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Utilization of Guar Gum in Production of Low Protein Bread

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INVESTIGATION was conducted to evaluate the effect of guar gum in percentage 0.2 ,0.4 , 0.6 ,0.8 , and 1.0 % to improve the low protein toast and balady bread, which are required for patients with severe chronic renal failure and moderate severity. Low protein bread with 30% starch replacement was found to have 4.8% , while with 50% starch replacement had 3.4% crude protein on dry basis .

The obtained results indicated that guar gum addition increased viscosity and falling number of dough . Moreover, it was clear that guar gum changed dough characteristics of both bread types, hence its addition increased water absorption as slight increasements in exensibility and energy were also reported. Therefore it was clear that guar gum addition in level 0.8 - 1.0% improved bread quality.

In Egypt, bread is produced in two main types; i.e balady bread and European or shamy bread. Both types have about 9% crude protein on dry weigth basis , (El- Bardeny *et al*, 1990) . Except short bread for regimen and diabetic patient, which are in fact high fiber bread type, there are no special commercial therapeutic bread as for patients with chronic renal failure of moderate severity or with subacute hepatic encephalopathy . For patoents, with severe chronic renal failure, bread must be salted and protein free. patient can consume 17 gm/ day protein of high biological value, whereas for those of the moderate severity, bread must contain low protein and patient can consume 40 gm / day protein of high biological value (Davidson et al., 1975).

Low protein bread is required for protein restricted diets as in renal disease and phenylketonuria (saxelly and Brown, 1980) . Also , there is a need for a low protein bread for patients in their treatment management. Fortunately, the first break flour has high quality with low protein content (7.2%) in the flour mill streams (El- Bardeny 1989) and it was superiority in the production of low protein bread .

Pomeranz (1971) cited that the gluten function is chiefly as a dough binding agent and is not essential for crumb structure. Therefore, the production of low production of low protein bread is accompanied with the problem of its lower gluten content. Content . Consequently, it is important to utilize a gel forming matering material to improve dough properties and also to facilitate the handle of dough during fermentation.

Guar gum, really a mucilage, is composed of the storage polysaccharide of the endosperm of the guar seeds (Cyamposis tetragonoloba). Sandford and Baird (1983) reported that the total production of guar gum in the year 1970 amounted to 60.000 metric tonnes and reached 90.000 tonnes in the year 1980. This increase was chiefly due to the wide range of functional characteristics exhibited by this polysaccharide. Khater (1977) stated that the guar gum has 5-8 times the thicking power of starch. Also, Apling et al. (1978) mentioned that the guar polysaccharide is used extensively in the food industry as a stabilizer and thickner in amounts below 1%

Guindi *et al* . (1989) studied the chemical structure of guar gum which is produced under the Egyptian conditions. The proposed structure of this polysaccharide consisted of 171 repeating segments, each segment composed of a main chain of four mannopyranose units Jointed by B (1-4) glycosidic linkages. Each segment is also jointed with two units of galactopyranose through B (1-6) , glycosidic bonds. The same investigators found that guar gum was suitable to form firm gel when compared with standard pectin. In addition, the ability of guar gum to form gel at room temperature was higher than that of pectin. On the other hand Ibrahim and Salem (1983) stated that the amount of pectin equals fifteen times that of guar gum to obtain the same gel strength in jam making. This point seems to be important from the economical point of view.

Therefore, the present investigation was carried out to produce low protein bread using first break flour and guar gum and to evaluate its chemical, rheolgical characteristics and baking quality.

MATERIAL AND METHODS

Materials

Samples of low protein flour (First break flour) were obtained from flour mill, North cairo Flour Milling Co. starch was obtained from the market . mean while, guar gum was obtained from guar seeds according the method described by Guindi et al. (1989).

Methods

1) Chemical analysis

Moisture, crude protein (N.X 5.7), ash, lipids, and total sugars contents were determined according to A. O. A. C. (1980). starch was determined enzymatically according to Kerr et al. (1951). Dietary fibers were estimated by using the following equation: Dietary fibers = 100 - (Total protein + available carbohydrates + lipids + ash). falling number was determined according to A.A.C.C. (1983).

