PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 5 (3): 263-268, 2006
ISSN 1680-5194

The Enzymic Activity in Flour and its Effect on the Quality of the Iranian Traditional Breads (Barbari and Lavash)

A.R. Feyzipour[1], S.M. Seyedain[2], A. Taslimi[3] and S.M.T. Mazloumi[3]
[1]Department of Food Science and Technology, Islamic Azad University, Azadshahr, Iran
[2]Faculty of Cereal and Bread Science, Institute of Technology, Tehran, Iran
[3]Department of of Food Science and Technology,
National Research Institute of Nutrition and Food Technology, Tehran, Iran

Abstract: Germination of wheat seeds will increase its nutritive values which is the result of amylolitic and proteolitic enzymes activity. The use of germinated wheat flour (GWF) also would affect the rheological and sensory parameters of produced breads. The aim of this study was to determine the effects of GWF on the qualitative characteristics of dough and bread. GWF was used in different proportion in Barbari & Lavash bread formulation mix. The Farinograph, Extensograph, maltose value and sensory tests were done on the Barbari & Lavash bread and dough. Results from Farinograph and Extensograph showed that enzymic hydrolysis of gluten which was the effect of added GWF would cause the loss of strength of gluten lattice and weaken the dough. The maltose values also indicated that by increase in the amount of GWF in the mix, these values will increase, which they are the effect of alpha-amylase on the starch and increase of reducing sugars. Sensory evaluation of these two breads also indicated that the addition of different percentages of GWF will affect the overall acceptance of the breads and will reduce the bread quality. The results of this research showed that in order to prevent wheat seed germination which is one of the reasons to lower the flour and bread quality and cause bread losses, the harvesting time, storage and handling condition need serious controls.

Key words: Farinograph, extensograph, maltose value, sensory evaluation, bread

Introduction

Some of the factors like rain fall during wheat harvest, and uncontrolled storage condition and handling causes seed germination and high enzymic activity along with chemical changes in wheat. The rate of the changes is related to wheat variety, the rain fall period, temperature and the period of the germination (Singh *et al.*, 2001; Sorrels *et al.*, 1989). The increase in amylolitic and proteolitic enzymes activity will have adverse effects on the bread quality, so germinated seeds will be useless in baking processes (Ranhotra *et al.,* 1977). The most important effect of germination on wheat is the raise of the amount of alpha-amylase and its activity which will effect on the starch hydrolysis, as a result, reducing sugars (glucose and maltose) will increase (Bajwa and Bains, 1990) and baked breads from this flour will have dark surface, sticky crumb and low volume. Part of these changes is related to the proteolitic enzyme activity in germinated seeds which will soften the gluten and rheological changes also will occur (Aryama and Khan, 1990).

Low enzymic activity in wheat seeds also will cause reduction in bread volume, and dried crumb with large holes in it (Kaur and Bains, 1976). The alpha-amylase activity is determined by Falling Number apparatus, and rheological properties are measured by Farinograph and Extensograph (Aryama and Khan, 1990, Singh *et al.,* 1987). In 1977, Ranhotra studied the producing good quality bread and its protein quality from germinated wheat flour. The results showed that high amylolitic and proteolitic activity will not allow producing good quality bread (with 100% GWF). Small amounts of GWF produced the bread with improved volume without any undesirable effect on the other quality parameters of it, but with the addition of 20% GWF and more, the produced bread was not acceptable (Ranhotra *et al.,* 1977).

Ichinose in 2001 germinated different varieties of wheat seeds for 24 hours, and showed that amylolitic and proteolitic enzymes activity increased 17-42 and 1.7 times, respectively in compare with the sound wheat. He concluded that the change in the protease-protein system compare with the amylase-starch system during germination has more adverse effect on the quality of breads. This results indicating that the protein hydrolysis in flour has important role on the reduction of flour baking quality, when GWF is used for baking (Ichinose *et al.,* 2001).

