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EFFECT OF PROCESSING ON AMYLASE RICH FIELDPEA PORRIDGE (*DALIA*)

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ABSTRACT

The nutritional importance of food legumes as an economic source of proteins has been recognized throughout the world. Porridge (*dalia*) formulated from amylase rich fieldpea was undertaken to study the nutritive value of raw fieldpea with that of germinated fieldpea, preparation of amylase rich legume and then studying the effect of processing on nutrients, organoleptic quality and shelf life of developed porridge using standard analytical methods. Proximate composition analysis of fieldpea was carried out on dry basis. Amylase activity increased on progressive germination, 60 per cent on 24 hr germination. A significant ($P<0.5$) decrease in starch content was observed to the extent of 33.68 per cent. Phytic acid content reduced to the extent of 39.77% fieldpea porridge. In raw unprocessed mixture of fieldpea porridge, trypsin inhibitor activity was 218.19 TIU/g whereas in processed amylase rich filedpea porridge no trypsin inhibitor activity was detected. Overall acceptability scores of porridge stored for 0, 7, 14 and 21 days were acceptable and fell in "liked moderately" category. Porridge itself is nutritious product and changing the source added value to its overall nutritive value.

Keywords: Fieldpea, *Dalia*; Physical; Sensory; Nutritional.

INTRODUCTION

Legumes are an important food source and play a significant role in traditional diets in many regions of the world (Nikolopoulou *et.al.*, 2007). Experimental, epidemiological and clinical studies show correlations between the consumption of food legumes and decreasing incidence of several diseases, such as cancer, cardiovascular diseases, obesity and diabetes (Baojun and Chang, 2008). Field pea (*P. sativum L.)* is an important cool season pulse crop that originated approximately 9000 years ago. Fieldpea originated in the Middle East (Syria, Iraq and Iran). Presently it is cultivated over more than 10 million hectares (ha) worldwide (Amarakoon *et.al.*, 2003). The crop is grown in many countries and currently ranks fourth among the pulses in the world with cultivated area of 6.33 million ha (FAOSTAT (2012)). It is the major food legumes with a valuable and cheap source of protein having essential amino acids (23 to 25%) that have high nutritional values for resource poor households (Habtamu and Million, 2013).

Protein-Calorie Malnutrition (PCM) is a major nutritional syndrome affecting more than 170 million preschool children and nursing mothers in developing Afro-Asian countries. The present trend in population growth indicates that the protein gap may continue to increase in the future unless well-planned measures are taken to tackle the situation. Provision of adequate proteins of animal origin is difficult and expensive. An alternative for improving nutritional status of the people is to supplement the diet with plant proteins. Attention, therefore, has to be directed to the nutritional evaluation of proteins from plant species. Legumes (poor man's meat) play an important role in human nutrition since they are rich sources of protein, calories, certain minerals and vitamins (Iqbal *et.al.*, 2006).

Development of amylase rich foods is a very well established process used to formulate nutritious products, including baby and weaning foods. However, despite the attractive cost and nutritional value of fieldpea seeds, amylase rich food items are based on this kind of food material are not common. The germination process which occurs during preparation of amylase rich flour promote many chemical and biochemical changes in the seed which may increase the nutritional value of final product and also decrease the amount of some undesirable compounds such as trypsin inhibitors, phytate etc.

The present study was undertaken to develop and standardize methods of amylase rich flour of fieldpea and its utilization for preparation of value added porridge *(dalia)* and also to evaluate the consumer acceptability and effect of processing technologies on nutrient composition with shelf life studies.

MATERIAL AND METHODS

MATERIALS

Jayanti and Uttara varieties of fieldpea legume were procured in a single lot from the Forage Section of Department of Plant Breeding, College of Agriculture, Chaudhary Charan Singh Haryan Agriculture University,

Hisar. The seeds were cleaned of dust. Cracked and broken seeds and other foreign material were handpicked. Raw seeds were ground in electric grinder.

PREPARATION OF AMYLASE RICH LEGUME

Seeds were soaked in distilled water [seed: water: 1: 4(w/v)] for 12 hours at 30°C in an incubator. The soaked seeds were washed and rinsed with distilled water. The steeped grains were spread uniformly on filter paper sheets lined in metal trays. The filter paper sheets were soaked with distilled water and germinated in a BOD incubator maintained at 25°C up to 72 hours. Water was sprayed periodically during germination. Samples were withdrawn at 24, 48 and 72 hour of germination and dried in hot air oven maintained at 55°C to a constant weight. The seed coat and rootlets were detached by gentle abrasion and separated from the endosperm splits. The germinated splits thus obtained were crushed, as represented in figure 1.

