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(RESEARCH ARTICLE)

Prediction of body weight from linear body measurement in two breeds of cattle

Jessie Ezekiel Udoh *, Emmanuel Godwin David and Uduak Linus Unah

Department of Animal Science, Faculty of Agriculture, University of Uyo Akwa Ibom State, Nigeria.

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Abstract

The study compared live weight and linear body measurements of two breeds of cattle (White Fulani and Muturu Cattle) and regressed linear body measurements on live weight.

A total of eighty-six cattle of forty-three per a breed were reared at the cattle production unit of the Teaching and Research Farm, Akwa Ibom State University – Obio Akpa Campus, Nigeria in a semi intensive management system. Parameters measured were; live weight (LW), face length (FCL), head circumference (HC), ear length (EL), neck length(NL), neck circumference(NC), height at wither(HW), body length(BL), body circumference(BC), hind limb(HL), fore limb(FL), and tail length(TL). The data obtained were subjected to statistical analysis for morphometric traits and prediction was done through linear model regression method using SPSS statistical software package. Breed of cattle significantly ($P>0.05$) affected all linear body measurements and live weight exception of NL .Linear body Parameters of both breeds were compared. The mean live weight of White Fulani and Muturu were 251.28kg and 149.81kg, respectively. Means of FL, EL, NL, BL, HL, TL and BC, NC and HW of White Fulani were significantly ($P<0.01$) higher than Muturu breed but the HC of Muturu was significantly ($P<0.01$) higher than White Fulani breed. Muturu breed had higher R^2 of 0.98 in BL and BC than White Fulani breed. In conclusion, White Fulani was considered a larger breed than Muturu cattle. Live weight can be accurately predicted from linear body measurements through BC and BL in both breeds.

Keywords: Breed; Linear body measurement; Live weight; Muturu; Prediction; Regression; White Fulani

1. Introduction

Cattle rearing is an enterprise which supplies food to many tables in the world through its products such as meat and milk and its by-products as raw materials for many industries as well as manure to the farmers to promotes farm yield and importantly, overall generation of income to the herdsmen in the rural areas. Cattle can efficiently survive on a deserted areas or uncultivated lands covered with grasses, shrubs, forages and trees. The essence of animal breeding practices are for the improvement of growth traits such as body weight which is considered to be a trait for selection of animals demanded for accurate estimation to enhance livestock breeding and production. Useful information for selection of animals resulting from genetic improvement programs could be evaluated on morphological grounds such as linear body measurement [1]. Linear body measurements are moderately heritable with strong positive relationship on growth traits in cattle [2]. Growth is one of the important selection criteria for the improvement of meat animals such as cattle, sheep and goats. Akpa et al. [3] defined growth as the sum total of increase in size of different structural body components measured from gain in body weight and linear body measurements. Linear body traits can be measured through skeletal and tissue measurements [4;5].The reliability of single measurements such as wither heights, body length, heart girth, rump height and width in the estimation of weight at both traditional and institutional levels have become widely important [6]. Some other people have used it as indicators of breed origin and relationship within species [7].

* Corresponding author: Jessie Ezekiel Udoh
Department of Animal Science, Faculty of Agriculture, University of Uyo Akwa Ibom State, Nigeria.

Body dimensions have been used in estimating body weight and appropriate pricing of meat animals and it is used in estimating weight and market value in terms of cost of the animals in the absent of weighing balance or lack of being able to read the calibrations on the weighing balance [8]. Linear measurement can be used as indicator or weight changes at maturing rate in cattle, sheep and goat [9]. Body measurement in addition to live weight measurement describes more completely on individual or population than the conventional method of weighing and grading. It is therefore imperative for livestock herdsmen to have knowledge of live weight on their animals as it is an important tool for farmers in decision making as in the case of market prices for standing animals, management decision such as how much to feed / ration requirements for growth and other respective production stages, determination of correct dosage of various medications and vaccines, when to mate and most importantly when to market either weaning, grower or for slaughter [10; 11; 12; 13; 14]. This is useful in predicting the genetic changes that could result from selecting one of the variables to another. Linear body measurements have been used severally to characterize breeds, evaluate breed performance and predict live weight gain [15]. Therefore this study compared live weight and linear body measurement of two breeds of cattle (White Fulani and Muturu Cattle) and regressed linear body measurement on live weight.

