J. Food and Dairy Sci., Mansoura Univ., Vol. 7(7): 307 - 314 , 2016

Effect of Moringa Leaves Powder (*Moringa oleifera*) on Some Chemical and Physical Properties of Pan Bread

Rania E. El-Gammal; Gehan A. Ghoneim and Sh. M. ElShehawy
Food Industries Department, Faculty of Agriculture, Mansoura University, 35516, Mansoura, Egypt

ABSTRACT

The current study was a trial to produce an acceptable herbal bakery product such pan bread using Moringa leaves powder at different ratios, (5, 10, 15 and 20%). Chemical composition, and minerals content of raw materials and processed pan bread samples were determined. Rheological characteristics of these treated dough, sensory evaluation, physical properties, staling rate and microstructure of processed pan bread samples were conducted. The obtained results indicated that Moringa leaves powder contained high amounts of protein and crude fiber, beside some essential minerals namely Calcium, Magnesium, Phosphorous and Iron. Addition of Moringa leaves powder to pan bread raised the protein content up to 21.85%, ash (5.21%) and carbohydrates content decreased and reached 59.34%. Treated pan bread with 10% Moringa leaves powder had higher amount of Magnesium (Mg), Calcium (Ca) and Iron (Fe) compared with control sample (from 25.50 to 102.56 mg/100g, 12.85 to 205.60 mg/100g and 4.54 to 12.56 mg/100g, respectively). Rheological properties showed that addition of Moringa leaves powder negatively affected on some farinograph and extensograph values. Sensory evaluation showed that although there was an improvement in nutritional value, the acceptability of all pan bread samples decreased with increasing level of Moringa leaves powder ratios, especially pan bread with 15 and 20%. As physical properties, baking loss % ranged from 3.5-5.5% in bread sample E and control sample, respectively. Results showed observed decreases in texture profile properties namely gumminess, chewiness, springiness and resilience in all pan bread samples compared with control sample. Results of staling rate indicated that there were gradual increases in all processed pan bread freshness up to 4 days of storage compared with control sample. Finally, microstructure results showed different crystal types varied in shape, size and distribution in processed pan bread with 15 and 20% compared with other samples 5 and 10%. Also, the starch granules appeared wrapped and swollen in pan bread with 15 and 20% addition ratios. Generally, it could be said that, it is possible to produce acceptable herbal bakery products such as pan bread using Moringa leaves powder with ratios of 5 and 10%. Moringa leaves powder is considered as a rich source of Ca, Mg and Fe, could be used to prepare many bakery products, but there is a need to carry out more studies to evaluate these minerals bioavailability.

Keywords: Bakery products, Moringa, sensory evaluation, rheological properties, chemical and physical characteristics.

INTRODUCTION

Moringa oleifera tree is an Indian plant, adapted to grow in different countries including Egypt. Many parts of this plant have various benefits such as seeds, leaves and flowers. It has a lot of uses like foods and drinks to try to get its highest advantages. High content of minerals especially iron and protein, antioxidants, vitamin A and B group are some of its benefits (Mahmood, *et al*., 2010).

Sengev, *et al*. (2013) found that processed bread samples using wheat and Moringa flour mixtures had high nutritive values especially in crude fiber, protein, fat, minerals and β-carotene, but had poor physical properties and lower of acceptability.

Mouminah (2015) investigated producing a type of bakery product such as cookies using dried Moringa leaves in ratios of 5, 10 and 15%. She concluded that it was possible to produce acceptable cookies with higher content of protein and minerals at replacement ratio of 10%.

So, this work is a trial to produce a type of herbal bakery product, pan bread, using Moringa leaves powder with different addition ratios (5, 10, 15 and 20%). To achieve this goal, approximate chemical composition, minerals content, rheological characteristics of treated dough, sensory evaluation, physical properties and microstructure using electronic microscope were carried out.

MATERIALS AND METHODS

Materials:

Moringa oleifera leaves were collected from Faculty of Agriculture farm, Mansoura University, Mansoura, Egypt.

Wheat flour (72%) extract was purchased from a hypermarket, El-Mansoura city, Egypt.

Salt, dry yeast, bread improvers, sugar and corn oil were bought from local market, El-Mansoura city, Egypt.

Methods:

Preparation of Moringa leaves powder:

Moringa leaves were washed using distilled water and divided to different portions for drying. Then, they were dried using microwave sharp oven model (R75MRW) at 300Watt output power for 3 min. as described by Sengev, *et al*. (2013). At last, dried leaves were milled and packed into tight polyethylene paper until further using and analysis were carried out.

Pan bread formulas:

The flour mixtures used to produce pan bread samples were prepared according to the ratios as follows:

Control A: 100g wheat flour only.
Sample B:95g wheat flour + 5g Moringa leaves powder.
Sample C:90g wheat flour + 10g Moringa leaves powder.
Sample D:85g wheat flour + 15g Moringa leaves powder.
Sample E:80g wheat flour + 20g Moringa leaves powder.

Baking process of pan bread:

Pan bread baking using straight method were carried out as described by Lazaridou *et al*., (2007). Bread dough were baked at 240°C for 20-25 min. in an electric oven (Mondial Formi, 4T 40/60, Italy). The resulted pan bread samples were allowed to cool at room temperature for 2 hours before being packed in polyethylene bags and stored at room temperature for further examinations.

