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Research Paper

Studies on the quality evaluation of idli prepared from barnyard millet (*Echinochloa frumentacaea*)

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■ **ABSTRACT :** Barnyard millet (*Echinochloa frumentacea*) is one of the hardiest millet, which is called by several other names *viz.*, kuthiraivali (T), shama (H), shamula (M), sawank (T) and sama (G). An investigation was undertaken to develop value added barnyard millet idlis. Standardization trials indicated that incorporation of barnyard millet at 30, 40 and 50 per cent could be incorporated in the standard recipe to yield acceptable idlis with low fat 0.88g per cent. Barnyard millet rice idlis were developed and its nutritionally superior than the control idlis. Wide variations in physico-chemical characteristics of the idlis were noted. Average value of volume, weight, pH, spreadability, specific gravity, diameter and width of barnyard millet rice idli ranged from 1.40ml, 2.91g, 1.03, 0.40cm, 1.25g/cm^3, 7.2cm and 2.6cm, respectively. The protein (6.82g), fibre (4.64g), phosphorus (122.01mg) and iron (4.05mg) were comparatively better than control idli. The organoleptic qualities of idlis were analysed by panellists on a 9 point hedonic scale and found to be organoleptically good.

■ **KEY WORDS :** Quality evaluation, Idli, Barnyard millet

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Barnyard millet (*Echinochloa frumentacaea*) or Japanese millet or billion dollar grass is grown principally as a forage grass. It resembles barnyard grass (considered a weed in many places) and probably originated from it. Japanese millet is usually grown as a late season green feed in temperate climates with humid or sub-humid conditions. It makes the most rapid growth of all millets under favourable weather conditions, occasionally producing ripe grain in 45 days after seeding. The growth habit of this annual grass is an erect plant 2-4feet tall with a panicle inflorescence made up of 5-15 sessile erect branches. Spiklets are brownish to purple and are borne on one side of each branch. Seeds are the slightly longer than wide and are larger than those of barnyard grass (Baker, 2008).

Barnyard millet is one of the hardiest millet, which is called by several other names *viz.*, kuthiraivali (T), shama (H), shamula (M), sawank (T) and sama (G). Barnyard millet is a multipurpose crop which is cultivated for food and fodder. It can be cultivated in all types of soils and sustains adverse climatic conditions. Nutritionally too, barnyard millet is an important crop. It is a fair source of protein, excellent source of dietary fibre with good amounts of soluble and insoluble fractions. For the health conscious genre of the present world, minor millet especially barnyard millet is perhaps one more addition to the proliferating list of healthy foods, owing to its nutritionally superiority. It is springtime for potential minor millets like barnyard millet to be woven in the fabric of daily diet.

Although barnyard millet like any other minor millet is nutritionally superior to cereals, yet its urbanization is limited. The major factor discouraging its cultivation and consumption with improvement in living standard or urbanization is the drudgery associated with its processing. However, there is a need to restore the lost interest in millets particularly barnyard millet that deserves recognition for its nutritional qualities and potential health benefits.

Food fermentations is an important technique in the

developing countries where the lack of resources limits the use of recent techniques such as vitamin enrichment of foods and the use of energy and capital intensive processes for food preservation. Millet grains can substitute for the rice or wheat component for the development of fermented foods like idli or dosa. Black gram originated in India where it has been in cultivation from ancient times, is one of the most highly prized pulses of India. Black gram has a mucilaginous material which makes it a valuable ingredient in idli preparation. The chief proteins present in black gram are albumins, globulins and glutelins. Fenugreek is used both as an herb (the leaves) and as a spice (seed). It is cultivated worldwide as a semi-arid crop. It is frequently used in curry and also as a main ingredient in the idli preparation.

Idli is a traditional cereal / legume-based naturally fermented steamed product with a soft and spongy texture which is highly popular and widely consumed as a food item in India (Agrawal *et al.*, 2000). Idli makes an important contribution to the diet as a source of protein, calories and vitamins, especially B-complex vitamins, compared to the raw unfermented ingredients (Srilakshmi, 2003). Idli also known as "Rice cake" is a traditional food of India. It is a favourite breakfast food in south India with spongy texture, attractive appearance, appetizing taste and flavour to get with its easy digestibility and good nutritive value contribute to its increasing popularity in all parts of India and also in other countries (Manay and Shadaksharaswamy, 2001). The present study was done to analyze the physical and chemical qualities of batter and barnyard millet incorporated idli with a view to determine the organoleptic acceptability.

