Advance Journal of Food Science and Technology 2(1): 67-71, 2010
ISSN: 2042-4876

Submitted Date: November 21, 2009 Accepted Date: December 02, 2009 Published Date: January 10, 2010

Effect of Supplementation of Malted Ragi Flour on the Nutritional and Sensorial Quality Characteristics of Cake

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Abstract: Cake is one of the most popular bakery product. Generally it is prepared from refined wheat flour and is a rich source of protein, fat and carbohydrates but limiting in minerals and dietary fibres. Malted ragi flour is rich in minerals like iron, calcium, phosphorus, fibre and vitamin contents. In the present study the mineral and fibre contents of cake samples were improved by the use of various blends of wheat flour and malted ragi flour (80:20; 60:40; 50:50; 40:60 and 30:70) with other ingredients. The results showed that cake samples enriched with malted ragi flour were rich in mineral contents like calcium, iron, phosphorus and crude fibre as compared to the control sample. Sensory scores of cake sample prepared with 50% wheat flour and 50% malted ragi flour was same as the control. The cake prepared with 70% malted ragi flour had highest mineral and fibre content, but the sensory score was low due to the loss in sponginess and increased intensity of brown colour. These cakes may be beneficial for growing children, teenagers and pregnant and lactating women due to its high nutritive value.

Key words: Cake, *Eleusine Coracana,* Indaf-15, malted ragi flour, mineral and sensory parameters

INTRODUCTION

Finger millet (Ragi, *Eleusine Coracana*) is an important staple food in the eastern and central Africa as well as some parts of India (Majumder *et al.*, 2006). It is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is said to be highest among all the food grains. Ragi has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al.*, 2004). Thus ragi is a good source of diet for growing children, expecting women's, old age people and patients.

Ragi provides highest level of calcium, antioxidants properties, phytochemicals, which makes it easily and slowly digestible. Hence it helps to control blood glucose levels in diabetic patients very efficiently. The bulkiness of the fibres and the slower digestion rate makes us feel fuller on, fewer calories and therefore may help to prevent us from eating excess calories. Therefore, ragi is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose/sugar in the body (Kang *et al.,* 2008 and Lakshmi and Sumathi, 2002). In the germination process, both starch and protein are partially degraded, important for better digestibility and some of the flatus factors are also degraded. There is also overall improvement in the flavour profile (Nirmala *et al.,* 2000, Ram *et al.,* 1979; Rao and Belavady, 1978,).

Finger millet is usually used for preparation of flour, pudding, porridge and roti (Chaturvedi and Srivastava, 2008). With the changes in scenario of utilization of processed products and awareness of the consumers about the health benefits, finger millet has gained importance because of its functional components, such as slowly digestible starch and resistant starch (Wadikar *et al.*, 2007).

Traditionally ragi is processed either by malting or fermentation (Rao and Muralikrishna, 2001). Malting of finger millet improves its digestibility, sensory and nutritional quality as well as pronounced effect in the lowering the antinutrients. Malting characteristics of finger millet are superior to other millets and ranks next to barley malt (Malleshi and Desikachar, 1986 and Pawar and Dhanvijay, 2007). There are various benefits of malting such as vitamin-C is elaborated, phosphorus availability is increased and lysine and tryptophan are synthesized (Dulby and Tsai, 1976). The malted and fermented ragi flour are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001).

Cake is the form of food that is usually sweet and often baked. It supplies body building protein, fats and carbohydrates. Cake is normally prepared with refined wheat flour, sweetening agent (sugar), binding agent, egg, fat and vanaspati, liquid flavour and some form of leavening agent such as yeast or baking powder. In recent years finger millet has received attention and efforts are under way to provide it to consumers in convenient forms (Malleshi and Desikachar, 1986). In the present study attempts were made to improve the nutritional quality of

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cakes with respect to the mineral contents and fibre content by supplementing with malted ragi flour.

MATERIALS AND METHODS

The investigation was carried out in the year 2008-2009 at the department of Food Science and Technology, Shivaji University, Kolhapur. Ragi seeds of 'Indaf-15' cultivar were procured from a local farm of Bhudargad Taluka, Kolhapur district of Maharashtra state (India) and were taken for the study as this cultivar was reported to be suitable for malting purposes (Nirmala *et al.,* 2000).

The malting of ragi was carried out with slight modification in the procedure suggested by Nirmala and Muralikrishna, 2002. In brief the ragi seeds were washed with water for 5 times and soaked in water for 5 hr. Excess water was drained, seeds were tied in a muslin cloth and 5 kg weight was kept on it. These seeds were germinated at 27± 3ºC for 24hr and dried in shade for 2 days. The malted ragi seeds were grounded into flour by using the electric grinder. The detailed flow chart for the preparation of malted ragi flour is given in Fig. 1.

