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Effect of sex and age on post weaning growth performance of Sokoto Gudali weaner calves

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Target Audience: *Livestock farmers, researchers, students and Animal scientists*

Abstract

The effects of sex and age on post weaning at different ages were investigated. Eighteen male and 18 female Sokoto Gudali calves were either weaned at 6 (n = 18) or 7 (n = 18) months of age. Vocalization activity and some behaviours (feeding, lying and walking / standing) were observed during the first 3 days following weaning. Body weight was recorded at 6 and 7 months and 2 weeks following weaning. Calves weaned at 6 months vocalized more often than calves weaned at 7 months and the females calves vocalised more than males on the first day (P < 0.05). The vocalization activity decreased at a higher rate in calves weaned at 7 months than in calves weaned at 6 from days 1 to 3. On day 2, calves weaned at 6 months spent less time lying and more walking / standing than calves weaned at 7 months (P < 0.05). Behaviours did not differ between males and females. Average daily gain after weaning did not differ between weaning ages (P > 0.05), but calves weaned at 7 months gained more from 6 to 7 months of age. In conclusion, weaning distress was more pronounced in calves weaned at 6 months than in calves weaned at 7 months. Calves weaned at 7 months also had a superior growth performance during 6 to 7 months of age. Form then results obtained in this study; it has been concluded that the effect of the calves' sex was less pronounced. It is recommended to wean beef calves later than 6 months.

Key words: *calves, growth performance, vocalization, weaning, age.*

Description of Problem

Weaning in beef cattle herds is a very demanding practice for the calves and the cows. Non-natural weaning at early calf ages is an effective management technique to decrease the lactational pressure to increase the reproductive performance of cows (1; 2). Additionally, the decision on the weaning age might be also based on other criteria. By weaning at younger age, the carrying capacity on the pasture can be improved and the cost of feeding abridged. Consequently, weaning is usually done at earlier age than when it occurs under natural conditions, which is characterised by a slow decrease of milk and increase of solid feed intake and a change in the relationship between the calf and the mother which shows the increasing social independence of the calf from its dam (3). Nevertheless, the cows must be able to rear their calves to a sufficient weaning weight. When calves are weaned, they surprisingly get unprotected to a new physical and social environment and food supply (3). The most frequently practical behavioural changes after weaning are vocalization, nervousness, increased intensity of walking and decreased feed intake and rumination which negatively affect performance (4; 5). In addition, weaning leads to a suppressed immune system and enhanced disease susceptibility (6; 7).

Although the effects of different weaning methods on various behavioural parameters and growth performance were evaluated previously, studies assessing the effects of sex and weaning age in combination are rarely found in the literature. For example, Kohari *et al*. (8) found high vocalization activities on days 1 and 2 after weaning of calves. At the Beef Research Programme (BRP) of the National Animal Production Research Institute (NAPRI), a semi-intensive production system is being practiced. Hence weaning of calves is carried out between the ages of 6 and 7 months. Weaning calves at younger age is detrimental under these conditions as they do better when they are raised together with their dams, while weaning older calves does not benefit the performance of the calves thereby encourages excessive lactational anxiety for the dams. The present study was therefore conducted to investigate the effect of weaning by unexpected separation in male and female Sokoto Gudali calves of the Beef Research Programme weaned at 6 or 7 months of age.

Materials and Methods

Study site

The study was conducted at the Beef Research Station in Talata Mafara, Zamfara State. Talata Mafara is located in the north – western part of Zamfara State. The climate of the area is variably hot, having November-April as dry season, March-April as hottest months, while May-October is the rainy season with August recording the highest amount of rainfall. The average rainfall is about 182mm per animal with a temperature is between November to March. However, the area also experiences a period of harmattan from month of December to February.

A total of 36 Sokoto Gudali calves (18 males and 18 females) of the beef cattle herd managed at the experimental farm were used. The trial was conducted for a period of 4 months. The calves were born in June or July, 2020.

Animals, Management and Weaning procedure

A 2×2 factorial design was conducted to determine the effects of weaning age and sex on the behavioural stress response and performance of the calves after weaning. The calves were either weaned at 6 months (group M6; $n = 18$) or 7 months of age (group M7; $n = 18$). For each treatment 9 male and 9 female calves were observed. Six months old calves were weaned at 184 ± 3 days of age with an average body weight (BW) of 130 ± 5 kg, and seven months old calves at 214 ± 3 days of age and 155 ± 5 kg. All calves were weaned on the same day.

