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# Studies on millet *idli* batter and its quality evaluation

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**Abstract**

Millet *idli* batter was prepared from decorticated little millet and black gram (2:1, 3:1 and 4:1) using wet grinder with adequate amount of water and salt (1-2%). The different blends were allowed for fermentation at 0, 2, 4, 6, 8, 10, 12, 14 and 16 h, separately. The batter property viz. bulk density, percent volume rise, pH and titrable acidity was studied for different fermentation time. *Idli* prepared from the above blends at different fermentation time showed that the CIE colour readings $L^*$ and $b^*$ were decreased and $a^*$ was increased, also firmness was found to be decreased (2.68-0.25 N). The organoleptic evaluation of *idli* prepared from 14 h fermentation showed a maximum overall acceptability corresponds to 4:1 blend ratio. It has been evidenced that the process variables in the preparation of millet *idli* are significant at $p<5\%$ and $p<1\%$ levels.



## Introduction

*Idli* is a savory cake of south Indian origin popular throughout the world. Generally, it is a fermented product made from parboiled rice and decorticated black gram. The predominant microorganisms responsible for souring and gas production were found to be *Leuconostocmesenteroides*, *Streptococcus faecalis* and *Pediococcuscerevisiae* (Mukherjee *et al*., 1965). *Idli* contributes to the diet as a source of protein, calories and vitamins, especially B-complex vitamins, compared to raw unfermented ingredients (Srilakshmi, 2003). Ghosh and Chattopadhyay (2010) reported that the maximum production of riboflavin (0.76 mg/100 g) and thiamine (0.73 mg/100 g) were found to be available in *idli* batter prepared from rice and black gram (3:1) blend; and the folic acid content was found to be maximum (0.75 mg/100 g) after 10 h of fermentation. Millets are probably the world's earliest food plants used by humans, and certainly the first cereal grain that was used for domestic purposes (Narpinder *et al*., 2007). These small millets are often grown in difficult conditions, and involve high production risks (Joshi and Agnihotri, 1984). It was originated in south east Asia and found in India, America, Australia and South Africa (Wet *et al*., 1983). It contains high fibre (Indira and Naik, 1971) and has reasonably good levels of protein, but very poor amino acid values. Millet grains can be used as a substitute for rice or wheat component of fermented foods like dosa or *idli* (Manay and Shadaksharaswamy, 2001).

## Materials and Methods

### *Raw materials*

The raw material namely little millet *(Panicummiliare)* was obtained from the hilly tribal regions of Madhya Pradesh, India and decorticated black gram (*Vignaradiate* L.) was purchased from a local market. The little millet was decorticated using a tangential abrasive dehusker (cap: 30 kg/batch, Mathesis Pvt. Ltd., India).

### *Basic formulation of idli batter*

Three blends of idli batter from decorticated little millet and black gram were prepared (Table 1) with adequate water and salt (1-2%).

Table 1.Fomulation of millet *idli* batter

| Raw materials | Blend ratio | | |
|---|---|---|---|
| Little millet: black gram | 2:1 | 3:1 | 4:1 |

### *Preparation and property of batter*

The decorticated little millet and decorticated black gram was soaked in excess distilled water for 10h at room temperature (28±1°C), separately. The soaked mass was subjected to wet grinding to yield a coarse particle size (0.5-0.7 mm) for littlemillet and plastic-like or glutinous consistency for black gram. The wet ground mass was blended in different ratio (2:1, 3:1 and 4:1) with water and salt was allowed

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Table 2. Regression coefficients from quadratic model, range values and their significance

| Term | Coefficient | Batter | | | | Millet *idli* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | BD | PVR | pH | TA | F | L* | a* | b* |
| | Range | 0.478-0.315 | 0-52 | 6.24-4.09 | 0.35-0.91 | 2.68-0.25 | 95.67-55.34 | -0.31- (-1.47) | 19.32-6.11 |
| Constant | $\beta_0$ | 0.51** | 193.08** | -2.02 | 3.05** | 7.71** | 114.48* | -5.84 | 3.51 |
| FT | $\beta_1$ | -0.05* | - 537.54 | 21.68* | -7.60 | -10.74 | -48.27 | 10.38* | 39.07* |
| MR | $\beta_2$ | -0.02 | 8.62* | -0.20 | 0.03 | -0.51** | -4.77* | 0.02* | -0.88** |
| FT.MR | $\beta_{12}$ | 0.01 | -7.601 | 0.09 | -0.02 | 0.28 | -1.01 | -0.07 | -0.53 |
| $FT^2$ | $\beta_{11}$ | 0.02 | 366.30 | -14.13 | 5.36 | 4.49 | 29.87 | -5.49 | -24.05 |
| $MR^2$ | $\beta_{22}$ | 0.0003 | 0.102 | -0.004 | 0.002 | 0.01 | 0.19 | 0.005 | 0.02 |
| $R^2$ | | 0.953 | 0.962 | 0.963 | 0.947 | 0.738 | 0.821 | 0.667 | 0.912 |

