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COMPARATIVE EVALUATION OF NUTRIENTS AND ANTI-NUTRITIONAL CONTENTS OF *Canavalia ensiformis* and *Canavalia braziliensis* LEAVES

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ABSTRACT

The leaves of *Canavalia ensiformis* and *Canavalia braziliensis* were evaluated for their nutritive quality, minerals and anti –nutritional contents. They were harvested at the Pasture Demonstration Plot of the Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igbo-ora at 8 weeks of age after sowing and sub-samples were oven dried at 65 ^{0}C to determine the proximate composition, minerals contents and anti-nutritional factors of the two species of Canavalia. The results of proximate analysis indicated that *C. braziliensis* leaves had significant (P<0.05) higher dry matter (70.18 %) and Crude fibre contents (21.33 %) above that of *C. ensiformis*. Higher Iron content (194.30 mg/kg) was in *C. ensiformis*, while *C. braziliensis* leaves had higher Zinc content (55.31 mg/kg). Higher Trypsin (25.67 %) and lower HCN (2.69 mg/kg) contents were in *C. ensiformis* compared with *C. braziliensis* leaves. The result of this research revealed that *C. ensiformis* and *C. braziliensis* leaves appeared to have the potential as feed supplement due to high protein and mineral contents with relatively low level of anti-nutritional factors.

Key words: Canavalia species, leaves, nutrients contents, anti- nutritional factors

INTRODUCTION

The livestock industry in Nigeria have contributed substantially to the national wealth and for supplying the populace with essential animal protein required for good health and body maintenance (Upton, 1985). However, supplementation of animal protein is expensive and not easily affordable for livestock. In view of this fact, legumes provides a viable economical alternative in developing countries (Famurewa and Raji, 2005). Legumes have long shelf life and provide more proteins; abundant carbohydrates, high fibre, and low fat with high concentration of polyunsaturated fatty acids. *Canavalia ensiformis* (Jack bean) is considered to be a legume with the highest potential as an economic crop of all the *Canavalia* genus To fulfill the growing demands of plant-based proteins for humans and livestock need, research on the possibilities of employing underutilized legumes as inexpensive and elegant source of protein than the conventional sources has to be pursued. Some underutilized wild legumes adapted to adverse conditions have been explored for their nutritional advantages (Sridhar and Seena, 2006).

Canavalia spp is high yielding and produces nutritious pods. It is a food in marginal areas where other pulses have failed and is high in green manure forages and helps in soil erosion control (Smatt, 1990). *Canavalia ensiformis* tolerates a wide range of soil texture and fertility. It can grow well on leached and nutrient depleted soil. Once established its deep root system allows the plant to utilize stored soil moisture and thus could survive dry season. The plant produces a large bulof green fodder and the leaf contains adequate level of crude protein (Sridhar and Seena, 2006).

Anti-nutritional factors (ANF) in *Canavalia* foliage are chemical substances present in products; although non-toxic but generate adverse physiological responses in animal that consumes them. In most cases, ANF interferes with the utilization of nutrients in legume products (Nwokolo, 1996), their presence could cause flatulence. Okeola and Machuka (2001) have identified presence of some ANF such as tannin, saponin, trypsin inhibitors, phytates and oxalate, HCN in *Canavalia* foliage. The present study focus on comparative evaluation of nutrient contents and anti-nutritional factors present in both leaves of *Canavalia ensiformis* and *Canavalia braziliensis.*

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, Pasture Units of Oyo State College of Agriculture and Technology, Igboora in the Derived Savanna Zone of Nigeria. Igboora is located within 7^0 15 North and 3^0 30 East of the equator with an average annual rainfall of 1278mm and average annual temperature 27 ^{0}C.

The leaves of *Canavalia ensiformis* and *Canavalia brasiliensis* were obtained from existing pasture demonstrated unit, Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igboora at 8weeks of age. About 500 g of each of the leaves were oven dried at 65°C until constant weight was obtained and ground to pass through 1 mm sieve for proximate composition according to AOAC (2000)

Calcium, Phosphorus, Potassium, Magnesium, Iron and zinc contents were determined using Vonadomolybdate Calorimetric Method AOAC, (2000).

Oxalate was estimated quantitatively by redox titration with standard potassium per manganite according to the procedure of Day and Underwood (1986). Saponin was determined using the method similar to that of Hudson and El- difrawl (1981), phytate was determined in accordance with the procedure of Ruales and Nair (1993). Tannin was determined in accordance with the procedure of AOAC (2000).