Casutt *et al.* (1984) showed that by wheat germination, flour strength and dough extensibility reduced and by increase in fermentation time, the height of the extensogram was also reduced. During the fermentation, the dough of strong flour to compare with the weak flour had higher tolerance. Also the area under

Table 1: The properties of raw flours (Barbari and Lavash bread flour)

	Property					
Flour	Moisture (%)	Protein (%)	Wet gluten (%)	Fat (%)	Ash (%)	Falling Number (S)
Lavash flour	10.04	10.67	29.1	1.40	0.83	420
Barbari flour	10.63	10.32	29.2	1.21	0.60	438

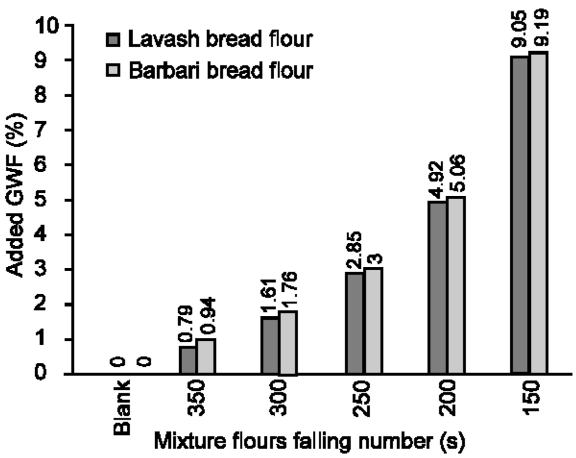


Fig. 1: The GWF% added to control flours

the extensogram curve became larger when the flour strength increased, but in the case of strong flours, the area under the graph did not change that much, when the fermentation period became longer.

The aim of this study was to determine the effects of added germinated wheat flour on the quality of dough and barbari and lavash breads.

Materials and Methods

Barbari and Lavash bread flours (with the extraction rate of 81 and 86.5%, respectively) purchased from Azadegan milling factory in Tehran. Chemical tests for moisture (44-16 AACC), protein (44-12 AACC), wet gluten (38-11 AACC), fat (30-25 AACC), ash (08-01 AACC) and falling number (Falling Number apparatus, 56-81 AACC) were done (AACC, 1990). In order to add GWF to the mentioned flours (for adjusting their falling numbers), wheat was soaked in water (tap water) for 9 hours at room temperature. Soaked seeds were germinated in germinator (WEISS TECHNIK, Germany), 24 hours at 25-30°c and the R.H was 75-80%. Germinated seeds were dried at 30°C for 72 hours and grinded in Brabender mill (Brabender, Germany) to GWF and its falling number was measured. In order to get desired falling numbers, different percentages of the GWF were added to the Barbari and Lavash bread flours till falling numbers of (150, 200, 250, 300, 350) ± 10 seconds achieved. The calculations for adjustment of targeted falling numbers were derived from Perten formula (Mjorndal, 1985).

Barbari and Lavash bread flours and the mixtures were tested in Farinograph (54-21 AACC) and six specific indications were determined, include: the percent of absorbed water, the dough development time, the dough resistance time, the rate of dough weakening after 10 and 20 minutes and valorimetric value.

Mentioned flours also were tested in Extensograph (54-10 AACC) and three specific parameters of the dough; dough resistance to extension, the dough extensibility and energy in three different fermentation times, 45, 90 and 135 minutes were determined.

The maltose values were determined too (22-15 AACC). Barbari breads were baked from control flour and the mixes (control+GWF) and Lavash Breads were baked from control flour and the mixes (control+GWF) in controlled condition. Sensory tests were also done by trained panels (8 panelists) and overall quality was judged. In this case, ranking method was used on the basis of bread shape, color, surface condition and palatability.

Barbari and Lavash formulas and baking condition were as fallow:

Barbari: 3kg flour, 15g bakers yeast, 45g salt, mixing time 7min, first fermentation stage 55min, second fermentation stage 10min, baking temperature 280-320°C and baking period 8min. The amount of added water to the flours for making dough was between 55.5 and 65.3 percent of the flour weight (depend on the flour's falling number).

