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STUDIES ON THE POTENTIAL OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA L. VERDC.*) AS AN ANIMAL FEED

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SUMMARY

Animal production is more prevalent than crop production in Botswana because this country is an area prone to drought. However the major challenge to livestock owners is the production and procurement of suitable animal feed. As a result most of the animals are free range and they feed on grasses and browses. Generally these have a low protein content (4.2-10.7%) and some of them are poisonous. This study was undertaken to investigate other sources of nutrients. The proximate composition, energy, mineral and tannin contents of four landraces of bambara groundnut which thrives in poor soils and in drought prone areas were determined. The AOAC methods were used in the determination. The condensed tannin content was estimated using the butanol/HCl method. The range of results (%) obtained were: energy 416.4-437.2 calories, dry matter 91.6-93.0, crude protein 15.2-17.3, crude fat 6.6-7.3, ash 3.7-4.3, crude fibre 3.1-3.9, carbohydrate 60.2-63.6, and tannins 28-88 (mg/100 g). For the minerals the concentration in mg/100g were: P 517-642, Na 3.9-5.7, K 399-426, Ca 25-42, Mg 137-147, and Fe 7.5-12.2. The results indicated that the amount of crude protein, carbohydrate, P, K, and Mg would be useful in formulating livestock feeds in Botswana. This legume can be used in supplementing the animal feeds currently used.

Keywords: Botswana, bambara groundnut, proximate composition, minerals, energy, tannins

INTRODUCTION

Livestock processing is one of the major industries in Botswana. The estimated livestock (cattle, goats, sheep, donkeys, horses, chicken, pigs) population in 1995 was 9 million (C.S.O. 1999), of these 2.5 million was cattle. The livestock population is many times more than the human population of 1.5million. Beef is a major export commodity. In 1997/98 15,264 tons of boneless beef were exported to the European Union (Botswana Meat Commission, 1998). Because of the outbreak of the *Bovine Spongiform Encephalopathy* (BSE) disease, one of the requirements of the European Union is that cattle should not be fed with animal products. Therefore feeds such as carcass meal, bone meal and poultry waste can no longer be used. A major challenge to livestock owners is the production and procurement of suitable animal feed. Mpapho (2000) reported that the most popular system for feeding for dairy cattle is continuous grazing. The animals feed on grasses and browses that are low in protein content (4.2-10.7%) and some of them are poisonous.

Natural pasture is the main source of livestock feed in Botswana. Rainfall patterns are erratic resulting in poor quality and quantity of these pastures. Because of these factors farmers resort to alternative means of obtaining animal feed. These include harvesting and storing crop residues, and the use of locally available industrial by- products such as wheat bran and carcass meal. Some commercial farmers import cattle feed such as lucerne, (alfalfa, *Medicago sativa)* from South Africa (Pelaelo and Karikari, 2000). Mphapo (2000) observed that imported feeds are expensive and that there is competition for industrial by-products. Aganga *et al.* (2000 a) noted that the cost of feeding is the largest expenditure incurred by ostrich farmers. A way of reducing cost is the use of legume seeds. They have a high crude protein, phosphorus and potassium content, which has resulted in their use as supplementary feed for livestock. Most legumes have a crude protein content which is more than the livestock maintenance requirement (7%), and they can be used with cereals and industrial by-products to enhance nutritional status of livestock (Pelaelo and Karikari, 2000). One legume that can be used is the under utilised crop, bambara groundnut. It is an annual herbaceous plant and the pods develop under ground . The pods bear one or two seeds, which are about 1.5cm in diameter, and are smooth rounded or flattened and hard (Nwokolo, 1996). The colour may be white, cream, brown, red, mottled or black . This crop grows in Sub Saharan Africa and it thrives in soils that are poor in nutrients (Doku and Karikari, 1971) and in drought prone areas like Botswana. The seeds are cultivated mainly for food. However they can be used as livestock feed. In a feeding experiment with rabbits in Botswana, Aganga *et al.* (2000a) concluded that bambara groundnut meal or Lucerne can be fed as protein sources to rabbits. Oluyemi *et al.*, 1976 successfully included raw autoclaved bambara groundnut seeds at 40% of the basal ration for chicks. In order to meet the challenge of providing feed for animals other feed

sources are being researched. This paper provides information on the chemical composition of four landraces of bambara groundnut with a view of exploiting their potential as an animal feed. The results obtained were compared with those of commonly used animal feeds such as sun cured lucerne (*Medicago sativa*) and lablab (*Lablab purpureus* (L.Sweet).

