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Development and Quality Evaluation of Millet Batter

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Authors Contribution

S. R. Ramyashree & M. L. Revanna : Conceptualization of research work and conduct of experiment;
K. B. Suresha : Provided facilities in centre of excellence on nutri cereals;
D. Shobha : Expertize in the development of ready-to-cook products

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Abstract

The objective of the study was to formulate batter from the different blend ratio of the finger millet and black gram. The different blend ratios were 85:15 (FMT1), 80:20 (FMT2), 75:25 (FMT3) and 70:30 (FMT4) along with control rice and black gram (70:30) (FMT0). The samples were further studied for different parameters such as fermentation time, moisture, pH, acidity, bulk density and rise in batter volume, water activity (aw), total solids in batter and colour. Sensory evaluation of the idli prepared from the batter of different blend ratios were carried out. The results revealed that, the moisture, pH, acidity, bulk density and raise in batter volume, water activity (aw) and total solids in the batter values ranged between 55-64 per cent, 4.25 to 4.6, 0.49 to 0.68, 0.44 - 0.89 (g/cm3), 40- 70 per cent, 0.91 to 0.92, respectively. The *L**, *a** and *b** colour values for the batter ranged from 64.73 to 84.03, -0.38 to 3.76 and 7.54 to 9.28 for the batter. Total dissolved solids in the batter ranged between 34 to 38 per cent. Sensory evaluation revealed that the overall acceptable scores and FMT1 (5.19) scored least blend ratio and the highest scored blend ratio was FMT4 (8) followed by FMT2 (7.16) and FMT3 (6.77).

Keywords : Finger millet batter, Moisture, pH, Acidity, Rise in volume, Colour, Water activity, Sensory profile

Millets are small seeded grain in the family Poaceae, is globally recognized as the sixth most important grain. It can survive under desert-like conditions in tropical regions of Asia and Africa is resistant to disease and pests, has a relatively short growing season and is able to grow in less fertile soil conditions. Grains are an example of a staple food for people of lower socio-economic status. Nutritionally, millets are equivalent to or even superior to other cereal grains and has health promoting effects. To create domestic and global demand and to provide nutritional food to the people. UN Govt. 2023 year is declared as the 'International year of millets (IYM)'.

Fermentation of cereals, is an ancient and inexpensive food preservation method and a cultural and traditional practice within indigenous communities in Africa as well as Asian countries. It improves the nutritional value and digestibility of raw products (cereals, roots), enhances sensory characteristics and improves the functional qualities available to local communities.

Traditional fermented foods are widely consumed all over the world. Generally, these are formulated from local food crops and other resources which are easily available. Fermented foods such as *idli* were described as early as 700 BC. There are numerous fermented foods are available in the market with different base material with different preparation methodologies. There is a unique group of micro-biota present in each fermented food and these micro-biota increases the level of proteins, vitamins, essential amino acids and

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fatty acids in the product. However, fermented foods are still produced traditionally by spontaneous fermentation and only limited knowledge has been obtained regarding the micro-biota of these products (Jeyaram *et al.,* 2009). Raw foods contain anti-nutrient components such as phytates and tannins, which hinder the absorption of the nutrients and make other essential nutrients unavailable for the body, during fermentation these components activity gets reduced and results in detoxification (Gadaga *et al.,* 1999).

Idli is produced by a blend of fermented rice (*Oryza sativa*) and dehulled black gram (*Phaseolus mungo*). The ratio of rice to dehulled black gram is 2:1. Rice and dehulled black gram are soaked separately in processing. After draining water, rice and dehulled black gram were ground independently with required quantity of water during the *idli* batter preparation. The rice is coarsely ground and the dehulled black gram is finely ground, then the rice and the dehulled black gram batters are mixed together with the addition of little salt and allowing it to ferment overnight at room temperature. Finally, the fermented batter is placed in special idli moulds and steamed for 5-8 minutes (Blandino *et al.,* 2003). The *idli* is prepared and served hot with sambar/ chutney.

Finger millet (Ragi) varieties with yellow, white, tan red, brown or violet color are available. However, only the red colored ones are commonly cultivated worldwide. It is a rich source of carbohydrates and comprises of free sugars (1.04 %), starch (65.5 %) and non-starchy polysaccharides or dietary fiber (11.5 %) (Gopalan *et al.,* 2009). Prolamins are the major fractions of finger millet protein. Finger millet is exceptionally rich in calcium (344 mg/100g), potassium (408 mg/100g) compared to all other cereals and millets and also contains phosphorus and iron. Finger millet seed coat contain several phytochemicals that may have health benefits. Finger millet is rich in calcium, hence helps in keeping the bones and teeth healthy and prevents osteoporosis. It helps in controlling diabetes as its seed coat is abundant in polyphenols and dietary fibers as compared to rice, maize or wheat. It helps in fighting anemia as since rich in iron (Shobha and Ravishankar, 2017).

