

HERITABILITY ESTIMATE OF BIRTH WEIGHT IN GUINEA PIG (*Cavia porcellus*)

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ABSTRACT

The study was conducted to estimate the heritability of birth weight in guinea pigs using half-sibs and full-sibs methods. A total of 40 piglets generated from 24 matured guinea pigs (4 males and 20 females) nested in the ratio of 1male to 5males were used for the study. After farrowing, birth weight of individual piglet was recorded using a digital weighing scale. Data generated were analyzed using analysis of variance and restricted maximum likelihood, correlation coefficients among parent and offspring birth weights were estimated. Sire had no effect on birth weight and heritability estimates of this trait using different components of variance (sire, dam and sire/dam) were low. Correlation coefficients between the parent weight and birth weight were low, negative and non-significant. This study indicated that birth weight has low transmissibility. Further research involving larger data sets should be conducted to ascertain these findings.

Key words: Guinea pig, heritability, birth weight, phenotypic correlations

INTRODUCTION

Guinea pigs are valuable species that can improve the livelihoods of smallholders (Lammers *et al.*, 2009). Food security in most parts of Africa remains a real challenge especially when quantity and quality is concerned (IFAD, 2011). As such, global poverty and food insecurity continue to remain critical (Lammers *et al.*, 2009). Conventional animal species (cattle, sheep and goat) cannot meet the protein deficiency gap because their multiplication rate is not commensurate with rapid increase in human populations (Dikko *et al.*, 2009). Cavies (guinea pigs) are promising mini livestock species as they require little capital or labour for keeping and management (NRC, 1991; Ngoupayou *et al.*, 1995). Therefore, food from micro-livestock such as guinea pigs, snail and grass cutter could play an important role in alleviation of protein deficiency (USDA, 2007; UA, 2008). The usefulness of guinea pigs as meat producers and source of income in peri-urban (Ngoupayou *et al.*, 1995) and rural areas (Nuwanyakpa, 1993; Lukefahr, 2004) is well documented. Published research information on cavies under different ecological and socio-economic conditions is needed to clearly show that raising of such species of livestock is one way for farmers to raise income, inexpensively produce meat for home consumption and organic manure for backyard crop production (Nuwanyakpa, 1997). Therefore, to increase the output obtained from this species of livestock, genetic parameter of growth traits specifically the heritability need to be estimated on which the selection response relies. Therefore, the current studies was designed to estimate the heritability of birth weight using both half and full sib methods.

MATERIALS AND METHODS

Study Area

The study was conducted at teaching and research farm of Federal University of Kashere, Gombe State. The State falls within the northern guinea savannah zone of Nigeria and is 431m above sea level. It is located between longitudes 11°10' and 11.16° 7' east and latitudes 10°15' and 10.25° 0' North (NPC, 2006). Gombe State has two distinct climates, the dry season (November - March) and the rainy season (April - October) with an average rainfall of 850mm/annum. Relative Humidity of 15 - 60 % in the north zone, 25 - 50 % in the central zone, and up to 80 % in the southern zones was noticed. The ambient temperature could be as low as 16.6° C during the dry cold season and as high as 39.4° C during the dry hot season (C-GIDD, 2008).

Management of the Experimental Animals and Data Collection

Twenty four guinea pigs consisting of 4 males and 20 females sourced from Jos, Plateau state Nigeria were used for this experiment. On arrival, body weight of each was recorded using electronics scale and this is repeated after two weeks prior to the commencement of the experiment. They were fed mostly forages (grass and legume mixture) and supplemented with broiler finisher diet and Vitamin C. Scanty health management was practiced and animals are kept under good environmental condition.

In each breeding group, 5 females were nested to a male and immediately after farrowing, birth weight of piglets was recorded according to sire and dam ID.