Statistical Analysis

Data obtained were subjected to one way analysis of variance using general linear model of SAS (2000). The significant means were separated using student T test.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of *Canavalia ensiformis* and *Canavalia braziliensis* foliage. The results indicated that *C. braziliensis* leaves had significant ($P<0.05$) higher dry matter (70.18 %) and crude fibre contents (21.33 %) above that of *C. ensiformis*. No significant difference ($P>0.05$) was recorded in other proximate parameters investigated.

The higher dry matter content indicated high shelf life of the foliage hence, long storage would not lead to spoilage due to its susceptibility to microbial attack during drying.

The crude protein recorded for both *Canavalia ensiformis* and *Canavalia braziliensis* were above 17.50% recorded for *Styolsanthes hamata* (Akinlade *et al*., 2007). The higher crude protein values in the two samples in the present study is above minimum of 7% crude protein requirement for ruminants which will provide ammonia requirement by rumen microorganism to support optimum microbial activity. Both foliage could serves as potential protein supplement and will enhance the intake and utilization of low quantity grass and fibrous crop residue by ruminant.

The ether-extract content of the two foliage fell within the range of 4-10% recommended (Campbell *et al*., 2006). Meanwhile, lower value of 1.89% was reported for *Canavalia ensiformis* leaves by Akinlade *et al*. (2007).

Differences could be as a result of age and season of harvest. The value of ether extract in the present study is an indicator of high energy level for ruminant animals (Babayemi and Bamikole, 2006) and this is a major form of energy store in plant which is been utilized by the animal for body maintenance and production.

Crude fibre contents in the Canavalia species investigated in this study was higher compared with 14.80% *Mucuna utilis* leaves reported by Ujowundu *et* al. (2010). Adequate fiber contents in diets assist in normal functioning of the intestinal tract animals. It increase stool bulk and decrease the time that waste materials spend in the gastro intestinal tract. Hence, Canavalia foliage could be recommended as a veritable crude fibre source in the diet as a result of its relatively high fibre content.

The ash contents of the two Canavalia species were observed to be higher than the value of 0.11% reported for *Mucuna utilis* leaves by Ujowundu *et al*. (2010) and also above 5.08% in *Psophocarpus tetragonolobus* leaves reported by Alalade *et al*. (2016). The values obtained for the present study fell within the range of 3.00 – 9.65% reported by Okoli *et al*. (2001). The proportion of ash content present is a reflection of mineral contents present in the feed material (Omotosho, 2005). This suggests that the samples could be a better source of essential valuable and useful minerals needed by ruminants for good body development.

Table 1: Proximate Composition of *Canavalia ensiformis* and *Canavalia braziliensis* leaves.

Proximate Composition (%)	*Canavalia ensiformis*	*Canavalia braziliensis*	SEM
Dry matter	60.90[b]	70.18[a]	0.43
Crude protein	19.88	18.27	0.39
Ether extract	5.39	4.16	0.16
Crude fibre	16.53[b]	21.33[a]	0.26
Ash	9.65	8.78	0.11

[ab:...]Means in the same column with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

Results of the mineral contents of both *Canavalia ensiformis* and *Canavalia braziliensis* foliage are present in Table 2. Higher Significant ($P<0.05$) content iron (194.30 mg/kg) was observed in *C. ensiformis*, while *C. braziliensis* leaves had higher Zinc content (55.31 mg/kg).

The mineral analysis of a plant gives the idea of possibility either the plant should be used for any feeding trial purpose. The phosphorus content for both *Canavalia ensiformis* and *Canavalia braziliensis* foliage was higher 0.15% recommended (NRC, 1985). The level of phosphorus in both foliages was consistently above 0.2% level which could satisfy livestock dietary maintenance requirement (NRC, 1985). Phosphorus plays an important role in carbohydrate, lipid and amino acid metabolic.

The concentration of potassium in this study were higher than 0.84% in *Psophocarpus tetragonolobus* leaves (Alalade *et al.*, 2016) and in 0.46% in *Canavalia ensiformis* leaves (Akinlade *et al.*, 2007). Moreover, result in this study was also higher than 0.18% recommended for grazing animals (Underwood, 1981).