2. Material and methods

2.1. Experimental site

This study was carried out at the cattle production unit of the Teaching and Research Farm, Akwa Ibom State University at Obio Akpa, Oruk Anam L.G.A. Akwa Ibon State, Nigeria. Obio-Akpa is located between latitude 5°17' N and 5° 27' N and between longitude 7°27' N and 7 °58' E with mean annual rainfall of between 20000 – 40000mm and average monthly temperature is between 26°C and 28°C with relative humidity of between 60-90%. It is in the tropical rainforest zone of Nigeria. The people in the areas depend on livestock and crop production [16].

2.2. Experimental animal / data collection

A total of 86 cattle comprising of 43 White Fulani Breeds and 43 Muturu cattle were used for the study. They were managed under semi-intensive system of management. Body parts measurements were obtained and recorded for each animal by the use of measuring tape calibrated in centimeter (cm) after restraining the animals. Reference point for body measurements include; Body Length (BL): the length of the cattle was measured from the joint of the scapular to the pin bone. Body Circumference (BC) or Hearth girth: hearth girth measurements were taken immediately posterior of the front legs or on the fore ribs. Ear Length (EL): the distance of the ear from the base to the tip of the pinna was used as the measurements of the ear. Height at Wither (HW): this was measured as the distance from the highest point of the dorsum of the animal to the ground surface at the level of the front feet. Hind Limb (HL): Measured as the Distance between the points of thurl and the end of the hind limb hoof. Face Length (FCL): Measured as the distance between the top line and the end of the muzzle. Tail length (TL): measured as the distance from the base to the end of the tail. Fore Limb (FL): Measured as the Distance between the point of the Shoulder and the end of the fore limb hoof. Neck Length (NL): Measured as the distance between the top line and the beginning of the hump region. Neck Circumference (NC): Measured as the distance that covered round from the crest of neck to the Throat. Head Circumference (HC): measured as the distance covered round the cranial skull.

2.3. Statistical analysis

All linear measurement were subjected to regression and correlation equations. All data were analyzed by one-way analysis of variance by the procedure of least Cost Model Using Statistical Package for Social Sciences (SPSS) software. T-test was used to determine differences among means.

2.3.1. Regression

The simple linear regression model.

$Y = a+b X$

Where Y represents the dependent variable (body weight)

a = intercept of the regression

b = Regression Coefficients

X = Independent Variable (linear measurements)

3. Results and discussion

3.1. Comparison of mean live weight and body linear parameters of White Fulani and Muturu breeds of cattle

Comparison of mean live weight and body linear parameters of White Fulani and Muturu breeds of cattle is summarized in Table 1. The mean live weight for White Fulani cattle breed was significantly ($p<0.05$) heavier than Muturu breed of Cattle with 251.28kg and 149.89kg, respectively. However, there was a significantly ($p<0.05$) higher mean values recorded for LW(251.28±39.74 cm), FCL(46.37±1.94 cm), EL(22.17±1.42 cm), NC(68.72±7.88 cm), HW(127.15±4.09 cm), BL(135.16±7.75 cm), BC(143.14±7.13 cm), HL(95.95±4.73 cm), FL(85.38±4.95 cm) and TL(96.78±14.78 cm) in White Fulani breed than Muturu breed with 149.89±63.95 cm, 41.01±6.88 cm, 15.15±1.57 cm, 57.87±9.69 cm, 96.51±18.86 cm, 115.10±16.26 cm, 116.10±17.76 cm, 70.22±9.03 cm, 79.10±11.16 cm and 71.29±19.46 for the same parameters, respectively. HC for Muturu breed was 72.36±10.53 cm significantly ($P<0.05$) higher than that recorded for White Fulani with 70.80±6.46 cm. However, there was no significant ($p>0.05$) different for the NL of White Fulani and Muturu breeds. The trend of the study showed that White Fulani had higher values in almost all the morphometric parameters measured.

