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Utilization of coarse grains for formulation of value added snacks

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The present study was carried out with the objectives to prepare *Pua* by incorporating bajra flour and soy flour, to assess the acceptability of developed product and to find the nutritive value as well as analyze elements by LIBS. The bajra flour, wheat flour and soy flour were mixed in the ratio of 10:80:10 (T_1), 20:70:10 (T_2), 30:60:10 (T_2) and 100 per cent wheat flour (control). Sensory analysis indicated that value added snacks were liked very much by the panelists. Nutrient analysis indicated that highest moisture and ash content was found in *Thalipeeth*. Protein content is similar in almost all four products showing highest in *Gatta* while highest carbohydrate, iron, calcium content and energy was found in *Laddo* followed by *Pua*, *Gatta* and *Thalipeeth,* respectively because of addition of jaggery as an ingredient in *Laddo*. Finally, fat content was maximum for *Laddo* and *Pua* followed by *Thalipeeth* and *Gatta*. This may be due to addition of Ghee in *Laddo* and deep frying of *Pua*. Elements detected from LIBS spectra for the developed products were carbon, hydrogen, nitrogen, calcium, iron, sodium, and magnesium. Therefore, it can be concluded that bajra flour in combination with wheat flour and soy flour can be successfully incorporated for the development of nutritious products.

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INTRODUCTION

Coarse grains are the name referred to the millets along with maize and sorghum, which constitute the food of the economically weaker sections of the population of India. Nowadays coarse cereals are gaining popularity amongst those who are accustomed to softer cereals like wheat and rice because of the presence of dietary fiber, beneficial in various degenerative diseases. Insoluble fraction of dietary fiber in cereal grains contains large proportion of cellulose, which has beneficial effects in the gastrointestinal tract. The soluble fractions, which mainly consists of pectin, arabinoxylan and β-glucan has the ability to lower blood serum cholesterol, through its tendency to increase viscosity in the intestine (Mridula and Gupta, 2008)

Millets are hardy plants capable of growing where most other cereal grains would fail. These are mostly grown in area with low rainfall, poor irrigation facilities and low soil fertility. These are well suited for dry farming. In developing countries, with the current rate of increase in population and less than adequate irrigational facilities, millets adequately meet the demand for additional food supply. These are especially beneficial to vegetarians who depend on plant food for their protein nourishment. It is reported that cardiovascular diseases, duodenal ulcers and hyperglycemia occurs rarely in regular millet eaters. Since millets which are rich in fiber are used less as staple though available in plenty, it would be worth while considering a supplementation study with selected millet. (Menon, 2004)

Among millets, bajra (Pearl millet) is the predominant crop of India which a staple food of rural people of dry land regions of India. In India, pearl millet is the 4th most important stale food crop after rice, wheat and sorghum (Singh et al., 2006). Bajra is comparable and even superior in some of the nutritional characteristics to major cereals with respect to its energy value,

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protein, fat and minerals (Anu *et al.,* 2007). Several studies reported that the possibility of utilization of bajra flour for making diversified food products for human consumption. Although its colour deteriorates the appearance and colour of the developed products due to presence of complex carbohydrate and lower glycemic response, bajra is also getting popularity amongst the health conscious consumers.

It was found that supplementation of cereal based diet with soybean can play an important role in combating the protein energy malnutrition because cereals are deficient in lysine and pulses in sulphur containing amino acids. Incorporation of soy flour in a small quantity will improve the protein quality of cereals based products. As per Food and Agriculture Organization report, replacing wheat flour with 20 per cent non-wheat flour for the manufacture of bakery products would result in an estimated savings in foreign currency of US $320 million annually (Mridula and Gupta, 2008). Government of India has recommended that the fortification of soy flour with wheat flour in 1:10 proportion would be beneficial in improving the nutritional status of our chapattis. and other products without affecting the texture of food products. (Pandey *et al.,* 2008)

Therefore, the present study was carried out to find the effect of incorporation of different proportion of bajra flour and soy flour in wheat flour on sensory characteristics and nutrient composition of the developed products. Qualitative assessment of value added products by Laser Induced Breakdown Spectroscopy (LIBS) was also done for elemental analysis.

METHODOLOGY

Bajra seeds, soybean seeds, refined oil, sugar, jaggery, groundnuts, Bengal gram flour were procured from the local market of Allahabad in the month of January 2010. Bajra seeds and soybean seeds were subjected to make flour. They were cleaned, washed, roasted and sun dried for 2 days, and then ground in the atta maker to make the flour.

