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Technical Note

Effect of Sprouting on Carbohydrate Content of Fluted Pumpkin Seed

ABSTRACT

*The concentrations of individual sugars contained in both dormant and sprouted fluted pumpkin seed (*Telfairia occidentalis, *Hook F.) were determined. Thin-layer chromatography (TLC) of extracts from fluted pumpkin seed showed marked reduction in the total carbohydrate concentration due to sprouting with corresponding increase in the total soluble sugar concentration. The carbohydrates of dormant fluted pumpkin seed consist mostly of sucrose and small amounts of glucose, fructose, galactose, raffinose and stachyose, while sprouted seed contained mostly glucose, fructose, maltose and a low concentration of sucrose and one unidentified sugar.*

INTRODUCTION

Analysis of fluted pumpkin seed shows that carbohydrate content is 14·5%, and protein content is 30·1% (Asiegbu, 1987) and that it is also a good nutritional source of both lipid and protein (Okigbo, 1977). The seed from the female fluted pumpkin is eaten as a nut when boiled or roasted in south-eastern Nigeria.

Studies on the nutritional changes of fluted pumpkin seed report an increase in glucose and maltose during fermentation while unfermented seeds contain mostly sucrose, fructose, galactose, raffinose and stachyose (Achinewhu, 1986).

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During germination of soybean, reserve carbohydrates are broken down to simpler sugars due to activities of hydrolytic enzymes (Hsu *et al.*, 1973). There are also changes in stachyose and raffinose contents.

This investigation is aimed at determining the qualitative and quantitative distribution of carbohydrates in fluted pumpkin seed during dormancy and early stages of sprouting.

MATERIALS AND METHODS

Two hundred seeds extracted from fluted pumpkin pods grown and harvested from a ferrilitic sandy loam ultisol,† Nsukka, were used. Half the number of the seeds were sprouted for eight days on moist sawdust medium at $26 \pm 1°C$ and the remaining half were left dormant. The two seed lots were freeze-dried and milled to fine powder before analysis.

The carbohydrate compositions of the two samples were determined using the AOAC (1970) method. Starch and total sugars were estimated as glucose equivalents according to the method of McCready *et al.* (1950), and reducing sugars were determined by a colorimetric method using 3,5-dinitrosalicyclic acid. Pentose sugars were precipitated as the phloroglucinol derivatives and estimated gravimetrically (AOAC, 1970).

Ethanol-soluble sugars were isolated by exhaustively extracting 50 g of each milled sample with 3×150 ml of boiling 80% ethanol. The extracts were pooled and passed through cation- and anion-exchange resins to remove amino acids and minerals and concentrated to low bulk using a rotary evaporator at 40°C. The sugars were eluted with different concentrations of ethanol (up to 25%) after absorbing a known volume of the concentrated extract on a carbon:Celite (1:1) column according to the Whistler & BeMiller (1962) method.

The eluted sugars were concentrated and 10 μl of the extracts were separated and identified on TLC plates coated with silica gel G alongside several reference sugars. The plates were developed with chloroform–methanol, 5:1 (v/v) as reported by Clappa *et al.* (1966). The sugar spots were visualised by spraying the developed plates with 0·2% α-naphthol solution in methanol:water, 1:1 (v/v), followed by light spraying with concentrated H_2SO_4. On heating the plates, the sugars yield purple spots. Estimations of oligosaccharides were by the phenol sulphuric acid method (Dubois *et al.*, 1956).

The whole experimental procedure was repeated three times to establish

† Ultisol—a Nigerian acid sandy loam soil of the tropics (Dogne, Hartley and Watson Soil Classification Scheme (1938)).

the reproducibility of the extracts and the results obtained are presented as the mean of triplicate analyses.

RESULTS AND DISCUSSION

Table 1 shows that sprouting significantly ($P < 0{\cdot}05$) decreased the total carbohydrate content of fluted pumpkin seed from 14·6% to 9·1%. The total soluble carbohydrate and reducing sugar contents of the seed show a slight increase from 4·6% to 5·3% and 0·8% to 2·6% respectively which are not significant ($P > 0{\cdot}05$).

The results show that constituent sugars isolated and identified from the ethanol extracts of the dormant fluted pumpkin seed comprise mostly sucrose, glucose, fructose, galactose, raffinose and stachyose. The extracts from sprouted seeds have a reduced concentration of sucrose, and contain maltose which is not identified in dormant seeds together with higher concentrations of fructose and glucose. There was in addition, one unidentified component which showed a pinkish purple spot during visualisation (Table 2).

The monosaccharide constituents increased considerably with sprouting whilst stachyose and raffinose disappeared. However, the unidentified sugar detected in both dormant and sprouted fluted pumpkin seed (Table 2) may be a pentose sugar as observed in Table 1.

The marked reduction in the total carbohydrate contents of fluted pumpkin seed in this study is mainly attributable to amylolysis of starch during sprouting. This possibly explains the corresponding increase in the soluble carbohydrate content, mainly as reducing sugar. Matheson & Saini (1977) working with germinating lupin seeds, reported constant low levels of reducing monosaccharides.

TABLE 1
Carbohydrate Content of Dormant and Sprouted Fluted Pumpkin Seed[a]
(g/100 g of seeds)

Seed	*Total carbohydrate*	*Soluble total*	*Reducing sugar*	*Non-reducing sugar*[b]	*Pentose sugar*	*Starch*
Dormant	14·6 ± 0·6	4·6 ± 0·3	0·8 ± 0·1	3·9 ± 0·1	0·4 ± 0·6	9·5 ± 0·3
Sprouted	9·1 ± 0·6	5·3 ± 0·6	2·6 ± 0·2	2·7 ± 0·3	0·8 ± 0·7	3·0 ± 0·8

Mean of three determinations ± standard deviation.
[a] Estimation based on chemical analysis.
[b] Expressed as the difference between soluble total and reducing sugar.

TABLE 2
Distribution of Soluble Sugars Detected in the Dormant and Sprouted Fluted Pumpkin Seed[a]
(g/100 g of seed)

Sugar detected	*Dormant*	*Sprouted*
Glucose	0·05	2·30
Fructose	0·74	1·25
Sucrose	4·28	0·40
Maltose	—	1·14
Unknown (R_f 0·76)[b]	0·06	0·17
Galactose	1·02	—
Raffinose	0·03	—
Stachyose	0·04	—

Mean of three determinations.
[a] Quantified after resolution and purification by TLC.
[b] The R_f value expressed is in reference to sucrose in chloroform: methanol 5:1 (v/v) system.

The alterations of the individual carbohydrate constituents in fluted pumpkin seed (Table 2) suggest oligosaccharide hydrolysis to simpler sugars with simultaneous starch degradation by amylases (Koller *et al.*, 1962).

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