The calcium content of both *C. ensiformis* and *C. braziliensis* foliage were within the value (0.30%) in *Psophocarpus tetragonolobus* leaves (Alalade *et al*., 2016). The forage calcium values found in this study were considered adequate for optimum performance of ruminants. The calcium contents of plants in this study will meet the theoretical calcium requirement of 0.30% calcium diet for all forms of production in ruminants (ARC, 1980). Calcium helps in the regulation of muscle contraction required by kid, weaner and foetus for bone and teeth development of animals (Margaret and Vickey, 1997).

Magnesium contents found in this present study were above 0.12 – 0.20 % requirement of ruminant's diet suggested by NRC, (1985). Magnesium is an important mineral element in connection with its role in circulatory disease such as ischemic heart disease and calcium metabolism in the above (Hassan and Umar, 2006).

Iron levels obtained on both foliage in the present study were above (50mg/kg) sufficient requirement of ruminants for optimal performance and also above the critical level of Fe in animal tissue (30 -50mg/kg) (Mc Dowell, 1985). This implies that the leaves are good source of dietary iron and its said to be an important element in the diet of pregnant animals, nursing animals, infant and other related disease (Oluyemi *et* al., 2006).

The concentration of Zinc in the plant samples were higher than 44.3mg/kg recorded for *Clitoria ternatea* leaves by Swati and Varsha (2014). It has been suggested that 30mg/kg Zinc is a critical dietary level, although it has been recommended that concentrate of 12-20mg/kg are adequate for growing ruminants (Anonymous, 1980). Zinc is a trace element for protein and nucleic acid synthesis and normal body development during period of rapid growth such as infancy and recovery from illness (Melaku *et al*., 2005).

Table 2: Mineral Composition of *Canavalia ensiformis* and *Canavalia braziliensis* leaves

Minerals Content (%)	*Canavalia ensiformis*	*Canavalia braziliensis*	SEM
Phosphorus	0.36	0.36	0.09
Potassium	0.88	0.94	0.11
Calcium	0.35	0.34	0.14
Magnesium	0.29	0.28	0.09
Iron (mg/kg)	194.30^{a}	181.30^{b}	1.75
Zinc (mg/kg)	52.89^{b}	55.31^{a}	0.83

$^{ab:\cdots}$Means in the same column with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

Table 3 revealed the level of anti-nutritional factor content in both *Canavalia ensiformis* and *Canavalia braziliensis* foliage. Higher ($P<0.05$) trypsin (25.67 %) and lower HCN (2.69 mg/kg) contents were in *C. ensiformis* compared with *C. braziliensis* leaves.

The *tannin* contents in Canavalia were lower than 5% at which goats may reject feed. *Tannin* at this level protects liable plant protein in the rumen and consequently increases the supply of high quality protein into the duodenum (Mcleod, 1974).

Very low oxalate contents were determined in the present study which was lower than 20g/kg that can be lethal to chicken (Acamovic *et al*., 2004). Oxalate has been shown to deplete the calcium reserves but the browse plants were found to contain responsibly amount of calcium, magnesium and phosphorus (Akinsoyinu and Onwuka 1988). Calcium carbon is also released from hydrolysis of calcium oxalate, some of which will be either absorbed or excreted by the ruminant animals.

Feedstuffs containing saponin had been shown to be defaulting agent (Teferedegne, 2000) and capable of reducing methane production (Babayemi *et al*., 2004). Saponin have effect on erythrocyte hemolysis reduction of blood and liver cholesterol, depression of growth rate, bloat (in ruminant), inhibition of smooth muscle activity, enzyme inhibition and reduction in nutrient absorption. Saponin have been reported to alter cell wall permeability and therefore to produce some toxic effect when ingested (Belmar *et al*., 1999).

The phytate content of both *Canavalia ensiformis* (0.62%) and *Canavalia braziliensis* (0.63%) Lower phytate contents of the two plants were recorded when compared with 25mg/100g reported by Amata (2010) for leaves of *Myrianthes arboreus*. The negative effect of phytate in nutrition is the chelating of certain essential element such as Ca, Fe, Mg, and Zn. Nevertheless, phytate are considered as phytol nutrient providing an antioxidant effect and their mineral binding properties prevent colon cancer by reducing oxidative stress in the lumen of the intestinal tract (Vucenik and Shamsuddin, 2003).

