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QUALITY ATTRIBUTES OF SOME BREADS MADE FROM WHEAT FLOUR SUBSTITUTED BY DIFFERENT LEVELS OF WHOLE AMARANTH MEAL

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ABSTRACT

Amaranth plant grows rapidly, with a high tolerance to arid conditions and poor soils. So, a trial was made to use amaranth meal in producing popular Egyptian breads. The quality attributes of balady, shamy (Egyptian traditional breads) and pan bread produced from wheat flour alone or substituted by different levels of whole amaranth meal were studied. The quality of the produced breads from different blends was compared to that of bread produced from wheat flour as control. Chemical composition, mineral content and the amino acids composition for raw materials were determined. Rheological properties were evaluated by Farinograph and Extensograph for dough produced from different blends of wheat alone and with amaranth meal. Moreover falling and liquefaction numbers were estimated for the studied doughs. Sensory evaluation for different breads was studied and the data were statistically analyzed. Finally, some baking properties of all breads were studied. The results indicate that, amaranth meal contains a good percentage of main components and acceptable percentage from essential amino acids. The Farinograph and Extensograph tests for different doughs containing amaranth were not greatly affected by adding amaranth. So, nearly the amaranth had good character like strong wheat. Data for sensory evaluation indicate that adding of amaranth till 20% was acceptable. The specific volume was decreased with adding more ratio from amaranth related to the percentage of fat in amaranth that affected in Farinograph and Extensograph tests. Finally, the amaranth meal could be utilized in making bread but needs more studies.

Keywords: Amaranth meal, Quality attributes, Balady bread, Shamy bread, Pan bread.

INTRODUCTION

The plant family Amaranthaceae consists of approximately 850 species in 65 genera, and is distributed world-wide, in both temperate and tropical regions. Many of these species are commonly used by man as medicinal herbs and as sources of both edible leaves and seeds (Marcone *et al.*, 2003).

Amaranth is a pseudo cereal of rapid growth, with a high tolerance to arid conditions and poor soils where traditional cereals can not be grown, so many countries have been adapting certain varieties to their soils (Tapia-Blacido *et al.*, 2005 Fadel *et al.*, 1996; Lehmann, 1996; Bressani, 1989 and Saunders and Becker, 1985). Nutritionally, based on essential amino acid composition, amaranth grain has been assigned an exceptionally high chemical score of 73 in the recommended FAO/WHO scoring patterns (Bressani, 1989). In fact, when amaranth grain is processed under conditions which do not damage the availability of essential amino acids, its protein quality is very close to that of casein (Bressani, 1989 and Mendoza and Bressani, 1987).

Amaranth has become popular among patients with celiac disease because it does not cause allergic reactions in the intestinal mucosa. However, the high prevalence of diabetes mellitus among these patients is well known (Guerra-Matias and Areas, 2005).

Information concerning the nutritional attributes and benefits associated with the consumption of grain amaranth abound, especially when incorporated into bakery goods, breakfast cereals, and infant food formulas, etc. (Lehmann, 1996 and Hazova *et al.*, 1997),whereas other studies have demonstrated a variety of important/unique application for grain amaranth (Lehmann, 1996 and Chaturvedi *et al.*, 1997). Such applications include the incorporation of amaranth grain as an adjunct in the human diet to lower blood glucose response in non insulin dependent diabetics as well as for making such diets more nutritious in terms of a more balanced amino acid pattern and providing high amounts of calcium and iron (Chaturvedi *et al.*, 1997). As a whole grain, amaranth is being increasingly used in breads and cookies (SanchezMarroquin *et al.*, 1985) as well as pasta and breakfast cereals (Lehmann, 1992).

Amaranth was a staple food of the pre-Columbian Aztecs, which first found its way to the Americas from China. The composition and nutritional properties of amaranth seeds have received special attention (Breene, 1991and Lehmann, 1996). The amaranth has a protein content of 18% (Tosi *et al.,* 2002), is recognized as lysine rich high-protein grains which have the potential to meet the world's requirements (Ruales and Nair, 1993; Singhal and Kulkarni, 1988) and contains significant amounts of calcium, iron, potassium, phosphorous, vitamins and dietary fibre (Escudero *et al.*, 1999).

There has been a growing interest in the possible use of grain amaranth in human nutrition and for animal production. Ravindran *et al.* (1996) found that the grain amaranth sample contained (g/100 g): Crude protein 16.8; crude fat 5.8; crude fiber 6.0; ash 2.6; calcium 0.22; total phosphorus 0.56; lysine 1.01 and methionine, 0.35.

