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PRODUCTION OF HIGH FIBER BREAD USING CORN COBS POWDER

BY

Torki, M.A. *; Foda, F.F. *; El-Bardeny, A. S. ** and Darwish, H.A. **

* Dept. of Agric. Biochem., Fac. of Agric., Moshtohor, Zagazig Univer. Banha Branch

** North Cairo flour mills company

ABSTRACT

Corn cobs powder was used as a source of dietary fiber by mixing with wheat flour (72% extraction) at different ratios (90:10, 85:15, 80:20 and 75:25) for the production of high fiber bread. The chemical properties, rheological characteristics and the organolyptic properties for both the raw materials and different blends were determined.

The results showed that addition of corn cobs powder in replacement rates 10, 15, 20 and 25% of wheat flour (72% ext.) increased the dietary fiber contents, ash and reduced sugars in all rates while, decreased starch, crude protein, ether extract and phytate content.

Farinograph properties showed that addition of corn cobs powder under the above-mentioned concentrations lead to increase water absorption and the arrival time. On the other hand, extensograph properties include different addition levels of corn cobs powder showed a decrease in dough extensibility and dough energy while, resistance to extension increased. Organolyptic evaluation of balady bread supplemented with 10% corn cobs powder showed no difference in crust color, aroma, taste, texture and overall acceptability compared with control (100% wheat flour (72% ext.). But toast bread producing by mixing wheat flour with different ratios of corn cobs showed gradual reduction in its volume by increasing replacing ratios. Also, the results showed an improvement in both rheological and organolyptic properties after the addition of L-ascorbic acid at level 100 ppm in balady and toast breads.

INTRODUCTION

Dietary fiber can be defined as the remainants of vegetable cell walls which are not hydrolyzed by alimentary enzymes of man. It is also considered as the indigestible component of foods that includes cellulose, hemicellulose, lignins, pectins, gums, and mucilages, Williams, (1985).

Wheat bran is the major source of dietary fiber incorporated into food products, such as breads, cakes, pasta, and baking products. Other fiber sources (especially industrial by - products) such as peanut hull have been extensively evaluated as a potential fiber, Collins and Post (1981).

Agricultural waste residues such as wheat straw, corn Stover, and oat hulls contain significant cellulose and hemicellulose fraction. These materials are potential sources of energy and dietary fiber, Reddy, *et al.* (1983).

Corn cobs powder (as a source of dietary fiber) apparently was superior to wheat bran in its minerals content, total dietary fiber, lower quantity of starchy components and their lack of phytate, Crampton and Harris (1969).

Chen, *et al.* (1988) observed that increasing water absorption may be due to the strong water-binding ability of fiber, the longer mixing time could result from the dilution of gluten and the difficulty of mixing fibers and wheat flour homogeneously. The increasing bread weight was caused by high water retention and while the decreasing loaf volume was due to the dilution of gluten, and also could result from the interaction between gluten and fiber material.

Seleem, (1991) reported that the wheat flour dough (Variety SaKha 69) had water absorption of 56.4%, mixing time 1.5 min., dough stability 1.5 min. and dough weakening of 220 B.U.

Faheid (1992) indicated that the farinograph and extensograph characteristics for dough made from the various fraction of strong canadian flour showed approximately the same general trends with slight decrease in the first fraction. The size of fractionation process of both weak and strong wheat flours caused actual increase in the strength of the coarse flour fraction. Dough development times and dough stability in the high protein fraction were increased. However, the water absorption increased for fraction having greater proportion of starch. The results of extensograph test indicted that there were an increases in the values of resistance to extension and the area under the curve (energy) of the coarser fractions (> 125 and 125 - 90) for both strong and weak flours.

Roberfroid, (1993) reported that some types of dietary fiber especially insoluble fiber, can affect colon cancer, fiber - rich wheat bran can protect against colon cancer in experimental animals.

Nagwa, *et al.* (1994) reported that imported American corn cobs have 10.1 % starch, 3.15% crude protein and 0.3% oil while, local white corn cob have 10.6% starch, 3.4% crude protein and 0.85% oil. They found that the husk tassel and cobs of corn plant can be utilize as good sources of different phytosterols for pharmaceutical industry.

Humpolikova and Hampi (1990) found that addition of L-ascorbic (optimum concn. 100 mg/kg) to flour resulted in marked improvement in the quality of the final dough product (particularly shape) especially with very poor quality flour. The effect was most pronounced in doughs with 0-1 % fat and with a fermentation time of 45 min.

His-Mei and Cheng-Yilii (1996) used functional additives, such as ascorbic acid, ∝-amylase, and surfactants, to study their effects on the qualities of bread. They concluded that ascorbic acid, ∝-amylase and surfactants (diacetyl tartaric acid ester of monoglyceride) could be used to make bread with high volume and good texture without using bromate.

Park, *et al.* (1997) found that white bread was fortified individually with fat-coated L-ascorbic acid (ASA), cold – water dispersible (CWD) ß-carotene and CWD all-rac-∝-tocopheryl acetate (TOAC) at levels of 64,5 and 100 mg, respectively of active ingredients per l00 gm flour. The freshly baked pup-loaves retained 76, 67 and 96% of added antioxidant, respectively. They noted that (TOAC) was in partially bound state "Protein-encased "(PE). ß-carotene did not yield a yellow colour to bread crumb and had one fourth higher retention in fresh bread when compared to CWD ß-carotene.

