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CHEMICAL COMPOSITION AND PHYTATE CONTENT OF *GMELINA ARBOREA* SEEDS.

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ABSTRACT
Studies were conducted on the proximate composition, mineral constituents and phytate contents present in the seeds of *Gmelina arborea*. The values obtained for protein, fat, fibre, ash and carbohydrate ranged as follows (%) 7.25 - 9.53, 5.35 - 8.32, 3.22 - 7.14, 2.03 - 3.28 and 82.15 - 71.73 in dehulled and hulled seeds respectively. Ca and Mg were the abundant minerals in both samples. All other minerals were relatively low. The levels of phytate were generally high and the seeds had over 50% of their total phosphorous linked to phytate. It is also hoped that if these seeds are adequately processed, they would be good for nutritional purposes especially as livestock feed.

KEYWORDS: *Gmelina arborea*, proximate composition, mineral ratio, phytate

INTRODUCTION

Gmelina arborea is a large, rapidly growing and deciduous tree. It was introduced into West Africa from Asia. It is common in Ghana, Serria Leone and Nigeria. The timber has general utility such as ornamental works, match and paper making, leaves crowd out and kill grass and acts as a good fodder. The roots, leaves and fruits are used medicinally in India (Irvine, 1961). In Nigeria, the tree grows in farms, nurseries and near homesteads, especially in the South, but has not been fully exploited as a food resource. The reason might be because there has not been any research works on the nutritional potentials of the seeds. The available data of the nutritional composition of the tree of this genus are scarce. The main target of our research was to study the nutritional potential of this tree, in order to know if they could be used for nutritional purposes.

MATERIALS AND METHODS

Sampling, the samples were collected at Federal College of Agriculture, Akure, Ondo State Nigeria. The samples (100g) were carefully washed in distilled water, one portion (50g) hulled was oven dried at 60°C for 6h, after which the dried seeds were dry-milled into flour in a Kenwood blender, sieved (45mm wire mesh) and kept prior to analyses. The second portion, dehulled was prepared by breaking the pod to remove seeds, these were later treated as in the hulled and kept prior to analyses.

Analyses.

Phytate was determined using a combination of two methods. Extraction and precipitation of phytate were carried out, while iron in the precipitate was determined by the method of Makower (1970).

Phytate and phytate phosphorous (P) contents were determined according to the methods of Young Greaves (1940). Phytate P was calculated as percentage of Total P. Total P was determined colorimetrically by the phosphovanadomolybdate methods (AOAC, 1990).

Table 1 Proximate Composition of Samples Analyzed (% Dry Weight, n=3) [a]

Parameter	Hulled	Dehulled	Mean	±SD	CV (%)[b]
Protein	9.55	7.53	8.39	1.6	19.2
Crude fat	8.32	5.35	6.84	2.1	30.7
Crude fibre	7.14	3.22	5.18	2.8	53.5
Total ash	.28	2.03	2.66	0.9	33.3
Carbohydrate (by difference)[c]	71.73	82.15	76.94	7.4	9.6

[a] n = 3 – number of determinations, [b] CV (%) – coefficient of variation in percent
[c]100 – protein + fat + fibre + ash.

Table 2 Mineral Compositions of Samples Analyzed (mg 100^{-1}g dry weight) [a]

Parameter	Hulled	Dehulled	Mean	±SD	CV (%)[b]
Calcium	465	440	452.5	17.7	3.9
Potassium	42	30			
Sodium	29	34	36.0	8.5	23.6
Magnesium	320	350	31.5	3.5	11.2
Iron	6.2	7.3	335.0	21.2	6.3
Mineral ratio					
K/Na	1.45	0.88	6.75	0.8	11.5
K/Mg	0.13	0.09	1.19	0.40	36.8
Mg/Ca	0.69	0.80	0.11	0.03	25.7
K/Ca	0.09	0.07	0.75	0.08	10.4
K/(Ca+Mg)	0.01	0.004	0.08	0.01	17.7
			0.07	0.04	60.6

[a, b] see footnote Table 1

Proximate composition was determined on all samples using methods (AOAC, 1990), Nitrogen was determined by the micro-kjeldah method (AOAC, 1990) and the nitrogen content was converted to protein by multiplying by 6.25. Carbohydrate was calculated by difference (100 – protein + fat + fiber + ash).

Minerals were analyzed from solutions obtained after ashing samples at 550°C and dissolving them in distilled water containing a few drops of concentrated HCL. Sodium and potassium were determined using a flame photometer, while all other minerals were determined using atomic absorption spectrophotometer (Pye Unicam SP 9). All determinations were in triplicate and statistically analyzed using SPSS 10.0 for windows.

