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Characterization of indigenous cattle genotypes based on linear body traits in the humid tropics

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Abstract

Selection for trait of interest is a major problem in cattle production when faced with the challenge of varied growth traits in different genotypes. Low understanding of the production potentials of these cattle breeds constitute problems in effective improvement of physical body characteristics. A total of 18 cattle was used to characterize the Nigerian local cattle genotypes based on quantitative traits. Three genotypic groups {White Fulani (WF), N'Dama (ND) and White Fulani x N'Dama (WFxND)} crosses were used for the experiment. Experimental design was a completely randomized design (CRD) with genotypic group as major factor of interest. Quantitative traits measured were body length (BDL) (cm), hip height (HHT) (cm), heart girth (HG) (cm), horn length (HL) (cm), tail length (TL) (cm), ear length (El) (cm) and neck length (NL). Results showed that there were significant differences ($p<0.05$) in body length in weeks 99 – 111 and 112 – 124 with the White Fulani and N'Dama genotypes having longer bodies. The values ranged from 33.00 to 39.29cm in WF, 39.49 to 39.59cm in N'Dama and, 18.25 to 32.90 in WF x ND. There were significant ($p<0.05$) differences in hip height of cattle in age interval of 99-111 and 112-124 weeks of age, with the White Fulani and N'Dama genotypes having highest hip. The genotypes showed significant ($p<0.05$) differences in heart girth in 99 and 124 WOA with the White Fulani and N'Dama genotypes having widest heart girth. The genotypes showed significant ($p<0.05$) differences in horn length in all the weeks with White Fulani showing superiority. The genotype had longer horns in the White Fulani and followed by WF x ND across the week intervals. The values ranged from 14.99 to 15.20cm in WF, 5.75 to 10.19cm in N'Dama and, 3.00 to 4.29 in WF x ND. The tail length of the three genotypes showed significant ($p<0.05$) differences in 99-111 and 112-124 WOA. Higher values were obtained in White Fulani genotype which showed longer tails than the N'Dama and WF x ND. There were significant ($p<0.05$) differences in neck length of the cattle genotypes in 112-124 WOA. Higher values were obtained in White Fulani genotype which showed longer neck than the N'Dama and WF x ND. White Fulani could be used to enhance growth of Nigerian indigenous cattle in the study area. The present findings could assist in the design of long-term genetic improvement programmes for cattle production in Nigeria.

Keywords: Nigeria indigenous cattle, genotypes, quantitative traits.

Introduction

Tropical cattle require the development of a very good model for its genetic improvement (Rege and Tawah, 1999). 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. The choice of the right type of animals to be raised in the area where it is best adapted which result in higher productivity and performance is very important. To improve effectively on physical body characteristics of cattle, there is need to understand the production potentials of these cattle breeds. Linear measurements are divided into two groups, which include skeletal and tissue measurements. Skeletal measurements include all the height and length measurements while tissue measurements include heart girth, chest depth, punch girth, and width of hips (Blackmore *et al.,* 1995). These body measurements can be further divided into horizontal measurements like body length (BDT) and head to shoulder (HDS) and vertical measurements like hip height (HPH) and chest depth. The local breeds of animals in Nigeria deserve improvement in their genetic profile and physiological status (Nosike *et al.,* 2013). Also, the main purpose of animal breeding practices is to improve traits of economic value (Mendes *et al.,* 2005). The study therefore aimed to characterize three genotypes of indigenous cattle based on quantitative traits.

Materials and methods

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°C 28' North and 07°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°C with a range 22°C and 30°C. Its relative humidity ranges from 50 to 90%. These meteorological data were obtained from the meteorological station at the National Root Crops Research Institute, Umudike Abia State (NRCRI, 2017).

Experimental animals and their management

A total of 18 cattle aged between 60 and 72 weeks comprising White Fulani, N'Dama and (N'Dama×White Fulani) crosses 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 themselves.

Experimental design

The experiment was a completely randomized design, with genotypic group as a single factor of interest. The statistical model was; $Y_{ij}=\mu+G_i++e_{ij}$

Where

Y_{ij} = j^{th} observation in the i^{th} genotype.

μ = overall mean

G_i = effect of i^{th} genotype

E_{ij} = random error assumed to be independently, identically and normally distributed with zero mean and constant variance.

