DISCRIMINANT FUNCTION ANALYSIS OF BODY WEIGHT AND GROWTH CONFORMATION TRAITS OF SOME NIGRIAN BREEDS OF CATTLE

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ABSTRACT
A study was conducted to determine the discriminant function analysis of body weight and body conformation traits among selected Nigerian indigenous cattle. Four (4) Local Government Areas (LGAs) from Adamawa and Taraba States, three (3) from Gombe State and two (2) from Sokoto State were selected. Snowball sampling method was used to sample (1,008) cattle, which consists of 162 Adamawa Gudali, (306) Sokoto Gudali, (234) Bunaji and (306) Rahaji cattle from pastoralists in most communities of the LGAs using purposive sampling techniques. Data were collected on body weight, face length, head width, horn length, ear length, neck length, neck circumference, fore leg length, height at withers, chest girth, body length, loin girth, rump height, rear leg length and tail length. Discriminant function analysis was used to determine the variable with discriminating power and large canonical coefficients among variables using (SAS) statistical software package. Significant ($p<0.05$; 0.01) discriminating powers were observed among other variables measured, such as height at wither (0.7402), body weight (0.7272), chest girth (0.6356), rump height (0.6321), body length (0.6266), face length (0.5038), loin girth (0.4905), neck circumference (0.4540), fore leg length (0.4241) and rear leg length (0.4110), which had high discriminating power in the first canonical function than other variables. Neck circumference exhibited a consisted levels of discriminating power across the three functions. Significant low to high ($p<0.05$; 0.01) canonical correlation variances were observed in fourth (0.1779), third (0.3685), second (0.5286) and first (0.9537) functions respectively. Stepwise discriminant analysis revealed that height at withers, body weight, chest girth, rump height and body length had the best discriminating powers than other variables studied.

Keywords: Growth conformation traits, discriminant function, body weight, canonical correlation and cattle

DISCRIPTION OF PROBLEM
Discriminant analysis in cattle is a statistical method used to classify cattle into different groups or categories based on specific traits or characteristics. Discriminant Analysis is a parametric technique to determine which weightings of quantitative variables or predictors best discriminate between two or more groups of cases and do so better than chance (1). The analysis creates a discriminant function which is a linear combination of the weightings and scores on these variables. It helps identify and differentiate between groups of cattle that may have unique production traits, health statuses, or other relevant attributes. It also determines which traits are most important for distinguishing between groups. Canonical correlation analysis is a procedure to determine the strength of relationships between among physiological, morphological or chemical traits of plants or animals (2). The goal of canonical correlation is to determine simultaneous relationships between two sets of variables such as X and Y (3). Correlation coefficients generally show relationships among independent characters and the degree of linear relation between these

characteristics (4). This study is aimed at determining the discriminant function analysis of body weight and body conformation traits of some indigenous cattle breeds.

MATERIALS AND METHODS

Study Location

Study was carried out in Adamawa, Gombe, Taraba and Sokoto States in Nigeria. Four (4) Local Government Areas (LGAs) from Adamawa and Taraba States, three (3) from Gombe State and two (2) from Sokoto State were selected.

Sample Size and Sampling Techniques

A total of one thousand and eight (1,008) cattle consisting of 162 Adamawa Gudali, (306) Sokoto Gudali, (234) Bunaji and (306) Rahaji cattle, which were sampled by snowball sampling method from pastoralists in many communities of the LGAs using purposive sampling techniques.

Data Collection

Data were collected on body weight, face length, head width, horn length, ear length, neck length, neck circumference, fore leg length, height at withers, chest girth, body length, loin girth, rump height, rear leg length and tail length. Reference marks for body measurements were according to the method of FAO, (5).

Statistical Analysis

Discriminant function analysis was used on quan titative variables to classify the sample populatio ns into homogenous group on the basis of the measured variables (6). Furthermore, the analysis was used to determine which variable had more discriminating power than others. The stepwise canonical discriminant function analysis was used to determine the traits with the largest canonical coefficients implying a higher contribution among variables using (6) statistical software package. The discriminant analysis model is shown below.

$$Z_{jk} = a + W_1X_{1k} + W_2X_{2k} + W_nX_nk$$

Where: Z_{jk} = Discriminant Z score of discriminant function for the j^{th} observation in the k^{th} group, a = Intercept, $W_1, W_2, \ldots, W_n$ are the weights or coefficients assigned to each predictor variable, $X_1, X_2, \ldots, X_n$ are the predictor variables.

