I.J.S.N., VOL. 1(1):77-81 ISSN 0973 -3140

INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

Www.scienceandnature.org

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STUDY THE LEVEL OF INBREEDING IN THE GUDALI AND WAKWA BEEF CATTLE AT ADAMAWA REGION, CAMEROON

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ABSTRACT

This work was carried out to study the level of inbreeding in the Gudali and Wakwa beef cattle. The data were collected from compiled herd books (calf record sheet, bull progeny record sheet and cow record sheet) consisting of pedigree information and performance records from birth to 36-months weight for both the Gudali and Wakwa breeds. Data utilized for this study was obtained from the Institute of Agricultural Research for Development (IARD), Wakwa Station, Cameroon. The data used consisted of pedigree information of 4514 animals and 2714 performance records for the Gudali and Wakwa cattle respectively, ranging from birth to 36-months weight collected from 1968 and 1988. Inbreeding coefficients were calculated by inverting the diagonal of the inverse relationship matrix using the MTDFNRM (Multiple Trait Derivative Numerator Relationship Matrix) program of the MTDFREML (Multiple- Trait- Derivative- Free-Restricted Maximum Likelihood) package**.** The method to calculate the numerator relationship matrix from the inbreeding coefficient (or for any pair of animals) depends on the correspondence of F of an animal and one-half the relationship between its sire and dam. An option of the MTDFNRM programme creates a file that includes the inbreeding coefficient for each animal. The mean inbreeding of the population was very low (7.3%) and (7.1%) for the Gudali and Wakwa inbred animals respectively. The results showed that inbreeding at present is not a serious problem in the Gudali and Wakwa beef breed.

KEY WORDS: Pedigree information, breed, Inter se mating.

INTRODUCTION

Inbreeding is the mating of closely related animals related through ancestry, so that the genes contained in the uniting gametes may be identical by descent (Falconer *et al*., 1996). It is possible that genes, which are alike in state, are copies of the same gene descended from a remote common ancestor. Thus, the degree of inbreeding, calculated as the inbreeding coefficient, refers to the inbreeding of animals in a given period of time. The inbreeding coefficient measures the percentage increase in homozygous gene pairs in an individual relative to the average of the breed (Cassall, 2007). Wright's coefficient of inbreeding, named after its originator Sewall Wright, is known as the most commonly used measure of inbreeding. Inbreeding is important in breed improvement through selection since selection and inbreeding affect each other. Selection increases inbreeding while an increase in inbreeding results in a decrease in additive genetic variance available for selection. Accurate selection of genetically superior animals for the next generation is of the utmost importance for genetic improvement. Recent advances in genetic selection programmes have greatly increased the annual response to selection, but rates of inbreeding have likewise increased substantially. According to Tseveenjav *et al*. (2001) the avoidance of inbreeding depression either in short or long-term selection programmes is important and requires restriction of the rate of inbreeding.

The effect of inbreeding has in the past been largely ignored in animal evaluation mainly as a result of computational difficulties. (MTDFREML) a set of program described by Van Vleck (2007), have, however, made the calculation of inbreeding coefficient feasible in large populations so that the effect of inbreeding can be accounted for in several ways. Many of the more traditional methods of genetic parameter estimation ignored the effect of inbreeding and assume that animals are unrelated (Fioretti *et al.,* 2002).

In the Gudali and Wakwa beef cattle, the question might arise as to what level inbreeding accumulated during the breeding programme (selection programme). The purpose of this study was to monitor the level of inbreeding in the Gudali and Wakwa beef cattle in which selection was practiced.

