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SENSORY AND NUTRITIONAL EVALUATION OF SORGHUM FLATBREADS SUPPLEMENTED WITH LEGUME FLOURS

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ABSTRACT

Sorghum is one of the major millet popularly consumed in the form of unleavened flatbread. It is gluten free and apart from noteworthy macronutrient content, offers as a very good source of vitamins, minerals and phytochemicals. Legumes such as whole bengal gram and soybean are used widely for supplementation as value addition to foods because of their high nutritional content and mutual supplementation in terms of protein. The present study was carried out with the objectives to supplement sorghum flatbreads with whole bengal gram and soybean flour; to evaluate their acceptability through sensory analysis and to study nutritional composition of selected variations. Control flatbread (CJ) was prepared with sorghum flour. Variations of flatbreads were formulated with sorghum flour by supplementing whole bengal gram flour and soybean flour each in the ratio of 70:30 ratio 50:50 and subjected to sensory evaluation. The data obtained was statistically analyzed using ANOVA and t test. The results revealed that sorghum flatbreads supplemented with whole bengal gram flour and soybean flour each in the ratio of 70:30 were well acceptable. Nutritional analysis of control and experimental variations of flatbreads which were found acceptable was carried out using standard procedures and the results showed increase in energy value, protein, fat and fiber and reduction in carbohydrate content.

Keywords: Unleavened flatbread, Sorghum, Whole bengal gram, Soybean

INTRODUCTION

The major cereals and millets consumed in India are wheat, rice, jowar (sorghum), bajra (pearl millet) and ragi (finger millet). Consumption of millets is higher in the states of Gujarat (pearl millet, maize), Karnataka (finger millet), Maharashtra (sorghum) but less in the states where rice is the most consumed cereal **(National Nutrition Monitoring Bureau, 2006).**

Singh (2016) reported that millets contain 60-70% carbohydrates, 7-11% proteins,

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1.5-5% fat, and 2-7% crude fiber and are also rich in vitamins and minerals. They are excellent source of vitamin B, magnesium, and antioxidants. According to **Rao et al. (2017),** sorghum and most of the millets contains about 10% protein, 3.5% lipids and are very good sources of micronutrients such as vitamins and minerals and phytochemicals with nutraceutical properties.

The term legume refers to the plants whose fruit is enclosed in a pod. Pulses are part of the legume family, but the term pulse refers only to the dried seed except peas and soybean. **Rao (2002)** has reported that legumes and pulses are the main source of protein in the primarily vegetarian Indian diet and are also good sources of vitamins, minerals, omega 3 fatty acids and dietary fiber or non-starch polysaccharides (NSP).

Among the legumes and pulses, bengal gram and soybean are used widely for value addition to foods. Addition of legume flours to foodstuffs can increase their nutritional value but may have effects on theirsensory and textural properties.

Hirdyani (2014) stated that chickpea also called as garbanzo bean or bengal gram is a good source of carbohydrate and protein and the protein quality is considered to be better than other pulses with significant amounts of all the essential amino acids, lipids are present in low amounts but it is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid.

Soybean is an excellent source of iron, calcium and B vitamins and also rich in high quality proteins. (**Raghuvanshi and Bisht, 2010)**

Kanchana et al. (2015) reviewed studies related to soybean and reported that soy contains significant amounts of all the essential amino acids for humans. Dry soybean contain 36% protein, 19% oil, 35% carbohydrate (17% of which dietary fiber), 5% minerals and several other components including vitamins, isoflavones and saponins. Whole soybeans are a good source of

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calcium, iron, zinc, phosphorus, magnesium, thiamine, riboflavin, niacin and folic acid.

Eating a variety of whole grain foods and legumes is beneficial in the prevention and management of diabetes **(Venn and Mann, 2004)**. Cereals and wholegrain foods can reduce the risk of developing certain diseases including coronary heart disease, colon cancer, diabetes and diverticular disease **(Sarwar et al., 2013)**.

Sorghum flatbread known as jowar roti or jowar bhakri is very popular in villages and small towns and is one of the traditional recipes of India. It is round, flat, unleavened bread often used in the cuisines of western and central India. According to **Unhale et al. (2015)**, jowar flour is gluten free so it is very tough to spread the dough for bhakri making without breaking the shape and no leavening agents or oil/ghee are added. Sorghum flatbread has its own advantages from dietary point of view hence the study was taken up with the with the objectives to supplement sorghum flatbreads with whole bengal gram and soybean flour; to evaluate their acceptability through sensory analysis and to study nutritional composition of selected variations.

MATERIALS AND METHODS

Sorghum flatbreads prepared using only sorghum flour and water were treated as control recipe. Experimental variations were prepared by supplementing sorghum flour with whole bengal gram (Red variety) flour and soybean flour. All the raw ingredients were procured from local market, cleaned and milled into flours. Soybean was soaked overnight in water, autoclaved for 30 min and dried for detoxification prior to milling into flour.

Formulation of recipes

Recipes were formulated and given codes for ease in evaluation. Control flatbread (CJ) was prepared with sorghum flour. Variations of flat breads were formulated with sorghum flour by supplementing whole bengal gram flour and soybean flour in the ratio of 70:30 and coded as EJ1 and

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EJ2 respectively, and in the ratio 50:50 which were coded as EJ3 and EJ4 respectively.

