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Full Length Research Paper

Effect of creep feeding on growth, haematology and serum biochemistry of bull calves reared in a humid tropical environment

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Abstract

The study was designed to evaluate the effect of creep feeding on growth performance, haematological and serum biochemical profile of crossbred beef bull calves grazed on native forages alongside their dams. Nine crossbred (N'dama x White Fulani) nursing bull calves, 4-5 months of age, weighing 51.50 ± 4.94 to 57.67 ± 4.94 kg were used for the study. Two creep diets namely CFA having soya bean as main source of crude protein and CFB having groundnut cake as main source of crude protein were formulated for the experiment. The animals were weighed and then randomly allotted to one of three treatments (3 calves/treatment) namely treatment one (T_1) or control (no creep supplementation), treatment 2 (T_2) or creep supplementation with CFA, and treatment 3 (T_3) or creep feeding with CFB. Calves were fed the creep diet at 3% of their weekly body weight between 06:00 and 09:30h daily. Thereafter each animal was allowed to suckle and graze alongside the dam in the farm grazing area. Calves belonging to each of the treatment groups were fed separately. Data collected were body weight changes (BWT), weekly weight gain (BWG), daily feed intake (DFI), cumulative feed intake (CumFI) and feed conversion ratio (FCR), as well as haematological and serum biochemical values. Results showed that creep feeding significantly influenced overall body weight gainand some blood and serum biochemical variables but not weekly body weightand final body weight.Source of crude protein influenced BWG, CumFI, FCR and some blood and serum biochemical variables but not weekly body weights and final body weights of calves. Generally, blood and serum biochemical values obtained were within normal rangesshowing that there were no adverse effects of creep feeding or source of protein on the animals. It was therefore, concluded that the practice of creep feeding of calves should be adopted to enhance their growth rate and fattening performance in the study environment and that groundnut cake was a better crude protein source for calves used in the study.

Keywords: Creep feeding, hybrid bull calves, growth parameters, blood indices, serumbiochemistry.

INTRODUCTION

Creep feeding is the practice of providing supplemental feed to calves before weaning (Lynch et al., *2012*). It helps in supplementing dam's milk and pasture or to compensate for decreasing milk yield and pasture availability or quality (Lynch et al., *2012*). The overall output of a breeding cow herd is dependent on weaning rate, and weaning weight of the calf. These two parameters are often expressed together as a trait of the

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cow called cow productivity (Vinoleset al., 2013). Beef cows grazing native grasslands are exposed to seasonal changes in the availability and quality of forage (Berretta et al., 2000). In temperate regions where animals are mostly seasonal breeders, summer is the season of greatest forage availability and the season of key events in the beef cow cycle: breeding, and pre-weaning (Vinoleset al., 2013). In the tropics, rainy season is the period of greatest availability of grazing resources, however animals breed all year round and so calving occur all year round (i.e., in and out of season of plenty). Therefore, methods that enhance the availability of nutrients for the cow-calf pair especially during the season of scarcity would be of benefit for increasing the productivity of the beef herd (Vinoles et al., 2013). In addition to other stressors (infections, incremental weather, antagonistic encounters etc) that face calves, they are also stressed by feed and water deprivation especially during the season of scarcity and under extensive and semi-intensive husbandry practices that rely on natural supply of forages for grazing (Cole, 1996). Apart from the direct adverse effects of nutrient deprivation, inadequate nutrition can accentuate the adverse effects of other stress factors (Cole, 1996). Creep feeding is advocated as a means of preventing or reducing the stress of forage scarcity, inadequate milk supply and nutrient deprivation as well as the stress of weaning (Cole, 1996; Vinoles et al., 2013).

