ESTIMATES OF GENETIC PARAMETERS FOR GROWTH TRAITS IN THE NIGERIAN INDIGENOUS AND EXOTIC BREEDS OF PIGS REARED IN THE DERIVED SAVANNAH

ILOGHALU, O.G., NDOFOR-FOLENG, H.M., and EZEKWE A. G.

Department of Animal Science, University of Nigeria, Nsukka

Corresponding author: harriet.ndoforfoleng@unn.edu.ng

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Abstract

A total of 32 each of Large White and Nigerian Indigenous Pigs were used in this study. The body weights from birth to weaning (8wks) where collected from each of the two breeds and the data were subjected to a completely randomized design (CRD). Where means were found to be significant separation was done using Duncan New multiple range test. Furthermore, the mean separation for body weights was carried out to determine the sire effect on the progenies. Heritability and genetic correlation estimates were also estimated from the data collected. Significant differences ($p<0.05$) were obtained between the Large White and the Nigerian Indigenous pigs (NIP). Body weight was also compared among sires for both breeds and was discovered that among the NIP sires and large white, there were significant differences indicating that there are variations among both breeds of pigs. For the heritability estimate of birth to weaning weight, in Large White, it ranged from 0.31 to 0.47 while in the Nigerian Indigenous pigs, it ranged from 0.20 to 0.53. Generally, the heritability estimate was within the moderate range. This implies that additive gene effects are in action rather than non-additive gene effect. The genetic correlation of birth and weaning weight (8weeks) in the Nigerian Indigenous pigs was -0.46, while for the Large White pigs, it was -0.59. This is on the moderate to high side though it is negative. This negative genetic correlation in probably due to environmental influence rather than genetic factors.

Keywords: body weight, heritability, genetic correlation

Introduction

The relevance of animal protein in human nutrition in Nigeria cannot be overemphasized (Owen *et al.*, 2009). In recent times, there has been a significant short fall between the production (Ibeawuchi *et al.*, 2000) and supply of animal protein or shrinkage in animal protein availability to feed the ever growing population (Akpan *et al.*, 2009) which has been a subject of great concern to the government and people of the country especially animal scientists. The escalating demand for limited livestock products has led to hike in prices thereby placing animal protein beyond the reach of the average Nigerian. In Nigeria today, the quality of a meal is being based on the size of meat. Ironkwe and Amefule (2008) reported that the animal protein intake of Nigerians is as low as 3.5g / caput/day which is far below the minimum recommendation of 35g by World Health Organization. Because of this gap in protein shortage, a case is being made for pig production as a realistic approach to counter the animal protein deficit in the diets of Nigerians.

Information on the growth performance, heritability estimates and genetic correlation of livestock, pigs inclusive, are prerequisites for genetic improvement of animal genetic resources. Pathiraja and Oyedipe (1990) noted that the NIP are very precocious with ability to thrive on low-quality diets in stressful environments. Adequate information on litter performance and genetic parameter estimates of the NIP are essential in developing breeding programmes for this pig population. Improvement of the growth traits of this population will increase their population and thereby increase the range of alternative protein sources for Nigerians.

This study was designed to evaluate growth performance, from birth to weaning, of the Nigerian Indigenous Pigs and the Large White breeds as well as to obtain the estimates of heritability and genetic correlations between the two traits to enhance genetic improvement of these growth traits.

Material and Methods

Location of Study

The experiment was carried out at the piggery unit, University of Nigeria Teaching and Research Farm Nsukka. Nsukka lies in the Derived Savannah region, and is located on Longitudes $6^0 25^I$ and latitude $7^0 24^I$ at an altitude of 430m above sea levels. The climate is a humid tropical setting with a relative humidity range of 56.01 – 103.83%. Average diurnal minimum temperature ranges between 22 – 24.7^{oc} while the average maximum temperature ranges between 33 – 37^{oc} (Energy Centre, UNN, 2008). Annual rainfall ranges between 1680 – 1700mm.

The Parent Population

The genotypes of the pigs used for the study were the Nigerian Indigenous Pigs and the Large White breed of swine. The local breeds were purchased from local pig farmers within Gboko (Benue State, Nigeria) while the Large White breed was obtained from piggery unit, University Of Nigeria Teaching and Research Farm. The pigs used for the research were acquired and quarantined for a period of one week to check, monitor their health conditions and left to acclimatize before introducing them into the experimental units. A total of 64 non- pedigreed and unselected random bred males and females of both the Nigerian Indigenous Pigs as well as the Large White breed that formed the base population for the study.