The aim of the present work was to use corn cobs powder as a source of dietary fiber through mixing with wheat flour (72%) at different ratios. The chemical, rheological and organolyptic properties of balady and toast bread of the products were studied. Also, ascorbic acid at different concentrations was used as dough improver.

MATERIALS AND METHODS

Wheat flour (72% extraction) was obtained from El-Hoda North Cairo flour mills Company, Shoubra El-khema, Cairo.

Corn cobs as a source of fiber was obtained from Field Crops Research Institute, Agricultural Research Center, Ministry of Agriculture, Giza. Ascorbic acid was obtained from EI-Nasr Pharmaceutical Chemicals.

2.1. Physical and chemical characteristics:-

Moisture content, ash content, total protein and total lipids were determined according to A.O.A.C.methods (1980). Total soluble sugars were determined as glucose by using the phenol sulphuric acid method (Dubois, et. al., 1956). Reducing and non-reducing sugars were determined by the method described in the A.O.A.C. (1980). Starch content was determined enzymatically according to the method described by Kerr, *et al.* (1951).

Phytate phosphorus was determined according to Lopez, *et al.* (1981). The soluble dietary fiber was determined according to A. A. C. C. method (1987). Total dietary fiber content was determined by difference:

100 – (protein + fat + starch + total soluble sugars + ash).

Total pectics substances were determined according to the method described by Pearson (1976).

2. 2. Ascorbic acid:-

The mixtures of corn cobs powder / flour at (15% / 85% replacement) are used to investigate the improvement effects of ascorbic acid on its dough characteristics and bread quality. Ascorbic acid was added at concentrations of 50, 75, 100, 125 and 150 ppm to both mixtures.

2. 3. Chemical composition of the mixture :-

The different mixtures of wheat flour (72% ext.) and corn cobs powder in different ratios (90%, 85%, 80% and 75%) were baked as balady bread. After baking and drying the bread were milled and the milling products were subjected to the formentioned chemical parameters.

2. 4. Bakery products preparation:-

Balady bread and pan bread (toast) were prepared according to the method described by Yassen (1985). Fermentation, baking process and sensory evaluation of bread were measured according to the methods of Pyler (1988).

2. 5. Technological characteristics:-

The rheological properties of the different doughs were carried out with farinograph and extensograph tests according to A. A. C. C. (1987).

2. 6. Organolyptic evaluation of balady and pan (Toast) breads were carried out according to the methods described by Kramer and Twig (1974).

RESULTS AND DISCUSSION

1. Chemical composition of wheat flour (72% extraction), corn cobs powder and shorts:-

The suggested fiber source was chemically analysed and the obtained results are tabulated in Table (1). The results indicated that the moisture contents were 13.9% in wheat flour (72% ext.), 8.0% in corn cobs powder and 13.0% in shorts. Ash contents were 0.46% in wheat flour (72% ext.), 2.45% in corn cobs powder and 3.85% in shorts. Crude protein contents were 9.84%, 4.62% and 15% on dry weight basis for raw materials wheat flour (72% ext.), corn cobs powder and shorts, respectively. These results are in agreement with those reported by Abd El-Daim (1986) and Soliman (1997). On the other hand, total lipids contents were 1.66%, 1.16% and 5.0% for wheat flour (72% ext.), corn cobs and shorts, respectively. Shorts contains the highest lipid content which may be due to its contamination with aleurone layer and wheat germ residues during the milling process.

The reducing sugars, non-reducing sugars and total soluble sugars contents were (0.36%, 1.31% and 1.74%) in wheat flour (72% ext.), (0.90%, 1.36% and 2.33%) in corn cobs and (1.6%, 3.04% and 4.8%) in shorts. These results coincide with those reported by Hafez (1996). However, starch content was found to be 83.5% in wheat flour, 8.12 in corn cobs and 21.15% in shorts. These results demonstrate the lower starch contents of corn cobs than shorts which may be preferred in making high fiber bread.

The data presented in Table (1) show that phytate phosphorous was absent in corn cobs powder (zero%) while, shorts and wheat flour (72% ext.) contain 1.4% and 0.08%, respectively.

The complicated relationships between dietary minerals, protein and phytate content on mineral availability in humans. The retention of calcium, iron and zinc were decreased by diets high in phytate, Kent (1983). Therefore corn cobs powder is excellent source of high fiber bread.

2. Dietary fiber content:-

Data presented in Table (2) show that total dietary fiber contents were 2.8% in wheat flour (72% ext.) and 81.32% in corn cobs powder while, it was 51% in shorts.

Table (1): Chemical composition of wheat flour (72% extraction), corn cobs powder and shorts (% on dry basis).

Components (%)	Wheat flour (72% ext.)	Corn cobs	Shorts
Moisture	13.9	8.00	13.0
Ash	0.46	2.45	3.85
Crude protein	9.84	4.62	15.0
Total lipids	1.66	1.16	5.0
Reducing sugars	0.36	0.90	1.6
Non reducing sugars	1.31	1.36	3.04
Total soluble sugars	1.74	2.33	4.8
Starch	83.5	8.12	21.15
Phytate phosphoraus	0.08	0.0	1.4

Table (2): Dietary fiber component of wheat flour (72% extraction), corn cobs powder and shorts (% on dry basis).

