GENETIC PARAMETERS FOR BIRTH WEIGHT, CALVING INTERVAL AND CALF MORTALITY IN SOKOTO GUDALI (BOKOLJI) CATTLE IN SUDAN SAVANNAH, NIGERIA.

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ABSTRACT

Twenty five years (1984-2008) data on birth weight (BWT), calving interval (CI) and calf mortality in Sokoto Gudali (Bokoloji) cattle where obtain from Talata Mafara an out station of beef research unit of National Animal Production Research Institute (NAPRI) Ahmadu Bello University, Shika, Zaria. Heritability and repeatability for BWT and CI as well as heritability for perinatal and late calf mortality when considered as calf or dam traits were computed from variance components obtained using the General Linear Model Procedure of Statistical Analysis System (SAS). The heritability and repeatability estimate for BWT and CI were 0.02±0.09, 0.20±0.18 and 0.11±0.16, 0.21±0.08 respectively. Whereas, heritability estimate for perinatal and late calf mortality considered as calf trait were 0.00±0.00 and 0.06±0.68. Similarly, heritability estimate for perinatal and late calf mortality considered as dam trait were 0.07±0.83 and 0.09±0.68 respectively. The low values of heritability and repeatability obtained in this study indicates that these traits were influenced by environmental factors. Therefore, Improvement in non-genetic factors viz. feeding, health and overall management of animals could be helpful in improving birth weight, reducing calving interval and calf mortality in the herd.

Keywords: Birth weight, Calf mortality, Calving interval, Heritability, Repeatability.

INTRODUCTION

Sokoto Gudali (Bokoloji) cattle are commonly reared for meat and milk production. However, at the National Animal Production Research Institute (NAPRI) the main breeding aim of this breed is beef production. Stereotypically they occur mainly in the northwest of Nigeria. However, in reality the breed is now distributed widely throughout the country.

Calf birth weight is one of the important breed characteristics in cattle breeding and is considered as an initial reference point with regard to subsequent development of individual as well as other characteristics. Calving interval (time between two successive calvings) is an important criterion for measuring reproductive efficiency of an animal in addition it also has a direct bearing on the economics of beef cattle. Longer calving interval besides reducing the number of calves born and the amount of milk produced by the cow in her lifetime it also increases the generation interval resulting in reduction in annual genetic gain. The survival of a calf after birth is clearly a component of overall reproductive performance of beef herd. Therefore, death of calves implies a loss of future breeding stock, loss of slaughter cattle, and loss of future draught oxen. Calf mortality is a major problem faced by livestock producers and it is higher in subtropical and tropical regions (Plasse, 1973) where *Bos indicus* cattle are the predominant type of cattle. Environmental factors such as sporadic disease or accidental losses were generally considered to be major causes of calf mortality from the perinatal period to weaning (Bellows *et al*., 1987; Patterson *et al*., 1987). Genetic studies on calf mortality are scarce in the tropics (Goyache *et al*., 2003; Tarrés *et al*., 2005). This is attributed to lower availability of records as reported by Bleul (2011). Consequently no such studies have been reported on Sokoto Gudali breed.

The effectiveness of any breeding programmes depends largely on the accuracy of genetic and phenotypic parameter estimates, which include heritability and repeatability (Burrow, 2001). Information on heritability is essential for planning efficient breeding programs and for predicting response to selection in the herd.

The objectives of this study were to: estimate heritability and repeatability of BWT and CI as well as heritability for perinatal and late calf mortality considered as dam and calf trait in Sokoto Gudali (Bokoloji) cattle.

MATERIALS AND METHODS

Source of data

Data were obtained from Talata Mafara beef research station in Zamfara State. The area is located on latitude 12^0 33'N and longitude 06^0 04'E at an altitude of 317m above sea level (Google, 2011). The area lies within the Sudan Savannah zone of Nigeria. The average annual rainfall is 722.9mm which spreads from June to September (wet season) with a peak between July and August. The dry season commences with a period of dry cool weather, known as the 'harmattan', from October to January (post rains). This is followed by a period of hot dry weather, which extends from February to May (dry season). The dry periods are invariably long and pronounced, resulting in most cases in feed and water shortage for the animals. Average daily temperature range from 17^{o}C during the harmmatan to 40^{o}C during the hot dry season, while during the wet season, average temperature and humidity were 29.3^{o}C and 60%, respectively.

