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

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### Abstract

Finger millet is known for its excellent source of calcium, iron and crude fibre. Addition of finger millet in sponge cake preparation helps to avoid the mal nutrition in modern life style. Since, finger millet is dark in colour acceptance for all people is reduced. To attract the children and youth finger millet was decorticated and utilized sponge cake preparation. 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 decorticated 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, color characteristics, finger millet, sponge cake

### Introduction

Finger millet (*Eleusine coracana*) is one of the important member in millet family (Poaceae). *Ragi, Mandua, Moothari, Ragulu, Nachini, Kurukkan* and *Bharin* are the common names of finger millet in India (Rachie and Peters, 1977) [11]. Karnataka is the leading finger millet growing are with 60% area followed by Uttarakhand (10%), Maharashtra (10%), Tamil Nadu, Odisha and Gujarat (Prabhakar, 2017) [10]. 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, cardiovascular disease, celiac disease, cancer (Chandrasekara and Shahidi, 2011) [3], inflammatory activity (Rajasekaran *et al.*, 2004), aging (Hegde *et al.*, 2005) [7], and cataractogenesis (Chethan *et al.*, 2008) [5]. 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) [13, 7, 17]. Ravindran (1991) [13] Reported that the anti-nutritional factors of the millet, namely, polyphenols and phytates are mainly concentrated in the seed coat and aleurone layers, decortication lowers their contents and as a result improves the bio-availability of the nutrients.

Indicated that decortication study of finger millet decreases the gelatinization temperature and dough development time. Utilization of decorticated finger millet in vermicelli lowers the breaking and tensile strength. Addition of finger millet in sponge cake preparation helps to avoid the mal nutrition in modern life style. Since, finger millet is dark in colour acceptance for all people is reduced. To attract the children and youth finger millet was decorticated and utilized sponge cake preparation. Decorticated 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 noodles (Shukla and Srivastava, 2011) and biscuit (Saha *et al.*, 2011).

### 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.

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### Decorticated finger millet

The decortication was performed using standardized process as per the recommendation of department of food science and technology. Cleaned finger millet was soaked in water for 6hrs then steamed in pressure cooker for 6 min followed by drying in dryer at 60°C for 5hrs the grains were conditioned using water at 2% tempered for 1hr and dried in shade for 2hrs and milled in Brabendermill. This treatment results in production of white flour.

### Proximate of finger millet

Proximate composition of finger millet flour such as moisture, fat, protein, crude fibre and ash were estimated by AOAC. (1990) [1]. The minerals such as calcium and iron were determined by following approved methods of A.O.A.C. (1990) [1].

### Preparation method of decorticated finger millet flour sponge cake

The sponge cake samples prepared with 0%, 20%, 40%, 60% and 80% replacement of maida with decorticated finger millet flour were designated as control, R20, R40, R60, and R80, respectively. The different level of maida and decorticated finger millet powder used for preparation of sponge cake were 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 cake batter was immediately poured into cake cups and baked at 160°C 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.

**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	112.70	1.58
20 DR	20.61	9.57	30.34	0.65	1.35	37.54	87.76	3.5
40 DR	20.43	8.69	30.62	0.77	1.43	38.12	97.58	4.53
60 DR	20.75	7.95	30.80	0.84	1.47	38.95	106.85	6.58
80 DR	21.25	7.28	31.47	0.92	1.53	39.83	114.11	8.20
SE±	0.0365	0.185	0.121	0.008	0.011	0.0805	1.721	1.0646
CD @ 5%	0.592	0.687	0.382	0.027	0.035	0.25371	5.4266	3.353

The moisture content of sponge cake ranged from 20.61 (20 DR) to 21.25% (80 DR). The carbohydrate content increased from 37.54 (20 DR) to 39.83% (80 DR). The protein content decreases with increased in decorticated finger millet 9.57 (20 DR) to 7.28 (80 DR). Ash content of sponge cake increases with increased in decorticated finger millet 20 DR (1.35%) to 80 DR (1.53%).

The carbohydrate content got increased from 20 DR (27.54%) to 80 DR (39.83%). Calcium and iron content present in the decorticated sponge cake increases with increase in the incorporation of decorticated finger millet flour from 20 DR (87.76 and 3.5 mg/100g) to 80 DR(114.11 and 8.20 mg/100g).

## Results and discussion

**Table 1:** Proximate composition of finger millet and wheat

Ingredients	Amount*	
	Decorticated Finger millet flour	Maida
Moisture (%)	10.52	12.55
Protein (%)	7.63	10.65
Fat (%)	1.19	0.94
Carbohydrate (%)	89.48	74.88
Crude fiber (%)	3.21	0.36
Ash(%)	2.01	0.94
Iron (mg %)	11.61	2.13
Calcium (mg %)	206.48	18.56

\*Average of three replication

Calcium (mg %) 206.48, 18.56

\*Average of three replication

The proximate analysis of decorticated finger millet and the maida is given in Table 1. The estimated values of decorticated finger millet and maida found for moisture (10.52 and 12.55), fat (1.19 and 0.94), proteins (7.63 and 10.65), crude fibre (3.21 and 0.36), ash (2.01 and 0.94) and carbohydrate (89.48 and 74.88), comparable results were reported by Anuradha *et al.*, 2010. The Ca and Fe content of decorticated finger millet were 206.48 (mg %) and 11.61 (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 kulkarniet *al.*, 2011.

