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Effect of heat treatments on nutritional quality of horse gram

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Abstract

The effect of heat treatments, namely soaking for 12 hrs and then cooking and direct cooking and autoclaving on crude protein, hydrolysable tannins, free amino acids and total sugars were evaluated. The results indicated that during soaking for 12 hrs and then cooking, there was a decrease of 23.4 to 13.3 per cent in protein; 75.5 to 56.2 per cent in hydrolysable tannins; 48.85 to 47.09 per cent in free amino acids and 27.19 to 22.22 per cent in total sugar over the raw (untreated) seeds. In direct cooking of untreated seeds the study showed the per cent decrease of 28.2 to 21.1 in protein content; 59.7 to 44.5 in hydrolysable tannins; 30.28 to 15.93 in free amino acids and 19.14 to 9.59 in total sugars over the raw (untreated) seeds. On autoclaving also substantial loss of 32.4 to 24.7 per cent in protein; 40.8 to 30.5 per cent in hydrolysable tannins; 28.2 to 13.94 per cent in free amino acids and 6.00 to 3.70 per cent in total sugars as compared to untreated seeds was noticed. Among various heat treatments the study indicated that soaking seeds for 12 hrs in water followed by cooking was the best heat treatment followed by cooking and autoclaving in elimination of anti-nutrients in horse gram seeds.

Key words: Horse gram, crude protein, hydrolysable tannins, free amino acid, total sugar.

Introduction

Horse gram (*Macrotyloma uniflorum* (L.) Verde.) commonly known as *kulth* or *kulthi* is an important underutilized pulse crop having vast medicinal value. However, owing to hardy nature of its seeds domestic consumption of horse gram is still limited in culinary preparations. In India, the most common domestic methods used for processing of legumes include soaking of dry mature seeds for different intervals of time, dehulling, ordinary cooking. pressure cooking, germination, parching etc. These processing methods have been reported to be beneficial for enhancing the nutritive value of various food legumes by substantially reducing the content of anti-nutritional factors and also improving the digestibility of carbohydrate and proteins (Bansal *et al.*, 1988; Bishnoi, 1991). Systematic information on nutritive value as influenced by various heat treatments in horse gram is limited. The present study was therefore, undertaken to evaluate the nutritional quality attributes especially protein, hydrolysable tannins, free amino acids and total sugars of evaluated promising genotypes of horse gram after various heat treatments.

Material and Methods

Four high protein genotypes namely HPKC-5, IC-14350, HPKC-7 and HPKC-4 were selected to study the effect of various heat treatments on t biochemical parameters of nutritional significance. Dry mature seeds of selected varieties / genotypes were cleaned and freed of any extraneous substances and divided in four categories for different treatments. Of these, three categories of processed seed included (i) soaking for 12 hr and then cooking (ii) direct cooking and (iii) autoclaving, whereas the fourth category was raw seeds (untreated) sample.

Soaking of seeds in water for 12 hrs followed by cooking in water : 5 g of horse gram seeds were weighed and soaked in tap water for 12hr and then were cooked in 50 ml of boiling water. During cooking seeds were taken out intermittently with the help of a long spatula.. Cooking time was recorded for each genotype selected for the purpose when the seeds became completely soft. .

Direct cooking without soaking seeds in water: 5 g of seeds of each genotype selected for the study were weighed in a beaker and cooked in 50ml distilled water. During cooking seeds were taken out intermittently with the help of long spatula and tested. When the seeds became

completely soft, the time taken for cooking was recorded.

Autoclaving seed samples without soaking in water : 5 g seeds of selected genotypes were placed in the conical flasks and were autoclaved at 121^0 C for 20 minutes at 15lb pressure. After autoclaving, samples were dried at 50^0 C and cooled, ground and then stored in polybags for further nutritional evaluation.

Chemical Analysis : Crude protein content in raw and processed seeds of various horse gram genotypes was determined according to AOAC (1970). Hydrolysable tannins were estimated by following the methods given by Makkar *et al.* (1993). Free amino acid content was determined as described by Jayaraman (1981).Total sugars were extracted in alcohol (80 per cent) by following the procedure of AOAC (1970) and then estimated by anthrone method of Yemm and Wills (1954). The genotypic rating was done as per routine practice of grading the genotypes for desirable parameters in descending order, whereas for undesirable traits in ascending order and cumulative ranking reveals overall superior genotypes taking into confidence all the relevant traits of nutritional significance in the study, so as to find out over all nutritional superior multipurpose/ versatile genotypes to be useful for human consumption and further crop improvement. However, the genotypes superior for individual trait might be useful for further breeding purposes for specific characteristics / attribute in association with other crop production parameters.

