Fatty Acid Compositions of the Oils of *Celtis sinensis* var. *japonica* and *Zelkova serrata*

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ABSTRACT

Oils were extracted from the pits of *Celtis sinensis* Pers. var. *japonica* Nakai and the fruits of *Zelkova serrata* Makino, of the family Ulmaceae. The oils were examined for their characteristics and fatty acid composition. The percentages of component acids of *Celtis* and *Zelkova* oils determined by gas liquid chromatography of their methyl esters were, respectively: propionic (-, 0.9), butyric (-, trace), caproic (-, 0.1), caprylic (-, 7.3), capric (-, 76.5), lauric (-, 3.3), myristic (0.1, 1.0), palmitic (6.8, 2.8), hexadecenoic (trace, -), stearic (3.5, 0.4), oleic (7.5, 3.9), linoleic (80.0, 3.3), linolenic (2.1, 0.5), and arachidic (trace, -) acids.

INTRODUCTION

Recently we have observed an exceedingly high level of linoleic acid in the kernel oil of *Aphananthe aspera*, a member of the family Ulmaceae (1). The present study was undertaken to elucidate the fatty acid composition of the oils of two additional species of this family, *Celtis sinensis* Pers. var. *japonica* Nakai (= *C. japonica* Planch.) and *Zelkova serrata* Makino, by gas liquid chromatography (GLC) of the derived methyl esters.

The fatty acid composition of *C. sinensis* var. *japonica* seed oil was studied by Koyama et al. (2) using an alkali-isomerization procedure (3) to give percentages of oleic, linoleic, and total saturated acids, On the other hand, *Z. serrata* oil was studied by several workers (4-6) with the results that the oil contains more than 90% of saturated acids among which capric acid is the major one.

In this paper some findings supplementary to the earlier observations are described.

PROCEDURES AND RESULTS

Extraction of Oil

The mature fruits of *C. sinensis* var. *japonica* and *Z. serrata* were collected in November 1976 from trees in Kawagoe-shi, Saitama-ken, Japan. Pits separated from the fruits of *C. sinensis* var. *japonica* were water-washed and dried in the shade. Because of the difficulty of a complete separation of the pit from the fruit, whole fruits of *Z. serrata* were dried. These seed materials were separately ground in a mortar and extracted with ether in a Soxhlet apparatus. The ether extract was treated with hexane in the manner previously described (1), and the hexane-soluble oil was used for determination of characteristics and preparation of methyl esters.

The dried materials of *C. sinensis* var. *japonica* (31.5 g) and *Z. serrata* (94.9 g) gave 4.1 g (13.0%) and 20.7 g (21.8%) of oils, respectively. Yield and characteristics of each sample oil are similar to the literature values (Table I). The sample oils showed no indication of conjugated unsaturation on UV spectrophotometric analysis.

TABLE I

Properties of Oils and Their Mixed Fatty Acids

	C. sinensis var. *japonica*	*C. sinensis* var. *japonica*[a]	*Z. serrata*	*Z. serrata*[b]
Oil				
Yield (%)	13.0	13.5	21.8	21
Sp gr (20 C/20 C)	---	0.9293[c]	0.9354	---
n_D^{20}	1.4762	1.4785	1.4547	1.4473[d]
Acid value	---	1.5	1.0	---
Saponification value	191.0	191.3	286.2	284
Iodine value (Wijs)	145.4	148.5	12.2	13
Unsaponifiable matter (%)	1.30	2.03	1.40	---
Mixed fatty acids				
Neutralization value	199.1	200.2	---	---
Iodine value	153.0	152.7	---	---

[a]Data reported by Koyama et al. (2).
[b]Data reported by Earle et al. (5).
[c]Sp gr (20 C/4 C).
[d]Determined at 40 C.

TABLE II

Fatty Acid Composition of Oils Determined by GLC

Sample	Component acids (% by wt)														
	3:0	4:0	6:0	8:0	10:0	12:0	14:0	16:0	16:1	18:0	18:1	18:2	18:3	20:0	20:1
C. sinensis var. *japonica*	---	---	---	---	---	---	0.1	6.8	trace	3.5	7.5	80.0	2.1	trace	---
Z. serrata	0.9	trace	0.1	7.3	76.5	3.3	1.0	2.8	---	0.4	3.9	3.3	0.5	---	---
Z. serrata[a]	---	---	---	11.5	77.9	3.2	0.6	1.7	---	0.3	2.4	2.0	0.3	---	0.1

[a]Mol %, data reported by Litchfield et al. (6).

Preparation and GLC of Methyl Esters

C. sinensis var. *japonica* oil was saponified in the usual manner, and the fatty acids, obtained after removal of the unsaponifiable matter, were refluxed with H_2SO_4/CH_3OH to give methyl esters. In the case of *Z. serrata,* methyl esters were directly prepared from the oil by a transesterification procedure using 1% Na methoxide/CH_3OH. After cooling and dilution with water the reaction mixture was extracted with ether. The ether layer was dried over anhydrous sodium sulfate and carefully concentrated with a rotating evaporator under atmospheric pressure at bath temperatures below 40 C, and injected directly into the gas chromatograph.

GLC of the methyl esters was carried out using a Hitachi 063 gas chromatograph equipped with a hydrogen flame ionization detector and a 2 m x 3 mm stainless-steel column packed with 15% diethylene glycol succinate polyester coated on 60/80 mesh Chromosorb G AW. Helium was used as carrier gas with a flow rate of 40 ml/min. The column temperature was 200 C, and injection port and detector were maintained at 300 C and 250 C, respectively. For the analysis of *Z. serrata* esters the column was programmed from 70 C to 200 C at 50 C/min. Identification of the components was based on the comparison of their retention times with those of the authentic materials. Peak areas were determined as the product of peak height and the width at half height. The fatty acid composition (% by wt) was calculated from the GLC data (Table II).

C. sinensis var. *japonica* oil was characterized by a high level of linoleic acid (80%), and the oil had a fatty acid pattern coincidental with that of *A. aspera* oil except for a trace of arachidic acid in the former oil.

As shown previously, over 90% of the fatty acids of *Z. serrata* oil were made up of saturated acids containing capric acid as the major one. In addition to the lower acids reported formerly, the present investigation revealed the presence of small amounts of propionic, butyric, and caproic acids in the oil.

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