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EFFECT OF SUPPLEMENTATION LEVEL ON GROWTH PERFORMANCE AND BLOOD PROFILE OF BUNAJI BULLS GRAZED ON GAMBA GRASS (*Andropogon gayanus* KUNTH) IN THE SEMI-ARID ZONE OF NIGERIA

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ABSTRACT

The objective of the study was to evaluate the effect of supplementation level on growth performance and blood profile of Bunaji bulls. Nine Bunaji bulls with an average live weight of 190±1.50kg were used in a thirteen weeks grazing experiment. The animals were balanced by weight and allotted to three treatments in a completely randomized design with three animals per treatment. The treatments were 0.00, 0.75 and 1.50% body weight supplementation levels. The animals were allowed access to an established Gamba pasture for grazing and then supplemented with cowpea husk daily. The animals were weighed at the on-set and at termination of the trial to monitor weight changes, while blood samples were taken at termination of the trial to determine the concentrations of haemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cells (WBC), serum total protein (TP), blood glucose (BG) and blood urea nitrogen (BUN). The results showed that animals offered 1.50% body weight supplementation level had significantly ($P<0.05$) higher daily weight gains (661.17g/day) relative to 0.75% level (322.35g/day). The values for PCV, RBC, TP and BUN showed significant ($P<0.05$) variations between levels and control but were statistically ($P>0.05$) similar between levels. Irrespective of the level, values for PCV, RBC, TP and BUN proved superior ($P<0.05$) to control treatment, but all other values showed no significant ($P>0.05$) differences across the treatments. In conclusion, supplementation at either 0.75% or 1.50% body weight increased the live weight gains of the bulls by 4.89% or 21.00%, respectively. Values for blood variables of the bulls were within normal physiological ranges for healthy cattle. Daily supplementation at 1.50% body weight, particularly with cowpea husk, is hereby recommended for Bunaji bulls grazed on Gamba grass for better performance.

Key Words: Bunaji bulls, Gamba grass, supplementation level

INTRODUCTION

One of the major problems facing ruminant livestock production in Nigeria is nutrition. Losses are due to mortality, lowering of reproductive rate, weight loss and increased cost of production. Nutrition influences growth and fertility particularly in the tropics where there are seasonal changes in quality and quantity of feed (Ndama *et al*., 1983). Obviously, most of the beef that reaches the market comes from the traditional cattle owner' herds whose input into production is very minimal and depends mostly on natural range to feed their stock with little or no supplementation (Richard and Church, 2010). For most of the beef production cycle,

requirements for protein and energy can be met with low to medium quality forages. The forages that form the basis of beef cattle production can be native forage species such as Gamba grass or introduced pastures (Richard and Church, 2010). Gamba is one of the most productive native forage grass species relished by livestock in Nigeria and is valued for its ease of establishment, high yielding ability, drought resistance and excellent palatability, particularly at vegetative stage (Ibrahim *et al.,* 2011). However, its palatability declines as it matures and thus becomes highly fibrous and may be deficient in both protein and energy with consequent decrease in quality. When forage is limited in quantity and/or quality, supplementation may be necessary to maintain the desired level of productivity. Frequently, a single feed resource may not meet animal's requirement for growth and production and thus supplementation with other sources is usually necessary (McDonald *et al.,* 2010). The goal of supplementation is to provide nutrients to the cows that are not available in sufficient quantity or adequate balance. Majority of the fattening activity in Nigeria is done by the small-scale producers. The animals go out to graze the open range and receive supplements of cereal by-products, legume hays and crop residues (Ashiru *et al.,* 2009). Most of the fattening operations in which animals are allowed to go out for grazing are on bulls, as they grow faster, have better feed conversion efficiency and heavier carcasses (McDonald *et al.,* 2010). Matching the cow's nutrient requirements with forage production is the key to profitable nutritional management. When the crude protein of forage falls below 6 to 7%, intake can be stimulated by supplementation with protein or non-protein nitrogen (NPN). Supplementary feed is required to maintain satisfactory condition especially in the case of young bulls (NRC, 1996). In order to overcome the problems highlighted above, supplementation with legume residues such as cowpea husk offers cheap sources of dietary protein and better feeding strategy in the dry season can reduce weight losses, increase milk yield and help to prevent nutritional anoestrus. Cowpea husk is used by farmers as a supplement, particularly in northern Nigeria, for both large and small ruminants fattening as it is highly acceptable to cattle, sheep and goats but often given *adlibitum* which may not be economical or cost effective. The present study was therefore undertaken to assess the effect of supplementation level, with cowpea husk as supplement to basal Gamba grass, on growth performance and blood profile of Bunaji bulls in the semi-arid zone of Nigeria.

