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Effect of Utilization of Horse gram Flour by Simple Processing Methods

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Horse gram (*Macrotyloma uniflorum*) is one of the inexpensive sources of protein, calcium and iron. Simple processing methods such as soaking and roasting were tested to reduce the anti-nutritional factors. A sample of horse gram was washed, soaked in sufficient water for 12 h with periodical change of water at 4 h interval. Later, the sample was dried in hot air oven at 60ºC for 2 h and powdered. In a separate processing method the horse gram sample was roasted for 10 min on low flame, cooled and powdered. Anti-nutritional factors such as tannins and phytates were found to be reduced on processing, while nutrients namely, protein, calcium, iron and phosphorus did not show significant changes when compared to raw horse gram. Further, wheat based common food product like chappathi was incorporated with the processed horse gram flour to improve the nutrient content. The sensory evaluation revealed that the chappathies prepared with wheat flour + 10 per cent soaked, dried and roasted horse gram powder or wheat flour + 15 per cent of roasted horse gram flour had received highly acceptable score.

Key words: Anti-nutritional factors, Soaking and drying, Roasting, Nutritional characteristics, Sensory quality.

Horse gram is largely cultivated in dry lands of Australia, Burma, India and Sri Lanka, mainly for animal feed. It is also used as a vegetable and poor man's pulse crop in India. Horse gram is an inexpensive source of protein; rich in minerals such as calcium, phosphorus, iron and vitamins such as carotenes, thiamine, riboflavin, niacin and L-ascorbic acid. Like other legumes, it is deficient in methionine and tryptophan (Sodani,*et.al*. 2004). Horse gram is an excellent source of dietary fiber. As known have positive effects on intestine and colon, besides other homoeostatic and therapeutic functions in human nutrition (Yadahally, *et.al.* 2012). Conventional processing methods, such as soaking, boiling, germination and fermentation are widely used to decrease the content of undesirable components, enhances the acceptability and nutritional quality (Kadam and Salunkhe, 1985).

Chappathi made from whole wheat flour is an unleavened one layered Indian flat bread. Almost 80 per cent of the wheat produced in India is consumed in the form of chappathi (Shalini and Laxmi, 2007). Wheat flour is the major ingredient for chappathi making. It is well reported that fortifying wheat flour with high lysine material, especially legume flour would improve the protein content and quality. Hence, this study was undertaken to compare the effect of two different processing methods on anti-nutritional factors in horse gram in order to standardize processed horse gram flour for incorporation during chappathi making.

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Materials and Methods

Horse gram was procured from departmental store in Madurai, Tamil Nadu. It was thoroughly cleaned to remove extraneous matters.

Soaking

Horse gram was soaked in sufficient water for 12 h with periodical change of water at 4 h interval. The sample was spread evenly on aluminium trays and dried in a cabinet drier at 60^{0}C for two hours. The dried gram was milled into flour.

Roasting

Horse gram sample was roasted on low flame without pre-soaking for 10 min till it changed to light brown color releasing roasted flavour. The sample was ground into flour.

Standardization of chappathi mix

The processed horse gram flour was incorporated with wheat flour to standardize chappathi mix. The composition of ingredients is given in Table 1. Chappathi prepared using wheat flour alone served as control, while variants I, II, III and IV were tried by incorporating horse gram powder processed in two different methods.

Table 1. Composition of chappathi mix incorporated with processed horse gram flour

Ingredients (g/100g)	Control	Variants							
		I		II		III		IV	
		A	A_1	B	B_1	C	C_1	D	D_1
Wheat flour	100	95	95	90	90	85	85	80	80
Soaked and dried horse gram flour	-	5	-	10	-	15	-	20	-
Roasted horse gram flour	-	-	5	-	10	-	15	-	20
Salt	3	3	3	3	3	3	3	3	3

Method for preparation of chappathi

Wheat flour + processed horse gram flour
↓
Mixing(addingsalt and water)
↓
Kneading
↓
Relaxing for 10 min
↓
Dividing into small portion
↓
Rolling into balls
↓
Sheeting
↓
Toasting on a tawa with oil
↓
Chappathi

