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Patel P

Department of Food Science and Technology, MPKV, Rahuri.
Tal.-Rahuri, Dis- Ahmednagar,
Maharashtra, India

Thorat SS

Department of Food Science and Technology, MPKV, Rahuri.
Tal.-Rahuri, Dis- Ahmednagar,
Maharashtra, India

Akash Mane

Department of Food Science and Technology, MPKV, Rahuri.
Tal.-Rahuri, Dis- Ahmednagar,
Maharashtra, India

Studies on chemical, textural and color characteristics of finger millet (*Eleusine coracana*) fortified sponge cake

Patel P, Thorat SS and Akash Mane

Abstract

Finger millet is highly nutritious as it contains an excellent amount of calcium, iron and crude fibre. The force max required for sponge cake decreased with increase in whole flour incorporation from 20 to 80%, as evident from the textural study. The proximate composition of sponge cake prepared with whole finger millet (20 to 80%) resulted in increase in moisture content, ash, carbohydrate, crude fibres, minerals (Ca and Fe) with reduction in protein. Good quality sponge cake can be prepared by replacing 80% maida with finger millet flour with higher content of Ca, Fe and crude fiber.

Keywords: Chemical, textural and color characteristics, finger millet, *Eleusine coracana*

Introduction

Finger millet (*Eleusine coracana*) is one of the important member in millet family (Poaceae). In India it is commonly known as *Ragi*, *Mandua*, *Moothari*, *Ragulu*, *Nachini*, *Kurukkan* and *Bharin* different states (Rachie and Peters, 1977) [12]. Karnataka is the leading finger millet growing area with 60% area followed by Uttarakhand (10%), Maharashtra (10%), Tamil Nadu, Odisha and Gujarat (Prabhakar, 2017) [11]. Finger millet is light brown to brick red colour seed having 1.2 to 1.8 mm diameter with minutely undulated surface. Its endosperm is white in colour.

Now a days finger millet are getting more value because of its property to prevent disease like diabetes (Hedge *et al.*, 2005) [8], cardiovascular disease (Lee *et al.*, 2010) [10], celiac disease (Saleh *et al.*, 2013), cancer (Chandrasekara and Shahidi, 2011), inflammatory activity (Rajasekaran *et al.*, 2004) [13], aging (Hegde *et al.*, 2005) [8], and cataractogenesis (Chethan *et al.*, 2008) [6]. Finger millet is loaded with phytochemical compounds like coumarins, steroids, carbohydrate, flavonoids, tannins and flavonon (Ravindran, 1991; Chethan and Mallashi, 2007; Shobana *et al.*, 2013) [14, 5, 18].

Finger millet is fortified in different food products to improve the nutritional status of the food. Recently fortified foods are muffins (Sudha *et al.*, 1998) [19], cake (Anuratha *et al.*, 2010), noodles (Shukla and Srivastava, 2011) and biscuit (Saha *et al.*, 2011) [17]

Materials and methods**Raw materials, chemicals and equipments**

The finger millet (*Phule nachni*) was purchased from National Agriculture Research Project, Kolhapur. The raw materials (Vanaspati, maida, sugar and egg) for preparation of sponge cake were purchased from the local market. All the chemicals were purchased from SDF chemicals, Mumbai. The Instron texture analyser, Brabender mill and colour analyser were used for finger millet cake analysis.

Proximate of finger millet

Proximate composition of finger millet flour such as moisture, fat, protein, crude fibre and ash were estimated by A.O.A.C. (1990). The minerals such as calcium and iron were established by following approved methods of A.O.A.C. (1990).