MATERIALS AND METHODS

Description of the Study Location

The experiment was conducted at the Kano University of Science and Technology Teaching and Research Farm, Gaya ($11^0 51^I$N; $9^0 20^1$E; alt. 430m above sea level) in the semi-arid zone of Nigeria (Dambazau, 2008). The mean annual rainfall is about 800mm, while the mean annual temperature is about 26^0C (Olofin *et al*., 2008). The study area is characterized by a defined wet season which normally begins in May and ends in October. The dry season therefore lasts from October to May. The soil of the study area is loamy sand with little organic matter (Adamu *et al.,* 2014). The natural vegetation is the savanna type which consists of moderately tall grasses such as *Andropogon gayanus*, *Panicum maximum*, *Pennisetum pedicellatum* etc and scattered browses such as *Acacia, Balanites, Faidherbia, Piliostigma and Zizipus spp* (Gefu and Amodu, 2004). The area supports good agricultural activities with sorghum, millet, cowpea and groundnut being the major crops cultivated (Dambazau, 2008). The common livestock found are the Bunaji, Yankasa and the Red Sokoto breeds of cattle, sheep and goats, respectively.

Experimental Animals and Management

A total of nine (9) growing Bunaji bulls with an average live weight of 190±1.50kg were used for the study. Prior to the commencement of the trial, the animals were balanced by weight, confined in individual pens, tagged (for identification) and given Ivermectin at dose rates of 200µg/kg body weight against endo- and ectoparasites and oxytetracycline hydrochloride (Long Acting) at dose rates of 10mg per kg body weight as prophylactic (Benjamin, 1985). The animals were kept in the pens for a period of two (2) weeks for adaptation. Thereafter, the animals were allotted to three (3) treatments in a completely randomized design (CRD), replicated three times. The treatments involved three supplementation levels, (0, 0.75 and 1.50% body weights). An established Gamba pasture was partitioned into three (3) paddocks, each paddock is a replicate, and used for the grazing experiment. The animals were allowed access to the established Gamba pasture for grazing and then supplemented with cowpea husk at 0 (control), 0.75 and 1.50% body weights daily. Mineral lick and water were provided *ad libitum* along with the supplement in the pens. The trial lasted thirteen (13) weeks.

Parameters Measured and Calculated

The body weight changes were estimated by the difference between initial weight and final weight of the animal.

Blood samples were collected at termination of the trial. Ten (10) ml of blood were collected, early in the morning before feeding, from the jugular vein of each animal using sterile syringe and needle, placed in a sample bottle and then taken to Haematology Laboratory (for haematological analysis) and Chemical Pathology Laboratory (for biochemical analysis). Seven (7) ml of the blood was placed in a sterile sample bottle containing Ethylene Diamine Tetracetic acid (EDTA) as an anti-coagulant (Sastry, 1989) for haemotological studies, while the remaining three (3) ml was used for blood chemistry (serum metabolites) as described by Coles (1986).

Chemical Analyses

Gamba grass and cowpea husk were analyzed for proximate composition (DM, ash, CP, CF, EE and NFE) according to the procedures described by AOAC (2005). Fibre fractions [acid detergent fibre (ADF) and neutral detergent fibre (NDF)] were determined by the procedures of Van Soest *et al.* (1991).