FT: Fermentation time (h), MR: Millet ratio (%), BD:Bulk density (g/cm$^3$), PVR: percent volume rise (%), TA:Titrable acidity (%), F: Firmness (N), *: p<5%, **: p<1%.

to ferment for different time (0, 2, 4, 6, 8, 10, 12, 14 and 16 h) in stainless steel vessels. During its fermentation, property of batter viz., bulk density, percent volume rise, pH and titrable acidity was studied (Balasubramanian and Viswanathan, 2006). 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. The rise in batter volume during fermentation was noted at every specific time (1 h) interval (Steinkraus *et al*., 1967) was measured in millilitre and represented in percentage. The pH of batter at different fermentation time was recorded using micro controller pH meter (Model: WTW PS323 Labtronics, India). For determining the percentage of total acidity, 5 g of batter was diluted in 10 ml water and titrated against 0.1 normality NaOH, as calculated as

$$\frac{\text{Titre value} \times \text{Normality of alkali} \times \text{volume made up} \times \text{milliequivalent weight of acetic acid}}{\text{Volume of sample taken} \times \left(\frac{\text{weight}}{\text{Volume of sample}}\right)} \times 100$$

*Preparation and quality evaluation of idli*

*Idli*, having a circular shape (7-8 cm diameter), flat with lower and upper surface bulging, so that the product is thick at the centre (2.0-2.5 cm) and tapering towards periphery were prepared using a proper template in steam cooking environmental chamber. The colour of idli was measured using Hunter LabScan XE (Model no. LX 16244, Hunter lab associates, Virginia) in terms of CIELAB readings;lightness ($L^*$ = 0 yields black and $L^*$ = 100 indicates diffuse white; specular white may be higher), its position between red/magenta and green ($a^*$, negative values indicate green while positive values indicate red) and its position between yellow and blue ($b^*$, negative values indicate blue and

Figure 1. Sample preparation for texture analysis

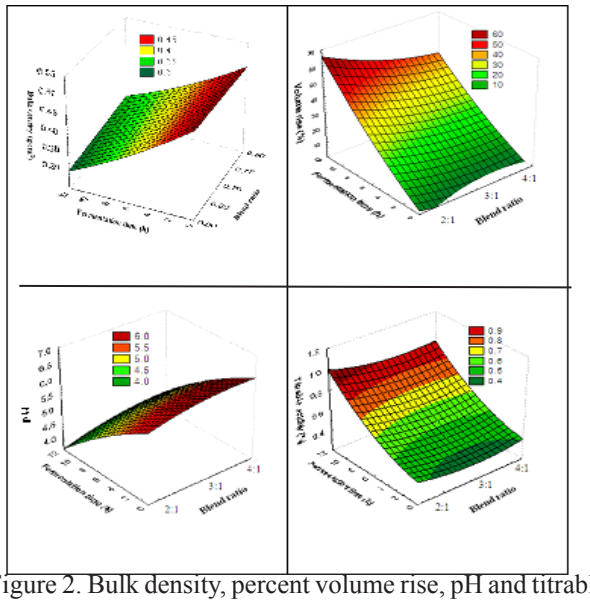

Figure 2. Bulk density, percent volume rise, pH and titrable acidity of *idli* batter at different blends and fermentation time

positive values indicate yellow). The firmness was determined using a texture analyser (Stable Micro Systems, UK, Model TA-XT PLUS). For textural analysis, cylindrical sample of 10 mm diameter was formed by inserting plastic rod on the *idli* surface (Fig. 1). Experimental condition followed were load

