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Response of Calves to Supplementation of Forage Legume - Based Concentrate Diets

Bello, R. A.[1], Fasae, O. A.[1]*, Oluwatosin, B. O.[2] and Olanite, J. A.[3]

[1]*Department of Animal Production and Health, Federal University of Agriculture, P.M.B 2240, Abeokuta, Nigeria*
[2]*Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria*
[3]*Department of Pasture and Range Management, Federal University of Agriculture, P.M.B 2240, Abeokuta, Nigeria*

ABSTRACT

Sixteen (16) crossbred (White Fulani, Muturu & Keteku) calves aged 7-10 months and with an average weight of 69.78 ± 8.81 kg were sampled in a 12-week experiment to evaluate the response of calves to supplementation of legume - based concentrate diets. These calves graze on natural pastures. The sampled calves were allotted in a completely randomised design into four treatment groups and offered 25% *Leucaena leucocephala, Enterolobium cyclocarpum* and *Glricidia sepium* based concentrate diets and natural pastures (control) for treatments 1 - 4 respectively. Data were collected on feed intake, weight gain, nutrient digestibility, nitrogen balance, blood profile and faecal egg count of calves. The supplementation of forage legume concentrate diets improved ($P < 0.05$) DM intake and weight gain of calves with best results were observed in calves fed *Glricidia sepium* concentrate diets with 450.56 g/day and 188.45 g/day respectively. Nutrient digestibility (%) and nitrogen balance varied ($P < 0.05$) across treatment groups. Blood parameters did not differ ($P > 0.05$) across treatments and falls within the normal range for healthy calves, while the supplementation of forage legume concentrate diets reduced ($P < 0.05$) faecal egg count (egg/g) to ascertain the level of worm burden in calves. The study concluded that supplementation with legume concentrate diets improved the performance of calves with Gliricidia forage supplemented concentrate diet recommended for calves' optimum performance.

Keywords: Calves, forage legumes, performance, blood, faecal egg count

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E-mail addresses:
rafbellforall@gmail.com (Bello, R. A.),
animalexp@yahoo.co.uk (Fasae, O. A.),
oduguwabmdl@gmail.com (Oluwatosin, B. O.),
olaniteja@funaab.edu.ng (Olanite, J. A.)
* Corresponding author

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INTRODUCTION

Nigeria is known for its nomadic nature of cattle rearing. The major constraints faced in the production of these animals is the severe drop in body condition during prolonged droughts (Ibrahim & Jayatileka, 2000), due to forage scarcity characterised by low quality, resulting in low digestibility and poor productivity of the animals (Richard et al., 1994). Despite the fact that production of cattle depends solely on natural pastures which have contributed to their dietary needs, there is need to exploit available forage for year-round feeding, which should be of good quality to meet their nutritional requirements so as to attain their genetic potential. With good management, quality forage could be available year-round and where this is lacking, alternative feed can be provided (Karageorge, 2005, Tufarelli et al., 2012).

Forage legumes are important feed resources in ruminant production systems, readily available in Nigeria and are found in natural grasslands, playing a valuable role in providing supplemental nitrogen to ruminant animals. The feeding value of any forage is a function of the characteristics of the species, such as its availability, accessibility and nutrient content as well as the balance between available nutrient and the quantity of the nutrient ingested by the animal (Matlebyane, 2005, Bansi, et al., 2014).

Enterolobium cyclocarpum, Leucaena leucocephala and *Gliricidia sepium* are tropical multipurpose leguminous tree species which are drought resistance, persistent, relatively fast-growing trees, used for forage production. These plants are widely used as a source of nitrogen for ruminants as they are available year-round, and for their rapid growth and re-growth as well as palatability (Adejumo, 1991; Abdulrazak et al., 1997; Reynolds & Atta-Krah, 2006, Fasae et al., 2010). Therefore, the aim of this experiment is to evaluate the supplementation of forage legume based concentrate diets in improving the performance of cross bred calves grazing natural pasture.

MATERIALS AND METHODS

Experimental Animals and Management

Sixteen (16) healthy cross bred calves (White Fulani, Muturu and Keteku) of mixed sex (8 males and 8 females), between 7 and 10 months of age, with weight ranging from 60 kg to 80 kg, managed by the cattle unit of the Directorate of Teaching and Research Farms of the Federal University of Agriculture, Abeokuta were used for this experiment. The calves were tagged for identification and allotted in a completely randomised design into four groups. They were offered 25% *Leucaena leucocephala, Enterolobium cyclocarpum* and *Gliricidia sepium* based concentrate supplements for treatments 1-3, with calves on the fourth treatment grazing natural pasture (NP), serving as the control.