The haematological parameters measured were haemoglobin (Hb) concentration, packed cell volume (PCV), red blood cells (RBC) and white blood cells (WBC) as described by Coles (1986). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using the formula stated in the Merck Veterinary Manual (2012) as MCV = PCV% ÷ RBC x 10; MCH = Hb g/dl ÷ RBC x 10; MCHC = Hb g/dl ÷ PCV% x 100%.

The biochemical parameters measured were serum total protein (TP) was estimated by Biuret method (Kohen and Allen, 1995), blood glucose (BG) was determined by glucose oxidase method as described by Stone (1954), while blood urea nitrogen (BUN) concentration was estimated by Nessler's reaction (Tanis and Naylor, 1968).

Statistical Analysis

The data collected were subjected to one-way analysis of variance (ANOVA) using the general linear model (GLM) of SAS (2002). Significant means were compared at 5% level of probability using standard error of means (SEM).

RESULTS AND DISCUSSION

The chemical composition of the experimental diets is shown in Table 1. At 12 weeks post planting, the basal diet (Gamba grass) had 95.65% DM, 6.13% ash, 7.37% CP, 34.36% CF, 4.37% EE, 47.74% NFE, 38.35% ADF and 66.60% NDF. The dry matter (DM) value

obtained in this study was high and thus, suggests a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen (McDonald *et al.,* 2010). High DM value of 91.05% was reported by Ajiji *et al.* (2013) in Gamba grass hay. Similar values were also reported for Gamba grass by several authors (Vazquez and Smith, 2000; Cook *et al*., 2005; Flores *et al.*, 2005; Pressland and Watson, 2008; Steve and Martin, 2008; Nyako, 2010; Ibrahim *et al*., 2011). The ash content in the present study (6.13%) was higher than the value (3.13%) reported by Ibrahim *et al*., 2011) but lower than 16.91% reported by Ajiji *et al.* (2013). Lower ash content might mean that diets may be low in minerals, as stated by McDonald *et al.* (2010) that total ash decreases as plant matures. Higher values of EE (4.37%) and NFE (47.74%) (indicates fat content and soluble carbohydrate, respectively) also suggests energy value of the grass. This implies that the grass has adequate energy required by grazing animals. However, the CP content (7.37%) is below the NRC (1996) recommended critical level (16%) to ensure optimum performance for animals on pasture. This suggests that animals raised on pure Gamba grass may respond positively to protein supplementation.

Table 1: Chemical composition of the experimental diets (%)

Feed	Composition							
	DM	**Ash**	**CP**	**CF**	**EE**	**NFE**	**ADF**	**NDF**
*Gamba grass	95.65	6.13	7.37	34.36	4.37	47.74	38.35	66.50
Cowpea husk	90.77	5.83	16.87	33.19	6.74	37.37	24.71	50.14

*At 12 weeks post planting, DM = dry matter, CP = crude protein, CF = crude fibre, EE = ether extract, NFE = nitrogen free extract, ADF = acid detergent fibre, NDF = neutral detergent fibre

Cowpea husk had 90.77% DM, 5.83% ash, 16.87% CP, 33.19% CF, 6.74% EE, 37.37% NFE, 24.71% ADF and 50.14% NDF. Crude protein (CP) values of 11.00 to 18.00% in cowpea husk, depending on preservation method, were reported by several authors (Alawa and Umunna, 1993; Olorunju *et al*, 1996; Larbi *et al.*, 1998; Ranjhan, 2001; Ayantunde *et al*, 2007; Addass *et al.,* 2011). The effect of feed supplementation using residues such as cowpea husk and vines (Ehlers and Hall, 1997; Mortimore *et al*, 1997; Rama Devi *et al*, 2000) to enhance production in livestock had been reported. Cowpea husk is fed as protein supplement during the dry season because of its palatability and nutritional value. Moreover, it is very common and cheap during the harvest period, particularly in northern Nigeria, and is highly acceptable to cattle, sheep and goats.

