STUDIES ON UTILIZATION OF WHEAT GERM IN THE PRODUCTION OF ENRICHED BREAD

BY
El-Bardeny*, A.E.; Abdel-Salam**, A.M.H.
and Saad**, S.M.M.

* North Cairo Flour Milling Company.
** Department of Agricultural Biochemistry, Faculty of Agriculture, Moshtohor, Toukh, Kaliobia, Egypt.

ABSTRACT

Wheat germ was analyzed for its physical and chemical constituents. It has a high content of ash, crude proteins, lipids, dietary fibers, phytate phosphorous, carotenoids and tocopherols compared to patent and brown flours.

The prepared enriched bread (10% wheat germ +90% patent flour) was rich in proteins, minerals, lipids, carotenoids, tocopherols, dietary fibers and some vitamins of B group.

This bread have a pleasent taste, flavour, good appearance and golden colour.

Dough characteristics was negatively reduced by incorporating 10% wheat germ. the data showed a pronounced decrease in elasticity and plasticity properties. Such negative effects after wheat germ 10% addition could be eliminated to some extent by ascorbic acid addition.

Increase of yeast percentage used in dough propagation in 10% wheat germ bread had not a potential effect on germ phytate reduction in bread as a final product.

INTRODUCTION

Bakery foods, in its various forms, is an ideal staple to be fortified with wheat germ as valuable nutrient for various feeding programs and public use. However, such fortification must be carefully accomplished since it can adversely affect dough properties and baking quality (Tsen, 1980). Addition of wheat germ to the bakery foods caused a weakening effect to the rheological properties. This effect can be eliminated to some extent by ascorbic acid addition which leads to the improvement of baking quality as suggested by Staudt and Ziegler (1973).

In England there are a commercial wheat germ bread e.g. (Hovis) and (Vitbe) as reported by Wenlock et al., (1983). On the other hand, Kent (1983), stated that the germ content in English bread must not exceed 10% of its total weight. The germ is used in USA in protein enriched bread, market type, but its amount is not more than 5% of the flour ingredient (Pyler, 1988).

Jones and Amos (1967), mentioned that the percentage of germ in the wheat berry is in the region of 2.5% but this quantity is never obtained. The actual amount which resulted from wheat berry varies between 0.3-1% (Anon, 1976) and 0.58-1.06% (Farrell et al., 1967). The produced amount of germ from local flour roller mill e.g. Fouad Factory, Cairo, Egypt is about 0.1% of the milled wheat (El-Bardeny, 1989). However, Farrell et all. (1967), stated that it is possible to increase the local percentage of germ from 0.1% to 0.2 or 0.3% in the rolled flour. The former values could be obtained by adjusting wheat moisture and damping before the first break which help in loosen the germ and release the whole particles.

Refai (1965) and El-Gendy (1982), stated that the major limitation of local wheat germ utilization in Egypt is the poor shelf-life of germ (2-3 days). Simple methods were developed to stabilize and improve the shelf-life of germ for more than 26 weeks (Kent, 1983). Wheat germ is an excellent source of tocopherols and B group vitamins (except B_{12}), (Schild, 1983). Wheat germ lipids contain a large proportion of essential unsaturated fatty acids (Refai, 1965). The protein content of the wheat germ amounted to 25-30% of its weight. The germ contains hemagglutinin, antitrypsin, phytic acid, high amount of non-protein nitrogen (11-15.3%) and some nucleic acids (3.5-4.2%) as reported by Pomeranz (1971).

Phytates represent a complex class of naturally occurring compounds that can significantly influence the functional and nutritional properties of wheat flour. Phytates are biologically important as they represent a store of phosphorous (Reddy et al., 1982). Phytic acid and its derivatives can bind essential dietary minerals, thus making them unavailable or only partially available for absorption and also they decrease protein solubility (Maga, 1982). Complexes may be formed between the anionic side chains of proteins ($-COO^-$) and divalent metal cations (M^{++}) e.g. Mg, Ca, Zn and Fe from one side while the phosphate group is attached to the other side (Robinson, 1987).