Wheat is the most common cereal used for bread production in Egypt. Flour constitutes one of the essential ingredients for a wide range of breads, noodles, cakes, and other bakery products. Also, wheat is consumed in the form of semolina for production of a variety of pasta products and couscous. In Egypt, wheat flour bread represents the main staple food for most people.

Hegazy (2002), Mohsen *et al.* (1997) and Seleem (2000) had used corn flour as wheat flour substitute before to produce bakery products and they found that the rheological properties of dough was affected by addition of corn flour. In Egypt and all world the price of corn nearly equal the price of wheat, but the price of them higher than the price of amaranth.

Therefore, looking for inexpensive materials is considered an important task for nutritionists in these countries. Recently Egypt started trail and experiments for cultivation amaranth. So, this work was done to publish the benefits of amaranth in Egypt.

Accordingly, this work was carried out as a trial to utilize the amaranth meal as wheat flour substitute in different levels in bread making. The quality attributes of balady, shamy and pan breads produced from wheat flour substituted by different levels of whole amaranth meal were studied.

MATERIALS AND METHODS

1. Materials

Whole-meal of amaranth: Amaranth light seeds (*Amaranth hypochondriacus* L.) were obtained from Horticulture Dept., Fac. Agric., Suez Canal Univ., Ismailia, Egypt.

Wheat flour of extraction rate 72 and 82% was obtained from South Cairo Mills Co., Cairo, Egypt. Activated compressed yeast was supplied by Starch and Yeast Co. Alexandria, Egypt. Other baking ingredients were obtained from local markets of Toukh City, Kaliobia governorate.

2. Methods

Preparation of different blends:

Whole meal of amaranth seeds was produced by milling clean seeds using Senior Quadrumat roller mill (Brabender, Germany). The milled seeds were used in the preparation of breads.

Different blends were prepared as presented in Table (1).

Table (1): Formulae of different balady, shamy and pan bread

Ingredients	Blends composition									
	Balady bread					Shamy or pan bread				
	1	2	3	4	5	1	2	3	4	5
Wheat flour 72% ext.	-	-	-	-	-	100	95	90	85	80
Wheat flour 82% ext.	100	95	90	85	80	-	-	-	-	-
Whole-meal of amaranth	0	5	10	15	20	0	5	10	15	20

Preparation of bread:

Balady bread:

Balady bread was prepared as formula presented in Table (1) by mixing the formula components with other ingredients which are 1.5% compressed yeast, 1.5% sodium chloride and water as needed. The mixture was mixed in mixer (250 rpm) for 20 min. The dough was left for fermentation at 30°C and 85% relative humidity for 15-30 min. After fermentation, the dough was divided into 130 g pieces. Each piece was molded on a wooden board previously covered with a fine layer of bran and left to ferment about 15 min at the same mentioned temperature and relative humidity. The fermented dough pieces were flattened to about 20 cm diameter. After flatting, the dough was left to final fermentation until suitable properties. The flat dough was baked in oven at 380-400°C for 3-4.5 min. The loaves were allowed to cool at room temperature before sensory evaluation (Yaseen, 1985).

Shamy bread:

Shamy bread was produced as balady bread but from wheat flour 72% extraction and Whole-meal of amaranth as indicated in Table (A) but the percentage of each compressed yeast and sodium chloride was decreased to 1%. The relative humidity in the fermentation was 65%. The times for the three stage of fermentation were 30, 15 and 40 min, respectively (Hamza and Shafez, 2005).

Pan bread

The basic straight dough-bread making method (AACC, 1995) was used to produce pan bread.

Organoleptic evaluation for Balady bread:

Types of Balady bread were evaluated for their sensory characteristics by ten panelists from the staff of Food Sci. Dept., Faculty Agric. Moshtohor, Benha Univ., Egypt. The scoring scheme was established as mentioned by El-Farra *et al.* (1982).

Organoleptic evaluation for shamy bread:

Panelists were asked for sensory evaluation of bread appearance, crumb, odour, crust, color and taste according to the method of Kramer and Twigg (1974) as reported by Foda *et al.* (1987).

Organoleptic evaluation for pan bread:

Pan bread was evaluated as described by Mostafa *et al.* (1980) and Jinge and Hoseny (1981). Bread loaves were scored by panelists for general appearance, crust color, crumb color, distribution of crumb, spong, odour, and taste.