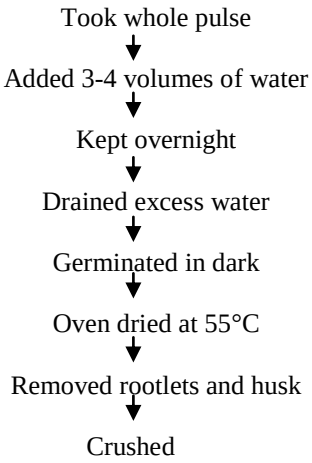

Fig.1. Flow chart for the preparation of amylase rich fieldpea

DEVELOPMENT OF *DALIA*

Table 1 provides the list of ingredients in the preparation of fieldpea *dalia*. Legume and wheat were coarsely ground. Water was added and pressure cooked till it becomes soft. Sugar was added and stirred on hot flame till it mixed thoroughly.

Table 1: Ingredients for fieldpea dalia

Ingredients	Fieldpea *dalia*
Wheat (g)	70
Amylase rich fieldpea (g)	30
Sugar (g)	80
Water (ml)	720

PROXIMATE COMPOSITION

The legume samples were estimated for their moisture, crude protein, crude fat, total ash content by employing standard methods of analysis (AOAC, 1995) and crude fibre (AOAC, 1990). Total minerals were determined by Atomic Absorption Spectrophotometer 2380, Perkin-Elmer (USA) according to the method of Lindsey and Norwell (Lindsey and Norwell, 1990) whereas carbohydrate profile was evaluated using ferricyanide method of Hulme and Narain (1931). The starch from sugar free pellet was determined by the method of Clegg (1956). Studies were conducted in triplicate.

ANTINUTRITIONAL FACTORS

The methods used were based on Haug and Lantzsch (1983) for phytic acid, Singh and Jambunathan (1981) for total polyphenols and modified method of Roy and Rao (1971) to assess Trypsin inhibitor activity.

EFFECT OF PROCESSING METHODS

The effect of processing on nutritional evaluation of processed and unprocessed *dalia* was studied after obtaining data on nutritional evaluation for the same parameter mentioned previously.

SHELF LIFE, SENSORY AND CHEMICAL EVALUATION

Samples were drawn at 7 days interval and analysed for sensory quality using 9-point hedonic scale by a panel of 10 judges drawn from Foods and Nutrition Department, CCS Haryana Agricultural University, Hisar.

CHEMICAL ANALYSIS

Dalia was analysed for change in moisture (AOAC, 1990), peroxide value (AOAC, 1984) using the below formula

$$\text{Peroxide value (meq/kg sample)} = \frac{S * N * 1000}{g\ of\ sample}$$

Where, S = ml sodium thiosulphate (blank corrected)
N = Normality of sodium thiosulphate solution

Fat acidity was determined using 10g sample extracted with petroleum ether and further titrated with standard KOH (AOAC, 1984). Fat acidity was reported as mg KOH required neutralizing free fatty acids from 100g mixture.

Fat acidity = 10 x (titrated blank – blank value)

The free fatty acids estimated were in accordance with AOCS, 1981. Extracted lipid in presence of phenolphthalein was titrated against 0.25 N NaOH to pink color end point which persisted for 30 seconds.

$$\%\ FFA = \frac{ml * N * F * 100}{Sample\ wt. * 1000}$$

Where, ml = ml of NaOH required
N = Normality of NaOH solution
F = Equivalent weight (282) of oleic acid

STATISTICAL ANALYSIS

The data were subjected to statistical analysis for "t "analysis of variance and correlation coefficients as per standard methods (Snedecor, 1967). ANOVA was used for testing the difference among more than two sample means.

RESULTS and DISCUSSIONS

PROXIMATE COMPOSITION

The moisture content, crude protein, crude fat, total ash, crude fibre and total carbohydrates of fieldpea varieties, processed and unprocessed mixture of *dalia* are represented in Table 2. Moisture content of Jayanti and Uttara varities of fieldpea varied significantly ($P<0.05$) from each other ranging from 7.89 to 8.83 g/100g, DM basis. Similar results have also been reported by McIntosh

and Topping (2000) in fieldpea. Whereas a non-significant (P<0.05) difference in the crude protein content of two varieties was observed.