Lavash: 3kg flour, 10g bakers yeast, 15g salt, mixing time 15min, first fermentation stage 55min, second fermentation stage 7min, baking temperature 300-350°C and baking period 1min. The amount of added water was between 62.1 and 70.0 percent of the flour weight

Statistical analysis: For the evaluation of data, the SPSS v.10 software was used. The detection of the differences in between data's was done by using one-way variance analysis (ANOVA) and for comparison of the averages of the treatments, the Tukey's test was used. For sensory data analysis, the Friedman test was used.

Results and Discussion

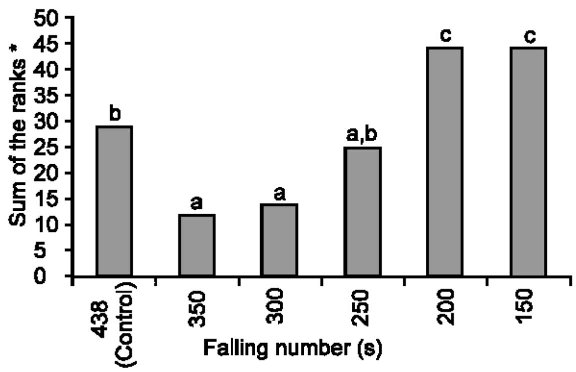
The chemical characteristics of flours: Results of the chemical analysis of raw flours (Barbari and Lavash bread flours) are shown in Table 1.

The adjustment of falling number: Falling numbers of the Barbari and Lavash bread flours and GW were 438, 420 and 62 seconds, respectively. In order to adjust the

Table 2: Farinogram results of Barbari and Lavash bread flours

Flours	W.A (%)	D.D.T (min)	D.S.T (min)	S.D 10	S.D 20	V.V
Lavash flour (control) (FN=420)	60.3	3.92	4.08	60.00	100.00	52.00
Lavash flour (FN=350)	59.9	3.61	4.25	61.67	101.67	50.33
Lavash flour (FN=300)	59.8	3.42	3.92	66.67	110.00	48.67
Lavash flour (FN=250)	59.8	3.17	4.00	70.00	116.67	48.33
Lavash flour (FN=200)	59.1	3.36	3.42	76.67	128.33	47.67
Lavash flour (FN=150)	58.8	3.08	3.50	81.67	130.00	46.00
Barbari flour (control) (FN=438)	58.8	3.17	4.36	71.10	126.10	48.67
Barbari flour (FN=350)	57.9	3.08	4.17	73.33	130.00	48.33
Barbari flour (FN=300)	57.4	3.50	3.92	80.00	136.67	48.33
Barbari flour (FN=250)	57.4	3.17	3.75	83.33	140.00	46.67
Barbari flour (FN=200)	57.1	2.50	3.67	90.00	156.67	42.33
Barbari flour (FN=150)	56.6	2.17	3.33	103.33	170.00	38.67

W.A= Water Absorption, D.D.T= Dough Development Time, D. S.T = Dough Stability Time, S.D 10 & S.D 20= Softening Degree in 10 and 20 minutes, V.V= Valorimetric Value



*Different letters have significant difference (p<0.05)

Fig. 2: The results of the sensory evaluation of Barbari breads

falling numbers of Barbari and Lavash bread flours to (150, 200, 250, 300, 350)±10 seconds, different percentages of GWF were added to them (Fig. 1). The results showed that the falling numbers of the flours had reverse relation with the percent of added GWF (Fernandez and Berry, 1989). A negative correlation coefficient was a good indication (Table 5). That is indicating that by increasing of GWF percent in the mixture, the rate of dough viscosity reduction in falling number apparatus also increases. This shows that amylolitic enzymes activity increases as a function of added GWF percent.

The results of maltose value test: The results of this test showed that by reduction of falling numbers (in both flours), maltose value goes up. The differences in values of maltose were also significant even in the case of flours with the adjacent falling numbers (Fig. 4). This is indicating that the amylolitic activity increases by addition of GWF%, so the hydrolytic activity goes up and starch will hydrolyze and reducing sugars which are fermentable, will also increase (Lukow and Bushuk 1984). In this research a positive correlation between GWF% and maltose values existed (Table 5).