RESULTS AND DISCUSSION

The canonical discriminant function of cattle is revealed in Table 1. The results showed that first four of the estimated five canonical correlation coefficients were significant (0.9537, 0.5286, 0.3685 and 0.1779, p<0.01; 0.05) with respect to the likelihood ratio test while the fifth canonical correlation coefficient was not significant (0.0848, p>0.7828). High to low (p<0.01; 0.05) significant canonical correlation variances were observed in first (0.9537), second (0.5286), third (0.3685) and fourth function (0.1779). The canonical correlation coefficient in the first function (0.9537) had the highest contribution for the discrimination among variables, which suggest high variations among canonical correlation coefficient. This indicates that canonical variables were best predicted in the first function because of the high levels of variations with moderate prediction in the canonical correlation of the second function (0.5286), third function (0.3685) and low prediction in the fourth function (0.1779) in a decreasing order of magnitude. Canonical correlation analysis is a data reduction technique (7). The results of this study corroborate the findings of Akbas and Takma (8) who reported high canonical correlations in the first function (0.813) and second function (0.152) between two sets of variables. Similar assertion was made by Balkaya *et al*. (9) who reported significant high canonical correlation in first (0.903) and second (0.571) functions, which is in conformity with the results of this study.

Table 1. Canonical discriminant function of cattle

			Variance						
Fun	**Canon. Corr.**	**Eigen value**	**Prop.**	**Cumm.**	**Likelihood ratio**	**F**	**Df1**	**Df2**	**P>F**
1	0.9537	10.0487	0.9450	0.9450	0.0542	52.917	75	4737	0.0000
2	0.5286	0.3877	0.0365	0.9815	0.5987	9.6884	56	3849	0.0000
3	0.3685	0.1571	0.0148	0.9962	0.8309	4.8552	39	2932	0.0000
4	0.1779	0.0327	0.0031	0.9993	0.9614	1.6416	24	1982	0.0258
5	0.0848	0.0073	0.0007	1.0000	0.9928	0.6538	11	992	0.7828

Fun: Function, Canon. Corr: Canonical correlation, Prop: Proportion, Cumm: Communality, DF: Degree of freedom, P: Level of probability.

Discriminant function of body weight and linear body traits of cattle is revealed in Table 2. The discriminant analysis resulted in significant ($p<0.01$) first, second and third canonical discriminant functions. Further results from stepwise discriminant function which were used to determine the discriminating powers of the variables within functions revealed that out of 15 variables considered, 10 variables had significant ($p<0.01$) discriminating power than head length, horn length, ear length, neck length and tail length.

Table 2. Discriminant function of body weight and linear body traits of cattle

Traits	Function 1	Function 2	Function 3	Function 4	Function 5
BWT (kg)	0.7272*	0.2498	-0.2469	0.0826	-0.2794
FLT (cm)	0.5038*	-0.1242	0.0105	0.1302	0.0106
HWD (cm)	0.1621	-0.0291	0.1430	-0.3380	-0.3439
HLT (cm)	0.2137	-0.0349	-0.3151	0.0271	0.0676
ELT (cm)	0.3077	0.0722	-0.3646	0.0163	0.0055
NLT (cm)	0.1146	-0.0803	-0.0988	0.0041	-0.2712
NCR (cm)	0.4540*	0.6600*	0.4309*	0.1909	-0.2283
FLL (cm)	0.4241*	0.2778	-0.2206	0.1234	-0.0489
HTW (cm)	0.7402*	-0.0847	0.2393	-0.9322	0.2075
CGT (cm)	0.6356*	0.0314	-0.0177	0.1543	-0.3969
BLT (cm)	0.6266*	-0.1163	0.2141	0.2229	-0.0699
LGT (cm)	0.4905*	-0.0855	0.0259	0.2294	-0.5288
RHT (cm)	0.6321*	-0.0819	0.2714	-0.4846	0.0017
RLL (cm)	0.4110*	0.2583	0.2158	0.0073	0.1864
TLT (cm)	0.3374	-0.0557	0.0002	0.2352	0.2312

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, *Traits with discriminating power.

