Research Paper

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Enhancement of functional properties of Indian fermented food idli through incorporation of *Moringa oleifera* leave

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KEYWORDS : Idli; Fermentation; Texture profile analysis; *Moringa oleifera*

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ABSTRACT

Idli is one of the most important balanced breakfast food in the India and other countries in the Indian sub-continent. The present study was undertaken to determine the enhancement of functionality of idli by incorporating Moringa oleifera in idli batter. Idli were prepared from rice and black gram dhal incorporating M. oleifera leaves at 5%, 10%, 15% and 20% after fermentation. The developed products were analysed for texture profile analysis and organoleptic evaluation. The results revealed that 10% incorporation of M. oleifera leaves was accepted in both in terms of sensory and textural parameters. Idli incorporated with greens enriched with vitamins, minerals and fibre would make it as a complete balanced breakfast food for all age groups.

2. Introduction

'Idli' is prepared by steaming the mixture of rice (*Oryza sativa*) and black gram (*Phaseolus mungo*) batter in the ratio of 3:1. Fermentation of ingredients (rice and black gram dhal) is essential and fermentation improves the quality of end product 'idli'. Fermentation time is an important step during the preparation, which regulates the sensory characteristics and nutritional quality of 'idli' in terms of flavour as well in the texture. From a nutritional point of view, it is advantageous to consume mixtures of cereals and legumes due to its balance in diet (Nout, 2009). Being a cereal–legume-based fermented product, idli has an improved nutritive value as evident from the higher protein efficiency ratio (PER) and increased essential amino acid and vitamin contents (Desikachar *et al.,* 1960). Production of idli has been optimised with respected to ratio of ingredients and fermentation time recently (Durgadevi and Shetty, 2012). Efforts are on for formulating suitable starter cultures for the fermentation (Sridevi *et al.,* 2010).

Nutritive value of staple food can be enhanced through complementation of their restrictive micronutrients with value added ingredients. Green leafy vegetables are rich sources of many nutrients as well as functional ingredients. In recent years, there has been a greater interest in making available the traditional foods as convenience foods to meet the growing consumer demands. The functional foods are designed not only to cover the basic needs in energy, macronutrients and micronutrients but also to bring additional nutritional and physiological benefits to the consumers (Urbano *et al.,* 2000). *Moringa oleifera* is one of the well-known vegetables and both the unripe fruits as well as the leaves are commonly used as vegetables. *M. oleifera* leaves are known to be rich in macro and micronutrients as well as functional ingredients (Thurber *et al.,* 2009). The present study is intended to incorporate *M. oleifera* leaves in idli to nutritionally enrich idli.

2. Materials and Methods

2.1. Preparation of control and *M. oleifera* idli

In the present study, the most commonly used variety of rice namely IR 20 and a protein rich black gram variety Aduthurai 3 (ADT3) were used ratio of rice and dhal and fermentation time for idli preparation optimised earlier (Durga devi and Shetty, 2012) was used as control idli for the present study. To standardise the ideal ratio, batters were prepared and incorporated with fresh *M. oleifera* leaves at different levels of 5% 10%, 15% and 20% of fermented idli batter .

2.2. Texture profile analysis (TPA)

The texture of each idli was analysed using SMS / 75mm compression probe in Texture Analyser (Stable Micro Systems, Surrey, UK). The extra top and bottom layers were sliced off to make the idli fit to the mould. The cut piece was placed on the heavy duty platform and the test speed was set to 5mm/sec and the probe compressed 50% of the idli to get the TPA of the idli. Based on the force deformation curves, several parameters like adhesiveness, springiness, cohesiveness, chewiness and resilience were calculated.

2.3. Sensory analysis of idli

Idli samples were coded and served to ten panellists for sensory analysis. The desirable parameters included were colour, fluffiness, sponginess and fermented aroma. The undesirable parameters included were compactness, firmness, stickiness and sourness. The score card also had an option to give the score for overall quality of the sample. The panellists evaluated the *M. oleifera* incorporated idli compared with the control idli. The panel members were given a fifteen point rating scale to evaluate the idli. The ranges of the quality of idli were given by panel members by marking a line on the rating scale. The marking in the rating scale was counted as the score by using a measurement scale.

2.4. Proximate analysis:

The proximate composition of the developed idli (protein, fats, ash, carbohydrate and moisture content) were determined according to AOAC procedure (AOAC, 1995).