Determination of nutritional compositions

The nutritional compositions such as moisture, protein, ash, calcium, iron, phosphorus, were determined as per AOAC (2000). Moisture content was determined by drying the flour of raw and processed horse gram in an oven at 80ºC for 24 h and expressed in percentage. Crude protein was determined by the micro Kjeldahl method using 6.25 as the conversion factor. Crude fiber was determined by acid hydrolysis, while fat and ash contents were determined by Soxhlet extraction and dry ash methods, respectively. Total crude carbohydrates was calculated by difference [100 – (crude protein + crude lipid + ash)]. Tannin was determined as per the procedure of Schanderl (1970) and phytate was determined by adopting the method suggested by Wheeler and Ferrel (1971) in raw and processed horse gram flour.

Organoleptic evaluation

Processed horse gram flour was incorporated into wheat flour at 5, 10, 15 and 20 per cent and Chappathi as were prepared. Organoleptic evaluation was carried out for gram flour incorporated chappathies and control. The most acceptable composition was further analyzed for nutritional qualities. For organoleptic evaluation, a panel of ten trained judges used 9.0 point hedonic scale (Amerine *et.al,* 1965).

Statistical analysis

The data obtained in the experiments were recorded and subjected to statistical analysis using standard procedures. The standard errors (SE) and critical differences (CD) at 5% level of significance were worked out for comparison. Factorial Completely Randomized Design (FCRD) as per the method described by Gomez and Gomez (1984) was used for the analysis.

Results and Discussion

The nutrient composition and anti-nutritional factors raw; soaked, dried and roasted horse gram flour are shown in Table 2.

Table 2. Nutrient composition and anti-nutritional factors in horse gram flour

Parameters	Horse gram flour				
	Raw (Unprocessed)	Soaked and dried	Roasted	SED	CD (0.05)
Moisture (g/100g)	10.60	11.30	6.40	0.0822	0.2615**
Carbohydrate (g/100g)	68.17	74.66	69.16	0.0754	0.0988**
Protein (g/100g)	21.40	15.20	20.60	0.0100	0.0318**
Fat (g/100g)	1.53	1.45	1.50	0.0342	0.0256**
Fiber (g/100g)	5.60	5.58	5.34	0.0426	0.0376**
Ash (g/100g)	3.30	3.10	3.40	0.0379	0.1205**
Calcium (mg/100g)	232.00	230.00	234.00	0.0122	0.0390**
Iron (mg/100g)	14.20	14.20	15.60	0.0168	0.0536**
Phosphorus (mg/100g)	315.00	312.00	318.00	0.0220	0.0700**
Phytate (mg/g)	10.20	4.38	1.49	0.0071	0.0225**
Tannin (mg/g)	16.12	10.30	8.38	0.0141	0.0450*

*Significant **Highly significant SED-Standard Error Deviation

The soaked and dried horse gram flour was found to have higher moisture contents than raw and roasted flour. After processing, there was a decrease in protein content, when compared to unprocessed flour. The fat content was also found to be decreased in processed horse gram flour than in unprocessed flour. The fiber content for soaked and dried and roasted, were horse gram flour 5.58 and 5.34 g/100g respectively, which was slightly less than that of raw horse gram flour. The iron content was 15.60 mg/100g, in roasted horse gram flour, which was more than found in unprocessed, and soaked and dried processing. Other nutrients such as phosphorus and calcium did not show much change in processed horse gram flour when compared to control. Unprocessed (raw) sample contained 10.20 mg/g phytate and 16.12 mg/g tannin. It was found that on roasting or soaking and drying, the phytate and tannin contents reduced considerably (4.38mg/g on soaking and drying; after roasting was found to be 1.49 mg/g). Similarly, tannin content was reduced from 16.12 mg/g to 10.30 mg/g on soaking and drying method, while it was 8.38 mg/g on roasting. The results of this study revealed a reduction of anti-nutritional factors. Nwosu (2010) also reported a time dependent reduction in phytate, tannins and trypsin during cooking.

