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DEVELOPMENT OF LONG-LIFE ROTI (BREAD)

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A prototype roti which remained quite palatable for 72 hr at 35°C was developed. As expected glyceryl monostearate was found to make the roti soft but on the other hand it adversely affected the pliability of the rotis. The effect of addition of glyceryl monostearate on physical dough characteristics was also studied. To counteract this effect wet wheat gluten and freeze-dried wheat gluten were incorporated. Both forms of gluten increased the resistance of the dough on Brabender Extensograph to a peak value of 1000 mm. Rotis prepared with increased amount of gluten remained very soft and resilient up to 72 hr. Sorbic acid was not found a suitable mycostatic agent for use in rotis as it imparted a bitter after taste.

Introduction

Baking roti/naan is a time-consuming operation. The roti baked in the conventional manner starts deteriorating in texture and flavour within a few hr of its baking.

Both leavened and unleavened rotis are consumed in West Pakistan, though some people prefer one to the other. Leavened roti/naan/kulcha is conventionally prepared by keeping the dough till spontaneous fermentation occurs and then supplementing the leavening effect by addition of soda bicarbonate. Some of the leftover leavened dough is utilised next day as sponge (starter). Apart from possessing a short life, the inherent hazards of such a roti produced on a bulk scale and fed on institutional basis do not require any elaboration.

Conventional roti, whether leavened or unleavened, teriorates by (a) drying out (b) undergoing staling, becoming crumbly and unfit for consumption alongwith curry in the usual Pakistani style (c) developing mould growth if drying out is inhibited or prevented, and (d) possibly developing ropiness due to contamination with *Bacillus mesentricus* etc.

Drying out can be largely prevented by suitable wrapping or packing. Paper-foil-polyethylene laminate bag affords good protection against loss of moisture when chapati has to be preserved for a few months.[1] Polyethylene bags have also been used for packing.[2]

Staleness can be retarded by proper selection of ingredients. Cathcart[3] has summarised the effect of various factors and ingredients on the staling rate of bread. Sugar and fat (shortening) help retarding staleness considerably. Surface active agents like glyceryl monostearate are widely used in bread manufacture for retarding the staleness. Glyceryl monostearate has been used for inhibiting stsalenes in chapati.[2]

A long-life roti must retain its characteristic resilience so that it can be dipped into the curry in the conventional manner. Although surface active agents like glyceryl monostearate retard staleness by conferring greater moisture-retaining power, it has adverse effect on the resilience of the roti. Little or no work seems to have been done on this aspect of the problem.

The work reported in this paper has been carried out from the following points of view. (a) The roti should remain palatable for at least 48 hr during summer. (b) It should retain its original resilience to a very large extent. (c) The recipe should be capable of being applied to large scale production.

Materials and Methods

Flour was obtained from the local army supply depot and it was ensured that it had not been in storage for more than 2 months after milling.

Dried baker's yeast was procured from the market and was assessed for its activity on Brabender Fermentograph. Glyceryl monostearate used was of self-emulsifying type. Wet wheat gluten was prepared by the following method, which is a modification of the method commonly described in textbooks on bread-making and cereal chemistry. "Prepare the dough of slightly tight consistency. Leave it to mature for 30 min. Squeeze it gently and place it beneath a slow stream of water from the tap. By gently manipulating the dough the starch is separated in a milky slurry and the gluten is retained as a single coherent mass. 100 parts of good quality atta give a yield of about 28 parts of wet gluten."

Wet gluten was also freeze-dried and used in the experiment. Freeze-drying was carried out on an accelerated freeze drying plant supplied by a British firm. Freshly extracted gluten was frozen at about −20°C. The frozen mass was subjected to dehydration in the vacuum chamber of the freeze drying plant which was maintained at a vacuum of 0.1–0.05 mm of Hg during the dehydration cycle. Maximum heating plate temperature and gluten surface temperature was controlled at 130°C and 60°C respectively. The dehydration cycle took about 8 hr. Sorbic acid, propionic acid and sodium propionate used were all of food-grade quality. All the remaining ingredients were obtained from the local army supply depot. The effect of addition of vanaspati, glyceryl monostearate and gluten and the physical dough characteristics were also determined by using the Brabender instruments mentioned earlier.

Preparation of Roti.—Yeast suspension was prepared as recommended by the manufacturer. Glyceryl monostearate was emulsified in hot water by stirring slightly. In order to determine optimum water absorption capacity of flour a number of experiments were carried out with varying amounts of water. Even though water requirement varies with the quality of flour and its fineness, the average of a number of trials indicated that the amount of water required to obtain a satisfactory dough and a roti possessing the requisite characteristics was 720–800 ml/kg of flour. All the ingredients including suspensions of yeast and glyceryl monostearate were kneaded for about 20 min. The dough was kept aside for about 1 hr at 37–40°C and was then divided into lumps, the size of which depended upon the type of baking to which the roti was to be subjected subsequently. When baking on hot plate (tawa) was carried out, 24 lumps of equal wt were made from 1 kg flour. The lumps were shaped as balls and then after 15–20 min they were flattened into discs of 7-in dia. If the rotis were to be subsequently baked in an electric oven the flattened discs of the dough were finally proved in suitable iron moulds of 7-in dia for about ½ hr at 37°–40°C. In case of hot plate (tawa) the baking temperature was 230°–250°C and the baking time was 1½–2 min. In case of electric oven the rotis were baked in moulds at about 450°C for 1–1½ min. Baking at 350°C for 3–5 min also proved equally suitable. All the experiments were repeated at least five times. The baked rotis were cooled to room temperature and packed in polyethylene bags.