3. Statistical analysis:

The results are expressed as means and standard deviation of the mean of triplicate observations made of three parallel extractions and determinations. The data were subjected to descriptive statistics, t-test, analysis of variance, multiple comparisons using SPSS 12.0.

4. Results and discussion

4.1 Texture analysis of idli (TPA)

Texture profile of control and *M. oleifera* leaves incorporated idli were shown in Table 1. Idli are circular shaped of 7–10 cm diameter depending on the mould size, with lower and upper surface bulging, so the product is thick at the centre and tapering towards its periphery. Hardness is measured as the peak force during compression in the first cycle. The variation in the force is due to the variation in the level of incorporation of *M. oleifera* leaves incorporated in idli batter. Higher the force shows that harder is the idli. Adhesiveness should be minimum for idli, if the idli is not sticky. The adhesiveness of *M. oleifera* leaves incorporated idli varies between- 0.94 to -1.08 N when compared to control idli batter.

Table 1: TPA of control and *Moringa oleifera* leaves incorporated idli

Parameters	Hardness(N)	Adhesiveness (mg/sec)	Springiness#	Cohesiveness#	Chewiness#	Resilience#
Control	18.54±1.10	-41.45±1.62	0.57±2.54	0.76±0.12	1185.87±51.16	0.37±0.01
5%	16.99±5.27	-0.94±0.02	0.78±0.01	0.78±0.01	1079.52±145.77	0.47±0.03
10%	17.04±4.23	-0.89±0.02	0.72±0.06	0.72±0.06	854.74±120.59	0.41±0.06
15%	13.66±2.06	-0.78±0.15	0.64±0.12	0.64±0.12	765.80±247.26	0.43±0.08
20%	11.36±8.83	-1.08±0.21	0.61±0.10	0.61±0.11	1543.17±236.21	0.35±0.06
p-value	0.053*	0.435^{NS}	0.428^{NS}	0.191^{NS}	0.002*	0.133*

Values are the mean ± standard deviation. * Significantly different (p<0.05),NS-not significant.,#-parameters were unit less.

Springiness is defined as the height that idli recovers during the time that elapses between the end of the initial bite and the start of the subsequent bite, usually in TPA the first compression and second compression. The difference between the first peak and the second peak in the` graph is taken as springiness. Highest springiness of *M. oleifera* incorporated idli was at 5% and next to 10% level of incorporation. The springiness of idli depends on the quantity of the dhal used because the soft spongy texture observed in the leavened steamed idli made out of black gram is due to presence of two components, namely surface active protein (globulin) and a polysaccharide (arabinogalactan) in black gram (Susheelamma and Rao, 1974). Cohesiveness is the ratio of the positive force area during second compression to that during first compression. Cohesiveness decreases as the level of incorporation of *M. oleifera* leaves increased in idli due to high content of fibre which disintegrates under mechanical action. Chewiness is the product of multiple of hardness, cohesiveness, springiness and is therefore influenced by the change of any one of these parameters. Lower the chewiness softer is the idli. The chewiness of the idli was 1185.87 for the control idli at12 h fermentation time, whereas in the case of *M. oleifera* leaves incorporated idli the minimum for 10% and 15% level of incorporation, but there is no significant difference in the level of incorporation when compared to control idli. Lower the resilience value shows that the product can recover faster from deformation and thus proves the firmness of the product due to addition of *M. oleifera* leaves incorporation the resilience decreases as the level of incorporation increases.

4.2 Desirable parameters of idli

The desirable and undesirable parameters of idli were evaluated by sensory analysis because the evaluation of different cooked varieties of idli revealed the wide acceptance of the conventional product due to its attractive aroma, taste and consistency (Soni and Sandhu, 1989). The sensory parameters were studied for the control idli and *M.oleifera* leaves incorporated idli. The idli showed large difference in the sensory parameters in relation to level of incorporation of *M.oleifera* leaves.