Data Collection

Breeding Procedure and Management of Experimental Animals

The parents were arranged in the following mating group pattern.

Data on body weight from birth to weaning (8weeks of age) were collected weekly and recorded using measuring scale like Salter measuring scale.

Table 1: Breeding Arrangements

Number Of Mating Group	Breeding Group	Number Of Breeder		Mating Ratio
		Male	Female	
1	Large White breed ♂ x Large White breed ♀	8 :	24	1 : 3
2	Nig. Indigenous Pigs x Nig. Indigenous Pigs	8 :	24	1 : 3

The above arrangements resulted to a total of 8 sires mated to 24 dams in a mating ratio of 1:3 for each breed. From this mating, pure bred progeny populations were obtained. After breeding, the animals were monitored till farrowing. The pregnant gilts were fed with a commercial diet of about 13-14% crude protein, 3400 k cal/kg digestible energy according to Frank *et al.* (1995). Their feed were increased in first one to three days after farrowing with about 0.5kg/day from the starting level according to Hypor (2009). Proper management and hygiene was ensured. Routine vaccinations were promptly carried out. After farrowing, data collection was individually carried out on the progenies.

Experimental Design

Data collected were analyzed using one way analysis of variance in a completely randomized design (CRD) and mean with significant differences were separated using Duncan New multiple range test (SPSS, 2013).

Experimental Model

The statistical model was: $\chi_{ij} = \mu + S_i + \varepsilon_{ij}$

Where, χ_{ij} = the observation of the j^{th} progeny of the i^{th} sire

μ =overall mean; S_i = effect of the i^{th} sire on the progeny (i=1, 2…8);

ε_{ij} = random error associated with the observation of the sire or the progeny.

Results and Discussion

Body Weight

Growth traits were employed to differentiate between the Nigerian Indigenous Pigs and the Large White Pigs in other to assess their genetic variability and to determine their potentials as genetic resources and their status for future protection and conservation. A total of 51 progenies were generated from the Nigerian Indigenous pig and 78 progenies from the Large White breed respectively. Table 2 reveals the difference in body weight within Nigerian Indigenous Pigs and Large White Pigs.

Table 2: Mean body weight of Large White breed and the Nigerian Indigenous Pigs

	LARGE WHITE BREED	THE NIGERIAN INDIGENOUS PIGS
WEEKS	MEANS ± SEM	MEANS ± SEM
1	0.84 ± 0.02	0.75 ± 0.07^{ns}
2	1.26±0.34	1.29 ± 0.01^{ns}
3	1.71 ± 0.06	1.77 ± 0.02^{ns}
4	2.40 ± 0.14	2.30 ± 0.02^{ns}
5	3.30 ± 0.22	2.63 ± 0.04^{s}
6	4.29 ± 0.19	3.60 ± 0.07^{s}
7	5.58 ± 0.24	4.06 ± 0.07^{s}
8	6.81 ± 0.25	4.12 ± 0.04^{s}

The Large White pigs were significantly different ($P<0.05$) in terms of body weight at 5 to 8 weeks when compared with the Nigerian Indigenous pigs indicating that the exotic pigs where superior to the NIP. This could be attributed to the nature of the breeds. However, the breeds recorded no significant differences at the early stages of growth. As it is generally known that exotic breeds have an excellent body weight than local pigs which was only expressed at weaning, therefore weaning weight could be used as a criterion for selection in pig breeding.

Body weight was also compared among sires for both breeds (Tables 3 and 4) and was discovered that among the NIP sires there were significant differences between the sires with the offspring of sires 4, 5, 6 and 8 performing better than the other sires. The offspring of sires 1 and 7 (NIP) and sires 6 and 7 (Large white) had the highest body weight at the end of the experimental period. At birth, the mean body weight for the Large White ranged between 0.7 – 1.15kg. While in the Nigerian Indigenous Pigs, the mean weight ranged between 0.7 – 0.8kg. At weaning, the mean weight for the Nigerian Indigenous Pigs was 4.12kg with a range from 3 – 5 kg while in the Large White pigs; the mean body weight was 6.99kg ranging between 5.5 – 9.8kg. The ranges obtained in this study are in concordance with the weight 6.1kg at weaning for Large White pigs as reported by Aladi *et al.* (2008). According to Aladi *et al.* (2008), the individual litter weight at birth for Nigerian Indigenous Pigs was 0.8kg while the weaning weight was 3.8kg which is within the range of weights of Nigerian Indigenous Pigs reported in this study.