Recently in Egypt, modern flour mills can produce more than 10.5 tons/day wheat germ (0.1% of 10,500 tons/day milled wheat) as mentioned by Abdel-Ghaffar (1989).

This study is mainly concerned by the possibility of germ addition in bakery industry and its effect on rheological properties of flour and sensory evaluation of the produced bread.

MATERIALS AND METHODS

Wheat germ and patent flour samples were purchased from Fouad Flour Mill, North Cairo, Flour Milling Company. Balady and European bread obtained from the local market.

The values of moisture, crude proteins (Nx5.7), ash, lipids, pigments (carotenoids) and fabling number were determined using A.O.A.C. methods (1980). Phosphorous phytate was determined according to Lopez et al., (1983). Available carbohydrates were determined enzymatically, according to Kerr et al., (1951). Dietary fibers were determined by difference on dry weight basis - [100 - (proteins + Lipids + ash available carbohydrates)], tocopherols were determined according to A.O.A.C. (1977).

Rheological properties of the different doughs blends were carried out using a farinograph and extensograph tests according to A.A.C.C. (1962). Wheat germ processed by heat treatment (toasted) 100°C for one hour to improve its shelf-life as reported by Kent (1983). Bread evaluation was carried out according to the method discribed by Grance and Wragg (1980).

RESULTS AND DISCUSSION

Different chemical constituents of wheat germ, patent and brown flours were determined, the results are shown in Table 1. The obtained data illustrated that wheat germ has higher contents of minerals (ash), crude proteins, lipids, dietary fibers, carotenoids and tocopherols. Such results are in agreement with that reported by Refai, (1965) and Abou-Zaid, (1978). Phytate phosphorous in wheat germ (1.224%) are higher than in patent (0.09%) and brown flours (0.18%). The wheat germ lipids amounted to 8.15% has 0.294% tocopherol content since it is the main source of vitamin E. This result is in agreement with that established by Schild (1983).

Table (1): Chemical constituents of wheat germ processed, patent flour and brown flour (on dry weight basis).

	Moisture %	Ash %	Crude protein %	Lipids %	Available carbohydrate %	Dietary fiber %	Tocopherols %	Phytate phosphorous %	Carotenoids (pigment content) ppm
Wheat germ processed	5.00	3.79	26.00	8.15	44.06	18.00	0.024	1.224	12.76
Patent flour (72%)	13.80	0.57	10.11	1.13	86.36	1.83	-	0.09	2.85
Brown flour (82%)	14.70	0.81	9.00	1.30	85.45	3.44	-	0.18	-

Rheological properties of wheat germ flours:

Farinograph data of different blended processed wheat germ added to patent flour are presented in Table 2. Water absorption slightly increased as the amount of processed wheat germ in the blend increased. the obtained values of dough development time, arrival time, stability and valorimeter were reduced. Such phenomenon might be attributed to the dilution effect on flour gluten after wheat germ addition. In general, weakening of dough properties partially due to flour gluten dilution, Refai (1965).

Extensograph data, Table 3, showed that the different blends of processed wheat germ i.e. 0, 10, 20 and 25% added to patent flour, showed a decrease in elasticity and plasticity properties especially in case of 25% wheat germ. The quality of energy required to measure the dough quality has been reduced from 241.4 to 81.3 cm^2, which simply means that the dough strength has been reduced.

However, it could be concluded that the rheological properties of the different blends revealed a weakening effect after wheat germ addition compared with control. This weakening effect is due to the low gluten and high lipids contents in wheat germ (gliadin, 3.64%; glutein, 0.078%, lipids, 8.15%) compared to patent flour (gliadin, 3.54% glutenin, 4.54%; liids, 1.13%) as reported by Jensens and Martens (1983).

The addition of different quantities of ascorbic acid (100, 150 and 200 ppm) to 10% wheat germ blend had led to improve baking quality as shown in Tables 4 and 5. Dough strength, elasticity and plasticity properties of 10% wheat germ blend were increased and the degree of softening was reduced by ascorbic acid addition. The data showed that the 100 ppm ascorbic acid was the most reasonable treatment.