Five days to the weaning, the cows and their calves were moved close to the waning pen where the calves got familiarized to each other. In the morning of the day of weaning, the calves were weighed and separated from their dams and further moved to the experimental unit where visual or physical contact between them and their dams was not possible. The calves were separated into male and female calf groups adjacent to each other. The concentrate feed consisted of a maize offal (60 %), cottonseed cake (39 %) and table salt (1 %)) Tables 1 and 2 while Digitaria smutsii hay served as the roughage a n d was fed *ad libitum*. The concentrate was offered in troughs per pen first around 9:00 hours and the hay around 12:00 hours after the calves had finished the concentrate. Water supply was provided in self-watering cut-drum with one cut-drum being installed per pen.

Table 1: Chemical composition (%) of *Digitaria smutsii* hay, maize offal, and cotton seed cake

	Ingredients		
Nutrients%	D. *Smutsii*	Maize offal	Cottonseed cake
Dry Matter	92.72	91.92	92.99
Organic matter	83.90	81.87	88.01
Crude protein	5.86	14.31	30.88
Ether Extract	4.05	8.03	11.05
Crude Fibre	41.09	31.21	37.23
Neutral Detergent Fibre	68.89	53.92	50.21
Acid Detergent Fibre	42.35	34.99	42.35
Ash	8.82	10.05	4.98
ME (MJ/kg DM)	11.03	10.88	11.51

The ME values of the experimental feed ingredients were calculated as per Alderman *et al.* (1985) as follows: ME= (MJ/kg DM) 11.78+0.00654CP+ (0.000665EE) 2 – CF (0.00414EE) -0.0118A Where DM=Dry Matter, CP = Crude Protein, EE = Ether extract, CF = Crude Fibre, A= Ash

Table 2: Ingredients and chemical composition (%) of concentrate Diet

Parameters	(%)
Ingredients	
Maize offal	60
Cottonseed cake	39
Table salt	1
Chemical composition	
Dry matter	92.37
Organic matter	80.82
Crude protein	19.63
Ether Extract	10.01
Crude fibre	27.40
Acid detergent fibre	35.95
Neutral detergent fibre	51.27
Ash	11.55
ME (MJ/kg DM)	10.52

The ME values of the experimental feed ingredients were calculated as per Alderman *et al.* (1985) as follows: ME= (MJ/kg DM) 11.78+0.00654CP+ $(0.000665EE)^2$ – CF (0.00414EE) -0.0118A Where DM=Dry Matter, CP = Crude Protein, EE = Ether extract, CF = Crude Fibre, A= Ash

Vocalization and behavioural observations

Direct observations were performed to determine the calves' behaviour and vocalization on days 1 to 3 after weaning. The animals were observed for a total duration of 5 h per day consisting of hourly observation periods (08.00–09.00, 10.00–11.00, 12.00–13.00, 14.00–15.00 and 16.00–17.00 hours). For each group, five people were used to count the total number of vocalizations of group (male M6, female M6, male M7 and female M7). Observations were performed alternately between the male and female groups. For each group there was a total observation period of 30 min per hour and 150 min per day, respectively. For comparability reasons the counts of two consecutive 5-min periods were summarized

and the number of vocalizations per calf in a 10-min period was calculated.

The behaviours of calves were classified as feeding, lying and standing/walking. There was no difference between standing without movement and walking of the calves. Feeding was determined as the calf were standing inside the feeding area according to Putnam *et al*. (9), who observed that 94 to 97% of the time spent at the feeder was spent feeding. In each group, the number of calves belonging to each of these types of behaviour was counted at the distinct sample points and the percentage of calves per group was calculated.

Growth performance

Individual BW of all animals was recorded at 6 and 7 months of age and fortnightly after weaning throughout the period of the experiment which lasted for three months. The total weight gain was obtained by subtracting the initial weight from the final weight. This was further used to calculate the average daily gain (ADG) which was calculated by dividing the total weight gained by the number of days the animals were on experiment.

