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COMPARATIVE STUDY OF MORNING, EVENING OR TWICE DAILY (MORNING AND EVENING) SUPPLEMENTATION 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 compare the effect of morning, evening or twice daily (morning and evening) supplementation on performance of Bunaji bulls. Nine (9) Bunaji bulls with an average live weight of $192.78 \pm 2.00\text{kg}$ were used in a thirteen weeks grazing experiment. The animals were balanced by weight and allotted to three treatments in a completely randomized design (CRD), replicated three (3) times. They were allowed access to an established Gamba grass for grazing and then supplemented with cowpea husk at 1.5% body weight daily. The animals were weighed at the on-set and end of the trial to monitor weight changes, while blood samples were taken at the 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 supplementation period had significant ($P < 0.05$) effect on total weight gain and average daily gain of the bulls. Values obtained for blood parameters showed no significant ($P > 0.05$) differences except that of serum total protein (TP) which was significantly ($P < 0.05$) higher in evening supplementation. In conclusion, twice daily and evening supplementations gave better performance, with live weight gains of 798.57g/day and 593.41g/day, respectively, but evening supplementation, with cowpea husk at 1.50% body weight, was cheaper for Bunaji bulls grazed on Gamba grass. The values for blood parameters of the bulls were within normal physiological ranges for healthy cattle. Twice daily supplementation is therefore recommended for higher live weight gains while evening supplementation is recommended for lower cost.

INTRODUCTION

The northern region of Nigeria is concentrated with most of the nation's ruminant livestock. However, this region is characterized by a long

dry season (6-9 months) which often causes serious shortage of feed for ruminant animals ((NRC, 1996).

The problem of dry season livestock feeding in particular, has directed research efforts towards harnessing and enhancing the utilization of abundant arable byproducts and crop residues. The abundance of crop residues makes them cheap sources of nutrients for ruminants (Leng, 1990). Beef production relies heavily on grazed forages to supply nutrients for the beef cattle (McDonald et al., 2010). For much 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 important 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. The goal of supplementation is to provide nutrients to the livestock that are not available in sufficient quantity or adequate balance. Supplementary feed is required to maintain satisfactory condition especially in the case of young bulls (NRC, 1996). Majority of the fattening activity in Nigeria is done by the small scale producers (Ashiru et al., 2009). The animals go out to graze the open range and receive supplements of cereal byproducts, legume hays and crop residues. Most of the fattening operations in which animals are allowed to go out for grazing involve bulls as they grow faster and have better feed conversion efficiency (NRC, 1996). One of the most important crops that are grown in the sub-Saharan Africa is cowpea (*Vigna unguiculata* L. Walp) (Ehlers and Hall, 1997; Mortimore et al., 1997; Stalker, 1997). It is grown either as monoculture or inter-cropped with cereals. The effect of feed supplementation using leguminous crop residues such as cowpea husk and vines as

supplement to cereal straws or native forages to enhance production in livestock has been described by several authors (Stares et al., 1992; Ehlers and Hall, 1997; Mortimore et al., 1997; Kaasschieter et al., 1998; N'jai, 1998; Rama Deviet al, 2000), but little attention was paid to the period at which they should be offered. Good animal feeding practice lies in recognizing the value of various feed resources and in using them at the right time for the correct purpose. The objective of this study was therefore to compare the effect of morning, evening or twice daily (morning and evening) supplementation on performance 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° 51' N; 9° 20' 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°C (Olofinet 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 (Adamuet 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 192.78 ± 2.00 kg 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. An established Gamba grass was partitioned into three (3) paddocks, each paddock is a replicate, and used for the grazing experiment. Cowpea husk was offered as supplement at 1.5% body weight of each animal daily and the animals were allowed access to the established Gamba pasture for grazing. The animals were allotted to three (3) treatments in a completely randomized design (CRD), replicated three times. The test periods were morning (08:00hrs), evening (16:00hrs), and twice daily (08:00hrs +16:00hrs). Mineral lick and water were provided *ad libitum* along with the supplement in the pens. The trial lasted for thirteen (13) weeks.

Parameters Measured and Calculated

The botanical composition of native forages in the established Gamba pasture was evaluated prior to grazing. The native annual forage species that emerged in the established gamba, after the last weeding, prior to the commencement of grazing, were identified and categorized into grasses, legumes, forbs and browses as described by Karsten and Carlssare (2002).