RESULTS AND DISCUSSION

Table 1 contained the values of the proximate composition of the hulled and dehulled seeds (%). Protein 7.53-9.53, fat 5.35-8.32, fibre 3.22-7.14, ash 2.03-3.28 and carbohydrate 82.15-71.73 in dehulled and hulled respectively. Crude fibre and ash were higher in hulled due to the presence of the hull. Results showed that the seeds have good potentials for their use as sources of good quality feed for livestock animals. The protein, ash fat, fibre compared favourably with many sources of vegetable protein, cotton and pawpaw seeds (Gohl, 1981; Magda 1990).

Table 3: Total phosphorus (P), phytate P and phytate concentrations (mg $100g^{-1}$ dry weight)[a] and phytate P (as % total P) of sample examined.

Parameter	Hulled	Dehulled	Mean	±SD	CV (%)[b]
Total P	200	240	220	28.3	12.9
Phytate P	160	138	149	15.6	10.4
Phytate	568	489.9	529	55.2	10.4
Phytate P (as % total P)	80	57.6	68.8	15.9	23.1

[a, b] see footnote Table 1

The values of minerals in the samples (Table 2) ranged as follows: Calcium 440 - 465 mg $100g^{-1}$; potassium 30 - 42 mg $100g^{-1}$, sodium 34 - 29 mg $100g^{-1}$, magnesium 350 - 320 mg $100g^{-1}$ and iron 7.3 - 6.2 mg $100g^{-1}$ all from dehulled and hulled seeds respectively. The low CV% values observed for Ca (3.9), K (23.6), Na (11.2), Mg (6.3) and Fe (11.5) indicated the closeness of values in their various parameters. The mineral levels were higher than those reported by Oyenuga (1968) and McDonald *et al*, (1988) for cereal by-products, but lower than those reported for apricots puree (Voi *et al*., 1995). Calcium and phosphorus were much higher than those reported by Mtimuni (1995) on grains and seeds. The values obtained for calcium and sodium were lower than those reported by Agbede and Aletor, (1999) for raw seeds of Leucaena. The hulled and dehulled seeds appeared to be good sources of calcium and magnesium and fair sources of potassium, sodium and iron. All mineral ratios (Table 2) were low. They ranged between 0.09 - 1.45 (hulled) and 0.004 - 0.88 (dehulled). Mineral ratios above certain quantities and proportion may trigger off metabolic disorders for example, ratios above 8.1 and 2.2 of Ca/P and K/Ca+Mg) respectively are capable of inducing metabolic disorders like hypomagnesemia and others (Ugbaja and Omeliko, 1996). A value of 3 to 4 of K/Na in the diet of mammals is considered to be the most adequate in order to obtain a normal retention of proteins at the growth stages (Guil-Guerrero *et al*, 1998). The Ca/P ratio must be close to 1 for a good Ca and P intestinal utilization (Beliz and Grosch, 1988).

Table 4. P-value of total P and phytate contents of samples

Parameter	P-Value	Error
Total P	0.02**	0.2
Phytate P	0.006*	0.3
Phytate	0.006*	0.3
Phytate P as percentage of total P	0.001***	0.3

* significant at 10.0% level
** significant at 5.0% level
*** significant at 1.0% level.

Table 3 depicted the mean results of total P, phytate P, phytate and phytate P as percentage of total P. The levels of phytate (mg $100g^{-1}$) were high both in the dehulled and hulled (489.9 and 568) respectively. The results were comparable to levels reported for some lesser-known leguminous crop seeds (Balogun and Fetuga, 1989), lupin

seeds (Trugo *et al*, 1993), *Carica papaya* and *Citrus sinensis* seeds (Abulude, 2000), but higher than those reported for African Yam bean seeds (AYB) (Adeparusi, 2001). The two seed preparations had above 50% of their total P linked to phytate. These results were also comparable to results of vegetables (Abulude, 2001) and AYB (Adeparusi, 2001), but higher than the results of some legumes (Ologhobo and Fetuga, 1984). Phytate occurs widely in plant material. It chelates metals and forms complexes with protein in legumes, thus reducing the nutritive value. Combination of phytate with phosphorous causes deficiency of phosphorous. Two-third of phosphorous in plant is stored in the form of phytate (Adeparusi 2001). The nutritional implication of high phytate P rests on the fact that monogastric animals lack phytase, which can break down phytate to release phosphorous for utilization. There was a significant reduction (P=10.0% level) in the values of phytate of dehulled seeds (Table 4).

CONCLUSION

From the analytical results, it is hoped that these seeds would be used for nutritional purposes due to their good nutritional qualities. The only limitation could be the presence of high phytate content in the seeds, which may have significant effects on the utilization of divalent minerals. It is also hoped that if these seeds are adequately processed, they would be good as livestock feed.

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