Components (%)	Wheat flour (72% ext.)	Corn cobs	Shorts
Acid soluble pectin	-	9.58	-
Ammonium oxalate sol. Pectin	-	12.87	-
Water soluble pectin	-	12.93	-
Total pectic substances	-	35.38	-
Water soluble hemicellulose	-	4.0	-
Soluble dietary fiber	-	39.38	-
Insoluble dietary fiber	-	41.94	-
Total dietary fiber	2.8*	81.32	51.0*

* According to El-Bardeny (1989)

On the other hand, the results showed that soluble dietary fiber content was 39.38% for corn cobs while, insoluble dietary fiber was 41.94%. These

values of dietary fiber reveal that corn cobs is a good source for both insoluble and soluble dietary fiber.

Also, these results demonstrate that corn cobs powder has a high content of pectic substances 35.38%.

It could be concluded that corn cobs powder can be use in the manufacture of high insoluble and soluble dietary fiber bread. One loaf (100 g) from high fiber bread (fiber source was corn cobs powder) will provide the adult with about 42 or 39 g fiber respectively, the WHO recommended the intake from fiber from 27 to 40 g/day as cited by Kathryn and Susans (1998).

3. Minerals content:-

Concerning some choice minerals contents i.e, Fe, Cu, Zn, Mn and pb (Table 3) found to be 280, 32, 85, 178 and Zero (ppm), and 18, 21, 20, 25 and Zero (ppm) in corn cobs and wheat flour (72% ext.) respectively. These values were in agreement with those reported by Crampton and Harris (1969).

Results reveal that wheat flour (72% ext.) replacement by corn cobs powder at rate 10% increases minerals content such as iron, copper, manganese and zinc. Now a days there is a project to add iron as ferrous sulfate (at rate 30 ppm iron). From the above-mentioned results corn cobs powder could be used for bread fortification instead of iron addition beside it's other benefits such as increament of fiber and Zinc.

Table (3): Minerals content of wheat flour (72% extraction) and corn cobs powder.

Minerals	Wheat flour (72% ext.) ppm	Corn cobs ppm
Fe	18	280
Cu	21	32
Zn	20	85
Mn	25	178
Pb	0	0

4. Effect of replacing wheat flour (72%extraction) by corn cobs powder on its mixture chemical composition:-

Data presented in Table (4) show the effect of mixing corn cobs powder with wheat flour (72% ext.) at ratios of 10, 15, 20 and 25%.

The obtained results demonstrated that there is a positive relationship between the percentage of corn cobs powder replacement and the mixture contents from ash, sugars, and total dietary fiber. Also, the results show that a negative relationship for crude protein, ether extract, starch and phytate phosphorus of the mixture. These results are attributed to the chemical constituents of each corn cobs and flour.

Table (4): Chemical composition of wheat flour (72% extraction) and corn cobs powder mixtures.

Mixing		Ash %	Crude protein %	Ether extract %	Reducing sugars %	Non-reducing sugars %	Total soluble sugars %	Starch %	Phytate phosphorous %	Total dietary fiber %
Wheat flour (72% ext.)	Corn cobs %									
100	-	0.46	9.84	1.66	0.36	1.310	1.740	83.50	0.080	2.80
90	10	0.66	9.32	1.61	0.41	1.316	1.795	75.96	0.072	10.83
85	15	0.76	9.05	1.58	0.44	1.318	1.827	72.19	0.068	14.57
80	20	0.86	8.80	1.56	0.47	1.320	1.860	68.42	0.064	18.50
75	25	0.96	8.54	1.54	0.50	1.320	1.892	64.65	0.060	22.42

5. Effect of replacing wheat flour (72% extraction) by corn cobs powder on its rheological properties:-

5.1. The Frainograph properties:-

Table (5) and Fig. (1) show the farinograph parameters of wheat flour as affected by different levels (10%, 15%, 20% and 25%) of corn cobs powder. The results showed that addition of corn cobs powder under the above-mentioned concentrations lead to increase water absorption which recorded 58.3, 61.7, 60.1 and 54.6% compared with control (54.2%). The increasing of water absorption may be due to the strong water- binding ability of fiber. Also, the arrival time increased at all levels except at level of 10%. On the other hand, dough development time was decreased then increased gradually and reached its maximum (8.5 min.) at 25% of corn cobs powder addition, longer dough development time may be a result from the difficults of mixing fibers and wheat flour homogenously as cited by Chen *et al.* (1988).

Table (5): Effect of replacing wheat flour (72% extraction) by corn cobs powder on the farinograph parameters.

Recipe mixtures		Water absorption	Arrival time	Dough development time	Dough stability	Dough weaking after 20 min.
Wheat flour (72% ext.) %	Corn cobs %	%	Min	Min	Min	B. U.
100	-	54.2	2.5	5.0	6.0	90
90	10	58.3	1.5	4.5	6.0	130
85	15	61.7	2.0	5.5	4.0	120
80	20	60.1	3.0	6.0	4.5	110
75	25	54.6	6.0	8.5	15.0	-

Also, dough stability did not change at level 10% of corn cobs powder then decreased gradually to reach its maximum (15 min) at 25% corn cobs powder. The data showed that dough weakening due to replacing wheat flour (72% ext.) by corn cobs increased compared with the control. The increasing of dough weakening is a result of the break down of gluten network after elapsing at the appropriate mixing time. As a result the polar points of contact would be few

