Correlation between milk consumption and body weight of white Fulani calves under semi-intensive management and linear body measurements.

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ABSTRACT
A study was conducted to determine the correlation between milk intake and body weight with linear body measurements in white Fulani calves raised in semi-intensive system of management. The overall mean±SEM value for milk intake, body weight, neck circumference, neck length, body length, body circumference, girth circumference, height at wither and tail length were 1.20±0.40g, 5.18±1.02kg, 21.54±0.66cm, 13.23±0.21cm, 28.36±0.31cm, 36.41±0.43cm, 35.84±0.37cm, 35.87±0.43cm and 23.43±0.39cm respectively. There was significant ($P<0.05$) effect of lactation stage on all body measurements taken except for neck circumference and tail length. Correlation between all body pairs of measurements were high, positive and highly significant ($P<0.01$, $P<0.05$). The highest correlation was recorded for body length, body circumference, girth circumference and height at wither. Linear function provided the best fit for milk intake weight and linear body measurements indicating that body measurements can be used for selection and the estimation of body weight in the fields were accurate scales are not usually available. It is recommended that any of the body measurement parameters could be used in the estimation of the body weight. Also, an improvement of non-genetic factor such as nutrition and general husbandry of the animal will bring about improvement in the body parameters as well as maintaining the animal's physiological balance.

INTRODUCTION

The most populous and widely distributed breeds of cattle in Nigeria has been found to be the white Fulani cattle; many of which are reared under the transhumance farming system while a few belong to institutions and private farms (Dim *et al.*,2012). Subjective pricing of meat animal is seen to be prevalent in developing countries against the objective marketing of live animals in developed countries. This is due to the ease of acquisition and setting up of weigh instruments (Laden *et al.*, 2009).

Body weight is an important assessment index in animals but its measurement is usually not accurately ascertained in the rural areas due to lack of reasonable and accurate measuring scales Younas *et al.*, 2013. This therefore makes the rural farmers rely on systems and estimates that are open to doubt and ultimately leading to inaccurate decision making. Linear body measurements together with body weight measurements have been described by Salako (2006) to describe more completely an individual or population than the conventional methods of weighing and grading do.

Since young animals require milk as their first and only food owing to the fact that it contains important nutrients and is almost a complete food (Pandey & Voskuil, 2011), it therefore becomes pertinent to estimate the quantity of milk supplied to the young by the dam for optimal development until weaning, for the perfection of new management techniques which would ultimately lead to flock productivity improvement. This study therefore was designed to determine the correlation of milk intake and body weight with linear body measurements in white Fulani calves at different stages of growth as well as investigate the prediction of live weight using some linear measurement parameters in white Fulani calves.

MATERIALS AND METHODS

Location of the study and management of the experimental animals.

The experiment was conducted at the cattle unit of the Department of Animal Science Akwa Ibom State University, Obio Akpa, Akwa Ibom State. The area is situated between latitude 4°30'N and longitude 7°30'E (SLUK-AK, 1989). A total of seven (7) white Fulani calves were used for the study. The animals were managed under a semi-intensive system of animal husbandry at the cattle unit of the department of Animal Science, The animals were released for grazing from 9:00am to 4:00pm while the calves were restricted to their pens for the first 6 weeks and thereafter allowed to graze with the cows. The experimental animals were identified by ear tagging. The dam and the calves were put together and allowed to suckle for a period of 1hour in the morning. The calves were weighed before suckling and after suckling using "Weigh Suckle Weigh (WSW)'' method as adopted by Adewumi & Kazeem, 2010 and the

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difference between the weight before and after suckling gave the milk intake of each calf. The weight of each calf was taken with the aid of a spring balance. This procedure was repeated in the evening (10 hours later). The total of morning and evening weighing was the daily milk intake of each calf.

Milk Intake (kg) = weight after suckling (kg) – weight before suckling (kg).

Each of the calves selected for linear body measurements were confined during measurements. The body weight of the calves was taken in kilogram with the aid of a measuring scale. Seven metric traits were taken on individual calves with the aid of a flexible tailor's tape rule. Body measurement was taken in (cm) twice a week for 12 weeks as described by Younas *et al*. (2013). Reference points for the measurements were:

Neck Circumference (NC): This was measured as the distance round the neck.
Neck Length (NL): This is measured as the distance between the edges of the neck to the lower jaw region.
Body Circumference (BC): Circumference around the body.
Body Length (BL): The body of the cattle was measured from the joint of the scapular to the pin bone.
Girth Circumference (GC): The body circumference is immediately posterior of the front legs or the body circumference on the fore ribs.
Height at Wither (HW): it is the distance from the platform on which the animal stands to the point of its shoulders.
Tail Length (TL): The tail length was measured as the distance between the base of the tail close to the body of each calf and the tip of the tail.

Statistical analysis
The data that was collected was subjected to one way analysis of variance. Where F showed significant difference among the means, means were separated using Duncan's New Multiple Range Test (Duncan, 1995). Pearson Correlation was used to compare the relationship among the parameters. Regression analysis was used to obtain the best fit for body weight and linear body measurements.