MATERIALS AND METHODS

Seeds of four landraces ,Gaborone speckled (black and white), Gaborone black, (black), OM2 (red). and Dipiri red (red) were obtained from local farmers. The matured. undamaged seeds (100 g) of each landrace were milled in a Thomas-Wiley Laboratory mill to pass through a one mm sieve. The weighed samples were dried in the oven at 80° C to constant weight and the dry matter calculated. These samples were used to determine crude protein. crude fibre, crude fat. and ash using the AOAC (1996) procedures. All analyses were carried out in triplicate and the mean calculated. For the determination of ash two gram samples were heated in pre weighed crucibles in a muffle furnace (Labcon. Type RM7) overnight at 500°C. They were allowed to cool to room temperature in a desiccator and then weighed. The crude fat was extracted using petroleum ether (40-60) as a solvent in a Soxtec HT6 system manufactured by Tecator limited, Bristol, United Kingdom. The analysis of crude fiber was according to Weende's method (as specified by the manufacturer's handbook) using a Fibretec System M manufactured by Tecator. For the protein determination the Kjeldahl method was used to analyze the samples. The nitrogen determined was converted to protein by multiplying by 6.25. The Kjeldahl apparatus was manufactured by Gerhardt Laboratory Instruments. West Germany. Carbohydrate (CHO) was calculated by difference. CHO =crude fibre + nitrogen free extract (NFE) where NFE= 100- (%moisture +%crude fibre + % ether extract + %crude protein). The digested samples used for the protein determination were used for the estimation of the minerals. The latter determined were: Ca, K. Mg, Na, P, and Fe. Ca, Fe, and Mg were measured using a GBC 908 Atomic Absorption Spectrophotometer. P was determined using Shimadzu Ultraviolet-Visible spectrophotometer 1601 PC. Both Na and K were evaluated using a Corning 410 flame photometer. For the condensed tannin determination, the samples were dried at 40°C. and extracted with 70% aqueous acetone. Condensed tannins were quantified using the butanol/HCl method of Makkar (1995). Energy was estimated with a Sanyo Gallenkamp bomb calorimeter. The nutrient contents of the bambara groundnut analysed were compared with those of popularly used feeds; lucerne and lablab .

RESULTS AND DISCUSSION

Details of the results are given in Tables 1 and 2. Table 1 gives proximate composition and Table 2 the mineral contents. The values (%) obtained were : dry matter 91.6-93.0, crude protein 15.2-17.3, ash 3.7-4.3. crude fat 6.6-7.3,crude fibre 3.1-3.9 and carbohydrate 60.2-63.6. The amount of dry matter, crude protein. crude fat. ash and carbohydrate were similar to those previously reported (Enwere and Hung.1996; Amarteifio *et al.* .1997). The speckled landrace had the highest crude protein (17.3%) and ash (4.3%) contents. These were significantly different form those of the other landraces.

Table 1. The proximate composition and tannin contents of bambara groundnut

Component	Land race			
g/100 g DM	G. spec.	G. black	D. red	OM2
Dry matter	91.8	92.2	93.0	91.6
Energy (kcal)	416.4	430.5	437.2	426.1
Crude protein	17.3	15.5	15.5	15.2
Crude fat	6.6	7.2	7.2	7.3
Ash	4.3	3.9	3.7	3.8
Crude fibre	3.3	3.5	3.1	3.9
Carbohydrate	60.2	62.1	63.6	61.7
C. tannins. (mg/100g)	0.88	0.63	0.28	0.52

Landraces:,G.spec.,Gaborone speckled; G.black, Gaborone,black: D.red, Dipiri red.