Chemical composition of raw materials and processed pan bread samples:

Moisture, fat, ash and crude fiber were determined using AOAC (2005) method. Crude protein content was determined using micro-kjelahel method as described by AOAC (2000). While, carbohydrate content was calculated by subtraction according to the following equation:

Carbohydrate % = (100 - Moisture% +ash% +fat% +crude protein% +crude fiber%).

Minerals content:

Minerals content of raw materials and treated pan bread samples were determined. Magnesium, Calcium, Cupper, Zinc and Iron were determined according to the method described by Hesse (1971) and Cottenie *et al*. (1982) using Perkin Elmer, Atomic Absorption Specol model 3300. Whereas, Phosphorous was calorimetrically determined as described by Page (1982).

Rheological measurements dough:

Rheological measurements were carried out for flour mixtures using farinograph and extensograph tests as described by Borune (2003) and AACC (2000).

Sensory evaluation of processed pan bread:

Sensory evaluation of pan bread samples were performed by 15 of staff members as described by AACC (2005) for smoothness, crust color, crumb color, taste and overall acceptability.

Baking loss % and texture profile analysis (TPA) of pan bread samples:

Baking loss % (wl) was calculated according to AACC (2000) using the following equation: [wl = (wi-wf) ÷ wi × 100] : wi = weight of pan bread before baking, wf = weight of pan bread after baking.

Meanwhile, pan bread texture profile analysis was performed using a universal testing machine (Cometech , B type ,Taiwan), the data were analyzed to measure pan bread firmness, cohesiveness, gumminess, chewiness, springiness and resilience as described by Gomez *et al*. (2007).

Staling rate of processed pan bread:

Staling rate of processed pan bread was determined after baking with one hour and after 2, 4 and 6 days of storage at room temperature (25±2°C) by alkaline water retention capacity (AWRC%) (AACC, 2000).

Microstructure of pan bread samples:

Pan bread samples prepared with *Moringa oliferia* leaves powder and control sample were observed in JEOL (JSM 6510LV) scanning electron microscope (Tokyo-Japan) with a 25 - KV acceleration voltage. The bread samples were sputtered with gold before examination, micrographs at 1000 magnification were presented.

Statistical analysis:

Data were analyzed using analysis of variance (one way ANOVA), while comparisons were done by Duncan's test at $P<0.05$ level of significance using SPSS (2008) version 17 program for windows.

RESULTS AND DISCUSSION

Chemical composition and minerals content of Moringa leaves powder and wheat flour:

Moringa leaves powder and wheat flour were chemically analyzed, obtained results were summarized in Table (1). Tabulated results revealed that *Moringa oleifera* leaves could be considered as a good source of protein, ash and crude fiber compared with these compounds in wheat flour, where they recorded 26.28, 6.36 and 18.20%, respectively. Generally, it could be stated that Moringa leaves powder was rich in plant protein, crude fiber and ash contents, thus some minerals were determined.

Results of some essential minerals including Calcium (Ca), Phosphorus (P), Magnesium (Mg), Zinc (Zn), Iron (Fe) and Copper (Cu) were observed in the same table. Calcium and Magnesium of Moringa leaves powder recorded the highest values being 489.20 and 342 mg/100g, respectively, followed by Phosphorus recorded 211.60 mg/100g. Tabulated results showed that Copper and Zinc were the most deficient minerals in Moringa leaves powder but it showed a good source of Iron being 40.51 mg/100g. The high content of Magnesium in Moringa leaves powder could be attributed to the high content of chlorophyll pigments which was considered a tetrapyrrole compound rich in Mg. These previous results were in agreement with those of Barminas, *et al*. (1998) and Aslam, *et al*. (2005). Some differences observed may be attributed to plant variety, soil structure, environmental conditions and agricultural treatments of Moringa farming.

Table (1): Approximate Chemical composition and minerals content of Moringa leaves powder and wheat flour:

Components / Raw materials	Moisture %	Ash %	Crude protein %	Carbohydrates %	Crude fiber %	Fat %	Minerals content (mg/100g) Ca	P	Mg	Zn	Fe	Cu
Moringa leaves powder	6.50	6.36	26.28	40.16	18.20	2.50	489.0	211.6	342	9.30	40.51	7.80
Wheat flour (72%)	12.50	1.08	11.50	70.92	2.50	1.50	3.84	8.20	22	0.23	2.54	0.74

Effect of Moringa leaves powder addition on chemical composition and minerals content of processed pan bread:

Effect of addition Moringa leaves powder on proximate chemical composition of processed pan bread samples was studied and the results are presented in Table (2). It could be easily observed that crude protein, crude fat and ash contents were gradually increased with increasing of Moringa leaves powder ratios. Whereas, moisture and carbohydrates contents were gradually decreased. The moisture content of any foods is usually considered as an indicator of food quality and shelf life. It is important to measure the moisture content of bakery products because of its potential effect on the sensory, physical, and microbial properties of such products.

Table (2):Proximate chemical composition and minerals content of processed pan bread using Moringa leaves powder.

