Original Article

Animal Science

Effect of Stall-Fed Management on Growth Performance of Pure and Crossbred Muturu Cattle

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ABSTRACT [ENGLISH/ANGLAIS]

Effect of Stall-fed management on growth performance of pure and crossbred Muturu cattle was conducted at Oshiri Muturu Cattle Breeding and Multiplication Centre Onicha Local Government Area, Ebonyi State, Nigeria. Thirty Six Muturu, Ndama and Muturu-N'dama crossbred calves were raised on field grazed and stall-fed management conditions for 24 months. The body weight and zoometric body measurement were determined from where the weight- gain, growth index, shape, depth and cow index were calculated. There were significant differences *($p < 0.05$)* in the body weight and weight gain among the pure and cross bred calves. The stall -fed management were superior to field grazed management among the pure and crossbred calves. There were also significant differences *($p < 0.05$)* in the shape index, growth index and cow index. These indices used for the feeding management of the calves were better on stall-fed management than field-grazed management.

Keywords: Purebred, crossbreed , Muturu cattle, productivity, performance, growth

RÉSUMÉ [FRANÇAIS/FRENCH]

Effet de la stabulation de gestion sur les performances de croissance des bovins Muturu pure et croisés a été menée au bétail Muturu Oshiri sélection et de multiplication du Centre Onicha zone de gouvernement local, l'Etat d'Ebonyi au Nigeria. Trente six veaux Muturu, Ndama et Muturu N'dama croisés-ont été soulevées sur le champ pâturé et les conditions de gestion stabulation pour 24 mois. Le poids du corps et de mesure du corps ont été déterminés à partir zoometric où l'indice de gain de poids, indice de croissance, la forme, la profondeur et la vache ont été calculés. Il y avait des différences significatives (p <0,05) dans le gain de poids corporel et le poids chez les veaux pure et croisée élevés. La gestion de stabulation ont été supérieures à la gestion des champs pâturés parmi les veaux purs et croisés. Il y avait également des différences significatives (p <0,05) dans l'indice de forme indice de croissance, et l'indice de vache. Ces indices utilisés pour la gestion de l'alimentation des veaux ont été mieux sur stabulation gestion que sur le terrain pâturées gestion.

Mots-clés: Pure race, de croisement, Muturu bétail, la productivité, la performance, la croissance

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INTRODUCTION

It is becoming increasingly difficult to provide enough plant materials for the ruminant animals because of pressure created by industrialization and urbanization that reduced the available grazing land for the ruminant animals [1, 2, 3]. Over the years various feeding systems such as nomadic system, sedentary pastoral farming, etc, have been adopted in an attempt to solve the feeding problems of ruminant animals [4]. However, none of these systems has achieved the desired result without serious socio-cultural consequences [4, 5]

For instance, reports have shown that cattle production under the nomadic system is prone to hazards, which militate against the livestock productivity. Cattle and their herdsmen are constantly faced with hazardous situation that hardly gives room for optimal livestock productivity under the nomadic system [6]. Furthermore, some scholars have argued that the productivity of ruminant animals could be adversely affected in any tropical environments during the dry season unless the forage materials are supplemented with other sources of feeding materials such as crop residue and other agro-industrial by-products [6, 7].

Stall-fed management system has been however adopted to enhance the feeding management and also to solve the problem of huge financial involvement and large expanse of land needed in pasture establishment and grazing land [5, 7]. Silage, hay and leaves from forage

trees have been made available especially in many arid regions of the tropics during the dry seasons for stall-feeding of ruminant animals. However some researchers have argued that apart from the fact that the system is labour and financially intensive, the welfare of the livestock in terms of free grazing and movement are highly jeopardized [5, 7, 8]. This is why the overall impact of stall-feeding and field grazing has to be assessed in order to confront the challenges of feeding ruminant animals in Nigeria. Furthermore, information about the productivity of some indigenous breeds in Nigeria such as Muturu, are scarce due to huge financial outlay, long breeding cycle and small herd unit of these cattle [6] . This situation usually creates a false idea and poor assessment of these animals. A study like this will help in an attempt to address the above problems.

MATERIALS AND METHODS

Experimental Site

The study was conducted at Oshiri Muturu Cattle Breeding and Multiplication Center in Ebonyi State, Nigeria located between latitude18°05' and 08°20'E and longitude 06°40' and 0645'N and within humid tropical climate. The study was conducted within two basic seasons namely rainy season and dry season. The dry season was always accompanied with a low humidity and high temperature while the rainy season had high relative humidity and rain fall. These seasons affect the vegetation of Ebonyi State which has mainly the common forages of legumes and grasses. The forages flourish during early rainy season while there is heavy scarcity during late dry season. A space of 4.5m² was provided for each animal where feed and water bunks were provided.