In growing animals, feeding and rearing systems has an important effect on the values of haematological and serum biochemical variables (Verheyen et al., 2007; Klinkon and Jezek, 2012; Mamun et al., 2013).In ruminants, the influence of feeding regime becomes more apparent after the 5th week when consumption of dry food (hay and starter) increases (Klinkon and Jezek, 2012). In this period, the values of RBC, Hb, and PCV (haematocrit) are expected to increase (Klinkon and Jezek, 2012). Knowledge of the haematological and biochemical profile of calves grazing native forages with or without supplementation would enable the assessment of health status and general welfare (Klinkon and Jezek, 2012; Lynch et al., 2012) and offer clues as to the health implications of creep rations and creep feeding practices in a production system. Hassan et al. (2012) and Mamun et al. (2013) stated that changes in biochemical and haematological constituents are important indicators of the physiological and pathological state of the animal. Thus biochemical determination of serum constituents and blood examination can provide valuable information relating to nutrition, and other environmental factors that influence the performance and well being of animals (Ate et al., 2009; Al-Fartosiet al., 2010; Dicostanzo and Gill, 2012).Furthermore, metabolic disturbances usually by inappropriate feeding without overt clinical manifestation are important in animal production and cause reduced performances (Radostitis et al., 2000; Mamun et al., 2013). Such altered metabolic status could be reflected in altered haematological and biochemical indices. Mamun et al. (2013) stated that factors such as nutrition and stress affect blood and serum biochemical values of animals.

Creep feeding involves additional costs on the beef production enterprise (Parish and Rhinehart, 2009). Therefore, the economic benefits of creep feeding must justify its practice. Among the factors that influence response to and economic benefits of creep feeding are supply and quality of forage, pasture or range; level of milk production by the dam, the growth potential of the calf, sex of calf, age of calf at weaning, type of creep feed, length of creep feeding period, and season of birth of calf (Shike et al., 2007; Anderson, 2008). The major benefits from creep feeding are reported to include improved weaning weight of the calf and increased weaning rate of the cow (Anderson, 2008; Parish and Rhinehart, 2009). Depending on the interplay of the variables enumerated above, calves creep fed can be expected to gain 2 to 45 kg more before weaning than non-creep fed animals (Mayo et al., 2002; Sexten et al., 2004). Relatively few studies have considered the effects of creep feeding on the haematological and serum biochemistry of creep fed animals in the study environment. The present study therefore,was designed to evaluate the haematological and serum biochemical profile of crossbred beef bull calves grazing native forages alongside their dams and fed or not fed two creep feed rations differing in source of crude protein. This was to enable informed decision as to the economic benefits of creep feeding in a beef herd in a humid tropical rainforest environment.

MATERIALS AND METHODS

The study was carried out at the Cattle Unit of Michael Okpara University of Agriculture, Umudike Teaching and Research farm located on latitude 05^{o}29^{I} North and longitude 07^{o}31^{I} East and on an altitude of 122m above sea level. The area is typically humid with annual mean rainfall of 2169.8mm, rainy day range of 148-155 days, daily mean ambient temperature of 26^{o}C, and relative humidity range of 50-72% (NRCRI, 2004, unpublished). The study lasted for 12 weeks.

Experimental Animals and management protocols

Nine crossbred (N'dama x White Fulani) nursing bull calves, 4-5 months of age, weighing 51.50 ± 4.94 to 57.67 ± 4.94 kg were used for the study. Two diets namely creep feed A (CFA) having soyabean meal as main source of crude protein and creep feed B (CFB) having groundnut cake as main source of crude protein were formulated for the experiment. The animals were

Table 1: Percentage and proximate composition of creep feed ration

Ingredient	CFA	CFB
Maize offal	45	45
Brewer's dried grain	18.5	18.5
Palm kernel cake	18	18
Soyabean meal	15	
Groundnut cake	-	15
Molasses	2	2
Bone meal	1.0	1.0
Salt	0.5	0.5
Total	100	100
Proximate composition (dry matter basis)		
Dry matter (%)	90.73	91.04
Crude protein (%)	19.18	19.30
Crude fibre (%)	7.18	7.80
Ether extract (%)	6.91	6.50
Nitrogen free extract (%)	50.70	53.50
Ash (%)	6.76	5.94
Energy (Kcal ME/kg)	2290.90	3300.50

weighed and then randomly allotted to one of three treatments (3 calves/treatment) namely treatment 1 (T_1) or control (no creep supplementation), treatment 2 (T_2) or creep supplementation with CFA, and treatment 3 (T_3) or creep feeding with CFB. Each calf in a treatment served as a replicate. Calves were fed the creep diet between 06:00 and 09:00h daily. Thereafter each animal was allowed to suckle and graze alongside the dam in the grazing area. Calves were fed 3% of their weekly body weight as creep feeding. Calves belonging to each of the treatment groups were fed separately but within sight of their dams and other calves. This was to stimulate adequate feed intake. Calves were fed once daily using a wooden feeder long and wide enough to allow the animals feed simultaneously. All calves in treatment 2 and 3 participated in the consumption of the appropriate creep feed.