Data collection

Twenty-five year (1984-2008) records on Sokoto Gudali cattle were obtained from Talata Mafara beef research station in Zamfara State. The records collected on the animals included: Sire number, dam number, calving interval (CI), calf birth weight, sex, date of birth and death, parity of the dam, month and year of birth. Calving interval was calculated as the difference between calving dates in two successive years. Data from all cows that lost calves at any time during the year were excluded from the analysis. Calf losses were considered using the definition listed in the Beef Improvement Federation Guidelines (BIF, 1986)

as modified by Goyache *et al.* (2003). The ability of a calf to survive at different ages were considered as dichotomous trait and defined as follows:

(a) Perinatal calf mortality.

0 -------- Calf born alive at birth but dead within 72 hours.

1-------- Calf alive at 72 hours up to weaning.

Perinatal mortality is characterised by the inability of a calf to be alive and survive to 72 hours.

(b) Late calf Mortality.

0 --------- Calf alive at 72 hours but dead before weaning.

1--------- Calf alive at weaning.

Late Mortality is characterised by the inability of the calves surviving the perinatal period to survive till weaning, whatever is the cause of death.

Management of the animals

The animals were kept in open paddocks and every paddock was supplied with adequate drinking water. Rotational grazing between paddocks was practiced. Mineral salt lick was usually provided *ad lib.* During the dry season, hay was normally supplemented in addition to concentrate mixture of undelinted cotton seed cake at the rate of 1.0 Kg/day/head for mature animals, while young bulls and replacement heifers received 1.5-2.0 Kg/day/head. During the rainy season animals were raised exclusively on pasture. The animals were maintained in different herds to prevent indiscriminate breeding as follows; Breeding cows/heifers (>24 months of age), breeding bulls (>18 months of age), heifers (6-23 months of age) and young bulls (6-18 months of age). Every herdsman was detailed to observe and make prompt report to the record officer of all calvings on the field, apparently sick or dead animals. The record of each animal was entered into the pedigree book with regard to information such as, calf number, date of birth, dam and sire number. Similarly, tag numbers of sick or dead animals were recorded and sick ones referred to the animal health unit for treatment. Animals were dipped in acaricides solution weekly during the wet season and fortnightly during the dry season to control ecto-parasites. Likewise animals were dewormed thrice in the year (i.e. before the rains, during the rains and post rains). They were also routinely vaccinated annually against common cattle diseases (such as Foot and Mouth Disease, Black Quarter, Contagious Bovine Pleuro- Pneumonia and Rinderpest).

Statistical procedures

The data were prepared for analysis using MS Office Excel. Variance components were obtained using the mixed model procedure of Statistical Analysis System for windows version 9.0 (SAS 2002). Values of the Variance components obtained were used for the estimation of heritability and repeatability for the traits.

Heritability for birth weight, calving interval, perinatal and late calf mortality considered as dam or calf trait were estimated by applying the model;

$$y_{ij} = \mu + a_i + e_{ij}$$

Where: y_{ij} = j^{th} record of the i^{th} sire;

μ = overall mean;

a_i = effect of the i^{th} sire;

e_{ij} = uncontrolled environmental and genetic deviations attributable to the individuals.

Heritability (h^2) was computed using the formula as follows:

$$h^2 = \frac{4\sigma_s^2}{\sigma_{\frac{2}{s}} + \sigma_E^2}$$

Where: σ_s^2 = sire variance component;

σ_E^2 = error variance component;

The standard error of heritability, S.E. (h^2) for unequal number of records was computed according to Swiger *et al.* (1964) as follows.

$$\text{S. E. } (h^2) = \sqrt[4]{\frac{2(n.-1)(1-t)^2\left[1+(j-1)t\right]^2}{j^2(n.-s)(s-1)}}$$

Where: n. = total number of observations

s = number of sires;

t = intra-class correlations

j = harmonic mean of number of observations per individual

For estimation of repeatability for birth weight and calving interval the following model was applied.

$$y_{ij} = \mu + a_i + e_{ij}$$

Where: y_{ij} = j^{th} measurement on the i^{th} individual;

μ = overall mean;

a_i = effect of the i^{th} individual;

e_{ij} = environmental deviation of j^{th} measurement within an individual;

