, respectively. Birth weight of the male kids was significantly ($P<0.05$) highest for the RS X RS (1.84 ±0.23kg), followed by WAD X RS kids (1.43 ±0.14kg); RS X WAD (1.37 ±0.57kg) while the WAD X WAD kids had the lowest birth weight (1.15 ±0.39kg). This

Table 2: Mean body weight and linear body measurements of male progenies of pure and crossbred Red Sokoto and West African Dwarf goats.

	GENETIC GROUP			
PARAMETER	**RS X RS**	**RS X WAD**	**WAD X RS**	**WAD X WAD**
Body Wt @ birth (kg)	1.84±0.23[a]	1.37±0.56[b]	1.43±0.14[b]	1.15±0.35[b]
Body Wt @ Wk 18(kg)	9.82±0.79[a]	8.34±0.85[b]	7.61±0.13[cd]	7.51±0.61[d]
Body Length (cm)	67.60±3.07[a]	59.86±0.10[b]	57.16±1.19[b]	57.02±0.75[b]
Height at withers (cm)	52.72±2.28[a]	46.16±0.94[b]	42.86±0.76[c]	40.24±0.76[c]
Heart girth (cm)	53.20±1.45[a]	47.26±1.91[ab]	47.30±1.62[b]	46.98±2.16[b]
Scrotal length (cm)	8.82 ±0.29[a]	7.53 ± 0.31[a]	6.97 ± 0.43[ab]	5.85 ± 0.27[b]
Scrotal circumf. (cm)	17.08 ± 1.74[a]	16.05 ± 1.52[a]	13.83 ± 1.62[b]	12.55 ± 1.02[c]

[abc] Means on the same row bearing different superscripts are significantly different (P<0.05)

observation was expected especially between the two pure lines (RS x RS and WAD X WAD) kids since such difference in body weight is common knowledge and underscores the need for the upgrading programme. The RS X RS kids maintained their superiority in body weight and were only equaled by the RS X WAD kids. This indicates obvious improvement in body weight following crossbreeding for the RS X WAD individuals. Significant improvement in body weight and linear body parameters in half bred RS X WAD goats have been reported by Ozoje and Herbert (1997) and in crossbred sheep by Weiner and Hayter (1974) and Hassen *et al.,* (2004).

The linear body measurements namely; body length, height-at-withers, heart girth, scrotal length and scrotal circumference followed similar pattern as body weight in the various genetic groups. This indicated strong influence of body weight on these structural body components. Indeed, strong and positive associations between body weight and most conformation traits have been well reported in farm animal species like goats (Ozoje and Herbert, 1997), Ayrshire cattle, (Russel, 1975) and humpless indigenous cattle (Ibe and

Table 3: Mean body weight and linear body measurements of female progenies of pure and crossbred Red Sokoto and West African Dwarf Goats.

	GENETIC GROUP			
PARAMETER	RS X RS	RS X WAD	WAD X RS	WAD X WAD
Body Wt @ birth (kg)	1.33±0.98[b]	1.50±0.54[a]	1.31±0.72[b]	1.09±0.11[c]
Body Wt @ Wk 18(kg)	6.88±0.85[a]	7.64±0.52[a]	5.24±0.37[b]	5.11±0.31[b]
Body Length (cm)	58.85±3.00[b]	56.35±1.00[a]	53.65±0.25[ab]	50.10±1.14[b]
Height at withers (cm)	51.38±2.78[a]	44.55 ±0.36[b]	42.38 ±0.75[b]	42.25 ±0.60[b]
Heart girth (cm)	44.78±2.02[a]	42.45±0.34[ab]	41.33 ±0.81[b]	39.28 ±0.36[b]

[abc] Means on the same row bearing different superscripts are significantly different (P<0.05)

Ezekwe, 1994).

The performance of the female kids (Table 3) revealed that the main crossbred (RS X WAD) doe- kids had significantly higher birth weight (1.50 ±0.54kg) than the RS x RS (1.33±0.98kg), WAD x RS (1.31±0.72kg) and WAD x WAD (1.09±0.11kg). Birth weight of a kid is a reproductive trait that could be influenced by such factors as body weight and condition score of dam, nutritional status, type of birth, sex and season of the year (Cassard *et al*., 1956). The WAD dams were well adapted to the rearing environment and may have utilized the concentrate – fodder based ration better than their RS dam counterparts. It could also be that the Red Sokoto bucks mated to the WAD does were able to stamp their superior genetic merits on their female progenies, thus resulting in the RS X WAD doe kids showing obvious improvement in body weight even above the RS X RS pure line. This superior-parent improvement in body weight in the females is desirable and is indeed, the essence of crossbreeding (Shrestha and Fahmy, 2007).