Statistical analysis

General Linear Model procedure (PROC GLM) of Statistical Analysis System (10) according to the following statistical model: For the analysis of the group recorded data (vocalization and behavioural parameters) the GLIMMIX procedure was used with a model including year (1, 2), weaning age (W6, W7), sex (male, female) and day after weaning (days 1, 2 and 3) as fixed main effects. Vocalization activity was analyzed considering the following model: $Yi_{jkl} = \mu + M_i + S_j + D_k + M_i \times S_j + M_i \times D_k + S_j \times D_k$

where y_{ijklm} = the m^{th} observation; μ = overall mean; M_j = fixed effect of weaning age (j = M6, M7); S_k = fixed effect of sex (k = male, female); D_l = fixed effect of day after weaning (l = days 1, 2 and 3); $M_j \times S_k$ = interaction between weaning age and sex; $M_j \times D_l$ = interaction between weaning age and day after weaning; $S_k \times D_l$ = interaction between sex and day after weaning; and e_{ijkl} = random residual.

For the analysis of the growth performance data (BW and ADG) the model included the effects of weaning age (M6, M7) and sex (male, female) as fixed main effects and additionally the significant 2-way interactions between these effects. For the performance data the individual calf served as the experimental unit. The following model was fitted for BW, ADG at 6 and 7 months of age, and ADG: $Y_{ijkl} = \mu + M_j + S_k + M_j \times S_k + e_{ijkl}$

where y_{ijkl} = the l^{th} observation; μ = overall mean; M_j = fixed effect of weaning age (j = M6, M7); S_k = fixed effect of sex (k = male, female); $M_j \times Sk$ = interaction between weaning age and sex and e_{ijkl} = random residual.

Results and Discussion

Behaviour

Given as the number of calls within the 10-min observation intervals, the vocalization activity of calves weaned at 6 months was greater ($P < 0.05$) than of calves weaned at 7 calves (7.37 vs. 4.29). Compared to females, males performed a higher ($P < 0.05$) number of vocalizations (6.39 vs. 5.27). Number of vocalizations was significantly ($P < 0.05$) different between the days after weaning and decreased from day 1 to 3 - 10.33, 5.43 and 1.73, respectively. The interactions between weaning age and day and sex and day were significantly ($P < 0.05$) different as presented in Table **3**. The number of vocalizations decreased

substantially during the first 3 days after weaning regardless of the weaning age or the sex. But calves weaned at 6 months were observed with a higher number of calls than those weaned at 7 months.in all 3 days. Regarding the sex, female calves vocalized more often than male calves on day 1 ($P < 0.05$), whereas no significant ($P > 0.05$) difference between sexes was found on days 2 and 3.

Table 3: Vocalizations of calves (calls/10 min) after three days in relation to the weaning age and sex of calves

Effect	Day after weaning			SEM
	1	2	3	
Weaning age				
Six months	12.57Aa	7.20Ab	2.35Ac	0.40
Seven months	8.08Ba	3.67Bb	1.12Bc	0.40
Sex				
Male	9.05Aa	5.00b	1.77c	0.40
Female	11.60Ba	5.87b	1.70c	0.40

A,B Means with different upper-case superscripts within each parameter are significantly different (P?<?0.05) between weaning age and sex. a,b,c Means with different lower-case superscripts within each parameter are significantly different (P?<?0.05) between days., Standard error of means (SEM)

With regard to the behavioural parameters presented in Table 4, significant ($P > 0.05$) differences between male and female calves were neither found for feeding (17.8 vs 15.6%) nor for lying (41.2 vs. 41.7%) and standing/walking (41.1 vs. 42.7%). In Table 2, the weaning age × day interaction significantly ($P < 0.05$) affected lying and standing/walking. While on days 1 and 3 neither the time spent lying nor standing/walking was affected by the weaning age. Calves weaned at six months spent less time lying and more standing/walking than M7 calves on day 2. In M6 calves, the duration of lying increased and standing/walking decreased significantly ($P < 0.05$) from days 1 to 3, whereas the most pronounced increase in lying duration and decrease in standing/walking duration was recorded from days 2 to 3. Contrarily, calves weaned at 7 months showed the highest increase in lying duration from day 1 to 2.

