

STUDIES ON THE PRESERVATION OF CHAPATIES

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(Received July 20, 1964)

The preservation and keeping qualities of chapaties were studied at room temperature (maximum 33°C. and minimum 18°C.) and at 37°C. over a period of one week. The effect of various preservatives, softening agents and storage conditions was studied. The chapaties containing 0.15 percent sorbate or propionate, milk, G.M.S. and 1.5 percent of salt kept well for the desired period.

Wheat flour when kneaded with water produces a paste which possesses the property of elasticity and plasticity. The paste thus prepared is used for making "Chapati" which is a kind of unleavened pan-baked or oven-baked bread. These chapaties become tough, leathery and stale after 12-24 hours. Food shortages and consequent demands for food conservation only serve to re-emphasise the importance of chapati preservation as a problem in our country. It was, therefore considered necessary to undertake work on the preservation of chapaties.

Katz¹ in 1912 worked in the hope of finding methods of retarding staleness in bread. Edelman *et al.*² tried a number of surface active agents as emulsifiers and found that glycerol monostearate (G.M.S.) and polyethylene stearate were fairly active in keeping the leavened bread soft. But the work carried out in the West is not very useful for the people of this sub-continent because of a great difference in the Western bread (leavened bread) and our chapati (unleavened bread).

Work was carried out by the authors to evolve new methods and techniques for the preservation of chapaties. Different surface active agents and effective preservatives were used for this purpose. The international laws about food additives were kept in view while carrying out the experiments.

Materials and Methods

Various preservatives, such as potassium sorbate, sodium sorbate, potassium propionate, sodium propionate, oxalic acid and softening agents like non-fat dry milk, G.M.S. and baker's yeast were tried. Sorbic acid was prepared in the laboratory according to Mann and Sanders method³. The various quality characters of the chapaties studied, included: (a) Appearance and smell: The surface should be smooth without any mold growth. The smell and flavour, should be appetizing and pleasant like fresh (b) Texture should be soft, smooth and pliable (c) The taste should be like fresh.

The flour obtained from the market was sifted through a 25 mesh sieve. The percentage extraction of the flour on the basis of total flour sifted was 96 percent. Dry matter percentage of flour as well as dough was calculated by keeping a weighed quantity of the sample in an oven at 105°C. for 40 hours. Moisture contents of chapati were also determined after every 24 hours. Gluten contents of the flour were estimated according to Rankin and Hildreth method.⁴ Dough consistency, mixing time, proving time, resistance, extensibility and product figure of the flour used were determined with the help of Frinograph.

Preparation of Chapaties.—Nine samples with various quantities of different ingredients (Table 1) were tried. In each case, 320 g. of sieved flour was taken in a tray and kneaded after adding sufficient volume of water till a dough of moderately stiff consistency was obtained. The dough was left at room temperature (30°C.) for one hour so that the moisture absorption could become uniform. The samples containing non-fat dry milk were kneaded in the milk solution. The dough was then divided into four equal portions. Each portion was rolled and flattened into a chapati and baked in a Tandoor (a mud-oven). The diameter and thickness of the chapaties was kept the same in all the experiments. The baked chapaties were cooled to room temperature and packed in polyethylene bags. The samples were kept at room temperature (maximum 33°C. and minimum 18°C.) and at 37°C. (to study the effect of additives at specific temperature). All the experiments were carried out in duplicate. The samples were examined after every 24 hours and opinion of a taste pannel was recorded about the quality characters (Tables 3 and 4).

Results and Discussion

On the basis of the experiments carried out it was observed that fifteen-minute mixing and thirty-minute proving time was suitable for making chapaties from the flour under examination. The gluten contents and various Frinograph tests showed that the flour used had the characteristics essential for chapati making.

TABLE I.—FORMULAE OF THE SAMPLES.

Sample No.	Flour		Vol. of water %	Preservatives			Softening agents			NaCl%
	Wt. of flour	D.M. %		Potassium sorbate	Sodium propionate	Oxalic acid	G.M.S.	Milk	Yeast	
1.	80 g.	90.6	97	—	—	—	—	—	—	2.175
2.	80 „	90.6	97	0.189	—	—	—	4.414	—	2.175
3.	80 „	90.6	97	0.189	—	—	0.189	4.414	—	2.175
4.	80 „	90.6	97	—	0.189	—	—	4.414	—	2.175
5.	80 „	90.6	97	—	0.189	—	0.189	4.414	—	2.175
6.	80 „	90.6	97	0.189	—	—	0.189	—	0.189	2.175
7.	80 „	90.6	97	0.189	—	—	—	4.414	0.189	2.175
8.	80 „	90.6	97	—	0.189	—	—	4.414	0.189	2.175
9.	80 „	90.6	97	—	—	0.189	—	—	—	2.175

N.B. The percentages of preservatives, softening agents and common salt are given on Dry Matter basis of flour.