Body weight attained by the pure and crossbred lines at 18 weeks (Table 3) showed that the RS x RS and RS x WAD female goats were not significantly different. However, the RS X WAD individuals had numerically higher final body weight (7.64±0.52kg) than even the RS X RS females (6.88 ±0.85kg). The WAD goat is a known meat animal (Jean, 1993) and with improvement in its body weight, both male and female hybrid WAD progenies could grow fast and mature early. This finding holds a good prospect for the RS X WAD hybrids and presents them as possible candidates for meat goats especially in the rainforest zone which is a natural habitat for the West African Dwarf goats.

The performance of the WAD X RS hybrid males (Table 2) and females (Table 3) is noteworthy. This genetic group did not differ significantly in final body weight from the WAD X WAD individuals. This result indicates that there was no obvious improvement in body weight for both male and female WAD X RS kids. The practical

Table 4: Average daily gain (ADG), feed conversion ratio (FCR), cost of production (CP), revenue (R) and gross margin (GM) realized from pure and crossbred progenies of Red Sokoto and West African Dwarf goats.

PARAMETER	GENETIC GROUP			
	RS X RS	RS X WAD	WAD X RS	WAD X WAD
ADG (g/d)	45.37±1.34b	46.03±1.41a	43.45±3.34b	38.62±3.04c
FCR	7.97±0.15a	5.38±0.27b	6.64±0.18b	7.02±0.21a
CP (N)	1,392.16±13.64a	953.40± 10.21c	1,110.76± 12.32ab	1,032.00±10.25b
R (N)	3,280.00± 24.01a	3,064.00±20.43b	2,930.00±26.01b	2,556.00±19.06c
GM (N)	1,888.00±13.22b	2,111.06±21.71a	1,819.24±15.01b	1,523.57±18.74c

[a, b, c] Means on the same row bearing different superscripts are significantly different (P<0.05)

implication of this finding is that the use of Red Sokoto does mated to WAD bucks to improve a goat herd could give disappointing results.

The production and economic performance indices of raising pure and crossbred progenies of Red Sokoto and West African dwarf goats are presented in Table 4. Average daily gain of 46.03 ± 1.41g/day at 126 days (18 weeks) achieved by the RS X WAD was higher than that of the RS X RS individuals (45.37 ± 1.34g/day) and this, perhaps must have precipitated the higher final body weight attained especially by the female kids of this genotype (see Table 3). This result indicated that the RS X WAD crossbreds were well adapted to the nutrition and rearing environment they were subjected to, when compared to their supposedly superior RS X RS counterparts. The ADG value of 37g/day recorded for half bred WAD X RS goats fed legumes and fodders with concentrate supplementation for 150 days at Ibadan (Ebozoje, 1992) was even poorer than the value achieved by the RS X WAD hybrid individuals in this study. This seems to confirm further that these main crossbred progenies were the most preferred and suitable genotype for the production environment

The feed conversion ratio (FCR) was significantly low and more efficient for the RS X WAD with a value of 5.38 ± 0.27 which however was not significantly different from a value of 6.64 ± 0.18 obtained for WAD X RS. FCR was significantly better for the hybrids when compared to the RS X RS and WAD X WAD pure lines which had FCRs of 7.97 ± 0.15 and 7.02±0.21, respectively at 18 weeks of age. Efficient feed conversion of the RS X WAD in particular showed that the upgrading exercise was effective and, of course with improved weight gain- appetite and feed intake were expected to increase for this genotype. This finding showed that the RS X WAD individuals were able to utilize the local feed resources more efficiently than their purebred counterparts. This potential of the RS X WAD individuals is desirable since good growth rate and efficient feed utilization are common attributes of good meat animals (Roge, 1992).

The RS X WAD hybrids which recorded the highest ADG and a better FCR also had significantly ($P<0.05$) the least cost of production (N953.40 = $6.60) at 18 weeks of age. This observation is understandable, since these animals converted much of their feed into flesh thus, resulting in higher final body weight. Gross margin which is an index of efficient production was also highest (N2,111.06 = $14.60) for the main crossbred individuals. The overall performance of this genetic group suggests that it is a promising genotype for the development of hybrid meat goat especially in the rainforest zone.

Conclusion

It is evident from the results of this study that the progenies of the main crossbred (RS X WAD) - males and females showed superiority in body weight and in most of the linear body measurements studied when compared to the reciprocal (WAD X RS) crossbreds. Average daily gain, feed conversion ratio, revenue and gross margin were all higher for the RS X WAD individuals compared to their reciprocal (WAD X RS) and pure (WAD X WAD) counterparts. The performance of these main crossbreds equaled those of the superior RS X RS individuals and seems to suggests that they are more promising goat genotype for the production of hybrid meat goat in the rainforest zone of South Eastern Nigeria.