The result of this study is in agreement with the findings of [17] who reported a higher and significant live weight for White Fulani Compared to Muturu and N'dama breeds. The mean values of body measurement studied exhibited breed differences in favour of White Fulani Cattle, this may be due to differences in genetic make-up. The result of this study agrees with the observation by [18] which noted that the influence of breeds on some morphometric traits which indicate the usual difference between breeds due to genetic constitution leading to differential growth rates.

However, values reported for linear body measurement in this study agreed with the work of [19] and further establish genetic differences as a source of variation in linear body measurement.

Table 1 Comparison of body parameters of white fulani and muturu cattle (cm)

Body parameters	White Fulani	Muturu	T-Value
Body Weight	251.28±39.74[a]	149.89±63.95[b]	5.69
Body Length	135.16±7.75 [a]	115.10±16.26[b]	4.92
Face Length	46.37±1.94 [a]	41.01±6.88[b]	3.51
Head Circumference	70.80±6.46[b]	72.36±10.53 [a]	2.55
Ear Length	22.17±1.42 [a]	15.15±1.57[b]	13.06
Neck Circumference	68.72±7.88 [a]	57.87±9.69[b]	3.49
Height at Wither	127.15±4.09 [a]	96.51±18.86[b]	7.54
Body Circumference	143.14±7.13 [a]	116.10±17.76[b]	6.15
Fore Limb	85.38±4.95[a]	70.22±9.03[b]	6.34
Hind Limb	95.95±4.73 [a]	79.10±11.16[b]	6.24
Tail Length	96.78±14.78 [a]	71.29±19.46[b]	4.23
Neck Length	31.15±3.08	29.72±1.66	1.44

BL=Body Length, FCL= Face Length, HC= Head Circumference, EL= Ear Length, NC= Neck Circumference, HW= Height at Wither, BC= Body Circumference, FL= Fore Limb. HL= Hind Limb, TL= Tail Length, NL= Neck Length

3.2. Linear Regression Equation Predicting Body Weight from Linear Body Measurement in White Fulani and Muturu breed of Cattle

The linear regression equations and their respective coefficient of determination are presented in Table 2. The regression coefficient (r) or growth coefficient showed estimates of the growth rate of various parameters in both cattle breeds. The regression coefficients (r) of the body parameters of Muturu breed were significantly ($p<0.001$) higher compared to white Fulani's body parameters. Neck circumference indicate carcass percentage in an animal, therefore the regression coefficient of neck circumference in Table 2 was (0.86) for Muturu breed which indicates high carcass percentage than White Fulani Cattle with 0.15. Body circumference indicates accumulation of fat in the body. Body

circumference's regression coefficient for Muturu breed was 0.99 indicates while White Fulani had 0.89. This indicates high accumulation of fat in Muturu than in White Fulani breed.

The various values in the predicting functions (r^2), showed the strength of independent parameter in predicting the body weight of the animals. Using the predicting functions (R^2), increase in live weight result in an increase in body circumference and body length in the two breeds of cattle. Body circumference and body length measured may be used to predict body weight in both breeds' of animal. Therefore, body circumference and body length are reliable indexes in estimating live weight of an animal. Coefficient of determination obtained for regression equations were positive and high for most of the parameters studied such as:- Body circumference (BC), body length (BL), face length (FCL) neck length (NL) and Neck circumference (NC) had the highest coefficient of determinations 0.98, 0.98, 0.78, 0.83, and 0.86 respectively in Muturu cattle than the White Fulani. This result agrees with the result of [20] who reported that regressions of body weight including the linear, quadratic, and cubic effects of a single independent variable as heart girth, wither height, hip width, or body length) could best predict body weight due to high $R^2 > .95$. The result of this study is in accordance to [21] which advocated that chest girth and body length are the two main parameters for estimation of live weight and growth trait in goats. The result of this study is similar to the findings reported by [22] in sheep that the best prediction equation (R2= 0.911) for body weight was obtained was on chest girth, body length and horn length.