MATERIALS AND METHODS

The Study Area

The study was carried out in the Beef Herd Unit, Wakwa Centre of the Institute of the Agricultural Research for Development, which is located on the Adamawa region of Cameroon. The Adamawa region is a constituent region of the Republic of Cameroon (Redmond, 2009). It borders the Centre and East regions to the south, the Northwest and West regions to the southwest, Nigeria to the west, the Central African Republic to the east, and the North region to the north. With over 64,000 km² in land area, the Adamawa region is the third largest of Cameroon's ten regions. The region is situated between latitudes 6^0 and 8^0N and 10^0 and 16^0E. It is situated at 1100 m above sea level. The land is rugged and sparsely populated; however, most of it is devoted to the rearing of cattle (Bayemi *et al*., 2005). The climatological map of this region is characterized by 3 to 5 months of dry season and 7 to 9 months of wet season. Rainfall here averages 900 to 1,500 mm per year and decreases further north. Mean relative humidity and temperature are 0.673 and 22.0 ^oC, respectively. Minimum and maximum temperatures are 10 and 34 ^oC, respectively (Bayemi *et al*., 2005).

Foundation animals

In Adamawa region of Cameroon, the local Gudali is the predominant breed and it constitutes about 19% of total cattle production in Cameroon and remains the most popular, especially in smallholder sector of the Adamawa highlands of Cameroon (Tawah *et al.*, 1993). The Gudali is a short-horned zebu cattle found within the West and Central African region. It is of good temperament; excellent beef production potential and it can produce and reproduce optimally under the prevailing conditions of the tropical environment without much additional inputs (Ebangi *et al.*, 2002a). The first successful attempt at genetic improvement of the local Gudali cattle in the Adamawa region resulted in the Wakwa Operation in 1952. The foundation population for the Wakwa project was composed of 45 purebred Brahman bulls imported from the United State of America between 1952 and 1958 and six herds each consisting of 40 females in 1965, and in 1969, 12 herds each consisting of 40 breeding females, all of purebred Gudali (Ebangi *et al*., 2002a). Breeding animals were obtained from two selection experiments. One involved a two-breed synthetic beef breed, the Wakwa, obtained from *inter se* matings of the first filial generation of American Brahman (50%) x Gudali (50%) crosses. The other involved recurrent selection of the indigenous purebred Gudali in an effort to enhance its beef production without any serious detrimental effects to its adaptation qualities (Ebangi, 1999). Service of cows was by natural mating. Bulls were allowed to run with specific groups of cows through out the year. Heifers were put to the bulls in the breeding herds as soon as they were considered sufficiently developed for breeding, physically and sexual maturity counting more than actual age.

Cows were checked for pregnancy by rectal palpation and all non pregnant cows were culled. (Tawah *et al*., 1993). The selection scheme consisted of bull evaluation on individual and progeny performance and mass selection of females on phenotypic performance. According to Tawah *et al.* (1993), conformation and physical or structural soundness were additional criteria used for sires and heifers. At weaning, 12, 24, and 36 months the animals were subjected to a selection scheme which was based on individual and progeny performance (Ebangi *et al*., 2002a).

Management of the Herd

The management system and production conditions have been well documented by Tawah and Mbah (1989). Calves were weighed soon after birth that was within 24 hours and a few days of its life. They were eartagged or earnotched with the calf number and parental identity. Eartagging and earnotching provided permanent identification but was not sufficient in the long run; therefore all animals above weaning age were branded using a red hot iron shaped into numbers which were pressed against the thigh of the animals concerned. This left a crust which fell off leaving an open wound, which later healed, leaving scar-tissue more or less easy to read. Dehorning was also done within the first three weeks of the calf's life (Seyedou, 2008). Health management involved routine dipping against ticks, deworming and vaccination for the control of pasteurellosis, brucellosis, rinderpest, and anthrax. Preventive and curative treatments were carried out against trypanosomiasis (Tawah and Mbah, 1989). Grazing and management were essentially extensive on natural pastures in paddocks. Most of the paddocks were dominated by permanent grass species, such as *Hyparrhenia spp, Panicum maximum, Pennisetum purpureum, Pennisetum clandestinum, Brachiaria brizantha, and Andropogon guyanensis* (Piot and Rippstein, 1975). Animals were allowed free range rotational grazing in the paddocks during the rainy season, and some supplementation with rice bran, maize offal, cotton seed cake, common salt and mineral salt licks during the dry season when animals grazed standing hay (Tawah *et al.*, 1993). Water was available *ad libitum* in the paddocks (Piot and Rippstein, 1975).