Preparation method of finger millet flour sponge cake

The sponge cake samples prepared with 0%, 20%, 40%, 60% and 80% replacement of maida with finger millet flour were designated as control, R20, R40, R60, and R80, respectively. The different level of maida and finger millet powder used for preparation of sponge cake were

Correspondence**Patel P**

Department of Food Science and Technology, MPKV, Rahuri.
Tal.-Rahuri, Dis- Ahmednagar,
Maharashtra, India

100:0, 80:20, 60:40, 40:60 and 20:80 with the addition of WMP (2g), eggs (30g), water (8g Sugar (24g) and Vanaspati (16g) in each combination. Whole eggs were poured into a bowl, and mixed with an eggbeater. The eggs and sugar power mixtures were then mixed for 3 min. The maida flour and finger millet were gradually mixed. The foam was collected in a bowl containing Vanaspati oil and non fat dry milk. Ingredients were mixed till it get smooth. The

cakebatter was immediately poured into cake cups and baked at 1600C for 40 min in a preheated oven. The cakes were allowed to cool for 2 hr, and then were removed from the pans. Polypropylene bag were used to pack cooled fortified cake at room temperature before chemical and sensory evaluation analysis.

Results and discussion

Table 1: Proximate composition of finger millet and wheat

Ingredients	Amount*	
	Finger millet flour	Maida
Moisture (%)	10.05	12.55
Protein (%)	6.01	10.65
Fat (%)	0.92	0.94
Carbohydrate (%)	78.94	74.88
Crude fiber (%)	2.89	0.36
Ash(%)	1.19	0.94
Iron (mg %)	340.42	2.13
Calcium (mg %)	13.7	18.56

*Average of three replication

The proximate analysis of finger millet and the maida is given in Table 1. The estimated values of finger millet and maida found for moisture (10.05 and 12.55), fat (0.96 and 0.94), proteins (6.01 and 10.65), crude fibre (2.89 and 0.36), ash (1.19 and 0.94) and carbohydrate (78.94 and 74.88), comparable results were reported by Anuradha *et al.*, 2010 [10]. The Ca and Fe content of finger millet were 340.42 (mg %) and 13.7 (mg %) respectively. These results are found similar with Bhatt *et al.*, 2003. Also Ca and Fe content of maida were 2.13 (mg %) and 18.56 (mg %) respectively, more or less similar results were obtained by kulkarni *et al.*, 2011.

Proximate analysis of finger millet fortified sponge cake

It was observed that with the increase in whole finger millet flour level in sponge cake, there was significant increase in moisture, ash, carbohydrate and crude fibre content and decrease in protein content (Table 2). The moisture content of finger millet fortified sponge cake increased significantly as level of whole finger millet flour increased from 20 to 80%. The ash content of finger millet sponge cake increased from 1.21 to 1.78% with increasing level of whole finger millet flour in sponge cake from control to 80%. This might be due to higher amount of ash than all other cereals (Gopalan *et al.*, 2009) [7]

Table 2: Proximate analysis of finger millet fortified sponge cake

Treatments	Moisture	Protein	Crude fat (%)	Crude fibres (%)	Ash	Carbohydrates	Calcium (mg/ 100g)	Iron (mg/ 100g)
Control	21.43	12.73	30.47	0.32	1.21	33.47	115.50	1.83
20 R	20.65	11.98	30.4	0.86	1.44	34.37	131.28	4.80
40 R	20.85	10.89	30.20	1.47	1.52	35.36	136.46	6.66
60 R	20.75	9.96	30.60	2.33	1.59	36.05	147.20	8.46
80 R	21.85	9.46	31.60	2.65	1.78	37.36	159.07	9.85
SE±	0.021	0.016	0.129	0.012	0.0087	0.094	0.536	0.063
CD@5%	0.06	0.053	0.409	0.040	0.027	0.298	1.690	0.199

The calcium and iron content of finger millet fortified sponge cake enhanced significantly as the level of whole finger millet flour raised from 20 to 80%. The highest calcium and iron matter was found in 80 R (159.07 and 9.87 mg/100g) and lowest in 20 R (131.28 and 4.80 mg/100 g). The crude fibre was significantly increased with increased level of finger millet flour from 0.32% (control) to 2.65 (80 R). Chethan and Malleshi (2007) [5] reported that finger millet grain contain 15.7% insoluble dietary fibre and 1.4% soluble dietary fibre. The carbohydrate content significantly increased from 33.47 (control) to 37.36 (80 R)%, in sponge cake prepared with addition of whole finger millet compared to that of control. This might be due to higher carbohydrate in finger millet flour compared to maida. in 1979 Wankhede, observed the carbohydrate profile of a some varieties of finger millet and reported 59.5 to 61.2% starch, 1.4 to 1.8% cellulose, 6.2 to 7.2% pentosans, and 0.04 to 0.6% lignins. The protein content of the sponge cake decreased as whole finger millet flour

increased from 12.73 (Control) to 9.46 (80 R). This might be due to high gluten content in maida compared to finger millet. Singh *et al.* (2005) [16] reported that protein content of wet finger millet was 8.69% and 9.90% on dry basis.