Data Collection

Growth parameters: The calves were weighed at the beginning of the study and at weekly intervals thereafter and values were recorded in kilogrammes (kg). Final body weight was taken at the end of the experiment and average gain in body weight was calculated for each experimental unit. Feed intake was obtained by weighing the feed provided and the left over after the duration of creep feeding each day. Feed conversion ratio (FCR) was calculated as feed intake over body weight gain.

Haematological indices: Blood samples were collected from each calf belonging to a treatment at the end of the study in bottles containing ethylene diamine tetra-acetate (EDTA) anticoagulant for haematology and in serum bottles for serum biochemistry. For the haematological profile, white blood cell (WBC) or leukocyte and red blood cell (RBC) counts were obtained using the Neubauer counting chamber (Baker and Silverton, 1982). Differential leukocyte count was carried out to determine the percentage of neutrophils, eosinophils, lymphocytes and monocytes using the procedure outlined by Ochei*et al.* (2000).Packed cell volume (PCV, hematocrit) was determined using the microhaematocrit method(Baker and Silverton, 1982) while haemoglobin concentration was determined using the Acid haematin method (Baker and Silverton, 1982).

Biochemical indices: The biochemical parameters determined included urea, creatinine and total serum protein, total and conjugated bilirubin, (biuret method, Toro and Ankerman, 1975), serum glutamic pyruvic transaminase (SGPT), and serum glutamic oxalo-acetic acid transaminase (SGOT) (Reitman et al*.,* 1957; Schmidt, 1983).

Data Analysis

Data collected were subjected to Multivariate Analysis of variance (MANOVA) in completely randomized design using the SPSS computer software to test for effects of treatments. Significantly different means were separated using the Duncan New Multiple Range Test option in SPSS. Comparison between sources of crude protein (creep fed groups) was performed using the independent samples t-test in SPSS.

RESULTS AND DISCUSSION

The percentage and proximate composition of the experimental diets were presented in Table 1 while Table 2 shows the weekly values of body weight of the experimental animals according to treatment. There were no significant (P>0.05) differences between the

Table 2: Weekly body weight of calves fed or denied creep feed

Age (wk)	Control	CFA	CFB	SEM
BWT_0	57.67	54.67	51.50	4.94
BWT_1	59.33	55.67	54.50	4.94
BWT_2	61.33	57.00	56.00	5.33
BWT_3	63.00	57.00	59.00	5.67
BWT_4	64.66	58.00	62.50	4.99
BWT_5	66.00	59.67	65.00	5.13
BWT_6	67.33	61.67	67.50	5.07
BWT_7	69.33	62.33	70.00	5.41
BWT_8	69.00	65.33	72.00	5.21
BWT_9	69.67	67.67	74.00	5.52
BWT_{10}	71.33	70.00	77.00	5.84
BWT_{11}	72.66	73.00	80.00	5.84
BWT_{12}	74.00	76.33	83.50	6.02

BWT_0= Initial body weight; BWT_i: body weight at the i^{th} week of the study; CFA: creep feed having soyabean as source of crude protein; CFB: creep feed having groundnut cake as source of crude protein.

Table 3: Performance indices of crossbred calves fed or denied creep feed

Parameter	Control	CFA	CFB	SEM
BWT_0	57.67	54.67	51.50	4.94
BWT_{12}	74.00	76.33	83.50	6.02
BWG	16.33^b	21.66^b	32.00^a	4.09
DFI (kg)	-	0.47	0.34	0.09
Cum FI (kg)		39.48^a	28.56^b	2.92
FCR	-	1.29^a	0.89^b	0.12

a, b: means on the same row with different superscripts are significantly different (P<0.05).

experimental groups in body weight values across the experimental period. Calves belonging to the control group were however numerically higher in body weight up to the 5^{th} week of the study after which they had lower body weight compared to calves creep fed with CFB. Calves that received CFA were also numerically lower in body weight to those of the control group up to the 10^{th} week of the study. This notwithstanding, the consistent numerically higher body weight values observed in calves fed CFB from the 6^{th} week to the end of the experiment indicated a tendency to higher weight gain.

