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Comparison of Chufa and Olive Oils

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ABSTRACT

Cold-pressed oils from chufa (Cyperus esculentus) *and olive* (Olea europaea) *were compared for fatty acid and triglyceride composition. The oils are of different botanical origin: chufa is a tuber and olive is a fruit. The fatty acid composition was analysed by GLC as the fatty acid methylesters, and the triglyceride composition was analysed by capillary GLC after direct injection. Also the fatty acid composition in the 2-position of the triglycerides was investigated. It is remarkable that the oils are similar in fatty acid composition as well as in the positional distribution of the fatty acids in the triglycerides. Colour and taste, however, are different.*

INTRODUCTION

Olive (*Olea europaea*) is known worldwide and is an important source of oil, but chufa (*Cyperus esculentus*) is not well known. Chufa is a small tuber, especially grown in the regions around the Mediterranean Sea. The tuber has a taste typical of almond or hazelnut and for this reason chufa is also known by names such as Earthalmond and Earthnut (Heywood, 1978). Chufa is used as a foodstuff. In Egypt chufa is soaked overnight and consumed fresh, but the most popular application is the preparation of 'Horchata de Chufa'. Horchata de Chufa is a milky looking extract which, when sweetened with sugar, produces a refreshing beverage with a very pleasant and characteristic flavour. Its consumption has been very popular on the

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Eastern coast of Spain for several centuries, especially in Valencia, where it is considered to have originated (Primo & Lafuente, 1962). Besides horchata, other applications of chufa tubers are possible in the food industry. Mokady & Dolev (1970) evaluated the nutritional components of chufa tubers. They conclude that chufa has a low nutritional value, but this conclusion is based on the high cellulose level of chufa tubers. More recently the importance of cellulose as dietary fibre has become clear. Addition of chufa flour to some food products increases the dietary fibre content significantly. Another interesting component of chufa is the oil fraction. The aim of this study was to compare the cold-pressed oils from chufa and olive.

MATERIALS AND METHODS

Materials

Chufa tubers were kindly provided by Professor Dr B. Lafuente (Valencia, Spain). Cold-pressed olive oil was bought in a local store in Wageningen (The Netherlands). The olive oil originated in Morocco.

Methods

Oil pressing
Chufa oil was obtained by using a hydraulic press, IKA, type IPH 2·5. The following pressing scheme was used: 5 min 50 bar, 10 min 100 bar, 10 min 150 bar, 10 min 200 bar and finally 30 min 220 bar.

Fatty acid composition and fatty acids on the 2-position
The fatty acid composition and the fatty acids on the 2-position were analysed as their fatty acid methylesters according to the IUPAC-Standard Methods (1979). The methylesters were analysed by gas–liquid chromatography using a Carlo Erba, model 4200, equipped with a flame-ionisation detector: the stationary phase was 15% CP sil 84 on Chromosorb WHP. The temperatures for injection, column and detector was 250, 170 and 250°C, respectively. The identification of the fatty acid methylesters was based on their retention times.

Triglyceride composition
The triglyceride composition was analysed by preparing a 0·01% oil solution in *n*-heptane; approximately 0·2 μl heptane solution was injected into a gas–liquid chromatograph, using a Carlo Erba model 4160, equipped with a flame-ionization detector and a cold on-column injector. The analyses

were carried out on a 25 m × 0·25 mm armoured fused silica column WCOT coated with TAP (0·10 μm), tailor made. The detector temperature was 350°C. The following temperature programme was used: starting from 90–340°C with a range of 25°C/min, then from 340–355°C with a range of 0·5°C/min and finally a temperature hold at 355°C for 5 min.