Colour character of finger millet sponge cake

The values of colouranalysed in colour analyser are present in Table 3. The L* (Lightness) value decreased significantly with the increased levels of whole finger millet flour. Control sponge cake had the highest brightness compared to the whole finger millet flour enriched sponge cake. The a* (redness) value significantly increased with the addition of whole finger millet flour. The change in b* value, which indicates the yellowness, significantly decreased with increased flour level of whole finger millet flour. The lightness of sponge cake was decreased with the addition of whole finger millet flour was increased.

Table 3: Effect of different level of whole finger millet flour on colour characteristics of sponge cake

Treatments	L*	a*	b*	c*
Control	95.81	-0.35	3.23	3.25
20 R	95.45	0.19	1.86	1.87
40 R	95.27	0.27	1.25	1.28
60R	95.24	0.31	0.85	0.92
80 R	95.19	0.35	0.59	0.59
SE ±	0.44	0.69	0.87	0.954
CD @ 5%	1.45	2.45	2.27	3.26

Textural character of sponge cake

Textural characteristics of finger millet fortified sponge cake are presented in Table 4 (Fig-1-5). There was significant effect of addition of whole finger millet flour to sponge cake on textural parameters. The force max, energy and min force of control and 80% replacement of maida with whole finger millet flour incorporated sponge cake ranged from 0.69 N (control) to 0.80 N(80 R), 0.0070 J (control) to 0.0072 J (80 R) and 0.014 N (control) to -0.011 N (80 R) respectively.

Table 4: Effect of different level of whole finger millet flour on texture characteristics of sponge cake

Treatment	Max. force	Energy	Min force
Control	0.69	0.0070	-0.014
20 R	0.52	0.0059	-0.015
40 R	0.63	0.0069	-0.010
60 R	0.78	0.0069	-0.003
80 R	0.80	0.0072	-0.011
SE ±	0.87	0.57	0.32
CD @ 5%	2.36	1.25	0.85

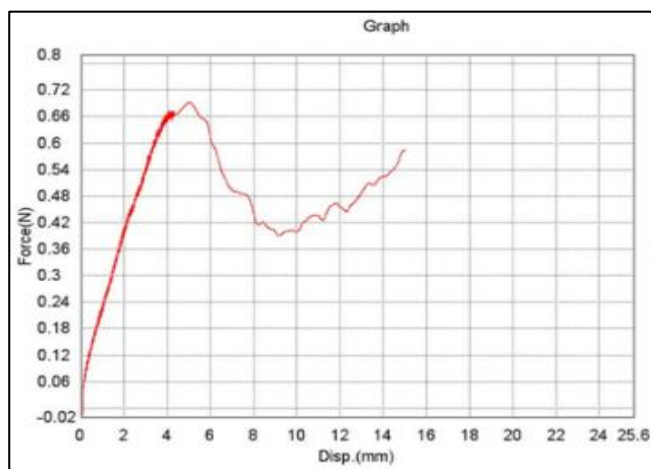


Fig 1 a: Textural study of sponge cake (control)

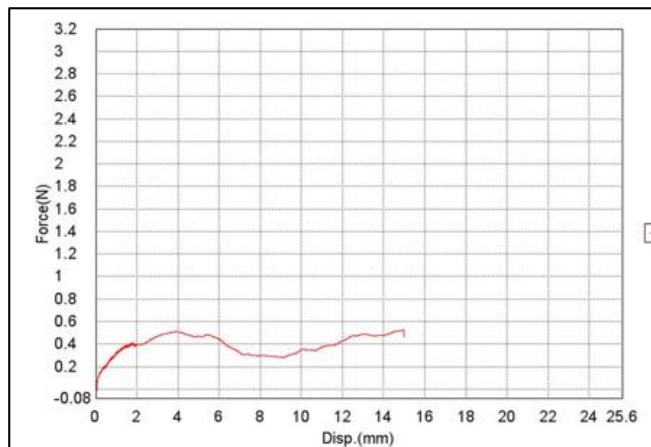


Fig 2 b: Textural study of sponge cake (20 R)