The height at wither (0.7402), body weight (0.7272), chest girth (0.6356), rump height (0.6321), body length (0.6266), face length (0.5038), loin girth (0.4905), neck circumference (0.4540), fore leg length (0.4241) and rear leg length (0.4110) in decreasing order of discriminating power had the best discriminating power in the first canonical function.

The neck circumference had good discriminating power in the classification of population in the first (0.4540), second (0.6600) and third (0.4309) functions. The contrasting effect of variables with high discriminant power observed in the first, second, third and fourth function in this study agreed with the findings of Goitom *et al*. (10) who reported height at withers, colour type, tail length and ear length in the first function, dewlap width and tail length in the second function as the best discriminating variables in morphological and morphometric characteristics of Barka and Arado cattle breeds in Eritrea.

The receiver operating characteristics of growth curve of breeds of cattle (Figure 1) shows that Sokoto Gudali cattle breed responded most to growth, followed Adamawa Gudali breed which had similar response of sensitivity to growth, which were better than Rahaji and Bunaji cattle breeds which also showed similar pattern of the response to growth in connection with body weight and body conformation traits measured.

CONCLUSION AND APPLICATION

Stepwise discriminant analysis revealed that height at wither, body weight, chest girth, rump height, body length, face length, loin girth, neck circumference, fore leg length and rear leg length had high discriminating power than other traits.

The canonical correlation coefficients for first, second, third, and fourth pair of canonical variables were found to be significant. The canonical correlation coefficient in the first function (0.9537) had the highest contribution, implying larger contribution for discrimination among population.

Sokoto Gudali cattle had the best sensitivity to growth compared to other breeds of cattle studied.

The height at wither, body weight, chest girth, rump height and body length should be employed in selection criteria because of their high discriminating power.

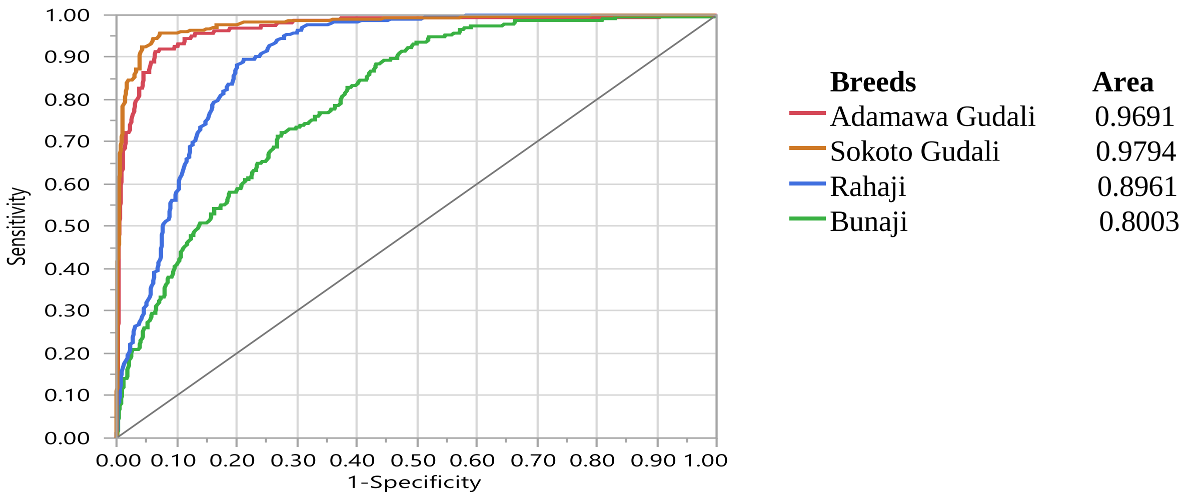

Figure 1. Receiver operating characteristics of growth curve of breeds of cattle

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