Experimental Animals

Thirty six calves at two weeks old consisting of twelve Muturu, Ndama and Crossbred calves of an average adjusted weight of 15.20kg each were provided for the experiment. The experiment was 3 x 2 factorial design involving three breeds of cattle on two feeding regimes. Each treatment consisted of three replicates with four calves per a replicate.

Experimental Procedure

The stall-feeding system was done as recommended for the intensive cattle management [10]. Calves were bucket-fed with supplemented feeding of hay, silage and cereal concentrate for the first six months while those on field grazed condition were bucket-fed with supplemental grazing (9.00am – 11noon and 3 – 5p.m, daily) for the first six months which were the pre-weaning period. During the post weaning period which was 6 – 24 months the animals were raised under normal grazing for field grazed animal and feeding of concentrate, silage/hay for stall-fed animals.

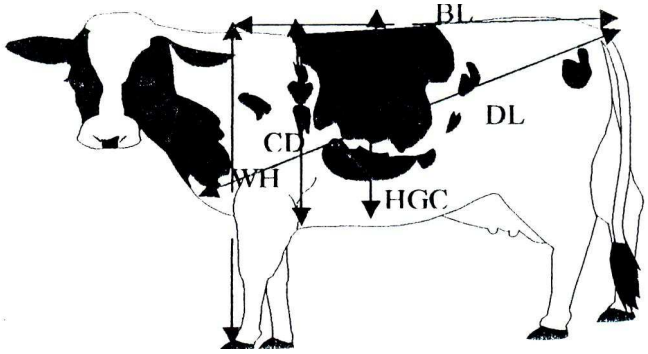
Linear Measurements

The linear measurements were obtained using instruments such as measuring tape – to determine heart girth, and hip girth circumference; measuring rod – to measure length at diagonal, body length, height at hip and height at withers. Table 1 shows the description of the linear measurements recorded during the experiment while figure 1 represents the descriptive structure of the animal.

Table 1: This table shows linear Measurements of Experimental animals.

Measurement (cm)	Measuring Technique	Measuring Instrument
Withers height (WH)	From the withers or shoulder rise (peak point) to the ground	Measuring rod
Diagonal length (DL)	From the point of shoulder to the pin bones (outside)	Measuring rod
Body length (BL)	From rump to withers	Measuring rod
Diagonals length (DL)	From withers to button brisket surface, just behind the elbow	Measuring rod
Heart girth circumference (HGF)	Just behind shoulder	Measuring tape

Figure 1: This figure shows descriptive structure of the Experimental Animal



Key BL = Body Length
WH = Withers height
CD = HGC/ π
CD = Chest depth
DL = Diagonal length

The daily weight gain was calculated using the expression below.

$$V = \frac{WT - Wo}{\Delta t} \quad [11]$$

Where V = daily wt gain
Wo = Initial weight of the calve at the beginning of the present month
WT = weight of the calves at the end of the previous month
Δt = Number of days taken for the weighing to occur.

Indices of Productivity

Growth Index (GI)

This was calculated as the ratio of weight gain and the body weight of the calves and expressed in percent

$$GI = \frac{W_T - W_o}{W_T} \times 100$$

Shape Index (SI)

This was calculated as the ratio of height at withers (HW) to diagonal length (DL) to and expressed in percentage as

$$SI = \frac{HW}{DL} \times \frac{100}{1} \quad [11]$$

Depth Index (DI)

This was calculated as the ratio between the chest depth (CD) and height at withers (WH) express in percent. The chest depth (CD) can be calculated apart from direct measurement. This can be obtained from the equation below as:

$$CD = \frac{HGC}{\pi}$$

$$DI = \frac{CD}{WH} \rightarrow \frac{HGC}{\pi WH} \times \frac{100}{1}$$

Where HGC = heart girth circumference
π = constant 22/7
DI = 7 HGC/22WH

Cow Index (CI)

This was calculated as the difference between the natural logarithm of cow weight and the natural logarithm of calf's weight at one-year period.

$$CI = W_{TCV}/W_{TCW} \times 100$$

Where CI = cow index; W_{TCW} = cow body weight; W_{TCV} = calf body weight at one year

Statistical Analysis

The statistical analysis used for the experiment was least square analysis [1] with a linear model shown as follows:

$$Y_{ijk} = M_u + A_i + B_j + AB_{ij}$$

Where Y_{ijk} = Observation made on i^{th} genotype and j^{th} feeding regimes
M_u = effect common to all the cattle
A_i = effect of i^{th} genotype, i = 1 – 3
B_j = effect of j^{th} feeding regimes j = 1 x 2
AB_{ij} = random error