The formulations of cakes prepared from different proportions of wheat and malted ragi flour are given in Table 1. Other ingredients like hydrogenated vegetable oil (vanaspati, 75g), butter (25gm), sugar (100g), egg (100g), baking powder (1.25g) and vanilla essence (0.5ml) were added to each of these formulations of cake preparation. Cake samples were prepared by following the procedure suggested by Singh *et al.*, 2006 with slight modification, which is shown in Fig. 2.

The pH and acidity of the cake batters of different formulations were analysed by AOAC (1980). pH of the batter was determined by using a digital pH meter. The acidity was determined by titration method and expressed as percentage of lactic acid.

The wheat flour, unmalted ragi flour, malted ragi flour and ragi supplemented cakes were subjected to proximate analysis such as moisture, protein, fat, crude fibre and ash content. The total carbohydrate was calculated by difference. Also unmalted and malted ragi flour and ragi supplemented cake were subjected to estimation of iron, calcium, phosphorus and vitamin C content. The standard procedures given by Ranganna (1986) were used for all the above determinations.

The sensory evaluation of ragi supplemented cake samples were carried out by a panel of 10 semi-trained judges for different sensory attributes. A 1 to 5 structured scale was used for this evaluation (Bartolome *et al.*, 1995).

The analytical data obtained for ragi-supplemented cakes were subjected to analysis of variance (ANOVA) using complete randomized design according to Panse and Sukhatme (1989). The critical difference at $P<0.05$ was estimated and used to find significant difference if any.

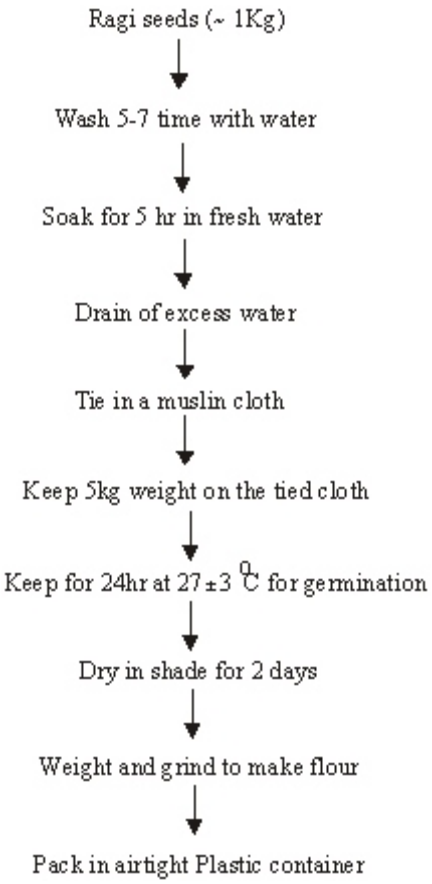

Fig. 1: Flow diagram for the preparation of malted ragi flour

Table 1: Formulation of ragi supplemented cakes

Sample Code	Wheat flour (g)	Ragi flour (g)
C(control)	100	--
C_1	80	20
C_2	60	40
C_3	50	50
C_4	40	60
C_5	30	70

RESULTS AND DISCUSSION

The proximate composition of wheat flour is given in Table 2. The data showed that wheat flour is a good source of protein and minerals. Singh (2005) reported, "The values obtained for wheat flour are in good agreement with the earlier results".

The chemical composition of unmalted and malted ragi flour is depicted in Table 3. It was noticed from the data that the malting process was useful to increase the calcium, phosphorus and vitamin C content of ragi flour. The protein and fat contents were unaffected by malting. Malting of finger millet improves digestibility and bioavailability of nutrients, improves sensory and nutritional quality (Malleshi and Desikachar, 1986). The significant increase in vitamin C content after malting is

Fig. 2: Flow diagram for the preparation of cake supplemented with malted ragi flour

Table 2: Proximate composition of wheat flour*

Parameter	Amount (%)
Moisture	12.67
Protein	10.55
Fat	0.94
Total carbohydrate	74.88
Crude fibre	0.36
Ash	0.94

*Values are average of three determinations

Table 3: Chemical composition of unmalted and malted ragi flour

Parameter	Amount*	
	Unmalted	Malted
Moisture (%)	12.67	12.67
Protein (%)	7.52	7.60
Fat (%)	1.08	1.14
Total carbohydrate (%)	76.51	76.18
Crude fibre (%)	3.62	3.80
Vit. C (mg/100g)	2.12	5.89
Calcium(mg/100g)	359.4	429.8
Iron (mg/100g)	13.7	12.4
Phosphorus (mg/100g)	284.3	305.5
Ash (%)	1.76	1.93

*Values are average of three determinations

Table 4: Titratable acidity and pH of ragi supplemented cake batter*

Sample code	pH	Titratable acidity(%)
C	7.85	0.032
C_1	7.56	0.036
C_2	7.49	0.039
C_3	7.22	0.042
C_4	6.97	0.048
C_5	6.56	0.054

*Values are average of three determinations.

attributed to the enzymatic hydrolysis of starch by amylases and diastases, which degrade starch and produce glucose. This increased amount of glucose becomes the precursor of vitamin C (Taur *et al.,* 1984). It is reported that during malting process calcium and phosphorus content increases whereas iron content decreases (Sangita and Sarita, 2000).