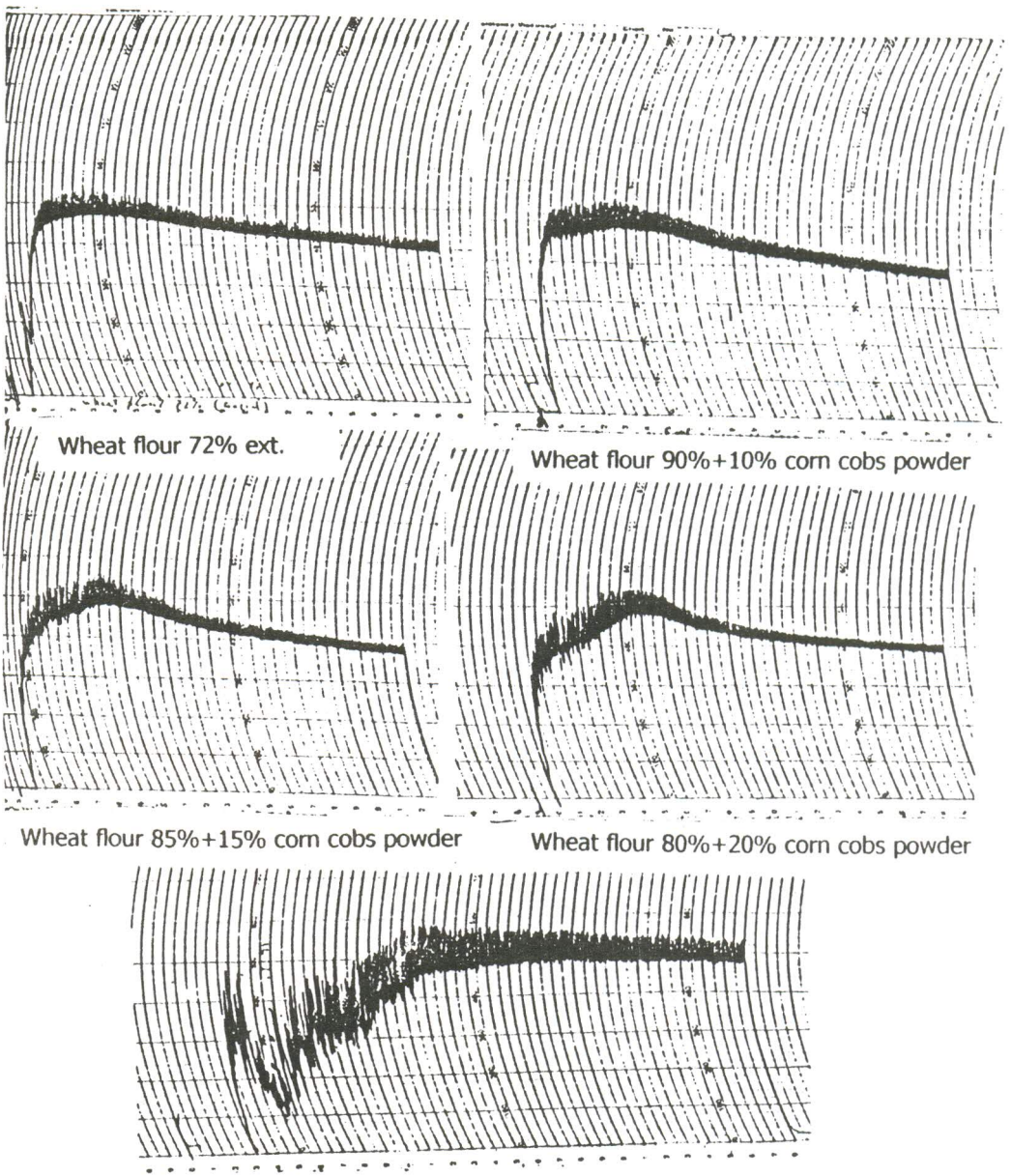


Fig (1): The farinograph characteristics of wheat flour (72% ext.) mixed with corn cobs powder at different ratios.

and weak, which led to increase the weakening of the dough mixture. These results are in agreement with those reported by Soliman (1997).

In general, it could be concluded that fiber source additions increase water absorption, dough development time and lower stability and weakening of dough, these dough characteristics may be attributed to high ability of dietry fiber components to swell and absorb more water.

The gluten dilution beside the slow formation of gluten network, which is the parameter of dough development time also, dough stability is an important index for the ability of the dough to capture sufficient amounts of gas during fermentation period, but here it had different trend attributed to the fiber addition. Fiber have the ability to absorb more water and dough become tough, Chen, *et al.* (1988).

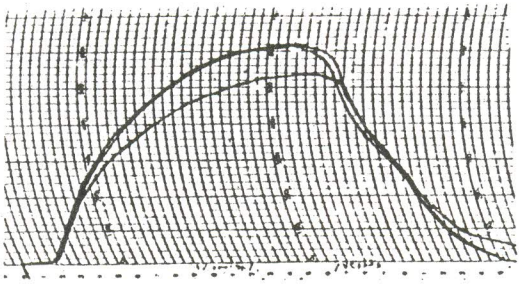
5.2. The extensograph properties:-

Table (6) and Fig. (2) show the extensograph parameters of wheat flour as affected by different levels of corn cobs powder (10, 15, 20 and 25%). The results showed that addition of corn cobs powder at different levels to wheat flour (72% ext.) decreased dough extensibility (E) which recorded 170, 105, 130 and 110 mm.) compared with control (215 mm.). The decrease in dough extensibility may be due to the absence of gluten in corn cobs powder which weakening dough structure, El-Farra, *et al.* (1985). Resistance to extension increased which is belived to be due to the deficiency of corn cobs protein in glutenin. Also, the dough energy decreased gradually and reached to maximum decrease at ratio 75% of wheat flour to 25% corn cobs powder.