The organoleptic evaluation of the Chappathi incorporated with processed horse gram flour is shown in table 3.

Table 3. Organoleptic evaluation of chappathi incorporated with processed horse gram flour

Parameters	Chappathi								
	Control	% of soaked and dried horse gram flour incorporation				% of roasted horse gram flour incorporation			
		5	10	15	20	5	10	15	20
Colour	8.8	8.6	8.7	8.4	8.2	8.4	8.5	8.8	8.5
Flavour	8.9	8.5	8.8	8.2	8.5	8.2	8.4	8.8	8.0
Texture	8.8	8.5	8.7	8.3	8.0	8.6	8.2	8.8	8.3
Taste	8.9	8.4	8.7	8.3	7.8	8.5	8.6	8.7	7.8
Overall acceptability	**8.9**	**8.5**	**8.7**	**8.3**	**8.3**	**8.4**	**8.4**	**8.8**	**8.1**

It was found that the overall acceptability for soaked and dried horse gram flour incorporated chappathi (at 10 per cent level) got the highest score of 8.8. Roasted horse gram flour incorporated chappathi (Table 3) at 15 per cent level also obtained the highest score of 8.8. Bhokre *et al.,* (2012) reported that the sensory evaluation of buns fortified with 5%, 10% and 15% germinated horse gram flour were more acceptable than the buns fortified with 20% germinated horse gram flour.

The nutrient content of processed horse gram flour incorporated chappathi mix is presented in Table 4.

Table 4. Nutrient content of processed horse gram flour incorporated chappathi mix

Parameters	Chappathi mix				
	Control	Soaked and dried horse gram flour (10%)	Roasted horse gram flour (15%)	SED	CD(0.05)
Carbohydrate (g/100g)	69.40	69.92	69.36	0.0157	0.0913**
Protein(g/100g)	12.10	12.41	13.37	0.0071	0.0225**
Fat (g/100g)	1.70	2.03	1.51	0.0168	0.0536**
Fibre (mg/100g)	1.90	2.24	2.41	0.0073	0.0234**
Ash (g/100g)	2.60	2.65	2.72	0.0395	0.0990**
Calcium(mg/100g)	48.00	66.20	75.00	0.0122	0.0390**
Iron(mg/100g)	4.90	5.83	6.50	0.0098	0.0240**
Phosphorus (mg/100g)	355.00	350.70	349.45	0.0100	0.0318**

*Significant **Highly significant SED-Standard Error Deviation

Significant difference was observed in the nutrient contents parameters of processed horse gram flour incorporated chappathi mix. There was increase in protein (13.37 g/100g); fibre (2.41 g/ 100g) and minor reduction in fat content (1.51 g/ 100g) in roasted horse gram flour incorporated chappathi mix when compared to control with protein (12.1 g/100g), fibre (1.9 g/100g) and fat (1.70 g/100g), respectively. Substantial increase in calcium (75 mg/100g in roasted, 66.2 mg/100g in soaked and dried) and iron (6.5 mg/100g in roasted, 5.83 mg/ 100g in soaked and dried) content and a slight reduction of phosphorus (349.45 mg/100g in roasted, 350.70 mg/100g in soaked and dried) was observed in processed horse gram flour incorporated chappathi mix than in control (calcium, 48mg; iron, 4.9mg; and phosphorus, 355mg/100g). The carbohydrate and ash content in both the treatments were found to be on par with control. Archana and Sharma (2012) developed processed horse gram flour incorporated dal pitha, which had high protein and low anti-nutritional factors.

Conclusion

The result of this study indicates that horse gram flour is rich in protein, calcium and dietary fiber. Hence, suitably processed horse gram flour could be used in the preparation of various food products. Among the two processing methods, roasting for 10 min was found to be effective in reducing the anti-nutritional factors. The results obtained from this study also indicate that the processes of soaking and drying or roasting are simple methods to reduce the anti-nutrients contents of horse gram.

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