The calves were fed forage legume concentrate supplements at 2-3 % body weight on dry matter basis at 0800 to 1100 hours and released for grazing between the hours of 1100 -1700 every day for five hours. Refusals of concentrate feeds were recorded in order to ascertain feed intake. Animals were weighed weekly with a weighing bridge. Clean water was provided *ad libitum*.

Experimental Feeds

The leaves of *Leucaena leucocephala, Gliricidia sepium* and *Enterolobium cyclocarpum* were harvested within the University premises, sun dried until the leaves become brittle and incorporated at 25% with other feed ingredients to formulate a concentrate supplement comprising maize (10%), wheat offals (35%), palm kernel cake (27.50%), bone meal (2%) salt and were premix at 0.25% for each treatment and fed to the animals at 5% of the body weight. The calves on the control treatment grazed natural pastures within the experimental site consisting of common forages. namely *Panicum maximum, Cynodon dactylon, Azadirachta indica, Gomphrena celosioides, Aspilia africana, Synedrella nodiflora, Pennisetum purpureum* and *Centrosema pubescens*. These forages were harvested from selected portions of the natural grazing land, sorted out and bulked together for the analysis of their chemical constituents.

Digestibility and Nitrogen Balance Trials

The 16 animals were transferred into metabolic crates at the 84th day of the experiment fitted with facilities for separate collection of faeces and urine. The quantity of feed offered, feed refusal, faecal output and urine were determined for 7 days. Ten percent of the faeces and urine were collected daily over the 7- day period and bulked. Faecal samples were weighed, oven dried at 70°C for 36 hours, milled and stored in air tight bottles for analysis.

Haematology and Biochemical analysis

Ten (10 ml) of blood samples was collected through the jugular vein of each calf using hypodermic needle and syringe at commencement and termination of the experiment. Five ml blood samples were released into sample bottles containing ethyl dimethyl tetra acetic acid as anticoagulant for haematological studies, while the rest were drawn into a clean test tube for he serum tests.

Faecal Egg Count Analysis

Faecal samples from the animals were collected at the onset of the experiment and at 2-week intervals directly from the rectum of the calves and then subjected to the modified McMaster egg-counting technique for nematode counts.

Chemical Analysis

Feed samples were oven-dried at 65°C for 48hrs, and analysed for proximate compositions (AOAC, 2005). The concentration of fibre components and tannin in feeds were determined based on` Van Soest et al., (1991) and Makkar et al., (1993) respectively.

Statistical Analysis

Data collected were subjected to one way analysis of variance in a completely randomized design (SAS, 1999) and significant means separated (Duncan, 1955).

RESULTS AND DISCUSSION

The dry matter content of the forage legumes varied (P<0.05) from 57.74 in *Leucaena leucocephala* to 45.52 % in natural pasture (Table 1). The values for the DM content of leaves for the forage legumes is at variance with that reported for indigenous multipurpose trees in Nigeria (Babayemi, 2006, Anele et al., 2009) which may be attributable to the maturity of the leaves used in this study to feed cattle. The crude protein contents of the forage legumes are within the range for reported values (Carew, 1983; Odeyinka, 2001; Oni et al., 2006), while that obtained for bulked forages from natural pastures is slightly lower than 18.96 % reported by Jolaosho et al. (2011). The forage legumes were found to contain varying percentages of tannin which were within the permissible range of 50 g/kg DM recommended by Frutos et al. (2004). Tannins have been reported to be the most widely occurring anti-nutritional factors found in plants, present in numerous tree and shrub foliages, seeds and agro-industrial by-products (Makkar & Becker, 1999), and have been shown to significantly reduce voluntary feed intakes at high levels.