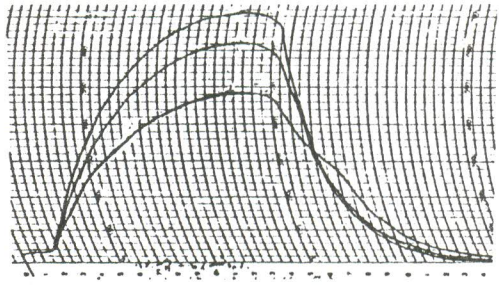
Table (6): Effect of replacing wheat flour (72% extraction) by corn cobs powder on the extensograph parameters:

Recipe mixture		Dough extensibility (E) mm	Resistance to extension (R) B. U.	Proportional number (R/E)	Dough energy Cm^2
Wheat flour (72% ext.) %	Corn cobs %				
100	-	215	640	2.97	174
90	10	170	960	4.05	148
85	15	105	680	6.47	112
80	20	130	560	4.30	100
75	25	110	800	7.20	96

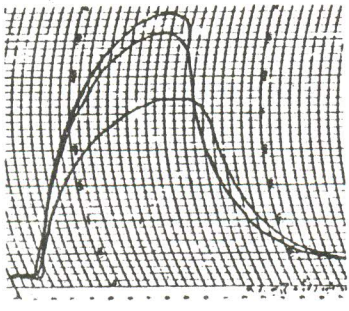
These results could be attributed to the low gluten content of the mixture and characteristics since there are a balance between the extensibility and resistance to extension, El-Sayed (1998).



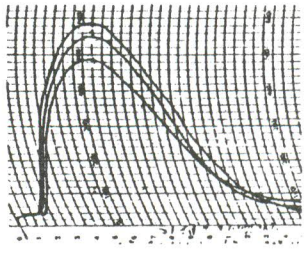
Wheat flour 72% ext.



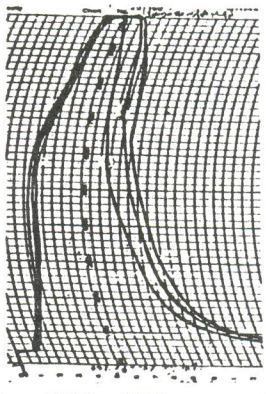
Wheat flour 90%+10% corn cobs powder



Wheat flour 85%+15% corn cobs powder



Wheat flour 80%+20% corn cobs powder



Wheat flour 75%+15% corn cobs powder

Fig (2): The extensograph of wheat flour (72% ext.) and its corn cobs mixtures at different ratios.

6. Organolyptic evaluation of Balady and Toast breads:-

6.1. Balady bread produced from wheat flour (72% extraction) with corn cobs powder:-

The results of sensory evaluation of balady bread which produced from mixing wheat flour (72% ext.) with different ratios i.e. 10, 15, 20 and 25% of corn cobs powder are tabulated in Table (7).

The results showed that balady bread supplemented with 10% corn cobs powder showed no difference in crust color, aroma, taste, texture and overall acceptability compared with control and other blends. On the contrary, balady bread supplemented with 15 and 20% corn cobs powder showed significance difference in crust color, aroma, taste, texture and overall acceptability compared with control.

Gradual reduction was noticed in all the parameters as the ratio of corn cobs powder increase. These may be attributed to that blends need more mixing and fermentation time according to their high values of dough development time, stability and energy. These results are in accordance with those obtained by Soliman (1997) and El-Sayed (1998).

Table (7): Quality properties of balady bread blends made from replacing wheat flour (72% extraction) by corn cobs powder.

Blends		Weight (gm)	Crust 10	Aroma 10	Taste 10	Texture 10	Total score 40
Wheat flour (72% ext.) %	Corn cobs %						
100	-	120.30	9	10	10	9	38
90	10	121.77	8	8	8	5	29
85	15	120.60	6	7	7	5	25
80	20	112.10	5	5	5	4	19
75	25	111.31	4	4	5	4	17

6.2. Toast bread produced from wheat flour (72% extraction) with corn cobs powder:-

The organolyptic properties of toast bread produced by mixing wheat flour with different ratios of corn cobs powder are represented in Table (8). It was noticed that the highest weight was obtained with 75% wheat flour and 25% corn cobs powder. However, toast bread produced from 90% flour and 10% corn cobs powder has a high specific volume (2.52) and total score (32) comparing with other bread blends. Specific volume and total score showed gradual reduction in their values by increasing replacing percentage.

7. Improvement of high fiber bread quality:-

The above results revealed that flour replacement by fiber source (corn cobs powder) weaked dough properties and reduced bread quality. To improve bread making quality and acceptability scores, addition of L-ascorbic acid was

choiced according to its safety and utilization in several countries in bread improvement (Humpolikova and Hampi (1990).

Table (8): Quality properties of toast bread blends made from replacing wheat flour (72% extraction) by corn cobs powder.

