

Proximate Composition, Antinutritional Factors and Protein Fractions of Guar Gum Seeds as Influenced by Processing Treatments

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Abstract: The proximate composition, antinutritional factors and protein fractions of guar seeds were studied before and after autoclaving, soaking followed by dehulling and germination treatments. Chemical composition was varied between the treatments. Soaking of seeds followed by dehulling significantly increase protein content to 67.8%. Germination of seeds increased tannin and phytic acid content of the seeds. Polyphenols were fluctuating during processing. Albumin fraction of the seeds was decreased; prolamin and globulin were fluctuated during processing while glutelin was greatly increased.

Key words: Guar gum, phytate, tannin, polyphenols, protein fractions

Introduction

It is well recognized that food grain legumes, such as common beans, lentils and kidney beans, represent the main supplementary protein source in cereal and starchy food-based diets consumed by large sectors of the population living in developing countries. Although, the nutritional value of these legumes is of great importance, their intake is unfortunately lower than what is desirable. Furthermore, food grain legumes should be free of antiphenological substances, have high nutrient bioavailability and be easily processed into edible, acceptable products (Bressani, 1989; Bressani, 1993). The nutritional value of grain legumes, not always fully understood and accepted by consumers, is divided here into two large groups: positive and negative factors. The positive factors include high protein and lysine content, which allows legumes to serve as excellent protein supplements to cereal grains (Bressani, 1989; Bressani, 1993). The health-related value of beans includes their positive effect on blood cholesterol and glucose levels (Walker, 1982; Leeds, 1982), possibly through the dietary fiber present in beans. The negative factors fall into two groups. Antinutritional factors such as enzyme inhibitors, flatulence factors, polyphenols, tannin and phytic acid. The other negative nutritional factors include protein, carbohydrate digestibility and sulfur amino acid deficiency (Bressani, 1989; Bressani, 1993). Legumes such as lentil contain a high concentration of proteins, carbohydrates and dietary fiber and make an important contribution to human diet in many countries. Legumes have to be processed prior to consumption due to their content of antinutritional compounds, such as trypsin inhibitors, phytic acid, α -galactosides (Vidal-Valverde *et al.*, 2002). Processing techniques such as soaking, cooking, germination and

fermentation have been found to reduce significantly the levels of phytates and tannins by exogenous and endogenous enzymes formed during processing (Moshia and Savanberg 1990; Iorri and Savberg 1995; WHO, 1998). The objective of this study was to investigate the effect of different processing methods on antinutritional factors and protein fractions of guar seeds.

Materials and Methods

Guar seeds were obtained from the Department of Crop Production, Faculty of Agriculture, University of Khartoum, Sudan. The seeds were cleaned and freed from foreign matters and milled in a laboratory miller to pass through a 0.4 mm screen. Unless otherwise stated all chemicals used in this study were of reagent grade.

Processing treatments

Soaking: The seeds were soaked in water for 18 h. Then the soaked seeds were dried at 60°C and ground to pass a 0.2 mm screen.

Dehulling: The seeds were soaked in water for 18 h and then hand pounded to separate the hull. The dehulled seeds were then dried at 60°C and ground to pass a 0.2 mm screen.

Autoclaving: The seeds were ground to pass a 0.2 mm screen and autoclaved at 110°C for 10 min.

Germination: The whole seeds were spread on trays lined with cloth. It was kept wet by frequent spraying of water. After 36 h the germinated seeds were removed from the trays, sun-dried and ground to pass a 0.2 mm screen.

Table 1: Chemical composition(%) of treated and untreated guar seeds

Treatments	Moisture	Ash	Fiber	Oil	Protein	Carbohydrates
Control	7.3	4.8	9.3	2.3	52.6	23.7
Soaked dehulled	9.7	4.8	3.5	4.1	67.8	10.1
Autoclaved	7.4	4.5	9	4.6	52.7	21.8
Germinated	10.4	5.5	5.3	6.5	44.8	27.5

Chemical composition

Proximate composition: Protein, moisture, ether extract, ash and crude fiber contents were determined as described in AOAC methods (1984). Carbohydrates content was determined by difference.

Determination of tannin content: Quantitative estimation of tannin for each sample was carried out using the modified vanillin-HCl in methanol method as described by Price *et al.* (1978). A standard curve was prepared expressing the results as catechin equivalents, i.e. amount of catechin (mg per ml) which gives a colour intensity equivalent to that given by tannins after correcting for blank.

Phytic acid determination: Phytic acid content was determined by the method described by Wheeler and Ferrel (1971) using 2.0 gm of a dried sample. A standard curve was prepared expressing the results as Fe (NO₃)₃ equivalent. Phytate phosphorus was calculated from the standard curve assuming 4:6 iron to phosphorus molar ratio.

Total polyphenols determination: Total polyphenols were determined according to Pursson Blue spectrophotometric method (Price and Butler, 1977). A standard curve was prepared expressing the result as tannic acid equivalent i.e. amount of tannic acid (mg/100g) which gives a color intensity equivalent to that given by polyphenols after correction for blank.