RESULTS AND DISCUSSION

The yield from the oil-pressing experiments was between 45 and 55%. Table 1 gives the results of the fatty acid composition of chufa and olive oil. Our experiments are compared with some literature data. First of all it can be seen that our results agree very well with the known values from the literature. Only the oleic and linoleic acid contents of olive oil differ slightly from the literature values, but this can be attributed to climatic circumstances. It is known that the temperature during growth influences the oleic/linoleic ratio (Belitz & Grosch, 1985). The fatty acid compositions of both oils show a great similarity. This is surprising, because the oils are from different origins. Chufa is a tuber and olive is a fruit. In spite of the similarity in the fatty acid compositions, the positional fatty acid distribution could be different. For this reason the position of the fatty acids in the triglyceride molecule was investigated. Table 2 shows the results of the fatty acid compositions of chufa and olive oils in the 2-position of the

TABLE 1
Fatty Acid Composition of Chufa and Olive Oils (Area %)

			Chufa oil		*Olive oil*	
			(*1*)		(*2*)	
Myristic acid	C14	(M)	0·4	tr	0	tr
Palmitic acid	C16	(P)	14·1	13·4 ± 0·1	11·5	10·8 ± 0·2
Palmitoleic acid	C16:1	(P_o)	0·3	0·2 ± 0·0	1·5	0·6 ± 0·2
Stearic acid	C18	(S)	3·3	3·0 ± 0·0	2·5	2·6 ± 0·1
Oleic acid	C18:1	(O)	71·7	73·5 ± 0·3	75·5	70·5 ± 0·6
Linoleic acid	C18:2	(L)	8·7	9·1 ± 0·0	7·5	15·1 ± 0·1
Linolenic acid	C18:3	(L_n)	0·4	0·4 ± 0·1	1·0	0·5 ± 0·1
Arachidic acid	C20	(A)	0·2	0·5 ± 0·0	0·5	0·3 ± 0·1

Values are means of triplicates ± SD.
(1) Average of several publications: Gad, A. M. & Osman, F. (1961); El-Difrawi *et al.* (1981); Navarro *et al.* (1983); Frega *et al.* (1984).
(2) Belitz & Grosch (1985).

TABLE 2
Fatty Acid Composition of Chufa and Olive Oils in the 2-Position of the Triglycerides (Area %)

		Chufa oil	*Olive oil*
Myristic acid	C14	0·3 ± 0·1	0·4 ± 0·1
Palmitic acid	C16	0·6 ± 0·1	2·1 ± 0·2
Palmitoleic acid	C16:1	0·1 ± 0·0	0·5 ± 0·0
Stearic acid	C18	0·1 ± 0·0	0·4 ± 0·1
Oleic acid	C18:1	85·3 ± 0·2	77·5 ± 0·6
Linoleic acid	C18:2	13·6 ± 0·1	18·5 ± 0·6
Linolenic acid	C18:3	tr	0·6 ± 0·1
Arachidic acid	C20	tr	tr

Values are means of triplicates ± SD.

TABLE 3
Triglycerides in Olive Oil and Chufa Oil (Area %)

Carbon number	*Triglyceride*	*Area % of triglycerides*	
		Olive oil	*Chufa oil*
	PSP	0·3 ± 0·2	0·2 ± 0·1
50	POP	6·0 ± 1·1	6·8 ± 0·9
	PP_oO + PLP	2·1 ± 0·3	0·8 ± 0·1
	PL_nP	0·1 ± 0·0	—
	POS	2·5 ± 0·3	2·5 ± 0·1
	POO	25·8 ± 1·1	27·7 ± 0·7
52	P_oOO + PLO	6·7 ± 0·4	4·5 ± 0·3
	P_oLO + PLL	1·3 ± 0·2	0·3 ± 0·1
	P_oL_nL	tr	tr
	PL_nL_n	tr	tr
	SOS	0·2 ± 0·1	0·6 ± 0·2
	SOO	4·8 ± 0·5	6·6 ± 0·4
54	OOO	39·9 ± 1·3	42·5 ± 0·8
	OLO	8·0 ± 0·8	5·8 ± 0·3
	OLL	1·4 ± 0·1	0·6 ± 0·1
	OOL_n	tr	—
	SAO	tr	tr
56	AOO	0·4 ± 0·1	0·6 ± 0·1
	AOL	0·3 ± 0·1	0·2 ± 0·1

Values are means of triplicates ± SD.