Foods which need some preparation like cooking, frying and reconstitution before consumption are called ready to use foods. These foods gaining acceptance primarily from Indian youth and younger generations and is becoming part of day to day life. Keeping in view of the working women and changing preferences towards convenience foods, this study was planned to standardize millet based ready-to-use batter and its quality evaluation.

Material and Methods

The present study was conducted in the Department of Food Science and Nutrition, University of Agricultural Sciences, GKVK, Bengaluru.

Procurement of Sample: Raw materials (Rice, finger millet, black gram and other ingredients) were purchased from the local market and stored at room temperature (25 ± 2 °C) in airtight containers and used as when required. The different ratios of ingredients were given in the Table 1.

Table 1

Different proportion of ingredients used in the preparation of millet batter

Blend ratios	Ingredients (%)		
	Rice	Ragi	Black gram
FMT0 (Control)	70	_	30
FMT1	_	85	15
FMT2	_	80	20
FMT3	_	75	25
FMT4	_	70	30

Preparation of Batter

Rice, Ragi, and black gram were soaked for 8 hours

↓

After soaking grinded them separately and mixed to prepare batter

↓

Batter was kept for fermentation for 24 hr at ambient temperature

↓

To the batter 1 % salt was added and poured into *idly* moulds

↓

Idlis were steamed for 14 min

Fig. 1 : Process flow chart for the batter and idly preparation

Chemical Properties of Batter

Determination of Moisture Content

Moisture was determined by taking about 10 g of sample in petridish and dried in an oven at 65 ºC till the weight of the petridish with its content was constant. Each time before weighing, the petridish was cooled in desiccators. Moisture content of the sample was expressed in percentage.

$$\text{Moisture content (g/100g)} = \frac{\text{Initial weight (g)} - \text{Final weight(g)}}{\text{Weight of the sample}} \times 100$$

pH: The pH of fermented batter was measured using digital pH meter.

Acidity: The acidity of fermented batter was measured using the titration method and using NaOH (1N) as the titrating chemical and phenolphthalein (1%) as indicator.

Bulk Density g/cm³: The bulk density was calculated as the ratio of mass to its batter volume. About 50 ml aliquots of batter were placed in a 100 ml measuring cylinder with lid.

Raise in Volume: The increase in volume of batters was analyzed by pouring the prepared batter in measuring cylinder and fermenting it for 24 hours.

The increase in volume was calculated by following formula :

$$\text{Increase in Volume (\%)} = \frac{\text{Volume after fermentation} - \text{Volume before fermentation}}{\text{Volume before fermentation}} \times 100$$

Water activity (aw) of the batter: It is determined by using Benchtop water activity meter.

Total Dissolved Solids (TDS) of the Batter: was measured by gravimetric method.

The Colour of the batter was estimated using a reflecting colorimeter (Chroma meter CR-300). The samples were kept in a colorimeter petri dish and readings were taken in triplicates. The *L**, value is a measure of lightness / brightness, ranging from 0 (black) to 100 (white). The *a** value is a measure of greenness/redness, ranging from –60 (green) to +60 (red) and the *b** value is a measure of bluishness/ yellowness, ranging from –60 (blue) to +60 (yellow).

Sensory Analysis: Sensory analysis of prepared *idli* samples was done by using 9-point hedonic scale.

Statistical Analysis

The data were subjected to analysis of variance (ANOVA) for testing the significance of variation using SPSS (Statistical Package for Social Sciences) software 16.0.

Results and Discussions

The results of moisture content of various ratios of the batter are depicted in the Table 2**.** The results revealed that, moisture content varied from 55 to 64 per cent. The highest moisture content was observed in the blend ratio of FMT1, which was on par with

Table 2
Moisture content of the batter

Blend ratios	Moisture %
FMT0	64.34 ± 0.43
FMT1	65.67 ± 0.33
FMT2	55.53 ± 2.47
FMT3	55.04 ± 2.44
FMT4	62.15 ± 0.84
C.D.	5.161
SE(m)	1.617
SE(d)	2.287
C.V.	4.625

FMT0 followed by FMT4 and significantly low moisture content was observed in FMT3. The variation in moisture content was due to change in the ratio of ingredients used. Chemical parameters such as pH, acidity and increase in volume were depicted in Table 3.