TABLE 2.—PERCENTAGE OF MOISTURE IN CHAPATIES.

Sample No.	Percentage of moisture in dough	Percentage of Moisture in samples											
		Fresh	At room temperature after (hours)					Fresh	At 37°C. after (hours)				
			24	48	72	96	120		24	48	72	96	120
1	49.8	33.4	32.8	32.5	32.8	29.8	29.8	33.4	32.6	33.8	30.7	Discarded	
2	48.6	35.2	34.8	35.3	32.0	29.9	31.2	35.2	34.6	32.9	29.9	„	„
3	49.8	36.3	35.4	33.1	32.2	31.9	31.8	36.3	35.1	32.8	31.8	„	„
4	49.1	36.8	35.4	32.5	32.2	31.9	28.5	36.8	35.1	36.0	31.5	„	„
5	49.4	33.6	32.7	32.1	32.6	32.1	28.8	33.6	34.0	27.4	26.8	„	„
6	59.1	35.5	34.4	34.0	33.7	32.4	31.7	35.5	33.6	31.9	27.3	„	„
7	52.1	33.1	32.6	32.2	31.5	32.0	31.8	33.1	32.3	30.5	29.6	„	„
8	51.3	35.7	34.7	34.2	34.2	32.9	32.0	35.7	33.8	33.1	32.0	„	„
9	49.9	34.1	33.3	32.8	30.6	31.2	30.5	34.1	32.9	32.1	30.8	„	„

Flour Tests

- (a) Gluten contents = 11.36 %
 (b) Frinograph tests of the flour:
 (1) Dough consistency = 243.5 F.U. (Frinograph units)
 (2) Mixing time = 15 minutes
 (3) Proving time = 30 minutes
 (4) Resistance = 60 F.U.
 (5) Extensibility = 12
 (6) Product Figure = $60 \times 12 = 720$.

The chapaties made with the different ingredients were compared with control (prepared daily) containing no additives for its keeping qualities. The results are presented in Tables 2, 3 and 4. The various changes in chapati are discussed in the following.

Moisture Contents.—The loss of moisture adversely effected the softness of chapati, making it hard, dry and brittle. It was observed that the rate of loss of moisture accorded with the rate of loss of freshness. Table 2 shows the moisture contents of various formulations after every 24 hours. The loss of moisture was comparatively small in case of samples 3 and 8. The retention of moisture seems to be due to G.M.S. and milk in sample 3, and yeast and milk in sample 8, respectively. These samples contained 31.8 percent and 32 percent moisture, respectively even after 120 hours at room temperature and when incubated at 37°C. also retained relatively more moisture even after 72 hours. The water absorption in dough of sample 6 was found to be maximum. This increased absorption of moisture appeared to be due to the addition of yeast which caused gas production during the fermentation.

Staleness.—The different quality characters of various chapati samples are given in Tables 3 and 4 at room temperature and 37°C., respectively. The results recorded in Table 3 showed that samples 3 and 8 possessed the desired standard mentioned in the beginning up to 96 hours and were acceptable even after 120 hours. The dough of formula 8 was comparatively more elastic than that of formula 3, due to more water absorption as indicated in Table 2. Hence the chapaties prepared from this dough were very soft, smooth and pliable. It was found that the incorporation of non-fat dry milk with propionate or sorbate had a good effect on the quality of chapati. It also improved the loaf volume and texture of chapati. The addition of milk also distinctly improved the flavour of the chapati. Blinc

*et al.*⁵ used 0.3 to 0.5 percent of propionic acid to check the ropiness in the bread. But in the case of chapati 0.15 percent addition of propionate seemed to be sufficient to check the mold growth. 0.15 percent use of sorbic acid salts was found to be equally effective as a fungistatic agent and did not effect the organolaptic quality of chapati. It has already been recommended as a harmless⁶ preservative in various foodstuffs. The control sample became moldy after 48-72 hours while the samples containing propionates and sorbates kept well upto 120 hours. The use of oxalic acid did not give encouraging results and its use was discarded.