The performance of Bunaji bulls grazed on Gamba grass supplemented with cowpea husk at 0.75 and 1.50% body weights (Table 2) indicated that level of supplements had significant ($P<0.05$) effect on performance of the bulls. Animals offered 1.50% body weight supplementation level had significantly ($P<0.05$) higher daily weight gain (661.17g/day). However, the cost was relatively higher (N255.52/kg gain) but it pays compared to 0.75% level with 322.35g/day at N231.72/kg gain. On the other hand, daily weight gain was lowest at the control treatment (zero supplementation) suggesting a low efficiency in utilization of the forage consumed by the grazing bulls which further suggests the vital role of supplementation in

grazing animals, irrespective of the level (Sayers *et al.,* 2016). Low level of supplementation (0.75% body weight) improved the performance of the bulls by 4.89% only, while high level (1.50% body weight) increased their performance tremendously by 21.00%. Kwaido *et al.* (2008) reported an increase in body weight with increasing levels of supplementation when *Uda* rams were fed cowpea husk. Carla *et al.* (2012) also reported a linear increase in body weight with increasing levels of supplementation from 0.5 to 1.5% body weight when they fed groundnut haulms to grazing pregnant beef cows during the dry period. Furthermore, Sayers *et al.* (2016) observed a higher weight gain (720.70g/day) in grazing dairy cows at 1.50% body weight supplementation level using cowpea or groundnut haulms.

Table 3 shows the blood profile of Bunaji bulls grazed on Gamba grass supplemented with cowpea husk at 0.75 and 1.50% body weights. The values for PCV, RBC, TP and BUN showed significant ($P<0.05$) variations between treatments and control but were statistically ($P>0.05$) similar between levels. Irrespective of the level, the values for PCV, RBC, TP and BUN proved superior ($P<0.05$) to control treatment. However, all other values showed no significant ($P>0.05$) differences across the treatments, even though the values were numerically different. The values were however, within the normal physiological ranges reported for healthy cattle (RAR, 2009; The Merck, 2012). This suggests that the nutrients in the supplements ingested, irrespective of the levels, were adequate and the bulls did not present stress for deficiency of nutrients. However, values obtained for MCHC were slightly above the normal values (30.0 - 36.0 g/dl) reported by The Merck (2012). The variation noted could be attributed to the differences earlier enumerated by Benjamin (1985) that differences could be due to breed, time of sampling, effect of storage, age, season as well as method of estimation. In another report (RAR, 2009) an increase in MCHC value indicates hemolysis (the destruction of RBC and the release of the Hb they contain) or laboratory error. Tambuwal *et al.* (2002) reported higher average MCHC value of 44.70±8.24g/dl for Red Sokoto goats, while Fajemisin *et al.* (2010a) reported lower values (33.06 – 33,90g/dl) in West African Dwarf rams. The results of this study are in conformity with earlier reports by Rasko (2013) that levels of supplementation do not usually manifest significant differences in blood variables of healthy ruminant animals. Similarly, Kwaido *et al*. (2008) reported no significant variations in haematological and blood urea nitrogen values of *Uda* lambs fed high levels of cowpea husk in Sokoto state (semi-arid zone). Values obtained in the present study were similar to those reported for Friesian x Bunaji heifers fed cowpea or groundnut haulms as supplement (Ashiru *et al.,* 2009). The similar trend in Hb and PCV could be ascribed to the direct relationship between Hb concentration and PCV, and the nutritional safety of the feeds (Sirois, 1995). Hb values in this study indicated that the feeds seemed to be capable of supporting high oxygen carrying capacity in the bulls. MCV, MCH and MCHC are the red blood cells used to further characterize and classify anaemia (The Merck, 2012), and since their values were within normal ranges, this further indicates that the bulls were not anaemic. The values for blood glucose (BG), which were also within normal range (2.3 – 4.1mmol/l), indicated that the bulls were not surviving at the expense of their body tissues (Sirois, 1995). Whitaker (1998) reported that serum total protein values are indications of both quantity and quality of protein utilization in the diet. This clearly indicates that the protein in the experimental diets is adequate both in terms of quantity and quality. Blood urea nitrogen is an accurate reflection of intake of effective rumen degradable protein and its

balance with fermentable metabolizable energy (Whitaker, 1998).

