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Preparation of Bakery Products by Incorporating Pea Flour as a Functional Ingredient

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Abstract: An experiment was conducted to study the functional behavior of pea flour for improvement of nutritional quality of bakery products. Wheat is the staple food of Indians and pea crop is seasonal. This study was conducted to improve the nutritional quality of wheat based bakery products by incorporating pea flour as it is a rich source of protein and fiber. Flour from mechanically and field dried peas of two cultivars was incorporated into bread and cookies at 5 and 10% level. Bread and cookie making characteristics were studied. Prepared bread and cookies were evaluated for sensory characteristics. There was observed an increase in water absorption and decrease in the stickiness of the dough. Bread weight increased and volume decreased with the incorporation. There was observed a decrease in the cookie spread ratio. Sensory score for bread and cookies containing 5% pea flour were comparable to the control. So pea flour could be incorporated in bread and cookies up to 5% to improve the nutritional quality without affecting the sensory quality.

Key words: Pea flour, bread, cookies, sensory, protein, fiber

INTRODUCTION

The demand of bakery products is increasing at the rate of 10.07% per annum. India is a developing country with large segment of population depending on wheat as staple foods and 25% of wheat is used in the preparation of baked foods. Due to changing life style the people have started demanding ready to cook or ready to serve convenience foods. More and more women are seeking employment to supplement the family income and they find less time for cooking and therefore demand ready to serve foods. Baked products are considered as excellent vehicle for fortification, value addition and feeding at mass scale. Baked products are the most important sources of dietary fiber in the total food consumption (Hans *et al*., 1986). Pea meal is a good source of protein, fibre, starch and iron. It also contains a number of anti-nutritional factors such as phytic acid and trypsin inhibitors (Periago *et al*., 1998). The role of dietary fiber in controlling chronic disorders like diverticulitis, bowel cancer, cardiovascular diseases, diabetes, constipation etc has been well documented (Painter and Burkitt, 1975). Protein deficiency is a major dietary problem facing the world today, particularly the underdeveloped and developing countries. The present study was designed to incorporate pea flour as protein and fiber source in the preparation of bread and cookies. Anu and Kawatra (2007) prepared biscuits, sweet biscuits (A) and sweet and salty biscuits (B) using flours of refined wheat, blanched pearl millet (*Pennisetum glaucum* L.) and green gram (*Phaseolus aureus*) in the ratio of 50: 40: 10 (Type I) and 30:60:10 (type II) and control containing 100% refined wheat flour. Both types of biscuits were liked

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very much by the panelists. Slightly higher antinutrient (polyphenol and phytic acid) contents were found in type-II sweet biscuits (A) and sweet and salty biscuits (B) as compared to type-I and control sweet biscuits (A) and sweet and salty biscuits (B). Blanched pearl millet flour in combination with refined wheat flour and green gram flour can be successfully incorporated for the development of nutritious biscuits. Sindhuja *et al.* (2005) carried out studies on composite flour cookies by incorporating amaranth seed (*Amaranthus gangeticus*) flour, on the basis of colour, taste, flavour, surface appearance of the cookies, 25% incorporation of amaranth flour was found to be optimum. Gupta and Singh (2005) used wheat flour and quality protein maize based biscuits prepared with and without processed defatted maize germ cake supplementation and compared with wheat flour based biscuits as standard. Dhull *et al.* (2006) studied the effect of replacing wheat flour with dried pea and red gram flours on the nutritional and sensory quality of biscuits. The protein content increased from 5.1 to 8.2 and 9.0% with replacement of 3.0% of wheat flour with dried pea and red gram flours, respectively. Singh *et al.* (2000) prepared soy fortified biscuits with standardized levels of ingredients and emulsifiers (SSL/GMS) and analysed for chemical composition, *in vitro* digestibility and protein efficiency ratio. Addition of 20% defatted soy flour in the recipe increased the protein, ash, crude fibre, calcium, phosphorus, iron, sugar and available lysine contents of biscuits. Marques *et al.* (2000) blended different types of flour and meal, which could significantly improve protein quality over that of individual flours. In this study, various flour/meal mixtures were prepared by blending wheat flour, soy meal and defatted sesame seed meal in proportions of 70:20:10, 60:20:20, 50:30:20 and 0:50:50. It was concluded that their low cost flour/meal blends could provide good quality vegetable protein sources in the preparation of foods and could serve to alleviate chronic protein malnutrition in underdeveloped and developing countries. Raidl and Klein (1983) studied effects of substituting 5, 10 and 15% field pea or defatted soy flour for wheat flour in a chemically leavened quick bread on physical characteristics of batters and bread and sensory characteristics of bread. Significant differences were observed for batter spread, consistency, loaf volume, darkness and yellowness value of bread crumbs. Results indicated that defatted soy flour could be successfully substituted for wheat flour in quick breads at levels upto 15%, whereas at the same substitution levels, field pea flour had adverse effects on both physical and sensory characteristics. Jan *et al.* (2000) studied replacement of 5 and 10% of wheat flour in chapati formulation with flours (meal) prepared from soybeans, peanuts, sunflower seeds and rapeseeds with regard to nutritional values and sensory properties of the chapaties. Khan *et al.* (1975) compared baking properties of bread containing three experimental peanut protein concentrates. The volumes of loaves produced from flour with concentrations of peanut protein higher than 10% were significantly lower than those of loaves made from flour containing other protein supplements. The present study was designed to incorporate pea flour as protein and fiber source in the preparation of bread and cookies. The objectives of this study were:

- To study the physicochemical and functional characteristics of pea flour
- To study the effect of incorporation of pea flour on bread making properties and acceptance of bread by sensory panel
- To study the effect of incorporation of pea flour on cookie making properties and acceptance of cookies by sensory panel

MATERIALS AND METHODS

Pea flour was prepared from mechanically dried and field dried peas of cultivars Pb-87 and Pb-88. The chemical composition and functional characteristics of these pea flours

are given in Table 1. This study was conducted during 2005. Commercial wheat flour for evaluation was obtained from Luxmi Electric Flour Mill, P.O. Box No. 7, Miller Ganj, Ludhiana. Bakers yeast, i.e., Prestige yeast (*Saccharomyces crevisae*) manufactured by SAF Yeast Co. Bombay was obtained from a local store and kept in refrigerator for baking test. Bakery shortening (manufactured by Amrit Vanaspati Ltd., Chandigarh Road Rajpura-140401) which had a melting point of 37°C was obtained from local market. Crystal cane sugar and ground sugar were purchased from the local store for use in bread and cookies. Sodium chloride (BDH) was used in the study. Sodium bicarbonate was used as leavening agent in cookies preparation, manufactured by SD Fine Chem. Ltd. Boisor-401506, India.

Baking Studies

Bread

Straight dough AACC method (Anonymous, 1990) was followed:

Ingredients	Quantity (g)
Flour	100
Compressed yeast	3.0
Sugar	2.5
Bakery shortening	4.0
Salt/NaCl	1.5
Potassium bromate	10 ppm
Water	Optimum (mL)

To the above formula the flour was substituted by 5 and 10% pea flour of both varieties.

The dough was prepared and baking schedule as under was followed.

Mixing	Optimum (3 min)
Fermentation	75 min (1.15 h)
Remixing	25 sec
Recovery	20 min
Sheeting and moulding	---------
Proofing (at 86^{0}F, RH 75%)	55 min
Baking	25 min at 450°F

Bread Quality

The loaves were packed in polypropylene bags and analysed for volume, weight and moisture content. Sensory panel evaluation for appearance, crust colour, crumb colour, aroma, taste and overall acceptability was done next by a panel of eight judges.

Table 1: Physicochemical and functional characteristics of pea flour

Cultivar	Treatment	Crude protein	Ash	Crude fiber	WBC	Swelling power	Solubility
		----------(%)----------			----------(g/g)----------		(%)
Pb-87	Mech. dried	31.45	3.13	5.14	4.03	5.85	19.79
	Field dried	31.24	3.02	6.22	2.48	5.28	28.45
Pb-88	Mech. dried	32.64	3.63	5.12	4.26	5.93	19.79
	Field dried	32.05	3.56	6.29	2.5	5.42	32.16
CD (0.05)		NS	NS	0.2	0.6	NS	0.3
0.47							
0.47							
0.16							
0.94							
0.17							
0.73							

Cookies

For baking cookies AACC method (Anonymous, 1990) was followed using following ingredients:

Ingredients	Quantity (g)
Flour	100
Sugar	58
Salt (NaCl)	0.9
Sodium bicarbonate	1.0
Shortening	28
Dextrose	13.8 mL (8.9 g glucose in 150 mL water)
Water	Optimum (mL)

To the above formula the flour was substituted by 5 and 10% pea flour of both varieties.

Dough was prepared, sheeted (5 mm) and cut into circular cookies (diameter 5.5 cm) and baked for 10 min at 400°F.

RESULTS AND DISCUSSION

Effect of Incorporation of Pea Flour on Bread Making Quality

Studies were carried out to incorporate pea flour at 5.0 and 10.0% level in bread. It was found that quality of bread was good at 5.0% level as compared to 10.0% level. The effect of incorporation of pea flour on external and internal bread quality is given in Table 2 and 3.