Data collection

Parameters measured

Body length, hip height, heart girth, horn length, tail length, ear length and neck length were measured on individual cattle with the aid of tailor's tape (cm). The animals were made of both male and female. The animals were restricted by the handlers using cattle crush. Measurement were taken early in the morning prior to feeding/grazing.

Body length (BDL): joint of the scapular to the pin bone.
Hip height (HPH): distance from the platform on which the animals stand to the point of its shoulder.
Heart girth (HG): the body circumference immediately posterior of the front legs or the body circumference on the fore ribs.
Horn length (HL): the length from the base of the horn to the tip of the horn.
Tail length (TL): distance from the base to the end of the tail.
Ear length (EL): distance from the base to the tip of the ear.
Neck length (TL): the length of the neck region from the head to the hump.

Statistical analysis

Data obtained were statistically analyzed with SPSS (2011). Analysis of variance (ANOVA) procedure appropriate for CRD was used to analyze the data on quantitative traits. Duncan's Multiple Range Test (Duncan, 1955) was used to compare significant means of parameters on three genotypes of cattle.

Results and discussion

Body length

The means of body length (BDL) of the various genotypes are presented in Table 1. The genotypes showed significant ($p<0.05$) differences in weeks 99 – 111 and 112 – 124 with the white Fulani and N'Dama genotypes having longest bodies. The values ranged from 33.00 to 39.29cm in WF, 39.49 to 39.59cm in N'Dama and, 18.25 to 32.90 in WF x ND. This implies that body length can be used effectively to discriminate among the genotypes in week 99 –111 and 112 – 124. Body length as a growth trait is useful in improving the market quality of breeding stocks (Nwachukwu *et al.,* 2011). Body dimensions have been used to indicate breed, origin and relationship through the medium of head measurements (Itty, *et al*, 1997) or to indicate size. EAAP and FAO have used wither height for example as a prime indicator type (Wilson, 1995).

Table 1: Mean Body length (cm) of White Fulani, N'Dama and White Fulani x N'Dama crosses

Age (weeks)	White Fulani	WFXND	N'Dama	SEM
60 – 72	33.00	18.25	39.49	5.72
73 – 85	33.10	18.30	39.49	5.72
86 – 98	33.10	32.90	39.59	2.08
99 – 111	39.19^{a}	32.90^{b}	39.59^{a}	1.37
112 – 124	39.29^{a}	32.79^{b}	39.56^{a}	1.88

[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 crosses

Hip height

The means of Hip height (HHT) of the various genotypes are presented in Table 2. There were significant ($p<0.05$) differences in Hip height of cattle in age interval of 99-111 and 112 -124 weeks of age, with the white Fulani and N'Dama genotypes having highest hip. The lower hip height in the WF x ND cattle indicates low vigour, which may be attributed to breed recombination. The EAAP and FAO have used wither height for example as a prime indicator type (Wilson, 1995). There were no significant ($p>0.05$) differences in HH in the other age groups.

Table 2: Means of hip height (cm) of White Fulani, N'Dama and their crosses

Age (wks)	White Fulani	WFXND	N'dama	SEM
60 – 72	42.50	35.00	47.99	2.78
73 – 85	42.55	35.15	47.99	2.75
86 – 98	42.70	35.20	48.19	2.78
99 – 111	48.19[a]	35.35[b]	48.19[a]	2.72
112 – 124	48.29[a]	36.29[b]	48.30[a]	3.46

[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 crosses

Heart girth

The means of Heart girth (HG) of the various genotypes are presented in Table 3. The genotypes showed significant (p<0.05) differences in Heart girth in 99 and 124 WOA with the white Fulani and N'Dama genotypes having widest heart girth. This implies that heart girth can be used effectively to discriminate among the genotypes in 99 and 124 WOA and heart girth as a growth trait is useful in improving the market quality of breeding stocks (Nwachukwu *et al.,* 2011). Body dimensions have been used to indicate breed, origin and relationship through the medium of head measurements (Itty *et al*, 1997) or to indicate size. Wilson (1995) reported that wither height has been used as a prime indicator type.