Table 1
Chemical composition (%) of the forage legumes and natural pasture

Nutrients	LL	EC	GS	NP	SEM
Dry matter	57.74	53.50	50.56	45.52	0.31
Crude protein	20.85	22.07	23.50	17.34	0.21
Neutral detergent fibre	62.43	64.67	52.34	70.57	1.34
Acid detergent fibre	43.45	37.00	31.87	43.23	0.10
Acid detergent lignin	12.54	20.37	10.34	7.35	0.13
Ether extract	3.78	2.50	1.80	5.32	0.17
Ash	7.90	9.03	10.90	12.23	0.37
Tannin	3.72	3.09	3.49	ND	0.15

LL: *Leucaena leucocephala*, EC: *Enterolobium cyclocarpum*, GS: *Gliricidia sepium* NP: natural pastures (bulked forage), ND – Not determined

The chemical composition of forage legume supplemented concentrate (Table 2) compares favourably with forage legume supplemented diets fed to cattle and other ruminant species (Gonzalez et al., 2002, Jokthan, 2013). The CP contents of the diets were above the threshold level of 6% CP required by the microbes in the rumen to support metabolic functions of their host while the NDF contents across the treatments with exception of the bulked forages from natural pastures were below the permissible limit of 65% guaranteed as optimal intake of tropical feeds by ruminant animals (Van Soest, 1994).

Table 2
Chemical composition (%) of experimental diets fed to calves

Nutrients	LSC	ESC	GSC	NP	SEM
Dry matter	92.93	88.82	92.54	45.52	1.14
Crude protein	22.63	22.82	24.73	17.34	0.31
Neutral detergent fibre	44.67	40.42	45.89	70.57	0.14
Acid detergent fibre	33.55	28.45	35.78	43.23	0.17
Acid detergent lignin	14.67	15.78	13.50	7.35	0.13
Ether extract	7.90	7.72	9.47	5.32	0.15
Ash	12.54	10.45	11.92	12.23	0.23

LSC: *Leucaena leucocephala supplemented concentrate*, ESC: *Enterolobium cyclocarpum supplemented concentrate*, GSC: *Gliricidia sepium supplemented concentrate*, NP: natural pastures (bulked forage)

The effect of forage legume supplement concentrate on the performance of calves is shown in Table 3. The improved ($P<0.05$) weight gain (g/day) of calves supplemented with forage legume concentrate diet may be attributed to the protein content of the forage legumes which would have influenced the available CP for animal performance. The range of 158.92 to 188.45 g/day observed in calves supplemented with ESC and GSC respectively, compares favourably with the findings of González et al., (2002) in Bunaji bulls fed a mixed concentrate containing *Gliricidia sepium*. However, higher values of 214.49 g/day were reported by Jolaosho et al. (2011) in calves fed diets supplemented with *Leucaena leucocephala*.

The improved ($P<0.05$) weight gain (g/day) in calves in the supplementary treatments is an indication of the superiority of the diets in relation to total protein and energy contents; This contributed to better forage digestibility, higher level of gastro intestinal tract fill and longer residence time of particulate and fluid digesta phase in the rumen (Demeyer, 1981) thereby, eventually having an effect on animal performance.

Moreover, the GSC diets appeared to promote faster growth rate and encouraged the best performance compared with the other forage legume supplemented treatments. The best performance in weight gain is justified by the high nutrient digestibility values observed in this study (Wanapat et al., 2009). In addition, the improvement observed in body weight gains of calves on GSC could be partly attributed to better balance and utilisation of absorbed nutrients in the tissue.

The increase in the intake of the supplemented forages could be attributable to the high crude protein content of these forages. Nitrogen supplementation for animals fed low-quality forage have been reported to favour the growth of fibrolytic bacteria, and increases the ruminal degradation and voluntary intake of fibre, as well as the energy extraction from forage fibre (Detmann et al., 2009).

Table 3
Performance indices of calves fed forage legume supplemented concentrate diets

Parameters	LSC	ESC	GSC	NP	SEM
Initial weight (kg)	70.12	68.80	69.87	69.25	8.81
Final weight (kg)	84.47[ab]	82.15[b]	85.70[a]	70.75[c]	9.36
Weight gain (kg)	14.35[b]	13.35[b]	15.83[a]	1.50[c]	4.31
Daily weight gain (g/day)	170.83[ab]	158.92[b]	188.45[a]	17.85[c]	0.05
Metabolic weight gain (g/dayW0.75)	47.25[b]	44.75[b]	50.86[a]	8.68[c]	3.42
Supplementary feed intake (g/day)	430.54[ab]	350.78[b]	450.56[a]	ND	0.51
Metabolic intake (g/dayW0.75)	94.52[a]	81.05[b]	97.79[a]	ND	8.21

