Fatty Acid Composition of Garlic (*Allium sativum* Linnaeus) Lipids

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ABSTRACT

Chloroform-methanol extracted lipids of garlic (*Allium sativum* Linnaeus) amounted to 0.6% on a dry weight basis. Fractionation by silicic acid column chromatography showed that garlic lipids comprise 62.6% neutral lipids 14.0% glycolipids and 23.4% phospholipids. Fatty acid compositions of total lipids and component lipid fractions were determined.

INTRODUCTION

Garlic (*Allium sativum* Linnaeus) has long been used as a condiment and popular remedy for various ailments (1). Recent studies have demonstrated its antibacterial properties (2,3). Its effectiveness against neurological manifestations of leprosy (4), alloxan-induced diabetes (5) and hypercholesteremia (6-8) have also been reported. Even though much information is available regarding the therapeutic value of garlic, data on chemical composition is limited to the study of sulfur compounds (9) and to the carbohydrates (10). In an attempt to fill this lacuna about other components, a study of garlic lipids was undertaken.

EXPERIMENTAL

Garlic was purchased from the local market. Solvents and chemicals used were analytical grade. Sephadex G-25, 100-200 mesh (Sigma Chemicals, USA) and silicic acid (Glaxo Laboratories, India) were used.

Garlic was deskinned manually and the cloves (bulblets) were extracted with a mixture of chloroform-methanol-water (1:2:0.8, where 0.8 part of water also includes the moisture content of the sample) according to Bligh and Dyer (11) in a Sorvall omnimixer for 2 min. The homogenate was diluted with chloroform and water to obtain chloroform-methanol-water (2:2:1.8). The resulting biphasic system was centrifuged and the chloroform layer which contained lipid was concentrated in a rotary vacuum evaporator. The concentrate was freed from nonlipid matter by passing through Sephadex G-25 (12).

The purified total lipid was fractionated into neutral, glyco- and phospholipids by silicic acid column chromatography (13). Neutral lipid was determined by gravimetry. Glycolipid and phospholipid were quantitated by estimating total sugar according to Dubois et al. (14) and phosphorus according to Marinetti (15).

Fatty acid methyl esters were prepared by transesterification with sodium methoxide (16) and extracted into hexane. They were separated on a gas chromatograph (Chromatographic Inst. Co., Baroda, India) equipped with a flame ionization detector. Conditions were as follows: stainless steel column (8 ft x 1/8 in) packed with 15% Diethyleneglycol Succinate (DEGS) on Chromosorb W (80-100 mesh) was used; column temperature was 180 C; carrier gas, N_2, 40 ml/min; H_2, 40 ml/min; chart speed, 1 cm/min. The peaks were identified by comparing with standard fatty acid methyl esters. The relative percentage of each fatty acid was calculated by triangulation.

RESULTS

Preliminary trials indicated that the Bligh and Dyer procedure (11) was convenient for extraction of lipids from fresh garlic. However, the chloroform layer obtained from the triphasic system was still not free from nonlipid material thus necessitating purification with Sephadex G-25. The quantity of extractable lipid was 0.6% compared to 0.5% extracted by petroleum ether. Fractionation of the total lipids yeilded 62.6% neutral lipids, 14.0% glycolipids and 23.4% phospholipids. Garlic lipids contain a considerably high percentage of polar lipids.

The fatty acid composition of the total lipids (TL) and component fractions (Table I) showed that palmitic, oleic, linoleic and linolenic acids constituted the major fatty acids; capric, lauric, myristic and stearic acids amounted to about 6% in all the lipid fractions. The unsaturated fatty acids together amounted to 72-80% and among these, linoleate was predominant in total lipids as well as in the neutral (NL) and phospholipid (PL) fractions. In contrast,

TABLE I

Fatty Acid Composition of Garlic Lipids[a]

