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Studies on incorporation of barley and finger millet flour in the preparation of cake

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The present investigation was undertaken to develop nutritious and fibre rich cake by substituting a part of wheat flour (maida) with barley and finger millet flours. Sponge cake was prepared from maida alone and by replacing maida with varying levels (5 to 20%) of barley and finger millet (FM) flours. Cake prepared from maida recorded the highest overall acceptability score but it did not differ significantly with those of cake samples prepared by incorporation of barley and FM flours upto 10%. Hence, replacement of maida with 10% barley and 10% FM flours was selected for further studies so as to optimize the other ingredients in making cake. Cake samples were prepared from maida (80g), barley and FM flours (10g each) with varying levels of fat (50, 45, 40g), sugar (100, 95, 90g) and baking powder (3, 3.5, 4g). Organoleptic evaluation of samples showed that optimum level of fat, sugar and baking powder were 45, 95, 3.5g, respectively. Cake prepared from maida (80g), barley and FM flours (10g each), fat (45g), sugar (95g) and baking powder (3.5g) contained protein, crude fat, total ash, carbohydrate, calcium and iron 9.81, 17.23, 2.97, 54.97, 66.81 mg/100g and 2.81 mg/100g, respectively.

Key Words : Cake, Barley flour, Finger millet flour, Calcium

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INTRODUCTION

The bakery sector in India is one of the largest segments of the food processing industries and important sources of nutrients *viz.*, energy, proteins, iron, calcium and several vitamins. Cake is a complex of fat and water emulsion system containing flour, fat, sugar, egg and baking powder. Refined wheat flour is basic ingredient but protein quality is inferior to other cereals. This is primarily because of low lysine, methionine and threonine content of wheat proteins. Bakery products are mostly prepared from refined wheat flour with 60-75% extraction rate, which has still lower nutritive value (Chavan and Kadam, 1993). However, such products can easily be enriched and fortified at lower cost with proteins, fibre, various vitamins and minerals to meet the specific need of the target groups and vulnerable sections of the population who are undernourished and malnourished (Sharma *et al*., 1998).

The use of grains is well established in various food sectors, particularly bakery and breakfast cereals. They make a positive contribution to the taste and texture of the products and consumers readily accept the health benefits. Barley is a versatile cereal grain with a rich nutlike flavor and an appealing chewy, pasta-like consistency (Zohary and Hopf, 1988). It has good fibre content, particularly β-glucan, which has been shown to reduce blood cholesterol and glucose. Use of barley flour and bran in the formulation of variety of food products like baked goods, instant foods, pasta and extruded snacks may broaden its application (Bhatty, 1996 and Newman, 2005). Partial substitution of wheat flour by barley flour can provide sufficient soluble dietary fibre to make a significant improvement in human health indicators.

Finger millet (*Eleusine coracana)* is rich in calcium, iron and protein. It is non-acid forming, digested easily by infancy through old age, and its nutrients are absorbed efficiently,

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delivering superior nutrition. Finger millet is especially valuable as it contains the amino acid methionine, which is lacking in the diets of hundreds of the poor who live on starchy staples such as cassava, plantain, polished rice, or maize meal. Finger millet can be ground and cooked into cakes, puddings or porridge. The grain is made into a fermented drink (beer) in many parts of Africa (Raiely, 2000).

The incorporation of finger millet flour and barley flour in cake preparation has been planned with the following objectives:

- To standardize the level of finger millet and barley flour for the preparation of cake.
- To improve the quality of finger millet-barley-wheat mix cake by varying the level of ingredients (sugar, fat and baking powder) on the basis of physical and sensory characteristics of cake.
- To determine the physico-chemical characteristics of the optimized cake.

METHODOLOGY

The sponge cake method was used to prepare cake as per the under mentioned recipe (U.S. Wheat Associates, 1983). The following ingredients per 100 g of flour were used.

Ingredients	Quantity
Wheat flour (*maida*)	100 g
Sugar (powdered)	100 g
Shortening	50 g
Baking powder	3 g
Egg (whole)	50 g
Flavor	1 g
Common salt	1.25 g
Milk	25 ml

The cake prepared by different blends of refined wheat, barley and finger millet flours was evaluated for physical [weight, volume, specific volume, volume index, symmetric index and uniformity index (AACC, 1969)] and sensory characteristics on five point hedonic scale. The cake, which significantly differed from the control preparation in overall acceptability, was selected for modification of recipe / formulation and further evaluated for physical and sensory characteristics. Finally the optimized product was subjected to the chemical analysis **[**moisture, crude protein, fat, total ash, carbohydrate by difference, crude fibre (AOAC, 1984), calcium (AACC, 1976) and iron (Ranganna, 1986)]. The statistical analysis of various data was done using ANOVA technique as described by Snedecor and Cochran (1968) Fig . 1.