Trypsin inhibitor is protease inhibitor occurring in raw legume seeds. Protease inhibitors are the most commonly encountered class of anti-nutritional factors of plant origin. The trypsin inhibitor has been reported to be partly responsible for the growth retarding property of legumes and in reducing digestibility of protein and in pancreatic hypertrophy.

Table 3: Anti-nutritional contents in both *Canavalia ensiformis* and *Canavalia braziliensis* leaves.

Anti-nutrients (%)	*Canavalia ensiformis*	*Canavalia braziliensis*	SEM
Saponin	0.43	0.45	0.05
Oxalate	0.39	0.39	0.07
Phytate	0.62	0.63	0.11
Tannin	0.06	0.04	0.01
Trypsin Inhibitor	25.67^{a}	20.78^{b}	1.95
HCN (mg/kg)	2.69^{b}	3.85^{a}	0.13

$^{ab:\cdots}$Means in the same column with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

CONCLUSION

The result of this research work revealed that *Canavalia ensiformis* and *Canavalia brasiliensis* leaves appeared to have the potential as feed supplements due to high protein contents and minerals with relatively low levels of anti-nutrients factors. the two forages can be recommended as good protein suppliments to low quality roughages, especially during the dry season.

REFERENCES

Acamovic, T., Steward. C. S. and Pennycott, T. W, (2004). Poison plants and related toxins.

Akinlade, J. A., Farinu, G. O, Taiwo, A. A., Aderinola, O. A., Adebayo, T. A., Ojebiyi, O. O. and Olaniran, O. A. (2007). Agronomic and nutritive evaluation of Jack beans (*Canavalia ensiformis*) for fodder in the derived savannah zone of Nigeria. *International Journal of Agricultural Research*, 2(12):1059-1063.

Akinsoyinu, **A**. **O**. **and Onwuka**, **C**. **F**. **I**. (**1988**). Mineral constituents of some browse plants used in ruminant feeding in southern Nigeria. *Nigerian Journal of Animal Production* 15:57-62

Alalade, J. A., Akinlade, J. A., Aderinola, O. A., Fajemisin, A. N., Muraina, T. O. and Amoo T. A. (2016). Proximate, Mineral and Anti-nutrient contents in *Psophocarpus tetragonolobus* (L) DC. (Winged bean) leaves. *British Journal of Pharmaceutical Research*, 10(2):1-7 2016.

Amata, I. A. (2010). Nutritive value of leaves of *Myranthus arboreus*: A browse plant. *Int. J. Agric. Res.*, 5:576-581.

Anonymous (1980). Analytical Method, for atomic absorption Spectrophotometry Perkin Elmer Corporation, nor work, Cummenticut; 1980.

AOAC (Association of Official Analytical Chemists). 2000. *Official Methods of Analysis*. 16th edn. Association of Official Analytical Chemists, Arlington, VA, USA.

ARC. (1980).The nutrient requirement of ruminant livestock 4th ed. 73-310. CAB International. Wallingford; 1980.

Babayemi, O. J., Demeyer, D. and Fievez, V. (2004). *In vitro* rumen fermentation of tropical browse seeds in relation to their content of secondary metabolites. *J. Anim. Feed Sci.*, 13, Suppl. 1:31-34.

Babayemi O. J. and Bamikole M. A. (2006). Some productive and nutritive effects of *Tephrosia brotealata*, *Tephrosia candida*, *Leucaena leucocephala* and *Gliricidia sepium* hay for West Africa Dwarf goats kept on range. Journal of Central European Agriculture. 2006:7(2):323.

Belmar, R., Nava-Montero, R., Sandoval-Castro, C. and Menab, J. M. (1999). Jack bean (*Canavalia ensiformis* L.DC) in poultry diets; Anti-nutritional factors and detoxification studies. A. Review. *Poultry Sci. J.* 55(1)37-59.

Campbell Kli, Garforth C., Heffernan, C., Morton, J., Paterson, R., Rymer C. andUpton, M. (2006). Small stock in development Natural Resources International LTD. Aylesford, Kent, UK

Day, R. A. and Underwood, A. L. (1986) Quantitative Analysis. 5th Edition, Prentice Hall Publication, Upper Saddle River, 701.

