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Mineral and Antinutritional Contents of Some Forage Legumes Consumed by Small Ruminants in the Derived Savanna of Nigeria

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Abstract: Experiment were conducted to evaluate the nutritive of 15 forage legumes collected from 5 locations Ogbomoso local government area of Oyo state in Nigeria. Analysis carried out for macro and micro-mineral contents of these plants showed high percentages of Mg (0.31), P (0.28), Ca (1.25), Na (0.02) and K (2.44). Overall mean levels were 23.64 ppm for Zn, 315.66 for Fe, 86.42 for Mn, 9.43 for Cu and 108.90 for Se. In all forages the concentrations of physic-acid (28.55-316.22mg g^{-1}), physic-phosphorus (20.1792.50 mg g^{-1}), oxalates (0.540.82) and nitrates (0.13-0.66%) were moderate to high. Saponin and hydrogen cyanide contents were inherently low or low due to a high drying temperature of the samples. Tannin acid differed considerably among the different species, being absent or low in some forages and extremely high in others. These differences may be genetic or due to cultural practices and soil composition. The nutritional implications of the results are discussed.

Key words: Antinutritional contents, derived savannah, forage legumes, mineral

INTRODUCTION

A major constraint to the use of legumes as a livestock feed is the presence of toxic and antinutritional constituents. These constituents have different but adverse effects on animal performance including loss of appetite and reductions in dry matter intake and protein digestibility. Tannins inhibit the utilization of nutrients through enzyme inhibition and reduced forage digestibility (Onwuka, 1983). Phytates chelate several mineral elements, especially Ca, Mg, Fe and Mo and interfere with their absorption and utilization (Olognobo, 1980). Oxalates affect Ca and Mg metabolism (Oke, 1969; Galloway and Cowling, 2002) and complexes which have an inhibitory effect on peptic digestion (Obon, 1986). The saponins act on the cardiovascular and nervous systems as well as on the digestive system. Large doses of legume juices containing saponins cause distention of the rumen (Gestetner *et al*., 1966). Cynanogenic glycosides impart a bitter taste, reduce palatability and cause toxicity. Infact plants contain little, if any, free hydrogen cyanide but this may be formed rapidly under the influence of β-glucosidase in cells injured by freezing, drying or maceration.

There are no data on nitrate phytate and some other antinutritional contents of perennial forage legumes in Nigeria. Some data on tannic acid are available for some perennial forage grasses and browse species (Okwuka 1983; Offiong and Awah, 1988). This study therefore provides information on the mineral elements and antinutritional toxic factors in some Nigerian forage legumes.

MATERIALS AND METHODS

Samples of 15 forage legume eaten by small ruminants were collected at 5 sites in Ogbomoso, Oyo State, Nigeria. Samples were moved with a scythe at various heights above the ground, chopped and wilted in the field. Grab samples of the wilted forage were taken, oven-dried at 70°C for 48 hour cooled and milled in a Christy-Norris grinder. Ground samples of about 500g were sealed in cellophane bags and stored at 40°C until required for analysis.

Contents of Mg, Zn, Cu, Fe and Mn were determined using the Parkin-Elmer atomic absorption spectrophotometer. A flame photometer was used for Na, K and Ca:P and Se were determined by standard methods (AOAC, 1990), saponin (Gestetner *et al*., 1966) , phytin-as physic acid and phytin-phosphorus (Young and Greaves, 1940) oxalate (AOAC, 1990), hydrocyanic acid (Tewe, 1980; Wood, 1965) and nitrate (Jackson, 1958) were determined by standard methods. Determinations were made on a dry weight basis.

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RESULTS AND DISCUSSION

The mean Phosphorus content was 0.25+0.02%. All the legumes for which Phosphorus was determined contained more than the 0.15% recommended for livestock. The highest level (0.42%) occurred in *Calopogonium mucunoides* and *Carnavalis ensiformis*. The Calcium content ranged from 0.40% to 1.57% with a mean value of 1.03+0.06%. These values compare favourably with other Nigerian results (Okwuka, 1983; Agishi, 1985; Ifut, 1987). All the forage legumes contained more than 1.6g kg^{-1} DM, the level generally recommended for non-lactating goats (NRC, 1981). Results obtained for Mg were lower than those found elsewhere in Nigeria (Offiong and Awah, 1988). This could result from the season in which the forage legumes were collected coupled with the fact that most soils in southern Nigeria are predominantly acidic. Ratios of Ca/P were higher than the recommended range of 1 to 2 (NRC, 1981) in most of the samples except for *Cajanus cajan* and *Crotolaria retusa*.