Protein fractionation: Protein fractions were extracted according to their solubilities in different solvents, as described by Landry and Moureaux (1970). Defatted guar flour (3.5 g) was extracted twice with 50 ml distilled water for 30 min at room temperature. The extract was centrifuged at 3000xg for 30 min and the supernatant was used for the determination of a water-soluble protein (albumin). The residue was then extracted successively in a similar manner with 1.0 M NaCl, 70% ethanol or 0.2% NaOH. The supernatant of each extract was collected separately and used to estimate the salt- (globulin), alcohol- (prolamin) or alkali- (glutelin) soluble fraction. The residue remaining after successive extractions represents the insoluble proteins.

Results and Discussion

Chemical composition: Table 1 illustrated the proximate composition of untreated and treated guar seeds. The moisture content of untreated sample (7.3%) was

approximate similar to that of untreated chickpea seeds (7.8) reported by Osman *et al.* (2005). The ash, oil and crude fiber content were found to be 4.8, 2.3 and 9.3% respectively. The protein content of untreated seeds was found to be 52.6%, which was higher than those of lupin seeds (44.7%) reported by Hassan *et al.* (2005). Autoclaved seeds have slightly similar moisture, ash, crude fiber, crude protein and higher oil content than raw one (4.6%). Germination treatment and soaking of seeds followed by dehulling decrease crude fiber to 5.3 and 3.5% respectively. This reduction may be attributed to the removal of the seeds hull. Moreover, germination of the seeds for 3 days reduced the protein content to 44.8%. However, soaking of seeds followed by dehulling significantly increased protein content to 67.8%. This increment may be due to quantitative reduction of antinutritional factor (tannin & phytic acid) and other water-soluble constituents.

Effect of processing on antinutritional factors: Fig. 1 shows the effect of processing treatments on tannin, polyphenols and phytic acid content of treated and untreated guar seeds. Tannin content of untreated seeds was found to be 1750mg/100g. Autoclaving and soaking of seeds followed by dehulling reduced tannin content to 450 and 150 mg/100g respectively. Similar results were reported for chickpea seeds soaked in water for different time intervals (Ahmed *et al.*, 2005). Since most tannin located in the testa, its physical removal reduced tannin content. Germination of seeds for 3 days significantly increased tannin content to 2650mg/100g. This increment may be due to solubilization of insoluble tannins due to germination, which caused soluble tannin to migrate from the seed coat to the core of the seed. Result obtained agreed with those reported by Oloyo (2004) who found that germination of pigeon pea seeds for 3 days caused increment in tannin content. Polyphenols of untreated seeds was 25 mg/100g. Autoclaving of seeds increased polyphenols content to 41 mg/100g, while, germination and soaking of seeds followed by dehulling caused a reduction of polyphenols to 19 and 22 mg/100g, respectively. Bishnol and Khetarpau (1989) reported that soaking of cowpea seeds for different periods of time significantly reduced polyphenols contents of the seeds. Germination also was observed to reduce polyphenols of beans (kataria *et al.*, 1989). Phytic acid content of untreated seeds was found to be 540 mg/100g (Fig. 1). Processing treatments were slightly increased phytic acid content. This increment may be due to inhibition

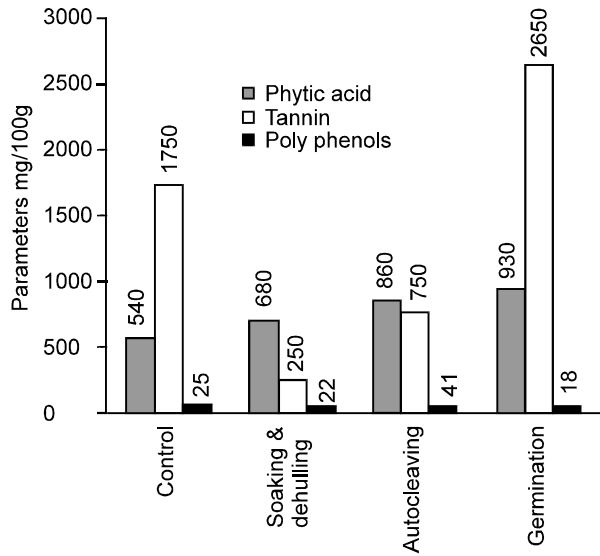


Fig. 1: Effect of processing treatments on antinutritional factors of guar seeds

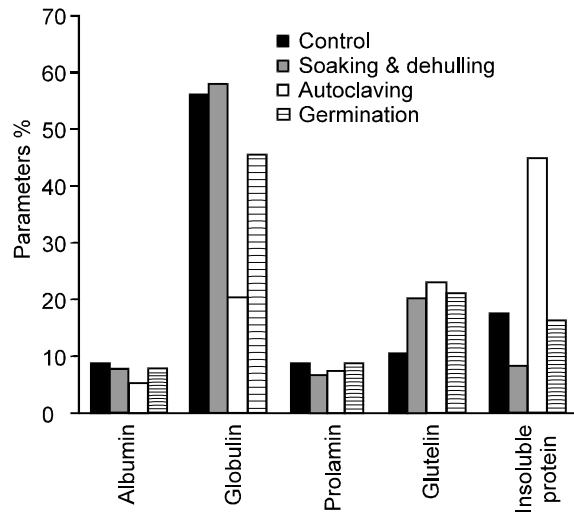


Fig. 2: Effect of processing treatments on protein fractions of guar seeds

of phytase activity during processing treatments as well as the concentration of phytic acid in the core of the seed.