Components / Pan bread samples	Moisture %	Crude protein %	Fat %	Ash %	Carbohydrates %	Minerals content (mg/100g) P	Ca	Mg	Fe
Control (A)	11.78	12.75	1.96	1.98	71.53	8.58	12.85	25.50	4.54
+ 5% (B)	10.50	17.72	2.08	3.52	66.18	90.14	189.50	86.98	10.51
+ 10% (C)	10.03	19.32	2.08	3.65	64.92	115.32	205.60	102.56	12.56
+ 15% (D)	9.89	20.56	3.25	4.96	61.34	140.87	345.30	122.36	15.96
+ 20% (E)	9.44	21.85	3.75	5.21	59.75	165.69	365.20	140.32	17.32
Recommended nutrient intakes mg/day (FAO, 2001)						1250	1300	230-250	29-38 (male) 62-65 (female)

The obtained data showed that moisture content were gradually decreased from 11.78% in control bread sample to 9.44 % in E sample, low moisture content in Moringa leaves powder used in the bread blends might have effective implications in texture and microbiological quality of bread processed. Olaitan *et al*. (2014) reported similar values for wheat, plantain and soybean composite bread.

Conversely, there was an increase in protein content with increasing level of addition of Moringa leaves powder in all pan bread samples from 12.75% in 100% wheat flour to 17.72, 19.32, 20.56 and 21.85% in pan bread with B, C, D and E samples, respectively. Using of Moringa leaves powder raised crude protein content about two times compared with control bread sample. This could be due to addition effect caused by the high protein content of Moringa leaves powder.

Also, in the same table there was a decrease in carbohydrate content, which ranged from 59.34% to 66.18% as the percentage of Moringa leaves powder addition increased. Whereas ash content was high in all processed pan bread compared with that of control sample. Conversely there was an observed increase of fat content in all processed bread samples with Moringa compared with control sample. In general, increasing amount of Moringa leaves powder to pan bread raised the amount of total protein and ash in all pan bread as compared with control sample.

Data in Table (2) represented that minerals content (P, Ca, Mg and Fe) of different processed pan bread samples with addition of Moringa leaves powder resulted in the high content of minerals. Also, it could be observed that all processed bread samples were superior in Phosphorus, Calcium, Iron and Magnesium compared with control sample. These results are in agreement with those of Gernah and Sengev (2011) and Barminas, *et al.* (1998), who found that the content of Iron, Calcium and Magnesium recorded 26.20, 454 and 450.60 mg/100 g, respectively.

From nutritional view, processed pan bread samples contained higher content of studied minerals. For example, pan bead sample E contained P, Ca, Mg and Fe contents 19.31, 28.42, 5.50 and 3.82 times than those in control bread sample. Concerning of recommendations of FAO (2001), eating about 100 gram of this pan bread sample (E) will cover 13.26, 28.09, 58.47, 50.94 and 27.06% of recommended nutrient intakes for adolescents, 10-18 years, from P, Ca, Mg, Fe (male) and Fe (female) (at 5% Fe bioavailability), respectively. So, it is important to design anther study to explore these minerals bioavailability.

Rheological measurements:

Effect of Moringa leaves powder addition on farinograph parameters of processed pan bread:

Dough rheological properties are important for their effect in bread quality due to their significant effect on final loaf volume. The rheological behavior of the dough prepared with the addition of Moringa leaves powder and wheat flour were determined by farinograph and the results are presented in Table (3) and Figure (1) showing water absorption, arrival time, dough development time and dough stability.

Strong flour should have higher water absorption value than weak flour to help producing good bread properties which remain soft as long as possible. Obtained results revealed that water absorption % decreased in all pan bread treatments compared with control sample (63.57% in control and around 60% in all treatments). The lowering of water absorption capacity may be attributed to the changes occurred in protein during Moringa leaves drying. Rakszegi, et al., (2014) reported that water absorption percentages was influenced by soluble protein and damaged starch content. Whereas, arrival time (min.) characterizes farinograph mixing properties of flour mixtures. The lowest arrival time was in control sample recorded 0.5 min. and Moringa leaves powder addition helped to raise this value.

Dough development time is defined as the time (min.) to be need to mix flour and water to form dough with suitable consistency. Dough development time sharply decreased in treated pan bread samples, especially in C, D and E samples with increasing of Moringa leaves ratios (1.5 min.). This note may be explained that the higher protein content in these treatment helped forming gluten net and reached faster to suitable consistency. Dough strength and its resistance for mechanical action is measured using dough stability (min.). Dough stability of all treatments was around five min., where it was 6.0 and 5.0 min. in samples A and B, respectively. However, it could be stated that addition of Moringa leaves powder caused changes in the previous rheological properties. These results are compatible with those of El-Sisy and El-Afifi, (2015) who reported that rheological properties of the same type of wheat recorded 57.0, 1.0, 4.0 and 2.50 for water absorption (%), arrival time (min.), dough stability (min.) and development time (min.), respectively

Table (3): Farinograph parameters of different processed pan bread samples.

parameters / Pan-bread samples	Water absorption %	Arrival time (min.)	Dough development time (min.)	Dough stability (min.)
Control (A)	63.57	0.5	5.0	6.0
+ 5% (B)	59.70	2.5	5.5	5.0
+ 10% (C)	59.80	1.0	1.5	5.0
+ 15% (D)	60.00	1.0	1.5	5.5
+ 20% (E)	60.43	1.0	1.5	5.5

