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Proximate Composition of Some Under-Exploited Leguminous Crop Seeds

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Abstract: Seeds of *Hexalobus crispiflorus*, *Clitandra togolana* and *Dioclea reflexa* were analyzed for proximate composition, cell wall carbohydrates, nutritive and non-nutritive components and then their energy values were estimated. Crop seeds contained 7.11-13.81% crude protein, 8.30-35.86% fat, 7.38-8.61% crude fibre, 3.11-4.25% total ash, 35.03-59.62% soluble carbohydrate; 7.10-9.80% cell wall carbohydrate; 3.20-4.60% cellulose, 3.90-5.20% hemicelluloses, 91.82-92.62% cellular content, 89.09-89.42% organic cellular content, 2.30-3.20% soluble ash, 0.66-1.06% acid insoluble ash, 0.80-1.20% lignin, 1507.33-2055.18 KJ total energy and 2.6156-9.0476 g digestible crude protein. It was concluded that all the seed samples are potentially good sources of dietary energy for animals. The need to further investigate the inorganic matter for their mineral element constituents in order to ascertain adequacy or otherwise in meeting the animals' requirement is suggested.

Key words: Crop seeds, cheap sources of protein, dietary energy

INTRODUCTION

The search for high-quality but cheap sources of protein and energy has continued to be a major concern of government and agencies charged with the responsibility for food and nutrition in many parts of the developing world. While every measure is being taken to boost food production by conventional agriculture, a lot of interest is currently being focussed on the possibilities of exploiting the vast numbers of less familiar plant resources existing in the wild. Many such plants have been identified, but lack of information on their chemical composition has limited the prospects for their utilization. Most reports on some lesser-known and unconventional crops indicate that they could be good sources of nutrients and many have the potential of broadening the present narrow food base of the human species (Ezeagu *et al*., 1996). The work reported here was aimed at providing basic information on the nutrient content and energy values of seeds of *Hexalobus crispiflorus*, *Clitandra togolana* and *Dioclea reflexa* and the information is intended to serve as a pre-requisite for further investigating their feeding value.

MATERIALS AND METHODS

Mature seeds of *Hexalobus crispiflorus*, *Clitandra togolana* and *Dioclea reflexa* were harvested from location around Federal Polytechnic, Ilaro. The seeds were shelled and winnowed manually. The seeds were sun-dried, milled into flour in a Wiley mill to pass through an 80-mesh sieve and stored in an air-tight container until use.

Three replicate samples of the respective flours were analysed for protein (% N multiplied by 6.25), fat, crude fibre and total ash (AOAC, 1990) carbohydrate (nitrogen free extractives) was obtained by difference. Total energy was estimated using the modified Atwater factor as follows: total energy of seed (kcal/100%) = protein (g) x 4) + (fat (g) x 9) + (Carbohydrate (g) x 1.1 x 3.75) (Hunt *et al*., 1987). Total ash was fractionated into acid-soluble and acid-insoluble fractions (Egan *et al*., 1981). Organic cellular content, cell wall carbohydrates (cellulose and hemicelluloses), Ligin, nutritive and non-nutritive matters were determined by the procedures of Fonnesbeck (Fonnesbeck, 1976). Digestible energy values of samples of different laboratory animals were estimated by fitting data from chemical analyses into the prediction equations described by Fonnesbeck (1976).

Digestible crude protein was estimated as follows: Digestible crude protein (g) = (protein (g) x 0.96) - 4.21 (Barrett and Larkin, 1977).

The data were subjected to analysis of variance (ANOVA) by the procedures of Gomez and Gomez (1976). Significant treatment means were separated by the multiple range test of Duncan (1955).

RESULTS AND DISCUSSION

The results of proximate composition Table 1 indicated that the crop seeds varied significantly in their nutrient contents and the estimated total energy values. The least protein content (7.11±0.02%) was found in *Hexalobus crispiflorus*, while *Dioclea reflexa* had the highest (13.81±0.02%). Compared to the seeds of widely consumed *Vigna unguiculate* in Nigeria, the results revealed that the seeds investigated contained low crude protein. *Hexalobus crispiflorus* showed very high ether extract values among the members. The

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Table 1: Proximate composition (%) and digestible crude protein of *Hexalobus crispiflorus, Clitandra togolana* and *Dioclea reflexa*