Table 3: Means of heart girth (cm) of white Fulani, N'Dama and their crosses

Age (wks)	White Fulani	WFXND	N'dama	SEM
60 – 72	33.00	18.25	39.49	5.72
73 – 85	33.60	34.20	37.99	1.47
86 – 98	33.65	34.25	38.19	1.48
99 – 111	38.19[a]	34.3[b]	38.29[a]	0.86
112 – 124	38.29[a]	33.39[b]	38.19[a]	1.41

[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 crosses

Horn length

The means of horn length (HL) of the various genotypes are presented in Table 4. The genotypes showed significant (p<0.05) differences in horn length in all the weeks with White Fulani showing superiority. The genotype had longer horns in the white Fulani and followed by WF x ND across the week intervals. The values ranged from 14.99 to 15.20cm in WF, 5.75 to 10.19cm in N'Dama and, 3.00 to 4.29 in WFxND. The horn length increases with increase in age. Increase in horn length indicates growth of the cattle. Growth is normally accompanied by an orderly sequence of maturational changes and involves accretion of protein and increase in length and size (Gous, 1997).

Table 4: Means of horn length (cm) of white Fulani, N'Dama and their crosses

Age (weeks)	White Fulani	WDxND	N'dama	SEM
60 – 72	14.99[a]	3.00[b]	5.75[ab]	2.56
73 – 85	14.99[a]	3.05[b]	5.90[ab]	2.55
86 – 98	15.19[a]	3.15[b]	5.95[ab]	2.56
99 – 111	15.19[a]	3.20[c]	10.19[b]	2.21
112 – 124	15.20[a]	4.29[c]	10.19[b]	1.70

[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 crosses

Tail length

The means of Tail length (TL) of the various genotypes are presented in Table 5. The tail length of the three genotypes showed significant ($p<0.05$) differences in 99-111 and 112-124 WOA. Higher values were obtained in White Fulani genotype which showed longer tails than the N'Dama and WFxND counterpart. The superiority of the White Fulani may be attributed to breed difference.

Table 5: Means of tail length (cm) of white Fulani, N'Dama and their crosses

Age (wks)	White Fulani	WFxND	N'dama	SEM
60 – 72	24.75	23.00	27.99	1.43
73 – 85	24.80	23.10	28.09	1.43
86 – 98	24.90	23.15	28.09	1.42
99 – 111	29.09[a]	23.25[c]	28.19[b]	1.15
112 – 124	29.09[a]	23.19[c]	28.21 [b]	1.30

[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 crosses

Ear length

The means of Ear length (EL) of the various genotypes are presented in Table 6. There were significant ($p<0.05$) differences in Ear length in cattle genotypes in 112-124 WOA with White Fulani having longer ears than the N'Dama and WFxND counterpart. The values ranged from 7.25 to 19.19cm in WF, 6.99 to 7.32 cm in N'Dama and 6.50 to 7.79 in WFxND The values followed an increasing trend with age which indicates growth (Nosike *et al*., 2013).

Table 6: Means of ear length (cm) of white Fulani, N'Dama and their crosses

Age (wks)	White Fulani	WFxND	N'dama	SEM
60 – 72	7.25	6.50	6.99	0.54
73 – 85	7.30	6.60	7.19	0.53
86 – 98	7.35	6.65	7.19	0.54
99 – 111	9.09	6.80	7.29	0.51
112 – 124	9.19[a]	7.79[b]	7.32 [b]	0.40

[a-b]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 crosses

Neck length

The means of Neck length (NL) of the various genotypes are presented in Table 7. There were significant ($p<0.05$) differences in neck length of the cattle genotypes in 112-124 WOA. Higher values were obtained in White Fulani genotype which showed longer neck than the N'Dama and WF x ND counterpart.

Table 7: Means of neck length (cm) of white Fulani, N'Dama and their crosses

Age (wks)	White Fulani	WF x ND	N'Dama	SEM
60 – 72	13.00	19.00	11.99	2.50
73 – 85	13.10	19.10	11.99	2.50
86 – 98	13.20	19.15	12.19	2.50
99 – 111	14.19	19.25	12.19	2.45
112 – 124	14.39[b]	27.29[a]	12.27 [c]	3.72

[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 crosses

Conclusion

The study has shown the characterization of local cattle based on quantitative traits. The results have shown that White Fulani and White Fulani x N'Dama genotypes exhibited greater performance in growth parameters among the three genotypic groups. The White Fulani and White Fulani x N'Dama had better growth and longest body measurements. In view of the results obtained in this study, it is recommended that the White Fulani and crosses with N'Dama genotypes should be selected by breeders to achieve improved production, using the quantitative traits BL, EL, TL, and BL.

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