[abc]….. Means along the same rows with different superscript are significant ($P<0.05$).
LSC: *Leucaena leucocephala supplemented concentrate*, ESC: *Enterolobium cyclocarpum supplemented concentrate*, GSC: *Gliricidia sepium supplemented concentrate*, NP: Natural pastures., ND: Not determined

The nutrient digestibility of the supplemented concentrate diets is shown in Table 4. In the present study, the digestibility values obtained for most nutrients were generally high, which could have provided better environment for digestibility to occur. Digestion is dependent on the activity of micro-organisms which require energy, nitrogen, minerals and a suitable medium to enable the microbes perform well (Ranjhan, 2001). The improvement in digestibility of nutrients across forage legume supplemented concentrates, relative to the natural pastures in the present study may be due to the availability of increased nutrient molecule in rumen and small intestine for digestion (Abdel-Ghani et al., 2011).

Further, results showed that nitrogen intake values increased ($P<0.05$) with forage legume supplementation, corroborating Arigbede et al., (2008) that the inclusion of fodder leaves in animal feed improves dietary nitrogen utilisation. The GSC had the highest ($P<0.05$) nitrogen balance, which contradicts the findings of Aye, (2013), in which Leucaena supplemented diet had higher N-value compared with those supplemented with cassava and Gliricidia leaf meals. However, nitrogen balance recorded in all the treatments in this study was positive.

The haematological and serum biochemical parameters of experimental calves were not influenced ($P<0.05$) by the forage legume supplemented concentrate (Table 5). Values observed were in accordance with the recommended values for normal blood parameters in cattle (Merck Veterinary Manual, 2009; RAR,

Table 4
Nutrient digestibility (%) and nitrogen balance of forage legume supplemented concentrate diets fed to calves (n = 16)

Nutrients	LSC	ESC	GSC	NP	SEM
Dry matter	72.56	71.92	73.40	68.56	4.05
Crude protein	76.06[a]	70.48[b]	77.68[a]	61s.01[b]	4.66
Neutral detergent fibre	61.52[b]	64.69[a]	62.32[b]	53.22[c]	5.99
Acid detergent fibre	51.23[ab]	46.70[b]	52.33[a]	40.31[b]	5.77
Acid detergent lignin	58.23[a]	53.34[c]	54.38[b]	55.41[c]	4.33
Ether extract	69.86[a]	57.66[b]	68.71[a]	52.11[b]	6.77
Ash	74.45	67.12	69.33	60.21	4.92
Nitrogen (N) balance					
N-intake(g/calves/day)	42.20[a]	41.10[a]	46.21[a]	30.21[b]	1.26
N-voided in faeces (g/calves/day)	15.76	12.37	16.28	14.11	1.00
N-voided in urine (g/calves/day)	0.60[b]	0.79[a]	0.73[a]	0.69[b]	0.03
N-balance (g/calves/day)	25.84[b]	27.94[b]	29.03[a]	15.41[c]	0.50

[abc]….. Means along the same rows with different superscript are significant (P<0.05).
LSC: *Leucaena leucocephala supplemented concentrate*, ESC: *Enterolobium cyclocarpum supplemented concentrate*, GSC: *Gliricidia sepium supplemented concentrate*, NP: Natural pastures

2009), suggesting that dietary forages are safe and not detrimental to the health of the calves. The knowledge about normal values of biochemical variables in blood serum and other physiological variables is important for assessment of damage of organs and tissues in case of diseases and for general health of the animal (Terosky, 1997; Tufarelli et al., 2015).

Table 5
Hematological and serum biochemical of calves fed forage legume supplemented concentrate diets

Parameters	LSC	ESC	GSC	NP	SEM
Pack cell volume (%)	32.50	32.00	32.25	36.25	1.08
Red blood cells (x 10^{12}/L)	3.03	3.00	2.92	3.41	0.05
Haemoglobin (g/L)	10.70	10.65	10.70	12.10	0.35
White blood cells (x 10^{9}/L)	8.17	7.12	10.60	11.02	0.72
Total protein (g/dl)	8.12	9.02	9.90	8.62	10.47
Globulin (g/dl)	5.01	5.50	6.40	4.80	6.95
Albumin (g/dl)	3.11	3.52	3.50	3.32	3.52
Glucose (Mg/dl)	78.41	76.65	82.22	77.25	79.97

