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Development and quality evaluation of soy-jambul seed powder fortified biscuits

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SUMMARY : In rural areas, malnutrition problem is severe in women and children because of traditional foods having low nutritive value. The nutritive valve of foods particularly biscuits could be improved by protein supplementation. Biscuits from blend of maida, soy flour and jambul seed powder were prepared by mixing in their different proportions *viz.,* 60 per cent : 34 per cent :6 per cent (A_1), 60per cent :32 per cent :8 per cent (A_2) and 60 per cent :30 per cent :10 per cent (A_3) and 60 per cent :40 per cent (control). Nutritional quality and sensory evaluations were carried out on the biscuits. The proximate composition of the biscuits ranged in values with moisture from 3.13 to 3.38 per cent, protein 16.10 to 18 per cent, fat 24.28 to 35.20 per cent, minerals (ash) 1.3 to 1.9 per cent. Significant difference (f < 0.01) existed in colour, texture, taste and overall acceptability of the biscuits.

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Though India is considered as the third largest producer of biscuits after USA and China. The production of biscuits in the country, both in the organized (0.44 mn tons) and unorganized sectors (0.66mn tons), is estimated to be around 11 million tonnes. The annual turnover of the organized sector of the biscuit manufacturers (as at 2001/ 2002) is 4'35 crores Indian Rupees. The biscuit market in the recent years has witnessed a little higher growth at around 8-10 per cent pa. The annual production of bakery products, which includes bread, biscuits, pastries, cakes, buns, rusk etc., is estimated to be in excess of 3 million tonnes.

Biscuits are very convenient and inexpensive food products and are becoming very popular among both rural and urban population especially among children as well as aged persons of India. A new type of jambul seed powder-containing biscuit have been developed and incorporated into the diabetic diet. It has been found to be effective in reducing the postprandial rise in the blood glucose level and in improving glycaemic control (Bhargava, 1991). These biscuits can be used for dealing with the symptoms of indigestion (Aiman and Shorti, 1962). These biscuits can be also stimulating the liver functions (Shorti, 1962). Hence, this biscuit contains high fiber and low calories so it is an excellent nutritional snack food with a high degree of acceptability especially to diabetic patients. If these biscuits are enriched with protein from soybean and jambul seed powder can help not only children's health but also maintaining health of diabetic patients. There is an ever increasing demand for high protein biscuits for therapeutic value. Nutritionally, biscuits can be easily fortified with protein – rich flours to provide a convenient food to supplement the poor quality diets. Protein, low calories and high fiber fortified biscuits contain nutrients in concentrated forms for feeding programmers at such institutes as day – care centers and schools or as emergency rations (Singh *et al*. 2000).

Biscuits may be regarded as a form of confectionery dried to very low moisture content. According to Fayemi (1981), biscuit is defined as a small thin crisp cake made from unleavened dough. Okaka (1997) described the production of biscuits as a mixture of flour and water but

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may contain fat, sugar and other ingredients mixed together into dough which is rested for a period and then passed between rollers to make a sheet. Biscuits may be classified either by the degree of enrichment and processing or by the method adopted in shaping them. Singh *et al.* (1998) studied physical and textural characteristics of soy biscuits standardized with baking powder (0.5, 0.8, 1.1 and 1.4%) and skim-milk powder (0.8, 1.6, 2.3 and 3.1%) levels, using the traditional creamery method. Studied physical properties and sensory evaluation of soy fortified biscuits. The colour, appearance, overall acceptability, texture, and flavour were found to be best for biscuit composition 60 per cent maida+32 per cent soy flour+8 per cent jambul seed and the taste and overall acceptability were best for biscuit composition 60 per cent maida+34 per cent soy flour+6 per cent soybean flour. All the organoleptic qualities were significantly affected at 5 per cent level. Soy fortified biscuits of different composition were developed by Meena and Meena (2004) as a value added product by fortifying biscuits with soy flour and sorghum. However, data on nutritional and sensory evaluation of biscuits prepared with d powder substitutes are not available. The present work examines the effect of jambul powder substitution up to 30 per cent on nutritional and sensory properties of soy biscuits.