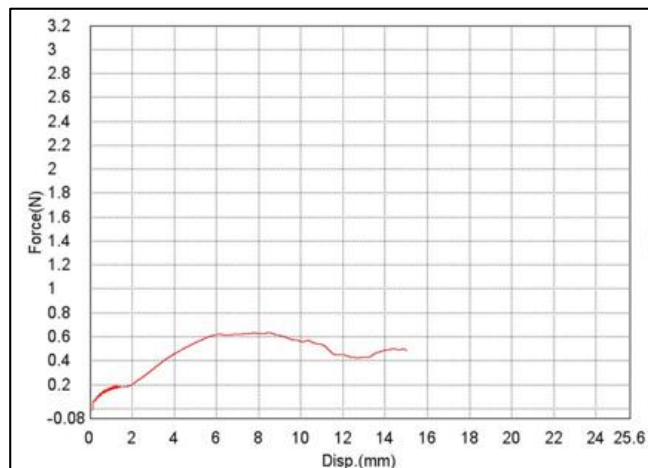


Fig 3 c: Textural study of sponge cake (40 R)

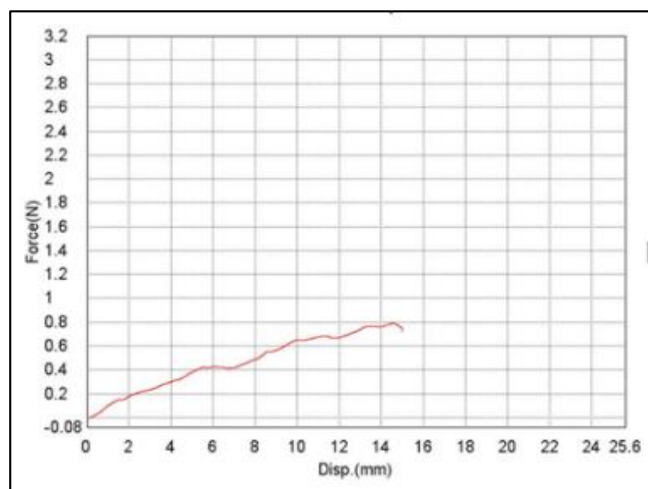


Fig 4 d: Textural study of sponge cake (60 R)

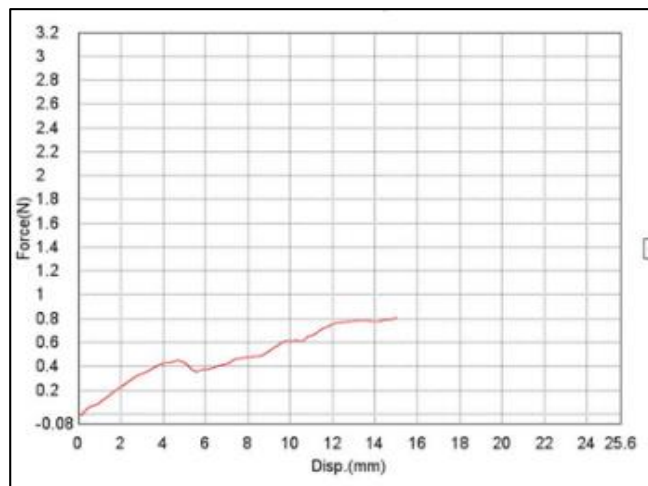


Fig 5 e: Textural study of sponge cake (80 R)

Conclusion

Finger millet is highly nutritious as it contain good source of calcium, iron and crude fibre. Good quality sponge cake can be prepared by replacing 80% maida with finger millet flour with higher content of Ca, Fe and crude fiber.

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