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Compositional Chemistry of *Cassia alata* Seeds

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ABSTRACT

The proximate fatty acid and mineral element compositions of Cassia alata *legume seeds have been determined. The protein content (as received basis) was about 15%; high total carbohydrate and nitrogen-free-extract (NFE) values were obtained. Total unsaturation (about 60% of the total fatty acid content) was due exclusively to fatty acids with 18 carbon atoms (C_{18}). Of the mineral elements examined (calcium, magnesium, sodium, manganese, and zinc), calcium was the most abundant at 17 mg/100 g, wet weight basis, of the legume seeds.*

INTRODUCTION

Legumes generally are rich sources of proteins (Chung & Satterlee, 1979; Martinex, 1979; Platt, 1980). Therefore, they are increasingly being looked upon as potential alleviators of the problem of high population to protein ratio in the world, despite the fact that some of them may have their real biological values lowered significantly by low sulphur amino acid contents (Silbernagel, 1971) or by the occurrence of anti-nutritional factors such as hemagglutinins, saponins, trypsin inhibitors and phytins (Kakade & Evans, 1963; Liener, 1966; O'Dell & Savage, 1969). Some legumes are rich, not only in protein, but also in other chemical entities such as starch, oils, vitamins and mineral elements (Oyenuga, 1968; Lolas & Markakis, 1975; Ukhun, 1986). They have, therefore, been exploited economically for some

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of these chemical components. Soybean and peanut oils, for example, are very popular commercial edible oils.

However, there are many other wild legumes which could be of equal nutritional and commercial values which, it would seem, have not been investigated for their compositional chemistry.

The present study addresses aspects of the compositional chemistry of *Cassia alata* which is a legume that has not apparently been investigated, found growing wild in Nigeria and, at present, largely unutilised.

MATERIALS AND METHODS

Mature pods of *Cassia alata* were harvested from mature plants in some bushes in and around the compound of the University of Benin, Benin City, Nigeria. The pods were then broken manually to release the seeds which were subsequently pooled for use in the various chemical analyses indicated below.

Analyses for proximate composition

Proximate composition analyses for moisture, crude fat, crude protein, crude fibre and ash, were in accordance with the official methods of the Association of Official Analytical Chemists (AOAC) (1975). Dry matter content was estimated as 100 − % moisture. Total carbohydrate was estimated by difference: 100 − (% moisture + % crude protein + % crude fat + % ash contents), while the nitrogen-free-extract (NFE) content was determined as: % total carbohydrate − % crude fibre.

Analyses for mineral elements

The levels of Ca, Mg, Na, Mn, and Zn in the legume seeds were quantified by atomic absorption spectrophotometry. Two grams of the ground legume seeds were digested with a mixture of 35 ml conc. HNO_3, 4·0 ml conc. H_2SO_4 and 4·0 ml $HClO_4$. After cooling, the digest was diluted with 50 ml deionised distilled water, filtered with Whatman No. 5 filter paper and the filtrate made up to 100 ml in a glass volumetric flask with deionised distilled water. The mineral elements indicated above were then quantified by atomic absorption spectrophotometry (Perkin Elmer No. 703).

Fatty acid composition of the lipid extract

The lipid extracted from the *Cassia alata* seeds by the Folch *et al.* (1957) method was converted to the fatty acid methyl esters by a modified conventional transesterification method of Stoffel *et al.* (1959) as described below: 1 g of the lipid extract was placed in a round-bottom flask and 10 ml methanol/sulphuric acid mixture (9:1) was added. After refluxing for 30 min, 10 ml *n*-heptane was added to the refluxed mixture in a separating funnel and left to separate. The upper layer of the fatty acid methyl esters was separated into a flask containing anhydrous sodium sulphate and left thus overnight. It was then filtered ready for use in the gas–liquid chromatograph. A Pye Unicam Series 104 gas–liquid chromatograph equipped with a 5 ft × 1/8 in column packed with PEGA adsorbed on Chromosorb W (80/100 mesh) and an FID, was operated under the following conditions: attenuation, 2×10^2 operating temperature, 180°C (isothermal): nitrogen carrier gas flow rate, 35 ml/min: load, 0·2 ml: total cycle time of standard programme, 76 min.

