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Characterization of indigenous cattle genotypes based on blood parameters in the humid tropics

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***Target Audience:** Animal Scientist, Animal breeders/Geneticist/Physiologist, Cattle farmers*

Abstract

Total of 18 growing cattle comprising 6 cattle each from white Fulani (WF), N'dama (ND) and WF x ND were used to characterize the Nigerian local cattle genotypes based on blood parameters in a randomized complete block design (RCBD). Parameters measured were packed cell volume (PCV) (%), haemoglobin (Hb) (g/dL), white blood cell (WBC/Lx10^9), red blood cell (RBC/Lx10^{12}), total blood protein (BPT) (g/dL), Platelet (PLT)(Fl) and Albumin (ALB)(g/dL). Results showed that PCV, Hb, WBC, RBC, BPT, and PLT were significantly ($p<0.05$) higher in WF x ND. The PCV and WBC were significantly different ($p<0.05$) among the genotypes. The RBC was significantly different ($p<0.05$) among the genotypes. BPT was significantly ($p<0.05$) high in ND and also highest values in WF. The parameters studied showed that WBC, RBC and Hb can be effectively incorporated in the selection process of WF, ND and WFxND therefore, could be used as indicators of good health of Nigerian indigenous cattle in the study area.

***Key words:** indigenous cattle; genotypes; blood parameters, selection*

Description of Problem

Nigeria is endowed with varied ecological zones with diverse animal genetic resources of the local breeds. These local breeds possess genes relevant for their survival and adaptation to their environment and local breeding goals.

In Nigeria, there is need to improve animal production to meet protein requirement, therefore, local breeds of animals in Nigeria deserve improvement in their genetic profile and physiological status (1).

The study aimed to characterize three genotypes of indigenous cattle based on blood parameters.

The measurements of the amount of various biochemical constituents of blood have been used in the evaluation of the physiological status of animals (2).

Identification of blood traits as indicators of good health of cattle is, therefore, important.

Materials and Method

Experimental site

This experiment was carried out at the Cattle Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located on latitude 05^{0}C 28′ North and 07^{0}C 32′ East and lies at an altitude of 122m above sea level. This area is situated within the tropical rainforest zone of West Africa which is characterized by long duration of rainfall (April

- October) and short period of dry season (November-March). Average rainfall is 2169.8 mm in 148 – 155 rain days. Average ambient temperature is 26^0C with a range of 22^0C and 30^0C. Its relative humidity ranges from 50 to 90%. These data were obtained from the meteorological station at the National Root Crops Research Institute (NRCRI), Umudike Abia State (3).

Experimental animals and their management

A total of 18 growing cattle comprising White Fulani, N'dama and N'dama×White Fulani with six cattle per group which was replicated three times with two animals per replicate were used for the experiment. The cattle were sourced from the university farm. They were managed semi-intensively. Iron injection was administered to cattle after collection of blood samples to enable the animals regain lost of blood.

Experimental design

The experiment was designed as a randomized complete block (RCBD) with genotypic group as factor of interest and age as block. The statistical model is given in Expression (1)

$$\mathbf{Y_{ijk} = \mu + A_i + G_j + e_{ijk}} \quad \ldots . (1)$$

Where

$\mathbf{Y_{ijk}}$ = k^{th} observation in the i^{th} block and in the j^{th} genotypic group

$\boldsymbol{\mu}$ = Overall mean

$\mathbf{A_i}$ = effect of the i^{th} age (Block) (i = 1,…,5)

$\mathbf{G_j}$ = effect of j^{th} genotypic group (j=1, …,3)

$\mathbf{e_{ijk}}$ = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance [iind $(0,\sigma^2)$].

Data Collection

Blood sample collection

Blood samples were collected from the experimental animals using the method of (4), by puncturing the jugular vein. 3ml of blood were collected from the each of the experimental animals using sterile disposable syringe which were emptied into sterile bottle containing Ethylene Diamine Tetra Acetic Acid, (EDTA), and serve as anti-coagulant and were used to determine the haematological components. Another 5ml of blood were collected and deposited in an anti-coagulant free sterile bottle and allow to cloths which were used for biochemical studies. It was done immediately after the skin had been damped with alcohol to disinfect the area and expose the vein.

Determination of Blood parameters

Packed cell volume (PCV): Packed cell volume (PCV) was determined by the micro haematocrit method by (5).

Haemoglobin (Hb): Haemoglobin (Hb) was determined using the cyanomethaemoglobin method as described by (6).

White blood cell (WBC): White blood cell (WBC) was determined using a microscope with improved Nuebauer haemacytometer as described by (6).

Red blood cell (WBC): Red blood cell (RBC) was determined using a microscope with improved Nuebauer haemacytpmeter as described by (6).

Total Blood Protein (TBP): The Total Blood Protein (TBP) was by method described by (7).

Blood Glucose (BGC): The Blood Glucose (BGC) determination was by the process describe by (8).