Table 2 Linear Regression Equation Predicting Body Weight from Linear Body Measurement in White Fulani and Muturu Cattle

Parameters	Breeds	N	Regression Equation	r	R^2	RSD
BL	W.Fulani	25	BW= 422.12+2.554BL	0.71	0.661	17.20
	Muturu	25	BW= -298.15+3.893BL	0.99	0.980	9.53
FCL	W.Fulani	25	BW= 50.71+4.33FCL	0.21	0.045	39.76
	Muturu	25	BW= -185.65+8.182FCL	0.880	0.775	31.96
HC	W. Fulani	25	BW= 136.71+1.44HC	0.23	0.055	39.55
	Muturu	25	BW= -222.199+5.14HC	0.85	0.717	35.86
EL	W. Fulani	25	BW= 512.77+-11.79EL	0.42	0.177	36.897
	Muturu	25	BW= -324.40+31.295EL	0.77	0.587	43.33
NC	W. Fulani	25	BW= 199.43+0.76NC	0.15	0.022	40.22
	Muturu	25	BW= -177.18+5.65NC	0.86	0.734	34.75
HW	W. Fulani	25	BW= 62.59+1.48HW	0.153	0.023	40.20
	Muturu	25	BW= -116.396+2.76HW	0.814	0.662	39.17
BC	W.t Fulani	25	BW= 456.13+4.98BC	0.89	0.787	18.33
	Muturu	25	BW= -264.02+3.57BC	0.99	0.980	9.46
FL	W.Fulani	25	BW= 46.54+2.399FL	0.29	0.089	38.82
	Muturu	25	BW= -44.46+2.77FL	0.39	0.153	62.06
HL	W. Fulani	25	BW= 134.60+1.22HL	0.15	0.021	40.25
	Muturu	25	BW= -235.98+4.88HL	0.85	0.725	35.36
TL	W. Fulani	25	BW= 171.71+0.82TL	0.31	0.094	38.73
	Muturu	25	BW= 46.37+1.45TL	0.44	0.195	60.47
NL	W. Fulani	25	BW= 94.30+5.04BW	0.39	0.153	37.44
	Muturu	25	BW= -890.11+34.996NL	0.91	0.829	27.896

W.Fulani= White Fulani, BL=Body Length, FCL= Face Length, HC= Head Circumference, EL= Ear Length, NC= Neck Circumference, HW= Height at Wither, BC= Body Circumference, FL= Fore Limb. HL= Hind Limb, TL= Tail Length, NL= Neck Lengthr= Regression Coefficient, R^2=Coefficient of determination (Predicting Function), SEM= Standard Error of Mean, N= Number of Animal Per breed

4. Conclusion

It is concluded that from this study showed that White Fulani breed with 251.28kg mean body weight was heavier than Muturu breed with mean body weight (149.81kg). White Fulani showed superiority in almost all the body linear parameters than Muturu breed exception in HC. This indicated that breed influenced the body measurement of both breeds studied.

Live weight can accurately be predicted from linear body measurements as body circumference and body length had higher coefficient of determination (R^2) in both breeds. Therefore BC and BL can best be used as tool to predict body weight in both breeds of cattle (White Fulani and Muturu).

Compliance with ethical standards

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Author's contribution

All authors contributed to the success of this work. All authors read and approved the final manuscript.

Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of ethical approval

This research was carried out according to the ethical guidelines of the Institutional Animal Care and Use Committee (IACUC) of the International Livestock Research Institute as per the ethics application approval numbers 2014.15 and 2014.16.

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