Table 3 showed that body weight gain at the end of the study was significantly (P<0.05) higher for calves fed CFB compared to those of CFA and the controlbut did not differ significantly between calves fed CFA and the control group (32.00 vs 21.66 and 16.33kg, respectively). Comparison between calves fed CFA and CFB for daily feed intake (DFI), cumulative feed intake (CumFI) and feed conversion ratio (FCR) showed significant (P<0.05) differences in CumFI and FCR between the groups but not in DFI. Calves that received CFA consumed significantly higher quantity of feed over the trial period compared to their counterparts fed creep feed B (39.48 ± 2.92 vs 28.56 ± 2.92kg).

Feed conversion ratio (FCR) was significantly (P<0.05) lower (better) in calves that received creep feed B (CFB) compared to those fed CFA (0.89 ± 0.12 vs 1.29 ± 0.12). The higher overall body weight gain observed for creep fed calves over control group was consistent with the reports of Shike et al. (2007), Parish and Rhinehart (2009) and Vinoles et al. (2013).Shike et al. (2007) reported 21% higher body weight gain (BWG) in creep fed calves compared to non creep fed animals.In the present study, percent BWG was 28.32% for the control group, 39.62% for calves fed diet A and 62.14% for those fed diet B. Thus calves fed CFA had 11.30% higher weight gain than the control while calves fed CFB had 33.82% higher BWG than the control.Thus on average, creep-fed calves had 22.56% higher BWG than non-creep fed calves. This result is in agreement with the 21% higher body weight gain for creep-fed calves reported by Shike et al. (2007). The better performance of calves fed CFB compared to CFA could be associated with differences in micro nutrient composition of the different crude protein sources used in the formulation especially mineral composition which enhances feed utilization while the lower CumFI for CFB could relate to higher energy content which resultsin lesser feed intake. The experimental groups differed significantly in most of the haemato logicalindices (Table 4).Haemoglobin concentration (Hb) was similar and lower in creep fed calves compared to the control (9.38 and 10.58 vs 12.52g/dl, P<0.05). Packed cell volume (PCV) was highest in the control group and least in calves that received creep feed A (36.67, 32.66, and 28.83% for control, CFB, and CFA, respectively) while RBC was similar between control calves and calves fed CFB but significantly lower in calves on CFA compared to calves fed CFB (8.50 and 8.72 vs 7.55 $x10^6/mm^3$).

Table 4: Haematological indices of crossbred bull calves fed or denied creep feed

Parameter	Control	CFA	CFB	SEM
Hb (g/dl)	12.52^{a}	9.38^{b}	10.58^{b}	0.38
PCV (%)	36.67^{a}	28.83^{b}	32.66^{c}	0.95
RBC (x 10^{6}/mm^{3})	8.50^{ab}	7.55^{a}	8.72^{b}	0.39
WBC (x 10^{6}/mm^{3})	8.77^{a}	6.53^{b}	7.42^{b}	0.52
Neutrophil (%)	30.83^{a}	25.33^{b}	22.67^{b}	1.67
Monocyte (%)	0.83	0.67	0.50	0.21
Eosinophils (%)	3.00^{a}	3.17^{a}	2.00^{b}	0.69
Lymphocyte (%)	63.17^{a}	71.17^{b}	65.50^{c}	0.67
Neutrophil/lymphocyte	0.49^{a}	0.36^{b}	0.35^{b}	0.02

a, b, c: means on the same row with different superscripts are significantly different (P<0.05).