RESULTS

Table 2 shows the mean calve weights for twenty four months feeding period. There were significant differences ($p < 0.05$) among the calves' body weights. The calves on stall-fed management condition were higher in body weights than those on field-grazed management condition. Muturu calves under stall-fed management had body weight 57kg, 93kg and 191kg at 6, 12 and 24 months respectively as against field-grazed calves that had 37.00kg, 78kg and 134.57kg for 6, 12 and 24 months respectively. Similar higher weights were observed among N'dama and crossbred calves under stall- fed management condition for 6, 12 and 24 months experimental period.

Table 3 shows the body weight gain during pre-weaning and post weaning period. There were significant differences ($p < 0.05$) among the calves under the feeding regimes for both pre and post weaning period. Muturu calves under the stall-fed management had higher body weight gain (0.26 and 0.25kg pre and post weaning weight gain as against 0.24 and 0.18kg pre and post weaning weight). N'dama breed had the highest pre and post weaning weight gain (0.33 and 0.28kg for pre and post weighing weight respectively. Also the crossbred calves were better under stall-fed condition (0.35 and 0.27kg pre and post weaning weight respectively) than field-grazed management condition (0.33 and 0.25kg pre and post weaning weight respectively.

Table 4 shows the depth index of the calves under the two feeding management conditions. There were significant differences *($p < 0.05$)* in the depth index of calves under the two feeling management conditions. Muturu calves under stall-fed management had better depth index of 42.13, 68.96 and 65.32% as against field grazed calves that had 32.36, 31.69, 25.95 and 24.35%) for 6, 12, 18 and 24 month of rearing respectively. Similar higher depth index were observed among the Ndama and Cross bred calves under stall fed condition than the

field -grazed condition for the 24 months of rearing of the calves.

Table 5 shows the shape index of the calves under the two feeding management condition. There were significances different *($p < 0.05$)* among the shape index of calves under the two feeding management condition. The shape index of Muturu calves were not significantly affected by stall-fed management condition but N'dama and crossbred calves had higher shape index (N'dama 73.87% as against 67.33% for 6 months, cross bred, 64.09 as against 67.53% for 6 months, crossbred, 64.09 as against 59.27% for 2 months).

Table 2: This table shows body weight of Crossbreeding on N'Dama and Muturu Calves under the two feeding

Months	Breed	Field Grazed	Stall-Fed
	N'Dama	70.99 ± 7.86^{d}	75.97 ± 5.06^{d}
6 Months	Muturu	37.00 ± 13.23^{a}	57.03 ± 4.84^{b}
	Crossbred	68.35 ± 3.61^{c}	73.40 ± 9.45^{d}
	N'Dama	97.03 ± 17.60^{b}	115.26 ± 14.73^{b}
12 Months	Muturu	78.30 ± 15.20^{a}	93.24 ± 14.73^{b}
	Crossbred	110.60 ± 6.22^{bc}	116.20 ± 11.7^{c}
	N'Dama	190.05 ± 17.2^{5b}	225.50 ± 8.78^{c}
24 Months	Muturu	134.57 ± 10.7^{2a}	191.37 ±17.11^{b}
	Crossbred	172.90 ± 7.11^{ab}	219.12 ± 7.47^{c}

Means S.E within the same row or within the same column with different superscripts are significantly different ($p < 0.05$)

Table 3: This table shows Daily Weight Gain of Muturu, Ndama and Crossbred Calves Under the two feeding systems.

Breed	Stage of Growth	Field grazed (kg)	Stall-fed (kg)
N'Dama	Pre weaning	0.27 ± 0.02^{b}	0.33 ± 0.05^{c}
	Post weaning	0.22 ± 0.02^{a}	0.28 ± 0.05^{b}
Muturu	Pre weaning	0.24 ± 0.02^{b}	0.26 ± 0.03^{b}
	Post weaning	0.18 ± 0.02^{a}	0.25 ± 0.02^{b}
Crossbred	Pre weaning	0.33 ± 0.01^{c}	0.35 ± 0.02^{d}
	Post weaning	0.25 ± 0.02^{b}	0.27 ± 0.1^{a}

Means S.E within the same row or within the same column with different superscripts are significantly different ($p < 0.05$)

Table 6 shows the growth index of calves under the two feeding condition. There were significant differences in the growth index of calves and in the feeding conditions. Stall-fed management had a better growth index than field geared management condition.

