

PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF
NUTRITION

ANSI*net*

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Effect of Different Processing Methods, on Nutrient Composition, Antinutritional Factors, and *in vitro* Protein Digestibility of Dolichos Lablab Bean [*Lablab purpureus* (L) Sweet]

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Abstract: The effect of different traditional processing methods, soaking, cooking roasting, autoclaving and germination on the nutrient composition antinutritional factor, and *in-vitro* digestibility in Dolichos lablab seeds were investigated. Germination significantly increased the protein and moisture content, whereas roasting and autoclaving decreased their contents. Crude lipid content, was significantly reduced by various processing. Ash content varied significantly between raw and processed samples. The trypsin inhibitor activity and phytic acid content significantly decreased by different process methods, while the amounts of tannins significantly decreased. The cooking of presoaked seed appeared to be the most effective method for reducing trypsin inhibitor activity. The reduction in content of phytic acid was found to be somewhat greater in roasted sample compared to others. Germination significantly increased tannins content compared to the other traditional methods. Germination was the most effective in improving protein digestibility when compared to soaking and cooking.

Key words: Dolichos lablab bean, traditional processing, nutrient composition, antinutritional factors, protein digestibility

Introduction

Legumes are important sources of proteins, carbohydrates, dietary fiber, and minerals consumed worldwide. They are generally well adapted to a wide range of climates and environmental conditions. Of the thousands known legume species only few have been extensively promoted and used. Many other potential legumes are still marginally known. These potential legumes might be of great importance in many zones of developing countries where there is a pressing need for food sources of high energy and good protein quality. The Dolichos lablab bean is one of the lesser-known legumes of arid and semi-arid land. The bean classified by the National Academy of Science (NAS) as potential source of the protein that has not been explored yet. Studies on nutrient composition showed that the bean is good source of protein, carbohydrate and energy (Purseglove, 1968; Duke, 1983; Deka and Sarkar, 1990; Salimath and Tharanathan, 1982). The antinutritional factors level of these bean have been studied by many authors. Trypsin inhibitors activity level ranged from 11.8 to 29.0 TIA /gm sample (Ahmed and Nour, 1990; Deka and Sarkar, 1990; Devaraj and Manjunath, 1995). Tannin content of untreated lablab bean has been reported to be high, (Deka and Sarkar, 1990; Shastry and John, 1991) Phytic acid level varied from 100.0 to 313.4 mg/100gm (Deka and Sarkar, 1990; Al Othman, 1999). In order to utilize bean effectively as human food it is essential to inactivate or remove these antinutritional. Generally, adequate heat processing inactivates the trypsin and chymotrypsin (DiPietro and Liener, 1989;

Osman *et al.*, 2002). Heat stable compounds in cereal and legumes such tannins and hydrates are easily removed after germination (Reddy *et al.*, 1985) and fermentation (Osman, 2004). A better understanding of the effect different traditional processing methods on nutritive value, may lead to wider use of this legume in food industry. The purpose of this study was therefore: To study the effect soaking, cooking, roasting an autoclaving, and germination on nutritive value, anti nutritional factors and *in-vitro* protein digestibility.

Materials and Methods

Materials: Dolichos Lablab bean [*Lablab purpureus* cl.) sweet] were obtained from The Agriculture Experiment Station, College of Agriculture, King Saud University, Saudi Arabia. The Beans were cleaned manually.

Samples preparation: Soaking, the beans were soaked in water for over night in tap water with bean to water ratio of 1 to 10 (w/v). After soaking excess water was drained off and the beans were dried at 60 and powdered. Cooked bean was prepared by soaking the bean and cooking them in water for 30 min in a pressure cooker. The finely ground flour was autoclaved for 20 min at 121°C under 15lb/in. Roasting was carried out according to the method of (Yanez *et al.*, 1986). Germinated beans was prepared by soaking the bean overnight, the beans were germinated at room temp for 5 days by keeping them in trays lined with wet filter paper.

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Table 1: Effect of different processing on chemical composition of lablab

	Moisture	Protein	Fat	Ash	Carbohydrates
Raw	6.41±0.03 ^C	26.86±0.38 ^B	1.9±0.01 ^A	3.96±0.04 ^{BC}	67.23±0.30 ^{BC}
Soaking	7.35±0.05 ^B	25.67±0.25 ^{DC}	1.4±0.13 ^B	3.32±0.01 ^D	70.10±1.05 ^A
Cooking	6.23±0.35 ^C	25.43±0.38 ^{DE}	0.89±0.07 ^D	2.86±0.19 ^E	70.80±0.26 ^A
Roasting	2.73±0.35 ^D	24.56±0.50 ^{EF}	1.10±0.16 ^{DC}	3.53±0.49 ^{DC}	70.77±0.20 ^A
Autoclaving	6.35±0.31 ^C	24.34±0.14 ^F	1.21±0.20 ^{BC}	4.13±0.08 ^A	70.35±0.07 ^A
Germination	12.95±0.80 ^A	28.55±0.21 ^A	1.19±0.08 ^{BC}	3.83±0.03 ^{ABC}	66.40±0.14 ^D

Proximate composition: The protein, fat, ash, crude fiber and moisture content of the Dolichos Lablab bean were estimated according to the method described by the (AOAC, 1984). Total carbohydrates were calculated by difference.

