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Investigations on the Trypsin Inhibitor, Urease and Cooking Behaviour of Soybean *Glycine max* Merr.

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ABSTRACT

Eleven varieties of soybeans were analysed for their trypsin inhibitor activity (TIA), urease activity and cooking behaviour. The TIA ranged between 8·1 and 38·5 trypsin units inhibited per mg meal. In general, black soybeans contain higher trypsin inhibitor activities than yellow varieties. There was no appreciable variation in urease activity whose values ranged between 1·93 and 2·12 pH units. Considerable variability was evident in cooking behaviour of soybeans. The cooking period ranged between 140 min and 318 min. Thus the present study suggests the possibility of lowering trypsin inhibitor activity and cooking periods by further selection and breeding programmes of soybean cultivars.

INTRODUCTION

Soybean, with 40 % protein and 20 % oil, has a great potential for meeting the food demand of the ever-expanding population in India. Soybean also contains an unusually large number of anti-nutritional factors. Notable among these are trypsin inhibitors and ureases, which cause various physiological disorders in humans such as pancreatic hypertrophy. Besides these toxins, soybean is very hard and more difficult to tenderise than other pulses. Although the technologies are available to detoxify the beans, control of processing is essential to retain the thermosensitive nutrients. The elimination of the anti-nutritional factors by heat

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treatment may be a temporary solution. A permanent breakthrough could be achieved by breeding programmes to achieve varieties or strains of soybeans with low anti-nutritional factors. The concentrations of anti-nutritional factors could be manipulated to a safe level for humans while at the same time maintaining resistance to pest attack both in the field and during harvest. Sometimes the elimination of trypsin inhibitor by breeding programmes may be counter-productive since it may reduce the total cystine content of the protein that is already limiting. However, this can be supplemented by blending with cereals. In the present investigation, 11 varieties of soybeans, grown in Madhya Pradesh, a leading soybean state in India, were selected. They were analysed for their trypsin inhibitor activity, urease activity and cookability.

EXPERIMENTAL

Materials

The varieties of soybean were obtained from M.P. State Cooperative Oilseed Growers Federation Ltd, Bhopal, India. These cultivars were harvested in November 1983 and stored at 20 °C.

Methods

Trypsin inhibitor activity and urease activities were determined following the ISI method (Indian Standards Institution, 1975). The trypsin inhibitor activity was expressed as trypsin units inhibited (TUI) per milligram meal. The urease activity was denoted as change in pH units.

For the cookability studies the soydhal (splits) was prepared in a small grain mill (Burr type) driven by a single phase 1 hp electric motor. The clearance between the two burrs was 3·5 mm. The hulls were removed by using a hand winnower. The cleaned soysplits were used for determining the cooking times. The soydhal was boiled in water in an open vessel until it was cooked. Pre-soaking of the soydhal for 6 h was done in water at ambient temperature (25 °C) to determine the influence of conditioning on the cooking behaviour. The cooking time (min) is the amount of time required until no hard core is observed at the centre while pressing the soydhal between two glass plates. About 10 soysplits were taken at each time. All analyses were done in triplicate and mean values were computed.

RESULTS AND DISCUSSION

Based on the analyses of 11 varieties of soybean commonly grown in Madhya Pradesh, the data in Table 1 reveal that trypsin inhibitor activity ranged between 8·1 and 38·5 trypsin units inhibited per milligram meal. For the percentage coefficient of variation (42·67) within the cultivars, a four-fold variation was observed. These values are in agreement with those of earlier workers (Kakade *et al.*, 1972; Gupta & Deodhar, 1975). Among these varieties, JS 76 205 and black local are black soybeans. The other cultivars are yellow. From the results it is evident that the black soybeans possess high trypsin inhibitor activities. Among the yellow varieties, MACS-13, JS 76-280 and JS 75-19 had low trypsin inhibitor activities. All the others showed close similarities. This suggests the possibility of reducing trypsin inhibitor activity by selection among these varieties.

The values of urease activity ranged between 1·93 and 2·12 pH units. The percentage coefficient of variation was 2·93. Varietal differences

TABLE 1

Trypsin Inhibitor Activity (TIA), Urease Activity (UA) and Cooking Period of Soybean, *Glycine max* Merr.

Variety	*Colour of seed coat*	*TIA (TUI/mg meal)*	*UA (change in pH units)*	*Cooking period (min)*
JS 76205	Black	29·6	2·06	310
Black local	Black	38·5	2·11	270
JS 78-67	Golden yellow	21·0	2·05	140
JS-2	Golden yellow	27·9	2·11	290
MACS-13	Golden yellow	8·1	2·83	245
JS 76-280	Golden yellow	9·3	1·94	265
JS 75-46	Golden yellow	26·9	2·03	240
JS 75-19	Golden yellow	8·8	2·11	160
JS 72-44	Golden yellow	26·7	2·05	300
Punjab-1	Golden yellow	17·1	2·12	318
Ankur	Golden yellow	17·6	1·93	220
Mean		20·32	2·05	250·0
Standard deviation		8·37	0·06	58·35
Percentage coefficient of variation		42·67	2·93	23·34

were not evident. All the cultivars exhibited close similarities. This suggests little possibility of lowering urease activity through breeding programmes.

The cooking time was established for all the varieties of soybean. The cooking period varied between 140 min and 318 min. The percentage coefficient of variation was 23·34. The soydhal in general took a very long time for complete cooking. The maximum cooking period was observed with JS 76 205 and Punjab-1. JS 7867 took 140 min, the shortest time among all cultivars.

These results are true even with the preconditioned dhal. Although the moisture content of the dhal was increased from 9·3 % (wet basis) to 60 % (wet basis) during 6·0 h of soaking, the cooking time was not changed in any of the cultivars. This reveals that the tempering of the dhal did not influence the cookability. As the soybeans were from the last harvest (November, 1983) and also stored at 20 °C, the effect of higher storage temperatures on the cooking time was also ruled out. Thus these results clearly indicate that the soybean is very hard and difficult to tenderise. Soybeans contain more divalent cations such as Ca and Mg which interfere with the cooking. Therefore the divalent cations could possibly be reduced to a level which facilitates easy cooking of soydhal without sacrificing its nutritional quality.

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REFERENCES

Gupta, A. K. & Deodhar, A. D. (1975). Variation in trypsin inhibitor activity in soybean (*Glycine max*). *Indian J. Nutr. Diet.*, **12**, 81–4.

Indian Standards Institution (1975). *Specifications for edible full fat soyflour*, IS:7837.

Kakade, M. L., Simons, N. R., Liener, I. C. & Lambert, J. U. (1972). Biochemical and nutritional assessment of different varieties of soybean. *J. Agr. Food. Chem.*, **20**, 87–90.