Preparation of the developed products:

Products were prepared by using bajra flour, wheat flour and soy flour in ratio of 0:100:0 (control), 10:80:10 (T_1), 20:70:10 (T_2) and 30:60:10 (T_3). The ingredients(g) used in preparation of *Pua* were wheat flour 50, sugar 35, milk 100ml, milk powder 3, sauf 3, and oil for frying. A thick batter of wheat with milk, milk powder and sugar was made and kept for an hour. Small flat balls in the shape of *Pua* were prepared and deep fried till golden brown.

The ingredients (g) used in preparation of *Thalipeeth* were wheat flour 50, onion 25, garlic 2 cloves, green chili 1 small size, ajwain ¼ tsp, salt ¼ tsp and oil 1 tsp. The dough was prepared by adding all the ingredients. Small ball in the shape of *Paratha* and shallow fried till golden brown on both sides.

The ingredients (g) used in preparation of *Laddo* were wheat flour 50, jaggery 35, groundnuts 20, cardamom 2 and ghee 25. The flour was roasted and added all the ingredients. The hands were greased with ghee and shape the mixture into *Laddos*.

The ingredients (g) used in preparation of *Gatta* were Bengal gram flour 50, onion 25, green chili 1 small size, curry leaves 5, rai ¼ tsp, salt ¼ tsp and oil 1 tsp. Small balls were prepared from the salted dough of the flour and boil in water till tender. Taken out, cut into small pieces and shallow fried with chopped onion, curry leaves, green chilies and rai.

Sensory analysis:

The sensory quality of the developed products in respect of colour and appearance, body and texture, flavour and taste, Overall acceptability was judged by five panelist using 9-point Hedonic scale.

Nutritional analysis:

Moisture, ash, crude fibre were estimated by AOAC (1980) method, protein (Micro kjeldhal method), fat (Soxhlet method), carbohydrate (difference method), iron (Colorimetry method), calcium (Titration method) and energy (Kcal/100g) = (4 X Protein) % + (9 X fat) % + (4 X CHO) %

Laser-induced breakdown spectroscopy (LIBS) of the developed products:

A high energy laser is focused on the sample material (solid, liquid or gas) which causes target material to undergo rapid local heating, vaporization, dissociation, ionization of its atoms and the atomic emission from the expanding plasma plume that is formed during the laser-matter interaction provides valuable information about the composition of the target material on the screen connected on-line. Products were subjected for elemental analysis by LIBS.

Statistical analysis:

The data were subjected analysis of variance (ANOVA) using completely Random Design. Significant difference between treatments was determined by using critical difference test at $p<0.05$. (Chandel, 2006).

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as well as relevant discussion have been presented under following heads :

Sensory evaluation:

Colour and appearance:

Table 1 shows that the most acceptable treatment was T_2 (20% incorporation level of *bajra* flour) for *Pua* and *Thalipeeth*, T_3 (30% incorporation level of *bajra* flour) for *Laddo* and control

Table 1. Average sensory scores of the value added snacks

Parameters / Treatments	Colour and appearance	Body and texture	Taste and flavour	Overall acceptability
Pua				
Control	7.78 ± 0.08	7.78 ± 0.09	6.15 ± 0.08	7.62 ± 0.07
T_1	7.86 ± 0.5	7.78 ± 0.12	7.8 ± 0.12	7.8 ± 0.1
T_2	7.98 ± 0.08	7.96 ± 0.14	8.5 ± 0.37	8.12 ± 0.09
T_3	7.12 ± 0.08	7.2 ± 0.04	7.8 ± 0.08	7.36 ± 0.08
C.D. (P< 0.05)	0.34	0.4	0.35	0.34
Thalipeeth				
Control	7.16 ± 0.11	7.4 ±0.12	7.44 ± 0.12	7.2 ± 0.27
T_1	7.84 ± 0.13	7.52 ±0.09	7.64 ± 0.15	7.7 ± 0.28
T_2	8.04 ± 0.14	8.44 ±0.13	8.44 ± 0.12	8.1 ± 0.29
T_3	7.92 ± 0.10	7.64 ±0.1	7.68 ± 0.15	7.8 ± 0.27
C.D. (P< 0.05)	0.47	0.35	0.51	0.47
Laddo				
Control	7.28 ± 0.10	7.28 ± 0.18	7.78 ± 0.08	7.53 ± 0.09
T_1	7.32 ± 0.09	7.6 ± 0.13	7.78 ± 0.12	7.5 ± 0.07
T_2	7.92 ± 0.21	8.24 ± 0.19	7.96 ± 0.14	7.8 ± 0.15
T_3	8.12 ± 0.2	7.6 ± 0.29	7.2 ± 0.04	8.02 ± 0.2
C.D. (P < 0.05)	0.39	-	0.41	-
Gatta				
Control	8.52 ± 0.12	8.34 ± 0.11	7.8 ± 0.13	6.15 ± 0.25
T_1	8.16 ± 0.03	8.12 ± 0.03	8 ± 0.05	7.8 ± 0.12
T_2	7.84 ± 0.14	8.56 ± 0.17	8.32 ± 0.15	8.5 ± 0.37
T_3	8.08 ± 0.2	7.78 ± 0.20	7.68 ± 0.37	7.9 ± 0.08
C.D. (P < 0.05)	-	0.56	0.32	0.35