Table 4: Effect of weaning age on the time spent lying, standing/walking and feeding (% of the observation period) of calves weaned at 6 ($n = 18$) or 7 months ($n = 18$)

Behaviour	Weaning age	Day after weaning			SEM
		1	2	3	
Lying	Six months	24.1^{a}	36.3^{Ab}	57.0^{c}	2.56
	Seven months	20.6^{a}	53.1^{Bb}	57.7^{b}	2.56
Standing/Walking	Six months	61.3^{a}	45.4^{Ab}	27.4^{c}	2.11
	Seven months	61.2^{a}	31.1^{Bb}	25.0^{c}	2.11
Feeding	Six months	14.6	18.3	15.6	1.79
	Seven months	18.2	15.8	17.3	1.79

^{ab} Means with different upper-case superscripts are significantly different ($P < 0.05$) between weaning ages. ^{abc} Means with different lower-case superscripts are significantly different ($P < 0.05$) between days, Standard error of means (SEM).

Independent of the weaning age, weaning caused distress in the calves, expressed in vocalization, behavioural changes and decreased weight gains. The extensive vocalization activity during the first 3 days after weaning emphasizes the suitability of this welfare indicator (11). Assuming the high correlation between the number of calls given by individual cows and their own calves (11), weaning also affected the cows. Within the first 3 days the calves seemed to get accustomed to their new social and physical environment after separation from their mothers. Nevertheless, calves weaned at 7 months showed a lower vocalization activity and the number of calls decreased by more than half from day 1 to 2, and hence by a much higher rate than those weaned at 6 months. On the one hand the older weaned calves were able to intensify their maternal bond, which consequently might have evoked a higher number of calls. Thus, the last-mentioned factor is assumed to be the major factor that resulted in the lower vocalization activity of calves weaned at 7 months.

The present finding that the vocalization activity decreased to pre-weaning levels regardless of the weaning age and sex is consistent with other previous studies. Smith *et al*. (12), weaned calves at 4 and 7 months of age and calves of both groups showed a similar decrease of the vocalization activity during the first 3 days. Although in opposition to our study, the younger calves were not observed with a higher vocalization activity than the older calves on any of the post-weaning days. Well in agreement, Kohari *et al*. (8) found the highest vocalization activity on days 1 and 2 after separation. Weaned at about 6 months of age, calves in the study of Haley *et al*. (**5**) called more than 40 times per hour on days 2 and 3 after weaning. In calves weaned already at 70 days of age the vocalization activity increased dramatically and, as observed here, within 2 days it decreased nearly to pre-weaning levels (13). In lambs also, the number of calls decreased continuously within the first 3 days of weaning to zero (14).

Regarding the sex, female calves vocalized more frequently than male calves on day 1 of weaning, indicating that females suffered slightly more from weaning stress than males. The finding of Veissier *et al*. (15) that female yearlings were in closer proximity to their dams than males support the fact that the stress responses are more pronounced in female calves.

The fact that feeding was neither influenced by age nor sex of the calves can be mainly explained by the nutritional status of the calves. In intensive beef production systems, the calves are well nourished and prepared for the nutritional change from milk to solid feed. This was also pointed out in a grazing trial by Kohari *et al*. (8) which did not indicate that grazing time can be used as a reliable indicator for the calves' stress responses. Contrarily, Price *et al*. (16) found out that time spent on feeding is an indicator for weaning distress. Similarly, in a study to compare calves that were weaned by fence-line or entirely weaned with calves that were not weaned, a decrease in feeding activity was observed in weaned animals on the second day following weaning. In the study of Ungerfeld *et al*. (13) weaning resulted in reduced grazing independent of the calf sex, but pre-weaning levels were reached after two days.

Further, several studies demonstrated that the lying and walking/standing durations can be used as indicators for weaning stress. In ours which supported the studies of Enríquez *et al*. (17) and Kohari *et al*. (8), the vocalization activity was accompanied by an

increased movement activity during the first days after weaning. The much shorter time spent lying and the higher time expended standing/walking of M6 than of M7 calves observed on day 2 indicated that the younger calves were more affected by weaning, although on the other 2 days no difference between the groups was noted. Another indicator that M7 calves recovered faster than M6 calves is the distinct increase in the lying duration from day 1 to 2. The extremely high proportion of standing/walking, particularly on day 1 of weaning, reflects the enhanced response to weaning. In a study which was conducted under comparable conditions, calves responded to weaning with a similar increase of the walking and standing and decrease of the lying duration (18). Independent of the sex, calves weaned at 70 days in the study of Ungerfeld *et al*. (13) responded with an extreme reduction of lying and increase of walking. Until 3 days after weaning the frequency of lying was still lower compared to the pre-weaning days. As already mentioned above, the differences between weaning ages can be mainly explained by the gradual separation of the mother-young bond and advanced social development of the offspring.