Table 3. Organoleptic evaluation of millet *idli* made from different blends

| Blend ratio | Texture | Flavour | Taste | Appearance | Color | Overall acceptability |
|---|---|---|---|---|---|---|
| 2:1 | 6.2 ± 0.78 | 6.54 ± 0.78 | 6.35 ±0.94 | 6.23 ± 0.56 | 6.82 ± 0.58 | 6.67 ± 0.85 |
| 3:1 | 6.9 ± 0.67 | 6.78 ± 0.78 | 6.52 ± 0.83 | 6.96 ± 0.83 | 7.24 ± 0.49 | 6.98 ±0.35 |
| 4:1 | 7.3 ± 0.39 | 7.24 ± 0.61 | 7.84 ± 0.91 | 7.45 ± 0.81 | 7.60 ± 0.67 | 7.54 ± 0.39 |

Mean ± SD of 9-point Hedonic scale.

cell: 5 kg, test mode: measure force in compression, test option: return to start, pre test speed: 1 mm/s, test speed: 1 mm/s, post test speed: 0.5 mm/s, strain: 70 % and test probe: P5. The organoleptic evaluation using 9-point hedonic scale for appearance, texture, flavour, taste and overall acceptability was performed for millet *idli* prepared from the batter fermented for 14 h with 10 min constant cooking time (Balasubramanian and Viswanathan, 2006; Yajurvedi, 1980). A panel of 10 semi-trained members was chosen to carry out this study.

## Results and Discussion

*Bulk density, batter volume rise, pH and titrable acidity of batter*

The results of bulk density, percent volume rise, pH and titrable acidity of batter and regression coefficients along with their significance are given in Table 2 and Fig. 2. The bulk density of batter at different fermentation time and blend ratio was ranged between 0.477 and 0.315 g/cm$^3$. It was found that the bulk density decreased 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 (Radhakrishnamurty *et al.*, 1961). Also, it was observed that the entrapment of air/gas pockets and functions of microorganisms responsible for the different functionality of batter density (Mukherjee *et al.*, 1965). The percent volume rise of was recorded up to 52 %. Balasubramanian and Viswanathan (2006) and Ghosh and Chattopadhyay (2010) have reported a similar increasing trend with respect to the increase of parboiled rice as evidenced by the microorganisms generated. The reason for increase in batter volume can be attributed to the microbial growth and secretion of enzymes, which catalyse the hydrolysis of carbohydrates, lipids, proteins, anti-nutritional and toxic factors (Rolle, 1998). The pH value of batter at different fermentation time was found to be ranged between 6.24 and 4.09. There is an increasing trend of acidity level, i.e., decrease in pH value with fermentation time, irrespective of blend ratio. According to Mukherjee *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 (Susheelama and Rao, 1978, Soni *et al*., 1986). There exists a higher reduction of pH for 4:1 blend ratio. The percent total acidity of idli batter at different fermentation time wasranged between 0.46 and 0.91%. 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 fermentation time is significant for bulk density and pH of batter at $p<5\%$ level. The blend ratio is significant for percent volume rise of batter at $p<5\%$ level.

*Texture, colour and organoleptic evaluation of* idli

The values of texture, colour and organoleptic evaluation of millet idli and regression coefficients along with their significance are given in Table 2&3, Fig. 3, respectively. The results showed that the idli made during initial stages of fermentation were relatively harder as compared to the idli prepared during later stages of fermentation i.e. 2.68 to 0.25 N. It was found that there was a significant hardness for the *idli* made with 2:1 blend ratio as compared to 4:1 blend ratio. 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). It was found that the idli formed after 14 h of fermentation was found to be softer with porous structure. Further, addition of little millet resulted in a loss of brightness ($L^*$) and a decrease in yellowness ($b^*$). The $L^*$ and $b^*$ values for fresh batter *idli* at 0 h of fermentation for all three blends were ranged as 90.43-93.47 and 17.67-18.79, respectively. Wherein, as the fermentation progressed the respective values were found to be decreased with time. The acceptable range of $L^*$(> 56.98) and $b^*$ (<

7.13) values for *idli* was found for 4:1 blend ratio. The organoleptic evaluation showed that the millet idli prepared with 4:1 blend ratio scored maximum (7.54) in the 9-point hedonic scale followed by 3:1 (6.98) and 2:1 blend ratio (6.67). The fermentation time is significant for colour values $a^*$ and $b^*$ of *idli* at $p<5\%$ level. The millet level is significant for colour values $L^*$ and $a^*$ at $p<5\%$ level and firmness and colour value $b^*$ at $p<1$ %.

## Conclusion

The millet *idli* batter with different blends of decorticated little millet and black gram were prepared and studied for its properties. Among these batter blends, millet *idli* prepared with 4:1 ratio having 14 h of fermentation was found acceptable.

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