Table 5: Serum biochemical indices of crossbred bull calves fed or denied creep feed

Parameter	Control	CFA	CFB	SEM
Urea (mg/dl)	34.67^{a}	35.17^{a}	27.67^{b}	3.01
Creatinine (mg/dl)	1.25	2.73	1.71	0.62
Total protein (mg/dl)	5.56^{ab}	6.52^{a}	4.63^{b}	0.63
Globulin (mg/dl)	2.53^{a}	2.95^{a}	1.10^{b}	0.49
Total bilirubin (mg/dl)	0.47^{a}	0.40^{ab}	0.36^{b}	0.04
Conjugated bilirubin (mg/dl)	0.27^{a}	0.13^{b}	0.18^{b}	0.03
SGPT/ALT (iu/l)	24.67	24.67	26.17	2.24
SGOT/AST (iu/l)	46.50^{a}	26.00^{b}	55.00^{a}	6.46

a, b: means on the same row with different superscripts are significantly different (P<0.05). SGPT/ALT: serum glutamic pyruvic transaminase/alanine transaminase; SGOT/AST: serum glutamic oxalo-acetic acid transaminase/arspartate transaminase.

For leukocyte count (WBC count), calves in the control group had the highest value of 8.77 x 10^{6}/mm^{3} compared to 6.53 x 10^{6}/mm^{3} for calves fed CFA and 7.42 x 10^{6}/mm^{3} for calves fed CFB. Similar results were observed for neutrophils while monocyte did not differ significantly between treatments. Eosinophils were similar and higher in calves belonging to the control and CFA compared to those of CFB (3.00 and 3.17 vs 2.00%) while lymphocyte differed significantly (P<0.05) between the treatments. The highest percentage lymphocyte was observed in calves fed diet A followed by those of diet B while calves belonging to the control had the lowest lymphocyte value of 63.17%. Table 4 also showed that calves in the control group had the highest value of neutrophil: lymphocyte ratio (0.49) compared to 0.36 and 0.35 for calves fed CFA and CFB, respectively. The importance of haematological indices in animal husbandry is well acknowledged. Metabolic disturbances usually by inappropriate feeding without overt clinical manifestation could cause reduced performance and productivity (Radostits *et al.,* 2000; Mamun *et al.,* 2013). Such altered metabolic status could be reflected in altered haematological indices. The significantly different haematological indices between treatments in the present study could relate to the different feeding materials and feeding regimes. Mamun *et al.* (2013) had stated that factors such as nutrition and stress affect blood values of animals. The significantly higher Hb, and RBC in the control animals could indicate higher oxygen capacity of the blood as a result of greater demand of oxygen by the tissues while the higher neutrophil and neutrophil:lymphocyte ratio indicate greater stress profile of non creep fed calves compared to creep fed animals. The haematological values reported in the present study were however consistent with some published blood parameters of apparently healthy calves. For instance, Mahima *et al.* (2013) reported values of blood profile of apparently healthy Hariana cattle heifers as 10.36 ± 0.298g/dl, 35.17 ± 1.249%, 7.15 ± 0.660 x 10^{6}µl, and 8.59 ± 6.22 x 10^{3}µl for Hb, PCV, RBC, and total WBC, respectively andthese are in close agreement with the values reported in the present study. For percentage distribution of leukocytes, these workers reported values of 51.24 ± 3.76, 33.14 ± 1.96, 6.94 ± 0.43, and 7.96 ± 0.58% for neutrophil, lymphocyte, eosinophils, and monocytes, respectively and these were generally higher than the values reported in the present study. Subhash *et al.* (2013) however reported values of 37(range: 12-38), 1.9 (range: 2-3.0), 68.6 (33-87), and 3.4% (1-5%), for neutrophil, eosinophil, lymphocyte and monocyte, respectively which substantially agree with the values reported in the present study. These results indicate that the creep rations employed in the present study did not adversely affect the animals and that the experimental animals were in good health condition during and until the end of the study. The serum biochemical indices of the experimental animals are presented in Table 5. Significant (P<0.05) differences were observed between treatments for all the serum biochemical parameters measured except in levels of serum creatinine and serum glutamic pyruvic transaminase (SGPT) or ALT levels.

