Fatty Acid Composition of the Oil of Winged Beans, *Psophocarpus tetragonolobus* (L.) DC

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ABSTRACT

The fatty acid composition of the oils of five varieties of winged beans, *Psophocarpus tetragonolobus* (L.) DC, was determined and found to be similar to peanut oil. The total unsaturated fatty acids ranged from 53.8% to 68.5% (mean, 62.0%). Oleic acid and linoleic acids were the major unsaturated fatty acids. The major saturated fatty acids were behenic, palmitic and stearic acids. Parinaric acid, a toxic fatty acid, previously reported to occur in winged beans, was not present in the oil of the winged beans analyzed.

INTRODUCTION

Winged beans, *Psophocarpus tetragonolobus* (L.) DC, are rich in protein and fat (1-5). Winged beans contain ca. 34% protein and 17% oil (5). Padilla and Soliven (6) recognized that the winged beans could be a source of oil for commerce. Pospisil et al. (7) and Cerny et al. (8) were the first to report the fatty acid analysis of the oil. Their results showed that 71% of the fatty acids are unsaturated, with oleic (39%) and linoleic (27%) acids predominating.

The fatty acid profile of winged bean oil is similar to that of soybeans and peanuts. Cerny et al. (8) reported that winged bean oil contains 18:4 (parinaric acid), a potential antinutritional factor. Kleiman, however [in a personal communication to Newell and Hymowitz, (9)] found no parinaric acid, employing UV and GLC analytical procedures.

This study was undertaken to determine the fatty acid composition and to confirm the presence or absence of parinaric acid in five promising varieties of winged beans.

EXPERIMENTAL

Sample Preparation

Winged bean flour was prepared according to the method of Garcia and Palmer (1). Winged beans, varieties CHIMBU (Asia Foundation, San Francisco, CA), TPT-2, (International Institute of Agriculture, Ibadan, Nigeria), WB-19 (originally TPT-12, USDA, PR) and Selections 10 and 12 (originally UPS 76 and 105 respectively, 27 Farms, Homestead, FL) were used in this study. Approximately 150 mg of the lipids (prepared by ether extraction of vacuum-dried winged bean flour) were hydrolyzed in a 50 ml volumetric flask by heating on a steam bath for ca. 5 min with 10 ml methanolic NaOH (0.5 N). Five ml of BF_3 in methanol (14% w/v) were then added and the mixture boiled for 2 min to methylate the fatty acids. Five ml of distilled hexane were added to the flask and the mixture was boiled for 1 min. Saturated NaCl was added to bring the liquid level into the neck of the flask. The upper layer (hexane) was pipetted into a glass-stoppered centrifuge tube. The volume was adjusted to 1 ml by the addition of hexane or by evaporation of hexane under a stream of nitrogen gas. Anhydrous sodium sulfate (0.10 g) was added to bind traces of water. One μl of this solution was injected into a gas chromatograph.

Gas Chromatography

A Bendix gas chromatograph (Bendix Process Instruments Division, Ronseverte, WV) Model 2600 was used with a flame ionization detector (FID). A 4 mm OD x 122 cm glass column was packed with 15% diethylene glycol succinate (DEGS) on 80-100 mesh Chromosorb W(AW).

The detector was set at 255 C and the injector port at 190 C. Air flow to the hydrogen flame detector was held at 600 ml/min., hydrogen at 30 ml/min., and helium at ca. 90 psi to maintain a constant flow rate of 9 ml/min. through the column.

The fatty acids found in the fat sample were identified and quantified with reference to known concentrations of known fatty acids. Fatty acid standards were obtained from Supelco, Inc. (Bellefonte, PA). Relative percentages of the fatty acids were calculated by using integrator counts (Spectra-Physics Minigrator, Spectra-Physics, Santa Clara, CA) adjusted to a standard attenuation.

RESULTS AND DISCUSSION

The fatty acid composition of the oil of the five varieties of winged beans (Table I) was similar to the results of Kleiman (as cited in 9). The fatty acid profile is more similar to peanut oil than soybean oil (Table I). The total unsaturated fatty acids of winged beans ranged from 53.80 to 68.55% assuming the contribution of linolenic acid is one half of the combined values of arachidic and linolenic acids in Table I. Kleiman (as cited in 9) reported that arachidic acid and linolenic acid (Table I) are present in equal amounts. Linolenic acid and arachidic acid were eluted as one peak under the conditions employed (described in methods section); hence, they are reported as the combined value for all five varieties. These values ranged from 2.43% (Selection 12) to 4.51% (WB-19). The values for unsaturated fatty acids are lower than those of Cerny et al. (8) who reported 71% total unsaturated acids. Kleiman (as cited in 9) reported 69% total unsaturated fatty acids. This is quite similar to the values obtained in this study for Selection 10 and 12. Neither Kleiman nor Cerny reported the variety used in their studies.