Source of Data, Data Collection and Editing.

Data utilized for this study was obtained from the Institute of Agricultural Research for Development (IARD), Wakwa Station, Cameroon. Data was collected from 1968 and 1988 from compiled herd books. The data that were collected included pedigree information and performance records from birth to 36-months weight for both the Gudali and Wakwa breed. The following information were obtained: calf identity (CID), sire identity (SID), dam identity (DID), calf date of birth (day, month and year), season of birth, sex of calf, breed of the calf, the monthly body weights of the calf which included birth weight (BWT), 3-months weight (3MWT), 4-months weight (4MWT), 6-months weight (6MWT), weaning weight (WWT), yearling weight(YWT), 18-Months weight (18MWT), 24-months weight (24MWT), 30- Months weight (30MWT) and 36- Months weight (36MWT). The data collected were edited and individuals that appear before parents were re-numbered to give them a new identity. The re-numbering was done considering the date of birth of the animals and the digits of new identity not to exceed its offspring as parent. The individuals that appear as both a sire and a dam were also be re-numbered. Duplicate records and individuals that were parents of themselves were deleted. All animals without a sire or a dam or without any weights were excluded from the analyses. Progeny not identified with herds were discarded.

Statistical Analysis

The pedigree records were used to calculate inbreeding coefficients. Inbreeding coefficients were calculated by inverting the diagonal of the inverse relationship matrix, $\mathbf{A^{-1}}$ using the Multiple Trait Derivative Free Numerator Relationship Matrix (MTDFNRM) programme, one of the three programmes in the MTDFREML (Multiple Trait Derivative Free Restricted Maximum Likelihood) package (Van Vleck, 2007) which is based on the algorithm of

Quaas (1976). Van Vleck (2007) described a simple method to compute the numerator relationship between any or all pairs of animals in the numerator relationship matrix. An option of the MTDFNRM program creates a file MTDF13 that includes the inbreeding coefficient for each animal and the average of the population. The method also makes use of how the inbreeding coefficient is traditionally calculated: one-half of the relationship between the animal's parents. To obtain the numerator relationship between any pair of animals, the original pedigree file was augmented with a dummy animal with an identification number (ID) greater than for any animal in the original pedigree file. The ID of the pair of animals for which the relationship was wanted was included as parents. MTDFNRM was then run with the option to create a file of ordered and original IDs for animals and their parents along with the inbreeding coefficients. We then multiply the inbreeding coefficient for a dummy animal by two to obtain the numerator relationship between the two animals designated as parents.

Table 1: Description of the population

	Gudali			**Wakwa**		
	N	**Decimal**	**%**	**N**	**Decimal**	**%**
Total number of animals including base animals	4514		100	2714		100
Non inbred	4386		97.2	2639		97.2
Inbred animals	128		2.8	75		2.8
Average **F of** all animals		0.073	7.3		0.071	7.1

Table 2: Coefficient of Inbreeding of Performance Traits of Gudali and Wakwa beef cattle