The cake batters prepared with different formulation were analysed for pH and acidity and the results obtained are presented in Table 4. The results showed that there was decrease in pH and increase in titratable acidity as the quantity of malted ragi flour increases. This change may be due to the hydrolysis of fats to produce fatty acids and production of ascorbic acid during germination process (Sangita and Sarita, 2000; Taur *et al.*, 1984).

Chemical compositions of cakes prepared from supplemented ragi flour were determined and obtained results are tabulated in Table 5. The data showed that there were no significant differences in fat content. The crude fibre and mineral contents viz. calcium, iron and phosphorus of supplemented malted ragi cakes were higher than the control cake sample. The protein content of cake samples was decreased slightly as the amount of malted ragi flour increases. This slight decrease in the protein content was due to the addition of malted ragi flour to the wheat flour (Singh *et al.*, 2005). Sangita and Sarita, 2000 has reported that supplementation of malted ragi flour increases mineral contents i.e. calcium, iron and phosphorus of burfi. The crude fibre content of cake samples was increased as the proportion of malted pearl millets flour was increased (Singh *et al.,* 2006).

The cake samples prepared from supplemented malted ragi flour were subjected to semi-trained panel for sensory analysis and the results are shown in Table 6. All the cake samples prepared with different combinations of malted ragi flour were organoleptically acceptable to the panellists. The data showed that the sensory scores of supplemented cake samples (C1, C2 and C3) for all the sensory attributes were same as the control sample. The sensory scores of C4 and C5 samples were same as that of control sample except for colour and texture. The colour and texture scores of these two samples were lower than the control. This lower value of colour score may be due to the increase in intensity of brown colour of cake samples, which is contributed from the malted ragi flour. The lower value of texture may be due to the decrease in sponginess of cakes resulting from the decrease in gluten content.

CONCLUSION

The cake samples prepared with combinations of refined wheat flour and malted ragi flour were rich in calcium, iron, phosphorus, and crude fibre. The cake prepared with 60% and 70% malted ragi flour had higher

Table 5: Chemical compositions of cakes supplemented with malted ragi flour

Sample code	Moisture(%)	Protein(%)	Fat(%)	Crude fibre (%)	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)
C	21.43	12.72	30.1	0.30	117.2	400	1.84
C_1	20.82	11.96	30.3	0.88	131.16	418	4.68
C_2	20.65	11.29	30.4	1.48	136.41	424	6.56
C_3	20.54	11.93	30.6	1.95	140.60	432	7.58
C_4	20.79	10.59	30.8	2.32	147.44	446	8.35
C_5	21.05	10.22	31.4	2.55	154.28	452	9.27
SE	0.131	0.382	0.188	0.354	5.300	7.775	1.114
CD (p=0.05)	0.336	0.982	0.483	0.910	13.621	19.981	2.862

Table 6: Organoleptic attributes of cakes supplemented with malted ragi flour

Sample code	Appearance[a]	Colour[b]	Flavour[c]	Taste[d]	Texture[e]	Overall acceptability[f]
C	2.86	3.00	4.16	3.00	4.00	4.38
C_1	2.78	2.84	4.16	2.96	4.00	4.36
C_2	2.71	2.75	4.15	2.95	3.95	4.34
C_3	2.66	2.63	4.15	2.93	3.95	4.32
C_4	2.40	2.20	3.90	2.83	3.30	4.15
C_5	2.33	2.16	3.83	2.90	3.20	4.05
SE	0.087	0.141	0.062	0.024	0.154	0.055
CD (p=0.05)	0.223	0.362	0.159	0.061	0.395	0.141

[a] = 3 –good, 2-fairly good, 1 – dull
[b] = 3 – golden brown, 2 – slightly brown, 1- dark brown
[c] = 5-characterstic, 4-moderate, 3-light, 2-mild, 1-very mild
[d] = 3-sweet, 2-fairly sweet, 1-less sweet
[e] = 4-spongy, 3-slighly spongy, 2- slightly firm, 1 –firm
[f] = 5-liked very much, 4-liked moderately, 3-liked slightly, 2-acceptable, 1-disliked slightly

mineral and fibre content than other samples, but the sensory scores for the same were low due to the loss in sponginess and increased intensity of brown colour. The cake sample prepared with 50% malted ragi flour had sensory scores same as the control. Hence the cake sample prepared by supplementation with malted ragi flour will be beneficial to growing children, teenagers, pregnant women, lactating women and anaemic patients.

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