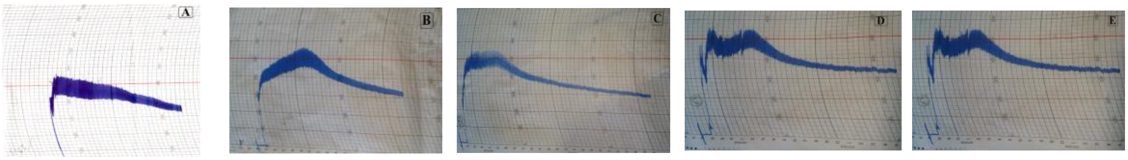

Figure (1): Farinograph parameters of different processed pan bread samples.

Effect of Moringa leaves powder addition on extensograph parameters of processed pan bread:

Extensograph analysis gives information about the viscoelastic behavior of a dough and measures dough extensibility and resistance to extension. A combination of good resistance and good extensibility results in desirable dough properties (Rosell and Rajas, 2001 and Zalatica *et al*., 2012). The obtained results are showed in Table (4) and Figure (2).

Table (4): Extensograph parameters of different processed pan bread samples.

parameters / Pan bread samples	Elasticity (B.U.) EC	Extensibility E (mm)	Proportional number (EC/E)	Dough energy (Cm^3)
Control (A)	320	175	1.83	44.60
+ 5% (B)	120	160	0.75	25.0
+ 10% (C)	170	115	1.48	30.0
+ 15% (D)	280	105	2.67	33.0
+ 20% (E)	290	100	2.90	35.0

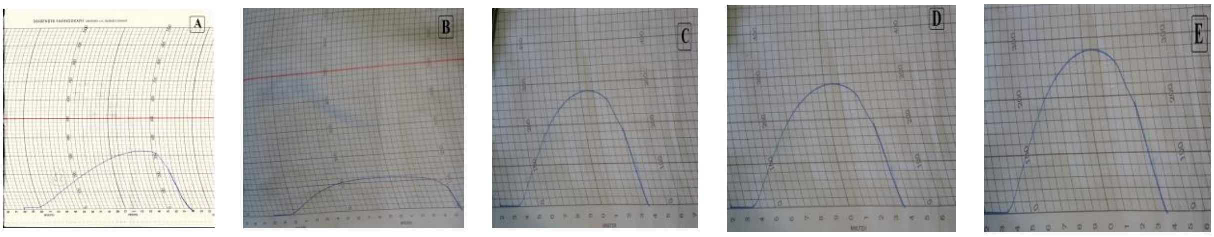

Figure (2): Extensograph parameters of different processed pan bread samples

Tabulated results indicated that control pan bread sample had the highest value of elasticity (320 B.U.), while sample B (+ 5%) had the least value (120 B.U.). Elasticity value gradually increased with increasing of Moringa leaves powder ratios (E>D>C>B). As for extensibility value (mm), it dramatically decreased with increasing of addition ratios, where it recorded 175 mm in sample A and 100 mm in sampled E. Consequently, proportional number which calculated from elasticity and extensibility values, recorded different values. The highest value was 2.90 in sample E, while the least value was 0.75 in sample B. Finally, dough energy (Cm^3) is the work input needed to refer to the bread crumb volume. Sample A had the highest value being 44.60 (Cm^3), meanwhile sample B had the least value recorded 25.0 (Cm^3). The same manner observed in elasticity was in dough energy. These results are in accordance with those of El-Karamany (2015).

Sensory evaluation of different processed pan bread:

Sensory evaluation of pan bread samples as affected by different ratios of Moringa leaves powder was presented in Table (5) and Figure (3). Tabulated data revealed that all sensory attributes of bread samples were decreased by increasing of Moringa leaves powder ratios. For example, there were significant differences at *P*<0.05 between control sample and +5%, +10%, +15% and +20% samples in descending order in all sensory properties. Taste scores of bread samples ranged from 6.29 to 9.33 in +20% and control samples, respectively. The same manner was seen in odor, smoothness, crust color and crumb color (6.30-9.33, 6.17-9.30, 6.00-9.37 and 5.90-9.37, respectively).

Table (5): Sensory evaluation of pan bread samples as affected by addition of Moringa leaves powder.

Property / Treatments	Taste (10)	Odor (10)	Smoothness (10)	Crust color (10)	Crumb color (10)	Overall acceptability (50)	Total score (50)
Control (A)	9.33±0.08^{a}	9.33±0.08^{a}	9.30±0.07^{a}	9.37±0.08^{a}	9.37±0.08^{a}	48.07±0.18^{a}	46.70±0.30^{a}
+ 5% (B)	9.00±0.08^{b}	8.80±0.13^{b}	8.77±0.08^{b}	8.80±0.07^{b}	8.77±0.08^{b}	45.73±0.30^{b}	44.13±0.40^{b}
+ 10% (C)	8.23±0.09^{c}	8.07±0.09^{c}	8.10±0.09^{c}	8.03±0.12^{c}	7.97±0.11^{c}	43.20±0.62^{c}	40.41±0.41^{c}
+ 15% (D)	7.39±0.10^{d}	7.29±0.08^{d}	7.29±0.08^{d}	7.31±0.08^{d}	7.25±0.09^{d}	39.47±0.65^{d}	36.53±0.38^{d}
+ 20% (E)	6.29±0.09^{e}	6.30±0.11^{e}	6.17±0.11^{e}	6.00±0.10^{e}	5.90±0.11^{e}	33.80±0.65^{e}	30.65±0.38^{e}
F value	188.91	140.06	213.01	210.49	200.43	116.96	267.33

Mean values ± standard error (n=15). Means of samples having the same letter(s) within a column are not significantly different (P<0.05).

