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Variation of the Anti-nutritional Behenic Acid Content Among the Cultivars of Winged Bean (*Psophocarpus tetragonolobus* L. DC)

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ABSTRACT

Twelve winged bean cultivars were investigated for variation of anti-nutritional behenic acid among the cultivars. The behenic acid content varied between 0·58 mg/g (8·22 %) and 0·96 mg/g (13·6 %) dry weight. The highest amount of behenic acid was detected in all Nigeria selections (TPt) cultivars and the lowest was recorded in Sri Lanka selection (SLS)-1 cultivar. All University of Papua New Guinea selection (UPS) cultivars recorded second highest amounts of behenic acid, while Indonesia selection (LBNC) cultivars had moderate levels.

INTRODUCTION

Legume seeds provide less expensive and important protein sources to combat malnutrition in developing countries of the world where protein-rich foods of animal origin are not available for the people in low socio-economic groups. Winged bean, a tropical legume, has received much attention in recent years as a promising legume that could be used to combat protein malnutrition in developing countries of the world. Unlike most other leguminous crops, which mostly provide protein-rich seeds, the winged bean gives additional protein in other parts of the plant as follows: flowers 6 %, tender leaves and shoots 6 %, (Claydon, 1975), pods 2 %, 'tubers' (swollen roots) 12 %, as well as its seeds 30 % (Anon, 1975). The consumption of different plant parts of the winged bean varies according to various geographical regions of the world.

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Even though legume seeds provide important nutritional components to the human diet, many of them contain a variety of anti-nutritional factors as well. For example, anti-nutritional trypsin inhibitors have been identified in soybean (*Glycine max L.* Merr.), (Hafez & Mohamed, 1983), field bean (*Vicia faba* L.) (Wilson *et al.*, 1972), lima bean (*Phaseolus lunatus* L.) (Haynes & Feeney, 1967), chick pea (*Cicer arietinum* I.) (Belew *et al.*, 1975), kidney bean (*Phaseolus vulgaris* L.) (King *et al.*, 1980) and winged bean (*Psophocarpus tetragonolobus* L. DC) (Chan & de Lumen, 1982). Chymotrypsin inhibitors have been reported in soybean (Liener & Kakade, 1969) and winged bean (Chan & de Lumen, 1982). Haemagglutinating activity was identified in the field bean (Wilson *et al.*, 1972), kidney bean (King *et al.*, 1980) and the winged bean (Schtrez *et al.*, 1960). In the fatty acid composition of winged bean seeds (Bean *et al.*, 1984) and groundnuts (Kritchevsky *et al.*, 1973), anti-nutritional behenic acid was identified. Kritchevsky *et al.* (1973) suggested that the atherogenic property of peanut oil may be due to the presence of behenic acid (2·3%).

Several investigations have been carried out to destroy or reduce these anti-nutritional factors from legume seeds and make them more safe for human consumption. Cerny *et al.* (1971) completely destroyed trypsin inhibitor activity in raw winged bean seeds by soaking the seeds in water for 30 min or autoclaving at 130 °C for 10 min. Haemagglutinating activity and trypsin inhibitor activity in the field bean was reduced by autoclaving at 121 °C for 30 min (de Muelenaere, 1964) and by heating at 110 °C for 40 min (Wilson *et al.*, 1972), respectively. Also it is known that the content of anti-nutritional factors varies in amounts among the different cultivars. Because of that, several investigators have studied the content of trypsin inhibitors, their variations and distribution among the different cultivars. For example, Hafez & Mohamed (1983) studied 11 soybean cultivars and winged bean cultivars for variation of trypsin inhibitor activity among the cultivars. A large differences in anti-tryptic activity among varieties of soybeans (Kakade *et al.*, 1972), faba beans (Bhatty, 1979) and chick peas (Belew *et al.*, 1975) has been previously investigated.

The reports in the literature reveal that no investigation was carried out to report the variation of anti-nutritional behenic acid in different cultivars of winged beans. The objective of this study was to determine the variation of behenic acid content among twelve winged bean cultivars.

