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Physico-chemical composition and characterisation of the seed and seed oil of *Sclerocarya birrea*

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Abstract. The physicochemical composition of *Sclerocarya birrea* was assessed by standard methods and was found to contain 11.0% Crude oil, 17.2% Carbohydrate, 36.70% Crude protein 3.4% fibre and 0.9% crude saponins. The fatty acid distribution in the seed oil was obtained by fractionating the volatised fatty acid by GC-MS. The oil is made up of nine fatty acids of which palmitic, stearic and arachidonic acids are the most dominant.

Introduction

Sclerocarya birrea belongs to the family sterocaceae [1] of which trees predominate. It includes tropical and sub-tropical plants which extend from Nigeria to Ethiopia. The trees have short bole and stout branchlets. The leaves have a slender glabrous common stalk with opposite or nearly opposite leaflets. It flowers during the months of January to May and fruits between April and June. Its fruit is yellow with leathery rind like a mango covering the stone or seed. The taste is acid but of a pleasant flavour when fully ripe.

The trees produce very large amounts of fruit each year. The fruits are edible but not very popular. In Northern Nigeria, expressed juice from the fruit is fermented to give a cider-like beaverage. The kernel is oily and edible. Although a lot of work has been done on vegetable seed oils of Nigeria origin [2–4], very little is known of the physicochemical properties of the fruit and seed oil of *sclerocarya birrea.* The physicochemical properties of the fruit and seed oil of *S. birrea* are therefore reported.

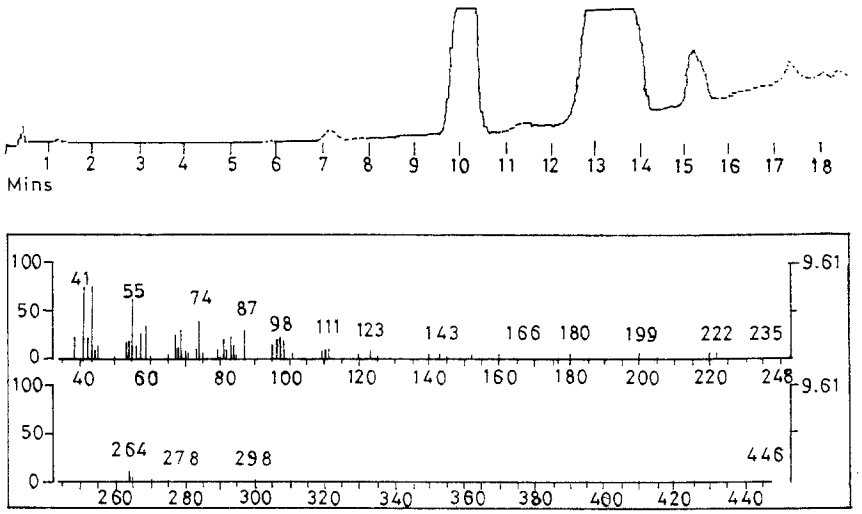

Fig. 1. Gas Chromatograph – mass spectra of the methyl esters of the seed oil of *Sclerocarya* at a probe temperature of 240 °C.

Experimental Methods

Extraction and analysis

Sclerocarya birrea oil was extracted by soxhlet from the ground seed using low boiling petroleum ether (40–60 °C) and immediately analyzed for iodine value, saponification value, refractive index, unsaponifiable matter, acid value and peroxide value [5].

The specific gravity, water, nitrogen and ash contents of the seed were determined by the usual methods recommended by the Association of Official Analytical Chemists [6]. Percentage protein was obtained by multiplying the total nitrogen by a factor of 6.25.

Toxic content of the seed was assessed by extracting the saponins content and hydrolyzing it to sapagenins using previously described procedures [7–9].

Methyl esters of extracted oil were prepared according to the official method of the American Oil Chemists Society [5]. Fatty acid distribution was done on a Varian aerograph series GC-MS in which a gas liquid chromatography (GLC) was coupled to a mass spectrometer. The equipment was operated isothermally at 240 °C. Identification of fatty acids in the oil was by comparison of obtained mass spectra with those of standard samples as well as molecular mass correspondence.