[abc]….. Means along the same rows are significantly different (P<0.05).
LSC: *Leucaena leucocephala supplemented concentrate*, ESC: *Enterolobium cyclocarpum supplemented concentrate*, GSC: *Gliricidia sepium supplemented concentrate*, NP: Natural pastures

The effect of forage legumes supplemented concentrate on the faecal egg count of calves is shown in Table 6. Calves supplemented with forage legume concentrate diets had a reduction ($P<0.05$) in faecal egg count which could be associated to the presence of tannin in the forage. Studies have confirmed the beneficial effects of dietary tannin in ruminant animals; the presence of tannin in several plant species have been found to reduce faecal egg count as well as increased daily weight gain in animals given protein-rich diets (Alonso-Díaz et al. 2008; Salam, 2015). Tannins have direct anthelmintic properties whereby they lower infections by gastrointestinal nematodes, thereby reducing larval migration and development and directly minimising abomasal and intestinal infections (Kahn & Diaz-Hernandez, 2000, Athanasiadou et al., 2000). Moreover, the high faecal egg parasite observed in calves on natural pastures maybe due to the non - supplementation of forage legume concentrate diets which could be attributed to reduced weight gain of calves on this treatment.

Table 6
Effect of forage legume supplemented concentrates on the faecal egg count of calves

Parameters	LSC	ESC	GSC	NP	SEM
Pre-faecal egg count	802.50	832.00	792.25	836.25	2.08
Post faecal egg count	103.03^{b}	117.00^{b}	102.92^{b}	1003.41^{a}	4.05
Reduction (%)	87.16^{a}	85.94^{a}	87.01^{a}	-19.99^{b}	0.72

^{ab} Means along the same rows with different superscript are significant ($P<0.05$).
LSC: *Leucaena leucocephala supplemented concentrate*, ESC: *Enterolobium cyclocarpum supplemented concentrate*, GSC: *Gliricidia sepium supplemented concentrate*, NP: Natural pastures

CONCLUSION

In conclusion, the performance of calves was significantly influenced by forage legume supplemented concentrate diets, with *Gliricidia sepium* supplemented concentrate diet promoting higher nutrient intake and weight gain. Forage legume supplemented concentrate diets can therefore be used as an alternative feed supplement source in enhancing the performance of calves grazing natural pastures, as well as controlling nematodes.

REFERENCES

Abdel-Ghani, A. A., Solouma, G. M., & Soliman, E. B. (2011). Productive Performance and Blood Metabolites as Affected Metabolites as Affected by Protecte Protein in Sheep. *Journal of Animal Science, 1*(02), 24-32.

Abdulrazak, S. A., Muinga, R M., Thorpe, W., & Orskov, E. R., (1997). Supplementation with *Gliricidia sepium* and *Leucaena leucocephala* on Voluntary Food Intake, Digestibility, Rumen Fermentation and Live-Weight of Cross-Bred Steers offered *Zea mays* Stover. *Livestock Production Science, 49*(1), 53-62.

Adejumo, J. O. (1991). Effect of Length and Girth of Vegetative Planting Material upon Forage Yield and Quality of *Gliricidia sepium*. *Tropical Agriculture, 68*(1), 63-65.

Alonso-Diaz, M. A., Torres-Acosta, J. F., & Hoste, H. (2008). Effects of four Tropical Tanniniferous Plant Extracts on the Inhibition of Larval Migration and the Exsheathment Process of *Trichostrongylus colubriformis* Infective Stage. *Veterinary Parasitology, 153*(1-2), 187-192.

Anele, U. Y., Arigbede, O. M., Südekum, K. H., Oni, O. Jolaosho, A. O., Olanite, J. A., … & Akinola, O. B. (2009). Seasonal Chemical Composition, *In Vitro* Fermentation and *In Sacco* Dry Matter Degradation of Four Indigenous Multipurpose Tree Species in Nigeria. *Animal Feed Science and Technology, 154*(1), 47-57.

AOAC. (2005). *Official Methods of Analysis of the Association of Official Analytical Chemists* (15th Ed.). United States of America, USA: Arlington, VA.