Forage intake (t/ha) was estimated by the difference between forage on offer and post grazing forage yield. In each paddock of the established Gamba, six (1m x 1m) quadrant locations were randomly selected, out of which three (3) were harvested before grazing and their individual fresh yield determined, while the remaining three (3) were protected and harvested after grazing (at termination of the trial) and their individual post grazing forage yield determined. Thus, the difference between pre grazing forage yield and the post grazing forage yield gives an estimate of the forage intake by the grazing bulls (Griffin *et al.*, 2012).

The body weight changes were estimated by the difference between initial weight of the animal before the trial and final weight at termination of the trial (in kilogram).

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 haematological 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 follows:

$MCV = PCV\% \div RBC \times 10$; $MCH = Hb \text{ g/dl} \div RBC \times 10$; $MCHC = Hb \text{ g/dl} \div PCV\% \times 100\%$.

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).

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) using the general linear model (GLM) of SAS (2002). Significant means were compared at 5% level of probability using the least significant difference (LSD).

RESULTS AND DISCUSSION

The botanical composition of native forage species in the established Gamba pasture prior to grazing is presented in Table 1. The native annual forage species that emerged in the established gamba after the last weeding, prior to the commencement of grazing, were identified and categorized into grasses, legumes, forbs and browses (Karsten and Carlassare, 2002). A total of thirty five (35) species were evaluated and the results showed that the grazing site had many forage species in addition to the established Gamba grass, although their composition varies. This is in line with the report of Muhammad and Abubakar (2004) that weeds emergence is inevitable in newly established pastures. Weeds compete with pasture species for nutrients, water and light, which consequently affects the vigour of the emerging seedlings and thus, reduces the forage cover (Gefu and Amodu, 2004). Pastures established on newly cleared lands are usually invaded by regrowth from stumps and roots of plant species that occur in the area and their emergence could be as high as 45 to 50% in the year of establishment of pasture species such as *Andropogon gayanus*.

Frequency of occurrence of the species evaluated indicated that grasses accounted for 31.43%, legumes 17.14% and browses 8.57%, and could serve as increasers. However, forbs were also encountered as invaders (42.86%), out of which seven (*Senna obtusifolia*, *Senna occidentalis*, *Tribulus terrestris*, *Zonia glochidiata*, *Hibiscus asper*, *Ampelocissus africanus* and *Amaranthus viridis*) were found to be noxious and unpalatable and thus, would not add to the feed resources of the grazing area. The results indicated that there were high proportions of grasses and forbs compared to legumes. Earlier reports showed that growth of newly established pasture may be impaired if weeds are not properly controlled, especially when the forage consists mainly of grasses (Gefu and Amodu, 2004; Muhammad and Abubakar, 2004).

The chemical composition of the experimental feeds is shown in Table 2. The basal diet (Gamba grass), which was analyzed at 12 weeks post planting, 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. Similar values were 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 high DM content (95.65%) obtained in this study suggests a good source of energy and forage that could enhance rumination and prevent digestive upset in the rumen (McDonald *et al.*, 1998). Higher values of EE (4.37%) and NFE (47.74%) (which 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.

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; Olorunjuet *et al.*, 1996; Larbiet *et al.*, 1998; Ranjhan, 2001; Ayantunde *et al.*, 2007; Addass *et al.*, 2011). The effect of feed supplementation using residue such as cowpea husk and vines (Ehlers and Hall, 1997; Mortimore *et al.*, 1997; Rama Deviet *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.

Table 3 shows the fresh forage on offer grazed by the experimental animals as affected by supplementation period. There was no significant ($P > 0.05$) difference in the forage offered to the experimental animals at the on-set of the experiment. Post grazing forage yield was significantly higher ($P < 0.05$) in animals offered twice daily supplementation (morning and evening).

Consequently, forage intake was significantly ($P < 0.05$) higher in animals offered morning or evening supplementation only relative to twice daily supplementation. This implies efficient utilization of nutrients by the animals. Knutsenet *al.*(1994) also reported similar observations in Friesian dairy cows.

The performance of Bunaji bulls grazed on established gamba grass (*Andropogon gayanus*) as affected by supplementation period (Table 4) indicated significant ($P < 0.05$) increases in mean body weights across the treatments. Average daily weight gains were significantly ($P < 0.05$) higher in twice daily (798.57g/day) than in evening (593.41g/day) supplementation. The better performance of the animals in twice daily or evening supplementation could be due to efficient utilization of nutrients by the animals and the fact that animals on twice daily supplementation consumed more feed than others. This finding agreed with earlier report by Knutsen *et al.* (1994) that twice daily or evening feeding improves animal performance over morning feeding. Feed cost per kilogram live weight gain showed no significant ($P > 0.05$) difference across treatments. Numerically however, results of economics of production suggested that evening supplementation is cheaper than twice daily or morning supplementation. Ayantunde *et al.*(2007) reported that cowpea husk supplement has tremendous potentials for ruminant animal production, particularly in the tropics, because of its availability, high nutritive value and reduced cost of feeding.