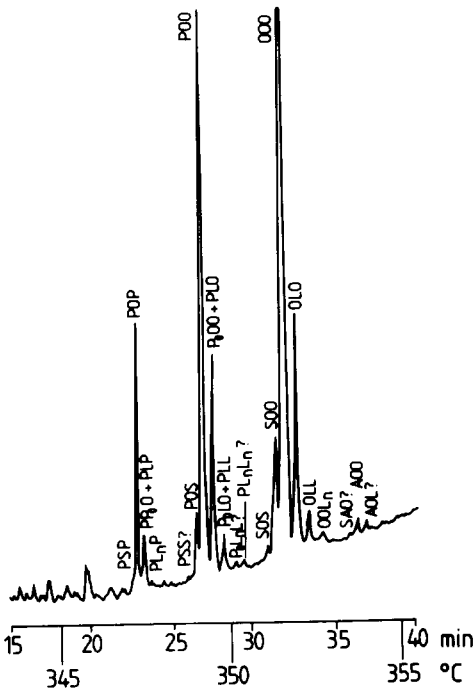

Fig. 1. Triglyceride pattern of olive oil.

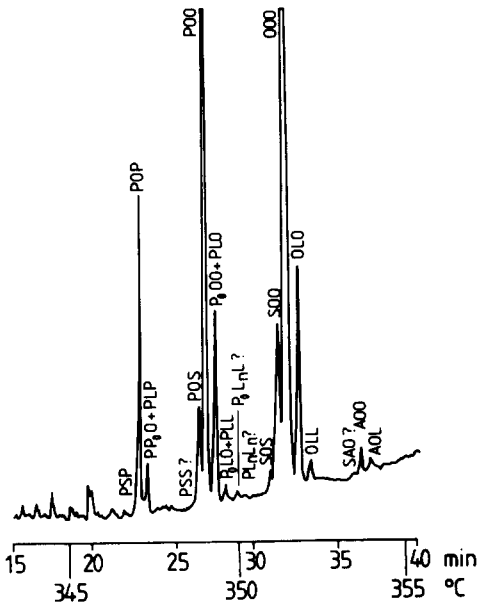

Fig. 2. Triglyceride pattern of chufa oil.

triglyceride. The fatty acid composition in the 2-position shows some slight differences. The palmitic and linoleic acid content is slightly higher in chufa oil. These results agree with the small differences in the oleic and linoleic acid contents of the oils. Although there are some differences in the fatty acid composition in the 2-position, the oils show a great similarity. These results indicate that the total positional fatty acid distribution in the triglyceride might be similar. Therefore the oils were analysed on capillary GC and the triglyceride patterns were compared. Figure 1 shows the triglyceride pattern of olive oil and Fig. 2 shows the chromatogram of chufa oil. Peak determination was done according to Geeraert & Sandra (1985). Both oils confirm the former experiments and show that chufa oil is very similar to olive oil in the positional fatty acid distribution. Table 3 gives the area % of the several triglyceride peaks. These values also show the great similarities in the triglyceride composition of olive oil and chufa oil. The abbreviations, used in Fig. 1 and Fig. 2 and Table 3, are explained in Table 1. Although the fatty acid composition and distribution of the oils are nearly the same, they are different in colour and taste, caused by accompanying components. Olive oil has a greeny colour, while chufa oil has a gold–yellow colour. The taste of olive oil is very characteristic, but the taste of chufa oil is neutral. Chufa oil can be used in the same manner as olive oil. Also the results of this study show that it is very difficult to recognize a mixture of olive oil and chufa oil by the usual analytical methods (i.e. fatty acid composition and positional fatty acid distribution).

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