

less costly can be advocated to be ideal components of integrated pest management system.

#### Reference

- Gomez, K.A. and Gomez, A.A. (1984). *Statistical Procedures for Agricultural Research*. A Wiley International Science Publication, John Wiley and sons, New Delhi, pp. 207-211.
- Hanifa, A.M., G. Balasubramanian, I. David and Subramanian, T.R. (1973) Screening of Lablab varieties for resistance to black bean aphid *Aphis craccivora* Koch. *South Indian Horticulture*. 21:131-133.
- Henderson, C.F. and Tilton, E.W. (1955) Tests with acaricides against the brown wheat mite. *J. Econ. Entomol.* 48(2) : 157-161.
- Khurna, A.D. and Kaushik (1991) Bioefficacy of insecticides against *Aphis craccivora* Koch and *Agrotis ipsilon* Hufn. on chickpea. *J. Insect Sci.* 4(2):193-194.
- Schmutterer, H. (1990) Properties and potential of natural pesticides from the neem tree; *Azadirachta indica* *Annu. Rev. Entomol.* 35 : 272-297.

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## Ready to use dry mix for Idli

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**Abstract :** A ready to use dry mix with parboiled rice flour and blackgram flour was prepared and its fermentation was augmented with curd or fermented batter - an external source of inoculum. Idlies prepared from that batter after 9-13 h fermentation was organoleptically equal to that of regular wet ground method. For this dry mix method, rice flour vs blackgram flour, dry mix vs water ratio and optimum time of fermentation were standardised. (**Key Words :** *Dry mix Idli, Wet ground, Curd, Fermented batter*)

The breakfast dish prepared out of milled rice is idli in Indian households and it requires stone grinding of soaked parboiled milled rice and blackgram dhal separately into pastes, mixing them together and fermenting for 16-18 h before steam cooking (Desikachar et al. 1960). This takes lot of time and in modern times, when most of the housewives also leave for jobs early, an instant Idli mix is the need to prepare Idli. Although attempts have been made in the past to prepare instant idli mixes, the quality of Idli made out of them was not comparable to that made from stone ground and fermented batter idli. Moreover, instant idli mixes available in the market are mostly non-fermented product and in it chemicals are added to get softness of the idli. Therefore, in the present study, possibilities were explored to develop a product of rice flour and blackgram flour that could be used readily for fermentation with external inocula to prepare idli.

#### Materials and Methods

Parboiled milled rice (variety IR 20) was

finely ground in flour mill (plate grinder) and sieved through -22 +30 BSS and decuticled dry blackgram dhal also was powdered and sieved through -50 BSS mesh. Two parts of rice flour, one part of blackgram dhal flour and 2 per cent sodium chloride were mixed together (dry mix) and stored. To identify the best source of external inoculum to ferment dry mix, different sources of inoculum, viz., bread yeast (5 mg), active dry yeast (5 mg), fermented idli batter (¼ spoon), toddy (5 ml) - a fermented product of the sugary exudates of inflorescence of palmyrah (*Borassus flabellifer* L.) or coconut (*Cocos nucifera* L.) and curd (¼ spoon) separately as well as each one mixed with curd were tried.

The batter was prepared from the dry mix stock by uniformly dispersing 100 g of dry mix in 200 ml water into a homogenous consistency. To that mixture, different sources of inoculum in different combinations as mentioned in Table 1 were added and kept in one glass beaker. The raise in batter volume, pH and flavour were observed after

12 h. Idlies were prepared by taking the batter in small perforated cup shaped holders in the idli vessel and steamed for 10 min. The quality of idli was assessed by six member panel of judges to evaluate the characteristics like appearance, flavour, texture, taste and acceptability. The experiments were replicated three times and mean results reported.

To standardise the optimum time required for fermentation to get batter for preparing good quality idlies, dry mix was inoculated with curd as well as fermented batter, allowed for fermentation and after 5, 9, 11, 13, 16 and 20 h idlies prepared. To standardise the optimum proportion of rice and blackgram flours into a dry mix and at which proper fermentation idlies of acceptable organoleptic quality could be obtained, varying proportions of rice flour and blackgram flour were mixed viz., 2:1, 3:1, 4:1, 5:1 and allowed for fermentation with fermented batter and curd as inoculum. To standardise the optimum quantity of water required for proper fermentation of dry mix, different quantities of water viz., 180, 200, 220 and 240 ml. were mixed with 100 g. of dry mix and allowed for fermentation with curd as inoculum. All the above treatments were imposed at room temperature of 28-30°C. After 12 h fermentation, the idli was prepared and quality assessed as mentioned earlier.