Peak identification was by retention time comparison with those of known fatty acid methyl esters while peak quantification was by triangulation. The percentage fatty acid contents were then estimated by use of the formula:

$$\text{Percentage fatty acid} = \frac{\text{Individual area of peak}}{\text{Total area of peaks}} \times \frac{100}{1}$$

RESULTS AND DISCUSSION

The low moisture content of the legume seeds (Table 1) accounts for its correspondingly high dry matter content and the low crude fat content of the legume seeds (Table 2) makes them uneconomic sources of commercial oil. Compared with other plant foods and exclusive of the legumes, the 15% protein content of the *Cassia alata* seeds is high. However, compared with other legumes (Platt, 1980), its protein content is somewhat low.

TABLE 1
Proximate Composition of *Cassia alata* Seed
(as received basis)

Component	(%)
Moisture	8·52
Dry matter	91·48
Crude fat	1·87
Crude protein	15·4
Crude fibre	6·62
Ash	4·41
Total carbohydrate	69·8
NFE	63·2

TABLE 2
Fatty Acid Composition of *Cassia alata* Seed Lipid

Fatty acid	(%)
$C_{12:0}$	2·65
$C_{14:0}$	3·71
$C_{16:0}$	29·7
$C_{18:0}$	4·51
$C_{18:1}$	13·3
$C_{18:2}$	44·8
$C_{18:3}$	1·39

Nevertheless, barring limitations that could be posed by limiting amino acids and anti-nutritive and toxic factors, *Cassia alata* seed represents a possible additional source of protein. The crude fibre content of 6·0% comparable with that of most other legumes (Oyenuga, 1968). Literature reports indicate that, although dietary fibre may be helpful in reducing gastro-intestinal disorders, it may also be detrimental (Spiller *et al.*, 1978; Mercurio & Behm, 1981). The ash content of the legume shown in Table 1 would be important to the extent that it contains the nutritionally important mineral elements, some of which are shown in Table 3. The high total carbohydrate and NFE contents of *Cassia alata* make the legume seed a good source of calories and therefore an antimarasmus, especially in infant nutrition. The values also make the legume potentially fermentable into alcoholic drinks and into products such as *tofu*, *miso* and *tempeh* (Wang & Hesseltine, 1981).

The fatty acid composition of the lipid extracted from the seeds of the *Cassia alata* legume is presented in Table 2. The dominant fatty acid was linoleic acid which accounted for about 45% of the total fatty acid. This is

TABLE 3
Mineral Element Content of *Cassia alata* Seed

Mineral element	*Amount (mg/100 g, wet wt basis)*
Calcium	17·0
Magnesium	14·4
Sodium	13·0
Manganese	3·0
Zinc	3·8

nutritionally desirable because of the importance of this fatty acid. The unsaturated fatty acids amounted to about 60% of the total fatty acid content of the lipid extract, and all the unsaturation was due exclusively to C_{18} acids.

The mineral elements analysed in the studies and which are presented in Table 3, are important nutritionally. Based on their recommended daily intakes (Davidson *et al.*, 1973) and on the values in Table 3, it is obvious, assuming high *in vivo* bioavailabilities, that the *Cassia alata* legume seeds would be important in contributing, even if only partially, to the overall daily dietary intakes of the elements. Generally, the values presented in Table 3 may be related to the soil type in which the legume plant was found growing and/or to the efficiency of uptake from the soil by the legume plant.

CONCLUSION

The analytical data in these studies suggest that *Cassia alata* seed is an important source of calories, essential fatty acids, and, to a lesser extent, of protein. It will also contribute, in varying degrees, to the overall dietary intakes of important nutrients such as calcium, magnesium, sodium, manganese and zinc.

The legume seed should find some use in human and animal nutrition, especially if toxic factors which might be present in the seeds are inactivated by heat treatment.

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