Statistical analysis

Data obtained were subjected to log transformation before they were statistically analyzed with (9) version 16.0. Analysis of variance (ANOVA) procedure appropriate for CRD was used to analyze the data on blood parameters. Duncan Multiple Range Test (10) was used to compare significant means of the parameters of three genotypic group of cattle.

Results and Discussion

Haemoglobin concentration

The means of haemoglobin concentration (Hb) of the various genotypes are presented in Table 1.

Table 1: Means of Hb (g/dL) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WFXND	N'dama	SEM
66	7.55[b]	10.05[a]	8.81[ab]	0.49
79	9.35[a]	9.70[a]	6.90[b]	0.56
92	6.90[ab]	8.10[a]	4.99[b]	0.62
105	7.60	7.20	4.79	0.71
118	8.39	8.60	8.20	0.25

[ab]Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WF x ND = White Fulani x N'dama

Haemoglobin counts ranged from 6.90 ± 0.62 to 9.35 ± 0.56 (g/dL) for White Fulani, 7.20 ±0.71 to 10.05±0.49 for White Fulani x N'dama and 4.79±0.62 to 8.81±0.49 for N'dama cattle. The values are within the normal bovine haematology (11; 12). The Hb counts were significantly different ($p<0.05$) among the genotypes in weeks 66, 79 and 92 with highest value in White Fulani x N'dama. Also, significant different ($p<0.05$) exist in weeks 79 with White Fulani having highest value of Hb. The appreciable amount of Hb in crosses of White Fulani and N'dama and also White Fulani indicates high efficiency of oxygen transportation, cellular metabolism and tissue respiration (13).

Packed cell volume

Mean Packed cell volume (PCV) of the various genotypes is given in Table 2.

Table 2: Means of Packed cell volume (%) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WF X ND	N'dama	SEM
66	22.55	26.50	25.05	1.13
79	29.90[b]	33.90[a]	27.90[c]	1.12
92	27.85	32.50	24.99	1.67
105	24.50	29.50	20.95	2.33
118	30.99	30.00	30.01	1.66

[abc]Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WF x ND = White Fulani x N'dama

The PCV ranged between 22. 55±1.13 – 30.991.66± in WF which is similar to normal range (21 -30%) reported by (11), 26.50±1.13 – 33.90 ±1.12 in WF x ND and within 28-38% as reported by (14) and 20.95±2.33 - 30.01±1.66 in N'dama cattle and values are within the range (21-30%) reported by (11). The PCV was significantly different ($p<0.05$) among the genotypes. PCV values are dependent on the physiological and nutritional status of the animals (15), and therefore is beneficial in assessing the protein status and possibly forecasting the degree of protein supplementation of animals at different

physiological states (16). However, PCV did not differ significantly (p>0.05) for all other weeks among the genotypes.

White blood cells

The means of White blood cells of the various genotypes are presented in Table 3

Table 3: Means of White blood cells (WBC/Lx10^{9}) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WF x ND	N'dama	SEM
66	8.65	11.90	9.29	0.96
79	13.15^{b}	13.64^{a}	10.79^{c}	0.56
92	9.40	8.58	10.84	0.51
105	13.30	12.70	11.39	0.98
118	10.04	11.57	10.06	0.78

^{abc}Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WFxND = White Fulani x N'dama

The values of WBC obtained in the study ranged between 8. 65±0.96 – 13.30±0.98 in WF and within normal range (21 -30%) (11), 8.58±0.51 – 13.64 ±0.56 in WFxND. Also, 9.29±0.96 - 11.39±0.98 in N'dama cattle, these values are within the normal range (21-30%) reported by (12). The WBC was significantly different (p<0.05) among the genotypes in week 79 with highest values obtained in White Fulani x N'dama. WBC was not significantly (p>0.05) different in other weeks intervals among the genotypes. The increased WBC counts at week 79 suggests a severe microbial infection and the response is a defensive mechanism against disease as reported by (17). Higher count of WBC in the crosses of White Fulani and N'dama may indicate disease presence, protective mechanism, providing rapid and potent defense against infectious agents. However, high percentages of WBC are associated with the ability of crosses of White Fulani and N'dama to perform well under very stressful conditions (18)**.**

Red blood cell counts

The means of Red blood cell counts **(**RBC) of the various genotypes are presented in Table 4.