OBSERVATIONS AND ASSESSMENT

Physical and sensory characteristics of cakes prepared from blends of wheat flour, barley flour, finger millet flour, fat, sugar and baking powder are presented in Table 1 and 2,

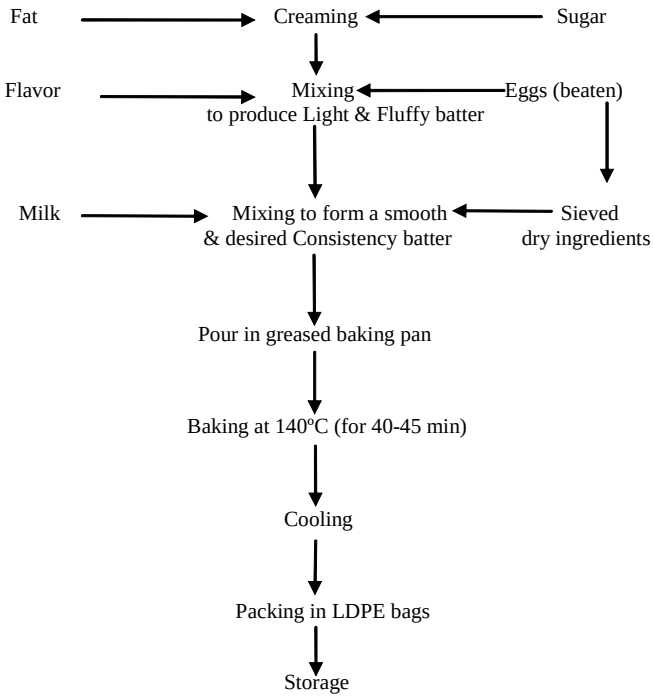

Fig. 1. Flow diagram for preparation of cake

respectively. Analysis of variance showed no significant difference in physical parameters among different cakes samples but sensory parameters showed significant result and sample containing 10 per cent barley and 10 per cent finger millet was selected as optimum blend for further studies. Aderiye *et al*. (1991) investigated the use of biodegraded cashew pomace into the cake flour and found that composite cake made from a 10:90 combination of cashew flour/wheat flour, respectively was the most accepted. Sponge cakes prepared by Gupta *et al*. (2009) incorporating (10, 20, 30, and 40 %) barley flour into wheat flours and record that the incorporation of 20 per cent barley flour into wheat flour was found to be optimum, containing rich in beta-glucan, iron, calcium, zinc and highest sensory scores.

To optimize the other ingredients in making cake with varying levels of fat, sugar and baking powder were evaluated for physical and organoleptic qualities of samples. It was observed that with decrease in level of fat, weight, volume and volume index of cake decreased gradually whereas specific volume and uniformity index showed no significant difference. Fat entraps air during the creaming process or leavening of butter and coats the protein and starch particles, disrupting the continuity of the gluten and starch structure to tenderize the cake crumb (Seitz and Walker, 1993). Sensory panelists also accept the sample containing 45 g of sugar.

Decrease in sugar levels in formulation, volume, weight and volume index of cake showed gradual decrease while their symmetry and uniformity index showed non significant result.

Cake volume increased with sugar concentration due to the bulking effect. Sensory scores of appearance, aroma, color, taste, texture and overall acceptability showed maximum score for the sample containing 95 g sugar.

The effect of different levels of baking powder on physical and sensory characteristics of cakes containing 10 per cent barley flour, 10 per cent finger millet flour, 45 g fat and 95 g sugar show the increased level of baking powder in formulation, volume, weight, specific volume and volume index of cakes gradually increased. On the basis of sensory scores, 3.5 g level of baking powder was considered as optimum. Mostafa and Sarhan (1986) reported that cake height and volume were increased by increasing the content of baking powder. However, cake taste, softness or grain uniformity were unaffected by this increase.

The optimized product was evaluated for chemical analysis (Table 3). Moisture content of optimized cake was less as compared to control cake. Abdal-Baki *et al.* (1980) found that the addition of 15 per cent peanut, soybean or potato flour in cake mix was found to increase water absorption, development time and suitability without any change in cake volume. The crude protein content of cake was 9.81%. The expeller pressed partially defatted peanut cake can be used to the extent of 10 per cent to prepare acceptable cup cakes with increased protein content reported by Chavan *et al.* (1991). Jisha and Padmaja (2008) reported that the crude protein content of the muffins from WPC fortified composite flour (wheat and cassava flour) ranged from 7.96 to 14.36 per cent. In present investigation the total ash showed higher value than control cake due to incorporation of finger millet flour which contained the maximum ash content (1.96 per cent) as reported by Rao (1994). Crude fibre content was also higher in optimized cake due to incorporation of barley flour having maximum amount of crude fibre (3.31 per cent) recorded by Gopalan *et al.* (1999) and Penkov and Gerzilov (2004). The cake prepared from cassava and wheat flour showed the total dietary fibre could be enhanced up to extent of 1.54 to 3.10 per cent (Jisha and Padmaja, 2008). Calcium and iron content was also higher in optimized cake due to incorporation of finger millet flour, contained maximum calcium lies in the range (259 to 520 mg/100 g) reported by Pore and Magar (1977) and barley flour which contained 1.05 mg/100 g iron recorded by Gopalan *et al.* (1999).