CONCLUSION

Based on the results of the present study, it was concluded that supplementation at either 0.75% or 1.50% body weight increased the daily live weight gains of the bulls by 4.89% or 21.00%, respectively. Values for blood variables of the bulls were within normal physiological ranges for healthy cattle. Daily supplementation at 1.50% body weight, particularly with cowpea husk, is hereby recommended for Bunaji bulls grazed on Gamba grass for better performance.

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REFERNCES

Adamu, U. K., Muhammad, A. and Adam, J. A. (2014). Evaluation of soil reaction, exchangeable acidity and cation exchange capacity of soil from Kano University of Science and Technology, Wudil Teaching, Research and Commercial Farm, Gaya. *Bayero Journal of Pure and Applied Sciences.* 7 (1): 52 – 55

Addass, P. A., Nyako, H. D., Agga, D. P., Mohammed, I. D., Midau, A., Fintant, J. S. and Ja'afar-Furo, M. R. (2011). Nutrients evaluation of some common feed resources for cost effective feeding of ruminants in Mubi, Nigeria. *Agriculture and Biology Journal of North America*, 2(1):1518.

Ajiji, I., Nyako, H. D. and Ashom, S. A. (2013). Performance of Yankasa rams fed *Andropogon gayanus* hay supplemented with *Faidherbia albida* pods. *Journal of Biology, Agriculture and Healthcare*, 3 (13): 137-141

Alawa, J.P. and Umunna, N.N. (1993). Alternative feed formulation in the Developing countries: Prospects For Utilisation of Agro-Industrial By-products. *Journal of Animal Production Research 13 (2):63-98.*

AOAC. (2005). Association of Official Analytical Chemists. Official Methods of Analysis 18th Edition AOAC Inc, Arlingon, Virginia USA. 1094pp.

Ashiru, R, M., Ehoche, A. W., Akpa, G. N., Muhammad, 1, R., Tanko, R. J. and Abdu, M. I. (2009). Haematological and biochemical parameters of Friesan x Bunaji heifers fed cowpea or groundnut haulms as supplement in sub humid zone of Nigeria. *Nigerian Journal of Basic and Applied Sciences* 17 (2): 229-234

Ayantunde, A.A., Delfosse, P., Fernandez-Rivera, S., Gerard, B. and Dan-Gomma, A. (2007). Supplementation with groundnut haulms for sheep fattening in the West African Sahel (Abstract). *Tropical Animal Health and Production 39 (3):207-216.*

Benjamin, M.M (1985). *Outline of Veterinary Clinical Pathology* (3rd Edition).W."B. Saunders Company, London.

Carla, H. A. C., Mario, F. P., Nelcino, F. D., Rilene, F. D. V. and Fabiano, L. D. (2012). Levels of supplementation for grazing pregnant beef cows during the dry period. *R. Bras. Zootec.* 41 (12) : 1806-1818.

Coles, E. H. (1986). Veterinary Clinical Pathology. 4th Edition. WB Saunders Company, Philadelphia.

Cook, B., Pengelly, B.C., Brown, S.D., Donnelly, J.L., Eagles, D.A., Franco, M.A.,

Hanson, J., Mullen, B.F., Partridge, I.J., Peters, M. and Schultze-Kraft, R. (2005), *Tropical forages: an interactive selection tool* (CD-ROM), CSIRO, DPI&F (Qld), CIAT and ILRI, Brisbane, Australia.