### Results and Discussion

Instead of traditional method of wet grinding of rice and blackgram and allowing for natural fermentation, dry powder mix of rice and blackgram was tested. The fermentation was augmented by different sources of external starters to get good quality idlies. Of all the inocula, curd, active dry yeast, fermented idli batter individually and in combination with curd had mild to strong fermented flavour in the batter, whereas in bread yeast and toddy inoculated batter, fruity flavour and acidity were observed (Table 1). On the other hand, in control, strong off flavour was observed. Higher batter volume raise was observed upto 46 per cent with curd inoculum and 58 per cent with fermented idli batter and curd inoculum. Low batter volumes of 28 and 30 per cent were observed in dry yeast and in bread yeast treatment respectively.

The texture of idli, prepared from the batter with curd or fermented batter was spongy and the taste was normal, good and acceptable, whereas, dry yeast and bread yeast inoculated batter idlies were either hard or pasty and tasted bitter and sour. Even though the idli prepared from control was spongy, it tasted bitter with foul smell. Desikachar et al. (1960) reported that the organoleptic qualities of the idlies prepared from the dry mix were poor

with foul smell. In the present study, these defects were overcome by the addition of external inoculum like curd or fermented idli batter. The use of starter culture in the form of dry yeast or bread yeast or toddy to initiate fermentation of batter failed to yield desirable results. But the success obtained in the present study with external inocula like lactic organisms in the curd and other organisms in the fermented batter as starter culture, might be due to prevention of the growth of unwanted types of microflora which caused foul smell.

Even though idlies can be prepared from dry mix with inoculum, the duration of fermentation play a major role in the preparation of acceptable idlies, as allowing more time leads to bitterness and sourness in idli. In wet grinding or dry mix fermentation, the time allowed for fermentation in a particular temperature is an important criterion for getting good quality idli. Desikachar et al. (1960) reported that optimum temperature for natural fermentation of idli batter is 29°-30°C and that this temperature, the rate of fermentation was faster and about 16 h is sufficient to give a ripe batter. Idlies made from that batter were soft retaining the full and characteristic aroma of idli. In the present investigation, the optimum time required for fermentation for getting good organoleptic quality idlies varied depending upon source of inoculum. In the dry method, the fermentation time was reduced to 9-13 h instead of 16-18 h in wet ground method. Allowing more time than required leads to bitterness and sourness with off smell in idlies from dry mix method. Wet ground batter also became sour when allowed more fermentation time, but in dry mix, the effect was more. When dry mix was inoculated with curd or fermented batter upto 5 h and in control upto 9 h, no fermentation changes occurred (Table 2). For dry mix, the optimum fermentation time of 11 to 13 h for curd inoculum and 9 to 11 h for fermented batter inoculum is required to get acceptable organoleptic quality idlies. The time of fermentation with curd inoculum was relatively longer presumably because of the presence of only the lactic organisms. On the other hand in fermented batter, many types of organisms that were present when inoculated, might have fermented the batter faster. A number of wild yeast combined with different lactic bacteria (Lewis et al. 1953); *Leconostoc mesenteriodes*, *Streptococcus faecalis*, *Pedicoccus cerevisiac* (Mukherjee et al. 1965) *L. mesenteriodes*, *S. faecalis*, *Lactobacillus delbruekii* and *L. buchnerii* (Ramakrishna et al. 1976) have been reported in the fermented batter.

Of the different ratios of rice and blackgram flour tested to standardize the dry mix, the maximum batter volume raise of 58 per cent was observed in



**Table 1.** Effect of different sources of inoculum to dry mix batter on qualities of idli

Particulars	Batter				Idli		
	pH	Flavour	Volume raise(%)	Texture	Flavour	Taste	Acceptability
Control	5.5	Os	42.5	Sp	Os	S&B	NA
Curd	4.4	MF	46.0	Sp	N	N	A
Dry yeast	5.5	St.F	28.0	Pa	N	S&B	NA
Dry yeast + curd	4.4	MF	39.0	SI	N	S&B	NA
Fermented idli batter	5.1	F	48.0	Sp	N	N	A
Fermented idli batter+curd	5.0	F	58.0	Sp	N	S	A
Toddy	5.0	St.Ac	47.0	Sp	N	SI.B	NA
Toddy+curd	4.5	St.Ac	36.0	Sp	Ac	S	A
Bread yeast	6.0	Fr	30.0	Pa	Os	B	NA
Bread Yeast+curd	5.5	Fr	32.0	Pa	Os	B	NA

Os - Off smell; M - Mild; St - Strong; F - Fermented; Ac - Acidic;  
 Fr - Fruity; N - Normal; Sp - Spongy; Pa - Pasty; H - Hard;  
 S - Sour; B - Bitter; SI - Slightly; NA - Not acceptable; A - Acceptable.