Fatty acids	As % total			
	Total lipid	Neutral lipid	Glycolipid	Phospholipid
$C_{10:0}$	0.5	1.0	0.7	TR[b]
$C_{12:0}$	0.5	0.5	2.8	1.0
$C_{14:0}$	TR	TR	1.7	TR
$C_{16:0}$	24.6 ± 0.6	13.8 ± 0.4	21.0 ± 1.1	26.6 ± 0.8
$C_{18:0}$	TR	TR	0.9 ± 0.2	0.5 ± 0.1
$C_{18:1}$	3.1 ± 0.7	6.6 ± 0.4	6.0 ± 0.3	3.5 ± 0.2
$C_{18:2}$	64.8 ± 0.8	64.3 ± 1.0	28.5 ± 2.0	64.1 ± 0.8
$C_{18:3}$	5.7 ± 0.5	9.5 ± 0.3	37.5 ± 2.6	4.0 ± 0.4
Total unsaturated fatty acids	72.6	80.4	72.0	71.6

[a]Values are mean ± SEM of 4 determinations.

[b]Trace: <0.5%

the glycolipid fraction was richer in linolenate (37.5%) compared to 4-9.5% in TL, NL and PL. Our data differ from the Stoianova-Ianova et al. report (17) that palmitic acid is the predominant fatty acid in garlic flesh, but agrees with their observation that oleic, linoleic and linolenic are the major unsaturated fatty acids. The relevance, if any, of the richness of unsaturates in garlic lipids to the reported pharmacological properties of garlic remains to be seen. Further studies regarding the characteristics of neutral, glyco- and phospholipids are in progress.

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Jojoba—Variability in Oil Content and Composition in a Collection of 1156 Native Plants

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ABSTRACT

Data are presented on the oil content and composition in the seeds of 1156 native jojoba plants harvested individually from inland and coastal areas of California and Arizona in the U.S. and from Sonora and Baja California in Mexico. The mean oil content of these samples was 53.2%; 34.2% of the samples exceeded 53%. The mean single seed weight was 0.56 g. A significant correlation between single seed weight and oil content was found but there was no correlation between oil content of the seed and seed yield per plant. Analysis of the oil for fatty acids and fatty alcohols showed very little variability among samples. This compositional uniformity is a major asset in terms of industrial application of this oil. Half the seeds studied in 144 samples had a mean oil content of 49.5% and mean single seed weight of 0.39 g. Simple correlations between fatty acids and oil content were similar to those reported earlier.

INTRODUCTION

The successful development of jojoba (*Simmondsia chinensis* [Link] Schneider) as a cultivated crop depends greatly on the breeding of cultivars which have a high production of oil per acre. Two quantitative characteristics are important in this connection: yield of seed per acre and oil content of the seed.

Large numbers of single plant selections from several populations of jojoba were made by us in 1978 with these breeding objectives in mind. The purpose of this study was to identify individual plants producing large amounts of seed with a high oil content in the collection of 1156 single plants harvested in the area of the Sonoran Desert. In addition, correlations were studied between seed weight and oil content, and seed yield per plant and oil content.

MATERIALS AND METHODS

A total of 1156 native jojoba plants were harvested individually from inland and coastal areas of California and Arizona in the U.S., and from Sonora and Baja California in Mexico. Seeds were taken at random from each parental plant. About 25 g from each such sample were used to estimate the oil content of the seed. The same seed sample was later crushed in a Carver Press at 10,000 psi to extract oil for fatty acid and fatty alcohol analyses. Jojoba fruits may have 1-3 seeds each. When there is one seed per fruit, the seed is large and spherical in shape. When there are 2 or 3 seeds they are considerably smaller and are shaped like half-spheres. The spherical seeds will be referred to in this text as "whole" and the half-sphere seeds as "half" seeds. These 2 kinds of seeds were analyzed separately.

The oil content of the seed was determined using wide line nuclear magnetic resonance (NMR) with a Newport Mark III instrument. Chemical analyses were performed by the ethanolysis procedure described by Duncan et al. (1). Separation of fatty acid ethyl esters and fatty alcohols was achieved by gas liquid chromatography (GLC) on a 100 cm x 0.3 cm (OD) stainless steel column packed with 20% Apiezon L on 100/120 mesh Chromosorb W (AW DMCS) and run isothermally at 265 C with a helium carrier gas flow of 80 ml/min. The instrument was a Varian 2700 fitted with FID detectors. Peaks were integrated by a Spectra Physics Autolab System 1 integrator.

RESULTS AND DISCUSSION

The mean oil content of the 1156 samples studied was