The farinogram results: The results showed that the water absorption of flour is the function of the percent of added GWF and we got a negative correlation between %GWF and percent of absorbed water. The reduction of water absorption is the result of gluten (the main protein of flour and flour strength factor) hydrolysis by the increased proteolitic activity which is accompanied with the addition of the GWF (Holas and Tipples, 1978). Part of reduction of water absorption is due to damaged starch hydrolysis by increased amylolitic activity (damaged starch has more water absorption capacity compare to undamaged starch).

With the germination process of wheat, the dough development time, the dough resistance time and valorimetric value of the flours reduced and there were no significant difference between the flours with adjacent falling numbers, but in the case of flours with more difference between their falling numbers (i.e. 150 and 350) all the qualitative parameters had significant differences. The correlation coefficient was a good indication for negative relation between %GWF and those factors (Table 5).

When the GWF was added to the flour, the degree of weakness of the dough increased after 10 and 20 minutes which was the result of high proteolitic enzyme activity and gluten hydrolysis. During 20 minutes, there were progressed hydrolysis to compare with 10 minutes and the difference between strength of the flours was more obvious (Table 2).

The Extensogram results: The results of the research showed that all determined factors in each period of fermentation reduced with the reduction of falling numbers (in both flours) and indicated that proteolitic enzyme activity and gluten hydrolysis, especially in flours with low falling number (high %GWF) are related cases (Indrani and Rao, 2000).

In the meantime, the reduction of energy factor (lower area in extensogram) which is the indicator of the dough strength was more obvious. Falling number reduction will result in the gradually reduction of the dough

Table 3: Extensogram results of Barbari and Lavash bread flours

Flours	Fermentation Time (min)	Resistance to Extensibility (Bu)	Dough Extensibility (min)	Energy
Lavash flour (control) (FN=420)	45	198.67	199.33	58.67
	90	158.33	201.67	54.67
	135	159.67	202.00	40.33
Lavash flour (FN=350)	45	178.33	201.00	56.00
	90	172.33	204.33	51.33
	135	145.67	209.00	45.33
Lavash flour (FN=300)	45	155.0	181.67	40.33
	90	128.33	167.67	32.00
	135	110.00	165.33	29.33
Lavash flour (FN=250)	45	150.00	176.33	39.00
	90	122.67	170.00	26.33
	135	118.33	161.00	26.00
Lavash flour (FN=200)	45	150.00	175.00	38.00
	90	120.00	160.00	25.67
	135	108.33	153.00	21.00
Lavash flour (FN=150)	45	145.00	175.00	36.67
	90	116.67	159.67	24.33
	135	108.33	155.33	21.00
Barbari flour (control) (FN=438)	45	203.33	167.00	50.33
	90	126.00	165.00	24.00
	135	95.00	160.33	21.00
Barbari flour (FN=350)	45	190.00	166.67	48.33
	90	138.33	148.00	27.00
	135	114.00	151.00	20.67
Barbari flour (FN=300)	45	135.00	164.67	33.33
	90	97.67	143.33	22.67
	135	85.00	140.67	15.33
Barbari flour (FN=250)	45	131.67	166.33	31.33
	90	95.67	146.00	18.00
	135	70.00	123.00	10.67
Barbari flour (FN=200)	45	120.00	148.33	26.33
	90	78.67	130.00	16.33
	135	73.33	122.00	12.00
Barbari flour (FN=150)	45	115.00	152.67	25.67
	90	75.67	130.33	17.33
	135	*	-	-

*Not drawn

strength in the fermentation period and it can't tolerate the long fermentation period. This was in the case of Barbari bread flour with the falling number of 150 seconds, and the curve for the fermentation time (135 min.) was not drawn, because of the serious weakness of the dough. In the case of other flours, when the length of fermentation period increased from 45 to 90 and 135 minutes, the parameters showed significant reduction. So we can conclude that by the reduction of falling number, the length of the fermentation period should be reduced (Table 3). The correlation coefficients between extensogram factors and %GWF are in Table 4.