It could be noticed that there was reverse relationship between Moringa leaves powder ratio and overall acceptability, total score of studied brad samples. The highest value of overall acceptability and total score were 48.07 and 46.7, respectively. The least values observed in + 20% bread sample was more than 50% of total score (67.6%, 61.3%, respectively). Figure (3) showed general appearance of pan bread samples as affected by adding different ratios of Moringa leaves powder. The decreased sensory attributes of bread samples with Moringa leaves powder may be due to the color and odor of the dried green leaves. These previous results were in good agreement with those obtained by Sengev, *et al*. (2013).

Figure 3. General appearance of pan bread samples as affected by adding different ratios of Moringa leaves powder.

Baking loss % and texture profile of processed pan bread samples:

Some physical characteristics namely, baking loss% and pan bread texture profile analysis (TPA) including firmness, cohesiveness, gumminess, chewiness, springiness and resilience were determined and the results are tabulated in Table (6).

Tabulated results indicate that processed pan bread samples using Moringa leaves powder had lower baking loss % than those of control bread, (3.5% and 5.5%, respectively).

Results in Table (6) show the effect of Moringa leaves powder addition on texture profile of different pan bread samples. Springiness is ability of dough to recover its original form after the deforming force removal. While, cohesiveness is the extent which the dough can be deformed before rupture. Gumminess represents the required force to disintegrate a semisolid sample to a steady state of swallowing. Chewiness is the needed work to chew a sample to be a steady state of swallowing. Finally, resilience shows how well a sample resists to regain its original position. Cohesiveness, springiness and resilience were calculated from texture profile graphic. Springiness and resilience, give information about the after stress recovery capacity (Borune, 2003). Results showed observed decreases in texture profile properties namely gumminess, chewiness, springiness and resilience values in all pan bread samples compared with those of control sample. Data revealed that there was an observed changes in firmness in all processed with added Moringa leaves powder from 5 to 20 % in compare with control pan bread. Also, results of cohesiveness were seemed to equal in processed pan bread samples (B and C) and control, while the other samples (D, E) being (0.41). Addition of Moringa leaves powder with different ratios to pan bread raised the amount of gumminess.

Also, in the same table it could be observed that, there was a decreasing in both of springiness and resilience with increasing Moringa leaves powder ratios in pan bread samples. These results are nearly in accordance with those found by Shiriki *et al*. (2015), who stated that addition of *Moringa oleifera* leaves to cookies at the ratio of 15 % resulted in reduction and lowering some quality attributes.

Table (6): Texture profile of different processed pan bread as affected by addition of powdered Moringa leaves.

		Processed pan bread samples			
	Control (A)	(B) + 5%	(C) +10%	(D) +15%	(E) +20%
Baking loss %	5.5	5.0	4.8	3.5	3.5
	Pan bread texture profile:				
Firmness	5.66	3.57	3.54	4.45	4.32
Cohesiveness	0.56	0.56	0.51	0.41	0.41
Gumminess (gram-force)	1.05	1.42	1.99	1.80	1.78
Chewiness (gram-force)	1.36	0.95	0.95	0.71	0.71
Springiness	0.64	0.68	0.54	0.41	0.41
Resilience	0.31	0.31	0.23	0.14	0.12

Staling rate of processed pan bread samples:

Staling is a physical phenomenon, concerns with the changes that occur in bread after baking. Alkaline water retention capacity (AWRC) is simplest test follow the stalling in bakery products, increases in AWRC are resulted from the freshness of baked products (Gray and Bemiller, 2003). Generally there were gradual increases in all processed pan bread freshness up to 4 days of storage in compare with control bread sample (Table 7). The best values of freshness recorded for processed pan bread in sample E, followed by sample D and B being 265.50, 250.20 and 230.33, respectively. All processed pan bread with different ratios of Moringa leaves powder were more freshness than those of the control sample prolonged storage. No differences were observed among all processed pan bread up to 4 days, while there was an observed decrease in staling rate values at 6 days of storage in all pan bread samples.

Table (7): Staling rate of different processed pan bread.

Pan bread samples	Storage time/days zero time	2	4	6
Control (C)	194.27	174.56	153.44	142.84
+ 5% (A)	206.11	198.71	205.32	167.11
+ 10% (B)	258.25	234.52	230.33	198.47
+ 15% (D)	298.32	257.36	250.20	202.56
+ 20% (E)	298.33	250.50	265.50	200.36

Microstructure of different processed pan bread samples:

The microstructure using electronic microscope (1000 X) of processed pan bread treatments is presented in Figure (4). The studied treatments included control pan bread, 5, 10 , 15 and 20% Moringa leaves powder. The scale bar for all micrographs is the same (1000 X). As control micrograph, starch granules surface appeared to be uniform, were nearly similar in size and shape, no cavities were observed. Also, protein matrix were compacted tightly with starch matrix, all granules were regularly distributed and no more clusters were observed.