Dalia was prepared using wheat grits and amylase rich grits (75:25) of fieldpea. Moisture content of *dalia* was significantly (P<0.05) lower than that of the raw unprocessed control sample. In the processed filedpea *dalia* 5.90 percent moisture was present. Dry heat treatment which was given to amylase rich fieldpea after germination might lead to reduction in moisture content. Although no significant (P<0.05) changes in the content of crude protein was observed when compared to the control sample. The non-significant (P<0.05) change in crude protein was as a result of the cumulative effect of soaking, germination, roasting and pressure cooking used in the preparation of *dalia*. On the other hand, decrease in protein content has been reported as a result of roasting and pressure cooking (Dogra *et.al.*, 2001).

A significant (P<0.05) difference was found in the carbohydrate content of unprocessed and processed filedpea *dalia*. Since the carbohydarate contents were calculated by difference method, the variation in carbohydrate content was attributed to the differences in the content of other constituents. Sood *et al.* (2002) also reported significant differences in carbohydrate content of the unprocessed and processed samples of chickpea varieties.

Table 2: Effect of processing on proximate composition (g/100g) of fieldpea and dalia prepared from amylase rich fieldpea (on dry matter basis)

Food Product	Moisture	Crude protein	Crude fat	Total ash	Crude fibre	Total carbohydrates
Fieldpea						
Jayanti	7.89^{b}±0.23	19.7^{b}±0.33	1.4^{b}±0.12	3.89^{c}±0.01	4.75^{b}±0.01	62.37^{b}±0.65
Uttara	8.83^{c}±0.10	19.0^{b}±0.23	1.5^{b}±0.29	2.62^{d}±0.01	5.35^{b}±0.03	62.70^{b}±0.63
dalia						
Unprocessed mixture	8.80^{a}±0.23	7.28^{b}±0.16	6.04^{a}±0.02	1.36^{a}±0.21	1.16^{a}±0.09	75.36^{b}±0.71
Processed	5.90^{b}±0.26	7.26^{b}±0.15	6.02^{a}±0.07	0.97^{ab}±0.04	1.16^{a}±0.08	78.69^{a}±0.61
CD (P<0.05)	0.83	0.42	0.59	0.58	0.40	2.68

Values are means ± SE of three independent determinations. Values with different superscripts are significantly different (ANOVA: P<0.05) from other group, column wise.

ANTI NUTRITIONAL FACTORS

Phytic acid content in unprocessed sample of fieldpea was 675 mg/100g, respectively. Amylase rich flour (ARF) had significantly (P<0.05) less amount i.e. only 189 mg phytic acid per 100g. This significant (P<0.05) phytic acid content decrease of 72.00 percent was as a result of the cumulative effect of soaking, germination and dry heat treatment used in the preparation. The phytic acid content of raw unprocessed mixture of *dalia* was 187.89 mg per 100g and combination of various treatments viz. soaking, germination, roasting, cooking etc. used for preparation of *dalia* from amylase rich fieldpea significantly (P<0.05) reduced the level of phytic acid by 39.77 percent over the control values in fieldpea *dalia*. Loss of phytic acid in the soaked grain may be because of leaching of phytate ions into soaking water under the influence of concentration gradient which governs the rate of diffusion. During germination losses may be due to hydrolytic activity of phytase. Decrease in phytic acid content was also reported by Alonso (1998) in their study on pea seeds. The apparent decrease in phytic acid content due to moist and dry heat treatments may be attributed to formation of insoluble complexes between phytic acid and other components (Kumar *et.al.*, 1978).

Polyphenol content in amylase rich flour of fieldpea was 50.00mg per 100g. A significant (P<0.05) decrease i.e. 75.00 percent was observed in ARF of fieldpea when compared to unprocessed control ones. The raw unprocessed mixture of fieldpea *dalia* contained 44.47 mg/100g polyphenols and the level reduced to 19.21 mg/100g in the final product (Figure 2). Loss of polyphenols during soaking may be attributed to passing out into the soaking medium through the periphery of the seed. Presence of polyphenoloxidase and enzymatic hydrolysis lead to further reduction in polyphenol contents during germination (Jood et.al., 1987). Beside this, exposure of the grains to the heat for larger period may also lead to higher losses in polyphenolic content. Cumulative effect of soaking and germination on reduction of polyphenols has also been reported in peas (Bishnoi *et.al.*, 1994).