Phytate phosphorous was determined according to lopez *et al.* (1983) . Total calories were calculated according to Yadkin and Offord (1980) by using the following equation E=4 (% protein + % carbohydrates) +9x% fat . where E= energy as calories per 100 gm

2- Rheological properties of the dough .

The rheological properties of the different doughs were carried out by using a Farinograph and Extensograph tests according to A.A.C.C. (1983) .

3- preparation of bread

Bread was prepared by using 100 % first break flour (Control) , 70% first break flour + 30% starch (Mixture I) and 50% first break flour +50% starch (Mixture II) .

Gouar gum was added at ratios of 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0 % to the two mixtures . Flour and flour mixtures were mixed with water to form the needed dough according to farinograph test. In addition, 2.0 % yeast and 2.0% sugar were added to the three doughs to form both Toast and balady bread.

Toast bread was fermented for 70 min and baked at 200° . Balady bread was fermented for 20 min, then the dough was divided into 165 g- pieces, the individual pieces were placed on a tray sprinkled wirh a layer of bran , fermented for 10 min then flattened and backed at 400- 450°.

4- Organoleptic evaluation

Panelists were asked for sensory evaluation of bread appearance, crumb, odour, crust, color and crumb according to the method of kramer and Twigg (1974).

RESULTS AND DISCUSSION

The chemical constituents of flour samples; i.e. first break flour, mixture I and mixture II are shown in Table 1 . The obtained results indicate that starch addition to first break flour lead to increasing of total carbohydrates content i.e. from 88. 75 to 92.00 and 94.32% in both mixtures I and II respectively. Also, total caloric values were increased i.e. from 391.9 to 394.4 and 396.2 in the two mixtures. Meantime, other constituents showed remarkable reduction in their values.

TABLE 1. Chemical constituents (%) of flour and flour mixtures

Tested sample	Ash	Total lipids	Crude protein	Available carbohydrates	Dietary fibres	Phytate phosphorus	Gluten		Total caloric values Kcal/100g
							wet .	dry	
	%	%	%	%	%	%	%	%	
First break* flour	0.5	1.1	6.8	88.7	2.90	0.064	20.6	7.9	391.9
Mixture I	0.4	0.8	4.8	92.0	2.00	0.045	14.3	5.5	394.4
Mixture II	0.3	0.6	3.4	94.3	1.40	0.032	10.3	4.0	396.2

First break flour (100%)
Mixture I = 70 % first break flour + 30 % starch .
Mixture II = 50 % first break flour + 50 % starch .

Table 2 shows the effect of guar gum addition on falling number (viscosity) of first break flour and its mixtures. The results illustrate that addition of starch was accompanied with higher values of falling number. This may be attributed to the higher carbohydrates content which produced more reducing sugars under the action of alpha amylase on starch (pomeranz, 1971) .

TABLE 2 . Effect of guar addition on falling number of flour and flour mixtures.

% Guar gum	Falling Number in Seconds		
	100% first break flour	Mixture I *	Mixture II **
0.0	353	300	419
0.2	367	389	446
0.4	378	412	455
0.6	400	426	520
0.8	414	471	543
1.0	470	471	620

* Mixture I = 70 % first break flour + 30 % starch .
** Mixture II = 50% first break flour + 50 % starch .

The obtained results also demonstrate that addition of guar gum which is composed of galactomannan polysaccharide (Guindi *et al.*, 1989) raised falling numbers especially with mixture II.