RESULTS AND DISCUSSION

Table 1: Means±SEM of milk intake, body weight and linear body measurement as affected by lactation stages

Week	MI(g)	BW(kg)	NC(cm)	NL(cm)	BL(cm)	BC(cm)	GC(cm)	HW(cm)	TL(cm)
1	1.60±0.10[a]	6.88±0.91[a]	19.09±2.00	10.56±0.43[c]	25.60±0.87[c]	33.50±1.15[c]	32.94±0.86[cd]	32.80±1.32[c]	21.03±1.22
2	1.53±0.18[ab]	6.80±0.96[a]	19.99±2.14	11.11±0.44[c]	26.44±0.93[bc]	34.04±1.15[bc]	33.71±0.89[c]	33.49±1.41[bc]	21.67±1.22
3	1.44±0.14[ab]	6.69±1.01[a]	20.54±2.20	11.73±0.36[c]	27.09±0.92[abc]	34.89±1.06[abc]	34.30±0.87[bc]	34.10±1.43[bc]	22.19±1.20
4	1.53±0.13[ab]	6.53±1.03[a]	20.97±2.26	12.36±0.39[ab]	27.53±0.99[abc]	35.53±1.16[abc]	34.95±0.99[bc]	34.76±1.47[abc]	22.61±1.14
5	1.04±0.10[c]	4.31±0.69[ab]	21.14±2.38	12.79±0.46[ab]	27.97±1.01[ab]	36.20±1.32[ab]	35.33±1.19[abc]	35.36±1.50[abc]	23.10±1.29
6	1.21±0.11[bc]	4.26±0.93[ab]	21.33±2.42	13.14±0.43[ab]	28.44±1.05[ab]	36.40±1.55[ab]	35.56±1.24[abc]	35.80±1.48[abc]	23.44±1.24
7	1.20±0.10[bc]	4.19±1.35[ab]	21.53±2.45	13.57±0.40[ab]	28.80±1.06[ab]	36.91±1.65[ab]	35.97±1.21[ab]	36.19±1.49[abc]	23.69±1.25
8	0.94±0.05[c]	4.05±1.60[ba]	21.91±2.47	13.99±0.44[ab]	29.11±1.06[ab]	37.20±1.64[ab]	36.47±1.18[ab]	36.64±1.48[abc]	23.93±1.28
9	0.97±0.68[c]	4.33±1.21[ab]	22.34±2.51	14.36±0.48[ab]	29.40±1.06[ab]	37.49±1.63[ab]	36.93±1.17[ab]	37.30±1.36[ab]	24.17±1.30
10	0.97±0.68[c]	4.56±1.00[ab]	22.79±2.57	14.71±0.50[ab]	29.69±1.05[a]	37.86±1.58[a]	37.33±1.16[ab]	37.67±1.40[ab]	24.41±1.35
11	0.97±0.61[c]	4.68±0.98[ab]	23.26±2.66	15.11±0.55[a]	29.99±1.08[a]	38.27±1.56[a]	38.53±1.87[a]	38.00±1.43[a]	26.10±2.08
12	0.96±0.08[c]	4.89±0.59[ab]	23.59±2.70	15.36±0.59[a]	30.31±1.14[a]	38.67±1.58[a]	38.04±1.20[a]	38.35±1.45[a]	24.81±1.40
Overal	1.20±0.40	5.18±1.02	21.54±0.6	13.23±0.21	28.36±0.31	36.41±0.43	35.84±0.37	35.87±0.43	23.43±0.3

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l mean	6	9

[abcd] means with different superscript within columns are significantly different (P<0.05)
MI=milk intake, BW=body weight, NC=neck circumference, NL=neck length, BL=body length, BC=body circumference, GC=girth circumference, HW=height at wither, TL=tail length

Table 3: Pearson correlation of body weight and linear body measurements in white Fulani calves

	MI	BW	NC	NL	BL	BC	GC	HW	TL
MI	1	-0.203	0.285	-0.328	-0.170	-0.056	-0.112	-0.040	-0.023
BW		1	0.822**	0.877**	0.976**	0.938**	0.914**	0.952**	0.872**
NC			1	0.667**	0.835**	0.839**	0.805**	0.891**	0.813**
NL				1	0.803**	0.756**	0.755**	0.805**	0.748**
BL					1	0.928**	0.912**	0.954**	0.853**
BC						1	0.880**	0.892**	0.822**
GC							1	0.896**	0.888**
HW								1	0.926**
TL									1

**correlation coefficient is significantly high (P<0.05)
MI=milk intake, BW=body weight, NC=neck circumference, NL=neck length, BL=body length, BC=body circumference, GC=girth circumference, HW=height at wither, TL=tail length

Table 2: Estimate of variables in linear function for milk intake, body weight and linear body measurement parameters of white Fulani calves