Dambazau, A. M. (2008). *Human Response to the Natural Environment in the Kano Region*. In: Barkindo (ed). Kano and Some of her Neighbours. ABU Press. pp 2-6

Ehlers, J.D. and Hall, A.E. (1997). Cowpea *Vigna unguiculata* (L.) Walp. *Field Crops Research*, 53: 187-204.

Fajemisin, A. N., Fadiyamu, A. A. and Alokan, J. A. (2010a). Nitrogen retention and haematological indices of West African Dwarf rams fed sun dried and fermented rumen digesta and cage hen droppings diets. *In:* O. J. Babayemi, O. A. Abu and E. O. Ewuola (eds.) *Fast – Tracking Animal Agriculture in a Challenged Economy*. Proceedings of the 35th Annual Conference of the Nigerian Society for Animal Production (NSAP) 14th - 17th March, held at University Ibadan, Nigeria. Pp 604 – 607.

Flores, T., Setterfield, S. A. and Douglas, M. M. (2005).'Seedling recruitment of the exotic grass *Andropogon gayanus* (Poaceae) in northern Australia', *Australian Journal of Botany* 53, pp. 1–7.

Gefu, J. O. and Amodu, J. T. (2004). *Forage Production and Management in Nigeria*. In: Gefu and Amodu (eds). A training manual. National Animal Production Research Institute (NAPRI), Shika, ABU, Zaria, Nigeria. pp 16-19

Ibrahim. U., Muhammad, I.R. and Hassan, A. M (2011). Effects of Spacing and Number of Shoots per Stand at Transplanting on Establishment and Yield of Gamba grass (*Andropogon gayanus*) in the semi arid zone of Nigeria. *Biological and Environmental Sciences Journal for the Tropics* 8(3): 78 – 82.

Kohen, R. A. and Allen, M. S. (1995). Enrichment of proteolitic activity relative to nitrogen in preparation from the rumen for *in vitro* studies. *Animal Feed Science and Technology*, 52 (1/2): 1 – 14.

Kwaido, A. A., Maigandi, S. A., Malami, B. S. and Daneji, A. I. (2008). Effects of feeding high level of cowpea husk on the haematological and blood urea nitrogen of *Uda* lambs. *Nigerian Journal of Basic and Applied Sciences* 16 (2):235-242

Larbi, A., Dung, D.D, Olorunju, P.E, Smith, J.W, Tanko, R.J. and Muhammad, I.R. (1998).

Groundnut (*Arachis hypogaea* L.) for food and fodder in crop-livestock systems; forage and seed yields, chemical composition and rumen degradation of leaf and stem fractions of 38 cultivars. *Animal Feed Science and Technology 10278: 1-15.*

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D., Morgan, C.A. Sinclair, L. A. and Wilkinson, R. G. (2010). Animal Nutrition, 7th Ed, Longman, London.

Ndama, P. H., Entwistle, K. W. and Lindsay, J. A. (1983). Effect of protected protein supplement on some testicular traits in Brahman cross bulls. *Theriogenology* 20: 639-650.

Mortimore, M.J., Singh, B.B., Harris, F. and Blade, S.F. (1997). Cowpea in Traditional Cropping Systems. In: Singh, B. B., Mahan Raj, D. R., Dashiell, K. F., and Jakai, L. E. N. (Eds), *Advances in Cowpea Research*. IITA, JIRCAS, pp. 99-113.

NRC (1996). National Research Council.Nutrient Requirements of Beef cattle. 6lh rev. Ed. Washington, DC: National Academy Press.