Conclusion :

It can be concluded that acceptable quality cakes can be prepared from blends of wheat, barley and finger millet flours in ratio of 80:10:10 with slight modification of recipe which

Table 1. Physical characteristics of cakes prepared from varying levels of flours, fat, sugar and baking powder

	Product formulation, % on flour basis					
W+B+F+FT+S+BP*	Volume (cc)	Weight (g)	Specific volume (cc/g)	Volume index	Symmetry index	Uniformity index
Effect of varying proportion of different levels of flours						
100:0:0:50:100:3	430.0	150.93	2.62	9.70	0.83	0.33
90:5:5:50:100:3	406.66	152.60	2.57	9.96	1.03	0.30
80:10:10:50:100:3	400.0	155.93	2.52	10.06	0.43	0.10
70:15:15:50:100:3	400.0	159.10	2.53	10.10	0.63	0.20
60:20:20:50:100:3	370	159.60	2.27	9.76	0.50	0.23
C.D. (P=0.05)	NS	5.13	NS	NS	NS	NS
Effect of different levels of fat						
80:10:10:50:100:3	428.33	155.89	2.74	10.08	0.39	0.13
80:10:10:45:100:3	416.66	152.20	2.73	9.90	0.26	0.10
80:10:10:40:100:3	410.0	147.66	2.77	9.56	0.43	0.13
C.D. (P=0.05)	4.70	1.04	NS	0.26	0.11	NS
Effect of different levels of sugar						
80:10:10:45:100:3	385.0	157.70	2.44	9.63	0.16	0.10
80:10:10:45:95:3	366.66	144.53	2.53	9.50	0.46	0.66
80:10:10:45:90:3	355.0	138.96	2.55	9.09	0.33	0.16
C.D. (P=0.05)	10.51	1.91	NS	0.18	NS	NS
Effect of different levels of baking powder						
80:10:10:45:95:3	346.66	149.46	2.31	9.76	0.23	0.13
80:10:10:45:95:3.5	363.33	152.78	2.37	10.60	0.30	0.13
80:10:10:45:95:4	371.66	152.96	2.42	10.76	0.30	0
C.D. (P=0.05)	12.8	NS	0.77	0.29	NS	NS

NS = Non-significant

Table 2. Sensory score of cakes prepared from varying levels of flours, fat, sugar and baking powder

Product formulation, % on flour basis						
W+B+F+FT+S+BP	Appearance	Aroma	Color	Taste	Texture	Overall acceptability
Effect of varying proportion of different levels of flours						
100:0:0:50:100:3	3.55	3.25	3.60	3.35	4.15	4.20
90:5:5:50:100:3	3.65	3.40	3.52	3.85	4.15	3.97
80:10:10:50:100:3	3.77	3.60	3.82	3.87	4.25	4.16
70:15:15:50:100:3	3.15	3.40	2.90	3.40	3.85	3.57
60:20:20:50:100:3	3.07	3.45	3.07	3.35	2.92	3.25
C.D. (P=0.05)	0.48	NS	0.46	0.42	0.69	0.55
Effect of different levels of fat						
80:10:10:50:100:3	3.30	3.54	3.07	3.40	3.53	3.37
80:10:10:45:100:3	4	3.90	3.80	4.30	4	4
80:10:10:40:100:3	3.80	4	3.20	3.50	3.40	3.58
C.D. (P=0.05)	NS	NS	NS	0.50	NS	0.46
Effect of different levels of sugar						
80:10:10:45:100:3	4.0	3.75	3.56	3.81	3.75	3.77
80:10:10:45:95:3	3.75	4.0	4.0	4.0	3.81	3.95
80:10:10:45:90:3	3.43	3.31	3.0	3.56	3.37	3.25
C.D. (P=0.05)	NS	NS	0.49	NS	NS	0.37
Effect of different levels of baking powder						
80:10:10:45:95:3	2.91	3.16	3.16	3.08	2.83	3.03
80:10:10:45:95:3.5	3.91	3.41	3.33	3.66	4.25	3.71
80:10:10:45:95:4	3.08	3.16	3.25	3.41	3.75	3.33
C.D. (P=0.05)	0.68	NS	NS	NS	0.55	0.24

*W, B, F, FT, S, BP stand for wheat flour, barley flour, finger millet flour, fat, sugar and baking powder, respectively.
All the physical values are average of three observations
All the sensory values are average of ten panelist's observation on five point hedonic scale.
NS = Non-significant

Table 3. Evaluation of chemical parameters of optimized product

Chemical parameters	Control cake	Optimized cake
Moisture (%)	20	14.92
Crude protein (%)	6.4	9.81
Crude fat (%)	17.12	17.33
Total ash (%)	1.8	2.97
Carbohydrate (%)	54.68	54.97
Calcium (mg/100g)	49.23	66.81
Iron (mg/100g)	1.27	2.81

include fat 45g, sugar 95g and baking powder 3.5g per 100g of flour and contained moisture, protein, fat, total ash and carbohydrates in cake were 14.92, 9.81, 17.23, 2.97, 54.97 per cent whereas calcium and iron were 66.81 and 2.81 mg/100 g, respectively which provided various health benefits.

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