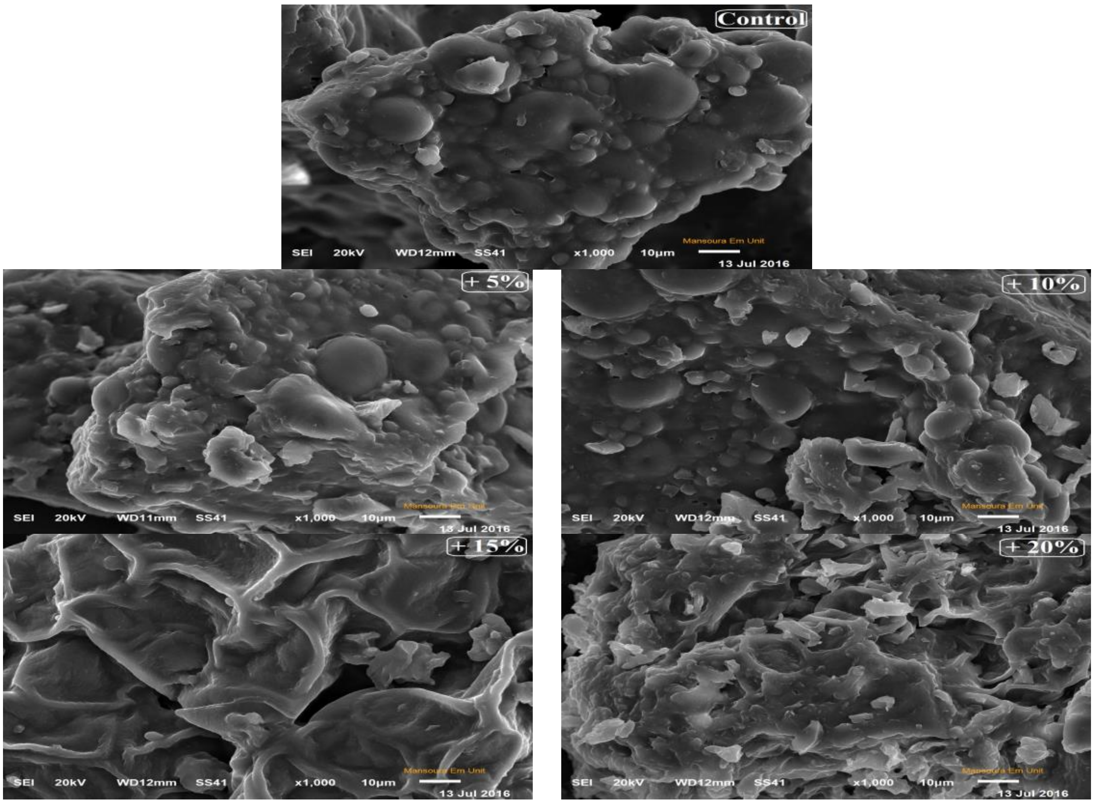

Figure (4): The microstructure of processed pan bread as affected by adding Moringa leaves powder (Control, + 5%, + 10%, + 15% and + 20%).

The granules structure of + 5% pan bread showed variations in shape, size and distribution. Small and large starch granules entrapped in protein matrix can also be seen. This sample has less cavities, inner surface of starch granules were smooth, spherical and round. Less bubbles were observed, protein matrix were completely cover the starch granules. No more clusters were appeared in the starch granules in compare with the other photos (Figure 4 - Control). In case of + 10% micrograph, bread also have less cavities, inner surface of starch granules nearly spherical, granules were nearly varying in size but the surface being smooth, little clusters were observed, starch granules appeared to be compact with protein matrix.

In 15% and 20% micrographs, starch granules were appeared to be more damaged in compared with those of other treatments and also granules gradually separated from protein matrix in Figure (4 - +15%), some damaged zone were observed. Clear disruption in the structure were appeared and clear cavities were observed. Starch granules have a sheet shape, granules also were swollen and wrapped. Some granules has a small amount of pitting and also other granules were fully damagedThese obtained results were almost in accordance with those given by Dachana *et al*. (2010), who stated that addition of Moringa leave powder for cookies have a positive effect in restricted starch granules and reduction viscosity and wrapped wheat dough and effect on protein matrix at the concentration of 15 and 20%. Also, Hathorn *et al*. (2008) reported that all processed bread samples were prepared with sweet potato flour, which the ratio of 15 and 20 % had damaged granules, cavities, and protein network were observed on the micrographs.

CONCLUSION

Finally, it could be concluded that it is possible to produce herbal bakery products such as pan bread using Moringa leaves powder with ratios of 5 and 10%. The results also indicated that there was reverse relationship between Moringa leaves powder ratio and all sensory attributes value, thus it is recommended to add some improvers or flavor enhancers to raise these quality attributes. Moringa leaves powder is considered as a rich source of Ca, Mg and Fe, could be used to fortify many bakery products, but there is a need to carry out more studies to evaluate these minerals bioavailability

REFERENCES

AACC (2000). American Association of Cereal Chemists Approved methods (10th Ed) St. PAUL MN: American Association of Cereal Chemists (Methods 08-01, 44-15A, 46-13, 54-20).