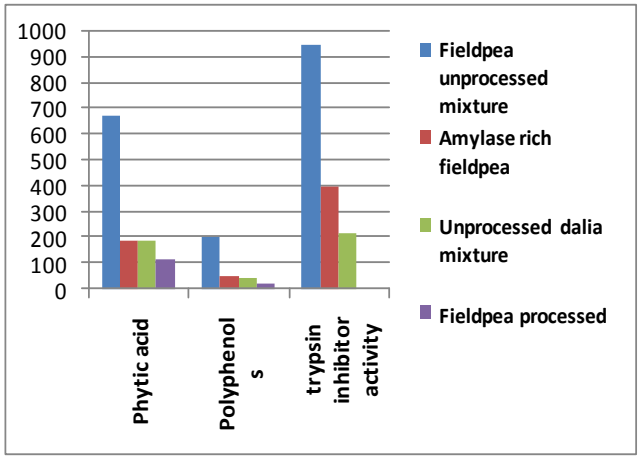

Figure 2: Phytic acid (mg/100g), polyphenols (mg/100g) and Trypsin inhibitor activity (TIU/g) in unprocessed mixture, amylase rich fieldpea, unprocessed mixture and processed dalia prepared from amylase rich fieldpea

Trypsin inhibitor activity (TIA) in unprocessed and ARF of fielpea was 392.00 and 400.00 TIU/g

respectively. A significant (P<0.05) decrease in TIA was observed in ARF. In raw unprocessed mixture of fieldpea *dalia*, TIA was 218.19 TIU/g. In processed amylase rich fieldpea *dalia* no trypsin inhibitor activity was detected. Trypsin inhibitors are low molecular weight proteins and are likely to pass from the seed against concentration gradient during soaking. Germination leads to mobilization and breakdown of chemical constituents including trypsin inhibitors. Besides, temperature above 100°C in the presence of water could remove trypsin inhibitor activity. The rate of inactivation of trypsin inhibitor is greatly increased with increasing moisture content of the food material.

SHELF LIFE EVALUATION

SENSORY EVALUATION

Mean scores of sensory parameters for cooked *dalia* prepared after storing *dalia* mix for 0, 7, 14 and 21 days as judged by the members of sensory panel using 9-point hedonic rating scale are presented in table 3.

Color scores for *dalia* prepared from amylase rich fieldpea were 7.70, 7.40, 7.30 and 7.30 on storage for 0, 7, 14 and 21 days, respectively and fell in 'liked moderately' category. Non- significant (P<0.05) change was found in color when *dalia* mix was stored for more than 21 days. Appearance of fresh *dalia* was in 'liked moderately' category. When *dalia* mix was stored for 1 week, 2 weeks and 3 weeks, color was still acceptable and fall in same category significant (P<0.05) change in appearance was noted when its storage period was increased upto 3 weeks.

Irrespective of storage interval, aroma scores were 'liked moderately' and non- significant (P<0.05) difference existed. Similarly texture scores of *dalia* was 'liked moderately' with no significant (P<0.05) effect of storage on texture of *dalia*. Whereas, a slight decrease in taste score was noticed when *dalia* mix was stored for 3 weeks. From table 3 it can be concluded that *dalia* prepared from fieldpea was acceptable when evaluated at four stage intervals was found to be in 'liked moderately' category on organoleptic evaluation.