**Table 2.** Influence of fermentation time of dry mix with different sources of inoculum on the qualities of batter and idli.

Time (h)	Batter				Idli			
	pH	Flavour	Volume raise(%)	Water seperation	Texture	Flavour	Taste	Acceptability
WITH CURD INOCULUM								
5	6.5	NoF	Nil	Nil	H	N	R	NA
9	6.0	MF	10	Nil	SI.H	N	R	NA
11	5.5	MF	34	Nil	Sp	N	N	A
13	5.0	F	48	Nil	Sp	N	SI.S	A
16	4.5	Ac	45	Y	Sp	S	B&S	NA
20	4.5	AC	45	Y	Sp	S	B&S	NA
WITH FERMENTD BATTER INOCULUM								
5	6.5	NoF	Nil	Nil	H	N	R	NA
9	5.0	F	34	Nil	Sp	N	N	A
11	5.0	MAc	51	Nil	Sp	N	N	A
13	5.0	Ac	58	Nil	Sp	Ac	S	A
16	5.0	Ac	48	Y	Sp	Ac	B&S	NA
20	4.5	Ac	46	Y	Sp	Ac	B&S	NA

2:1 ratio and lowest of 42 per cent in 5:1 ratio. The idlies prepared from 2:1 and 3:1 ratios were spongy and soft with normal flavour; however the taste was slightly sour in 3:1 ratio (Table 3). On the other hand, 4:1 and 5:1 treatment idlies were hard with sour taste. The same trend was observed when fermented batter was used as inoculum. Yaurvedi (1980) also reported that for idli preparation in the traditional method of wet grinding, rice and black gram ratio of 2:1 or 3:1 was the best.

Of the different ratios of water mixing with dry mix tried, the idlies prepared from 1:2 and 1:2.2 (w/v) ratio batter had acceptable qualities with spongy texture and normal flavour (Table 4).

However, the taste was slightly sour in 1:2 (w/v) treatment. On the other hand, the lowest water mix ratio idli was hard and the highest water ratio batter idli was pasty.

From the above investigation, a process was standardised for the preparation of idli from ready to use dry mix with curd or fermented batter as inoculum with a fermentation time of 9-13 h. instead of the traditional wet grinding of soaked rice and black gram and allowed for 16-18 h fermentation. The rice flour to blackgram flour ratio of 2:1 for dry mix, the dry mix to water ratio of 1:2 (w/v) were found to be optimum for fermentation to prepare idlies with good organoleptic qualities. So,

Table 2. Contd...

Time (h)	Batter				Idli			
	pH	Flavour	Volume raise(%)	Water seperation	Texture	Flavour	Taste	Accept ability
NO INOCULUM								
5	6.5	R	Nil	Nil	H	R	R	NA
9	6.5	R	Nil	Nil	H	F	R	NA
11	6.0	MF	28	Nil	Sl.Sp	Os	Sl.B	NA
13	5.5	Os	58	Y	Sp	St.Os	B&S	NA
16	5.5	Os	50	Y	Sp	St.Os	B&S	NA
20	5.0	Os	46	Y	Sp	St.Os	B&S	NA

R - Raw; F - Fermented; M - Mild; N - Normal; OS - Off smell; Ac - Acidic; H - Hard; Sp - Spongy; Sl - Slightly; St - Strong; Y - Yes; S - Sour; B - Bitter; A - Acceptable; NA - Not Acceptable

Table 3. Effect of different proportions of rice powder mixing with blackgram powder on qualities of idli

Rice : Blackgram ratio (W/W)	Batter				Idli			
	pH	Flavour	Volume raise(%)	Texture	Flavour	Taste	Accept ability	
WITH CURD INOCULUM								
2:1	4.8	F	58.0	Sp	N	N	A	
3:1	4.8	MF	57.0	Sp	N	Sl.S	A	
4:1	4.8	MF	55.0	Sl.H	N	S&B	NA	
5:1	4.8	MF	42.0	H	N	S&B	NA	
WITH FERMENTED BATTER INOCULUM								
2:1	5.0	M	61.5	Sp	N	N	A	
3:1	5.0	F	58.8	Sp	N	Sl.s	A	
4:1	5.0	Ac	48.7	Sl.H	N	S&B	NA	
5:1	5.0	Ac	38.5	H	N	S&B	NA	