for *Gatta*. As the proportion of *bajra* flour increases, its undesirable grey colour becomes more dominant which makes the color and appearance of product less acceptable. Rathi *et al.* (2004) reported that as the proportion of bajra flour increases in flour blends, it results in darkening of the biscuits which ultimately affected the sensory scores for appearance and colour.

Body and texture:

The Table 1 shows that treatment T_2 got highest score for *Pua*, *Thalipeeth*, *Laddo* and *Gatta* which contained 20 per cent Bajra flour. The average score decreased in treatment T_3 at 30 per cent level of incorporation of bajra flour because its coarse and rough texture become more dominant. Mridula *et al.* (2008) also found that the high fiber and low gluten content in bajra flour than wheat flour may be attributed to the increased rough and coarse texture of the biscuits in proportion to the bajra flour levels in flour blends.

Taste and flavour:

Treatment T_2 got highest score for *Pua*, *Thalipeeth*, *Laddo* and *Gatta* which contained 20 per cent bajra flour while the average score decreased in treatment T_3 at 30 per cent level of incorporation of bajra flour because as the proportion of flour increases, its distinct bitter taste gradually becomes more dominant which makes the product less acceptable.

Overall acceptability:

As the proportion of bajra flour increases, its rough and coarse texture, its grey colour and distinct peculiar taste gradually becomes more dominant which decreases the overall acceptability of the product. Hence, treatment T_2 got highest score for *Pua*, *Thalipeeth*, *Laddo* and *Gatta* which contained 20 per cent bajra flour while the average score decreased in treatment T_3 at 30 per cent level of incorporation of bajra flour.

Nutritional evaluation:

Table 2 reveals that that highest moisture and ash content was found in *Thalipeeth*. Protein content was similar in almost all four products showing highest in *Gatta.* Anu *et al.* (2008) reported higher protein, fat, ash content in pearl millet based products while decrease in starch content with addition of

Table 2. Average nutrient content of the valuie added snacks

Nutrients	Pua	Thaipeeth	Laddo	Gatta
Moisture (%)	18.46	47.34	9.64	36.56
Ash (%)	0.99	1.95	1.16	0.95
Fat (g)	22.3	7.3	22.3	7.33
Protein (g)	6.43	6.39	6.53	7.7
Dietary fiber (g)	0.68	0.68	0.68	0.58
Carbohydrate (g)	51.13	36.34	59.69	46.88
Iron (mg/100g)	2.195	2.145	3.08	2.2
Calcium (mg/100g)	35.52	31.32	59.34	32.52
Energy (Kcals/100g)	431	237	466	284

pulse flour and pearl millet.

Highest carbohydrate, iron, calcium content and energy were found in *Laddo* followed by *Pua*, *Gatta* and *Thalipeeth* respectively because of addition of jaggery as an ingredient in *Laddo*. Singh *et al.* (2006) reported that moisture, ash, protein, fat, iron, calcium and phosphorus content increased while carbohydrate content decreased in soy and bajra flour incorporated cake as compared to control. Anu *et al.* (2007) also reported that pearl millet contained higher amount of calcium and iron as compared to refined wheat flour. Finally, fat content was highest for *Laddo* and *Pua* followed by *Thalipeeth* and *Gatta*. This may be due to addition of Ghee in *Laddo* and deep frying of *Pua*.

Elemental analysis of the value added snacks by LIBS:

Fig. 1, 2, 3 and 4 show the LIBS spectra of *Pua,*

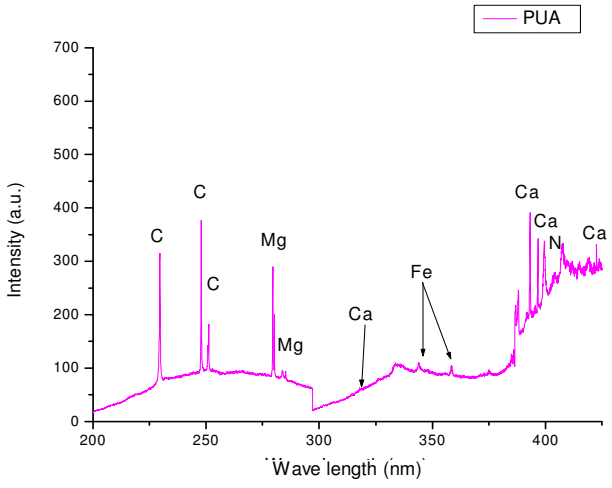

Fig. 1. LIBS Spectra for Pua

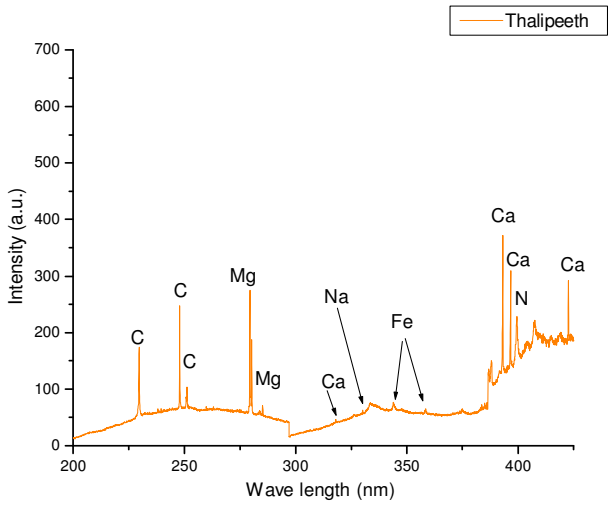

Fig. 2. LIBS Spectra for Thalipeeth

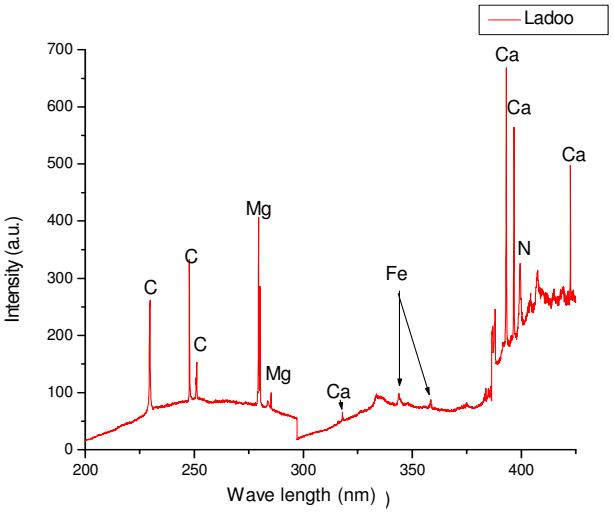

Fig. 3. LIBS Spectra for Laddu

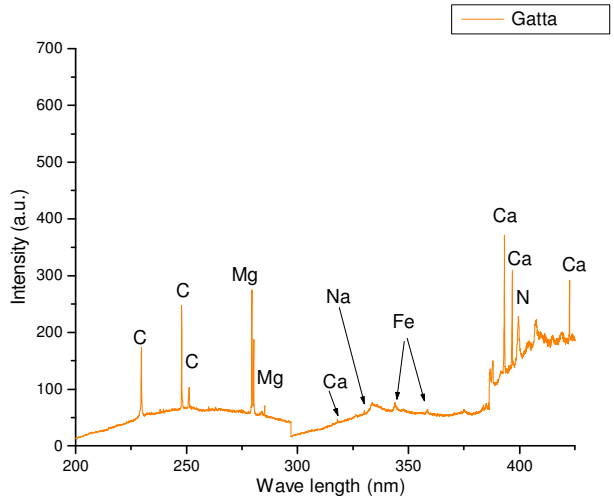

Fig. 4. LIBS Spectra for Gatta

Thalipeeth, Laddo and Gatta, respectively consisting of following elements as carbon, hydrogen, nitrogen, calcium, iron, sodium and magnesium.

Conclusion:

It is concluded that millet like bajra flour could be successfully incorporated in wheat flour and soy flour to enhance the nutritive value of value added snacks. Among the experimental treatments, the treatment incorporated with 20 per cent bajra flour T_2 was the most acceptable for all the four products namely *Pua*, *Thalipeeth*, *Laddo* and *Gatta*. Nutrient estimation indicated that highest moisture and ash content was found in *Thalipeeth i.e.* 47.34 per cent and 1.5 per cent, respectively, protein content was similar in almost all four products showing highest in *Gatta i.e.* 7.7 per cent while highest carbohydrate (59.69%), iron (3.08mg), calcium (59.34mg) and energy (466kcal) was found in *Laddo* followed by *Pua*, *Gatta* and *Thalipeeth* respectively. Finally, fat content was highest for *Laddo* (*i.e.* 22.3%) and *Pua* (22.3%) followed by *Thalipeeth* (7.3%) and *Gatta* (7.6%).

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