Table 3: Differences in body weight within Nigerian indigenous pigs

	Sire 1	Sire 2	Sire 3	Sire 4	Sire 5	Sire 6	Sire 7	Sire 8
1	0.74±0.02b	0.76±0.02b	0.76±0.02b	1.16±0.22ab	1.42±0.26a	1.23±0.25ab	0.85±0.09b	1.50±0.29a
2	1.26±0.02	1.30± 0.02	1.35±0.03	1.26 ±0.02	1.33 ±0.02	1.27±0.07	1.20±0.07	1.30±0.03NS
3	1.78±0.02ab	1.76±0.02ab	1.69±0.02ab	1.78±0.02ab	1.87±0.04a	1.87±0.06a	1.60±0.04b	1.69±0.04ab
4	2.25±0.06	2.36±0.01	2.29±0.04	2.28±0.05	2.22±0.07	2.33±0.01	2.39±0.01	2.38±0.01NS
5	2.36±0.20	2.54±0.08	2.75±0.05	2.78±0.02	2.65±0.07	2.73±0.05	2.62±0.07	2.65±0.20NS
6	3.86±0.19	3.44±0.11	3.91±0.31	3.46±0.01	3.45±0.01	3.46±0.01	3.45±0.02	3.46±0.01NS
7	3.95±0.02bc	3.96±0.02bc	3.94±0.01bc	3.90±0.00c	4.00±0.02bc	4.50±0.00ab	4.75±0.75a	4.50±0.29ab
8	4.11±0.09	4.20±0.09	4.09±0.02	4.08±0.03	4.20±0.11	3.98±0.01	4.49±0.30	3.93±0.33NS

a, b, c. . . means of progenies of each sire followed by difference letter in significant differences at 5% level

Table 4: Differences in Body Weight within Large White Breed

Wks	Sire 1	Sire 2	Sire 3	Sire 4	Sire 5	Sire 6	Sire 7	Sire 8
1	0.82±0.36bc	0.88±0.01a	0.74±0.03b	0.74±0.33bc	1.68±0.05a	1.00±0.21b	0.99±0.31b	0.99±0.03b
2	1.25±0.03bc	1.28±0.02b	1.23±0.09bc	1.05±0.02bc	1.70±0.22a	1.00±0.91c	1.23±0.23bc	1.23±0.13bc
3	1.77±0.02a	1.68±0.31cd	1.59±0.40cd	1.89±0.00abc	1.83±0.01abcd	1.76±0.50bcd	2.01±0.01ab	2.11±0.14a
4	3.00±0.02a	1.94±0.31d	1.98±0.03cd	2.89±0.09ab	2.37±0.06bcd	2.40±0.05bcd	2.49±0.21abc	2.22±0.06cd
5	3.75±0.11a	3.04±0.38ab	2.62±0.03a	3.33±0.44ab	2.62±0.25a	2.78±0.22ab	2.57±0.33a	2.38±0.19a
6	4.53±0.01ab	4.10±0.02b	4.16±0.16b	4.15±0.07b	4.75±0.09ab	5.40±0.04a	5.40±0.01a	5.11±0.53a
7	5.19±0.05a	5.73±0.16bc	5.17±0.09a	5.82±0.06bc	6.18±0.00a	5.68±0.05bc	5.68±0.51bc	5.83±0.07bc
8	6.14±0.09d	6.66±0.01cd	6.40±0.31d	7.36±0.36abc	7.00±0.02bcd	8.00±0.21a	7.85±0.16ab	7.56±0.05ab

a, b, c. .means of progenies of each sire followed by difference letter in significant differences at 5% level

However, the wide variability between the minimum and maximum values in the growth trait from birth to weaning depicts the unselected nature of these pigs and this indicates the possibility of improving the genetic potentials of the growth traits / litter traits of the Nigerian Indigenous Pigs through appropriate selection and mating methods using exotic breeds (more especially the Large White breeds).

Heritability Estimate of Body Weight

The heritability of body weight at birth and weaning (Table 5) ranged from 0.20 to 0.53 for the Nigerian Indigenous Pigs while in the Large White pigs, it ranged from between 0.31 to 0.47.