Water absorption was observed more at 10% level of pea flour. The reason for this increase may be due to increase in protein and fibre content by incorporation of pea flour. Mixing time at both levels varied non significantly at both levels. Dough handling was observed smooth at higher levels. Loaf volume and specific volume was decreased with increase in levels of pea flour in both varieties. Prentice and Appolonia (1977) had earlier reported the decrease in the specific volume with increasing level of pea meal incorporation. Shogren *et al*. (1981) had reported that the decrease in loaf volume and specific volume with

Table 2: Effect of incorporation of pea flour on the bread making properties

Cultivar/ Treatment	Level	Water absorption (mL)	Mixing time	Dough handling	Weight of bread (g)	Volume of bread (cc)	Sp. Volume (Cc g^{-1})
Control	0	67.5	3 min	Slightly sticky	140	590	4.21
Pb-87 Mech. dried	5	69.4	2 min 50 sec	Smooth	142	595	4.19
	10	71.7	2 min 45 sec	Smooth	146	510	3.49
Pb-87 Field dried	5	71.4	2 min 45 sec	Smooth	142	485	3.41
	10	71.5	2 min 45 sec	Smooth	148	490	3.31
Pb-88 Mech. dried	5	69.3	2 min 30 sec	Smooth	147	525	3.57
	10	71.8	2 min 30 sec	Slightly sticky	142	460	3.23
Pb-88 Field dried	5	71.4	2 min 20 sec	Smooth,pliable	140	485	3.46
	10	71.6	2 min 20 sec	Slightly sticky	148	470	3.17

Table 3: Effect of incorporation of pea flour on the sensory quality of bread

Cultivar/Treatment	Level	Appearance	Crust colour	Crumb colour	Aroma	Taste	Overall acceptability
Control	0	8.1	7.6	7.7	7.9	7.8	7.8
Pb-87 Mech. dried	5	7.5	7.6	7.9	7.8	7.5	7.7
	10	6.8	7.8	6.3	7.4	6.3	6.9
Pb-87 Field dried	5	7.9	7.1	7.5	7.7	7.1	7.5
	10	7.1	7.6	7.7	7.3	7.4	7.4
Pb-88 Mech. dried	5	7.9	7.4	7.1	7.1	7.6	7.4
	10	6.7	7.9	6.6	7.8	6.9	7.2
Pb-88 Field dried	5	7.6	7.7	7.8	7.2	7.6	7.6
	10	7.2	7.6	6.4	7.3	6.2	6.9

Table 4: Effect of incorporation of pea flour on cookie making properties

Cultivar/Treatment	Level	Width	Thickness	Spread ratio	Top grain	Texture	Flavour	Overall acceptability
Control	0	24.77	3.96	6.25	7.7	7.5	7.7	7.6
Pb-87 Mech. dried	5	24.13	3.93	6.13	6.9	7.5	6.8	7.1
	10	24.37	4.00	6.09	7.1	6.8	7.1	7.0
Pb-87 Field dried	5	24.80	4.23	5.86	6.8	7.7	6.9	7.1
	10	24.76	4.26	5.81	6.6	7.4	7.0	7.0
Pb-88 Mech. dried	5	24.97	4.27	5.85	7.7	7.1	6.7	7.2
	10	24.60	4.17	5.89	7.2	7.3	7.1	7.2
Pb-88 Field dried	5	25.17	4.13	6.09	7.5	7.6	7.3	7.5
	10	24.03	4.20	5.72	7.2	7.0	7.1	7.1

increase in levels of fibre could be due to the dilution of gluten proteins. Raidl and Klein (1983) concluded that defatted soy flour could be successfully substituted for wheat flour in quick breads at levels upto 15%, whereas at the same substitution levels, field pea flour had adverse effects on both physical and sensory characteristics. In the present study it was found that pea flour could be substituted at 5.0% level for preparation of bread.

Data regarding the sensory evaluation for appearance, crust color, crumb color, aroma, taste and overall acceptability of breads are presented in Table 3.

Sensory score showed that breads were acceptable at 5.0% level of incorporation of pea flour. Panelists awarded less scores for breads prepared at 10% level of pea flour to appearance, crust color and crumb color where as scores for aroma and taste varied non significantly. Overall acceptability of breads was observed better at 5.0% level of pea flour as compared to 10.0% level in both varieties.

Effect of Incorporation of Pea Flour on Cookie Making Quality

Cookies were prepared after incorporation of pea flour of different cultivars i.e., Pb-87 and Pb-88, both mechanically dried and field dried at 0, 5.0 and 10.0% level in flour. Data regarding quality and organoleptic evaluation is given in Table 4. Results showed that pea flour incorporation decreased the spread ratio in all cultivars in comparison to control. With increase in level of pea flour spread ratio of cookies decreased. This might have been due to the increase in protein content of flour. Cookies were organoleptically evaluated for top grain, texture, flavour and overall acceptability. Panelists awarded more scores for texture of cookies at 5.0% whereas flavour scores were observed more at 10% level of pea flour. Overall acceptability of cookies were liked more at 5.0% level of pea flour cookies.

CONCLUSION

Pea flour was incorporated in wheat flour up to 10%. There was increase in water absorption and decrease in bread volume and spread ratio of cookies. Sensory score for bread and cookies containing 5% pea flour were comparable to the control. So pea flour could be incorporated in bread and cookies up to 5% to improve the nutritional quality without affecting the sensory quality.

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