Aregheore, E. M. (2005). *Feeds and Forages in Pacific Islands Farming Systems*. Animal Science Department Alafua Campus, the University of the South Pasific. Retrieved from http://www.fao.org/ag/AGP/AGPC/doc/Newpub/feeds_forages/feeds_forgaes.htm

Arigbede, O. M., Anele, U. Y., Jolaosho, A. O., Onifade, O. S., Olanite, J. A., & Wahab, T. A. (2008). Season Chemical Composition and *In Vitro* Gas Production of African Bread Fruit (*Treculia africana*) Var. Decne. *Archivos de zootecnia, 57*(218), 113-121.

Athanasiadou, S. L., Kyriazakis, I., Jackson, F., & Coop, R. L. (2000). Consequences of Long-Term Feeding with Condensed Tannins on Sheep Parasitized with *Trichostrongylus colubriformis*. *International Journal for Parasitology, 30*(9), 1025-1033.

Aye, P. A., & Adegun, M. K. (2013). Chemical Composition and some Functional Properties of Moringa, Leucaena and Gliricidia Leaf Meals. *Agriculture and Biology Journal of North America, 4*(1), 71-77.

Babayemi, O. J. (2006). Antinutritional Factors, Nutritive Value and *In Vitro* Gas Production of Folliage and Fruit of *Enterolobium cyclocarpum*. *World Journal of Zoology, 1*(2), 113-117.

Bansi, H., Wina, E., Matitaputy, P. R., & Tufarelli, V. (2014). Evaluation of Zapoteca Tetragona Forage as Alternative Protein Source in Ruminants' Feeding. *Italian Journal of Animal Science, 13*(1), 147-150.

Carew, B. A. R. (1983). *Gliricidia sepium* as Sole Feed for Small Ruminants. *Tropical Grassland, 17*(4), 181-183.

Demeyer, D. I. (1981). Rumen Microbes and the Digestion of Plant Cell Walls. *Agriculture and Environment, 6*(2-3), 295-337.

Detmann, E., Paulino, M. F., Mantovani, H. C., Valadares Filho, S. C., Sampaio, C. B., & Souza, M. A. (2009). Parameterization of Ruminal Fibre Degradation in Low-Quality Tropical Forage using Michaelis-Menten Kinetics. *Livestock Science, 12*6(1), 136-146.

Duncan, D. B. (1955). Multiple Range and Multiple F Tests. *Biometric, 11*(1), 1-42.

Fasae, O. A., Adesope, A. I., & Ojo, V. O. A. (2010). The Effect of Leucaena Leaf Meal Supplementation to Maize Residues on Village Goat Performance. *Journal of Animal and Plant Sciences, 10*(2), 1276 – 1282.

Fielder, S. E. (2009). Haematologic reference ranges. *Merck Manual, Veterinary Manual*. New Jersey, USA: Merck & Co., Inc.

Frutos, P., Hervás, G., Giráldez, F. J., & Mantecó, A. R. (2004). Tannins and Ruminant Nutrition – Review. *Spanish Journal of Agricultural Research, 2*(2), 191-202.

Ibrahim, M. N., & Jayatileka, T. N. (2000). Livestock Production under Coconut Plantations in Sri Lanka: Cattle and Buffalo Production Systems. *Asian Australian Journal of Animal Science, 13*(1), 60-67.

Jokthan, G. E. (2013). Intake and Digestibility of *Gliricidia sepium* by Bunaji Bulls. International *Journal of Research in Applied, Natural and Social Sciences, 1*(5), 9-23.

Jolaosho, A., Olanite, J., Omenogor, I., Amole, T., & Ogunlolu, B. (2011). Performance of Calves Fed With Hay, Silage and Browse Plant as Feed Supplement during the Dry Season. In *2011 International Conference on Asia Agriculture and Animal IPCBEE* (Vol. 13, pp. 76-80).

Kahn, L. P., & Diaz-Hernandez, A. (2000). Tannins with Anthelmintic Properties. In J. D. Brooker, (Ed.), *Tannins in livestock and human nutrition* (pp. 130-140). Adelaide, Australia: Australian Centre for International Agricultural Research.

Makkar, H. P. S., & Becker, K. (1999). Plant Toxins and Detoxification Methods to Improve Feed Quality of Tropical Seeds – Review. *Asian-Australasian Journal of Animal Science, 12*(3), 467–480.

