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Studies on effects of composite flour on some important quality attributes of fermented *Idli*

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Abstract
Present work have been undertaken to study the effect of composite flour on textural and keeping quality of *idli*. Four sample were prepared and samples coded as T0 (rice: black gram (75: 25), T1 (rice: black gram: soybean: bajra (65: 15: 15: 5), T2 (Rice: Black gram: Soybean: Bajra (75: 10: 10: 5) and T3 (rice: black gram: soybean: bajra (80: 5: 5: 10). Guar gum and xanthan gum were used about 0.1 percent. The viscosity of batter for sample T2 was found more as compare to other sample i.e. 580 Cp/s. The spreadability of batter for T0 sample was 4.1cm and after fermentation it was 4.3cm whereas for sample (T2) spreadability was 4cm and after fermentation it is was 4.2 cm. The textural characteristics of *idli* showed hardness of sample T3 is higher than other samples. Microbial quality revealed that the highest yeast and mould count, and standard plate count (SPC) of *idli* sample were found on 6th day while the coliform count was negative. It can be concluded that product having better overall sensory acceptability with storage for 6 days under refrigerated condition.

Keywords: coliform count, *Idli*, soybean, texture, yeast and mold count

Introduction
Protein malnutrition is a serious problem in India due to cereal based dietary pattern. Malnutrition is condition resulting from inappropriate nutrition. Malnutrition among under-five children is a major public health problem in India. The most recent estimates show that more than one billion people worldwide are undernourished (FAO, 2009) [4]. Food and Agricultural Organization suggested that to meet the recommended dietary allowances of infants, preschool children, adolescent girls, pregnant and lactating women through simple and inexpensive technology in the form of ready to eat snacks, baked, fermented and convenient food. Therefore various preparations based on cereal-pulse combination are of paramount important to improve the protein quality of Indian diet.

Rice (*oryza sativa*) is a staple crop and forms the foundation of the diet for many of the world's population. About 85% of the rough rice produced in the country is converted into rice. Rice is an excellent food source, low in fat and high in starchy carbohydrate. Black gram (*Phaseolus mungo*) or urad is one of the important pulse crops in India. It contains about 26% protein which is almost three times that of cereals. Soybean is derived from seeds *Glycine max* (L) merr of family- L*egumiodae* or *Fabaceae*. India rank 5th in soybean production with 11.7 million tons (GFP, 2016). Kadam *et al.* (2012) [7] stated that Legumes have been known as "a poor man's meat". Soybean contains about 40 percent protein and defatted soybean contains more than 50 percent protein. Pearl millet (*Pennisetum glaucum*) also known as bajra, is a cereal crop grown primarily in Africa and Asia. Bajra rich in iron and zinc, contains high amount of antioxidants and these nutrients along with the antioxidants may be beneficial for the overall health and wellbeing.

Xanthan gum is a natural polysaccharide and an important industrial biopolymer. xanthan gum, produced by the bacterium *Xanthomonas campestris.* Xanthan gum is highly soluble in both cold and hot water. Xanthan solutions are highly viscous even at low polymer concentrations. Xanthan is used as thickener, binder and emulsifier. Guar gum is an extract of the guar bean, where it acts as a food and water store. Guar gum comes from the endosperm of the seed of the legume plant (*Cyamopsis tetragonoloba*). The most important property of guar gum is its ability to hydrate rapidly in cold water to attain uniform and very high viscosity at relatively low concentrations.

Fermentation is simply breakdown of complex molecule to simple molecules by the action of enzyme produced by microorganism.

The fermented foods are better in quality with high bioavailability of nutrients. The fermentation process causes enrichment and improvement of food through flavor, aroma and change in texture, preservation by providing organic acids, nutritional enrichment, reduction of exogenous toxins and reduction in the duration of cooking. There are various types of food products which are prepared by fermentation, such as *idli*, dhokla, dosa, bread etc. *Idli* is a traditional cereal and legume based naturally fermented steamed product with a soft and spongy texture which is highly popular and widely consumed as a breakfast food item in India (Steinkraus, 1995) [11]. Generally *idli* is prepared from rice and black gram. For increasing its nutritional value *idli* was incorporated with soybean and pearl millet with basic grains in addition with gum. In this research the effect of soybean and pearl millet and gums were studied for analyzing effect on viscosity of batter, texture of *idli* and microbial quality.

Material and Method

Material

Raw material

Best quality grains such as Rice, Black gram; Soybean and Bajra were obtained from local market of parbhani.