Independent	Dependent	Equation	R	R^2	SEM
Milk intake	BW	Y=70.56-8.32x	0.58**	0.47	6.62
Milk intake	NC	Y=-15.83+4.77x	0.83**	0.69	5.85
Milk intake	NL	Y=-15.28+1.71x	0.75**	0.56	1.79
Milk intake	BL	Y=29.98-1.35x	0.82**	0.66	2.86
Milk intake	BC	Y=37.13-0.59x	0.85**	0.82	3.92
Milk intake	GC	Y=37.08-1.03x	0.96**	0.92	3.35
Milk intake	HW	Y=36.40-0.44x	0.95**	0.90	3.97
Milk intake	TL	Y=23.70-0.23x	0.83**	0.75	3.62

**correlation coefficient is significantly high (P<0.05)
MI=milk intake, BW=body weight, NC=neck circumference, NL=neck length, BL=body length, BC=body circumference, GC=girth circumference, HW=height at wither, TL=tail length

The overall mean±SEM value for MI, BW, NC, NL, BL, BC, GC, HW and TL were 1.20±0.40g, 5.18±1.02kg, 21.54±0.66cm, 13.23±0.21cm, 28.36±0.31cm, 36.41±0.43cm, 35.84±0.37cm, 35.87±0.43cm and 23.43±0.39cm respectively. There was no significant (P>0.05) effect of lactation on MI, TL and NC, however, there was significant (P<0.05) effect of lactation stage on NL, BL, BC, GC and HW. There was variability as the age of the animal increased most particularly in the weight gain. This result aligns with the report of Okon *et al.*, 2018 and Orthenuata & Olutogun (1994) who reported that linear body measurement is closely related to live weight in cattle. MI increased between the early stages of the animal's growth and thereafter decreased as lactation progressed but all linear body measurements increased as the animal advanced in age. However, weight gain decreased as lactation progressed. This increment agrees with the work of Adewumi & Kazeem, 2010 in yankasa lambs, Singh *et al.*, 1978 in grey and brown Bengal goats and Okon *et al.*, 2018 in bunaji calves. The mean weight gain value (5.18) as observed in this study was slightly similar to the value of (5.15kg) reported by Okon *et al.*, 2018 but lower than the value (3.25kg) reported By Afolayan *et al.*, 2006 in a research with yankasa lambs. The low mean weight value of the calves could be attributed to the small number of animals used for the experiment as well as the inability of the calves at their later growth stage to utilize nutrients from forages eaten as they went along with the cows to feed on pasture due to inadequate fermentative rumen microbes to breakdown the feed for nutrient supply. This agrees with the report of Adewumi & Kazeem, 2010 and Okon *et al.*, 2018.

Table 2 presents the coefficient of correlation between BW and LBM. Correlation between all body pairs of measurements were high, positive and highly significant (P<0.01, P<0.05). The highest correlation was recorded for BL, BC, GC and HW. This high correlation suggests that frame size and absolute height were complementary and that the total size of the animal is a function of length, height and circumference measurements. This result is in line with the findings of Adewumi & Kazeem (2010), Okon *et al*., 2018. Alade *et al*., 2008 and Cam et al., 2010 also reported high phenotypic correlation between BW and LBM in their research with goats and yarayaka sheep respectively. There was however a negative and non-significant (P>0.05) correlation between MI and LBM parameters with the highest correlation recorded between MI and NC (0.285). This agrees with the findings of Adewumi *et al*., 2006

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and Adewumi & Kazeem, 2010 in their research on lactating ewes and yankasa lambs respectively. This implies that as milk intake increases, LBM parameters tend to decrease though at a very slow rate. Milk intake was low but positively correlated with body weight (0.203).

Table 3 presents estimate of parameters in linear function fitted for milk intake, weight and linear body measurements. The implication of the above is that the equation could be used to predict body weight effectively and accurately. MI, NL and NC associated negatively but significantly ($P<0.05$) which implies that for every increment in milk intake, NC and NL tends to decrease though at a slow rate. This result agrees with the findings of Adewumi & Kazeem (2010) who reported a low NL and NC association with MI. Coefficient of determination R^2 values were high for all LBM indices assessed, with the highest R^2 value recorded for HW and GC. In this study, the equations show that BW as affected by MI is dependent on the growth of other component parts of white Fulani calves. This is in line with the findings of Alabi *et al*., 2012 in three indigenous chicken breeds who reported that body weight is highly dependent on the growth of its component parts.

CONCLUSION/RECOMMENDATION

From the findings, it can be concluded that milk intake increased between the early stages of the animal's growth and thereafter decreased as lactation progressed but all linear body measurements increased as the animal advanced in age. Correlation between all body pairs of measurements were high, positive and highly significant with the highest correlation recorded for BL, BC, GC and HW. Linear function provided the best fit for milk intake weight and linear body measurements indicating that body measurements can be used for selection and the estimation of body weight in the fields were accurate scales are not usually available. It is recommended that any of the body measurement parameters could be used in the estimation of the body weight. Also, an improvement of non-genetic factor such as nutrition and general husbandry of the animal will bring about improvement in the body parameters as well as maintaining the animal's physiological balance.

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