Nyako, H.D. (2010) Utilisation of Local Feed Resources for Improved Small Ruminants Production in Adamawa State. Unpublished Ph.D Thesis ,Submitted to the Department

of Animal Science and Range Management, MAUTECH,Yola.174pp

Olofin.E.A, Nabegu.A.B, and Dambazau A.M, (2008).Wudil within Kano Region geographical synthesis. A publication of the Department of Geography, Kano University of Science and Technology, Wudil

Olorunju, P E, Ntare, B R, Babalola, O A, and Alabi O. (1996). Proceeding of a workshop on

Nationally coordinated groundnut research project 25-29 September, 1995. Zaria, Nigeria, 47pp

Pressland, T and Watson, D (2008). A report of gamba grass (*Andropogon gayanus*): policy options and the evidence supporting the preferred options as presented by the Queensland Department of Primary Industries and Fisheries.

Ranjhan, S. K. (2001). Animal nutrition in the tropics. Vikas Publishing House PUT Ltd. New Delhi.

Rama Devi. K., Bandyopahyay, R., Hall, A.J., Indira, S., Pande, S. and Jaiswal, P. (2000). Farmers Perceptions of the Effects of Plant Diseases on the Yield and Nutritive Value of Crop Residues used for Peri-Urban Dairy Production on the Deccan Plateau: Findings from Participatory Rural Appraisals. *Information Bulletin* No. 60. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 35pp.

RAR (2009). Research Animal Resource.: Reference values for laboratory animals. Normal haematological values.RAR Websites, RAR, University of Minnesota. AVaible at: http://www.rndconsult.com/books/about.do?about=true&eid=4

Rasko, J. (2013). Haematology/Research. Day in the Life RCPA Foundation. Education + Research. Available at: www.rcpa.edu.au/../haematology.htm

Richard, O. K. and Church, D. C. (2010). Livestock Feeds and Feeding, 6th Edition, Pearson Education, Inc., NJ. pp335-348.

SAS (2002). Statistical Analysis System. INSTITUTE Inc. SAS/STAT user's guide. 6.03 Edition, Gray NC, USA

Sastry, G. A. (1989). *Veterinary Clinical Pathology*. Salish Kumar Jain for CBS Publishers & Distributors, Delhi-32, India.

Sayers, H.J., Mayne, C.S. and Bartram, C.G. (2016). The effect of level and type of supplement offered to grazing dairy cows on herbage intake, animal performance and rumen fermentation characteristics. *Ani. Sci:* 76(3); 439-454

Sirois, M. (1995). Veterinary Clinical Laboratory Procedure. Mosby Year Book, Inc St-Louis, Missouri, USA.

Steve, C. and Martin, H. (2008). Pest risk assesment: Gamba grass (*Andropogon gayanus*) information sheet, Bio-security Queensland Department of Primary Industries and Fisheries.pp2.

Stone, S. H. (1954). Method of obtaining venous blood from the orbital sinus of rat or mouse. *Science*, 119: 100 – 102.

Tambuwal, F. M., Agaie, B. M. and Bangana, A. (2002). Haematological and biochemical values of apparently healthy Red Sokoto goats. Proceedings of the 27th annual conference of the Nigerian Society of Animal production (NSAP) 17th – 21st March, held at Federal University of Technology Akure, Nigeria. Pp 50 – 53.

Tanis, R. J. and Naylor, A. W. (1968). Physical and chemical studies of a low molecular weight form of cheese. *Biochemical journal*, 108:771.

The Merck (2012). The Merck Veterinary Manual. 10th Edition, Susan, E. A. (ed.).

Haematologic reference ranges. Published by Merck and Co., Inc. Whitehouse Station, N. J., U.S.A. 2311pp.

VanSoest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fibre, neutral detergent fibre, non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*. 74:3583-3597.

Vazquez, O. P. and Smith, T. R. (2000). Factors affecting pasture intake and total dry matter in grazing dairy cows. Journal of dairy science.83:2301-2309.

Whitaker, D. A. (1998). Use and interpretation of metabolic profiles in dairy cows. *In:* A.H. Andrews (ed.) The Health of Dairy Cattle. *Blackwell Science*. ISBN 0-632 – 04103X. pp 89 -107