■ RESEARCH METHODS

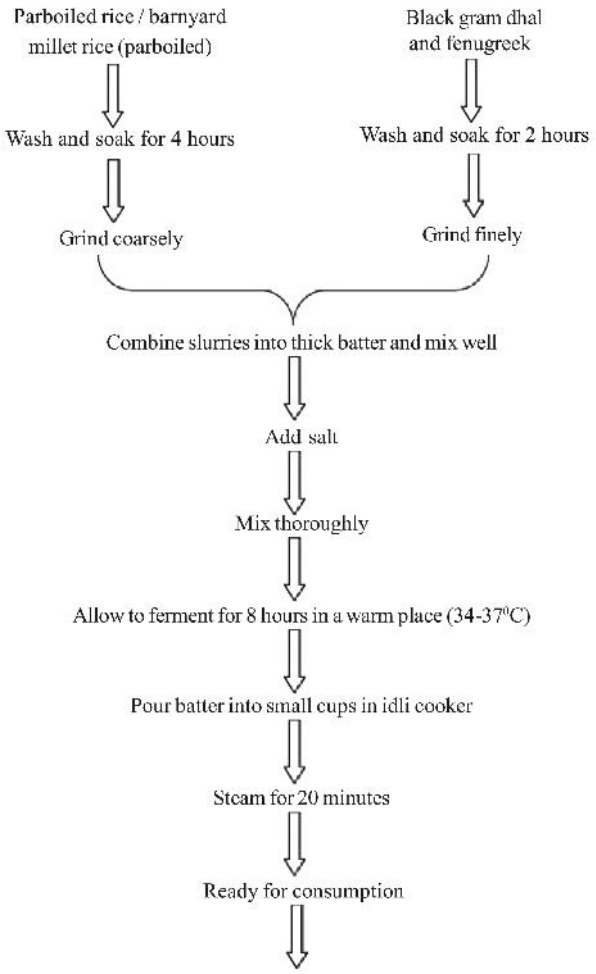
Formulation of idli :

Two different types of idlis with varying proposition of ingredients were prepared and the composition is given in the Table A.

Preparation of idlis :

The ingredients of different variables in the above specified proportion were soaked overnight and ground separately. Rice (parboiled), barnyard millet rice (parboiled) was ground coarsely and black gram to a fine paste with fenugreek seed. Ingredients were mixed together and salt was added. Parboiled rice is found to be more suitable than raw rice for making soft and spongy textured idlis. The speciality of black gram in idli preparation is owing to the mucilaginous material present in it which is absent in other edible legumes. This mucilaginous principle helps in the retention of carbon dioxide evolved during fermentation. The batter was allowed to ferment for 8 hours after that it was poured in an idli steamer and steamed till it was done (Flow chart).

Flow chart for idli preparation



Physical properties of developed batters before and after fermentation :

Various physical properties of the developed batters such as height, weight, pH, spread ability and specific gravity

Table A : Proportion of ingredients in barnyard millet idli

Standard idli		Barnyard millet idli	
Rice (parboiled)	100g	Rice (parboiled)	50g
Black gram	25g	Barnyard millet rice (parboiled)	50g
Fenugreek seeds	5g	Black gram	25g
Water	Required consistency	Fenugreek seeds	5g
		Water	Required consistency

of the batter are analyzed using standard techniques.

Physical parameters of developed idlis :

Various parameters such as diameter, width, weight of the cooked idlis, time taken for complete steaming were assessed using standard procedures. A special test called 'INK print test' was done to record the appearance of idlis permanently by means of photography on Ink prints. These prints furnish a record of number of pores per square inch in the graph sheets which indicates the softness of the developed idlis.

Organoleptic evaluation :

The developed idlis were served to a group of 30 trained panelists for the evaluation of appearance, colour, flavour, taste, texture and overall acceptability on a 9 point hedonic scale with a scores ranging from 9 to1 where scores 9 to1 represented like extremely and dislike extremely, respectively. The quality parameters were quantified and the mean scores of the three evaluations were evaluated.

Nutritive value of the developed idlis :

Nutrients like carbohydrates, protein, fat, calcium and iron were analyzed. Total carbohydrates were determined by volumetric method as described by Ranganna (2004), protein by Micro-kjeldhal method using a conversion factor of 6.25, fat by Soxhlet extraction method using petroleum ether (B P60 -70°C), fibre by fibra plus method, calcium content was determined by $KMnO_4$ titration method and iron content was estimated by the calorimetric methods as described by Ranganna (2004).

Statistical analysis :

The collected data were compiled and analyzed by using statistical methods. Descriptive statistics, ANOVA and correlation was computed using s statistical software SPSS version 15.0. Results revealed that determine the significant differences between the idlis.