The results presented in Table 3 show that water absorption was modified by increasing starch ratio. such trend could be attributed to the higher water absorption of starch as mentioned by Dexter and Matsuo (1979). Dough development and stability were decreased by starch replacement. On the other hand, dough weakening had positive proportional relation with the added starch. However, weakening of the dough was a result of the break down of gluten network after elapsing an appropriate mixing time (10 and 20 min). Protein in first break flourstarch mixtures was of low quality because of its deficiency of gluten and therefore, the weakening values were increased .The obtained results also indicate that first break flour-starch mixture had less desirable rheological properties than the first break flour. this observation may be due to the dilution effect of gluten by the starch addition (Shuey,1972). Dough weakening values (B.U.) were improved by the addition of gum up to 1.0% as shown in table 3 .A desirable reduction in the degree of weakening was observed by adding 0.6% guar gum to mixture I, where weakening vaues were reached to the lowest values i.e. 155 and 170 B.u. after 10 and 20 min , respectively. Increasing guar ration up to 0.8 and 1.0% resulted to the best weaking values improvement specially with mixture I.

TABLE 3 . Farinograph parameters of blends of 0% , 30% , 50% starch added to different concentrations of guar gum.

Parameters	Control 100 % first break flour	Guar gum additions (%)											
		0.00		0.20		0.40		0.60		0.80		1.00	
		MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**
Water absorption %	54.00	59.30	60.00	59.50	59.90	59.80	59.80	60.40	59.90	60.60	60.00	60.90	60.10
Arrival time min	0.75	0.50	0.75	0.50	0.75	0.50	0.75	0.50	0.75	0.75	1.00	0.75	1.00
Dough development time (min)	1.25	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00
Stability	1.25	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Degree after of 10 min	95	215	225	195	2.10	190	210	155	200	150	200	145	190
Weakening after B.U. 20 min	115	225	245	205	230	200	230	170	220	165	215	165	210

* MI = Mixture I = 70 % first break flour + 30% starch.
** MII = Mixture II = 50% first break flour + 50% starch.

The results in Table 4 indicate that dough resistance to extension, proportional number and energy of mixture II were higher than those of mixture I which could be attributed to higher percentage of the added starch. Addition of guar gum, which is used extensively as stabilizer and thickner in food industry (Apling *et al.*, 1978), improoved dough extensibility and reduced the other parameter values of the extensograph .

TABLE 4. Extensograph parameters of blends of 0.0%, 30% and 50% starch added to different concentration of guar gum.

Parameters	Control 100 % first break flour	Guar gum addition (%) 0.00 MI*	0.00 MII**	0.20 MI*	0.20 MII**	0.40 MI*	0.40 MII**	0.60 MI*	0.60 MII**	0.80 MI*	0.80 MII**	1.00 MI*	1.00 MII**
Extensibility (Min.)	153	112	80	114	85	115	90	118	90	122	92	120	95
Resistance to extensibility (B.U)	370	190	375	180	350	160	325	150	300	110	250	110	200
Proportional number	2.42	1.69	4.68	1.58	4.12	1.39	3.61	1.27	3.33	0.90	2.71	0.91	2.10
Higher peak (B.U.)	3.90	190	615	180	500	160	450	150	400	140	406	140	220
Energy (Cm^2)	48	28	41	26	36	24	34	23	31	22	30	22	25

* MI = 70% first break flour + 30 % starch.
** MII = 50% first break flour + 50 % starch.

The results concerning the quality of the produced toast bread are shown in Table 5 . These results indicate that bread produced from first break flour (Control) was characterized by lower weight than that produced from the two mixtures. This could be attributed to the higher water absorption of the mixtures. First break flour bread also had the highest organoleptic properties (Total of 46 vs. 26 and 24). Guar addition up to 0.4 % resulted in a reduction in weight and increment in volume of bread produced from the two mixtures. Increasing guar gum percentage from 0.6 to 1.0 % resulted a gradual reduction in specific volum of the produced bread from mixture I, while such increment in guar addition had no effect on bread produced from mixture II. Addition of guar gum improved the organoleptic properties of produced bread specially at the ratios of 0.8 and 1.0 %

TABLE 5 . Effect of guar gum on organoleptic qualities of 30% and 50 % starch toast bread .