Oleic acid and linoleic acids were the major unsaturated fatty acids present, with oleic acid present in the largest amount. This is similar to peanut oil in that both oils contain more oleic acid than linoleic acid. Oleic acid content of winged bean oil ranged from 35.04% (Selection 10) to 41.01% (CHIMBU). Linoleic acid content ranged from 15.28% (CHIMBU) to 31.77% (Selection 10).

Behenic acid was the major saturated fatty acid found in winged beans, followed by palmitic, stearic and lignoceric acids. Behenic acid content ranged from 13.35% (Selection 10) to 19.74% (WB-19). Stearic acid content ranged from 4.19% (Selection 12) to 7.51% (WB-19); lignoceric acid content from 3.32% (CHIMBU) to 4.60% (WB-19); and palmitic acid content from 8.53% (Selection 10) to 11.99%

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TABLE I

Fatty Acid Composition of the Oil of Winged Beans, Soybeans and Peanuts (Percent)

	Winged beans								
	CHIMBU	Selection 10	Selection 12	TPT-2	WB-19	Cerny et al (8)	Kleiman[a]	Soybean[b]	Peanut[b]
14:0 – Myristic acid	0.11	0.06	0.06	0.10	0.10	0.1	0.1	0.1	---
16:0 – Palmitic acid	10.35	8.58	8.58	11.30	11.99	9.7	7.4	10.5	11.0
16:1 – Palmitoleic acid	--[c]	---	---	---	---	0.8	0.1	---	---
18:0 – Stearic acid	7.36	5.00	4.19	4.90	7.51	5.7	2.8	3.2	2.3
18:1 – Oleic acid	41.01	35.04	35.57	38.38	36.15	39.0	33.9	22.3	51.0
18:2 – Linoleic acid	18.14	31.77	31.55	17.61	15.28	27.2	28.0	54.5	30.9
18:3 – Linolenic acid	4.00[d]	2.64	2.43	3.67	4.51	2.0	1.4	8.3	---
20:0 – Arachidic acid							1.3	0.2	0.7
18:4 – Parinaric acid	---	---	---	---	---	2.5	---	---	---
20:1 – Eicosenoic acid	---	---	---	---	---	---	4.0	0.9	---
20:2	---	---	---	---	---	---	0.1	---	---
22:0 – Behenic acid	15.71	13.35	13.97	19.29	19.74	13.4	15.9	---	2.3
22:1 – Erucic acid	0.06	0.27	0.22	0.27	0.12	---	0.7	---	---
24:0 – Lignoceric acid	3.32	3.34	3.43	4.46	4.60	---	3.4	---	0.8
Total unsaturated	61.21	68.40	68.55	58.09	53.80	70.5	69.1	86.0	81.9
Total saturated	38.85	31.60	31.45	41.89	45.20	30.9	30.9	14.0	17.1

[a]As cited by Newell and Hymowitz, (9).

[b]Weiss, (10).

[c]Not detected.

[d]18:3 and 20:0 were not separated under the conditions employed and are reported as the combined value for the five varieties analyzed in this study.

(WB-19). Both winged beans and peanuts contain the long chain saturated fatty acids. Behenic acid is not present in soybeans and is present only in a small amount (2.3%) in peanuts (Table I).

Erucic acid and myristic acid were present in trace amounts in all five varieties of winged beans. Parinaric acid (9,11,13,15-octadecatetraenoic acid) a toxic fatty acid first isolated from an oil bearing tree *(Parinarium laurinum)* by Farmer and Sunderland (11), was not present in the winged bean oils analyzed. This finding is not in agreement with Cerny et al. (8) who found parinaric acid in winged beans. Results of Kleiman (as cited in 9) showed the absence of parinaric acid in the winged beans he analyzed. More winged bean varieties will have to be analyzed to prove the presence or absence of parinaric acid.

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