Trait	Total number of animals.	Number of pedigree	Number of inbred animals	Average inbreeding
GUDALI CATTLE				
Birth weight	4514	3787	128	0.074
Three months weight	4514	3787	128	0.073
Four months weight	4514	3787	128	0.074
Six months weight	4514	3786	128	0.074
Weaning weight	4487	3751	117	0.074
Yearling weight	4471	3731	119	0.072
Eighteen months weight	4476	3742	123	0.073
Twenty four months weight	4514	3787	123	0.073
Thirty months weight	4514	3787	128	0.071
Thirty six months weight	4514	3787	128	0.071
WAKWA CATTLE				
Birth weight	2714	2276	75	0.071
Three months weight	2714	2276	75	0.071
Four months weight	2714	2276	75	0.071
Six months weight	2714	2276	75	0.071
Weaning weight	2714	2276	75	0.071
Yearling weight	2714	2276	75	0.071
Eighteen months weight	2714	2276	75	0.071
Twenty four months weight	2714	2276	75	0.071
Thirty months weight	2714	2276	75	0.071
Thirty six months weight	2714	2276	75	0.071

RESULTS AND DISCUSSION

Table 1 shows the number of animals and average inbreeding coefficients while Table 2 shows the number of animals, number of pedigree, number of inbred animals and average inbreeding coefficients of performance trait of the Gudali and Wakwa beef cattle. The average inbreeding obtained in this study was 0.073 (7.3%) with 128 inbred animals for the Gudali and 0.071 (7.1%) with 75 inbred animals for Wakwa cattle. The minimum level of inbreeding was zero over the years whereas the maximum level of inbreeding in the population fluctuates between 7% and 7.5%. The fluctuation is as a result of variation in individual levels of inbreeding. However, the average inbreeding with in the herds in all years was low in the two breeds. Almost 97.20% of the animals were non inbred, whereas at least 2.8% of animals were inbred. This result is similar to the result reported by Pico (2005) who obtained inbreeding coefficient of 7.7% with 153 inbred animals for *Bos indicus* herd but is different from the very low inbreeding coefficient of 0.78% obtained by Dezfuli and Mashayekhi (2009) in Najdi calves with a total number of 186 inbred animals. Fioretti *et al*. (2002) reported an average inbreeding value for the whole data set as 0.013 (1.3%) for Piedmontese cattle in USA, while Aguilar and Misztal (2007) reported 0.011 (1.1%) as calculated inbreeding coefficients for US Holsteins. On the other hand (Gama and Carolino, 2000) reported a trend for an increase in inbreeding, with a rate of inbreeding per year of 0.33% in Alentejana breed in Portugal. Equally Parland *et al*. (2007) obtained a mean inbreeding coefficient in 2004 in Hereford cattle of 2.19% and Ferraz *et al*. (2006) reported the average inbreeding level of Santa Gertrudis herd to be 0.0395 (3.96%) with 6,884 inbred calves out of 29,921 animals in the pedigree file. It can be seen that inbreeding in the Gudali and Wakwa breeds was low and should not be allowed to a level that is not acceptable. Inbreeding should not exceed 0.3% per year (Van der Westhuizen and Mostert, 1998).

CONCLUSION AND RECOMMENDATIONS

From this study, it could be concluded that the level of inbreeding was low in both breeds, and hence the effects of inbreeding on performance traits were relatively low. The results obtained showed that inbreeding at present, is not a serious problem in both breeds of cattle. The low level of inbreeding could be attributed to increased efforts to avoid the mating of closely related animals. Nicholas (1989) suggested that inbreeding rates of up to 0.5% per year should be acceptable in animal breeding programmes. It appears that rates of inbreeding in the breeds are well below the critical levels suggested by the author and consideration of additional methods to avoid inbreeding is not necessary at the present time. However, unless care is taken to restrict the accumulation of inbreeding in future generations, the level of inbreeding could be increased due to selection based on breeding values which most breeders are interested in presently especially in the Gudali beef breed.

ACKNOWLEDGMENT

The author wishes to express her profound appreciation and gratitude to the Ministry of Scientific Research and Innovation, Director General of the Institute of the Agricultural Research for Development, Yaoundé, Cameroon, the Chief of Centre Institute of the Agricultural Research for Development, Wakwa, Ngaoundere and all who participated in the collection and the recording of this data for kind permission to use the data. Dr Ebangi lot was instrumental in the realization of this work.

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