Properties	Control 100 % first break flour	percentage of guar gum											
		0.00		0.20		0.40		0.60		0.80		1.00	
		MI*	MII*	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**
Weight (g)	435	452	454	456	454	44 8	458	448	437	444	437	44 0	437
Volume (cc).	1670	1160	1485	1325	1485	1355	1520	1220	1420	1200	1420	1180	1420
Specific volume (C/gm)	3.83	2.57	3.27	2.90	3.27	3.02	3.32	2.72	3.25	2.70	3.25	2.68	3.25
Crust	8	3	3	5	7	6	8	7	8	6	9	7	9
Crumb.	8	3	3	7	6	7	6	6	6	6	6	6	6
Aroma	6	6	5	6	5	6	5	6	5	6	5	6	5
Structure.	8	3	4	6	6	7	7	7	7	8	8	8	8
Taste.	7	7	6	7	6	7	6	7	6	7	6	7	6
Grain.	9	4	3	6	5	7	6	6	6	8	7	8	7
Total.	46	26	24	37	35	40	38	39	38	41	41	42	41

* MI = 70% first break flour + 30 % starch.
** MII = 50% first break flour + 50 % starch.

The organoleptic qualities of tested balady bread are shown in Table 6 . Balady bread produced from first break flour had higher organoleptic properties score than those of bread produced from the two mixtures. Crumb was sticky and the prepared bread had a broken top. This observation may be due to that the fermentation time was very short. Guar addition facilitated bread flattening, avoided crust cracks, and improved the results of appearance and other properties . Mixture I with guar produced higher quality bread than that produced from . Mixture II with guar gum and best results were obtained by adding guar at ratios of 0.8 and 1% . This may due to the higher gluten content in the first mixture .

Genrally, it could be concluded that guar gum might be used as a stabilizer and thickner at ratios of 0.8 or 1.0 % in low protein bread making

TABLE 6 Effect of guar gum additions on organoleptic of 30 % and 50 % starch balady

Properties	Control 100 % first break flour	percentage of guar gum											
		0.00		0.20		0.40		0.60		0.80		1.00	
		MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**	MI*	MII**
Crust	8	4	4	7	6	6	6	7	7	7	7	7	7
Colour	8	4	4	6	7	8	8	7	6	7	6	7	6
Taste	8	5	4	5	4	5	4	5	4	5	4	5	4
Odour	7	6	5	6	5	6	5	6	5	6	5	6	5
General appearane	8	4	4	6	6	6	6	6	6	6	6	6	6
Crumb	9	7	6	8	7	8	7	9	7	9	7	9	7
Total / 60	78	30	26	38	35	39	36	40	35	40	35	40	35

* MI = 70 % first break flour + 30 % starch .
MII = 50 % first break flour + 50 % starch .

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استخدام صمغ الجوار فى إنتاج الخبز منخفض البروتين

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أجريت التجارب لاستخدام صمغ الجوار بنسب ٢ر٠ ، ٤ر٠ ، ٦ر٠ ، ٨ر٠ ، ١٪ لتحسين الخبز المنخفض البروتين التوست والبلدى، وذلك لمرضى الكلى والفشل الكلوى ، وكانت نسبة البروتين الخام ٨ر٤٪ فى الخبز المحتوى على ٣٠٪ نشا ، فى حين كانت ٤ر٣٪ على الوزن الجاف من الخبز المحتوى على ٥٠٪ نشا ، وأظهرت النتائج أن إضافة صمغ الجوار يؤدى إلى ارتفاع كل من اللزوجة ورقم السقوط (نشاط الالفا اميليز) .

وبدراسة تأثير صمغ الجوار على الخواص الريولوجيه تبين أن إضافته تؤدى إلى ارتفع نسبة الامتصاص للماء وتخفض درجة الضعف مع زيادة طفيفة فى المطاطية وانخفاض فى المرونة والطاقة.

كما تبين من خواص التوست والخبز البلدى أن صمغ الجوار قد حسن نوعية الخبز الناتج عند إضافة ٨ر٠ - ١٪ دون أن يظهر له تأثير على الطعم .