Xanthan gum and Guar gum

Xanthan gum and Guar gum were used from department of Food Engineering, college of food technology, VNMKV, Parbhani.

Chemicals

All the chemicals used in this investigation were of analytical grade. They were obtained from Department of Food and Industrial Microbiology, Department of Food Chemistry and Nutrition, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Methods

Functional properties of gum

The water holding capacity (%), Emulsifying stability and Foaming capacity (%) were studied.

Rheology of batter

The rheology of the *idli* batter was determined using a Brookfield viscometer DV-E having a disc spindle with speed 100 rpm. And it was determined in the department of Food Engineering.

Microbial analysis

The yeast and mold count, coliform counts were determined by the method recommended by Harrigan and McCance (1966) [6].

Texture analysis

Texture analyzer (Stable Micro System *TAXT plus* sr. no. 12981, USA) was used for texture profile analysis (TPA) of *idli.*

Results and Discussion

Table 1: Functional properties of guar and xanthan gum

Functional Properties	Guar gum	Xanthan gum
Water Holding Capacity (%)	67.18	66.27
Emulsifying Stability	0.79	0.77
Foaming Capacity (%)	24.32	23.21

*Each value is the mean of three determinations.

The functional properties of guar gum and xanthan gum were examined and found the water holding capacity, emulsifying stability and foaming properties shown in Table 1. The water holding capacity of guar gum was found to contain 67.18%, emulsifying stability 0.77 and foaming capacity is 24.32%. Whereas the water holding capacity of xanthan gum was found to have 66.27%, emulsifying stability 0.77 and foaming capacity is 23.21% respectively. The results were in close agreement to the results obtained by Amir *et al.*, (2015) [1].

Table 2: Rheology (viscosity) of *idli* batter

Samples	Viscosity (Cp/s)
T 0	560
T1	553
T2	580
T3	595

*Each value is the mean of three determinations.

The rheology of the *idli* batter was determined using a Brookfield viscometer DV-E having a disc spindle with speed 100 rpm. The increase of rice content in the batter showed marginally increased values of consistency index which indicated non Newtonian behavior (pseudo plastic or shear thinning). Volume increases during the course of the fermentation for the batter types 2:1, 3:1 and 4:1 of ratios. There was volume increased up to 14 h of fermentation.

From Table 2 it was revealed that the rheological characteristics of the *idli* batter were found viscosity of *idli* batter of T0 sample (560 Cp), sample T1 (553 Cp), sample T2 (580 Cp) and sample T3 (595 Cp). The viscosity of sample T3 is higher as compare to the other samples whereas sample T1 was found lower viscosity among all the samples because of change in the ratio of rice and black gram. The results were in close agreement to the results obtained by Nagaraju and Manohar (1999) [8] and Ghosh and Chattopadhyay (2010) [5].

Table 3: Physical characteristics of *idli* batter

Parameters	T0			Sample (T2)		
	Initial	Final	Difference	Initial	Final	Difference
Height (cm)	3.0	3.9	0.9	3.0	3.7	0.7
Weight (g)	20	19.3	0.7	20	19.1	0.9
pH	6.4	5.6	0.8	6.4	5.5	1.1
Spread ability (cm)	4.1	4.3	0.2	4.0	4.2	0.2
Specific gravity (g/cm^3)	0.91	-	-	0.95	-	-

*Each value is mean of three determinations

The data presented in Table 3 showed that the initial height of the control (T0) *idli* batter was (3 cm), after fermentation the raise in height (3.9cm), weight (20g), after fermentation (19.3g), pH of *idli* batter is 6.4, after fermentation pH was 5.6 because of increase in the acidity. The spread ability of batter was 4.1cm and after fermentation it was 4.3cm. The spread

ability of batter increases as increase in the fermentation period. The specific gravity of control sample was found (0.91g/cm^3) and sample (T2) was found (0.95g/cm^3). Whereas the initial height of the sample (T2) was 3 cm and after fermentation raise in height of batter was 3.7cm, initial weight of batter was 20 g and after fermentation was 19.1g. Loss of weight in sample (T2). The pH of *idli* batter is 6.4 and after fermentation was 5.5 because of increase in the acidity and spreadability of sample (T2) is 4 cm and after fermentation it is was 4.2 cm. The spreadability of batter increases as increase in the fermentation period. There was significant correlation between the variables of weight and height of the batter level. If weight increases air holding capacity decreases. Spreadability of the batter had strong positive correlation with the pH of the batter. Density of the batter decreases as the level of air incorporation or water addition to the batter increased. The results were in close agreement to the results obtained by Nazni and Shalini (2010) [9].