Chemical analysis:

Moisture, protein, ash, crude fiber, ether extract, starch and reducing and non reducing sugars contents were determined according to the methods described in AOAC (2000). Total carbohydrates were calculated by difference.

Minerals analysis:

Sodium, potassium, calcium, phosphorus, Magnesium, manganese, iron, zinc, copper and nickel contents were determined using a Pye Unicom SP 19000 atomic absorption spectroscopy in Food Technology Research Institute, Agriculture Research Center, Giza, Egypt as described by AOAC (2000).

Rheological properties of dough:

Farinograph test was carried out to determine the water absorption, arrival time, dough development time, dough stability and degree of weakening according to the method described in AACC (1995).

Extensograph test was carried out to determine resistance to extension (BU), extensibility (mm), proportional number and energy (cm^2) according to the method described in AACC (1995).

The falling number of wheat flour (control and blends) was determined by using Falling Number 1400 (perten) according to the method described in AACC (1995).

Liquefaction number of wheat flour (control and blends) is calculated as follows: Liquefaction No. = 6000/ (Falling No. – 50)

Physical characteristics of bread products:

Physical characteristics of prepared breads, loaf weight and loaf volume (cm^3/g) was calculated by dividing volume of loaf by its weight according to the method described by Colims *et al.* (1982) and AACC (1995).

Alkaline water retention capacity:

Loves freshness of each formula was tested by alkaline water retention capacity (AWRC) according to method of Yamazaki (1953), as modified by Kitterman and Rubenthaler 1971).

Statistical analysis:

The obtained results were statistically analyzed by analysis of variance (ANOVA) followed by multiple comparisons applying least significant difference (LSD) according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Proximate chemical composition of raw materials

Data in Table (2) reveal the difference of the raw materials in their contents of protein, fat, ash, crude fiber, total carbohydrates on dry basis and moisture content. Wheat flours were found to contain 11.85 and 12.80% for protein, 1.06 and 1.9 % for fat, 0.52 and 1.06% for ash, 0.54 and 1.93% for fiber, 86.04 and 82.30% for carbohydrates and 11.99 and 12.37% for moisture, for wheat flour (72% ext.) and wheat flour (82% ext.), respectively. These results as are in agreement with those reported by Seleem (2000). From the results, it could be noticed that the amaranth meal contained the highest value in protein, fat, ash, crude fiber.

Table (2): Chemical composition of amaranth and wheat flour (72 & 82%)

Chemical composition (%)	Amaranth meal	Wheat flour (72%)	Wheat flour (82%)
Moisture	10.11 ± 0.16	11.99 ± 0.292	12.37 ± 0.037
Protein*	17.24 ± 0.30	11.85 ± 0.401	12.80 ± 0.048
Fat*	7.63 ± 0.15	1.06 ± 0.068	1.91 ± 0.015
Ash*	3.29 ± 0.68	0.52 ± 0.018	1.06 ± 0.019
Crude fiber*	4.38 ± 0.10	0.54 ± 0.034	1.93 ± 0.018
Available Carbohydrates*@	57.35	86.04	82.30

* (on dry basis) @: Available carbohydrate by difference

Minerals contents of raw materials

Data in Table (3) represent the minerals contents of the raw materials. From the data, it can be concluded that amaranth meal was superior in potassium, calcium, magnesium, manganese, iron, zinc, copper and nickel while wheat flour either (72 or 82%) extraction rate were superior in sodium and phosphorus. These results for wheat flour either (72 or 82%) extraction are in agreement with those reported by Cara *et al.* (1992). Therefore it could be mentioned that fortification of wheat flour with amaranth meal can produce balady, shamy and pan bread with high levels of minerals.

Table (3): Minerals contents of amaranth and wheat flour 72 & 82%

Mineral contents (mg/100 g)	Amaranth meal	Wheat flour 72%	Wheat flour 82%
Na	21.42 ± 1.63	25.89 ± 0.27	32.87 ± 0.43
K	381.67 ± 14.29	139.50 ± 2.03	128.79 ± 0.75
Ca	174.58 ± 3.89	12.94 ± 0.07	21.31 ± 0.09
P	46.37 ± 0.19	139.42 ± 2.41	145.78 ± 1.08
Mg	239.50 ± 7.36	118.94 ± 0.71	129.94 ± 2.38
Mn	2.29 ± 0.02	0.70 ± 0.03	0.88 ± 0.02
Fe	9.91 ± 0.35	0.73 ± 0.06	1.56 ± 0.01
Zn	3.79 ± 0.07	0.46 ± 0.003	0.76 ± 0.004
Cu	0.82 ± 0.01	0.31 ± 0.004	0.36 ± 0.003
Ni	0.18 ± 0.002	0.07 ± 0.001	0.11 ± 0.001