EXPERIMENTAL METHODS

Preparation of biscuits:

Three types of jambul seed powder fortified soy biscuits *viz.,* biscuits containing maida, soy flour and jambul seed powder in various proportions 60:34:6 (A_1), 60:32:8 (A_2) and 60:30:10 (A_3) were prepared, using the traditional creamy method described by Meena and Meena (2004). The ingredients included (g) maida 300, soy flour (170,160,150), jambul seed powder (30,40,50), baking powder 5, baking soda 4 and salt 5 were added to prepared cream containing ghee 150, sugarfree 15 and cardamom powder 1. After adding 250 ml milk, dough was prepared by kneading. The prepared dough was flattened with the help of traditional wooden roller "belan", used in making chapattis, to a thickness of 5.0 mm. Square pieces of size 45 mm X 45 mm were then taken out of the flattened dough with the help of a steel lid. These moulds of biscuits were then kept in a tray and placed in a thermally controlled oven at a temperature of 140^{0}C for 30 minutes. The process flow chart for preparation of biscuits is given in Fig. A. The baked biscuits were allowed for nutritional and sensory evaluation.

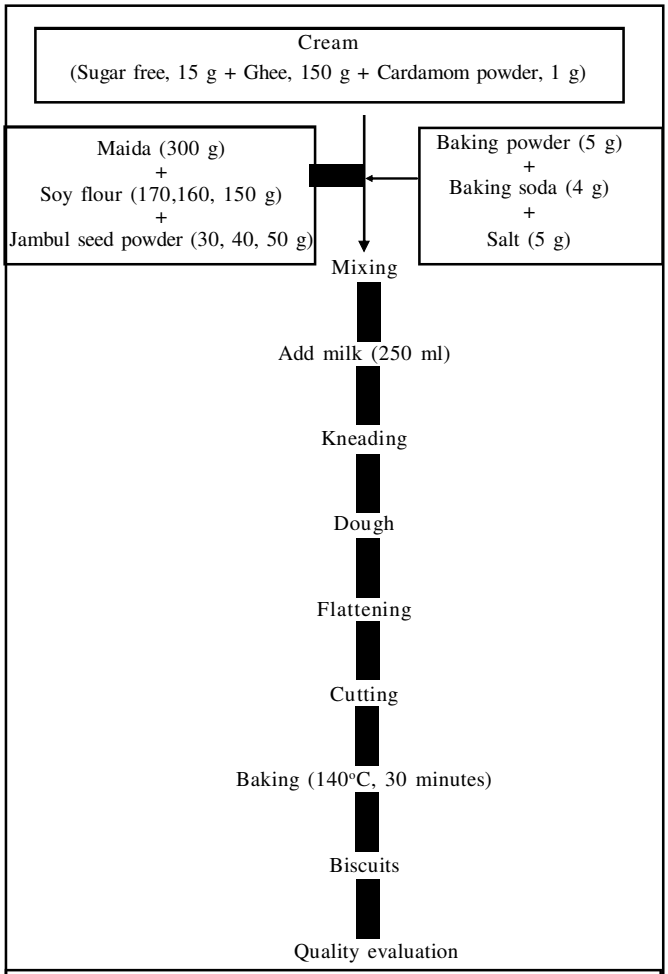

Fig. A : Process flow chart for preparation of soy-jambul seed powder fortified biscuits

Nutritional quality evaluation:

Nutritional qualities such as protein, fat, minerals, carbohydrates, reducing sugar were calculated for biscuits of compositions A_1, A_2 and A_3 by proximate analysis as described by Sawhney and Singh (2002). Moisture content was determined by oven drying 1.4 g of ground biscuit for 4 hr at 130^{0}C (Czuchajowska, 1989).

Sensory evaluation of products:

Prepared biscuits were subjected to product oriented testing using a panel of 15 judges. They were all requested to identify differences among similar food products or to measure the colour, intensity of flavour (odor and taste) texture or appearance characteristics. The products were rated on a nine-point hedonic scale. Nine points were awarded as like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2, dislike extremely-1.The quality evaluation data were statistically analysed by using the analysis of variance.

The statistical analysis was performed on the basis of grade score of biscuits. In analysis of variance, obtained values of sum of square, degree of freedom, mean square and F-ratio were evaluated.

