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RESEARCH NOTE

Characterisation of Nigerian citrus seed oils

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The physico-chemical properties and fatty acid composition of six citrus seed oils from Nigeria, including *Citrus sinensis*, *C. paradisi*, *C. aurantium*, *C. reticulata*, *C. aurantifolia* and tangelo (a hybrid between *C. paradisi* and *C. reticulata*) were determined. The oil contents ranged between 24% and 41%. Their fatty major acids were palmitic ranging from 12·1 to 28%, oleic (between 26·1 and 45·3%) and linoleic (between 29 and 38%). Other fatty acids included stearic and linolenic. The oils showed high degrees of unsaturation, between 67·3 and 86·2%.

INTRODUCTION

Citrus species, of the Rutaceae family, are grown in West Africa, principally for their fruit juices (Opeke, 1987) while their seeds are wasted. While the manufacture of citrus seed oils seems to be well established in several citrus growing countries (Sattar *et al.*, 1987), little or no attention has been hitherto paid to this in West Africa.

Extensive studies have been carried out on the fatty acid composition of various citrus seed oils in many countries (Kefford & Chandler, 1970; Habib *et al.*, 1986; Sattar *et al.*, 1987), but so far no research work has been reported on citrus seed oils from Nigeria. However, a knowledge of the properties of Nigerian citrus seed oils is needed as: (i) differences may occur in the composition of agricultural products from one country to another due to changes in soil type and climate among other factors (Harris, 1960); (ii) the storage life of the fruit juice (squash) is affected by the presence of small amounts of oils from crushed seeds that enter the former during juice extraction (Sattar *et al.*, 1987). This report therefore evaluates the seed oils of the more common citrus fruits in Nigeria with a view to finding their possible edible and/or industrial applications.

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MATERIALS AND METHODS

Six citrus species, sweet orange (*Citrus sinensis* L.), sour orange (*C. aurantium*, L.), grape fruit (*C. paradisi*, L.), lime (*C. aurantifolia* L.), tangerine (*C. reticulata blanco*) and tangelo (hybrid between *C. paradisi* and *C. reticulata*) were used in this study. All the fruits reach the market around the same period of the year (September–January) and collection is about the same time.

Fresh mature fruits of each species were purchased from the local market. They were cut into small pieces and their seeds hand-picked, washed, air-dried, crushed and Soxhlet-extracted for 8 h with hexane. Each extract was vacuum concentrated with a rotavapor and the last traces of solvent removed under nitrogen to obtain the various yellow oils.

The iodine and saponification values of the oils were examined using standard methods (AOAC, 1975). Methylation was by the method of Hartman and Lago as reported in *Pearson's Chemical Analysis of Foods*, (Egan *et al.*, 1981). The fatty acid methyl esters were chromatographed using 10% DEGS on Chromosorb W HP packed in a glass column (200 cm × 2 mm i.d.) on a Varian 3700 GC equipped with a flame ionisation detector. Column, injector and detector temperatures were at 190°, 220° and 250°C respectively with nitrogen carrier gas flowing at 30 ml/min. The methyl esters were identified by comparing their retention times with those of standards under the same operating conditions and quantified by triangulation.

Table 1. Characteristics and fatty acid profiles of the citrus seed oils[a]

	C. sinensis	*C. paradisi*	*C. aurantium*	*C. reticulata*	*C. aurantifolia*	Hybrid (tangelo)
Oil (% dry wt)	34·8±0·41[b]	29·9±0·29	32·4±0·29	24·3±0·24	41·1±0·22	39·3±0·25
Iodine value	102±0·65	101±0·41	109±0·49	108±0·50	100±1·31	114±0·78
Saponification value	186±0·85	192±0·67	186±0·64	188±0·59	196±0·65	193±0·52
Total fatty acids (%)						
C 16:0	25·2±0·45	28·0±0·59	24·8±0·94	27·5±0·74	24·6±0·65	12·1±0·68
C 18:0	4·2±0·54	2·9±0·50	3·0±0·59	1·2±0·42	8·6±0·60	1·7±0·22
C 18:1	26·1±0·45	26·9±0·51	27·2±1·14	29·0±0·82	33·9±0·60	45·3±0·52
C 18:2	37·8±1·11	34·5±0·54	37·6±0·79	29·0±0·87	30·0±0·90	36·4±0·50
C 18:3	6·7±0·51	7·7±0·57	7·4±0·94	13·2±0·42	3·4±0·39	4·5±0·40
DU (%)	70·6	69·1	72·2	71·2	67·3	86·2

[a] Average of three determinations.
[b] Mean ± standard deviation.
DU = degree of unsaturation.

RESULTS AND DISCUSSION

The physico-chemical characteristics and fatty acid profiles of the various citrus seed oils are reported in Table 1. All the seeds have high oil contents (between 24·3% in *C. reticulata* and 41·1% in *C. aurantifolia*). Palmitic acid (ranging between 12·1% in tangelo and 28·7% in *C. reticulata*) was the major saturated acid. Oleic and linoleic acids were the major unsaturated acids. The oil contents and fatty acid distributions compared well with many reported in the literature (Lazos & Servos, 1988; Romero *et al.*, 1988) but were higher than those reported in India (Saleem *et al.*, 1977; Sattar *et al.*, 1987, 1988). There were no unusual acids nor any conjugated acids.

The physico-chemical properties and fatty acid compositions compared well with good quality vegetable oils. Their high degrees of unsaturation reduce the probability of aiding heart diseases (Ajewole & Adeyeye, 1991). Consequently, refining could provide a useful component for edible oil formulation or in soap manufacture. The oils, being non-drying because of the absence of conjugated acids, have little potential in the paint and varnish industries. The highly unsaturated nature of the oils will have deleterious effects in the storage quality of the juices of these fruits. The up-and-coming juice manufacturers should therefore be fastidious in their seed removal to prevent such potential storage problems.

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