Table 5 shows the blood profile of Bunaji bulls grazed on established Gamba grass (*Andropogon gayanus*) as affected by supplementation period. Values for Hb, PCV, RBC, MCV, MCH, MCHC, WBC, BG and BUN showed no significant ($P > 0.05$) differences between the treatments, even though the values were numerically different. However, the concentration of serum total protein (TP) showed significant ($P < 0.05$) variations between supplementation periods. Evening supplementation had significantly ($P < 0.05$) higher TP value than twice daily or morning supplementation. The mean values of all the parameters obtained in the present study were similar to those reported for Bunaji and

N'dama (Olayemi and Oyewole, 2002), Friesian x Bunaji heifers (Ashiru *et al.*, 2009). Furthermore, the values obtained were within the reported ranges for healthy cattle (RAR, 2009; The Merck, 2012). However, values obtained for MCHC from the present study were higher than the range of 30.0 – 36.0 (g/dl) reported for healthy cattle by The Merck Veterinary Manual (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. Tambuwalet *al.*(2002) reported higher average MCHC value of 44.70 ± 8.24 g/dl for Red Sokoto goats.

Serum total protein is a direct response to protein intake and quality. Whitaker (1998) reported that serum total protein values are indications of both quantity and quality of protein utilization in the diet. This clearly suggests 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 effective rumen degradable protein and its balance with fermentable metabolizable energy (Whitaker, 1998). This suggests that the animals used in this study were in a positive energy balance. By and large, the results of the haematological study of the present experiment suggested that the nutrients in the supplement consumed were adequate and the animals were not predisposed to any health hazard.

CONCLUSION

Based on the results of the present study, it was concluded that supplementation period had positive effect on animal performance. Twice daily and evening supplementations gave better performance, with live weight gains of 798.57g/day and 593.41g/day, respectively, but evening supplementation was cheaper. Values evaluated for blood profile of the bulls were statistically similar across the treatments and were within normal physiological ranges for healthy cattle, suggesting that grazing on gamba grass and supplementation with cowpea husk does not manifest adverse effects on animal performance.

Twice daily supplementation is hereby recommended for higher live weight gains while evening supplementation is recommended for lower cost. Further research should be carried out, particularly with small ruminants.

REFERENCES

- 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
- Adass, 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.
- 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, Arlington, Virginia USA. 1094pp.
- Ashiru, R. M., Ehoche, A. W., Akpa, G. N., Muhammad, I. R., Tanko, R. J. and Abdu, M. I. (2009). Haematological and biochemical parameters of Friesian 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., Dan-Gomma, A (2007). Supplementation with groundnut haulms for sheep fattening

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- Benjamin, M. M. (1985). *Outline of Veterinary Clinical Pathology* (3rd Edition). The Iowa State University Press, Ames, USA pp 361
- Coles, E. H. (1986). *Veterinary Clinical Pathology* (4rd Edition). W. B. Saunders Company, London.
- Cook, B, Pengelly, BC, Brown, SD, Donnelly, JL, Eagles, DA, Franco, MA, Hanson, J, Mullen, BF, Partridge, IJ, 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. Ahmadu Bello University Press. pp 2-6
- Ehlers, J. D. and Hall, A.E. (1997). Cowpea *Vigna unguiculata* (L.) Walp. *Field Crops Research*, 53: 187-204.
- Flores, T, Setterfield, SA and Douglas, MM (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