The effect of different blends of processed wheat germ on the percentage of phytate phosphorous content of the produced bread were studied. Data in Table 6 revealed that bread phytate phosphorous have a positive relationship with germ percentage addition.

On the other, phytate loss in wheat germ breads ranged from 53.69 to 55.69% which are higehr than in Balady bread i.e. 46.07%. However, phytate loss in bakery might be attributed to multiple factors. The action of phytase enzyme on the hydrolysis of its phytate content during the fermentation period of dough as reported by Reinhold (1975).

Table (2): Farinograph parameters of different blends of wheat germ added to patent flour.

Processed wheat germ %	Water absorption %	Dough development time (min.)	Arrival time min.	Stability min.	Valorimeter value B.U.	Degree of softening	
						after 10 min.	after 20 min.
Control	57.7	3.0	2.0	4.5	42	90	120
10	58.3	1.7	0.8	3.5	34	120	150
20	58.5	1.7	0.8	4.0	32	115	190
25	61.5	1.3	0.4	3.5	26	130	210

Table (3): Extensograph data of blends wheat germ in patent flour.

Processed wheat germ in blend %	Elasticity mm	Plasticity B.U.	Proportional number	Energy cm^2
Control	210	310	1.47	241.4
10	195	340	1.74	122.9
20	210	400	1.90	149.4
25	165	240	1.45	81.3

Table (4): Farinograph parameters of ascorbic acid addition to 10% wheat germ blend in patent flour.

Processed wheat germ %	Ascorbic acid added ppm	Water absorption %	Dough development time (min.)	Arrival time min.	Stability min.	Valorimeter value B.U.	Degree of softening	
							after 10 min.	after 20 min.
0	0	52.6	1.4	1.1	1.0	31	115	145
10	0	54.8	1.4	1.1	0.9	21	170	210
10	100	55.0	1.3	0.9	0.9	23	150	205
10	150	55.0	1.3	0.9	1.0	24	145	185
10	200	55.0	1.3	0.9	1.0	24	145	175

Table (5): Extensogram data of ascorbic acid addition to 10% wheat germ blend in patent flour.

Processed wheat germ %	Ascorbic acid added ppm	Elasticity mm	Plasticity B.U.	Propotional number	Energy cm^2
0	0	205	315	1.54	90.0
10	0	102	135	1.32	16.5
10	100	110	260	2.36	30.0
10	150	118	275	2.33	34.9
10	200	118	300	2.54	39.5

Table (6): Phytate content of wheat germ added to patent flour bread (on dry weight basis).

Processed wheat germ in blend %	Name of bread	Flour phytate %	Bread phytate %	Phytate* loss %
0	Balady	0.191	0.103	46.07
0	European	0.090	0.041	54.45
10	Germ bread	0.203	0.094	53.69
20	Germ bread	0.316	0.140	55.69
25	Germ bread	0.373	0.170	54.42

* Phytate loss % = $\frac{\text{Flour phytate \% - Bread phytate \%}}{\text{Flour phytate \%}} \times 100$

Also, the thermal destruction of phytate during bakering might lead to the hydrolysis of phytate resulting in simpler phosphorous forms as penta and tetra phosphate compounds (de Boland et al., 1975).

Phytate loss which might attributed to the action of phytase enzyme was faster in patent flour (European bread) during fermentation than Balady bread (Table 6). Such results are in accordance with those reported by Reinhold, (1975). Wheat germ bread (10%) have approximately the same phytate phosphorous content (0.094%) as balady bread (0.103%). Kent (1983), stated that wheat germ always contains higher phytate content than in flour.

Effect of yeast percentage on phytate loss:

An attempt was made to minimize the phytate phosphorous content of wheat germ bread by increasing yeast percentage used in dough propagation from 2 to 3 and 4%. Results in Table 7 showed that the fermentation of blended wheat germ (10%) for 1 and 1½ hr. minimized its phytate amount to 35-50.7% of its original content according to the added yeast percentage. These results are in agreement with the work of Reinhold (1975), who reported that yeast fermentation of doughs has been shown to lower phytate levels by one-third to half. Also, the results in Table 7 indicated that yeast percentage increment had not a potential effect on germ phytate reduction in bread as a final product. Such result was mentioned before by El-Bardeny (1989).