■ RESEARCH FINDINGS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Physical properties of the batter :

In the present study, the mean initial height of the batter was noticed as 3.2 to 3.4 cm for the variations. After fermentation (8hrs), the raise in height was higher for standard idli batter (1.5cm) followed by barnyard millet idli batter (1.4cm), regarding the mean weight, increase weight was observed in barnyard millet idli batter (2.91g) followed by standard idli batter (2.77g). About pH, high reduction was noted in standard idli batter (1.30) followed by barnyard millet idli batter (1.03). High difference in spreadability was noted in barnyard millet idli batter (0.4 cm) compared to the standard. High specific gravity was noted in the barnyard millet idli batter (1.25g/ml) compared to the standard idli batter (Table 1). According to Nagaraju and Manohar (2000), there was a decrease in diameter of the product as the ratio of rice to black gram increases in the batter. According to Narpinder *et al.* (2007) the effect of substituting rice with extrusion cooked (75, 100 and 125C) rice flour at 30, 40 and 50 per cent levels had significant effects on the specific gravity, acidity and pH of the idli batter, and textural and sensory quality of the idlis.

There was a significant co-relation between the variables of weight and specific gravity of the batter at 5 per cent level in negative sense which shows if weight increases air holding capacity decreases. Spreadability of the batter has strong positive co-relation with the pH of the batter at 1 per cent level (Table 2). According to Soni *et al.* (2000),

Table 1 : Mean physical properties of the batter

Parameters*	Standard idli			Barnyard millet idli		
	I	F	D	I	F	D
Height (cm)	3.40	4.90	1.50	3.20	4.60	1.40
Weight (g)	22.61	19.84	2.77	22.43	19.52	2.91
pH	6.70	5.40	1.30	6.59	5.56	1.03
Spreadability (cm)	4.30	4.54	0.24	4.70	5.10	0.40
Specific gravity (g/cm^3)	1.00			1.25		

Note:*Values are averages of three replicates in each sample , I-Initial, F-Final, D-Difference

Table 2 : Co- relation matrix of the physical properties of the batter

Parameters	Height(cm)	Weight(g)	pH	Spreadability (cm)	Specific gravity (g/cm^3)
Height (cm)	1				
Weight (g)	0.726	1			
pH	0.614	0.129	1		
Spreadability(cm)	0.783	0.329	0.469	1	
Specific gravity (g/cm^3)	0.821	-0.979*	0.102	0.369	1

* Co-relation is significant at 0.05 level (2- tailed)

density of the batter decreased as the level of air incorporation or water addition to the batter increased .The spreadability of batter was directly proportional to the water content but inversely proportional to the air in corporation in the batter. The radial growth decreased linearly with increase in apparent viscosity of batter.

Physical parameters of the developed idlis :

Physical parameters of the idlis are given in Table 3. The diameter of the standard idli was found to be high with a value of 7.8 cm followed by barnyard millet idli (7.2cm) respectively. The highest width value (2.9cm) was obtained by standard idli followed by barnyard millet idli (2.6cm). The cooked weight of the standard idli was found to be high (56g) followed by barnyard millet idli. More cooking time was taken by the barnyard millet (12 minutes) and least in standard idli (7 minutes). The greater number of pores (15) per square inch in the ink print test was noted in the barnyard millet idli followed by standard idli (12) which shows that if the number of pores increases the softness of the idli will also increase (Table 3).

Table 3 : Physical parameters of the developed barnyard millet idlis

Parameters	Standard idli	Barnyard millet idli
Diameter (cm)	7.8	7.2
Width (cm)	2.9	2.6
Cooked weight (g)	56	51
Cooking time (min)	7	12
Number of pores in a square inch	12	15

Organoleptic evaluation of idlis :

The mean acceptability scores obtained by the sensory evaluation of millet idlis are in Table 4. Among the different variations, standard idli has got a highest scores of 8.72 followed by the variation barnyard millet idli with a score of 7.82 for the appearance attributes. Regarding the colour attributes, the highest score 8.54 was obtained by standard idli followed by barnyard millet idli score was 7.84. The texture attributes was found to be maximum for the standard with the score of 8.84 followed by the barnyard millet idli (7.60). Regarding the taste attributes the highest score of 8.72 was obtained by the standard which was followed by the barnyard millet idli with the score of 7.86. The overall scores of standard were found to be slightly higher (8.58) than the barnyard millet idli with the score of 7.78. Results revealed that there was significant difference between standard and other variations for all the attributes such as appearance, colour, flavour, texture, taste and overall acceptability. It was found that there was a strong negative correlation for the number of pores with cooking time and over all acceptability and positive correlation between cooking time with overall acceptability at 5 per cent level. It was found that there was a strong positive correlation between overall acceptability and taste of the developed idlis at 1 per cent level.