Table 2: Effect of *M..oleifera* addition on the sensory characteristics of idli

Variations	Colour	Fluffiness	Sponginess	Fermented aroma	Overall acceptability
Control idli	12.30±0.81	9.07±0.58	12.57±0.43	7.60±0.16	11.60±0.81
5%	10.43±1.36	8.46±0.05	7.60±0.52	6.66±1.04	9.13±1.26
10%	9.16±0.78	7.66±0.15	6.83±0.76	7.60±0.17	7.06±1.28
15%	7.86±0.23	6.50±0.50	5.90±0.85	8.66±0.83	5.10±1.21
20%	6.43±0.51	5.83±0.28	4.86±0.80	7.76±0.68	3.03±1.30

Values expressed as mean ± standard deviation given in the table were significantly different (p<0.05)

Colour is a basic sensory parameter of food. Table 2 sums all the colour parameters of idli. The mean scores for the control idli was 12.30, in the case of *M.oleifera* leaves incorporated idli, the product has an appearance of scattered green colour due to fresh incorporation of drumstick leaves. The fluffiness and sponginess depends on the ratio of rice and black gram dhal and fermentation time. The important factor responsible for the texture which includes sponginess, firmness and stickiness of the idli depends on the starch content of the rice and dhal (Tharanathan and Mahadevamma, 2003). This glutinous and foam stabilizing properties of native polysaccharide is a special functional property of foods prepared from black gram (Tharanathan *et al.,* 1994). The *M. oleifera* leaves incorporated idli didn't contribute any special sensory criteria, though it was freshly included in batter. Idli has a fermented aroma due to beneficial bacteria during fermentation. Lactic acid bacteria contributes more fermented aroma to idli. The flavour of control idli was compared with *M. oleifera* incorporated idli. The flavour was acceptable and good for *M. oleifera* incorporated idli.

The compactness was high for the idli made with 20% followed by 15% and low for the idli made with 5% level of incorporation. This shows that the level of incorporation of *M.oleifera* leaves have a direct impact on the quality of the product. The results of undesirable parameters of sensory evaluation shows that in *M. oleifera* leaves the compactness was low because the greens were freshly added but not ground with idli batter. This makes less change in the compactness when compared to control idli (Table 3).

The firmness decreased with increase in black gram dhal quantity. The undesirable parameter does not insist on the attributes are not required for the product but should have moderate effect on the product. When the attributes such as compactness, firmness and stickiness were high are generally disliked by the consumers. The firmness of *M. oleifera* incorporated idli does not differ much, but it was significantly different when compared to control idli.

Table 3: Effect of *M. oleifera* addition on the sensory characteristics of idli

Variation/ parameters	Compactness	Firmness	Stickiness	Sourness	After taste
Control	2.82±0.85	9.35±0.20	2.15±0.20	2.27±0.17	1.35±0.30
5%	3.00±0.62	3.26±0.64	4.63±0.8	3.20±1.05	2.96±1.19
10%	4.76±0.37	5.26±1.27	6.13±2.08	3.83±0.72	4.90±1.38
15%	6.56±0.30	7.30±2.13	8.93±162	5.33±0.30	7.13±1.33
20%	8.36±0.49	9.30±3.10	11.83±2.01	7.00±0.50	9.03±1.23

Values expressed as mean ± standard deviation given in the table were significantly different (p<0.05)

The data concerning to nutritive value of the developed *M. oleifera* incorporated idli is presented in Table-4. Energy values of *M. oleifera* incorporated idli was 280.6 Kcal, though less in comparison to control 248.33 Kcal and difference was significant. Carbohydrate content of standard idli (77.6 g) was maximum followed by minimum for *M. oleifera* incorporated idli (70.31g). On comparing the protein content of the Idli, it was found to be maximum in of *M. oleifera* incorporated idli (9.31g) followed by control idli 12.07g). Fat content was decreased in *M. oleifera* added idli (0.62 g) in comparison to control idli 1.26 g. Fibre in *M. oleifera* added idli 3.17 g)which was the highest as present in control idli (1.42 g).

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Table 4: Proximate analysis of *M. oleifera* leaves incorporated idli.

Nutrients(g/100g)	Control idli	***M.oleifera* idli**
Energy(kcal)	280.6±5.13[a]	248.33±4.9[b]
Carbohydrates	77.6±2.5[a]	70.31±0.31[a]
Protein	12.07±0.54[a]	9.31±0.22[b]
Fat	1.26 ±0.51[a]	0.62±0.03[b]
Fibre	1.42 ±0.01[a]	3.17±0.50[b]

Means with different superscripts between columns were significantly different (p<0.05)

5. Conclusion

The incorporation of *M.oleifera* leaves in idli makes the product nutritious. Although this micro level of incorporation doesn't make a great change in the usual dietary pattern but reveals a marked change when the greens incorporated idli. The bright colour of the leaves, well cooked, soft fibres and good blending ability with the pulses makes the product softer and easily accepted. Being a cereal and legume based fermented food, idli incorporated with green leafy vegetables would make a complete balanced breakfast food suited for all age groups.

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