Table 5: Heritability (h^2) estimate of body weight from birth to weaning for Large White breeds and the Nigerian Indigenous Pigs

Week	Large White Breeds Heritability ± Sem	Nigerian Indigenous Pigs Heritability ± Sem
1	0.36 ± 0.19	0.35 ± 0.18
2	0.36 ± 0.18	0.40 ± 0.21
3	0.47 ± 0.24	0.43 ± 0.28
4	0.42 ± 0.21	0.29 ± 0.16
5	0.30 ± 0.16	0.53 ± 0.27
6	0.31 ± 0.16	0.20 ± 0.11
7	0.32 ± 0.17	0.31 ± 0.17
8	0.40 ± 0.20	0.40 ± 0.21
Mean h^2	0.37 ± 0.19	0.36 ± 0.15

The heritability estimates for Large White was moderate respectively except at week 3 and 4 where it was high (0.47 ± 0.24 and 0.42 ± 0.21). On the other hand for the Nigerian Indigenous Pigs, it was equally moderate except at week 3 and 5 where it appeared high (0.43 ± 0.28 and 0.53 ± 0.27) respectively. However, in this study, the heritability was mostly moderate from birth to weaning which agrees with the Horst (1998) (0.22 – 0.24). Nguyen *et al.* (2002) also reported moderate heritability estimates at birth and weaning (about 0.30 as a litter trait). Okoro *et al.* (2013) reported a heritability estimate as high as 0.45 for birth and weaning weight which equally agrees with this study. Rosendo *et al*. (2007) reported an average heritability for birth and weaning weight as 0.36 and 0.24 which was equally within the range of this study. These variations are due to the number and the records, the models and estimation methods used. This study was at variance with the heritability estimates reported by Cassady *et al.* (2002) (0.06 and 0.02) and Arango *et al.* (2006) (0.03 – 0.06).

Moderate to high heritability estimates of growth traits implies that direct selection for growth trait would be more efficient than indirect selection. However, knowing that birth and weaning weight are quantitative traits, additive genes are probably in action more than the non-additive genes. Also, heritability being the proportion of traits transferable from parents to offspring or from one generation to the next. Therefore, reasonable proportion of the trait (birth to weaning weight) is heritable from parents by their off-springs. The moderate to high heritability estimate in this study might be due to small population size used as against the large population sizes used elsewhere.

Genetic Correlation

The genetic correlation between birth and weaning weight at 8weeks in Nigerian Indigenous Pigs was - 0.46 and for the Large White pigs - 0.59. The genetic correlation gives an estimate of extent of relationship between two traits genetically. Its knowledge between various traits allows the breeder to select for one trait at the same time making genetic improvement on the other traits that have a favourable relationship. This is in agreement with the report of Roehe *et al*. (1999) of negative and slightly high genetic correlation of about -0.36. The negative genetic correlation obtained was not consistent with other workers in literature, probably due to experimental error and the de-accelerating phase of growth, which was controlled mainly by environmental influences rather than genetic factors (Falconer, 1989). Generating genetic parameter such as heritability and genetic correlation among traits is essential in designing effective breeding programmes that incorporates the gene from Nigerian Indigenous Pigs. However, estimation of genetic correlation is quite scanty for pigs generally. Roehe (1999) and Arango *et al*. (2006) all reported low to moderate negative correlation between the two traits. This in contrast with reports of Rosendo *et al.* (2007) who reported a high and positive correlation between birth and weaning weights(0.51 – 0.57), as well as Kaufmann *et al*. (2000) (0.59). This implies that environmental factors have strong impact on pre-weaning and weaning periods.

Conclusion

Indigenous pigs still have a position in genetic improvement of our tropical stock. Though, only small genetic response can be expected in pure-breeding, however, the indigenous pig genome will still be useful in special breeding for advance /extensive production systems because of its adaptive potential.

Heritability estimate for the two breeds show that on the average birth and weaning weight is moderately heritable. This implies that reasonable improvement in the traits could be achieved. Knowing the Indigenous pigs has a great diversity as in its adaptation to harsh environmental conditions in-addition to performance. This diversity can serve as a base for the creation of foundation stock for the indigenous pigs. A concomitant improvement in husbandry and management conditions will result to a net improvement in the indigenous stock and at the end make it a source of cheap meat and quality protein.

The Nigerian Indigenous Pigs are going into extinction due to genetic dilution. There is need for proper conservation of indigenous stock for upgrading our exotic breeds, having in mind their good potentials like high survivability, disease resistance, heat tolerance etc. which will invariably increase pork availability even to the moderate populace and at the end increase and improve protein availability of common Nigeria.

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