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RESEARCH NOTE

Effect of processing and cooking on the antinutritional factors of faba bean (*Vicia faba*)

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Seeds of two varieties, VH-131 and WF, of faba bean (*Vicia faba*) were subjected to various processing and cooking treatments such as soaking, dehulling, ordinary cooking, autoclaving and sprouting. Soaked and dehulled seeds showed significant reductions in phytic acid (4%) and saponin (26 to 29%) contents of both the varieties, whereas lectins could not be eliminated, though they were observed in the soaking water. Loss of antinutrients was at a maximum when soaked and dehulled seeds were autoclaved for 25 min. Antinutrient concentrations declined during germination; the longer the period of germination the greater was the reduction. Reduction in phytic acid and saponin was greatest in the WF variety of faba bean. Lectin was present even after 48 h of sprouting.

INTRODUCTION

Legumes are one of the richest and least expensive sources of protein in the human diet in many parts of the world. As the requirement of pulses is increasing with population increase, emphasis is being laid upon utilization of nonconventional food legumes like faba bean.

A major obstacle in utilizing the faba beans is the tough nature of their seed coats and the presence of various antinutrients. Phytic acid lowers the bioavailability of minerals and inhibits proteases and amylases. Saponins in large amounts cause gastrointestinal lesions, enter the blood stream and haemolyse red blood cells, causing respiratory failure, convulsions and coma. Lectins cause agglutination of erythrocytes and bind complex carbohydrates and other glycoproteins. Removal of these antinutrients is, therefore, necessary for effective utilization of food legumes for human nutrition.

Domestic processing and cooking methods are known to reduce the antinutrients and thus improve the nutritive value of legume grains (Khokhar & Chauhan, 1986a). The present investigation was undertaken to determine the extent to which antinutrients in faba beans survive various processing and cooking treatments.

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MATERIALS AND METHODS

Soaking and dehulling

Seeds of two varieties of *Vicia faba*, VH 131 and WF, were soaked in tap water for 12 h at 37°C (seed-to-water ratio was 1:10 (w/v)). Unimbibed water was retained for chemical analysis. The seeds were dehulled manually after soaking.

Cooking

Soaked seeds and the dehulled seeds were boiled in distilled water (three times the weight of dry seeds) until cooked soft. Seeds, both soaked and dehulled, were also autoclaved at 15 lbs/in^2 (1·05 kg/cm^2) pressure for 15 and 25 min (seed-to-water ratio 1:2).

Sprouting

Seeds soaked for 12 h were sprouted in Petri dishes lined with wet filter paper for 24, 36 and 48 h at 37°C with frequent watering. After each treatment, seeds were dried at 70°C to a constant weight.

The oven-dried unprocessed, as well as processed, samples were milled in a cyclone mill to pass through a 0·5 mm sieve and stored in plastic containers until required for analysis.

Chemical analysis

Phytic acid was extracted into 0·5 M nitric acid for 3 h and determined colorimetrically by the method of Davies & Reid (1979). A modified method of Gestetner *et al.* (1966) was employed for extraction and determination of saponins. Lectins extracted in normal saline were incubated with red blood cells of rabbit at 37°C for 1 h as advocated by Liener (1955). After incubation, the presence of lectins was observed by clot formation.

Statistical analysis

The data were processed for the analysis of variance according to the standard method of statistical analysis (Snedecor & Cochran, 1967).

RESULTS AND DISCUSSION

Phytic acid

Soaking and dehulling reduced the phytate content up to 4% only. It may be that a soaking time of 12 h was not sufficient for reducing the phytic acid content (Table 1). Ologhobo & Fetuga (1984) also reported that it required 3 days of soaking for a reduction in phytic acid from 1·45 to 1·04% in cowpea.

Cooking of soaked as well as soaked and dehulled seeds caused a loss of 32 and 35% in VH 131 and WF, respectively.

Autoclaving for 15 min had less effect on destruction of phytic acid than had cooking. Only 16 to 18% reduction in soaked seeds and 39% in soaked and dehulled seeds were observed However, autoclaving of soaked and dehulled seeds for 25 min destroyed 53 and 55% of phytates in VH 131 and WF, respectively. It was suggested by Rackis (1974) that a long time is required for destroying phytates. So, possibly more time would have had a more pronounced effect on the destruction of phytates.

Germination caused the most significant reduction in phytates. The longer the period of germination, the greater was the reduction in phytic acid content. Germination of seeds for 48 h caused a reduction of 66 to 69%. This reduction was possibly due to activation of phytase during germination. Phytase has been reported in faba beans and other legumes by Michael Eskin & Wiebe (1983).

Saponins

In soaked and dehulled seeds there were 29 and 26% reductions in saponin contents of VH 131 and WF varieties, respectively. This reduction was possibly due to leaching out of the saponins during soaking, which is evident from Table 2.