Trypsin inhibitor activity (TIA): Trypsin inhibitor activity was assayed according to the (Kakade *et al.*, 1969) using BAPA N-benzoyl-DL-arginine-P-nitroanilide hydrochloride and trypsin type III from bovine pancreas.

Phytic acid: Phytic acid analysis was performed according to the method of (Mohamed *et al.*, 1986), using chromophore reagent. Phytic acid (Dodecasodium salt) from corn was supplied by Sigma chemical company and used as a standard.

Tannin: The modified vanillin-Hcl method of (Price *et al.*, 1978) was followed with minor modification.

In-vitro protein digestibility: *In-vitro* digestibility was determined following (Hsu *et al.*, 1977) as modified by (Satterlee *et al.*, 1977).

Results and Discussion

The effect of the different treatments on nutrient composition of lablab bean is presented in Table 1. Both soaking and germination significantly increased moisture content of the bean, whereas, roasting significantly decreased the moisture content. Cooking and autoclaving showed no significance difference in moisture content as compared to the raw. The protein content of raw bean was similar to that reported by (Al-Othman, 1999), but higher than those reported by (Ahmed and Nour, 1990). Germination increased protein content significantly whereas, the other methods significantly decreased it. This increase is related to increased water activity during germination due to hydrolytic enzymes. Similar results were reported in tepary bean (Idouraine *et al.*, 1989), in winged bean (King and Puwastien, 1987), and Nigerian cowpeas (Akpapunam and Achinewhu, 1985). Soaking, cooking, roasting or autoclaving significantly decreased protein content. The decrease in protein content during soaking and cooking might be attributed to the leaching of soluble proteins. The lipid content of the raw lablab bean is in agreement with reported by (Al-Othman, 1999) and (Purseglove, 1968). In general there was a significance

decrease in fat content due to various processing. Cooking of presoaked bean beans was more effective than other methods. This can be attributed to high lipolytic enzyme activity which, break down the triglyceride to simple fatty acids sterol esters and polar lipids, especially with soaked, soaked and cooked and germinating, the ash values varied. Autoclaving resulted in a significant increase in ash content, while, soaking and cooking significantly reduced the ash content. There were no significant different in ash content of germinated and roasted samples compared to the raw lablab bean. Cooking caused greater decrease in ash content than soaking. The reduction in ash content might be due to the leaching out of both macro and micro elements into soaking and cooking water. There, were significant increase in carbohydrate content due, soaking, cooking, roasting, or autoclaving. In contrast, germination significantly reduced carbohydrates content. Similar results were reported by (Ologhobo and Fetuga, 1986) they found a decrease in total carbohydrates in cowpea after 48 hr germination. This, reduction, can be attributed to the use of carbohydrates as source of energy for young seedlings.

Data on trypsin inhibitor, phytic acid and tannins of raw and processed bean are summarized in Table 2. The trypsin inhibitor values were significantly ($P < 0.05$) reduced by the different treatments, cooking being the most effective. Soaking of the bean overnight reduced TIA by 6.3% and cooking of soaked beans caused further reduction in TIA content (66.7%). This finding, agree with that of (Marquez and Alonso, 1999) who reported a reduction in trypsin inhibitor level during soaking and boiling chickpea. Similarly (Kadam and Smithard, 1987) also observed that a significant decrease in TIA in winged bean after cooking of presoaked bean. (Devaraj and Manjunath, 1995) found that the Dolichos lablab protienase inhibitors activity was completely lost by 60 min cooking. Roasting, and autoclaving significantly reduced the amount of TIA, by 23.05%, and 12.09% respectively. The data agree with found by (Kapoor and Gupta, 1978; Carlini and Udedibie, 1997) in other legumes. Germination significantly decreased TIA by 19.3%. This results was similar to those observed on other legumes, like soybean (Collins and Sanders, 1976), Lentil (Frias *et al.*, 1995; Vidal-Valverde *et al.*, 1994), great Northern bean (Sathe *et al.*, 1983), faba bean (Rahma *et al.*, 1987), and chick bean (Savage and Thompson, 1989).

