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EFFECT OF DIFFERENT DOMESTIC PROCESSING AND COOKING METHODS ON THE TANNIN CONTENTS OF LENTILS (*LENS ESCULENTA*)

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Significant reduction in tannin contents was observed after soaking the lentils in simple water or salt solutions of different concentrations. Soaking in sodium bicarbonate solution was the most effective way to reduce the tannin content. Cooking lentils also further reduced tannin and improved protein digestibility.

Key words: Lentils, Tannins, Reduction.

Introduction

Food legumes are considered a good source of protein, but presence of antinutrients, particularly tannin, saponin and phytic acid limit their utilization in human diet [1]. Tannin inhibits the activities of trypsin, chymotrypsin, amylase and lipase [2-4]. Tannin also interacts with protein and causes significant reduction in protein digestibility [5-6]. In view of the deleterious effects of tannin, many workers attempted to reduce the tannin contents of various food materials by use of different physical and chemical methods [7-8]. Soaking of beans before cooking is a common practice to soften texture and hasten the cooking process. Soaking in a salt solution resulted in a considerable reduction in cooking time [9]. Lentils are the most important food legume grown and consumed in Pakistan. Lentils contain about 24% dietary protein [10] but it is necessary to reduce tannin before use in order to increase the protein digestibility. This work reports varietal differences and effect of different domestic processing and cooking methods on the tannin content of lentils.

Materials and Methods

Seed samples of four high yeilding lentil cultivars were obtained from Ayub Agricultural Research Institute (AARI), Resalewala, Faisalabad. These cultivars were grown under similar soil and agroclimatic conditions. Samples were cleaned and freed from broken seeds, dust and other foreign materials prior to investigating the effect of soaking and cooking on tannin content and protein digestibility of the lentils. All four cultivars were analysed for their proximate composition, tannin contents and protein digestibility. Cultivar AARI-87519 was selected for further processing as it contained the highest amount of tannin and the least protein digestibility.

Soaking. Seeds were soaked in tap water, sodium chloride and bicarbonate solutions of different concentration for different time periods at two temperatures (30° and 100°C). A seed to water ratio of 1 : 5 (wt : vol) was used. The soaked seeds were rinsed twice in distilled water and then dried in hot air oven maintained at 55°C.

Cooking. After rinsing with distilleds water the soaked seeds were put in a round bottom flask fitted with a condenser. Tap water (three time the weight of dry seeds was added and the samples were cooked on a hot plate until they became soft as felt between the fingers).

For presure cooking, soaked seeds were cooked at 15 lbs/inch^2 for 5 mins in an autoclave. The cooked samples were mashed and then dried at 55°C. Using a ratio of 1 : 7 (wt :vol) unsoaked lentils were also cooked using both cooking methods.

Moisture content of lentils was estimated by placing a ground sample (3-5 g) at 100 ± 5°C in an oven for 20-24 hr till a constant weight was attained, whereas ash contents were determined after ignition at 550 ± 5°C in a muffle furnace for a period of 4 hr [11]. Crude portein contents of the lentils were estimated after digestion with concentrated sulphuric acid using $CuSo_4$; K_2So_4; SeO_2 (1:9:0.02)) was catalyst according to Micro-Kjeldahl method as described in A.O.A.C. [11]. Protein digestibility was determined *In vitro* after digestion with pepsin-HCl solution at 37.5°C for 24 hrs [12]. Tannin content of the samples was estimated on spectrophotometer at 760 nm using Folin Denis reagent according to A.O.A.C. method after extraction with 1% hydrochloric acid in methanol [11]. All determinations were carried in triplicate and standard deviations were calculated. All data were also subjected to an analysis of variance and the significant difference calculated by Duncan's multiple range test [13].

Results and Discussion

Table 1 indicate that chemical composition of the four cultivars of lentils was almost the same. However, tannin contents varied from 880 to 1032 mg/100g and protein

TABLE 1. PROXIMATE COMPOSITION OF DIFFERENT VARIETIES OF LENTILS*.