AACC (2005). American Association of Cereal Chemists Approved methods (11th Ed) St. PAUL MN: American Association of Cereal Chemists (Methods 10-90.01).

AOAC (2000). Association of Official Analytical Chemist, Official Methods of Analysis 17th Ed., AOAC international, Maryland, USA.

AOAC (2005). Association of Official Analytical Chemist, Official Methods of Analysis 18th Ed., AOAC international, suite 500, 481 north frederick avenue, gaithersburg, Maryland 20877-2417, USA.

Aslam, M., Farooq, A., Raziya, N., Umer, R., Kazi, T.G. and Nadeem, M. (2005). Mineral Composition of *Moringa oleifera* Leaves and Pods from Different Regions of Punjab, Pakistan. Asian Journal of Plant Sciences: 417-421.

Barminas, J., Charles, T. and Emmanuel, D. (1998). Mineral Composition of Non-Conventional Leafy Vegetables. Plant Foods for Human Nutrition, 51 (10: 29-36.

Borune, M. (2003). Food Texture and Viscosity, Concept and Measurements. Elsevier Press, NewYork, London, 416 pp.

Cottenie, A., Verloo, M., Kiekens, L., Velghe, G. and Camerlynck, H. (1982). Chemical analysis of plant and soil. Lab Anal. and Agro chemistry state Univ., Gent., Belguim.

Dachana, K., Rajiv, J. and Paraskah, J. (2010). Effect of dried Moringa (*Moringa oleifera lam*) leaves on rheological, microstructures, nutritional, textural and organoleptic characteristics of cookies. J. Nat. Prod. Med. (5): 45-49.

El-karamany, A.M.M. (2015). Effect of irradiation on rheological and baking properties of flour wheat grain. Journal of Food and Dairy Sciences, Mansoura University, 6(12): 753-769.

El-Sisy, T.T. and El-Afifi, T.M. (2015). Effect of protein fraction on quality characteristics of wheat flour obtained from different wheat kernels. Journal of Food and Dairy Sciences, Mansoura University, 6(7): 501-521.

FAO (2001). Human Vitamin and Mineral Requirements. FAO/WHO expert consultation on human vitamin and mineral requirements. Food and Nutrition Division, Food and Agriculture Organization of the United Nations.

Gernah, D.I. and Sengev, A.I. (2011). Effect of Processing on Some Chemical Properties of the Drumstick Tree (*Moringa oleifera*) Leaves. Nigerian Food Journal, 29(1): 70-77.

Gomez, M., Ronda, F., Coballera, A.P., Blanco, A.C. and Rosell, C.M. (2007). Functionality of different hydrocolloids on the quality and shelf-life of yellow layer cakes. Food Hydrocolloids, 21(2): 167-173.

Gray, J.A. and Bemiller J.N. (2003). Bread Staling : Molecular basis and control. Comprehensive Reviews in Food Science and Food Safety 2: 1-21.

Hathorn, C.S., Biswasb, M.A., Gichuhia, P.N. and Bovell Benjamin, A.C. (2008). Comparison of chemical, physical, micro-structural and microbial properties of breads supplemented with sweet potato flour and high-gluten dough enhancers. LWT- Food Science and Technology, 41: 803-815.

Hesse , P.R. (1971). Alex book of soil chemical analysis. Jhan Murry (Publishers) Ltd. 50 Albemarle Steer, London, 520 pp.

Lazaridou, A., Duta, D., Papageorgiou, M., Belc, N. and Biliaderis, C.G. (2007). Effects of hydrocolloids on dough rheology and bread quality parameters in gluten-free formulations. Journal of Food Engineering, 79:1033-1047.

Mahmood, K.T., Mugal, T. and Ul Haq, I. (2010). *Moringa oleifera*: a natural gift-A review. J. Pharm. Sci. and Res, 2 (11): 775-781.

Mouminah, Haneen H. S. (2015). Effect of dried *Moringa oleifera* leaves on the nutritional and organoleptic characteristics of cookies. Alexandria Science Exchange Journal, 36 (4): 297-302.

Olaitan, N.I., Eke, M.O., Uja, A. and Oja, E.A. (2014). Quality evaluation of complementary food formulated from *Moringa Oleifera* leaf powder and pearl millet (*Pennisetum Glaucum*) flour. The International Journal of Engineering and Science (IJES), (3): 59-63.

Page, A. (1982). Method of soil analysis Part 2, chemical and microbiological properties. 2nd Edition. American Science Society of Agronomy, Madison, Wisconsin, USA.

Rakszegi, M., Balazs, G., Bekes, F. Harasztos, A. Kovacs, A., Lang, L., Bedo, Z. and Tomoskozi, S. (2014). Modelling water absorption of wheat flour by taking into consideration of the soluble protein and arabinoxylan components. Cereal Research Communications, 42(4): 629-639.

Rosell, C.M., and Rojas, J.A.C.(2001). Influence of hydrocolloids on dough rheology and bread quality. Food Hydrocolloids 15:75-81.