Storage stability:

The sample was stored in three different air tight packing materials such as plastic pouch, plastic container and steel box. The biscuits were withdrawn at an interval of 15 days over a period of 60 days and analyzed for colour, water activity, fat and extractable fat acidity.

EXPERIMENTAL FINDINGS AND ANALYSIS

The findings of the study have been discussed in detail as under:

Physical properties of biscuits:

The biscuits were prepared by making different proportional of soy flour and jambul seed powder. The maida, soy flour and jambul seed powder were taken 60 per cent, 34 per cent and 6 per cent in one sample and it was taken as A_1, similarly 60 per cent maida, 32 per cent soy flour and 8 per cent jambul seed powder was in sample A_2 and A_3 was prepared by taking 60 per cent maida, 30 per cent soy flour and 10 per cent jambul seed powder.

The average value of the length, width, thickness, mass, volume and spread ratio before and after baking are presented in Table 1. The average length and thickness of unbaked biscuits was maintained 4.50 and 0.7 cm, respectively. The length of biscuits after baking was increased to 4.60 cm showing 2.22 per cent change. The thickness of biscuits was also increased after baking and was found in the range of 0.81 to 0.83 cm showing 15.7 to 18.6 per cent increment. The width of unbaked biscuit was same 4.5 but after baking it was increased in the range of 4.58 to 4.66 cm showing 1.77 to 3.55 per cent increment.

The mass of individual biscuits before baking was measured and found to be 12.13, 12.59 and 12.78 g for A_1, A_2 and A_3 composition, respectively which was reduced to 9.26, 10.17 and 10.30 g, respectively showing reduction in mass in the range of 19.22 to 23.66 per cent. The volume of individual biscuits before baking was 14.20 cm^3 which increased to 16.97 to 17.93 cm3 sharing 19.50 to 26.27 per cent increment.

The spread ratio of biscuits before and after baking was also determined and spread ratio before baking were found to be in the range of 6.40 to 6.42 which reduced to 5.52 to 5.71 for various proportion of soy flour and jambul seed powder are presented in Table 1.It can be seen from Table 1 that as the soy flour per cent in composition decreased from 34 to 32 per cent and jambul seed powder increased from 6 to 8 per cent in the biscuits, the spread ratio decreased from (-) 12.30 to (-) 14.01per cent, however, further increase in the jambul seed powder to 10 per cent, the spread ratio increased to (-) 10.92 per cent. The results found in the study are also in confirmation with the studies conducted by Singh *et al.* (1996).

Proximate composition:

The data for chemical analysis of the biscuits made from different blends from soy flour are shown in Table 2. The moisture content of control biscuits and biscuits prepared from different blends was found to be 3.13, 3.38, 3.31 and 3.20 per cent for control, A_1, A_2 and A_3 samples, respectively. It can be seen that as the jambul seed powder content increased in the samples, the moisture content values decreased. Similar type of results have also been found and reported by Brewer *et al.* (1992). It may be due to higher water holding capacity of the soy flour due to which samples containing larger percentage of soy flour.

The total ashes of composition A_3 biscuits were higher

Table 1 : Physical properties of biscuits before and after baking

Biscuit samples	A_1 (60% maida + 34% soy flour + 6% jambul seed powder)			A_2 (60% maida + 32% soy flour + 8% jambul seed powder)			A_3 (60% maida + 30% soy flour + 10% jambul seed powder)		
	Before baking	After baking	Change (%)	Before baking	After baking	Change (%)	Before baking	After baking	Change (%)
Length (cm)	4.50	4.60	(+)2.22	4.50	4.60	(+)2.22	4.50	4.60	(+)2.22
Width (cm)	4.50	4.66	(+)3.55	4.50	4.63	(+)2.89	4.50	4.58	(+)1.77
Thickness (cm)	0.70	0.82	(+)16.70	0.70	0.83	(+)18.60	0.70	0.81	(+)15.71
Mass (g)	12.13	9.26	(-)23.66	12.59	10.17	(-)19.22	12.78	10.30	(-)19.40
Volume (cm^3)	14.20	17.82	(+)25.49	14.20	17.93	(+)26.27	14.20	16.97	(+)19.50
Spread ratio, L/T	6.42	5.63	(-)12.30	6.42	5.52	(-)14.01	6.40	5.71	(-)10.92

than those of composition A_1 and A_2 biscuits. Correspondingly higher level of minerals in soy beans and jambul seed powder may be responsible for these increased values. Similar results have been reported by Singh *et al*. (2000)