Table 4: Textural profile analysis of *idli*

TPA Parameters						
Sample	**Hardness (N)**	**Adhesiveness (m)**	**Springiness(sec)**	**Cohesiveness(m)**	**Chewiness(g/sec)**	**Resilience**
T0	32.17	-0.078	0.965	0.719	1277.9	0.37
T1	37.25	-0.011	0.713	0.498	1390.21	0.43
T2	36.59	-0.061	0.733	0.523	1389.17	0.41
T3	37.85	-0.009	0.708	0.513	1393.14	0.42
Mean	35.965	-0.0398	0.7798	0.5633	1362.6	0.4075
SE±	0.0117	0.0002	0.0006	0.0008	0.1725	0.0051
CD at 5%	0.0353	0.0006	0.0018	0.0023	0.5273	0.0155

*Each value is the mean of three determinations.

The data presented in Table 4 showed the effects of ingredients on texture of *idli* and it was found that hardness of T0 sample (32.17N), sample T1 (37.25N), sample T2 (36.59N) and sample T3 (37.85N). The hardness of sample T3 is higher than other samples. The higher force indicate hardness of *idli*. The ratio of rice and black gram dhal used for *idli* had linear effect on the hardness of the *idli*. At 0.1% concentration of xanthan and guar gum, the hardness of the *idli* was found to be minimal. The negative peak in the graph is taken as the adhesiveness. The adhesiveness of control sample was (-0.078 m), sample T1 (-0.011m), sample T2 (-0.061 m) whereas sample T3 (-0.009 m). If the product is sticky, adhesiveness will be higher. The adhesiveness of the control sample was higher than other samples. The springiness of *idli* depends on the quantity of rice and dhal ratio used, because the soft spongy texture observed in the leavened steamed *idli* made out of black gram. The presence of two components, namely surface active protein (globulin) and a polysaccharide (arabinogalactan) in black gram. The springiness of control sample (0.965 sec), sample T1 (0.713 sec), sample T2 (0.733 sec) whereas sample T3 (0.708 sec). The control *idli* sample was found higher springiness compare to other samples. Cohesiveness of control sample (0.719 m), sample T1 (0.498 m), sample T2 (0.523 m), whereas sample T3 (0.513 m). The cohesiveness of control sample is higher than other samples, because of change in rice and black gram dhal ratio in linear effect. The cohesiveness of the *idli* samples decreased with an increase in the concentration of guar and xanthan gum as compare to control sample. Chewiness of the control (T0) sample (1277.9 sec), sample T1 (1390.21 sec), sample T2 (1389.17 sec), whereas sample T3 (1393.14 sec). The sample T3 is higher in chewiness compare to other samples, if chewiness is increased softness of the product is decreased. The ratio of rice and black gram dhal in linear effect and fermentation period also have significant impact ($p<0.05$) on the chewiness of the *idli*. The resilience of control *idli* was (0.37), sample T1 (0.43), sample T2 (0.41) whereas sample T3 (0.42 resilience). The Lower resilience value indicates that the product can recover faster from deformation proving the firmness of the product. The control *idli* sample is softer than other samples. The prepared *idli* sample results were in close agreement to the results obtained by Thakur *et al*., (1995), Balasubramanian (2007) [2] and Durgadevi and Shetty (2012) [3].

Table 5: Microbial and storage study of *idli* (Sample T2)

Storage Period (days)	**Microbial quality (cfu/gX10^{-3})**			
	Total plate count (cfu/gm)x10^{-3}	**Yeast and mould (cfu/g)x10^{-3}**	**pH**	**Coliform count**
0	0	0	6.5	ND
3	6.2	2.1	4.6	ND
6	8.7	7.5	4.2	ND

ND: Not Detected

The *idli* scored higher for sensory attributes was analyzed for yeast and mould count, standard total plate count and coliform count (Table 5). The highest yeast and mould count of *idli* sample were found on day six. The highest standard plate count (SPC) of *idli* sample was found on day six. The coliform count is negative which means that strict hygienic practice was observed during preparation of *idli.* The results were in close agreement to the results obtained by Sheela and Kowsalya (2013) [10] and yadav and Prasad (2013) [14].

Conclusion

From the research it was concluded that with increasing levels of composite flour to *idli* there was increases in hardness but use of gums in *idli* batter were reduced this problem to some extent. It was also concluded that due to fermentation (increased in acidity) and hygienic environment of preparation increased the shelf life of *idli* upto six days.

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