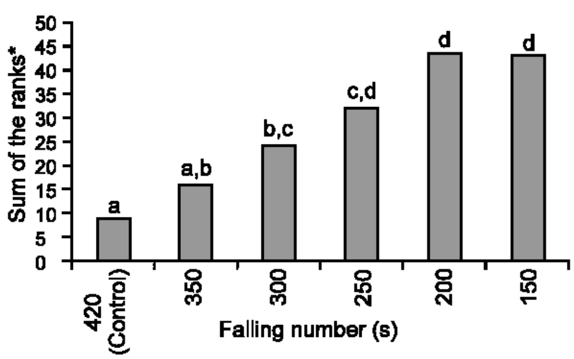
Sensory evaluation of barbari and lavash breads: The results of sensory test showed that the addition of the GWF to the flours and high enzymic activity would affect the breads quality (Singh *et al.*, 2001). As whole, by the reduction of falling number, the produced breads were indicated as worse. In the case of Lavash, the bread without GWF had the highest quality and by the addition of about 0.79% GWF (to FN=350), there were no significant change on the Lavash quality, but by the addition of 1.61% GWF, the bread quality reduced significantly (Fig. 3). In the case of the Barbari bread, addition of 0.94% of the GWF (FN=350) caused the best quality, but adding more GWF (up to 3%) had no effect on the bread quality and its quality was the same as the control (0% GWF). This means that the reduction of the enzymic activity will reduce the bread quality (as high enzymic activity does) and for good quality bread, we

Table 4: Correlation coefficient between added GWF% and Extensograph properties for Barbari and Lavash bread flours

	Correlation coefficient	
	GWF% in Lavash flour	GWF% in Barbari flour
45 min		
Resistance to Extensibility (Bu)	-0.726	-0.781
Dough Extensibility (min)	-0.706	-0.751
Energy	-0.736	-0.813
90 min		
Resistance to Extensibility (Bu)	-0.734	-0.824
Dough Extensibility (min)	-0.745	-0.816
Energy	-0.754	-0.743
135 min		
Resistance to Extensibility (Bu)	-0.690	-0.724
Dough Extensibility (min)	-0.724	-0.930
Energy	-0.794	-0.844

Table 5: Correlation coefficient between added GWF% and Farinograph properties, maltose value, for Barbari and Lavash bread flours

	Correlation coefficient	
	GWF% in Lavash flour	GWF% in Barbari flour
Water absorption (%)	-0.851	-0.862
Dough Development Time (min)	-0.714	-0.799
Dough Stability Time (min)	-0.736	-0.882
Dough softening degree after 10 min	0.901	0.910
Dough softening degree after 20 min	0.902	0.963
Valorimetric Value	-0.868	-0.964
Maltose Value (%)	0.852	0.882
Bread Quality		
Barbari	-	-0.712
Lavash	-0.839	-
Falling Number (s)	-0.928	-0.919



*Different letters have significant difference (p<0.05)

Fig. 3: The results of sensory evaluation of lavash breads

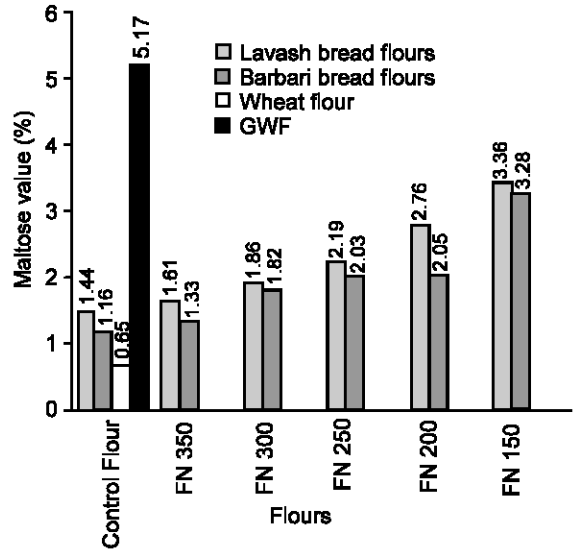


Fig. 4: The results of maltose value test

need proper enzymic activity (Kaur and Bains, 1976) (Fig. 2).

Conclusion: There is not enough information about the flat breads in compare with other types of bread, so it is supposed the science and technology of other types of bread is applicable to flat bread, but few studies done on the flat breads did reject this hypothesis (Qarooni and Miskelly, 1989).