Sengev, A.I., Abu J. O. and Gernah, D.I. (2013). Effect of *Moringa oleifera* leaf powder supplementation on some quality characteristics of wheat bread. Food and Nutrition Sciences, (4): 270-275.

Shiriki, D., Lgyor, M. and Gernah, D. (2015). Nutritional evaluation of complementary food formulation from maize, soybean and peanut fortified with *Moringa oleifera* leaf powder. Food Nutr. Sci., 6:494-500.

SPSS (2008). Statistical Package for Social Sciences Program, Version 17 for Windows, SPSS Inc., Chicago, IL, USA.

Zalatica, K., Jolana, K. and Michaela J. (2012). Influence of carrot pomace powder on the rheological characteristics of wheat flour dough on wheat rolls quality. Acta Sci. pol. Technol. Aliment. 11(4): 381-387.

تأثير مسحوق أوراق المورينجا على بعض الخصائص الكيميائية و الفيزيائية للخبز القالب

رانيا إبراهيم الجمال ، جيهان علي غنيم و شادي محمد الشهاوي
قسم الصناعات الغذائية – كلية الزراعة – جامعة المنصورة – المنصورة – جمهورية مصر العربية

تعتبر هذه الدراسة محاولة لإنتاج منتج مخابز مقبول مثل خبز القالب باستخدام مسحوق أوراق المورينجا بنسب إضافة مختلفة ، (٥ ، ١٠ ، ١٥ و ٢٠%). تم تقدير كلاً من التركيب الكيماوي و محتوى بعض المعادن في المواد الخام و عينات الخبز القالب المصنعة. تم تقدير كلاً من الخواص الريولوجية لعجائن هذه المعاملات ، التقييم الحسي ، الخصائص الفيزيائية ، معدل البيات و التركيب الدقيق لعينات الخبز المصنعة. و قد أشارت النتائج إلى أن مسحوق أوراق المورينجا يحتوي كميات مرتفعة من البروتين والألياف الخام بجانب بعض العناصر المعدنية الهامة مثل الكالسيوم ، المغنيسيوم ، الفوسفور و الحديد. كما أظهرت النتائج أن إضافة مسحوق أوراق المورينجا للخبز القالب قد رفعت كمية البروتين إلى ٢١,٨٥% ، الرماد (٥,٢١%) ، بينما إنخفضت كمية الكربوهيدرات ووصلت ٥٩,٣٤%. و قد إحتوى الخبز المدعم بـ ١٠% مسحوق أوراق المورينجا على كميات أعلى من كلاً من المغنيسيوم ، الكالسيوم و الحديد مقارنةً بالعينة الضابطة (من ٢٥,٥٠ إلى ١٠٢,٥٦ مجم/١٠٠جم ، من ١٢,٨٥ إلى ٢٠٥,٦٠ مجم/١٠٠جم و من ٤,٥٤ إلى ١٢,٥٦ مجم/١٠٠جم على التوالي). أظهرت نتائج الخواص الريولوجية أن إضافة مسحوق أوراق المورينجا قد اثر سلبياً على بعض قيم الفارينوجراف و الاكستنسوجراف. كما أظهر التقييم الحسي أنه على الرغم من أن هنالك تحسن في القيمة الغذائية ، و لكن قابلية جميع عينات الخبز تحت الدراسة قد إنخفضت بزيادة نسبة إضافة مسحوق أوراق المورينجا ، خاصةً عينات خبز القالب ١٥ و ٢٠%. أما بالنسبة للخصائص الفيزيائية ، فقد تراوحت النسبة المئوية لفقد الخبيز بين ٣,٥ إلى ٥,٥% في العينة E و العينة الضابطة على التوالي. كذلك أظهرت النتائج إنخفاضات ملحوظة في كلاً من اللزوجة ، القابلية للمضغ ، المرونة و القدرة على الانكماش في جميع عينات الخبز مقارنةً بالعينة الضابطة. هذا و قد أوضحت نتائج معدل البيات أن هنالك زيادات تدريجية في طزاجة جميع عينات الخبز حتى اليوم الرابع من التخزين مقارنة بالعينة الضابطة. و أخيراً ، فإن نتائج التركيب الدقيق قد أظهرت إنتشار أنواع من البلورات المختلفة في الحجم و الشكل في عينات الخبز ١٥ و ٢٠% مقارنة ببقية العينات. كذلك فقد ظهرت حبيبات النشا مغلفة و منتفخة في عينات الخبز بنسب الإضافة ١٥و ٢٠%. بصفة عامة يمكن القول بأنه في الاستطاعة إنتاج منتجات مخبوزات مقبولة مثل الخبز القالب باستخدام مسحوق أوراق المورينجا بنسب ٥ و ١٠%. كما أن مسحوق أوراق المورينجا يعتبر مصدر غني لكلاً من الكالسيوم ، المغنيسيوم و الحديد ، يمكن أن يستخدم لإعداد العديد من منتجات المخابز ولكن هنالك حاجة إلى تنفيذ المزيد من الدراسات لتقييم الاتاحة الحيوية لتلك العناصر المعدنية.

الكلمات الدالة: منتجات المخابز ، المورينجا ، التقييم الحسي ، الخصائص الريولوجية ، الخواص الكيميائية و الفيزيائية.