Table 3: Effect of storage period on sensory quality of dalia prepared from amylase rich fieldpea

Food product	Storage period at 37±2°C	Sensory parameters					
		Color	Appearance	Aroma	Texture	Taste	Overall acceptability
Fieldpea *dalia*	0	$7.70^{a\pm}0.15$	$7.80^{a\pm}0.13$	$7.60^{a\pm}0.16$	$7.40^{a\pm}0.16$	$7.60^{a\pm}0.16$	$7.62^{b\pm}0.06$
	7	$7.40^{a\pm}0.16$	$7.60^{ab\pm}0.16$	$7.50^{a\pm}0.16$	$7.30^{a\pm}0.15$	$7.40^{a\pm}0.16$	$7.44^{ab\pm}0.11$
	14	$7.30^{a\pm}0.15$	$7.30^{bc\pm}0.15$	$7.30^{a\pm}0.15$	$7.30^{a\pm}0.15$	$7.30^{a\pm}0.15$	$7.30^{ab\pm}0.15$
	21	$7.30^{a\pm}0.15$	$7.10^{c\pm}0.10$	$7.30^{a\pm}0.15$	$7.30^{a\pm}0.15$	$7.30^{a\pm}0.15$	$7.26^{b\pm}0.13$
Mean		$7.42^{\pm}0.07$	$7.45^{\pm}0.07$	$7.42^{\pm}0.07$	$7.32^{\pm}0.07$	$7.40^{\pm}0.07$	$7.40^{\pm}0.06$
CD (P<0.05)		0.44	0.39	0.45	0.44	0.45	0.35

Values are means ± SE of three independent determinations. Values with different superscripts are significantly different (ANOVA: P<0.05) from other group, column wise.

CHEMICAL ANALYSIS

Results for moisture, peroxide value, fat acidity and free fatty acids of fieldpea *dalia* mix at each storage interval have been shown in table 4.

Moisture content of fresh *dalia* mix was 5.90g/100g. A non- significant (P<0.05) difference was observed in moisture content at 0 day of storage. Whereas after 14 days of storage interval significant (P<0.05) increase in moisture was observed.

The primary products of lipid oxidation are hydroperoxides which are generally present as peroxides. The peroxide value of *dalia* mix at 0 and 7 days of storage was 0.10 meq/kg while after 14 days of storage, peroxide value varied from 0.11 to 0.12 meq/kg. Non- significant (P<0.05) difference was observed in peroxide values of *dalia* mix at different storage periods.

The changes in lipid during storage were followed by determining fat acidity value. There were significant (P<0.05) difference between fat acidity value of fresh and stored *dalia* mix. Both types of *dalia* mix stored for 0, 7, 14 and 21 days showed gradual increase in fat acidity on storage. Increase in fat acidity with advancement of storage period in porridges might be due to the breakdown of triglycerides and oxidation of unsaturated fatty acids.

Table 4: Effect of storage on moisture (g/100g), peroxide value (meq/kg), fat acidity (mg KOG/ 100 g) and free fatty acids (mg/100g fat as oleic acid) on dalia prepared from amylase rich fieldpea

Parameters	0	7	14	21	Mean	CD (P<0.05)
Moisture	$5.90^{a}\pm0.05$	$6.00^{ab}\pm0.01$	$6.00^{ab}\pm0.02$	$6.10^{b}\pm0.01$	6.00	0.10
Peroxide value	$0.10^{a}\pm0.01$	$0.10^{a}\pm0.01$	$0.11^{a}\pm0.01$	$0.12^{a}\pm0.01$	0.11	0.11
Fat acidity	$22.90^{a}\pm0.10$	$27.73^{b}\pm0.52$	$35.00^{c}\pm0.28$	$39.93^{d}\pm0.63$	31.39	1.42
Free fatty acids	$84.93^{a}\pm0.46$	$98.10^{b}\pm0.49$	$123.06^{c}\pm0.42$	$164.53^{d}\pm1.14$	117.65	2.28

Values are means ± SE of three independent determinations.
*significant at 5% level of significance, NS= non- significant, Values with different superscripts are significantly different (ANOVA: P<0.05) from other group, row-wise

Fresh fieldpea *dalia* mix had 84.93 mg free fatty acids per 100g respectively. It had 98.10, 123.06 and 164.53 mg/100g free fatty acids at 7, 14 and 21 days of storage interval respectively which were significantly

($P<0.05$) different form each other. Longer the storage period, more was the increase in free fatty acid values.

CONCLUSION

Amylase rich fieldpea can replace chickpea in many processed foods. It is commonly consumed by poor mass of country. It forms a major source of protein and calorie. Germination of fieldpea improves digestibility, reduction of polyphenols and phytases. Amylase rich fieldpea is important in the manufacture of foods designed for special targeted groups such as infant, pregnant and lactating women. Fieldpea *dalia* is low cost, nutritious food and can be consumed by individuals belonging to different economic groups.

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