Variety of lentils	Moisture (%)	Ash (%)	Crude protein	Tannin (mg/100g)	Protein digestibility before cooking (%)	Protein digestibility after cooking(%)
AARI-86520	9.37±2.6	2.37±1.99	24.23±4.0	981±1.9(a)	42.00±1.1 N.S.	64.0±1.3N.S.
AARI-87519	11.13±3.1	3.01±2.7	24.00±2.8	1032±2.1	41.93±2.6	63.0±1.5
AARI-88527	9.20±1.9	2.99±3.3	23.97±3.9	945±3.3	42.87±2.4	64.0±0.9
AARI-89503	8.57±2.1	2.40±4.1	23.88±1.6	880±4.0	43.26±1.8	65.5±0.4
S.E. of difference	2.86	1.99	4.05	3.12	0.47	0.66

* Average of three determinations alongwith standard deviations, (a) Significant at $P < 0.05$ within the column, N.S= Non significant within the column.

digestibility values ranged from 63.0 to 65.5%. These results indicate, that digestibility of protein is affected by the amount of tannin present in the lentils.Variation in tannin contents of various cultivars were found to be statistically significant ($P< 0.05$) while non-significant differences were observed in case of protein digestibility of uncooked lentils.

TABLE 2. TANNIN CONTENTS OF LENTILS AFTER WATER SOAKING*.

Treatment conditions		Tannin	Removal of
Temperatures (°C)	Extraction time	(mg/100g)	tannin (%)
Control	-	1032±5.6(a)	-
30	1 hrs	908±6.9	12.00
30	2 hrs	745±15.6	27.81
30	3 hrs	730±5.2	29.26
30	4 hrs	725±7.9	29.74
100	15 mins	881±6.0	14.63
100	30 mins	700±14.1	32.17
100	45 mins	695±5.2	32.65
S.E. of difference		5.33	-

* Average of three determinations alongwith standard deviations, (a) signi ficant at $P < 0.05$ within the column.

Results of Table 2 indicate a significant difference ($P<0.05$) in tannin reduction after soaking the lentils in water at 30°C and 100°C for different time periods. Soaking lentils in water at 30°C removed 29.26% tannin in 3 hrs. Non significant differences in reduction of tannin contents were observed on increasing the time of soaking from 3 to 4 hrs. When soaking was carried at 100°C, it removed about the same amount of tannin in 30 and 45 mins. These results suggest that solvent (water) easily penetrates into the material and leaches out the tannin. Removal of tannin during water soaking process from various food materials has already been reported [14].

Statistically significant amount of tannin was extracted from lentils soaking in sodium chloride solution than in simple water ($P < 0.05$) (Table 3). Sodium chloride solution (0.1 M concentration) extracted 42.05% tannin when when soaking was conducted at 30° for 2 hrs. The same amount of tannin was extracted when lentils were soaked in 0.1 M sodium chloride solution at 100°C for 45 mins. Soaking at high temperature significantly ($P < 0.05$) reduced the time of extraction of tannin.

Maximum extraction of tannin was observed when lentils were soaked in sodium bicarbonate solution at 30°C and

TABLE 3. TANNIN CONTENTS OF LENTILS AFTER SOAKING IN SODIUM CHLORIDE AND SODIUM BICARBONATE SOLUTION*.

Treatment conditions			Sodium chloride		Sodium bicarbonate	
Temperature (°C)	Extraction time	Conc. (M)	Tannin (mg/100 g)	Removal of tannin (%)	Tannin (mg/100 g)	Removal of tannin (%)
30	2 hr	0.05	680±11.5 (a)	34.10	545±4.5(a)	47.18
30	3 hr	0.05	676±11.2	34.49	538±7.0	47.86
30	2 hr	0.10	598±21.3	42.05	500±7.0	51.50
30	3 hr	0.10	580±6.2	43.79	488±6.5	52.71
100	15 mins	0.05	650±3.6	37.01	555±6.0	46.22
100	30 mins	0.05	612±4.3	40.69	536±7.0	48.06
100	45 mins	0.05	600±6.08	41.86	518±5.5	49.80
100	15 mins	0.10	630±6.0	38.75	497±9.1	51.84
100	30 mins	0.10	610±2.0	40.89	479±8.7	53.58
100	45 mins	0.10	596±12.7	42.24	410±9.8	60.27
S.E.. of differene			5.85	-	4.33	-

* Average of three determinations alongwith standard deviation, (a) significant at $P < 0.05$ within the column.

TABLE 4. EFFECT OF COOKING ON TANNIN CONTENTS AND PROTEIN DIGESTIBILITY OF LENTILS*.