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Table 2: Effect of various processing on antinutritional factors level

	Trypsin inhibitor (TIU/mg)		Phytic acid (mg/100g)		Tannins (%catechin)
		% Reduction		% Reduction	
Raw	28.96±0.30 ^A	100	605.39±0.39 ^A		0.42±0.01 ^F
Soaking	27.14±0.69 ^B	6.30	471.07±2.5 ^B	22.19	0.54±0.01 ^D
Cooking	9.66±0.23 ^F	66.66	309.68±5.15 ^D	44.85	1.08±0.2 ^B
Roasting	22.23±0.11 ^E	23.05	237.95±3.61 ^C	60.69	0.60±0.014 ^C
Autoclaving	25.46±1.36 ^C	12.09	288.84±2.8 ^E	52.29	0.59±0.01 ^C
Germinated	23.354±0.81 ^D	19.39	309.10±5.35 ^D	48.94	1.27±0.01 ^A

Table 3: Effect of different processing on *in-vitro* protein digestibility (IVPD)

Treatment	Raw	Soaking	Cooking	Roasting	Autoclaving	Germination
IVPD	88.17±1.70 ^B	87.97±0.00 ^B	89.31±0.02 ^B	85.28±1.64 ^D	86.97±0.00 ^D	92.27±1.83 ^A

Similar to trypsin inhibitor activity, various treatments caused significant decrease in phytic acid level. The phytic acid content of the raw lablab bean is lower than that reported by (Deka and Sarkar, 1990), but higher than those reported by (Al-Othman, 1999). Roasting caused greater reduction (60.69%) on PA followed by autoclaving (52.29%), germination (48.94%), and cooking (44.85%), while soaking showed the lowest reduction (22.19%). The phytic acid content in treated samples varied from 237.95 mg/100gm (roasted) to 471.07 mg/100gm (soaked), whereas control had 605.39 mg/100gm phytic acid. Similar reduction pattern in PA content during soaking, cooking or germination has been reported by many investigators, (Chau and Cheung, 1997; Alonso *et al.*, 1998; Alonso *et al.*, 2000; Desphande and Sheryan, 1983; Vidal-Valverde *et al.*, 1994; Sievwright and Shipe, 1986), for Chinese legumes, pea, faba pea, dry bean, lentil and black bean respectively. The decrease of phytic acid content by soaking, cooking of presoaked bean or germination may be due to leaching out of this compound in water. Similarly, roasting and autoclaving has been reported to decrease phytic acid in dry bean (Tabekhia and Luh, 1980), chickpea and black gram (Duhan *et al.*, 1989), cowpea (Akinyele, 1989), and black bean (Siewwright and Shipe, 1986). Phytate is thought to be responsible in mineral bioavailability.

In contrast to trypsin inhibitory activity and phytic acid level, the tannins content was significantly increased due to different treatments. Germination and cooking of presoaked beans showed the highest increase whereas, soaking, autoclaving and roasting showed moderate increase. Similar trend had been reported by some authors, (Vijayakumari *et al.*, 1995) reported 55% increase of tannin of Dolichos lablab, after soaking. (De Lumen and Salamamat, 1980) reported that cooking increased assayable winged bean tannins by 89-100%. (Al-Jasser, 2005) and (Ahmed *et al.*, 1996), independently showed an increase in tannins in sorghum due to soaking and germination. This increase may be due to the hydrolysis of high molecular weight insoluble polymer in to small molecular weight soluble

polymers, during soaking and germination or due to inhibition of polyphenol oxidase which is responsible to the loss of tannin by heat treatment. Controversially, (Vijakumari *et al.*, 1995) reported that cooking or autoclaving of dolichos lablab seeds reduced tannins content by 70% and 60% respectively. However, they also found that soaking of the bean increased the tannins content by 55%, that agree, with the our findings. Table 3 showed the effect of different processing treatments on protein *in-vitro* digestibility. The IVPD of untreated bean was found to be 88.17. The IVPD value in our study was in agreement with that reported by (Al-Othman, 1999), and (Shastry and John, 1991). But, higher than those reported by (Vijayakumari *et al.*, 1995). Germination significantly increased *in-vitro* protein digestibility to 92.27%, whereas, roasting and autoclaving, significantly decrease to 85.28% and 86.97% respectively. There was no significance difference *in-vitro* digestibility among raw, soaked and cooked samples. The high value of protein digestibility of germinated bean might be due to reduced enzyme inhibitory activity and phytic acid hydrolysis as well as degradation of protein. Similar results have been obtained in Dolichos lablab (Shastry and John, 1991), and sorghum (Bhis *et al.*, 1988) and (Romo-Parade *et al.*, 1985). Contrary to our finding, (Vijayakumari *et al.*, 1995) found that soaking, cooking or autoclaving of Dolichos lablab seeds increased the IVPD values by 3 and 13% respectively.

In conclusion, this study indicated that different processing methods, significantly effected chemical composition of lablab bean. The various processes significantly decreased the levels of trypsin inhibitor activity and phytic acid, whereas the tannins content was found to increase by the processing. Germination seemed to good procedure to improve *in-vitro* protein digestibility. Therefore, soaking, cooking of presoaked beans and germinating hold a good potential for improving the nutritional value of lablab bean by reduction in antinutritional factors such trypsin inhibitors and phytic acid and there by enhancing its utilization.

Acknowledgment

The author is grateful to the Agriculture Research Center, College of Food Science and Agriculture, King Saud University for the financial assistance.

The Author wish to thank Mr. Ibrahim El-Zien and Mr. Abubaker for their excellent technical assistance.

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