Results and Discussion

Crude Protein

Table1 depicts the crude protein content of promising horse gram varieties/genotypes as influenced by different processing treatments. Soaking seeds of horse gram genotypes for 12 hr and then cooking resulted in marked decrease (23.4 to 13.3 per cent over raw seeds) in protein content. The decrease in protein content from 28.2 to 21.1 per cent over raw seeds was found on direct cooking, whereas the maximum loss of proteins was witnessed in autoclaving i.e. 32.4 to 24.7 per cent. It is thus, evident that the decrease in protein content was minimum during soaking followed by cooking as compared to direct cooking and autoclaving.

The loss of soluble seed protein during soaking might be attributed to increase in the moisture content as reported by Giri *et al.* (1981) in mungbean, black gram, pigeon pea, chick pea and also in pigeon pea by Srivastava *et al.* (2004). However, Akinyele and Akinlosotu (1991) observed that soaking for 4 hrs and dehulling increased the protein content by 5.7 and 2.7 per cent as compared to raw values in local brown and local white cowpea cultivars.

Nevertheless substantial loss of proteins on cooking might be attributed to the leaching of proteins into cooking broth, which was infact not taken into consideration in the study. However, the findings of the study on this aspect are in agreement with the findings of Pawar and Ingle (1988) in moth beans of Meiners *et al.* (1976) in field peas and pigeon pea.

Table 1. Effect of heat treatments on crude protein content of promising horse gram genotypes

Varieties / genotypes	Crude Protein (%)				
	Raw	Soaking for 12 hr and then cooking	Cooking	Autoclaving	Mean
HPKC-7	24.50	20.30 (-17.1)	19.13 (-21.19)	18.22 (-25.6)	20.54
HPKC-4	24.50	21.25 (-13.3)	19.32 (-21.1)	18.44 (-24.7)	20.88
IC-14350	25.55	19.58 (-23.4)	19.01 (-25.6)	18.51 (-27.6)	20.54
HPKC-5	26.08	21.68 (-16.9)	18.73 (-28.2)	17.63 (-32.4)	21.03
Mean	25.04	20.70	19.70	18.20	

CD (P=0.05) for treatments and genotypes = 0.53

Values with in the parenthesis indicate per cent loss / decrease over control (untreated seeds)

The loss of proteins on autoclaving in food legumes have also been reported elsewhere (Geervani and Theophilus, 1980; Usha *et al.* 1981).

Hydrolysable tannins

The status of hydrolysable tannins in promising horse gram varieties / genotypes is presented in Table 2. The study showed that there was a decrease of 75.5 to 56.2, 59.7 to 44.5 and 40.8 to 30.5 per cent in hydrolysable tannins on soaking for 12 hr followed by cooking, direct cooking and autoclaving of dry mature seeds of horse gram genotypes in that order. It was observed that prior soaking followed by cooking seeds of this crop significantly reduced hydrolysable tannin content as compared to cooking alone and autoclaving. The decrease in hydrolysable tannins on prior soaking and then cooking might be attributed to leaching of tannins in cooking broth and also possibly due to elimination of cooked water during analysis. The declining trend of tannins on cooking observed from 45 to 75 per cent was in agreement with the findings of Sangle *et al.* (1993). However, the study indicated comparatively less decrease in hydrolysable tannins on autoclaving as compared to prior soaking and then cooking and direct cooking alone.

Table 2. Effect of heat treatments on hydrolysable tannins in promising horse gram genotypes

Varieties / genotypes	Hydrolysable tannins (mg / 100g)				
	Raw Seeds	Soaking for 12 hr and then cooking	Cooking	Autoclaving	Mean
HPKC-7	868	212 (-75.5)	349 (-59.7)	513 (-40.8)	484.89
HPKC-4	1115	488 (-56.2)	649 (-44.5)	775 (-30.5)	744.62
IC-14350	1162	499 (-57.1)	636 (-45.3)	776 (-33.2)	768.63
HPKC-5	1158	450 (-61.14)	627 (-45.85)	779 (-32.73)	753
Mean	1075.01	412.53	588.05	7	
CD (P=0.05)) for treatments and genotypes = 7.70					

Values with in the parenthesis indicate per cent loss / decrease over control (untreated seeds)

Free amino acids

Free amino acids status of promising horse gram varieties/genotypes as influenced by heat treatments are presented in Table 3. Soaking seeds of horse gram genotypes for 12 hr and then cooking showed marked decrease (48.85 to 47.09 per cent over untreated seeds) in free amino acid content as well. This was followed by direct cooking, in which the extent of decrease in free amino acids was found from 30.28 to 15.93 per cent over raw (untreated) seeds accompanied by autoclaving treatment i.e. about 28.02 to 13.94 per cent decrease of free amino acids over control (raw) seeds.