Blends		Crust color 10	Aroma 10	Taste 10	Texture 10	Total score 40	Weight Gm	Volume CC	Specific volume CC/g
Wheat flour (72% ext.) %	Corn cobs %								
100	-	10	10	10	10	40	224.61	680	3.03
90	10	8	8	8	8	32	229.83	580	2.52
85	15	7	7	6	6	26	240.69	540	2.24
80	20	5	5	4	4	18	249.8	500	2.00
75	25	3	4	2	2	11	254.2	460	1.81

7.1. Effect of L-ascorbic acid addition on the rheological (farinograph and extensograph) properties:-

Table (9) and Figs (3 and 4) show effect of L-ascorbic acid addition on the rheological parameters of the wheat flour mixed with 15% corn cobs powder.

Addition of L-ascorbic acid to each of the mixtures resulted in a marked improvement in the quality of dough. The addition of L- ascorbic acid to the mixtures showed an increament each of dough development time, dough stability, resistant to extension, proportional number and dough energy accompanied by a reduction in dough weakening and dough extensibility.

These results are in agreement with those obtained by Humpolikova and Hampi (1990). Also, the results showed that L-ascorbic acid (100 p.p.m) was the suitable addition level to flour-corn cobs mixture (15%) to obtain the highest improvement of rheological properties.

7. 2. Effect of L-ascorbic acid addition on the bread quality and sensory evaluation:-

Results in Tables (10 and 11) reveal that L-ascorbic acid addition improved the quality of balady and toast breads made from wheat flour and corn cobs 15% mixture. Concerning toast bread, crust, color, aroma, taste, texture and specific volume improved as L-ascorbic acid addition rate increased to 150 p.p.m. The quality parameters of balady bread made from wheat flour-corn cobs 15% mixture showed the same trends. In general, it could be concluded that addition of L-ascorbic acid at level 100 p.p.m may improve bread baking quality and improved over all sensory acceptability scores.

Table (9): Effect of ascorbic acid addition to wheat flour (72% extraction) blends with corn cobs powder on the farinograph and extensograph tests.

Recipe mixture			farinograph test					extensograph test			
Wheat flour (72% ext.) %	Corn cobs %	Ascorbic acid (PPM)	Water absorption (%)	Arrival time (min)	Dough development time (min)	Dough Extensibility (E) m m	Dough Weakening after 20 min (B.U)	Dough Extensibility (E) m m	Resistance To Extension (R) * (B.U)	Proportional number (R/E)	Dough Energy Cm²
85	15	-	61.7	2.0	5.5	105	120	105	680	6.5	112.4
85	15	50	61.7	2.5	6.0	75	115	75	840	11.2	84.6
85	15	75	62.3	3.0	6.5	75	100	75	870	11.6	92.8
85	15	100	62.9	2.0	6.5	85	100	85	860	10.1	96.4
85	15	125	62.2	2.0	6.0	85	105	85	970	11.4	106.4
85	15	150	62.7	2.5	6.5	70	105	70	965	13.8	80.0

Table (10): Effect of adding ascorbic acid to wheat flour (72% extraction) with corn cobs powder on the organolyptic properties of balady bread.

Recipe mixture			Weight (gm)	Crust color 10	Aroma 10	Taste 10	Texture 10	Total score 40
Wheat flour (72% ext.)	Corn cobs %	Ascorbic acid (p.p.m)						
85	15	-	122.80	6	7	6	6	25
85	15	50	139.11	8	8	7	7	30
85	15	75	143.21	8	8	8	7	31
85	15	100	155.81	8	9	8	8	33
85	15	125	153.22	9	9	9	8	35
85	15	150	167.31	9	9	9	9	36