Makkar, H. P., Blümmel, M., Borowy, N. K., & Becker, K. (1993). Gravimetric Determination of Tannins and their Correlations with Chemical and Protein Precipitation Methods. *Journal of Science of Food and Agriculture, 61*(2), 161-165.

Matlebyane, M. M. (2005). *Relationship between Chemical Composition, In Vitro Digestibility and Locally based Feeding Value Rankings and Medicinal use of some Common Forages for Ruminant Livestock in Three Chief Areas of Capricon Region of Limpopo Province, South Africa*. (Masters Dissertation). University of Limpopo, Department of Animal Production, South Africa.

Odeyinka, S. M. (2001). Effects of Feeding Varying Levels of *Leucaena leucocephala* and *Gliricidia sepium* on the Intake and Digestibility of West African Dwarf Goats. *Nigerian Journal of Animal Production, 2*8(1), 61-65.

Oni, A. O., Onwuka, C. F. I., Oduguwa, O. O., Onifade, O. S., Arigbede, O. M., & Olatunji, J. E. N. (2006). Utilization of Citrus Pulp Based Diet and *Enterolobium cyclocarpum* Foliage (Jacq. Griseb) by West African Dwarf Goats. *Journal of Animal and Veterinary Advances, 5*(10), 814-818.

Ranjhan, S. K., (2001). *Animal Nutrition in the Tropics* (5th Ed.) (pp. 556-559). New Delhi, India: Vikas Publishing House PVT Ltd.

RAR. (2009). *Reference Values for Laboratory Animals - Normal Haematological Values*. Research Animal Resource Websites, University of Minnesota.

Reynolds, L., & Atta-Krah, A. W. (2006). *Alley farming with livestock*. Paper presented at the International Workshop on Alley Farming for Sub-humid Region of Tropical Africa. IITA, Ibadan, Nigeria.

Richard, D. E., Brown, W. F., Rugsegger, G., & Bates, D. B. (1994). Replacement Value of Tree Legumes for Concentrates in Forages based Diets it Replacement Value of *Leucaena leucocephala* and *Gliricidia sepium* for Lactating Goats. *Journal of Animal Feed Science and Technology, 46*(1-2), 53-65.

Salam, N. A., & Elly, R. (2015). Potency of Fresh Cassava Leaves (*Manihot esculenta* crantz) as Natural Anthelminthic on Goat Performances. *Pakistan Journal of Nutrition, 14*(6), 358-361.

SAS. (1999). *SAS User's guide: Statistical Analysis system*. Cary North Carolina, USA: SAS Institute Inc.

Terosky, T. L., Wilson, L. L., Stull, C. L., & Stricklin, W. R. (1997). Effects of Individual Housing Design on Special Fed Holstein Veal Calf Growth Performance, Hematology and Carcass Characteristics. *Journal of Animal Science, 75*(7), 1697-1703.

Tufarelli, V., Khan, R. U., & Laudadio, V. (2012). Evaluating the Suitability of Field Beans as a Substitute for Soybean Meal in Early-Lactating Dairy Cow: Production and Metabolic Responses. *Animal Science Journal, 83*(2), 136-140.

Tufarelli, V., Lacalandra, G. M., & Laudadio, V. (2015). Reproductive and Metabolic Responses of Early-lactating Dairy Cows Fed Different Dietary Protein Sources. *Reproduction in Domestic Animals, 50*(5), 735-739.

Van Soest, P. J. (1994). *Nutritional Ecology of the Ruminant* (2nd Ed.). Ithaca, NY, USA: Cornell Univ Press.

Van Soest, P. J., Robertson, J. B., & Lewis, B. A. (1991). Method for Dietary Fibre, Neutral Detergent Fibre and Non-Starch Polysaccharides in Relation to Animal Nutrition. *Journal of Dairy Science, 74*(10), 3583-3597.

Villalobos, D. G., Naveda, R. P., Navarro, E., Razz, R., Castillo, G. S., & Moreno, A. Q. (2002). The use of *Gliricidia Sepium* in the Supplementary Feeding of Crossbred Female Calves. *Revista Científica, 12*(5), 384-387.

Wanapat, M., Polyorach, S., Boonnop, K., Mapato, C., & Cherdthong, A. (2009). Effect of Treating Rice Straw with Urea or Urea and Calcium Hydroxide upon Intake, Digestibility, Rumen Fermentation and Milk Yield of Dairy Cows. *Livestock Science, 125*(2), 238-243.