The quantity of crude fibre (3.1-3.9%) determined in this study is less than the 4.9% . obtained by Enwere and Hung (1996) .5.7-6.5 % noted by Amarteifio *et al.*. (1997) and 5.2% reported by Aganga *et al.*, 2000b). The OM2 had the highest amount of fibre and it was different from those of the other landraces. The energy value of 416.4- 437.2 kcalories is more than the 367 kcalories reported by Duke (1981). The result obtained shows that bambara groundnut is a good source of energy. The

tannin contents were low (28-88mg/100 g) compared with the 0.16-0.86 % (catechin equivalents) reported by Amarteifio *et al.*, (1998). However a similar observation was made indicating that the black landraces had more tannins than the red landraces. The low level of tannins is acceptable as they may not precipitate the protein.

Table 2 indicates that the Gaborone speckled had the highest concentration of P, Na, K, Ca, Fe, and Mg, when compared with the other landraces. The P, Na, K, and Ca contents were significantly different from those of the other landraces. The Mg contents were not different from those of the other landraces. The Na (3.9-5.7 mg/100 g), Mg (137-147 mg/100 g) and Fe(7.5-12.2 mg/100 g) values are similar to those reported (Amarteifio *et al.*, 1997; Moholo,1997; Aganga, 2000b). The P concentration (517-642 mg/100 g) is slightly higher than the 310 mg/100g (Nwokolo, 1987). 296mg/100 g (Moholo,1997) and 214 mg/ 100 g (Aganga *et al.*, 2000b) reported. The 399-426mg/ 100 g obtained for K is much lower than the 1134-1435mg/ 100 g cited by (Amarteifio *et al.*, 1997) and 1300mg /100 g assessed by Aganga *et al.* (2000b). Similarly the concentration of Ca (25-42mg/100 g) was lower than the reported values of 95.8-99.9 mg/ 100 g (Amarteifio *et al.*,1997), and 78 mg/ 100 g (Moholo, 1997), but more than the 14mg/ 100 g (Aganga *et al.*, 2000 b) previously reported. The differences may be due to the different landraces analysed, management of crops and analytical methods used.

Table 2. Mineral composition of four landraces of bambara groundnut

Mineral	Landrace			
mg/100 g DM	G. spec.	G. black	D. red	OM2
P	642	533	567	517
Na	5.7	4.5	4.5	3.9
K	425.9	409.3	397.3	399.5
Ca	42.8	25.5	30.8	26.5
Fe	12.2	12.0	7.5	11.3
Mg	147.3	142.8	137	137.8

Table 3 compares the crude protein, crude fibre, Ca, P, Mg , Na, K and Fe contents of sun cured lucerne, and lablab, with those of the mean values for bambara groundnut. The crude protein of 15.9% for bambara is similar to the 16.0% and 16.6% for sun cured lucerne and lablab respectively. It is more than twice the required livestock maintenance value of 7%. The crude fibre content of 3.4% is low compared with the 32% and 30.3% for sun cured lucerne and lablab respectively. Calcium, Potassium and phosphorus are important minerals in animal nutrition. The amount of phosphorus in bambara groundnut (0.56%) is more than that of sun cured lucerne (0.19%) and lablab (0.18%). For the other minerals Ca, Mg, Na, K and Fe, the amounts in sun cured lucerne and lablab are more than that of bambara groundnut. Since lucerne is imported and it is expensive, it can be supplemented with bambara groundnut. The levels of crude protein, carbohydrate, condensed tannins , K, P and Mg indicated that bambara groundnut could be valuable in formulating feed stuff. One or all of the four landraces can be used as a feed supplement.

Table 3. Comparison of the nutrient content of sun cured lucerne, lablab and bambara groundnut meal

Nutrient(%)	Sun cured lucerne	*Lablab	Bambara meal
Crude protein	16.0	16.6	15.9
Crude fiber	32	30.3	3.5
Ca	1.16	1.06	0.03
P	0.19	0.18	0.56
Mg	0.24	0.41	0.14
Na	0.03	0.02	0.005
K	1.68	1.93	0.41
Fe (ppm)	195	300	107

Source- * Macala, *et al.* (1995). #Aganga and Nsinamwa ,M. (1997).

CONCLUSION

The amount of crude protein, . carbohydrate, P, K and Mg would be useful in formulating livestock feeds. Bambara groundnut can be used in supplementing animal feeds currently being used.

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