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SHORT COMMUNICATION

Fatty Acids of Winged Bean, *Psophocarpus tetragonolobus* (L.) DC

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Winged bean, *Psophocarpus tetragonolobus* (L.) DC, is a crop that grows easily, quickly and yields abundantly. Its green pods, leaves and tuberous roots are rich in protein and are edible. The bean's seeds are a potential source of edible oil.

Because of its multiplicity of uses and the relative ease of cultivation, winged bean is receiving considerable attention especially in Sri Lanka and other tropical and sub-tropical developing countries. The winged bean's growth potential has been likened to that of the soybean. Soybean has risen from neglect to one of the world's premier protein sources in less than 60 years.

Whilst numerous studies have been reported on the composition and nutritional aspects of pods and leaves of winged bean, reports on the composition of its seed oil[2,3,6,7,9] have been relatively few and sometimes contradictory. Here, we report on the lipids and fatty acids of six varieties of winged bean, grown in Sri Lanka.

Seed Samples

Seeds from six varieties of winged bean, namely TPT-2, S-40, U-53, U-62, U-31 and L-133 were obtained from plants grown on an experimental basis at Angunukolapellesa, Sri Lanka. The seeds were harvested in January 1981.

Extraction of lipid and preparation of methyl esters

Oil was extracted with petroleum ether (b.p. 40-60°C).[1]

To prepare methyl esters the oil (1 g) was refluxed with dry benzene (3 ml) and methanolic sodium methoxide (0.5M. 6 ml) for 45 min. The esters were extracted in the usual way.[4]

Gas chromatography

Gas chromatography was carried out on a Varian Model 2440 chromatograph equipped with a flame ionisation detector and using glass columns (1.8 m x 2 mm i.d)

packed with 10% SP 2340 coated on 100/120 chromosorb W AW. The column was maintained at 190°C. Argon was used as the carrier gas at a flow rate of 30 ml min^{-1}.

Urea crystallisation

Esters (1 g) were crystallised at 0°C, overnight, from a solution of methanol (30 ml) containing urea (5 g). After filtration and washing with methanol saturated with urea, the filtrate was concentrated by heating under reduced pressure, diluted with water (25 ml), and esters extracted thoroughly with diethyl ether (2 x 25 ml). The combined ether extracts were washed with water (10 ml) before final removal of solvent.

The adduct released its esters when mixed with water (50 ml) and these were extracted with ether (2 x 50 ml) as described for the filtrate.

Silver ion chromatography

Silver ion chromatography was carried out on plates (20 x 20 cm) coated with silica gel G (1 mm thick) containing silver nitrate (10%). A mixture of benzene and hexane (70:30) was used as the developing solvent. After development, the plates were dried in a gentle stream of nitrogen and sprayed with an ethanolic solution of 2', 7' - dichloro-fluorescein (0.2% w/v). The separated components appeared as yellow bands on a purple background when viewed under ultraviolet light. These were scraped off and the esters extracted with ether.

Identification of fatty acids

The structural assignments shown in Table 1 were based mainly on the gas chromatographic behaviour (equivalent chain length) of the methyl esters and comparison with authentic standards. These conclusions were confirmed, in part, by dividing the esters by urea fractionation into an adduct of saturated and monoene esters, and a mother liquor enriched in polyene esters. Further evidence was obtained by hydrogenation results and also by separating the esters according to unsaturation by silver ion thin layer chromatography.

The nature of our gas chromatography column was such that 20:1* overlapped with 18:3 (n-3). We divided this peak between its monoene and triene components on the basis of information obtained in the urea fractionation, where all of the monoene esters and some of the polyene esters is present in the urea adduct and the remainder of polyene esters but none of the monoene esters is present in the mother liquor. This division was supported by the proportion of 20:1 to that of 18:1 in the monoene ester fraction separated by silver ion chromatography.

Component acids of the oil

Table 1 shows that the fatty acid composition of winged bean oil differs from that of other common seed oils in that it has appreciable quantities of the long-chain acids

* Fatty acids are reported in shorthand; the first figure shows the number of carbon atoms in the chain and the figure after the colon shows the number of double bonds.

Table 1 – Oil content and fatty acid composition of winged bean oil

Variety	Oil Content (as a percentage of dry weight of seed)	Fatty Acid Composition (g/100 g of total acids)											
		14:0	16:0	16:1	18:0	18:1	18:2	20:0	20:1	18:3(n-3)	22:0	22:1	24:0
T.P.T-2	17.2	t[a]	6.4	0.1	4.0	33.2	26.9	2.3	2.8	2.0	16.3	1.1	1.9
S—40	16.7	t	7.2	0.1	4.5	35.8	29.7	1.7	3.0	1.2	13.2	0.9	2.7
U—53	20.4	t	5.8	0.1	5.1	32.6	25.9	2.3	2.7	1.5	18.2	1.1	4.7
U—62	16.2	t	6.2	0.1	4.1	32.5	29.4	2.2	2.7	1.4	15.4	1.3	4.7
U—31	19.6	t	7.9	0.1	4.5	35.9	30.8	1.5	2.3	1.0	14.0	0.6	2.3
L—133	20.4	t	6.5	0.1	4.3	35.3	30.7	1.5	2.4	1.1	14.7	0.8	2.6
mean:	18.4	t	6.5	0.1	4.4	34.2	28.9	1.9	2.6	1.4	15.3	1.0	3.6

[a] t denotes quantities less than 0.1%

20:0 (range 1.5-2.3%, mean 1.9%). 22:0 (range 13.2-18.2%, mean 15.3%) and 24:0 (range 2.3-4.9%, mean 3.6%). Groundnut oil contains all three of these, but at much lower levels, the three together making up 4-9%.[1] Occurrence of as much as 18% of behenic acid (22:0) in winged bean oil is interesting, as such high levels of this acid have not been found in any other seed oil. Winged bean oil is also atypical in the presence of the long-chain monoene acids 20:1 (range 2.3-3.0%, mean 2.6%) and 22:1 (range 0.6-1.3%, mean 1.0%).

On the average 68% of the winged bean fatty acids are unsaturated, the major unsaturated acids being oleic acid, 18:1 (range 32.5-35.9%, mean 34.2%); and linoleic acid, 18:2 (range 25.9-30.8%, mean 28.9%). Apart from 20:0, 22:0 and 24:0, the main saturated acids in winged bean are palmitic, 16:0 (range 5.8-7.2%, mean 6.5%) and stearic 18:0 (range 4.0-5.1%, mean 4.4%).

Although Cerny and co-workers[3] previously reported the presence of a 18:4 acid, which they considered to have anti-nutritional properties, we do not find evidence for occurrence of 18:4 acids in any of the six varieties of winged bean examined by us. Gas chromatography of winged bean methyl esters did not show any peaks indicative of 18:4 even after concentrating the polyunsaturated esters by urea crystallisation. Silver ion chromatography too failed to produce a fraction corresponding to tetraenes, confirming the absence of 18:4 acids.

Varietal Differences:

U-53 and L-133 have the highest oil content (20.4% on the weight of dry seed) and appear to be the best winged bean varieties for extraction of oil.

However, the fatty acid compositions of the oils extracted from the different varieties do not show any significant differences.

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