Acceptability Assessment.—In the laboratory organoleptic qualities, viz. appearance, freshness, texture (softness and resilience) and taste, were assessed at 24-hr intervals by a panel of 4–6 members. For eliciting user opinion details of the final recipe along with the additives sufficient for 100 lb flour were supplied to 12 army units and one naval unit.

Results and Discussion

The formulae of the different samples tried out are given in Table 1 and the results of sensory evaluation tests in Table 2. Since the emulsifying agents like glyceryl monostearate owe their softening effect to the polar and non-polar nature of the radicals of their molecules, the basic formula of a long-life roti must contain fats, e.g. vanaspati, in addition to sugar and salt. Table 2 shows that sample 1 became hard only after 24 hr. Incorporation of glyceryl monostearate did make the roti soft but also made it more crumbly. The effect of incorporation of glyceryl monostearate on physical dough characteristics was also studied on Brabender Extensograph. It was observed that incorporation of glyceryl monostearate decreases the energy value, resistance and extensibility of the dough. This finding substantiates the observation that glyceryl monostearate increases the softness but diminishes the resilience.

TABLE 1.—FORMULA OF THE ROTIS.
(Baking was done in an electric oven)

Sl. No.	Flour roti g	Salt g	Sugar g	Vanaspati g	Yeast g	GMS g	Wet gluten g	Freeze dried gluten g	Sorbic acid g	Sodium propionate g	Propionic g
1	62.5	1.28	1.86	1.28	0.31	—	—	—	—	—	—
2	62.5	1.28	1.86	1.28	0.31	0.31	—	—	—	—	—
3	62.5	1.28	1.86	1.28	0.31	0.31	—	—	0.07	—	—
4	62.5	1.28	1.86	1.28	0.31	0.31	—	—	—	0.14	—
5	62.5	1.28	1.86	1.28	0.31	—	—	—	—	—	0.07
6	51.0	1.28	1.86	1.28	0.31	0.31	11.0	—	—	—	0.07
7	56.0	1.28	1.86	1.28	0.31	0.31	—	6.5	—	—	0.07
8	46.0	1.28	1.86	1.28	0.31	0.31	16.5	—	—	—	0.07
9	52.75	1.28	1.86	1.28	0.31	0.31	—	9.75	—	—	0.07

TABLE 2.—RESULTS OF THE SENSORY EVALUATION TESTS AT 35°C.

Sl. No.	Appearance and smell after hr			Texture (resilience) after hr			Taste after hr			Mycological condition
	24	48	72	24	48	72	24	48	72	
1	Satisfactory	—	—	Slightly hard and crumbly	—	—	Satisfactory	—	—	Developed mould after 36 hr
2	,,	Satisfactory	Satis-factory	,,			,,			,,
3	,,	,,	,,	,,	Soft but crumbly	Soft but crumbly	Bitter after taste	Bitter after taste	Bitter after taste	Developed mould after 96 hr
4	,,	,,	,,	,,	,,	,,	Satis-factory	Satis-factory	Satis-factory	Developed mould after 72 hr
5	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
6	Like fresh	Like fresh	Like fresh	,,	Soft and pliable almost like fresh	Soft and pliable almost like fresh	Like fresh	Like fresh	Almost like fresh	,,
7	,,	,,	,,	,,	,,	Soft and pliable like fresh	,,	,,	Like fresh	,,
8	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
9	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

TABLE 3.—EFFECT OF INCORPORATION OF GLYCERYL MONOSTEARATE, WET GLUTEN AND FREEZE-DRIED GLUTEN ON BRABENDER EXTENSOGRAPH VALUES.

Sample	Energy value cm	Resistance to extension mm	Extensibility mm	Ratio figure resistance/ extensibility
Control	92	670	78	8.57
With glyceryl monostearate	57	490	92	5.32
With wet gluten	185	1000	89	11.3
With freeze dried gluten	167	1000	97	10.3

Incorporation of wet and freeze-dried gluten enormously enhanced the energy value, resistance to extensibility and ratio figure as is evident from Table 3. The resistance of the dough is increased to the peak value of 100 mm. Table 2 indicates that samples 6 and 7 containing added wet/freeze-dried gluten retained their original resilience to a large extent. Incorporation of wet/freeze-dried gluten at an additional level of 50% further enhanced the resilience and softness of rotis as shown by serial numbers 8 and 9 of Table 2.

Sorbic acid did not prove suitable because of bitter after taste which it imparted to the rotis as shown by formula 3 of Table 2. However, it did inhibit mould growth for a longer period. Sorbic acid is undoubtedly highly effective against moulds but is not very suitable for unsweetened baked goods particularly bread because it gives rise to an undesirable aroma and flavour. Among the baked products it has been found suitable and recommended for cakes and other flour confectionery products.[4]

Propionic acid and sodium propionate proved equally effective in retarding mould growth and did not produce any unpleasant aroma and flavour. Tables 1 and 2 embody the results of those experiments in which baking was done in an electric oven. The same results were obtained when baking was carried out on a hot plate(tawa). Unleavened prototype rotis, i.e. when yeast was omitted, exhibited similar behaviour on storage.

The results of the user trials carried out by 12 different army units and one naval unit indicated that the roti remained palatable and free from mould for 72 hr under field service conditions.

References

1. G. Kameshwara Rao, M.A. Malathi and P.K. Vijayaraghavan, Food Technol., **20,** 94(1966).
2. M. Yasin, A.H. Khan and Karmiullah, Pakistan J. Sci. Ind. Res., **8,** 126 (1965).
3. W.M. Cathcart, Cereal Chem., **17,** 100 (1940).
4. *Food Standards Committee Report on Presservatives in Food* (Her Majesty's Stationery, Office, London, 1959), p. 42.