Amino acid composition of amaranth meal

Data in Table (4) indicate that amaranth meal contains all amino acids presented in wheat flour (essential and non essential amino acid). Amaranth meal has high percentage from cysteine and tyrosine more than wheat flour (72 and 82 %). The cysteine contained sulfur which improved gluten net by inter in sulfur bond. So the addition of amaranth meal to wheat flour improve dough characters. In the other hand for non essential, amaranth meal contains high percentage from arginine more than in wheat flour. Arginine acid help children in growth. Tryptophane and glycine acids were found in amaranth meal more than in wheat flour. Tryptophane acid is aromatic amino acid.

Table (4): Amino acids percentages of amaranth meal and wheat flour (% of protein)

Amino acids	Amaranth meal	Wheat flour 72%	Wheat flour 82%
Essential amino acids:			
Lysine	5.92	5.59	6.26
Cysteine	2.28	1.59	1.78
Methionine	2.80	4.72	4.94
Phenylalanine	4.26	5.99	5.98
Tyrosine	3.50	2.53	2.92
Valine	4.90	5.63	6.48
Threonine	4.18	5.18	5.47
Isoleucine	4.00	3.89	4.68
Leucine	6.26	7.78	8.09
Non-essential amino acids:			
Arginine	10.08	6.92	7.73
Histidine	2.98	3.11	3.98
Aspartic	9.48	7.74	7.47
Serine	5.94	4.49	4.36
Glutamic	15.20	11.67	11.85
Proline	4.40	9.40	5.98
Glycine	7.86	7.32	5.83
Alanine	4.16	5.34	5.07
Tryptophan	1.82	1.17	1.15
Essential amino acids %	38.10	42.90	46.60
Non-essential amino acids %	61.90	57.10	53.40

Effect of amaranth meal blended with wheat flour both (72 and 82% extraction) on the falling and liquefaction numbers

The falling No. as an indication of amylase activity (the greater the amylolytic activity, the shorter is the time required) of wheat flour dough and the effect of addition of whole-meal of amaranth on such parameter was determined and presented in Table (5).

Data in Table (5) show the addition of whole-meal of amaranth with wheat flour either (72 or 82% ext.) increase the falling No. compared to control. In addition, such increase by raising the levels of whole-meal of amaranth. The liquefaction no. was decreased by increasing the level of whole-meal of amaranth. This means that increasing the level of whole-meal of amaranth decreases the amylolytic activity of the dough and consequently increases the maximum viscosity. These data are in the line with those of Seleem (2000) and Hussein (2001).

Farinograph parameters of wheat flours dough blended with amaranth meal

Data in Table (5) show the effect of blending amaranth meal with wheat flour (72 and 82% ext.) on the farinograph parameters, i.e. water absorption, arrival time, dough development time, dough stability and dough weakening.

Water absorption of the control (wheat flour 72 and 82% ext.) showed a value of 58.38 and 66.7 ml, respectively. While wheat flour blended with different ratios of amaranth meal, 5, 10, 15 and 20% showed a gradual increase in parallel with amaranth meal increase, this may be due to the high protein and fiber contents in amaranth meal. Arrival time showed a time in min ranged between 1.30 -3.00. Dough development time of blends with amaranth meal at the ratios of 5, 10, 15 and 20% resulted in (2.4 to 4.6 min) and (2.88 to 4.00 min) for wheat flour (72 and 82% extraction), respectively. Dough stability showed its maximum value (8.25 min.) when the blend contained 20% amaranth meal and 80% wheat flours 82% extraction followed by 20% amaranth meal and 80% wheat flours 72% extraction (7.1 min.).

From the above mentioned data, it could be concluded that, the replacement of amaranth meal at different ratios improved the gluten network and farinograph parameters of the wheat flour dough.

In the contrast, maize flour had a bad effect on the farinograph parameters of the wheat flour. Mohamed *et al.* (1989) and Hegazy (2002) found that, the wheat/maize doughs containing either 15 or 20% maize flour showed lower water absorption (54.5 and 54%), mixing time (2.0 and 1.5 min.) and dough stability (3.5 min. for both), as compared to 55%, 2.5 min., and 4.0 min. for control dough, respectively. Dough weakening degrees increased from 100 for control to 110 and 120 BU. for test doughs.