The pH value of batter at different fermentation time was found to be ranged between 6.24 and 4.25. There was an increasing trend of acidity level, reduction in pH

TABLE 3
Chemical parameters of the batter

Blend ratios	Chemical Parameters		
	pH	Acidity (%)	Bulk Density (g/cm^3)
FMT0	4.6	0.49	0.44
FMT1	4.5	0.57	0.62
FMT2	4.25	0.63	0.73
FMT3	4.25	0.68	0.75
FMT4	4.33	0.52	0.89

value fermentation time, irrespective of blend ratio. According to Mukharjee *et al.* (1965), leavening action of hetero fermentative lactic acid bacterium, *L. mesenteroides* which causes increase in acidity with time. Acidification and leavening are the two most important changes that occur during fermentation (Susheelamma and Rao, 1978 and Soni and Sandhu, 1986). There exists a higher reduction of pH for FMT4 blend ratio. The per cent total acidity of *idli* batter at different fermentation time was ranged between 0.32 and 0.52. Soni and Arora (2000) have reported that, the contribution of yeast towards the acid and gas production. Also, black gram provides a maximum number of microorganisms for fermentation (Ghosh and Chattopadhyay, 2010). The acidity ranges from 0.49 to 0.68 per cent of lactic acid. There was no significant difference found in pH of the sample with respect to different blend ratios. The bulk density of batter at different fermentation time and blend ratio was ranged between 0.44 to 0.89 g/cm^3. It was found that, the bulk density increased with the increase of fermentation time. This trend is corroborated with the action of various hetero fermentative lactic acid bacteria which in turn produces carbon dioxide by acting upon fermentable sugars. The fermentation time is significant for pH of batter at p<5 per cent.

Fig. 2 showed the increase in volume of the batter, it was decreased with increase in the amount of finger millet and also was affected by the room temperature as the room temperature is less in monsoon and winter season. The range of increase in volume is 40 to 70 per cent. In both FMT0 and FMT4 the increase in volume is 70 per cent which is significantly high. Similar results of batter was reported for maize batter during natural fermentation (Shobha and Neenajoshi, 2015). The least volume recorded in FMT1 (40%).

TABLE 4
Water activity (a_w) of the batter

Blend ratios	Water activity (a_w)
FMT0	0.910 ± 0.01
FMT1	0.917 ± 0.00
FMT2	0.920 ± 0.01
FMT3	0.923 ± 0.00
FMT4	0.927 ± 0.00
C.D.	N/A
SE(m)	0.008
SE(d)	0.011
C.V.	1.459

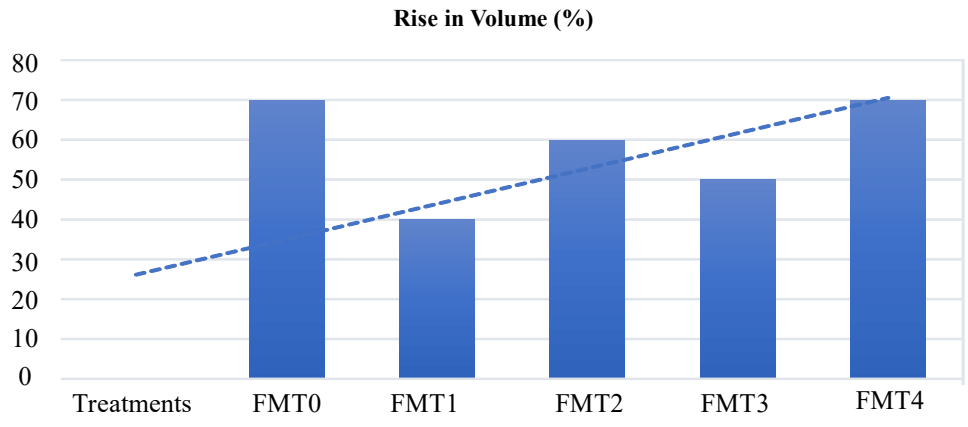

Fig. 2 : Rise in volume of the batter

The blend ratio is significant for percent volume rise of batter at (p<5%).

Water Activity (a_w) of the Batter

Water activity of the dried batter sample was depicted in the Table 4. Significantly more water activity was noticed in FMT4 (0.927) followed by FMT3 (0.923). The least water activity was observed in FMT0 (0.910).

Colour Analysis of the Batter

The colour analysis of the batter results were depicted in Table 5 and 6**.** Results revealed that, *L*, a** and *b** values for batter ranged from 64.73 to 84.03, -0.37 to 3.76 and 7.54 to 9.28, respectively. It shows that there is a no significant difference among all the parameters *viz., L*, a*,* and *b**.

