The Composition of the Oil of Starfruit (*Averrhoa carambola*, Linn.) Seeds

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ABSTRACT

The starfruit (*Averrhoa carambola*, Linn.) seeds were found rich in oil. The oil was examined for its refractive index, iodine value, acid value, saponification number, unsaponifiable matter, and fatty acid composition by gas liquid chromatography. The values (area percent) for fatty acids as methyl esters were: C14:0 (0.67%); C16:0 (21.34%); C18:0 (8.15%); C18:1 (45.83%); C18:2 (22.33%); C18:3 plus C20:0 (1.14%); C20:1 (0.28%); C22:0 (0.26%) and C24:0 (trace).

INTRODUCTION

Averrhoa carambola, Linn. (*Oxalidaceae*) is a small tree widely grown throughout tropical countries mainly for its fruit. The fruit, when ripe, is golden yellow in color and possesses an attractive waxy appearance. It is ovoid or oblong in shape, three to five inches long, and with three to five prominent longitudinal ribs giving in cross section a star-shaped figure, hence its name. The flesh of the fruit is tender and pulpy with a sweet, acid, or tart taste. Each fruit may contain up to five pale seeds, the kernel of which is rich in oil. There is no account available in the literature on the composition of the starfruit seed kernel and the oil contained in it. It would be of scientific interest to know the composition of seeds of this fruit, especially the kernel oil. It is with this aim that this study was undertaken.

MATERIALS AND METHODS

The seeds were recovered from the fresh fruits (*Averrhoa carambola*) grown at the farm of the Faculty of Agriculture, University of Malaya, Kuala Lumpur. Petroleum ether (b.p. 40 to 60 C), diethyl ether, benzene, and methanol were of analytical reagent grade. Methyl fatty acid esters were obtained through Sigma Chemical Company, St. Louis, MO. Other reagents required during the analysis were prepared according to AOAC procedures (1).

TABLE I

Analytical Data on Starfruit Seed and Oil

Property	Value
Composition of seed kernel (%)	
Moisture	4.00
Oil	73.87
Protein (N x 6.25)	14.00
Oil characteristics:	
Refractive index, 25 C	1.4658
Iodine value (Wijs)	81.64
Saponification number	197.68
Unsaponifiable matter (%)	2.96
Acid value	0.6
Fatty Acid Composition (Area, %)	
C14:0	0.67
C16:0	21.34
C18:0	8.15
C18:1	45.83
C18:2	22.33
C18:3	
C20:0	1.14
C20:1	0.28
C22:0	0.26
C24:0	Trace

Extraction of Oil and Analyses

The starfruit seeds were shelled manually, and pulverized kernels (100 g) were extracted with petroleum ether (b.p. 40 to 60 C) in a Soxhlet apparatus for 16 hr. The petroleum ether containing the oil was filtered. The crude oil (73.87 g) was recovered from the filtrate by evaporating the ether on a rotary evaporator under reduced pressure. The oil was dried over silica gel in a desiccator for 24 hr.

Moisture content (air oven method) and protein content (Kjeldahl method) of kernels, and refractive index, iodine value, saponification number, unsaponifiable matter, and acid value of the oil were determined as described by A.O.A.C. (1).

Preparation and Gas Liquid Chromatography of Methyl Esters

Methyl esters of the oil fatty acids were prepared essentially according to H_2SO_4/methanol method as given by AOAC (2) except that the reaction was carried out in a sealed bottle.

The mixture of methyl esters was analyzed on a Pye, series 104, gas chromatograph equipped with a hydrogen flame ionization detector. Injection port and detector temperatures were held at 150 C and 210 C, respectively. The analysis was performed on two glass columns of the same length (1.5 m x 4 mm, ID), but containing two different phases of opposite polarity. Column A, which was packed with 10% w/w diethylene glycol adipate adsorbed on 100-120 mesh Diatomite CAW treated with phosphoric acid, was operated at 200 C. Column B which contained 5% w/w SE 30 supported on 80-100 mesh Diatomite CS, was operated at 220 C.

Nitrogen (OFN) carrier gas was used at a flow rate of 30 ml/min.

Gas chromatograph peaks were identified by comparison with pure methyl esters through retention time relative to methyl heptadecanoate on two columns containing two different phases of opposite polarity. Area of peaks was determined by cutting out and weighing them after establishing the relationship between area and weight of the chart paper. The percent of each ester was calculated as the percent of the total area of all the peaks. The analysis was performed in duplicate.

RESULTS AND DISCUSSION

The starfruit seed kernels on extraction with petroleum ether yielded about 74% oil, while the remaining cake contained over 50% protein. The oil is a clear fluid with a faint yellow color. The characteristics and fatty acid composition of the oil are presented in Table I. The composition of the oil is more or less similar to that of groundnut oil (3). The unsaturates comprise mainly oleic and linoleic acids, together forming about 68% of the total fatty acids. The ratio of saturated to unsaturated fatty acids is ca. 1:2. Fatty acids with a molecular weight higher than stearic acid are the minor components.

Although the starfruit seeds are rich in oil, their commercial value as a source of oil may probably be insignificant since the fruit contains only a few seeds. Nevertheless, the knowledge of the composition of the oil would be of taxonomic importance in defining the close relationship between the seed fatty acids and the botanical family (3).

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