Nutritive value of the developed idlis :

The data pertaining to nutritive value of the developed barnyard millet based idlis is presented in Fig.1. On comparing the protein content of the two types of ldli, it

Table 4 : Mean organoleptic scores of barnyard millet idlis

Type of variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Standard idli	8.72±0.32	8.54±0.36	8.84±0.11	8.74±0.20	8.72±0.17	8.58±0.37
Barnyard millet idli	7.82±0.29	7.84±0.21	7.60±0.54	8.17±0.08	7.86±0.63	7.78±0.81
F ratio	22.42	27.34	29.93	219.77	28.28	10.13
P value	0.000**	0.000**	0.000**	0.001**	0.000**	0.003**

9-point hedonic scale is as follows: 1—dislike extremely, 2—dislike very much, 3—dislike moderately, 4—dislike slightly, 5—neither like or dislike, 6—like slightly, 7—like moderately, 8—like very much, 9—like extremely. ** Indicate significance of value at P=0.05 and 0.01, respectively

Table 5 : Nutrient composition of barnyard millet idlis

Nutrients	Quantity	
	Standard idli	Barnyard millet mixed idli
Protein (g)	5.40	6.82
Fat (g)	0.50	0.88
Fibre (g)	0.18	4.64
Carbohydrate (g)	52.46	48.71
Calcium (mg)	8.91	12.30
Phosphorus (mg)	95.37	122.01
Iron (mg)	0.93	4.05

Table 6 : Co- relation matrix for the physical parameters with organoleptic scores of the idlis

	Diameter (cm)	Thickness (cm)	Weight (g)	Number of pores (sq. inch)	Cooking time(min)	Texture	Taste	Over all acceptability
Diameter (cm)	1							
Thickness(cm)	0.343	1						
Weight (g)	0.091	0.288	1					
Number of pores (sq inch)	0.186	0.768	0.385	1				
Cooking time (min)	-0.316	-0.752	-0.333	-0.946**	1			
Texture	0.497	0.305	0.129	0.336	-0.226	1		
Taste	-0.170	-0.264	0.167	0.380	-0.261	0.328	1	
Overall acceptability	0.183	0.428	0.378	0.892**	-0.816**	0.433	0.732*	1

* and ** Indicate significance of value P=0.05 and 0.01, respectively

was found to be maximum in barnyard millet idli (6.82g) followed by standard idli (5.40g). Fat content was also improved in barnyard millet idli (0.88g) in comparison to standard idlis (0.50g), carbohydrate content of standard idli (52.46g) was maximum followed by barnyard millet idli (48.71g). Fibre in barnyard millet idli (4.64g) was the highest amount than in standard idli (0.18g). Calcium content was found to be maximum in barnyard millet idli (12.30mg) followed by standard idli (8.91mg). Phosphorus in barnyard millet idli (122.01mg) was the highest amount than the standard idli (95.37mg). Presence of iron in barnyard millet idli and standard idli was 4.05mg and 0.93mg, respectively (Table 5).

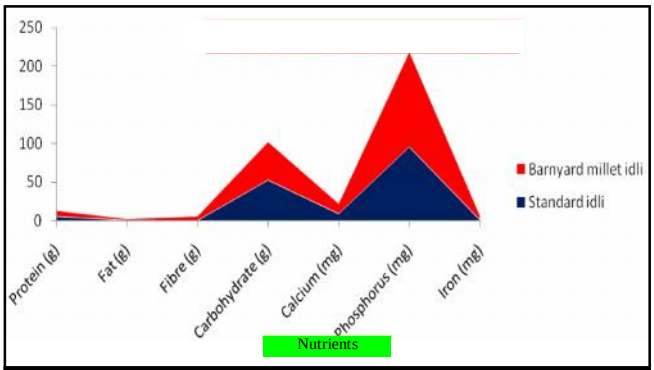


Fig. 1 : Nutrient composition of idlis

Co-relation matrix for the physical parameters with organoleptic scores of the idlis is presented in Table 6.

Conclusion :

Cereals are less costly source of energy compared to fats in the developing countries. Barnyard millet can be used in idli preparation instead of rice in scarcity areas. In barnyard millet an important feature is its high fibre content, which is recognized for its hypoglycemic effects. For the health conscious in the present world, minor millet especially barnyard millet is perhaps one more addition to the proliferating list of healthy foods, owing to its nutritional superiority. With the modern people chasing ready to cook food items, the nutritive minor millets are being faded into oblivion. It is springtime for potential minor millets like barnyard millet to be woven in the fabric of daily diet.

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