Mean values of Na and Cl were 0.05 and 0.02%. Based on the dietary values of 0.5% recommended for goats (NRC, 1981). Na was deficient in all the legumes. Levels of K were high in *Calopogonium mucunoides* (2.0%), *Carnavalia ensiformis* (2.05%), *Desmodium scropiurus* (2.55%), *Stylosanthes scabra* (2.36%), *Stylosanthes guyanensis* (2.59%) and *Teramus labialis* (2.10%). The levels of K in all the forages with the exception of *Cajanus cajan* (0.75%), *Centrosema pubsecens* (0.45%), *Dolichos lablab* (0.78%) and *Peuraria phaseoloides* (0.70%) were above the 0.80% recommended for lactating ewes and ewes (NRC, 1981). The K levels in *Centrosema pubescens* was lower than the maintenance requirement of 0.5% for non-lactating ewes and does (NRC, 1981).

A mean value of 240.3+39.64 ppm was obtained for Fe, the range being 60-633 ppm. Most legumes contained less than the 350 ppm recommended for ewes and does (NRC, 1981). The level of 45 ppm of Zn recommended for goats (Mba, 1981) was not found in any of the samples. The mean for Mn was 90.92+6.52 ppm in the range 43 to 146 ppm. Only 12 legumes had Mn values above the recommended 90 ppm (NRC, 1981). The mean value for Cu was 7.79+0.63 ppm a nd the range 3.5 to 14.5 ppm. Based on the 10 ppm recommended for goats Mba, 1981), the Cu levels in all legumes except *Centrosema pubescens* (130 ppm), *Stylosanthes h u milis* (11.5 pm) and *Peuraria phaseoloides* (14.0 ppm) were below the recommended value.

Toxic and antinutritional factors: Phytin content ranged from 89.2mg g^{-1} in *Cajanus cajan* to 316.4 mg g^{-1} in *Vigna marina*. The corresponding phytin-phosphorus ranged from 24.8 to 92.5mg g^{-1} with an overall mean of 61.25+3.51 mg g^{-1}. These values compare with those reported elsewhere for leafy vegetables (Ojenuga, 1960) and for cowpea and limabean (Olognobo, 1980) where phytin is the major Phosphorus store.

Mean tannin content was 5.05+0.75% in the range 0.00% to 10.72%. The wide variation in tannin contents suggests considerable differences in the nutritional quality of the different species. The level of tannin which adversely affects digestibility in sheep and cattle is between 2% and 5% (Diagayete and Huss, 1981). With the exception of *Lablab purpureus* (10.13%), *Stylosanthes gracilis* (10.72%) and *Tefrosia vogelli* (10.03%), it would appear that most of the forage legumes analysed in this study contained tannin at levels tolerable to the animals.

Saponin levels were low, as found in other studies (Gestetner *et al*., 1966). From the levels obtained in this study, it is not likely that the saponin content of forages will affect their nutritional potentials to any significant extent.

Oxalate contents were similar in all samples. Values ranged between 0.52 mg^{-1} 100 g^{-1} and 0.82 mg^{-1} 100 g^{-1}, with a mean of 0.67+0.02 mg^{-1} 100 g^{-1}. Oxalates affect Ca and Mg metabolism (Onwuka, 1983) but ruminants, unlike monogastric animals, can consume considerable amounts of high-oxalate plants without adverse effects, due principally to microbial decomposition in the rumen (Oke, 1969).

Hydrocynic acid contents were low due to the high drying temperature employed during sample preparation (Olognobo and Fetuga, 1984). Iodine and protein deficiency syndromes might be the sole etiological factors in a number of endocrine and neurological anomalies observed during cyanide toxicity in animals (Tewe, 1980).

Nitrate values ranged from 0.13% in *Centrosema pubescens* to 0.51% in *Lablab* purpureus with an overall mean of 0.32+0.02%. On a comparative basis the nitrate contents were high in *Lablab purpueus* and *Crotolaria spp*. Contents in *Centrosema pubescens*, nutrition, since a high concentration of nitrate is known to be toxic. Nitrate LD_{50} is about 45g^{-1} 100 kg^{-1} body weight when given to cattle and 25g^{-1} 100 kg^{-1} when given to goats (Crawfond *et al*., 1966). Nitrate per se may not be toxic to animals but may be reduced by rumen bacteria to nitrite which then causes poisoning through combination with haemoglobin to form a brown pigment, methaemoglobin, which is incapable of transporting oxygen to body tissues (Apata, 1987). The nitrite is further reduced to ammonia to be utilized by the ruminant.

It is not likely that the nitrate levels obtained in this study are high enough to produce adverse effects on animal performance. The validity of this statement needs to be verified by appropriate feeding trials to investigate the actual levels of antinutritional factors that are toxic, the fate of the absorbed substances and their cumulative effects on the animal. For the animal to fulfill its potentialities, the effects of factors which not only reduce dry matter intake and digestibility but also decrease nutrient utilization and cause metabolic disorders should be reduced or eliminated.

CONCLUSION

These investigations have demonstrated the considerable variability among plants in their contents of antinutritional factors. This will help to guide in the choices of forage legume in animal feeding.

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