	Samples		
Components	*Hexalobus crispiflorus*	*Clitandra togolana*	*Dioclea reflexa*
Moisture	10.03^{c}±0.01	8.04^{a}±0.03	9.02^{b}±0.01
Dry matter	89.97^{a}±0.01	91.96^{c}±0.03	90.98^{b}±0.01
Crude protein	7.11^{a}±0.02	10.81^{b}±0.23	13.81^{c}±0.20
Fat (Ether extract)	35.86^{c}±0.41	9.90^{b}±0.53	8.30^{a}±0.30
Crude fibre	8.61^{c}±0.08	7.38^{a}±0.10	8.18^{b}±0.16
Ash	3.36^{b}±0.12	4.25^{c}±0.05	3.11^{a}±0.16
Nitrogen free extractives (CHO)	35.03^{a}±0.41	59.62^{c}±0.80	57.58^{b}±0.38
Total energy (KJ/100 g)	2055.18^{c}±2.45	1551.64^{b}±2.32	1507.33^{a}±0.91
Digestible crude protein (g/kg)	2.6156^{a}±0.02	6.6176^{b}±0.12	9.6476^{c}±0.10

Mean±Standard deviation of triplicate determinations on dry weight basis. Values with different superscript in the same row are significantly different ($p<0.05$)

value is higher than the values reported for under-exploited leguminous crop seeds in Nigeria by Balogun and Fetuga (1986). The values obtained for fat in this investigation are comparably lower than 52.13±0.13% reported for *Cucubita* maxima by Amoo *et al.* (2004). However, *Hexalobus crispiflorus* fat content may serve as new source of oil for nutritional and industrial uses.

The crude fibre is highest in *Hexalobus crispiflorus* (8.61±0.08%) and lowest in *Clitandra togolana* (7.38±0.10%) the values obtained are higher than 4.51±0.13% that was reported for *Adenopus bereviflorus benth* whole seed flour by Oshodi (1992) but lower than 14.24±0.01% reported for *Bauhinia reticulate* by Amoo (2003). High Crude fibre could effectively trap and protect a greater proportion of their nutrients (protein and carbohydrates) from hydrolytic breakdown, resulting in lower digestibility and therefore reduce the extent to which their end products of digestion could be utilized (Balogun and Fetuga, 1986). The ash content was lowest in *Dioclea reflexa* (3.11±0.16) and highest in *Clitandra togolana* (4.25±0.05%). The ash values were indicative of these crop seeds as fair sources of minerals. Close carbohydrate values were obtained for *Dioclea reflexa* and Clitandra *togolana* (57.8±0.38%) and (59.62±0.08%) respectively and they are higher than that obtained for *Hexalobus crispiflorus* (35.05±0.41%). This value (35.03±0.41%) is similar to 36.12±0.93% reported by Amoo and Moza (1999) for *Bauhinia racemosa* seeds. *Dioclea reflexa* and *Clitandra togolana* could be good supplements to scarce cereal grains as sources of energy in feed formulations (Ezeagu *et al.*, 1996). Total energy values for seeds analysed indicated that *Hexalobus crispiflorus* which contained significantly highest fat content had more total energy (2055.18±2.45 KJ/100) than those contained in *Clitandra togolana* (1551.64±2.32 KJ/100) and *Dioclea reflexa* (1507.33±0.91 KJ/100). Estimation of the total caloric value of foods by the methods of Osborne and Voogt (1978) was based on energy contributed by protein, fat and carbohydrate. Crude fibre (or cell wall carbohydrate) was not considered on the assumption that it was indigestible by human digestive enzymes Wheeler and Ferrel (1971). On the contrary, Fonnesbesk (1976) confirmed partial utilization of cell wall carbohydrate and declared lignin as the indigestible component of the cell wall carbohydrate. Together with acid insoluble ash, lignin constituted the non-nutritive matter of the food. Furthermore, Fonnesbeck (1976) established regression equations describing the relationship between nutritive and non-nutritive components of foods and Digestible Energy (DE) values of such foods for different species of animals.

The partially nutritive component, the cell wall carbohydrates, was fractionated into cellulose and hemicelluloses and the results are shown in Table 2. The fractions were remarkably higher in *Hexalobus crispiflorus* than the rest of the seeds. All the values reported for *Hexalobus* crispiflorus are comparably similar to values reported for pigeon pea (*Cajanus cajan*) and some lesser-known crops (Oloyo, 2002) and Oloyo and Ilelaboye (2002), respectively. The significantly higher fibrous nature, coupled with the higher non-nutritive components in *Hexalobus crispiflorus* might limit utilization of its nutrients by the animal and hence reduce the energy derivable from the seed.

There are significant difference between the cellular matter contents of *Hexalobus crispiflorus*, *Clitandra togolana* and *Dioclea reflexa* with the peak value obtained in *Clitandra togolana* (92.62±0.10%) while the least is in *Hexalobus crispiflorus* (91.39±0.08%). A similar trend was observed in the case of soluble ash and soluble carbohydrate. There was no significant difference between the organic cellular content of *Clitandra togolana* and *Dioclea reflexa* but that they are superior to *Hexalobus crispiflorus*.