Serum urea concentration was 34.67 and 35.17mg/dl for calves in the control and those fed CFA, respectively and these were similar but higher than 27.67mg/dl for fed CFB. Calves that were fed on CFA had similar serum total protein as calves in the control but those fed CFB had significantly lower total serum protein of 4.63mg/dl. A similar result was obtained for serum globulin concentration while serum total bilirubin level in control calves exceeded (P<0.05) that of calves fed CFB but were equivalent to that of calves fed CFA. The creep fed calves did not differ in this parameter. For conjugated bilirubin, control fed calves had the highest concentration of 0.27mg/dl followed by calves fed CFB at 0.18mg/dl. Calves fed CFA had the least conjugated bilirubin level of 0.13mg/dl. Liver enzyme activity differed significantly with regard to SGOT or AST which was similar for calves in the control and calves fed CFB (46.50 and 55.00iu/l, respectively) but significantly (P<0.05) lower in calves fed CFA (26.00iu/l). Nutrition among other factors influences serum total protein, urea, globulin and bilirubin concentrations (Klinkon and Jezek, 2012). Serum protein and urea concentration is hence influenced by the amount of protein in diets. Klinkon and Jezek (2012) stated that increased urea concentration in serum of calves is indicative of increased protein catabolism. On the other hand, creatinine is synthesized during endogenous metabolism in muscles and do not depend on nutrition (Klinkon and Jezek, 2012). The similarity in serum creatinine levels of experimental units is hence not surprising. AST (SGOT) activity is increased above normal range in pathological situations that cause cell necrosis such as damage to liver cells (Klinkon and Jezek, 2012). The significant differences observed between treatments in biochemical parameters notwithstanding, the values reported for the various variables fell within ranges reported for apparently healthy subjects by other studies. For instance, Mahima et al. (2013) reported reference values for urea as 34.26 ± 0.90g/dl, creatinine (0.93 ± 0.03g/dl), total protein (5.34 ± 0.10g/dl), globulin (1.94 ± 0.31g/dl), ALT (29.58 ± 1.08iu/l), and AST (66.63 ± 2.38 iu/l) in healthy Hariana cattle. Omer *et al.* (2009) reported values of 26.78 ± 1.77mg/100ml, 1.33 ± 0.20mg/100ml, 7.24 ± 0.20g/100ml, 9.74 ± 1.98iu/l, and 25.24 ± 2.27iu/l for urea, creatinine, total protein, ALT and AST, respectively in suckling and yearling Sudanese carmels (Camelusdromedarius). In cattle breeds of Saudi Arabia, Al-Shami (2003) reported values of serum urea as 24.1 ± 2.1mg/dl, 1.3 ± 0.01mg/dl for creatinine, 7.4 ± 0.62g/dl for total serum protein, 270 ± 20.1iu/l for AST and 0.1 ± 1.4 for ALT. These values substantially agree with the values reported in the present study and this showed that both natural forages and the formulated rations were well tolerated by the animals and that the creep feed diets caused no adverse pathological effects on the bull calves.

CONCLUSION

Creep-fed calves achieved higher body weight and higher percent body weight gain than non creep-fed calves over the study period. Creep feeding influenced the haematological and serum biochemical indices of the calves although all values were within normal ranges. Given the seasonal nature of forage availability in the study environment, it is advisable to develop and adopt the practice of creep feeding calves to enhance their growth rate and fattening performance.

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REFERENCES

Al-FartosiKH, Talib GYJ and AliSh (2010). Comparative study of some serum biochemical parameters of cattle and sheep of the marshes in the south of Iraq. AL-Qadisiya Journal of Veterinary Medical Sciences 9 (2): 78-84.

AL-Shami SA (2003). Studies on normal haematological and biochemical parameters of Hassawi cattle breed in Saudi Arabia. Pakistan Journal of Biological Sciences 6 (14): 1242-1242.

Anderson BB (2008). Early high-starch diet critical to carcass quality.Angus Journal pp. 270.

Ate IU, Rekwot PI, NokAJ and Tekdek LB (2009). Serum electrolyte values of cows during 3rd trimester f pregnancy and early lactation in settled cattle herds in Zaria, Northern Nigeria. African Journal of Biomedical Research 12 (2): 125-130.

Baker FS and Silverton RE (1982). Introduction to medical laboratory technology.5th edition.Butterworth S. C. Publication London. Pp. 481-494.

Berretta EJ,Risso D, Montossi F and Pigurina G (2000). Campos in Uruguay. In: Lemaire G, Hodgson J, de Moraes A, Nabinger C, Carvalho PCDF. (Eds). Grassland Ecophysiology and Grazing Ecology. CAB International, New York, USA, pp. 377-394.

Cole NA (1996). Review of bovine respiratory disease: nutrition and disease interactions. Conservation and Production Research Laboratory Agricultural Research Division U. S. Department of Agriculture, Bushland, Texas.