The calves under stall-fed management condition were better that field grazed condition and continued to reduce in growth index as the rearing period progressed from 6 months to 24 months.

Table 4: This table shows the Depth Index of Muturu, Nadama and Crossbred Calves Under the two Feeding Systems

Months	Breed	Field grazed	Stall-fed
6 Months:	N'Dama	52.12 ± 4.31^{b}	52.12 ± 2.45^{b}
	Muturu	32.36 ± 10.15^{a}	42.13 ± 12.40^{a}
	Crossbred	51.83 ± 8.10^{b}	51.83 ± 10.31^{b}
12 Months:	N'Dama	58.37 ± 7.10b	73.58 ± 10.35^{c}
	Muturu	31.69 ± 10.15^{a}	68.96 ± 2.50b^{c}
	Crossbred	60.10 ± 7.15^{b}	61.22 ± 8.20^{b}
18 Months:	N'Dama	69.50 ± 8.76^{c}	69.94 ± 11.00^{c}
	Muturu	25.95 ± 16.25^{a}	69.73 ± 5.2^{c}
	Crossbred	54.83 ± 3.50^{b}	58.8. ± 6.2^{b}
24 Months:	N'Dama	54.36 ± 0.30^{b}	53.37 ± 12.16^{b}
	Muturu	24.35 ± 19.10^{a}	65.32 ± 3.20^{c}
	Crossbreed	55.12 ± 4.20^{b}	59 ± 3.60b^{c}

Means ± S.E. within the same column or within the same row with different superscripts are significantly different ($p < 0.05$)

Table 5: This table shows the Shape Index of Muturu Ndama and Crossbred Calves under the two feeding systems

Months	Breed	Field grazed (%)	Stall-fed (%)
	N'Dama	67.57 ± 3.88^{ab}	73.87 ± 4.10^{b}
6 Months:	Muturu	65.08 ± 3.25^{a}	65.40 ± 3.10^{a}
	Crossbred	65.66 ± 4.15^{b}	69.36 ± 4.20^{b}
	N'Dama	63.30 ± 3.49^{b}	63.40 ± 3.00^{b}
12 Months:	Muturu	60.45 ± 4.81^{b}	57.00 ± 4.12^{b}
	Crossbred	59.27 ± 5.33^{a}	64.09 ± 4.31^{b}
	N'Dama	63.90 ± 3.35^{a}	65.00 ± 4.81^{b}
18 Months:	Muturu	61.29 ± 5.32^{a}	63.60 ± 3.32^{a}
	Crossbred	69.29 ± 2.60^{b}	63.93 ± 2.72^{a}
	N'Dama	75.92 ± 5.3^{c}	76.67 ± 3.40^{b}
24 Months	Muturu	61.22 ± 4.30^{a}	61.19 ± 4.50^{a}
	Crossbred	71.06 ± 2.44^{b}	75.53 ± 4.25^{b}

Means ± S.E. within the same column or within the same row with different superscripts are significantly different ($p < 0.05$)

Table 7 shows the cow-calf index of calves under the two feeding regimes. There were no significant differences *($p < 0.05$)* among the calves under the two feeding regimes. However, Muturu cattle under stall-fed management were marginally higher (29.48%) than field grazed

(28.48%). Similar observations were made with N'dama and Crossbred cattle.

Table 6: This table shows the Growth Index of Muturu, Ndama and Crossbred Calves under the two feeding systems

Months	Breed	Field grazed	Stall fed
6 Months:	N'Dama	47.00 ± 2.00[a]	49.14 ± 3.10[a]
	Muturu	43.83 ± 1.21[a]	48.89 ± 3.20[a]
	Crossbred	46.83 ± 2.10	45.69 ± 3.25[a]
12 Months:	N'Dama	26.84 ± 6.20[a]	40.39 ± 5.20[b]
	Muturu	37.68 ± 4.25[b]	44.35 ± 6.00[c]
	Crossbred	30.88 ± 5.20[b]	46.81 ± 5.20[b]
18 Months:	N'Dama	37.75 ± 8.20[c]	47.70 ± 10.25[c]
	Muturu	37.56 ± 3.0[c]	41.86 ± 3.52[c]
	Crossbred	30.88 ± 2.10[c]	46.28 ± 3.20[c]
24 Months:	N'Dama	18.00 ± 3.0[b]	26.82 ± 3.20[c]
	Muturu	6.81 ± 12.09[c]	16.66 ± 2.0[d]
	Crossbred	7.46 ± 10.12[a]	14.56 ± 10.01[c]

Mean ± S.E within the same column or within the same row with different superscripts are significantly different (p<0.05)