Non-nutritive matter, a combination of lignin and acid-insoluble ash, was highest (2.26±0.08%) in *Hexalobus crispiflorus* and least in *Dioclea reflexa* (1.56±0.25%). There was no significant difference between lignin and non-nutritive matter contents of *Clitandra togolana* and *Dioclea reflexa*, but they are inferior to *Hexalobus crispiflorus*. There was no significant difference between the acid insoluble ash content of *Hexalobus crispiflorus*

Table 2: Structural carbohydrates, nutritive and non-nutritive fractions (%) of *Hexalobus crispiflorus, Clitandra togolana* and *Dioclea reflexa*

	Samples		
Structural carbohydrates	*Hexalobus crispiflorus*	*Clitandra togolana*	*Dioclea reflexa*
Cellwall carbohydrates	9.80^{c}±0.03	8.50^{b}±0.01	7.10^{a}±0.03
Cellulose	4.60^{c}±0.01	3.70^{b}±0.01	3.20^{a}±0.02
Hemi-cullulose	5.20^{c}±0.02	4.80^{b}±0.01	3.90^{a}±0.01
Nutritive components			
Cellular content	91.39^{a}±0.08	92.62^{c}±0.10	91.82^{b}±0.16
Organic cellular content	89.09^{a}±0.06	89.42^{b}±0.10	89.37^{b}±0.16
Soluble ash	2.30^{a}±0.02	3.20^{c}±0.01	2.45^{b}±0.01
Soluble carbohydrates	46.14^{a}±0.38	68.77^{c}±0.70	67.26^{b}±0.27
Non-Nutritive component			
Acid-Insoluble ash	1.06^{b}±0.04	1.05^{b}±0.05	0.66^{a}±0.16
Lignin	1.20^{b}±0.10	0.80^{a}±0.10	0.90^{a}±0.10
Non-nutritive matter	2.26^{b}±0.08	1.85^{a}±0.13	1.56^{a}±0.25

Mean±Standard deviation of triplicate determinations on dry matter basis. Values with different superscript in the same row are significantly different ($p<0.05$)

Table 3: Estimated Digestible Energy (DE) values of *Hexalabus cryspiflorus, Clitandra togolana* and *Dioclea reflexa* for different laboratory animals

	DE KJ/100 gDM	Obtainable from	
Laboratory animal	*Hexalobus crispiflorus*	*Clitandra togolana*	*Dioclea reflexa*
Rabbit	1600.13^{c}±1.92	1568.96^{b}±2.48	1539.67^{a}±5.45
Rat	1429.80^{a}±0.87	1672.05^{c}±1.95	1647.95^{b}±1.00
Swine	1427.71^{a}±2.11	1725.77^{c}±2.30	1702.00^{b}±1.56

Prediction equations of Fonnesbeck (1976) used for DE estimation are:
Rabbit DE = 4.67-0.231 NNM (%) -0.0456 CP (%) $R^2$0.971; Sy.x, 0.101;
Rat DE = 2.54-0.0272 CF (%) + 0.0241 SC (%) $R^2$20.973; Sy.x, 0.094
Swine DE = 222 + 0.0292 SC (%) -0.129 Lignin (%) $R^2$20.983 Sy.x, 0.073
Mean±Standard Deviation of triplicate determinations on dry weight basis. Values with different superscript in the same row are significantly different ($p<0.05$). NNM = Non-Nutritive Matter; CP = Crude Protein; CF = Crude Fibre; CS = Soluble Carbohydrates

(1.06±0.14%) and *Clitandra togolana* (1.05±0.05%) but they are superior to *Dioclea reflexa* (0.06±0.16%), the values of non-nutritive matter reported for the seeds under investigation are comparable similar to values reported for *Cajanus Cajan* (Oloyo, 2002) and lower than the values reported for seeds of some lesser known crops (Oloyo and Ilelaboye, 2002).

The low non-nutritive matter and fair fibrous nature of the samples will enhance the utilization of nutrient by animal and hence increase the energy derivable from the seeds.

Digestible energy values of samples for different laboratory animals were determined and the results are shown in Table 3. All the values obtained are significantly different and are comparably similar to values reported for *Cajanus cajan* (Oloyo, 2002).

Estimated digestible crude protein ranged from 2.16 g/100 g to 9.04 g/100 g with least occurring in *Hexalobus crispiflorus* and the highest in *Dioclea reflexa* (Table 1).

From the foregoing discussion, it may be concluded that all seed samples analysed are potentially good sources of dietary energy and protein and may constitute an addition to the list of food legumes being advocated for consumption in Nigeria. However, there is the need to further investigate the possible toxic constituents and amino acid patterns before they can be used as human or animal food.

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