- Griffin, W. A., V. R. Bremer, T. J. Klopstein, L. A. Stalker, L. W. Lomas, J. L. Moyer, and G. E. Erickson. (2012). A meta-analysis evaluation of supplementing dried distillers grains plus solubles to cattle consuming forage based diets. *Professional Animal Scientist* 28:306–312.
- 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.
- Kaasschieter, G.A., Coulibaly, Y., Heitkonig, I.M.A. & Ketelaars, J.J.M.H. (1998). La Supplémentation du bétail: Un besoin In: Breman, H., Sissoko, K.(Eds.), L'intensification Agricole au Sahel. Karthala, Paris, pp. 79-105.
- Karsten, H. D. and Carlsson, M. (2002). Describing the botanical composition of a mixed species of north eastern U. S. pasture rotationally grazed by cattle. *ACSESS DL*. 42(3):882-889
- Knutsen, J. S., Vetos, J. J. and Pritchard, R. H. (1994). Effect of morning, evening, or twice daily feeding on yearling steer performance. *Beef reports*, pp49 – 53. retrieved from www.sdstate.edu/cattle
- Kohen, R. A. and Allen, M. S. (1995). Enrichment of proteolytic activity relative to nitrogen in preparation from the rumen for *in vitro* studies. *Animal Feed Science and Technology*, 52 (1/2): 1–14.
- 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* 102/78: 1-15.
- Leng, R. A. (1990). Factor affecting the utilization of poor quality forages by ruminants Particularly under tropical conditions. *Nutrition Research Review* 44(1990) pp. 277-303.
- McDonald, P., Edwards, R.A., Greenhalgh, J.F.D. and Morgan, C.A. (1998). **Animal Nutrition**, 5th Ed, Longman, London.
- 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.
- Mortimore, M.J., Singh, B.B., Harris, F. & 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.
- Muhammad, I. R. and S.A. Abubakar (2004). Establishment and Management of sown Pastures. In: Gefu and Amodu (Eds). *Forage Production and Management in Nigeria*. A training manual. pp 11 – 15.
- NRC (1996). National Research Council. Nutrient Requirements of Beef cattle. 6th rev. ed. Washington, DC: National Academy Press.
- N'jai, O. (1998). Comparisons of Groundnut hay, Sesame Seed Cake, *Leucaena leucocephala*, and *Gliricidia sepium* as Protein sources for Rams. In: Daniel, J. N., Roshetho, J. M. (Eds.), *Nitrogen fixing Trees for Fodder Production*. *Proceedings of the International Workshop*. FACT net/Winrock International/BAIE, FACT net, Reports, Special Issue, pp. 170-180.
- 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. 174p
- Olayemi, F. O. and Oyewale, J. O. (2002). Comparative assessment of the erythrocyte osmotic fragility and of haematological and plasma biochemical values in the Nigerian White Fulani breeds of cattle. *Tropical Animal Health and Production* 34 (3): 181-187

- 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.
- RAR (2009). Research Animal Resource.: Reference values for laboratory animals. Normal haematological values. RAR Websites, RAR, University of Minnesota. Available at: <http://www.mdconsult.com/books/about.do?about=true&eid=4>
- Rama Devi. K., Bandyopahyay, R., Hall, A.J., Indira, S., Pande, S. & 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.
- Rajhan, S. K. (2001). **Animal nutrition in the tropics**. Vikas Publishing House PUT Ltd. New Delhi.
- 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 and Distributors, Delhi-32, India.
- Stalker, H.T. (1997). Peanut (*Arachis hypogaea* L.). *Field Crops Research*, 53: 205-217.
- Stares, J.E.S., Said, A.N. & Kategile, J.A. (1992). The Complementarity of Feed Resources for Animal Production in Africa. *Proceedings of the Joint Feed Resources Network Workshop*, Gaborone, Botswana. African Feeds Research Network, ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.
- 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., Agake, 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.
- Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fibre, neutral detergent fibre and non starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.* 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. Andrew (ed.). *The Health of Dairy Cattle*. Blackwell Science Publishers: Blackwell Science. ISBN 0-632 – 04103X. pp89-107

Table 1: Botanical composition of native forage species in the established Gamba pasture prior to grazing