The results of this study showed that the addition of GWF to the undamaged flour would reduce the baking value of the dough. The addition of small amount of GWF will not affect the dough properties but increase in the amount of the GWF will reduce the falling number, and the mixture of flour and GWF will loss its resistance, the dough will be sticky with lose texture. Dark color of the bread is the result of the extensive browning reaction during baking, and got low ranking score by panels.

The results from the Farinograph and Extensograph showed that there were no significant differences between the flours with adjacent falling numbers, but the existence of significant differences between the maltose values of above mentioned flours indicating the by the wheat germination, the increase in proteolitic activity is much less than amylolitic activity (Aryama and Khan, 1990).

The results of this study show that the adjustment of the flours' enzymic activity is necessary for the production of Barbari and Lavash breads with the desirable quality.

Acknowledgments

We would like to express our great thanks to the people in Institute of Cereal and Bread Science and Technology in Iran-Tehran for their helps on the process of this research work.

References

AACC., 1990. Approved Methods of Analysis of the American Association of Cereal Chemists, St. Paul, Minnesota, U.S.A.

Aryama, T. and K. Khan, 1990. Effect of laboratory sprouting and storage on physicochemical and breadmaking properties of hard red spring wheat. Cereal Chem., 67: 53-58.

Bajwa, U. and G.S. Bains, 1990. Supplementation of glycerolized oils and alpha-amylases in breadmaking. III. Changes in water soluble components during ageing of bread. J. Fd. Sci. Tec., 27: 153-155.

Casutt, V., K.R. Preston and R.H. Kilborn, 1984. Effects of fermentation time, inherent flour strength, and salt level on extensograph properties of full-formula remix-to-peak processed doughs. Cereal Chem., 61: 454-459.

Fernandez, M.L. and J.W. Berry, 1989. Rheological properties of flour and sensory characteristics of bread made from germinated chickpea. Int. J. Fd. Sci. Tec., 24: 103-110.

Holas, J. and K.H. Tipples, 1978. Factors affecting Farinograph and baking absorption. I. Quality characteristics of flour streams. Cereal Chem., 55: 637-652.

Ichinose, Y., K. Takata, T. Kuwabara, N. Iriki, T. Abiko and H. Yamauchi, 2001. Effect of increase in α-amylase and endo-protease activities during germination on the breadmaking quality of wheat. Fd. Sci. Tec. Res., 7: 214-219.

Indrani, D. and G.V. Rao, 2000. Effect of chemical composition of wheat flour and functional properties of dough on the quality of south Indian Parotta. Fd. Res. Int., 33: 875-881.

Kaur, M. and G.S. Bains, 1976. Effect of amylase supplements on the rheological and baking quality of Indian wheats. J. Fd. Sci. Tec., 13: 328-332.

Lukow, O.M. and W. Bushuk, 1984. Influence of germination on wheat quality. II. Modification of endosperm protein. Cereal Chem. 61: 340-344.

Mjorndal, A., 1985. Benefits of the falling number method, calculation of mixtures and malt addition. NEWS. Published by Falling Number. Box 5101, S-141 05 HUDDINGE, Sweden, No. 56.

Qarooni, J. and D. Miskelly, 1989. Factors affecting the quality of Arabic bread-fermentation variables. J. Sci. Fd. Agri., 48: 99-109.

Ranhotra, G.S., R.J. Loewe and T.A. Lehmann, 1977. Breadmaking quality and nutritive value of sprouted wheat. J. Fd. Sci., 42: 1373-1375.

Singh, H., N. Singh, L. Kaur and S.K. Sexena, 2001. Effect of sprouting condition on functional and dynamic rheological properties of wheat. J. Fd. Engin., 47: 23-29.

Singh, N., K.S. Sekhon and H.P.S. Nagi, 1987. Laboratory sprout damage and effect of heat treatment on milling and baking properties of Indian wheats. J. Fd. Sci., 52: 176-179.

Sorrells, M.E., A.H. Paterson and P.L. Finney, 1989. Milling and baking quality of soft white wheat genotypes subjected to preharvest sprouting. Cereal Chem., 66: 407-410.