### Proximate analysis of finger millet fortified sponge cake

The chemical composition of decorticated finger millet sponge cake regarding moisture, ash, crude fibre, crude protein and carbohydrate is presented in the Table 18. It was observed that with increase in level of decorticated finger millet in sponge cake there was increase in moisture, protein, crude fiber, crude fat and ash content and decrease in carbohydrate content.

### Colour character of decorticated finger millet sponge cake

The L\* (Lightness) value decreased significantly with the increase in the levels of decorticated finger millet flour (Table 3). Control sponge cake had the highest lightness compared to the decorticated finger millet flour enriched sponge cake. The a\* (redness) value significantly increased with addition of decorticated finger millet flour. The change in b\* value, which indicates the yellowness. The L\* value of sponge cake added with finger millet significantly decreased viz., 95.63 (20 DR), 95.50 (40 DR), 95.48 (60 DR) and 95.5 (80 DR). The highest L\* value was recorded in control (95.814) and lowest in 80 DR (95.375).

**Table 3:** Effect of different level of decorticated finger millet flour on color characteristics of sponge cake

Treatments	L*	a*	b*	c*
Control	95.81	-0.35	3.23	3.25
20 DR	95.63	-0.09	2.64	2.64
40 DR	95.50	0.09	2.16	2.47
60 DR	95.48	0.17	2.17	2.48
80 DR	95.5	0.26	2.12	2.14
SE ±	0.001033	0.000907	0.005209	0.001125
CD @ 5%	0.00325	0.002857	0.01644	0.003546

The a\* value significantly increased from -0.35 (control) to 0.26 in 80 DR. It means that the redness increased as the decorticated finger millet addition to the sponge cake increased from 20 to 80% i.e., sponge cake become darker in color. The b\* value ranged from 3.23 (control) to 2.12 (80 DR). The significant decrease in b\* value was observed from 2.64 (control) to 2.12 (80 DR) as decorticated finer millet flour addition to sponge cake increased. The chroma value

decreased significantly from 3.25 (control) to 2.14 (80 DR) as decorticated finger millet flour addition to sponge cake increased.

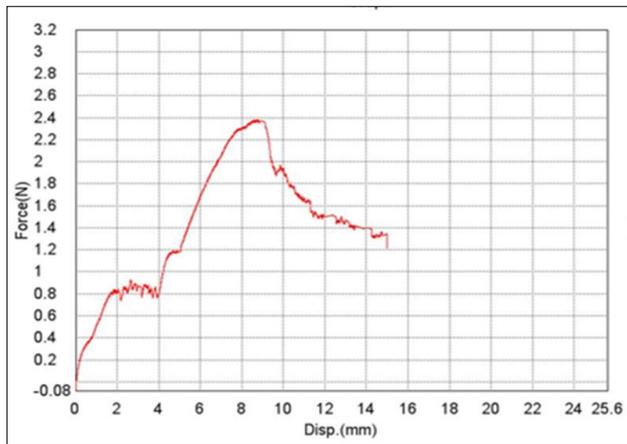
**Textural character of decorticated sponge cake**

There was significant effect of addition of decorticated finger millet flour to sponge cake on textural parameters by penetration (Table 4) (Fig 1-5). There was increase in force max, energy and min force of decorticated finger millet flour incorporated sponge cake ranged from 0.47N to 2.38 N, 0.0042J to 0.021 J and -0.011 to -0.070 N, respectively. The textural parameters were observed in significant increasing trend as increasing level of decorticated finger millet flour addition (20 to 80%).

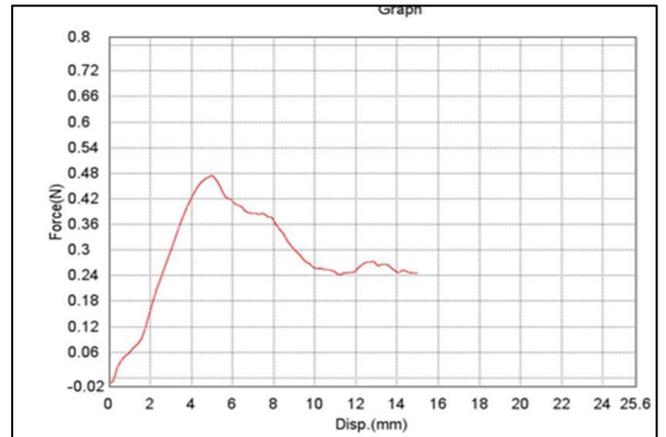
The force max (N) was found highest in 80 DR (2.3805 N) and lowest in control (0.47 N). The energy was significantly increased from 0.0042 Jin control to 0.021 Jin 80 DR. The min force (N) was found to be -0.011 N for control and it was -0.07 N (80DR).