Growth performance: The effects of weaning age and sex of the calves on the growth performance are presented in Table **5,**. The growth performance of the calves was not ($P > 0.05$) affected by a weaning age × sex interaction. Male calves were about 15 and 25 kg heavier than females at 6 and 7 months of age, respectively. Adjusted for their BW at 6 months of age, calves weaned at 6 and 7 months did not differ ($P > 0.05$) at 6 months of age, but at 7 months calves weaned at 7 were more than 30 kg heavier than those weaned at 6 months at 7 months of age.

From birth to 6 months of age, male and female calves gained 1.14 and 1.06 kg/day, respectively. The weight gain from birth to 7 months was about 0.1 kg/day lower for both sexes. ADG calculated for the 2 weeks after weaning was not influenced by the weaning age ($P > 0.05$) with calves weaned at 6 months gaining 0.61 kg/day and calves weaned at 7 months 0.76 kg/day during the 2-week period following weaning. During this period, ADG was greater in male than in female calves ($P < 0.05$). The growth rate during the period between 6 and 7 months of age was influenced by weaning age ($P < 0.05$) and sex ($P < 0.05$). Calves weaned at 6 months had a lower ADG compared to those weaned at 7 months ($P < 0.05$), and males had a greater ADG than the female calves ($P < 0.05$).

Table 5: Effects of weaning age and sex of the calves on growth performance

Parameters	Weaning age		Sex		SEM
	6 months	7 months	Male	Female	
N	18	18	18	18	
Birth weight (kg)					
At 6 months	249.3	257.0	261.7^{a}	244.6^{b}	4.17
At 7 months	268.3^{a}	300.6^{b}	296.4^{a}	272.4^{b}	4.17
ADG (Kg/day)					
Until 6 months	1.08	1.12	1.14^{a}	1.06^{b}	0.02
Until 7 months	0.94^{a}	1.07^{b}	1.05^{a}	0.96^{b}	0.02
2 weeks after weaning	0.61	0.76	0.94^{a}	0.43^{b}	0.08
6 to 7 months of age	0.39^{a}	0.89^{b}	0.71^{a}	0.57^{b}	0.04

^{a,b} Means with different superscripts are significantly different ($P < 0.05$) within weaning age and sex, Standard error of means SEM), Average daily weight gain (ADG).

Regarding the weight gain, our results did not support a faster growth from weaning in M7 than in M6 calves. In contrast, the growth rate during 6 to 7 months of age was about 0.5 kg/day higher in M7 than M6 animals. It can be assumed that the advanced growth rate of M7 calves was mainly due to the fact that they remained with their dams, and therefore were able to suckle milk until 7 months of age. Although the milk probably accounted only for a limited proportion of the diet at 7 months of age, it might have benefitted the performance of M7 calves. In an experiment by Wolcott *et al*. (19), weaning Shorthorn cattle at highly different ages either at 120 days and 145 kg or at 260 days and 270 kg, results did not show any effect of the weaning age on the post-weaning growth rate. In a like manner, our result opposed the one obtained by Blanco *et al*. (209) in which a higher weight gain of calves weaned at 90 than at 150 days of age was discovered. Male calves reached a weight gain of more than 0.6 kg/day during the first 2 weeks after weaning and did not show a depression of the growth rate as it was recorded in female calves.

Conclusion and Applications

1. In this study, it has been established that weaning distress measured by vocalization activity and behavioural response was more noticeable in calves weaned at 6 than in those weaned at 7 months of age.
2. The latter-weaned calves also had a superior growth performance during 6 to 7 months of age.
3. The effect of calves' sex on weaning stress was less pronounced.
4. In order to reduce the stress response to weaning, it is recommended to conduct weaning in beef calves later than 6 months of age.

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