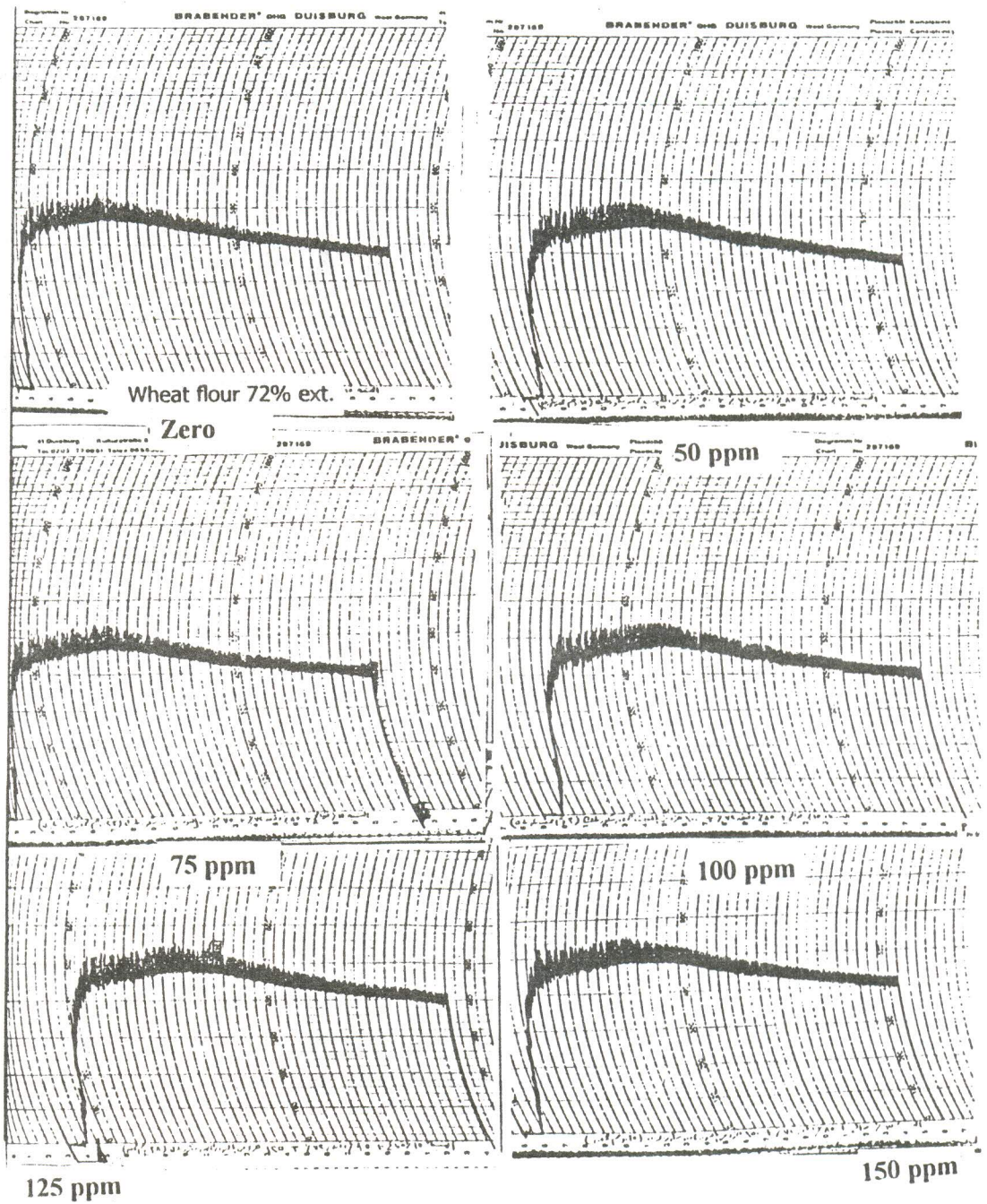
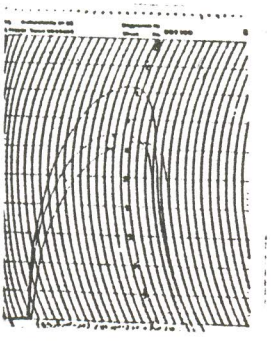
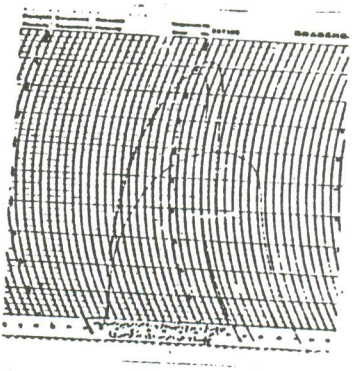


Fig (3): The farinograph character of wheat flour (72% ext.) and corn cobs powder mixture (85:15) after addition of L-ascorbic acid.

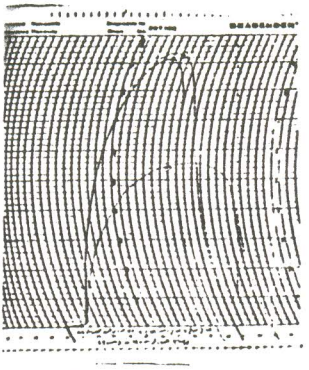


Wheat flour 72% ext.

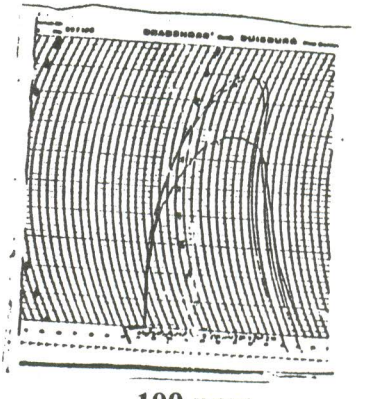
Zero



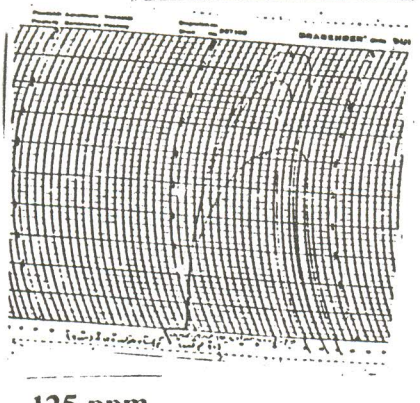
50 ppm



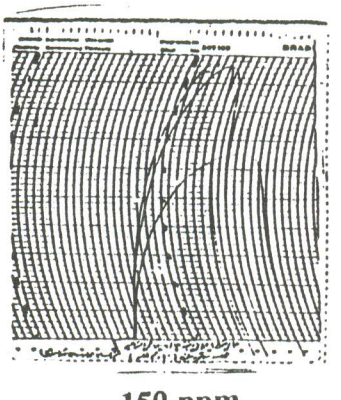
75 ppm



100 ppm



125 ppm



150 ppm

Fig (4): The extensograph character of wheat flour (72% ext.) and corn cobs powder mixture (85:15) after addition of L-ascorbic acid.

Table (11): Effect of adding ascorbic acid to wheat flour (72% extraction) mixed with corn cobs powder on the organolyptic properties of toast bread.