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

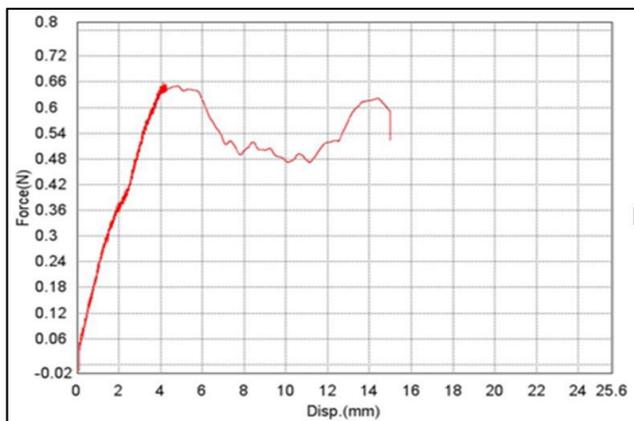
Treatment	Max. force (N)	Energy (J)	Min force (N)
Control (100% maida)	0.69	0.0070	-0.014
20 DR	0.47	0.0042	-0.011
40DR	0.65	0.0075	-0.014
60DR	1.24	0.013	-0.043
80DR	2.38	0.021	-0.070
SD ±	0.91	0.625	0.739
CD @ 5%	3.925	2.45	3.28



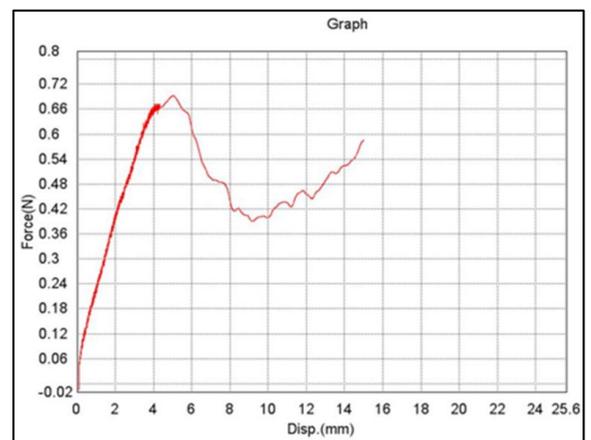
**Fig 1:** Textural study force required for penetration of control sponge cake



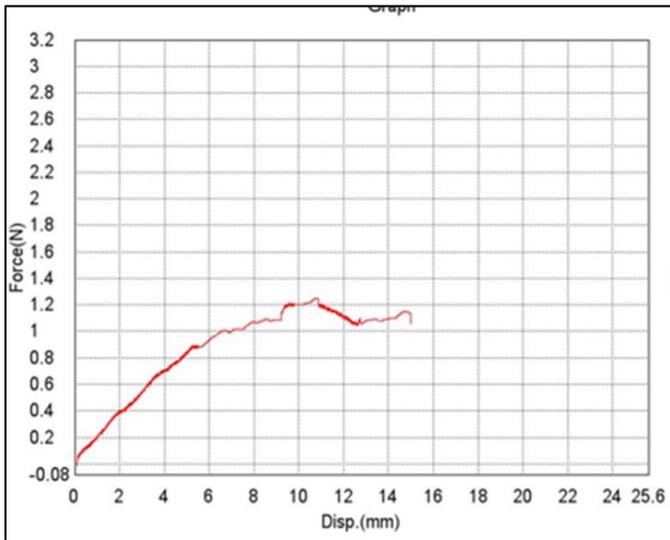
**Fig 3:** Textural study force required for penetration of 40 DR decorticated finger millet flour sponge cake



**Fig 2:** Textural study force required for penetration of 20 DR decorticated finger millet flour sponge cake



**Fig 4:** Textural study force required for penetration of 60 DR d decorticated finger millet flour sponge cake



**Fig 5:** Textural study force required for penetration of 80 DR decorticated finger millet flour sponge cake

Keetels *et al.* (1996) <sup>[11]</sup> reported that starch gelatinization resulted in elastic bread crumb but defatted peanut meal flour lacks in starch hence deteriorating that property. Similarly, addition of rye flour resulted in a firmer bread by Esteller and Lannes (2008) <sup>[11]</sup>. The high protein content of defatted maize germ flour has affected the 'polymerization of proteins', resulting in more plasticized dough, which was eventually reflected in the increased hardness (Siddiq *et al.*, 2003) <sup>[11]</sup>.

### Conclusion

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

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