Temperature Effect.—The increase in temperature from room temperature to 37°C. increased the

TABLE 3.—CHAPATI TEST AT ROOM TEMPERATURE.

Sample No.	Appearance and smell after (hours)					Texture after (hours)					Taste after (hours)				
	24	48	72	96	120	24	48	72	96	120	24	48	72	96	120
1	Smell fresh	Stale smell	Mouldy	Dis-carded	Semi stiff	Stiff	Not acceptable			Good	Not accept	Discarded			
2	Good Smell fresh	Good smell fresh	Good smell fresh	Good smell fresh	Slightly stale moldy	Soft, smooth pliable	Soft, smooth pliable	Soft, smooth pliable	Semi-soft	Semi-soft	Good	Good	Acceptable	Acceptable	Slightly stale
3	"	"	"	"	No Mold Acceptable	"	"	"	Soft smooth	Semi-soft	"	"	Good	"	Acceptable
4	"	"	"	"	Slightly stale moldy	"	"	"	Semi-soft	Brittle	"	"	Acceptable	Slightly stale	Stale
5	"	"	"	Slightly stale moldy	Dis-carded	Soft pliable	Soft and smooth	Soft acceptable	Not pliable	"	"	"	"	"	"
6	"	"	"	Acceptable smell	Restricted mold	Spongy soft	"	"	Soft	Semi soft	"	"	Good	V. slightly stale	Stale
7	"	"	"	"	"	"	"	"	Soft pliable	"	"	"	"	Acceptable	Slightly Stale
8	V. good smell fresh	V. good smell fresh	Good mell fresh	Good smell fresh	No mold Acceptable	V. soft spongy pliable	V. soft spongy pliable	Soft pliable	"	Soft	"	"	"	Good	Acceptable
9	Smell fresh	Smell fresh	slightly stale smell	moldy stale	Dis-carded	Soft pliable	Soft pliable	Semi soft	Stiff	Stiff	"	"	Acceptable	Stale	Stale

N.B. Average maximum temperature 33°C. and average minimum temperature 18°C.

TABLE 4.—CHAPATI TESTS AT 37°C.

Sample No.	Appearance and smell after (hours)					Texture after (hours)					Taste after (hours)				
	24	48	72	96	120	24	48	72	96	120	24	48	72	96	120
1	Slightly stale	Moldy stale	Discarded			Semi Stiff	Stiff	Discarded			Slightly Stale	Stale	Discarded		
2	Good acceptable smell	V. slightly stale	Slightly stale	Moldy	Discarded	Soft pliable	Soft pliable	Semi Soft	Stiff	Brittle	Good	Acceptable	Slightly stale	Not acceptable	acceptable
3	„	Good acceptable	„	„	„	Soft smooth pliable	Soft smooth pliable	Soft smooth	Soft smooth	Semi stiff	„	Good	Acceptable	„	„
4	„	Good V. slightly stale	„	Moldy stale	„	„	Soft pliable	„	„	Stiff	„	Acceptable	Slightly stale	„	„
5	„	Slightly stale	Completely Stale smell			„	„	Semi stiff	„	Stiff	„	Slightly stale	Slimy Taste	Completely	stale
6	„	„	Slightly stale	Moldy	completely stale	Spongy soft pliable	Soft smooth	„	„	„	„	Acceptable	Unacceptable	„	„
7	„	„	„	„	„	„	„	Soft pliable	Semi stiff	Stiff	„	„	Slightly stale	„	„
8	„	Good acceptable	V. slightly stale	Stale	Moldy	„	Soft smooth pliable	Soft smooth	Semi soft	Stiff	„	„	Acceptable	„	„
9	„	Slightly stale	Completely	Stale	„	Soft	Semi stiff	Brittle stiff	„	V. stiff	„	„	Not acceptable	„	—

rate of loss of moisture (Table 2). Various samples retained the desired quality characters for 72 hours at 37°C. and 120 hours at room temperature.

Acknowledgement.—The authors are grateful to Dr. F.H. Shah for his valuable suggestions in carrying out the investigations. Thanks are also due to Mr. M. Hanif for his co-operation in handling the instrument.

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