Hausa/English name	Scientific name	Classification			
		Grass	Legume	Forb	Browse
*Tafasa	<i>Senna obtusifolia</i>			x	
Coffee senna	<i>Senna occidentalis</i>			x	
**Kyasuwa grass	<i>Pennisetum pedicellatum</i>	x			
*Alkamar tururuwa	<i>Monechma ciliatum</i>			x	
*Harkiya	<i>Digitaria velutina</i>	x			
*Komayya	<i>Eragrostis ciliaris</i>	x			
Carpet grass	<i>Axonopus compressus</i>	x			
*Garafuni	<i>Momordica balsamina</i>		x		
*Farar kaya	<i>Acacia senegal</i>				x
*Kargo	<i>Piliostigma thonningii</i>				x
*Tsidau	<i>Tribulus terrestris</i>			x	
*Dankadifi	<i>Zonia glochidiata</i>			x	
Love grass	<i>Eragrostis tremula</i>	x			
*Yakuwar kare	<i>Hibiscus asper</i>			x	
*Aya-aya	<i>Cyperus rotundus</i>	x			
*Gemun kwado	<i>Kyllinga spp</i>	x			
*Yawo	<i>Ampelocissus africanus</i>			x	
*Kan Barawo	<i>Leucas martinicensis</i>			x	
*Balasaya	<i>Commelina spp</i>	x			
*Kayar rakumi	<i>Hygrophila auriculata</i>				x
*Karangiya	<i>Cenchrus biflorus</i>	x			
*Yadiya	<i>Leptadenia hastata</i>		x		
*Nonon kurciya	<i>Euphorbia hirta</i>			x	
*Goga masu	<i>Mitracarpus villosus</i>			x	
*Hanjin kuda	<i>Commelina forskalaei</i>			x	
Witch weed	<i>Striga spp</i>		x		
Bahama grass	<i>Cynodon dactylon</i>	x			
*Gude-gude	<i>Dactyloctenium aegyptium</i>	x			
*Zaki banza	<i>Amaranthus viridis</i>			x	
*Gyadar awaki	<i>Crotalaria spp</i>		x		
*Hankufa	<i>Waltheria indica</i>			x	
*Miyar tsanya	<i>Indigofera echinata</i>			x	
*Gabaruwar kasa	<i>Tephrosia linearis</i>			x	
*Gadagi	<i>Alysicarpus vaginalis</i>		x		
*Yaryadi	<i>Ipomea eriocarpa</i>		x		
Total	35	11 (31.34%)	6 (17.14%)	15 (42.86%)	3 (8.57%)

*Hausa name

**Recognized both in Hausa and English

Table 2: Chemical composition (%) of the experimental feeds

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

Table 3: Fresh forage on offer (t/ha) grazed by Bunaji bulls as affected by supplementation period

Parameter	Period			LSD
	Morning	Evening	Morning & Evening	
Forage on offer	20.03	20.21	20.23	6.100
Post grazing forage yield	5.20 ^b	4.30 ^b	7.70 ^a	4.500
Forage intake	14.84 ^a	15.81 ^a	12.47 ^b	3.700

^{ab}: means within the same row with different superscripts are significantly different (P<0.05); LSD = least significant difference.

Table 4: Performance of Bunaji bulls grazed on established Gamba grass (*Andropogon gayanus*) as affected by supplementation period

Parameter	Period			LSD
	Morning	Evening	Morning & Evening	
Initial body weight (kg)	194.33	190.00	194.00	88.190
Final body weight (kg)	238.00 ^b	244.00 ^{ab}	266.67 ^a	81.780
Total Weight gain (kg)	43.67 ^b	54.00 ^{ab}	72.67 ^a	25.290
Average daily gain (g/day)	479.89 ^b	593.41 ^{ab}	798.57 ^a	277.900
Supplement cost (N)/Kg	50.00	50.00	50.00	-
Supplement cost (N)/Kg gain	326.35	252.07	378.07	214.660

^{ab}: means within the same row with different superscripts are significantly different (P<0.05); LSD = least significant difference.

Table 5: Blood profile of Bunaji bulls grazed on established Gamba grass (*Andropogon gayanus*) as affected by supplementation period

Parameter	Period			LSD	*Normal range
	Morning	Evening	Morning & Evening		
Hb (g/dl)	10.2	12.0	10.6	2.50	8.0 – 15.0
PCV (%)	30.6	33.4	32.7	6.50	24.0 – 46.0
RBC (x 10 ¹² /l)	7.2	9.5	9.6	1.10	5.0 – 10.5
MCV (fl)	40.8	44.7	46.6	6.10	40.0 – 60.0
MCH (pg)	16.7	17.5	16.9	3.70	11.0 – 17.0
MCHC (g/dl)	44.1	43.9	44.2	12.80	30.0 – 36.0
WBC (x 10 ⁹ /l)	7.6	9.5	9.6	3.10	4.0 – 12.0
TP (g/dl)	7.6 ^b	8.0 ^a	7.7 ^{ab}	0.40	7.0 – 8.5
BG (mmol/l)	3.5	3.9	4.1	0.20	2.3 – 4.1
BUN (mmol/l)	6.0	5.6	6.0	1.30	2.8 – 8.8

*Source: The Merck (2012)

^{ab}: means within the same row with different superscripts are significantly different (P<0.05); Hb = haemoglobin, PCV = packed cell volume, RBC = red blood cell, MCV = mean corpuscular volume, MCH = mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration, WBC = white blood cell, TP = total protein, , BG = blood glucose, BUN = blood urea nitrogen