Table 4: Means of Red blood cell (RBC/Lx10^{12}) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WF x ND	N'dama	SEM
66	6.37^{b}	8.19^{a}	7.05^{ab}	0.38
79	4.75^{b}	5.43^{a}	4.47^{c}	0.18
92	4.46	5.20	3.99	0.27
105	3.92	4.72	3.35	0.37
118	4.95	4.80	4.73	0.26

^{abc} Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WFxND = White Fulani x N'dama

The RBC was significantly different (p<0.05) among the genotypes in weeks 66 and 79 with highest values in White Fulani x N'dama. RBC was not significantly (p>0.05) different in other

weeks among the genotypes. RBC ranged from 3.92±0.37 to 6.37±0.38 for White Fulani, 4.72±0.37 to 8.19±0.38 for White Fulani x N'dama and 3.35± 0.37 to 7.05±0.38 for N'dama. According to (19), Red blood cell counts are very important in the transport of oxygen bound to haemoglobin from the lungs to the tissues and carbon (iv) oxide from tissues to the lungs for excretion. RBC is highly dependent upon glucose as its energy source (20). Most of the RBC values in this study are lower than normal range which may be as a result of absolute anaemia (19). Some of the values are within the normal range (5.0 - 7.2 x 10^6/µL) (11).

Platelet

The mean platelet of the various genotypes of indigenous cattle genotypes is given in Table 5.

Table 5: Means of Platelet (Fl) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WF x ND	N'dama	SEM
66	12.02	11.93	12.20	0.21
79	16.79^{b}	28.90^{a}	16.05^{c}	2.63
92	12.06^{ab}	15.60^{a}	11.39^{b}	0.91
105	9.78	11.39	10.57^{c}	0.42
118	27.19^{a}	15.26^{b}	11.62^{c}	3.45

^{abc}Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WFxND = White Fulani x N'dama

The platelet was significantly different (p<0.05) among the genotypes with highest values in White Fulani x N'dama and White Fulani. Platelet was not significantly (p>0.05) different in other weeks among the genotypes.

Platelets are a nuclear cytoplasmic fragments of megakaryocytes, and play an essential role in hemostasis (21). Bovine platelets are small compared to those of other species (22). Average platelet in cattle was reported as 4.0 – 4.8 femtoliters (Fl) (22) which is lower than the values obtained in this study. This may be attributed to environmental condition (homeostalsis) of the animal (23). According to (19), PLT are sequestered in the spleen and enter into circulation in response to epinephrine release.

Blood protein

The mean Blood protein (BPT) of indigenous cattle genotypes is given in Table 6.

Table 6: Means of Blood protein (g/dL) of White Fulani, N'dama and their crosses

Age (weeks)	White Fulani	WF x ND	N'dama	SEM
66	5.66	4.19	6.50	0.60
79	7.47^{b}	6.90^{c}	8.91^{a}	0.38
92	9.81	7.90	8.74	0.61
105	7.71^{a}	6.24^{b}	5.15^{b}	0.49
118	8.24	8.43	8.52	0.15

^{abc} Means within the rows with different superscripts differ significantly (P < 0.05); SEM- Standard error of the mean, WFxND = White Fulani x N'dama

There were significant ($p<0.05$) differences in Blood protein with highest values in N'dama and White fulani genotypes respectively. The significant difference could be as a result of fluctuation in environmental temperature (24). There were no significant differences ($p>0.05$) between the genotypes in mean values of blood protein in weeks 66, 92 and 118.

The increased concentrations of total protein may be explained by the very quick somatic growth that could occur in growing cattle.

Albumin

The mean Albumin (ALB) of indigenous cattle genotypes is given in Table 7.

Table 7: Means of Albumin (g/dL) of White Fulani, N'dama and their crosses

Age (wks)	White Fulani	WFxND	N'dama	SEM
66	3.40	2.40	4.02	0.38
79	4.72^{b}	4.02^{c}	5.11^{a}	0.20
92	5.13	4.13	4.20	0.28
105	4.81^{a}	3.48^{b}	2.86^{b}	0.38
118	5.11^{a}	4.98^{b}	4.84^{b}	0.04

^{abc} Means within the rows with different superscripts differ significantly ($P < 0.05$); SEM- Standard error of the mean, WFxND = White Fulani x N'dama

There were significant ($p<0.05$) differences in Albumin with highest value in N'dama, and White Fulani genotypes. The values of Albumin (ALB) in this study is within normal albumin range of 3.4 to 5.4 g/dL. ALB function in regulating the oncotic pressure of blood. Albumin was not significant ($p>0.05$) in other age intervals. White Fulani performance may be superior because natural selection over hundreds of generations has provided them with high degree of heat tolerance, resistant to many tropical diseases and the ability to survive long periods of feed and water shortage (25).

Conclusions and Applications

1. Blood parameters have shown that the cattle were of normal physiological conditions in terms of oxygen transportation, energy distribution and general good health.
2. The characteristic performance of the indigenous cattle studied showed certain qualities that can be tapped in strategic improvement programme of the cattle industry.
3. In the study, blood parameters showed predominantly that Hb, PLT can be effectively incorporated in selection of White Fulani and White Fulani x N'dama: PCV, RBC and WBC for WF x ND and BPT and ALB for ND genotypes for improved physiological and health conditions of cattle in Nigeria.
4. In view of the study, it was therefore, recommended that White fulani x N'dama genotype could be selected to enhance production of healthy Nigerian indigenous cattle in the study area.

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