Table 7: This table shows the Cow Index Muturu Ndama and Crossbred Calves under the two feeding systems

Breed	Field grazed (%) ± SE	Stall-fed X (%) ± SE
N'Dama	18.51 ± 0.83[a]	19.88 ±0.64[a]
Muturu	28.48 ± 0.76[b]	29.48 ± 0.76[ab]
Crossbred	37.07 ± 1.36[c]	39.45 ± 1.82[c]

Mean ± S.E within the same column or row with different superscript are significantly different (p<0.05)

DISCUSSION

Growth pattern of cattle like any other farm animals are function genotype as well as environment and age of animals [10]. This is indicated in table 2 where the weights of calves increased as the age of calve progressed from 6 months to 24 months, according to species and feeding regimes. The Ndama calves with 75.96kg at 6months were the highest among the breed of cattle. Muturu calves weighed 75.03kg under stall-fed compared to 37.00kg under field-grazed management; showing that stall-fed was better than field-grazed feeding management of Muturu Cattle. The low body size of Muturu Cattle under range grazing has been a trend of most ruminant farm animals found in rainforest regions of Nigeria [10]. Increase in weight of Muturu cattle from 134.57kg under field grazing to 191.37 under stall fed management was an improvement in the body size of the cattle.

It was observed that improvement has been made toward increasing the body weight gain of Muturu, Ndama and Crossbred calves through stall-feeding management (table 3). Field grazing management system affects cattle productivity in Nigeria because of the climate changes in Nigerian environment which has serious effects on cattle directly and indirectly [11]. In dry seasons, cattle trek a long distance in search of feed and water that is usually scarce to satisfy their nutritional need [12]. Also during rainy season, animal suffer from many diseases available during this period [13]. Even though there is abundance of forages in the rangeland grazing during rainy season, such forages lignified as the forages grow old and flower [14]. The high moisture associated to the forages during this period make the animal not to satisfy their nutritional need [15]. It has been reported that most tropical forages species are deficient of some essential nutrients as the forage grow older and so can not meet up the need of most ruminant animals under rangeland grazing and needed their diets to be supplemented [15].

The results indicated a significant *($p < 0.05$)* difference in the depth index which is a useful instrument of judging beef cattle [16]. The scoring of depth index is an important parameter in determining the carcass yield. The result has shown that depth index can be improved through stall-feeding management. It was also observed that depth index of Muturu increased more with stall-fed than field-grazed management (42.13% as against 32.36% in 6 months; 68.96% as against 31.69% in 12 months and 69.73% as against 25.95% in 18 months and 65.32% as against 24.35% in 24 months.

The result on shape index was significantly influenced *($p < 0.05$)* by breed age and feeding system of the animals. The shape index decrease with age and field grazed management. The reason for this could be due to marginal body weight gain obtained as the cattle grow older. The energy used during trekking on field grazing system could result to wasting away of tissues which account for the low weight gain among the calves in the field grazed management as shown in the table 5. The scoring of shape index is a useful parameter for estimating the carcass yielding as it has been shown that it is positively correlated to carcass yield [12].

There was significant difference in growth index of calves *($p < 0.05$)*, with stall-fed management being superior to field grazed management as shown in table 6.

The growth index of calves which can be defined as the average live weight gain of calf per unit kilogram weight of cow is an important productivity index measurement. The result shows that field grazed Muturu, Ndama and cross bred calves had growth index not exceeding 50%, which was considered to be low [13]. The low growth index among Muturu cattle under field grazing is a major problem associated to field grazing management of most breed of cattle under tropical range grazing [13]. The wide variation of available forage resources during dry and rainy seasons for grazing of ruminant animals had been attributed to this low growth index of farm animal in the rain forest region of tropical climate [13].

There are several interacting parameters which determine the cattle herd performance, among which is the cow-calf index that gives the precise information of the herd in short term basis. This result has shown that the cow index of Muturu, N'dama and crossbred calves were below 40% (Table 5); indicating a low cattle productivity that needed an urgent enhancement. Stall-fed management appeared to solve this problem of improve cattle productivity of Nigerian breed. It also suggests that the productivity of Muturu breed needed to be improved through genetic and environmental management. Cross breeding and sound nutritional management, among which is stall-feeding management would give positive result in this direction; as observed in cross bred stall-fed calves that had 39.45% as against 18.57% field grazed Ndama calves.

CONCLUSION

Stall-fed management improved the growth performance of Muturu calves and could be adopted among other strategies to improve the productivity of Muturu cattle found in South East of Nigeria.

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CONFLICT OF INTEREST

No conflict of interests was declared by authors.