MATERIALS AND METHODS

The winged bean seeds used in this study were obtained from International Dumbala Institute, Sri Lanka. The 12 winged bean cultivars investigated were SLS-1, SLS-37, SLS-6, SLS-41, UPS-139, UPS-46, UPS-31, TPt-15, TPt-10, TPt-8, LBNC-3 and LBNC-8. Samples of winged bean seeds were ground in a Wiley mill to pass through a 40-mesh screen and collect into cellulose extraction thimbles. A known amount of heptadecanoic acid (17:0) was added to each ground sample as an internal standard (Fernando & Bean, 1984). Lipids were extracted by refluxing $CHCl_3$–methanol (2:1, vol./vol.) through the samples in a Soxhlet apparatus for 24 h. The lipid extract was collected and flash evaporated in a water bath at 40 °C and the residue was resuspended in 10 ml of $CHCl_3$–methanol (2:1, vol./vol.). The solvent was evaporated and the total lipid weight was determined. Lipids were then saponified with 10 ml 70% ethanol/KOH for 30 min, and extracted with 10 ml of BCl_3 in methanol (10%, wt/vol.) by boiling for 5 min. The methylated fatty acids were partitioned into 60 ml of hexane and the sterols were separated from fatty acids by column chromatography. Fatty acids were then identified and quantified by gas chromatography, comparing their relative retention time (RRT) to known concentrations of standard fatty acids.

Gas chromatography

A Varian gas chromatograph (Varian Associates, Inc.) model 3700 was used with a flame ionisation detector. The operating conditions were for fatty acids; column 1·8 m × 3·4 mm, i.d., 15% Hi Eff 1BP on gas Chrom P (Applied Science Labs), 20 psi and 165 °C; detector 205 °C; and flash heater, 205 °C (Fernando & Bean, 1985).

RESULTS AND DISCUSSION

The amounts of behenic acid in 12 winged bean cultivars are given in Table 1. The behenic acid content varied among the 12 cultivars ranging from 0·58 mg/g (8·22%) to 0·96 mg/g (13·6%) dry weight. Hafez & Mohamed (1983) reported a variation of total trypsin inhibitor (TTI)

activity among the 11 winged bean cultivars tested. The highest amount of behenic acid was identified in all the TPt cultivars whereas the lowest was recorded in the Sri Lanka selection, SLS-1. Next to TPt cultivars, all UPS cultivars had the second highest levels of behenic acid, while LBNC cultivars had moderate levels. The highest levels of TTI was observed in UPS cultivars (UPS-139 and UPS-46) by Hafez & Mohamed (1983), but

TABLE 1
Variation of Behenic Acid Content Among the 12 Cultivars of Winged Bean

Cultivar	*Behenic acid (22:0) content*[a]	*Behenic as a % of total fatty acids*
SLS[b]-1	0·70	9·92
SLS-37	0·89	12·6
SLS-6	0·58	8·22
SLS-41	0·87	12·3
UPS[c]-139	0·93	13·2
UPS-46	0·91	12·9
UPS-31	0·90	12·8
TPt[d]-1	0·95	13·5
TPt-3	0·96	13·6
TPt-8	0·95	13·5
LBNC[e]-3	0·80	11·3
LBNC-8	0·79	11·2

[a] Quantities expressed as mg/g dry weight.
[b] SLS = Sri Lanka selections.
[c] UPS = University of Papua New Guinea selections.
[d] TPt = Nigeria selections.
[e] LBNC = Indonesia selections.

the TPt cultivars were not included in that investigation. The lowest TTI was found in the SLS-1 cultivar (Hafez & Mohamed, 1983).

The variation of anti-nutritional factors among cultivars of different legumes has been observed by different investigators (Belew *et al.*, 1975; Haynes & Feeney, 1967). Besides the methods that could be used to reduce the anti-nutritional factors, the use of cultivars that have lesser amounts is another alternative for the safe use of legumes.

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