F - Fermented; M - Mild; N - Normal; Ac - Acidic; H - Hard; Sp - Spongy; S - Sour; B - Bitter; Sl - Slightly; A - Acceptable; NA - Not acceptable;

Table 4 Effect of different proportions of water and dry mix on qualities of batter and idli (with curd inoculum)

Particulars	Batter				Idli			
	pH	Flavour	Volume raise(%)	Texture	Flavour	Taste	Accept ability	
100 g mix + 180 ml water (1:1.8)	5.0	MF	42.8	H	N	N	NA	
100 g + 200 ml water (1:2)	5.0	F	59.2	Sp	N	N	A	
100 g mix + 220ml water (1:2.2)	5.0	F	62.4	Sp to Pa	N	Sl	A	
100 g mix + 240 ml water (1:2.4)	5.0	Ac	50.4	Pa	Sl.Ac	Sl.S	NA	

F - Fermented; M - Mild; N - Normal; Ac - Acidic; H - Hard; Sp - Spongy; Pa - Pasty; S - Sour; Sl - Slightly; A - Acceptable; NA - Not acceptable;

this technology which saves the time needed for soaking and wet grinding on one hand and shortens the fermentation period on the other hand, is best suited for housewives, who can prepare dry mix batter during the previous night to prepare delicious idlies in the next morning.

### Reference

- Desikachar, HSR, Radhakrishnamurthy, R and RAMA RAO, G. (1960). Studies on Idli fermentation some accompanying changes in the batter. *J. Sci. Ind. Res.* 19: 168-172.
- Lewis, Y.S. and Johar, D.S. (1953) Microorganisms in fermenting grain mashes used for food preparations. *Bull. Central Food Technol. Res. Intt. Mysore India*, 2:288.
- Mukherjee, S.K., Allury, M.N., Pederson, C.S., Vanvenn, A.G. and Steinkraus, K.H. (1965). Role of *Leuconostoc mesenteroides* in leavening the batter of Idli. *Appl. Microbiol.* 13(2): 227-231.
- Radhakrishnamurthy, R. Desikachar, HSR., Srinivasan M. and Subramaniyan, V. (1961). Studies on Idli fermentation: Part II: Relative participation of blackgram flour and rice semolina in the fermentation. *J. Sci. Ind. Res.* 20 : 343-345.
- Ramakrishna, C.V., Parekh, L.J., Akolkar, P.N., Rao, G.S. and Bhandari, S.D. (1996). Studies on Soy - Idli Fermentation. *Plant Foods for Man* 2: 15-23.
- Yajurvedi, R.J. (1980). Microbiology of Idli fermentation. *Indian Food Packer.* 34(6):33-38.

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## Study on the spatial variability of rainfall in Tamil Nadu Agricultural University campus

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**Abstract :** The monthly, seasonal and annual rainfall of two locations in Coimbatore viz., New Area (NA) and Eastern Block (EB) have been statistically analysed based on the data of seven years (1992-1998). It is seen that higher annual rainfall was recorded at the NA than EB in all the seven years. The highest amount of rainfall was received in the year 1998 with less number of rain days in both the locations. The variations of rainfall amount was less in NEM season between the locations. (*Key Words : Rainfall, Coimbatore, Variability*)

The analysis of rainfall over a place assumes greater importance for micro level planning. Many literature speak on the variability of Indian rainfall with reference to space and time. In agricultural planning, rainfall variability analysis aids for taking decisions on the time of sowing, inter culture operations, fertilizer application, scheduling of irrigation, time of harvesting, etc. and also useful for designing farm ponds, tanks / irrigation projects.

Several studies have been reported the trends and periodicities of Indian rainfall. Blanford (1886) was the first meteorologist who made extensive

studies on Indian rainfall variability, taking the whole country as one unit. Analysis of average rainfall of India as one unit had been subsequently done by Parthasarathy and Dhar (1976), Parthasarathy and Mooley (1978) and Mooley and Parthasarathy (1979) by using the data from different raingauge locations of the country. Bhukan Lal and Dharampal Gupta (1991) studied the rainfall variability of Delhi and found the lowest co-efficient of variation (34 per cent) for annual rainfall and highest (343 per cent) for November rainfall. In this paper, an attempt was made to statistically analyse the monthly, seasonal and annual variability