Biscuit composition A_2 were found to have a higher protein value because of the high initial protein of the soy flour and jambul seed powder. The protein content was observed highest with progressive highest proportion of soybean flour in the biscuits, indicating that supplementation of jambul seed powder with soy flour would greatly improve the protein nutritional quality of biscuit. Similar results have been reported for the enrichment of protein may be achieved through incorporation of protein-rich soy flours by Gandhi *et al*. (2001), Patel and Rao (1996), Sharma and Chauhan (2002) and Singh *et al.* (1996).

The biscuits made from 60 per cent maida + 40 per cent soy flour had highest value of carbohydrates because of high per cent of carbohydrates in the soy flour. Here, the fat content of the control biscuits was 35.20 per cent. Acidity of extracted fat was about 0.4 per cent for all samples, indicating no danger of rancidity in the biscuits. Similar type of results have also been found and reported by Manly, (1996).The pH values of all the biscuit samples above 7 and only jambul seed powder showed below 7. The calorific value of control biscuit (60% maida + 40% soy flour) was higher than other biscuits because of the higher amount of oil in control biscuit.

The sugar free reduced the total sugar level with a simultaneous increase of reducing sugar level. The biscuits supplemented with 6 per cent, 8 per cent and 10 per cent of jambul seed powder showed a non-significant decrease in total and reducing sugar contents as compared to control biscuits. Among the supplemented biscuits, biscuits with jambul seed powder exhibited minimum values of total and reducing sugars namely vary between 12.8-12.34 per cent and 3.52 – 3.96 per cent for all the three combinations, respectively. Biscuits made from blends of 30 per cent Maida + 10 per cent jambul seed powder exhibited maximum contents of total and reducing sugars. Ascorbic acid was not found in all the combinations of biscuits. The water activity values below 0.4 indicated that the products were below the levels at which microbial growth could takes place. At 0.3 – 0.4, a relatively smaller enzyme activity was there and the lipid oxidation rate also reached its minima in this range of water activity.

Sensory evaluation:

The average scores of soy-jambul seed powder fortified biscuits given by the consumer panel for each characteristic are given in Table 3. It was observed that the maximum scores of colour (8.13), texture (8.13), flavour (7.78), taste (8.26) appearance (8.00), and overall acceptability (8.26) were obtained for the composition of

Table 2 : Nutritional analysis of different biscuit compositions

	Biscuit Composition				Jambul seed powder
	A_1	A_2	A_3	Control	
Moisture (%)	3.38	3.31	3.20	3.13	3.08
Total ash (%)	1.13	1.30	1.57	1.90	0.97
Soluble protein (%)	0.5	0.7	0.8	0.6	0.03
Crude protein (%)	16.67	16.43	16.10	18	3.67
Carbohydrates (%)	67.2	66.9	66.4	68.0	10.23
Crude fat (%)	24.28	26.22	26.76	35.20	3.74
Free fatty acids (%)	0.4	0.4	0.4	0.4	0.1
Calorific value (Kcal/100g)	554.02	569.30	570.84	660.80	89.26
Reducing sugar (%)	3.1	3.5	3.6	5.07	0.57
Total sugar (%)	12.8	12.52	12.34	13.3	2.3
pH (%)	7.37	7.41	7.57	7.8	4.7
Per cent titrable acidity (%)	NS	NS	NS	NS	6.8
Ascorbic acid (%)	NS	NS	NS	NS	0.1
Water activity (%)	0.319	0.325	0.357	0.384	0.398

Table 3 : Average score of biscuits by consumer panel

Sample No.	Colour	Texture	Flavour	Taste	Appearance	Overall acceptability
A_1	7.46	7.73	7.66	7.28	7.6	7.66
A_2	8.13	8.13	7.78	8.26	8.00	8.26
A_3	6.40	6.06	5.86	6.13	6.26	6.2