Recipe mixture			Crust color (p.p.m) 10	Aroma 10	Taste 10	Texture 10	Total score 40	Weight Gm	Volume CC	Specific volume CC/g
Wheat flour (72% ext.)	Corn cobs %	Ascorbic acid								
85	15	-	3	4	4	3	14	335	515	1.53
85	15	50	5	4	4	4	17	345	650	1.88
85	15	75	6	5	5	4	20	343	650	1.90
85	15	100	7	6	6	6	25	331	700	2.11
85	15	125	8	7	8	7	30	327	700	2.14
85	15	150	9	8	9	8	34	363	800	2.20

Finally, from these results it could be concluded that corn cobs powder can be used in manfacturing of high fiber bread with less phytate and higher iron contents than shorts bread.

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إنتاج خبز عالى الألياف بإستخدام مسحوق قوالح الذرة

منير عبدالعظيم تركى*، فرحات فوده على فوده*،
أحمد السيد البردينى ، أحمد حسن درويش****
* قسم الكيمياء الحيوية الزراعية – كلية الزراعة بمشتهر – جامعة الزقازيق – فرع بنها
** شركة مطاحن شمال القاهره

يهدف البحث إلى إمكانية إستخدام مسحوق قوالح الذره الشامية كمصدر للألياف الغذائية فى تصنيع خبز بلدى و توست عالى الألياف وذلك بخلط مسحوق قوالح الذرة مع دقيق القمح (إستخلاص ٧٢%) بنسب مختلفة ١٠, ١٥, ٢٠, ٢٥%. وقد تم دراسة الخواص الكيميائية لمسحوق قوالح الذرة الشامية ومقارنتها مع التركيب الكيميائى لكل من دقيق القمح إستخلاص ٧٢% والسن وكذلك دراسة الخواص الريولوجية والحسية للخلطات المختلفة.

أظهرت نتائج التحليل الكيميائى لمسحوق قوالح الذرة الشامية أنها تحتوى على ٢ر٤٥% رماد, ٦٢ر٤% بروتين خام, ١٢ر٨% نشا ,٣٢ر٨١% ألياف غذائية كلية, ٨٠ P.P.M حديد, ٣٢ P.P.M نحاس ,٨٥ P.P.M زنك, ٧٨ P.P.M منجنيز. بينما كان دقيق القمح إستخلاص ٧٢% يحتوى على ٤٦ر٠ % رماد, ٨٤ر٩% بروتين خام, ٥ر٨٣% نشا ,٨ر٢% ألياف غذائية كلية, ١٨ P.P.M حديد, ٢١ P.P.M نحاس, ٢٠ P.P.M زنك ,٢٥ P.P.M منجنيز. ولكن أوضحت نتائج التحليل الكيميائى للسن كمصدر تقليدى لتصنيع خبز عالى الألياف أنها تحتوى على ٨٥ر٣% رماد, ١٥% بروتين خام, ١٥ر٢١% نشا, ٤ر١% حمض فيتيك, ٥١% ألياف غذائية كلية.

بينما أظهرت النتائج أن الخبز البلدى الناتج من إضافة مسحوق قوالح الذرة الشامية بالنسب ١٠, ١٥, ٢٠, ٢٥% مع دقيق القمح إستخلاص ٧٢% زيادة الألياف الغذائية والرماد والسكريات المختزلة للنسب المضافة بينما إنخفضت نسبة النشا والفيتات والدهون والبروتين.

أوضحت نتائج الفارينوجراف أن إضافة مسحوق قوالح الذرة الشامية بالنسب سابقة الذكر إلى دقيق القمح إستخلاص ٧٢% يزيد من كمية الماء الممتص وزمن الوصول ماعدا نسبة خلط ١٠% بينما نسب الخلط ١٥% لايوجد فرق بينها وبين الكونترول. أما بالنسبة لثبات العجينة لايوجد فرق بين نسبة الخلط ١٠% والكونترول بينما يقل فى نسب الخلط ١٥%, ٢٠% ويرتفع فى النسبة ٢٥% ودرجة ضعف العجين بعد ٢٠ دقيقة يزداد مقارنة بالكونترول. بينما أظهرت نتائج الأكستنسوجراف أن إضافة مسحوق قوالح الذرة الشامية بالنسب المختلفة إلى دقيق القمح تقل المطاطية والمساحة تحت المنحنى بينما تزداد المرونه بالمقارنة بالكونترول.

أوضحت الأختبارات الحسية أن الخبز البلـــدى والتوســت المضـــاف إليـــه مسحوق قوالح الذره الشامية لايوجد فرق يذكر بين إضافة النسبة ١٠% والكونـــترول من حيث لون القصرة ,الرائحة, الطعم, القوام والقبول العام بينما يزداد الإختلاف عنـــد الإضافات الأخرى بالنسب ١٥, ٢٠, ٢٥% عند مقارنتها بالكونترول.

وتم أيضا دراسة تأثير إضافة حمض الأسكوربيك بنســـب ٥٠, ٧٥, ١٠٠, ١٢٥, ١٥٠ P.P.M إلى مخلوط الخبز المكون من ١٥% مسحوق قوالح الذرة الشامية مـــع ٨٥% دقيق إستخلاص ٧٢% وأظهرت النتائج تحسن الخواص الريولوجية والحسية للخبز البلـــدى والتوست عالى الألياف تحت تركيز ١٠٠ جزء فى المليون من حمض الأسكوربيك.

ومن هذه النتائج يتضح أنه يمكن إستخدام مسحوق قوالح الذرة الشـــامية فـــى تصنيع خبز عالى الألياف منخفض الفيتات وغنى فى محتواه من الحديد.