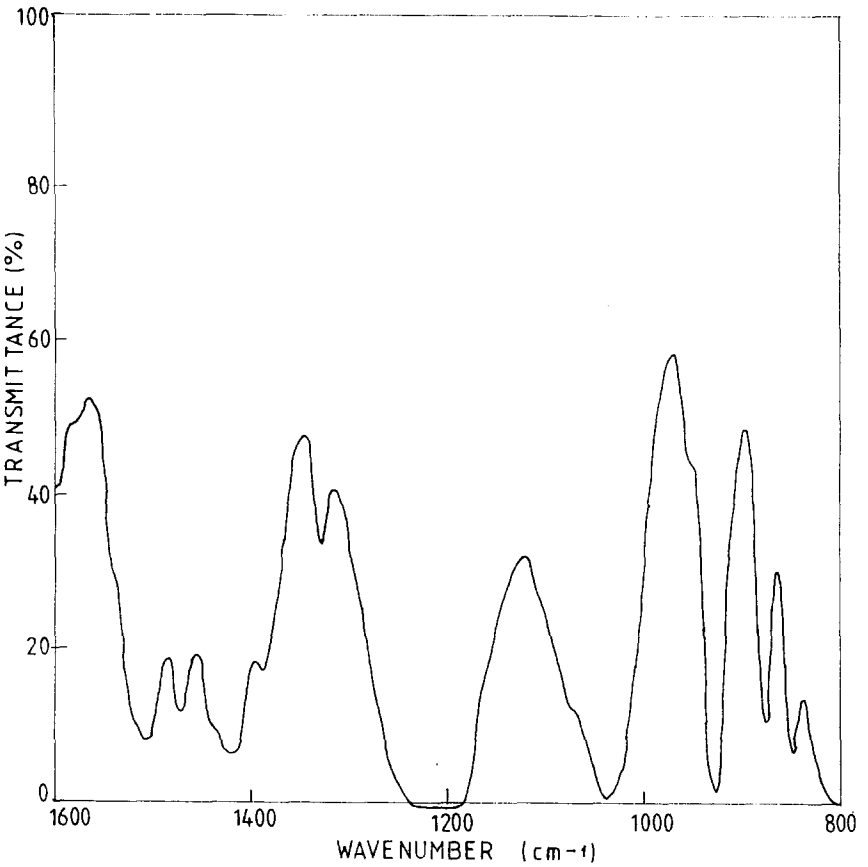

Fig. 2. Infrared spectrum of sapogenins of *Sclerocarya birrea*.

Table 1. Chemical composition of defatted *Sclerocarya birrea* seed (means of six determinations)

Assay	%
Oil content	11.00
Crude protein	36.70
Carbohydrate	17.20
Saponins	0.90
Fibre	3.40
Ash content	11.70
Moisture	2.50

Table 2. Physicochemical properties of *Sclerocarya birrea* seed oil

Assay	%
Saponification value	162.70
Iodine value	100.25
Acid value	33.70
Peroxide value	4.58
Unsaponifiable matter	3.06
Refractive index	1.46
Melting point (°C)	26–28
Solidification point (°C)	−1–(−4)
Specific gravity	0.88

Results and discussion

Chemical composition

The chemical composition of defatted *Sclerocarya birrea* seed is given in Table 1. The seed has a protein content of 36.7% which is greater than those of soyabean (33.2%) and peanut (30.0%). This suggests that the seed is a potential source of protein. Table 2 shows the physico-chemical properties of the seed oil of *sclerocarya birrea.* An iodine value of 100.25 suggests that the oil is a semi-drying oil and must contain unsaturated fatty acids which are essential in food oils. Figure 1 shows the GC-MS of the esterified fatty acids of the oil showing the following fragment ions; M^+ at m/e 102, m/e 130, m/e 242, m/e 270, m/e298, m/e326, m/e354, m/e 382 and m/e 296. The distribution of these fatty acids in % by weight is shown in Table 3. It is significant to note that the oil contains arachidonic acid which is a member of one of the principal families of unsaturated fatty acids. It belongs to the n-6 family (linoleic 18:2, gamma linolenic 18:3 and arachdonic 20:4). Physiologically, it is the most important member of the n-6 family as it is a

Table 3. Fatty acid distribution (% by weight) in *Sclerocarya* seed oil

Assay	% by weight
Butyric	0.35
Caproic	1.41
Myristic	2.12
Palmitic	22.56
Stearic	50.76
Arachidonic	8.46
Behemic	5.14
Oleic	4.13
Lignoceric	4.13

precursor of eicosanoids. It is known to be essential in human diet [10]. However, Lands [11] showed that a high intake of the n-6 family of unsaturated fatty acids may be undesirable as they may precipitate pathophysiological states.

The level of crude saponins extracted from the seed (0.90%) is much lower than those of soyabean and *Mucuna uriens* [9] both of which are widely eaten in Nigeria, suggesting that the toxicity level is not dangerous. The thin layer chromatography of the extracted saponegin showed three spots of R_f values 0.63 ± 0.001, 0.74 ± 0.002 and 0.86 ± 0.001. Figure 2 shows the infrared spectra of the saponegin test sample. The bands in the IR spectra were at $980\,cm^1$, $860\,cm^{-1}$ and $840\,cm^{-1}$ which are characteristic of the spirotan structure as demonstrated by Brain et al. [12].

Conclusion

The seed and seed oil of *Sclerocarya birrea* have been studied. The seed has a high protein content. It also contains some unsaturated fatty acids (oleic and arachridonic). The saponins content was found to be lower than those of soyabean and *Mucuna uriens*.

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