Table 4 : Analysis of variance for sensory attributes of biscuits

Attributes	Source	Sum-of-square	Degree of freedom	Mean-square	F-ratio
Colour	Treatments	22.933	2.00	11.4665	6.55*
	Judges	27.66	14.00	1.97	
	Error	49.067	28.00	1.75	-
Texture	Treatments	36.05	2.00	18.025	12.17*
	Judges	22.31	14.00	1.593	
	Error	41.6	28.00	1.48	-
Flavour	Treatments	34.98	2.00	17.49	9.5*
	Judges	29.78	14.00	2.127	
	Error	51.52	28.00	1.84	-
Taste	Treatments	37.33	2.00	18.86	11.22*
	Judges	32.8	14.00	2.34	
	Error	47.07	28.00	1.68	-
Appearance	Treatments	24.71	2.00	12.355	9.73*
	Judges	27.25	14.00	1.94	
	Error	36.54	28.00	1.305	-
Overall acceptability	Treatments	33.91	2.00	16.955	9.8*
	Judges	31.91	14.00	2.27	
	Error	48.67	28.00	1.73	-

* indicates significance of value at p=0.05

A_2 and the scores were also plotted in Fig. 1. It can be clearly seen from Table 1 that the scores for colour, texture, taste and overall acceptability of biscuits are more significant. The scores for colour and texture seem approximately same for all three combinations. Unequal proportions of soy flour and jambul seed powder greatly affected the colour, texture, taste and overall acceptability of biscuits.The combination A_2 containing 32 per cent soy flour and 8 per cent jambul seed powder was most accepted by the judges of consumer panel. The analyses of variance of biscuits performed for each organoleptic quality factor are presented in Table 4.

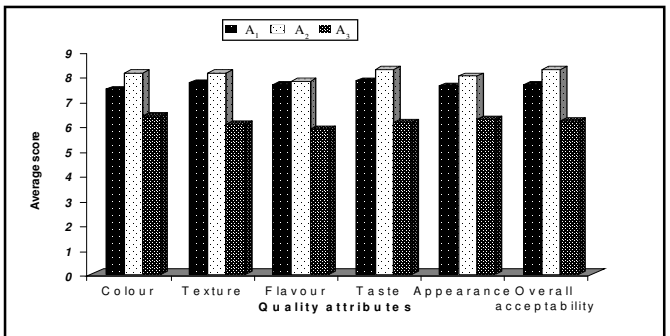

Fig. 1 : Score of various attributs of sensory evaluation

Statistical analysis of sensory evaluation obtained by various judges:

It can be concluded that biscuits composition A_2 (60% maida + 32 % soy flour+ 8 % jambul seed powder) gave the highest biscuit colour, texture, flavour, appearance and overall acceptability and was found significantly superior to that composition A_1 (60% maida + 34% soy flour+6 % jambul seed powder) and A_3 (60% maida + 30% soy flour+ 10%jambul seed powder) whereas its superiority over that composition A_1 (60% maida + 34% soy flour+6 % jambul seed powder) only was not significant.

Conclusion:

During baking the length and thickness of biscuits increased by 2.22 per cent and 17.00 per cent, respectively. However, the spread ratio and mass of biscuits decreased by 12.41 per cent and 20.76 per cent, respectively during baking. The amount of protein, carbohydrates and total sugar were maximum for the soy rich biscuits of composition A_1, whereas, soluble protein, fat, ash and reducing sugar were rich in sample A_3. The moisture content of baked biscuits ranged between 0.032 to 0.038 g H_2O/g DM. There was not difference in free fatty acids values among the all the compositions. The calorific value of control biscuit was higher than other biscuits. However, the calorific value of all the three compositions of biscuits was slightly different from each other because of less fat contained in it. The average water activity values of all the products ranged from 0.319 to 0.398. Hence, in view of their nutritional significance as well as convenience, the biscuits can be suitable for feeding trials in

supplementary feeding programmes and also have commercial viability.

The quality evaluation data were statistically analysed by using the analysis of variance for both the products and it was significant ($f < 0.01$) for colour, texture, taste and overall acceptability of biscuit. Supplemented biscuits can be stored safely in plastic pouch at room temperature for 30 days without any adverse changes.

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