Dicostanzo A and Beka G (2012). Cow-calf early fall management tips. In: Beef cattle. Extension bulletin, University of Minnesota.

Hassan MMMA, Hoque SKM, Islam A, Khan SA, Hossain MB and Banu Q (2012). Efficiency of anthelmintics against parasitic infections and their treatment effect on production and blood indices in Black Bengal goats in Bangladesh. Turkisk Journal of Veterinary and Animal Sciences 30 (4): 400-408.

Klinkon M and Jezek J (2012). Values of blood variables in calves, A bird's-eye view f veterinary medicine. In: C. C. Perez-Martin (Ed). ISBN: 978-953-51-0031-7, In Tech, Available from http://www.intechopen.com.

Lynch EM, McGee M, Doyle S and Earley B (2012). Effect of pre-weaning concentrate supplementation on peripheral distribution of leukocytes, functional activity of neutrophils, acute phase protein and behavioural responses of abruptly weaned and housed beef caives. BMC Veterinary Research .downloaded from 8://http://www.biomedcentral.com/174-6148/8/1.

Mahima KVS, Verma AK, Kumar V, Singh SK and Roy D (2013). Hematological and serum biochemical profile of apparently healthy Hariana cattle heifers in Norther India. Pakistan J. Biol. Sci. 16 (21): 1423-1425.

Mamun MA, Hassan MM, Shaikat AH, Islam SKMA, Hoque MA, Uddin M, and Hossain MB, (2013). Biochemical analysis f blood of native cattle in the hilly areas of Bangladesh. Bangladesh Journal of Veterinary Medicine 11 (1): 51-56.

Mayo SJ, Lalman DL, Selk GE, Wettermann RP and Buchanan DS (2002). Effect of level of cow winter nutrition and calf creep-feeding on fall calving system productivity.Animal Science Research Reports.Oklahoma Agricultural Experimental Station.

Ochei J and Kolhatker A, (2000). Medical Laboratory Science: Theory and Practice. Tata McGraw-Hill Education.Amazon.Com.

Omer SA, Salawa MEK, AgabH and Gussey HAS (2009). Studies on some biochemical and haematological indices of Sudanese camel (Camellusdromedarius)

Parish J, and Rhinehart J (2009). Creep feeding beef calves. Publication 2524.The Mississipi State University Extension Service.

Radostitis OM, Blood DC, and Gay CC (2000). Veterinary Medicine.A textbook of the diseases of cattle, sheep, goats and horses.8th edition. London.

Reitman S, Frankel S, Amer J (1957). GPT, GOT, total protein manual.Clinical Pathology, United Kingdom. RANDOX Laboratory limited. 20: 56.

Schmidt E, and Schmidt FW (1983).GPT, GOT and total protein manual.Enzymatic Biological Clinic, United Kingdom. RANDOX Laboratory Limited, 3:1.

Sexton WJ, Faulkner DB and Ireland FA (2004). Influence of creep feeding and protein levels on growth and maternal performance of replacement beef heifers. The Professional Animal Scientist 20: 211-217.

Shike DW, Faulkner DB, Cecava MJ, Parrett DF and Ireland FA (2007). Effects of weaning age, creep feeding, and type of creep on steer performance, carcass traits, and economics. Journal of Animal Science 23: 325-332.

Subhash M, Verma AK, Gupta MK, Sharma SD, Sharmar AK and Rahal A (2013). Haemological profile and blood chemistry in diarrhoeic calves affected with collibacillosis. Journal of Animal Health and Production 1 (1): 10-14.

Toro G and Ankerman PG (1975).Practical Clinical Chemistry.1st edition.Boston., Little Brown and Coy.

Verheyen AJM, Maes DGD, Mateusen B, Deprez P, Janssen GPJ, de Lange L and Counotte G (2007). Serum biochemical reference values for gestating and lactating cows. The Veterinary Journal 174: 92-98.

Vinoles C, Jaurena M, De Barbieri I, Canno MD and Montossi F (2013). Effects of creep feeding and stocking rate on the productivity of beef cattle grazing grasslands. New Zeland Journal of Agricultural Research 56(4): 279-287.