Sensory evaluation

Sensory analysis was carried out for each control and experimental variation by using numerical scoring test wherein judges evaluated samples on a specific scale for a particular sensory characteristic indicating rating of the sample. The individual scores obtained for each sensory characteristic were averaged to get mean score.

Nutritional evaluation

For nutritional evaluation, cooked samples of control and experimental variations of flatbreads which were selected on the basis of sensory evaluation were estimated for moisture, ash, protein, fat, carbohydrates and fiber. Standard procedures for estimation were followed as given in Manual of Laboratory Techniques **(Raghuramulu et al., 1983)**.

Statistical analysis

Data obtained from sensory evaluation was analyzed using statistical tests Analysis of variance (ANOVA) and t test of significance. Significance was accepted at $p \leq 0.05$. For nutritional evaluation, samples were analyzed in triplicate and the results were obtained by calculating mean and standard deviation.

RESULTS AND DISCUSSION

The results of sensory evaluation with statistical interpretaion are presented in table 1.

Table 1 highlights the mean scores of control and experimental sorghum flatbreads obtained by sensory evaluation. The control sorghum flatbread (CJ) obtained the highest mean score of 10 for the characteristics appearance, shape, taste and acceptability followed by 9.8 for texture and flavor. Among the sensory characteristics of the variations having ratio of supplementation 70:30, taste of EJ1 obtained the highest score 9.8 whereas flavor of EJ2 obtained the lowest score 8.8. Experimental variations EJ3 and EJ4 having supplementation 50:50 denoted that increasing the

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amount of pulse flours in the recipes, minimizes the scores for the sensory characteristics. Except for appearance and shape, the variations EJ3 and EJ4 obtained lower score for texture, taste, flavor and acceptability when compared to EJ1 and EJ2.

Results of one way ANOVA showed significant difference ($p = 0.0002$) in the overall acceptability of experimental samples as compared to the control which indicated a significant difference between the means of control and experimental variations of sorghum flatbreads.

The results of t test applied between control and experimental samples are presented in table 2.

The result showed insignificant difference between control and variation EJ1 and EJ2 and hence well accepted. However, t value was found significant which showed difference between control and experimental variation EJ3 and EJ4. It can be said that these variations were not accepted. Based on these results, variation EJ1 and EJ2 along with control were selected for nutritional evaluation (Table 2).

Samples were analyzed for moisture, ash, protein, fat, total fibre and energy by standard analytical methods. Proximate composition of cooked samples of control and selected experimental variations of sorghum flatbreads were estimated in triplicates using standard laboratory procedures. The results are shown in table 3.

Observations from table 3 values reflect that supplementation of sorghum flatbreads with legume flours increased its energy value, protein, fat and fiber. Supplementation by soybean almost doubled the protein and fiber content than control sorghum flatbread. It is noteworthy that reduction in total carbohydrate content was observed in experimental variations than control and more evident in variation supplemented with soybean. The total ash content was also increased in experimental variations pointing towards increase in mineral content. The results supported the fact that

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supplementation of pulses to cereals or millets makes them nutritionally superior.

CONCLUSION

Results showed that supplementation of legume flour viz whole bengal gram flour and soybean flour in the ratio 70:30 was well acceptable. Increase in energy value, protein, fat and fiber and reduction in carbohydrate content make supplemented sorghum flatbreads more advantageous for persons suffering from lifestyle diseases.

Table 1:Mean scores for sensory attributes of sorghum flatbreads

Sensory attributes	**Sorghum flatbreads**					**ANOVA**	
	CJ	**EJ1**	**EJ2**	**EJ3**	**EJ4**	**F**	**P**
Appearance	10	10	10	8.8	9.4	8.6047	0.0002
Shape	10	10	10	9.86	9.86		
Texture	9.86	9.86	10	7.86	8.93		
Taste	10	10	9.8	9.8	7.6		
Flavor	10	9.8	9.8	8.86	7.53		
Overall acceptability	10	10	10	8.6	7.86		
Mean	9.977	9.943	9.933	8.963	8.530		
SD	0.057	0.090	0.103	0.760	1.000		

Table 2: Comparison between control and experimental sorghum flatbreads

Variations	**'t' value**	**Inference**
CJ Vs EJ1	0.767	Insignificant
CJ Vs EJ2	0.899	Insignificant
CJ Vs EJ3	3.255	Significant
CJ Vs EJ4	3.538	Significant

Table value for t: 0.05 = 2.228, 0.01 = 3.169

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Table 3: Proximate composition of selected sorghum flatbreads

Parameters	CJ (Mean ± SD)	EJ1 (Mean ± SD)	EJ2 (Mean ± SD)
Moisture (g)	43.46 ± 0.05	42.04 ± 0.04	44.25 ± 0.06
Total Ash (g)	0.85 ± 0.03	1.04 ± 0.04	1.16 ± 0.04
Energy (kcal)	225.11 ± 0.10	233.35 ± 0.21	232.75 ± 0.69
Protein (g)	5.31 ± 0.04	7.33 ± 0.04	10.06 ± 0.06
CHO (g)	49.92 ± 0.13	48.46 ± 0.06	41.64 ± 0.04
Fat (g)	0.47 ± 0.05	1.13 ± 0.04	2.89 ± 0.07
Fiber (g)	1.02 ± 0.02	1.75 ± 0.03	2.08 ± 0.05

(Values per 100 g)

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