Cooking of soaked seeds reduced the saponin content by 35% in both varieties. In soaked, dehulled and cooked seeds, saponins were reduced by 37 and 36%,

Table 1. Effect of processing and cooking on phytic acid content (mg/100 g) and saponin content (mg/100 g) of *Vicia faba*

Treatments	Variety			
	VH 131		WF	
	Phytic acid	Saponin	Phytic acid	Saponin
Raw (control)	980 ± 1·4 —	1370 ± 70 —	978 ± 0·9 —	1331 ± 20 —
Soaked	947 ± 4·1 (3)	1047 ± 24 (23)	943 ± 3·3 (3)	1059 ± 23 (20)
Soaked and dehulled	940 ± 4·7 (4)	964 ± 42 (29)	937 ± 5·2 (4)	978 ± 20 (26)
Soaked and cooked	880 ± 4·7 (10)	892 ± 58 (35)	857 ± 4·3 (12)	860 ± 21 (35)
Soaked, dehulled and cooked	661 ± 4·0 (32)	853 ± 11 (37)	636 ± 1·0 (35)	852 ± 6·8 (36)
Soaked and autoclaved (15 min)	824 ± 3·2 (16)	822 ± 22 (40)	796 ± 3·2 (18)	739 ± 11 (44)
Soaked, dehulled and autoclaved (15 min)	596 ± 3·2 (39)	705 ± 50 (48)	589 ± 2·8 (39)	666 ± 48 (50)
Soaked and autoclaved (25 min)	781 ± 3·6 (20)	540 ± 11 (60)	697 ± 2·9 (28)	494 ± 19 (63)
Soaked, dehulled and autoclaved (25 min)	453 ± 4·1 (53)	260 ± 25 (81)	438 ± 4·0 (55)	211 ± 16 (84)
Sprouted (24 h)	897 ± 2·1 (8)	949 ± 5·7 (30)	891 ± 5·9 (9)	923 ± 14 (30)
Sprouted (26 h)	528 ± 2·3 (46)	487 ± 17 (64)	503 ± 2·3 (48)	495 ± 14 (63)
Sprouted (48 h)	328 ± 2·0 (66)	315 ± 21 (77)	299 ± 1·8 (69)	308 ± 5·3 (77)

Values are mean ± SE of three independent determinations.
CD (5% level): 10·34; 89·93.
CD (1% level): 13·58; 118·86.
Figures in parentheses indicate % decrease over control values.

Table 2. Levels of various antinutritional factors in soaked water of *Vicia faba*

Antinutritional factors	Variety	
	VH 131	WF
Phytates (mg/100 ml)	2·5 ± 0·1	2·4 ± 0·1
Saponins (mg/100 ml)	30·0 ± 0·8	25·0 ± 0·4
Lectins (haemagglutinins)	Present	Present

Values are mean ± SE of three independent determinations.

respectively. Loss during cooking may perhaps indicate the thermolabile nature of saponins. Khokhar & Chauhan (1986*b*) also mentioned a reduction in saponin content during cooking. They stated that this reduction may be due to formation of a poorly extractable complex between saponins and sugar or amino acids.

Autoclaving of soaked seeds for 15 min resulted in a reduction of 40 to 44% of the saponin content. A further reduction in the saponin content of up to 48 to 50% was observed when soaked and dehulled seeds were autoclaved for 15 min. Soaking and autoclaving for 25 min brought down the saponin content by 60 to 63%. The maximum reduction in saponin content was observed (81–84%) when soaked and dehulled seeds were autoclaved for 25 min. Germination of the seeds for 24 h reduced the saponin content by 30%. The longer the period of germination, the higher was the reduction. After 48 h germination, a reduction to the level of 77% was observed in both the varieties. Enzymic degradation could be a possible explanation of the saponin loss during germination, which is far from established. Loss of saponin from mothbean during germination has earlier been reported from this laboratory (Khokhar & Chauhan, 1986*a*).

Lectins

Lectins were present in raw seeds of both the varieties. Processing methods, such as soaking, soaking and dehulling, and soaking and cooking, did not remove the haemagglutinating activity completely. Although, leaching out of the lectins could be observed during soaking, the amount left in seeds was still sufficient to agglutinate rabbit erythrocytes. Kantha and Heltiarachchy (1982) also reported that soaking of beans for 10 h did not reduce the lectins.

Cooking of dehulled seeds and autoclaving for 15 and 25 min eliminated this antinutrient completely. Complete inactivation of lectins after autoclaving winged beans at 120°C for 10 min (Kadam & Smithard, 1987) has been reported earlier.

Lectins could be detected in faba beans even after 48 h of germination. Nielsen & Liener (1988) reported that it required 10 days of germination of *Phaseolus vulgaris* seeds for complete removal of lectins. In this study, probably the lectins were not all removed in up to 48 h of germination, and the amount left in sprouted seeds was sufficient to cause agglutination.

Phytic acid, saponins and lectins present in faba beans were significantly reduced by different processing and cooking methods. Autoclaving of dehulled seeds for 25 min was effective in removing most of the lectins and saponins. Phytic acid was reduced greatly by germination for 48 h. Germination of faba bean seeds seemed to be the most effective method of getting rid of these antinutrients.

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