Effect of processing on protein fractionation: Fig. 2 shows the protein fractions of treated and untreated guar seeds on the basis of solubility. Untreated seeds were fractioned into albumin (8.4%), globulin (55.9%), prolamin (8.3%) and glutelin (10.2%). The results obtained indicated that about 82.8% of the total could be extracted by solvents and the remaining percentage account for the non-protein nitrogen and insoluble proteins. Soaking of seeds followed by dehulling

significantly decrease fraction 1 & 3 (albumin and prolamin) to 7.5 and 6.7% respectively. Autoclaving of seeds had caused further reduction in albumin, globulin and prolamin fractions and were reduced to 5.1, 20.1 and 7.3%. The glutelin fraction was significantly increased upon processing treatments.

References

A.O.A.C, 1984. Official methods of the analysis of the Association of Office Analytical Chemists. 14th edn., published by the A.O.A.C, Inc. North nineteenth street, suite 210 Arlington, Virginia 22209, USA.

Amro B. Hassan, Gammaa A. Osman and Elfadil E. Babiker, 2005. Effect of domestic processing on antinutrients and availability of protein and mineral of lupin (*lupinus termis*) seeds. J. Food Tec., 3: 263-268.

Bishnoi, S. and N. Khetrapau, 1989. Saponin content and trypsin inhibitor of pea cultivars: effect of domestic processing and cooking methods. J. Food Sci. Tec., 31: 37-46.

Bressani, R., 1993. Grain quality of common beans. Food Rev. Int., 9: 217-297.

Bressani, R., 1989. Revision boreal catedad del grano de de frijol. Archio Latino Americano de nutrition, 39: 419.

Iorri, W. and U. Svanberg, 1995. An overview of the use of termented food for child feeding in Tanzania. Eco. Food Nutr., 34: 65-81.

Kataria, A., B.M. Chauhan and D. Puria, 1989. Anti-nutrients and protein digestibility (*in vitro*) of Mung bean as affected by domestic processing and cooking. Food Chem., 32: 9-17.

Leeds, A.R., 1982. Legumes and gastrointestinal function in relation to diet for diabetics. J. Plant Food, 4: 23-27.

Maha, M. Ahmed, Elfadil E. Babiker, Amro B. Hassan and Abdullah H. El Tinay, 2005. Effect of domestic processing on antinutritional factors and protein quality of chickpea cultivars. Ind. Res. J. Sudan, 3: 10-30.

Mosha, A.C. and U. Svanberg, 1990. The acceptance and food intake of bulk reduced weaning. The liganga village study. Food Nutr. Bulletin., 12: 69-74.

Nuha M. Osman, Amro B. Hassan, Mohamed Ahmed, I. Ali and Elfadil E. Babiker, 2005. Effect of autoclaving on solubility and functional properties of chickpea (*Cicer areitinum* L) flour as a function of salt concentration. J. Food Tec., 3: 336-341.

Oloyo, R.A., 2004. Chemical and nutritional quality changes in germinating seeds of *Cajanus cajan* L. Food Chem., 85: 497-502.

Price M.L., S. Van Socoyoc and L.G. Butter, 1978, A critical evaluation of the vanillin reaction as an assay for tannin in sorghumgrain, Agric. Food. Chem., 26: 1214-1218.

Ahmed *et al.*: Guar Gum Seeds

- Price, M.L. and L.G. Butler, 1977. Rapid visual estimation and spectrophotometer determination of tannin content of sorghum grain. *J. Agri. Food Chem.*, 25: 1268-1273.
- Vidal-Valverde, C., J. Frías, I. Sierra, I. Blazquez, F. Lambien and Y.H. Kuo, 2002. New functional legume food by germination. Effect on the nutritive value of beans, lentils and peas, *Eur. Food Res. Tec.*, 215: 472-476.
- Walker, A.F., 1982. Physiological effect of legumes diet. *A Rev. J. Plant Food*, 4: 5-14.
- Wheeler, E.I. and R.E. Ferrel, 1971. Methods for phytic acid determination in wheat and wheat fractions. *Cereal Chem.*, 48: 312-320.
- WHO, 1998. Complementary feeding of young children in developing countries: A review of current scientific knowledge- Geneva.