Acknowledgement
The authors are grateful to the Directorate of Research and Development, Michael Okpara University of Agriculture, Umudike for supporting this research work through Research Grant No. API/07/05 of 2007. We are also grateful to the staff of Goat Unit of the University who assisted in the daily care of the experimental animals.

References

Cassard, D. N., P. W., Weir, W. C, and Wilson, J. F. 1956. Environmental factors affecting body dimension in yearling Hampshire ewes. J. Anim. Sci. 15: 922 – 929.

Dickerson, G.E. 1992. Manual for evaluating breeds and crosses of domestic animals publications Div., FAO, Rome, Italy.

Duncan, C.B. 1955. Multiple range and multiple F-test Biometrics 11:1-42.

Ebozoje, M.O. 1992. Preweaning performance of West African Dwarf and West African Dwarf X Maradi Halfbred goat in Ibadan, Ph.D Thesis. University of Ibadan, Ibadan, Nigeria, pp329.

Hamayun, K.; Fida, M; Riaz, A; Gul, N; Rahimullah and Muhammad, Z. 2006. Relationship of body weight with linear body measurements in goats. J. Agric and Biol. Sci. (1) No. 3: 51 -54.

Hassen, Y.Y. and Fuerst-Walti, B. 2004. Body weight of Awassi and indigenous Ethiopian sheep and their crosses. Small Ruminant Res. 55 (1 - 3): 51 - 56.

Ibe, S. N. and Ezekwe, A.g. 1994. Quantifying size and shape difference between Muturu and N'dama breeds of cattle Nig. J. Anim. Prod. 21:51-58.

Jean, P. (1993). Anim. production in the tropics and subtopics. Published by the Macmillan Press Ltd. London and Basingstoke.

Lamb, M.A., Tess, M.W. and Robinson, O.W. 1992. Evaluation of mating systems involving five breeds for integrated beef production systems:1 cow-calf segment. J. Anim. Sci. 70:689-713

Ladele, A. A., Joseph, K., Omotesho, O.A and Ijaiya, T. O. 1996. Sensory quality ratings, consumption pattern in Nigeria. Brit. J. Food Sci. and Nut. 47:141-145.

Malik. R.C. Singh, R. N., Acharya, R. M. and Dutta, O. P. 1980. Factors affecting lamb survival in crossbred sheep, Tropical animal health and production 12:217-223.

Nwosu, C. C. 2005. Strategies for improvement of animal genetic resources in a developing economy. Invited paper. Proc. 30th Ann. Conf. genetic Soc. Of Nigeria Nsukka, 5-8 Sept, 2005.

Otuma, M. O. and Osakwe, I. I.2008. Estimation of genetic parameters of growth traits in Sahelian goats. J. Anim. and Vet. Adv. 7 (5): 535-538.

Ozoje, M. O and Herbert, U. 1997. Linear measurements in West African Dwarf (WAD) and WAD X Red Sokoto goats. Nig. J. Anim. Prod. 24(1) : 13-19.

Roge, J.E.O. (1992). Indigenous African small ruminants: A case for characterization and improvement. Proc. of 2nd Biennial conf. of the African Small Ruminant Res. Network, Arusha, Tanzania. PP. 205-211.

Russel, W.S. 1975. The growth of Ayrshire cattle: an analysis of linear body measurements. Anim. Prod. 20:217-226

Shrestha, J.N.B. and Fahmy, M.A. 2007. Breeding goats for meat production: 3 Selection and breeding

strategies. Small Rum. Res. 67(2):113-126.

Taiwo, B.B.A., Buvanendran, V. and Adu, I. F. 2005. Effects of body condition on the reproductive performance of Red Sokoto goats. Nig. J. Anim. Prod. 32(1): 1-6.

Ukpabi, U.H., Emerole, C.O, and Ezeh, C.I. 2000. Comparative study of strategic goat marketing in umuahia regional market in Nigeria. Proc. 25th Annual conf. NSAP. pp, 364-365.

Weiner, G., Lee, G.J. and Wooliams, J.A. 1992. Effects of rapid inbreeding and the crossing of inbred lines on conception rate, prolificacy and ewe survival in sheep. Anim. Prod. 55:115-121.

Wiener, G and Hayter, S. 1974. Body size and conformation in sheep from birth to maturity as affected by crossbreeding, maternal and other factors. Anim. Prod. 19:47-65.

Received: 26th August, 2011
Accepted: 5th May, 2012