Data Analysis

Sire effect on birth weight and variance components for both sire and dam were generated using one-way analysis of variance (ANOVA) and restricted maximum likelihood (REML), respectively in general linear model (GLM) procedure of SPSS, version 25 (2017). Significantly different means were compared using the least significant difference (LSD). Model utilized to determine the sire effect was as follows:

$$Y_i = U + S_i + e_i$$

Y_i = Observation on dependent variables (birth weight)

U = Common Mean

S_i = effect of i^{th} sire

e_i = random error term

After estimating the components of variance, heritability was calculated according to Becker (1984) using the following formulas:

Sire Variance Component:

$$h^2(S) = \frac{4\sigma^2_S}{\sigma^2_S + \sigma^2_D + \sigma^2_W}$$

Dam Variance Component:

$$h^2(D) = \frac{4\sigma^2_D}{\sigma^2_S + \sigma^2_D + \sigma^2_W}$$

Sire + Dam Variance Component:

$$h^2(S + D) = \frac{2(\sigma^2_S + \sigma^2_D)}{\sigma^2_S + \sigma^2_D + \sigma^2_W}$$

Where

h^2 = heritability

σ^2_S = Sire Variance Component

σ^2_D = Dam Variance Components

σ^2_W = Error Variance Components

The relationships between the parents (sire and dam) live weight and offspring birth weight was determined using the Pearson's product moment correlation.

RESULTS AND DISCUSSION

Average birth weight of piglets according to sire is presented in Table 1 which indicates that sire had no effect on this trait (birth weight). Heritability estimate (h^2) of birth weight from different variance components (sire, dam and combination both sire and dam) are presented in Table 2. The heritability obtained using dam component of variance (0.125) was higher compared to those of sire and sire-dam components (0.068 and 0.012, respectively). The lower heritability estimate obtained for birth weight is consistent with those reported by Canario *et al.* (2010) and Garreau *et al.* (2008) in rabbits (0.14 and 0.06, respectively). Odubote and Somade (1992) reported estimate of 0.33 ± 0.08 for average litter birth weight which is high compared to values of 0.068 obtained in the present study. The variation from other report might have resulted from differences in genotypes, location, environmental factors and different sample sizes. Further report by Ajayi *et al.* (2014) showed that heritability estimate of birth weight is higher and more reliable than that of weaning weight (0.19 ± 0.15 and 0.09 ± 0.12 , respectively). Similarly, Wolf *et al.* (2008) estimated a heritability of 0.10 for birth weight in light piglets. However, Randi and Scossiroli (1980) reported higher estimate of 0.455 ± 0.348 and 0.212 from maternal half-sibs and full-sibs methods, respectively among New Zealand white rabbits. The higher value observed when dam component was used in the estimation of heritability agrees with the earlier report of Mostageer *et al.* (1970) who reported value of 0.931 from maternal half-sibs method

and attributed this fact to maternal genetic effect. Blasco *et al.* (1982) reported values of 0.73 ± 0.26 from maternal half-sibs for individual weight at 21 days and related it to maternal genetic effect which is believed to have originated from mitochondrial DNA of ovum (Sato and Sato, 2013). The correlation coefficients between parent weight and off-springs birth weight is shown in Table 3 and were negatively low and not significant, this indicated that off-spring birth weight cannot be predicted from parents' live weight. It also implies that genetic correlation between the two traits is low. This is in agreement with the work of Odubote and Somade (1992) that live weight of parent had no significant relationship with birth of off-spring in rabbits.

Table 1: Effect of sire on birth weight

Sire ID	Birth weight (g)
1	75.00 $\pm$ 5.00
2	82.50 $\pm$ 6.61
3	79.17 $\pm$ 2.39
4	78.00 $\pm$ 2.00
LOS	NS

NS = Non-significant

Table 2: Heritability estimates of birth weight from different components

Components	h^2
Sire	0.012
Dam	0.125
Sire + Dam	0.068

h^2 = heritability

Table 3: Correlation coefficients between parents' weight and off-spring birth weight

Parent weight	Birth weight
Sire	-0.322 ^{NS}
Dam	-0.132 ^{NS}

NS = Non-significant

CONCLUSION

From the findings of this study, it can be concluded that sire had no effect on birth weight; heritability estimate of this trait was low and parent and offspring birth weights cannot indicate each other

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