Table 3. Effect of heat treatments on free amino acid content of promising horse gram genotypes

Varieties / genotypes	Free amino acid content (mg/100g)				
	Raw Seeds	Soaking for 12 hr and then cooking	Cooking	Autoclaving	Mean
HPKC-7	14.35	7.34 (-48.85)	10.85 (-24.32)	11.01 (-23.80)	10.87
HPKC-4	15.24	7.92 (-48.03)	11.08 (-27.30)	11.44 (-24.93)	11.42
IC-14350	13.06	6.91 (-47.09)	10.98 (-15.93)	11.24 (-13.94)	10.55
HPKC-5	14.63	7.71 (-47.37)	10.20 (-30.28)	10.53 (-28.02)	10.75
Mean	14.32	7.47	10.78	11.06	
CD (P=0.05) for treatments and genotypes = 7.70					

Values with in the parenthesis indicate per cent loss / decrease over control (untreated seeds)

The decrease in free amino acids on cooking encountered in the present study might be due to leaching losses during cooking. According to Vasudeva (1997) the free amino acids content in untreated and treated samples was observed as 0.085 to 0.05 per cent, respectively. The results of the accompanying work on this aspect are also in accordance with the findings of Sharma (1995), who reported the maximum decrease during prior soaking and then cooking treatment followed by direct cooking and autoclaving in pea seeds.

Total Sugars

The status of total sugar content of promising horse gram varieties/genotypes is depicted in Table 4. The maximum decrease in total sugar content was noticed during soaking followed by cooking and soaking i.e. 27.19 to 22.22 per cent accompanied by direct cooking from 19.14 to 9.59 and 6.00 to 3.70 per cent on autoclaving. The study revealed that soaking altogether reduced the level of total sugars in horse gram genotypes. Loss of sugars and starch during soaking might be due to simple diffusion of sugars after getting solubilized. Loss of sugars and starch content in various pulses had also been reported earlier (Jood *et al.*, 1988 and Kataria *et al.*, 1988).

Rao and Belavedy (1978) also observed increased level of sugars in the cooked pulses. But the decrease was reported after cooking the seeds as the water in which the seeds were cooked was discarded and the findings of the study on this aspect are in close consonance with the observations of Kataria *et al.* (1988). Studies conducted by Kalyan (1983) and Kataria *et al.* (1988) also revealed that both ordinary and pressure cooking caused rupturing of starch granules followed by the hydrolysis of the starch, thereby resulting in the decrease of starch content of the cooked legume seeds. The study revealed that among various heat treatments soaking seeds for 12 hr in water followed by cooking was found to be the best heat treatment followed by cooking and autoclaving.

Cumulative rating of various heat treated seeds in search of multipurpose varieties/genotypes in respect of prominent quality attributes depicted in Table 5 further indicated that genotypes HPKC-7 and HPKC-4 among raw varieties/genotypes; HPKC-5 in soaking followed by cooking seeds; HPKC-7 and HPKC-4 in direct cooked seeds; HPKC-4 in autoclaved seeds were adjudged to be the promising genotypes over others.

Table 4.Effect of various heat treatments on total sugar content of promising horse gram genotypes

Varieties /genotypes	Total sugar content (mg/100g)				
	Raw Seeds	Soaking for 12 hr and then cooking	Cooking	Autoclaving	Mean
HPKC-7	4.86	3.78 (-22.22)	3.93 (-19.14)	4.68 (-3.70)	4.31
HPKC-4	4.45	3.24 (-27.19)	3.85 (-13.48)	4.23 (-4.94)	3.94
IC-14350	4.17	3.17 (-23.98)	3.77 (-9.59)	3.99 (-4.32)	3.78
HPKC-5	4.33	3.28 (-24.25)	3.87 (-10.62)	4.07 (-6.00)	3.89
Mean	4.45	3.37	3.86	4.24)	
CD (P=0.05)) for treatments and genotypes = 0.065					

Values with in the parenthesis indicate per cent loss / decrease over control (untreated seeds)

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Table 5. Rating of raw seeds on the basis of prominent quality characters

Character(s)	HPKC-7	HPKC-4	IC-14350	HPKC-5
Protein	3	3	2	1
Hydrolysable tannins	1	2	4	3
Free amino acids	3	1	4	2
Total sugars	1	2	4	3
Total	8	8	14	9
Rating	I	I	III	II
Rating of prior soaked and then cooked horse gram seeds in respect of prominent quality attributes				
Protein	3	2	4	1
Hydrolysable tannins	1	3	4	2
Free amino acids	3	1	4	2
Total sugars	1	3	4	2
Total	8	9	16	7
Rating	II	III	IV	I
Rating of directly cooked horse gram seeds based on prominent quality characters				
Protein	2	1	3	4
Hydrolysable tannins	1	2	4	3
Free amino acids	3	1	2	4
Total sugars	1	3	4	2
Total	7	7	13	13
Rating	I	I	II	II
Rating of autoclaved horse gram seeds with respect of prominent quality attributes				
Protein	3	2	1	4
Hydrolysable tannins	1	2	3	4
Free amino acids	3	1	2	4
Total sugars	1	2	4	3
Total	8	7	10	15
Rating	II	I	III	IV

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