TABLE 5

Colour analysis of the unfermented batter

Blend ratios	Colour		
	*L**	*a**	*b**
FMT0	82.82 ± 333	0.830	8.710
FMT1	70.39 ± 333	4.433	7.566
FMT2	70.87 ± 231	4.430	7.643
FMT3	70.22 ± 201	4.583	8.290
FMT4	70.13 ± 333	4.910	8.273
C.D.	0.681	0.208	0.107
SE(m)	0.859	0.272	0.033
SE(d)	1.488	0.471	0.530
C.V.	0.502	4.212	0.691

TABLE 6

Colour analysis of the fermented batter

Blend ratios	Colour		
	*L**	*a**	*b**
FMT0	84.313 ± 0.02	-0.373	9.287
FMT1	64.870 ± 0.18	3.633	8.487
FMT2	64.737 ± 0.26	3.767	8.450
FMT3	66.13 ± 0.03	3.167	7.543
FMT4	67.40 ± 0.20	3.167	8.200
C.D.	0.681	0.208	0.107
SE(m)	0.213	0.065	0.033
SE(d)	0.302	0.092	0.047
C.V.	0.532	4.217	0.691

TABLE 7

Total dissolved solids (TDS) in batter

Blend ratios	TDS (%)
FMT0	35.720 ± 0.01
FMT1	34.830 ± 0.00
FMT2	38.642 ± 0.01
FMT3	37.642 ± 0.00
FMT4	37.852 ± 0.02
C.D.	N/A
SE(m)	0.009
SE(d)	0.013
C.V.	1.450

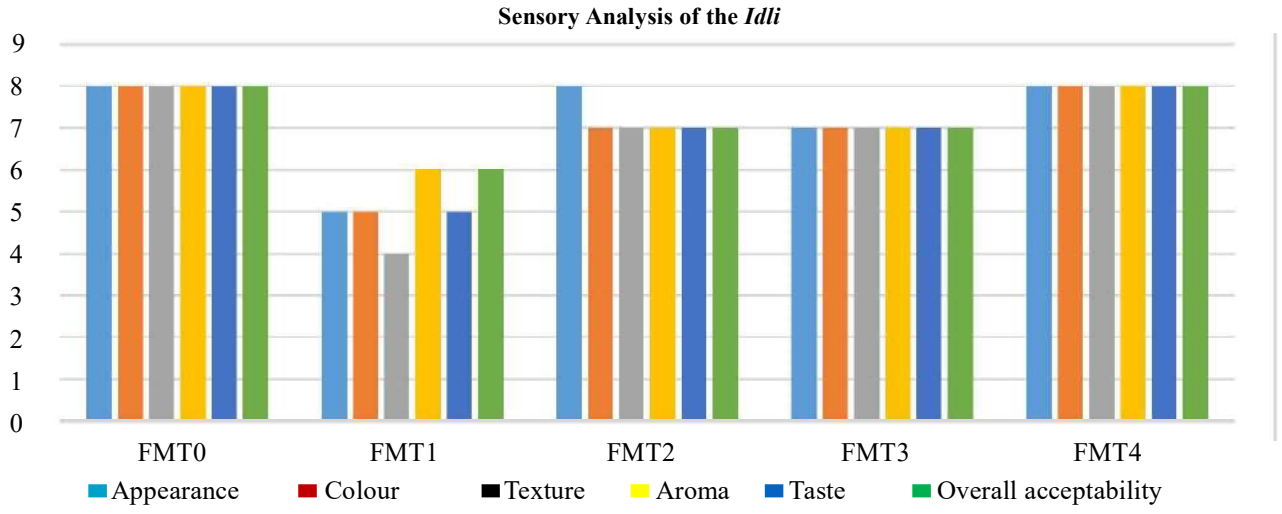

Fig. 3 : Sensory scores of the *idli*

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The total dissolved solids (TDS) in the batter was depicted in the Table 7. TDS were one of the important parameter to describe product texture. The results revealed that there was no significant difference was found in the blend ratios. The solids was ranged between 34 to 38 per cent and results found to be positively associated with respect to product (*Idli*).

Sensory Analysis of the *idli* Prepared from Different Ratios of the Finger Millet

The sensory scores of the idli prepared from the different blend ratios were depicted in the Fig. 2. The results revealed that the FMT0 (Control) scored significantly highest sensory score followed by FMT2 (80:20), FMT3 (75:25), FMT4 (70:30) and least by FMT1 (85:15). It was found that, there was a significant hardness for the *idli* made with FMT1 blend ratio as compared to FMT4 blend ratio. The overall acceptable scores ranged from 8, 7.16, 6.77, and 6.77 to 5.16 out of 9. Thus, the blend level attributed for softening and tenderizing effect. Similar result was reported for the *idli* prepared from pearl millet (Nazni and Shalini, 2010).

Among these batter blends, millet *idli* prepared with FMT4 (70:30) ratio and FMT2 (80:20) with 12 h of fermentation time was found to be optimum for *idly* making and ratio was acceptable with respect to sensory attributes. Hence, the study concluded that, the fermented finger millet batter can be utilized as convenient food.

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