Treatment conditions				With pressue cooker			With pressure cooker		
Type of solution	Temp. (°C)	Extraction time	Conc. (M)	Tannins (mg/100g)	Removal of tannin (%)	Protein digestibility (%)	Tannins (mg/100g) (%)	Removal of tannin (%)	Protein digestibility (%)
Unsoaked Lentils (Control)	-	-	-	670±4.5(a)	35.07	63.0±7.1	681.2.6±(a)	34.01	61.0±6.1(b)
Simple water	30	3 hrs	-	505±3.9	51.06	71.0±8.1	501±7.0	51.45	68.0±7.1
Simple water	100	45 mins	-	483±5.2	53.19	73.5±9.5	478±9.8	53.68	68.0±8.4
Sodium Chloride	30	3 hrs	0.1	295±6.9	71.41	74.9±4.3	280±1.8	72.86	70.4±2.5
Sodium Chloride	100	45 mins	0.1	169±11.0	83.62	76.5±3.9	181±9.0	82.46	70.6±3.9
Sodium Bicarbonate	30	3 hrs	0.1	101±9.7	90.21	77.4±5.6	112±7.0	89.14	72.0±4.1
Sodium Bicarbonate	100	45 mins	0.1	nil	100.00	79.2±6.0	nil	100.00	72.8±5.9
S.E. of difference				3.11	-	4.73	4.21	-	5.05

* Average of three determinations alongwith standard deviation, (a) Significant at P<0.1 within the column, (b) Significant at P <0.05 within the column.

100°C (Table 3). Soaking of lentils in 0.1 M sodium bicarbonate solution at 30°C for 3 hr and 100°C for 45 mins resulted in a reduction of tannin by 52.71 and 60.27% respectively. Statistical analysis of this data reveals that reduction in tannin contents was significantly different from each other under these two conditions of soaking in sodium bicarbonate solution ($P < 0.05$). These results suggest extraction with sodium bicarbonate solution, not only enhances the rate of tannin removal but also reduces extraction time. Reduction in tannin contents of winged bean soaked in sodium bicarbonate solution has already been reported [4]. It is possible that some soluble sodium salts of tannic acid were formed under alkaline conditions which might be responsible for reduction of tannin content. However, the exact mechanism of leaching the tannin is still unexplained.

Tannin contents of the lentils were further reduced (P<0.1) during cooking process (Table 4). However, it appears, reduction of tannin was similar in both the cooking processes. About 53% reduction in tannin was achieved when water soaked lentils were cooked either in pressure cooker or by ordinary cooking method (without pressure cooker). Similarly 83.62% reduction in tannin contents was observed on cooking the presoaked lentils in 0.1 M sodium chloride solution in pressure cooker. Tannin was apparently completely removed when sodium bicarbonate (0.1 M) soaked lentils were subjected to either cooking processes. Reduction of tannin on cooking has been reported for winged and field beans with high amount of tannin recovered in the cooking broth [4,15]. Laurena *et al.* [16] and Poel [17] reported a significant removal of tannin from differnt legumes during cooking processes which ultimately enhanced the digestibility of protein..

Protein digestibility of raw lentils was 61.0% in case of ordinary cooking method whereas it was 63.0% on cooking in pressure cooker. Significant ($P < 0.05$) improvement in protein digestibility of lentils was observed as a result of cooking by either method but is comparatively higher when cooking is under pressure. Maximum (P<0.05) protein digestibility (79.2%) was observed when sodium bicarbonate soaked lentils were cooked in a pressure cooker. Improvement in protein digestibility of the lentils may be due to the partial or total removal of tannin by applying either of soaking and cooking processes. Sathe and Salunkhe [18] reported an improvement in protein digestibility of winged beans due to the removal of tannin during soaking process whereas findings of Wu *et al.* [19] revealed that protein quality of red kidney beans was improved due to cooking under pressure.

It may be concluded from these studies that different soaking methods affected the level of tannin in samples of lentils to varying extent. Soaking lentils in sodium bicarbonate solution doubled (P<0.1) the rate of extraction of tannin as compared to use of water. Cooking also brought about a greater reduction in the levels of tannin compared with the water soaking. Significant (P<0.05) improvement in protein digestibility attributable to removal of tannin was observed. Removal of tannin may be attributed to leaching out of this antinutrient into the soaking solution under the influence of concentration gradient. Such losses may be taken as a function of changed permeability of seed coat. Soaking is an integral traditional method for processing legumenous grains in this part of the world and offers the dual advantage of reducing energy costs by shortening cooking time as well as rendering the grains nutritionally superior.

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