Famurewa, J. A. V. and Raji, A. O. (2005). Parameters affecting milling qualities of undefatted soybeans (*Glycine max*, 1 Merill) (1) selected thermal treatment. *Int. J. Food Eng.*, 1:19-19.

Hassan, L. G. and Umar, K. J. (2006). Nutritional value of Balsam apple (Momordica balsamina L.) leaves. *Pakistan Journal of Nutrition*, 5. Pp.522–529.

Hudson, B. J. F. and El-Difrawl, E. A. (1981). The sapoagenins of the seeds of four ipin species. *J. Plant Foods*, 3: 181-186.

Margaret, L. and Vickery, B. (1997). Plant products of tropical Africa. Macmillan in College Ed. London; 1997.

McDowell, L. R. (1985). Calcium, Phosphorus and Flourine. In: Nutrition of Grazing Ruminants in Warm Climates (Ed): L. R. McDowell. Academic Press, Orlando, Florida. Pp.189–212.

McLeod, M. N., (1974). Plant tannin. Their role in forage quality. Nutrition Abstracts and Reviews 1974; 11: 803-815.

Melaku, U., Clive, E. W. and Habtamon, F. (2005). Content of zinc, iron, calcium and their absorption inhibitors in Ethiopia. *Journal of Food Composition Analysis*, 18:803-817.

NRC (1985). National Research Council Recommended Dietary Allowance, National Academy Press, Washington D. C.

Nwokolo, E. (1996). African Yam Bean In: Harms in legumes and oil seeds in Nutrition. ed. Nwokolo and J. Smart, chapman and hall, London. pp. 183 – 188.

Okeola, O. G. and Machuka, J. (2001). Biological effects of African yam bean lectin on *Clavigralla tomentosicollis* (Hemiptera: Coreidae), J Econ Ent., 94:28-34.

Okoli, I. C., Ebere, C. S., Emenalom, O. O., Uchengbu, M. C. and Esonu, B. O. (2001). Indigenous livestock paradigms revisited 11: An assessment of the proximate value of most preferred indigenous browses of South Eastern Nigeria. *Tropical Animal Production Investigation*, 4, No. 2, Pp. 99 – 107.

Oluyemi, E. A., Akilua, A. A., Adenuya, A. A. and Adebayo M. B. (2006). Mineral contents of some commonly consumed Nigerian foods. *Science Focus*, 2006;11(1):153-157

Omotosho, O. T. (2005). Nutritional quality, functional properties and anti-nutrient composition Of the leaves of cirinaforda (Westwood) (*Lepidoptera saturnidae*). *Journal of Zhejiang University of Science* 7(1); 51-55. Oxford University press, Pp.608.

SAS (2000). Statistical Analysis System (SAS) User's Guide. SAS Institute Inc., North Carolina, USA.

Smartt, J. (1990). Tropical Pulses. Longman Group Ltd., London, Pp.348.

Thompson, A.K. (1996). Post-harvest treatment; in post-harvest Technology of Fruit and vegetables, Blackwell science Ltd. Cambridge, mass. Pp.95–128. Upton, M., (1985). Returns from small ruminant production in Southwest Nigeria. *Agric. Syst.,* 17: 65- 68.

Sridha, K. R. and Seena, S. (2006). Nutritional and anti-nutritional significance of four unconventional legumes of the genus Canavalia-A comparative study. *Food Chem*., 99:267-288.

Swati, D. and Varsha, J. (2014). Bromatological and minerals assessment of *Clitoria ternatea* leaves. *International Journal of Pharmacy and Pharmaceutical Sciences*, 6:3

Teferedegne, B. (2000). New perspective on the use of tropical plant to improve ruminant nutrition. *Pro. Nutr. Soc*., 59; 209-214.

Ujowundu, C. O., Kalu, F. N, Emejlu, A. A., Okafor, O. E., Nkwonta, C. G. and Nwosunjoku, E. C. (2010). Evaluation of the chemical composition of *Mucuna utilis* leaves used in herbal medicine in South Eastern Nigeria. *Africa Journal of pharmacy and pharmacology* 4(11):811-816.

Underwood, E. J. (1980).the mineral nutrition of livestock. Commonwealth Agricultural Bureaux, Slough, England. 1981; 10.

Vucenik, I. and Shamsuddin, A. M. (2003). Cancer inhibition by inositol hex phosphate (1p6) and inositol; from laboratory to clinic. *J. Nutri*. 33:3778-3784.