Sensory evaluation of wheat germ bread:

The results concerning the quality of the produced bread are shown in Table 8. Wheat germ bread (10%) have a pleasent taste, flavour, good appearance with golden colour, a good monthfeel and good acceptability. It was found that wheat germ bread (10%) has a higher score i.e. 83 than other blended processed wheat germ (20 and 25%). The obtained results indicated that it could be possible to produce enriched bread containing 10% of processed wheat germ rich in proteins, minerals, lipids, tocopherols (Vit. E.), dietary fibers and some vitamins of B group. Such bread will be also less in its phytate phosphorous content.

ACKNOWLEDGEMENTS

The authors thanks **M. Magdy Said and Mrs. Sanaa Attia** of North Cairo Flour Milling Company for helpful assistances in technological analysis.

Table (7): Effect of yeast percentage of phytate loss in making 10% wheat germ added to patent flour bread.

10% wheat germ blend* + yeast %	Fermentation				After baking	
	After 1 hr.		After 1½ hr.			
	Phytate %	Phytate loss %	Phytate %	Phytate loss %	Phytate %	Phytate loss %
2	0.132	34.97	0.129	36.45	0.094	53.69
3	0.125	38.42	0.111	44.77	0.093	54.19
4	0.108	46.20	0.100	50.73	0.091	55.17

* Phytate content into wheat germ blend (10%) before yeast addition reached to 0.203%.

Table (8): Sensory evaluation of wheat germ added to patent flour bread.

	Maximum	Home loaf	Competitors			
			(Control) wheat 100%	Wheat germ		
				10%	20%	25%
General appearance	10	7	9	8	7	6
Volume	10	8	9	8	6	5
weight	10	9	9	8	7	6
Quality of crust	10	8	9	9	8	7
Colour of crumb	10	8	7	8	7	6
Suitability for buttering	10	8	8	9	7	6
Flavour	10	9	8	9	9	9
Crumb structure	10	8	9	8	7	6
Moisture	10	7	8	8	9	9
Clarify od crumb	10	10	9	8	7	7
	100	82	85	83	74	67

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دراسة عن استخدام جنين القمح فى انتاج خبز محسن

أحمد السيد البردينى ، عبد السلام محمد حلمى ، صلاح مصطفى سعد

لقد تمت دراسة الخواص الطبيعية والكيماوية لجنين القمح ولقد تبين ارتفاع نسبة البروتين الخام (٢٦٪) والليبيدات (٨,١٥٪) والالياف الغذائية (١٨٪) وفيتامين هـ (توكوفيرول ٠٢٤,٪) والكاروتينات وبعض مجموعة فيتامين ب هذا اذا قورن بالدقيق البلدى والأوربى.

ولقد أضيف جنين القمح الى الدقيق بنسب مختلفة (١٠، ٢٠، ٢٥٪) ولقد وجد أن الدقيق المضاف اليه ١٠٪ من جنين القمح يعطى خبزا جيدا من ناحية الطعم والرائحة والمظهر واللون الذهبى المرغوب.

ولقد لوحظ انخفاض قوة العجينة باضافة جنين القمح فتقل المطاطية والمرونة للعجين الناتج. ولقد أمكن التغلب الى حد ما على هذا التأثير السلبى باضافة نسب مختلفة من حامض الأسكوربيك (١٠٠، ١٥٠، ٢٠٠ جزء فى المليون). ولقد وجد أن أنسب هذه الأضافات هى ١٠٠ جزء فى المليون من حمض الاسكوربيك.

ولقد درس ايضا تأثير اضافة نسبة أعلى من خميرة الخباز على نسب فوسفور الفيتات فى الخبز الناتج فوجد أن الخميرة لاتؤثر على هذه النسبة.