Repeatability (R) was calculated as follows:

$$R = \frac{\sigma_w^2}{\sigma_w^2 + \sigma_D^2}$$

Where: σ_w^2 = among dam variance;

σ_D^2 = within dam variance

The standard error of repeatability, S.E. (R) for unequal number of records was calculated according Swiger *et al.* (1964) as follows:

S. E. (R) =

$$\sqrt{\frac{2(M.-1)(1-R)^2\left[1+(j-1)R\right]^2}{j^2(M.-N)(N-1)}}$$

Where: R = repeatability;

M. = total number of observations;

N = total number of dams;

j = harmonic mean of number of measurements per individual

RESULTS AND DISCUSSIONS

The results presented in Table 1 shows variance components, heritability (h^2) and repeatability (R) ± S.E. for birth weight and calving interval. The heritability estimate obtained for calving interval in the herd was low. The estimate of 0.20±0.18 obtained is lower than the estimate of 0.32 reported by Johnson (1987) in the same herd. This difference may be due to the fact that heritability varies from one generation to the next and since the genes effect changes due to selection in the herd therefore, the estimation of heritability may not be repeated (Johnson, 1987). Another possible reason may be due to changes in environmental effect (nutrition and other climatic factors) and sample size. Lower values of heritability estimates of 0.01±0.20 for Bunaji breed were reported by Van der Westhuizen *et al.* (2001) and 0.03±0.02 by Makgahlela *et al.*(2007) in South African Holstein.

Table 1. Variance components, heritability (h^2) and repeatability (R) ± S.E. for birth weight and calving interval

Trait	σ_s^2	σ_E^2	h^2 ± S.E.	σ_w^2	σ_D^2	R ± S.E.
Birth weight	0.03714	8.6664	0.02±0.09	0.9566	7.7159	0.11±0.16
Calving interval	39.3077	733.60	0.20±0.18	296.7688	1150.23	0.21±0.08

σ_s^2 = Sire variance component, σ_E^2 = Error variance component, σ_w^2 = among dam variance, σ_D^2 =within dam variance

The repeatability estimates of 0.21±0.08 for calving interval fall within the range (0.0–0.23) reported by several authors for cow populations managed under tropical environments (Ageeb and Hayes, 2000; Van der Westhuizen *et al.*, 2001; Oyama *et al.*, 2002; Amimo *et al.*, 2006; Estrada-leon *et al.*, 2008; Yague *et al.*, 2009). However, the value was considered low, which is an indication that this trait is more influenced by effects due to temporary environmental factors. Therefore, genetic improvement of those traits by selection may be slow. Variance components and heritability (h^2) ± S.E. for calf mortality were presented in Table 2. The heritability estimates of 0.0-0.08 for perinatal calf mortality when considered as either calf or dam trait were lower than 0.10 - 0.15 reported by Koots *et al.* (1994). However, the estimates obtained are within a range of reported estimates for similar traits (survival to 24 or 48 hours, or perinatal mortality) from 0.00 to 0.15 in cattle (Cundiff *et al.*, 1986; Koots *et al.*, 1994; McGuirk *et al.*, 1998; Fuerst-Waltl and Fuerst, 2010; Segura-Correa *et al*., 2012).The heritability estimates of 0.06 for late mortality of calf obtained in Sokoto Gudali when considered as calf trait was similar to the estimates of 0.06 for preweaning mortality reported by Riley *et al.* (2004) in Brahman cattle. The low values of heritability obtained could have been due to deterioration in management and nutritional stature of the animals during the period under study or may be due to the use of same sire for a number of years, hence resulting in inbreeding.

Table 2: Variance components and heritability (h^2) ± S.E. estimate for calf mortality

	Perinatal mortality			Late mortality		
			h^2 ± S.E.			h^2 ± S.E.
Calf trait	0.000084	0.08367	0.00±0.00	0.001464	0.09421	0.06±0.68
Dam trait	0.001756	0.09386	0.07±0.83	0.001834	0.08423	0.09±0.68

σ_s^2 = Sire variance component, σ_E^2 = Error variance component

CONCLUSION

The low values of heritability and repeatability is an indication that these traits were more influenced by effects due to temporary environmental factors. This is an indication that improvement in beef production in the herd by selection may be slow. Improvement in non-genetic factors viz. feeding, health and overall management of animals could be more helpful in improving birth weight, reducing calving interval and calf mortality in the Sokoto Gudali breed.

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