From the aforementioned data, it could be concluded that blending with amaranth meal had a good farinograph parameters.

Extensograph parameters of wheat flours dough blended with amaranth meal

Data in Table (6) show the effect of blending amaranth meal (in ratios of 5, 10, 15 and 20%) with wheat flours (82 and 72% extraction) dough on the extensograph parameters, i.e. extensibility (E), resistance to extension (R) and the ratio between them and also the energy.

The results show that the resistance was 821.25 and 724 B.U. for the control (wheat flour 82 and 72% ext., respectively), while it decreased with increasing the levels of amaranth meal in prepared blends. Also, the resistance value of dough produced from blends of wheat flour (82% ext.) + amaranth meal more than of dough produced from blends for wheat flours (72% ext.) + amaranth meal but both still decreased than the control.

Extensibility (E) showed a value of 177 and 154 mm for the control (wheat flour 82 and 72% ext.), respectively. Blending with amaranth meal showed a slight decrease due to amaranth meal. The lowest extensibility value was recorded due to blend containing 20% white amaranth meal. The ratio between resistances to extension of extensibility reflects the effect of blends on the elasticity of the produced dough. Concerning the energy, the control resulted in the highest value while other treatments resulted in the following decreasing. From the above mentioned data, it could be concluded that addition of amaranth meal had a good extensograph parameters like the control. Data published by Mostafa (1982) and Seleem (2000) indicated that, the addition of corn flour reduced the strength of the dough. This could be attributed to the effect of corn flour prolamin (Zein) on the dough and gluten network. Presence of zein as a substitute for part of gliadin couldn't combine with glutenine and should affect the amount of the formed gluten. Also, this may be due to the induction of more hydrogen bonds in gluten-carbohydrate complex of dough which refine forces the dough resistance.

Sensory evaluation of balady bread produced from wheat flour (82% ext.) blended with amaranth meal

Table (7) shows the sensory evaluation of balady bread produced from a blend containing wheat flour 82% extraction, whole-meal of amaranth at the ratios of 5, 10, 15 and 20%. The sensory evaluation included the general appearance, taste, crust color, separation of layers, roundness, distribution of crumb, odor and overall acceptability. The obtained data reveal that the addition of whole-meal of amaranth resulted in significant differences ($P<0.05$) compared with those of control. The score of sensory evaluation was decreased with increasing the levels of amaranth meal.

The tested bread samples proved to be inferior in average values of organoleptic properties as compared with control samples. It was also proved that the higher of the level of whole-meal of amaranth substitute had the lower values scored for the resulting bread with insignificant ($P>0.05$) quality reduction at 5 and 10% whole-meal of amaranth substitution levels and with significant ($P<0.05$) reduction at higher levels. It could be concluded that replacement of whole-meal of amaranth could be added to wheat flour to produce acceptable loaf to some extent and the level of addition can be reach to 20% of amaranth meal to wheat flour to produce balady bread, as an economical level with the acceptable properties (overall acceptability scores [illegible] 5%).

Table (5): Effect of amaranth meal addition with different levels to wheat flour on falling number, liquefaction number and farinograph parameters of dough

Dough mixture	Falling number	liquefaction number	Farinograph parameters				
			Water absorption (%)	Arrival time (min)	Dough development (min)	Dough stability (min)	Degree of weakening (B.U.)
Control 100% W.F (82% extraction)	329	21.51	66.70	1.50	2.75	6.00	73.25
95% W.F. (82% ext.) + 5% A.M.	330	21.43	67.38	1.75	2.88	6.20	70.25
90% W.F. (82% ext.) + 10% A.M.	331	21.35	68.20	1.88	3.25	6.65	65.25
85% W.F. (82% ext.) + 15% A.M.	355	19.67	68.85	2.38	3.50	7.25	59.75
80% W.F. (82% ext.) + 20% A.M.	393	17.49	69.85	3.00	4.00	8.25	56.00
Control 100% W.F (72% extraction)	321	22.14	58.38	1.30	2.20	4.40	67.00
95% W.F. (72% ext.) + 5% A.M.	337	20.91	60.86	1.40	2.40	3.90	64.00
90% W.F. (72% ext.) + 10% A.M.	350	20.00	62.62	1.50	3.20	5.10	60.20
85% W.F. (72% ext.) + 15% A.M.	362	19.23	65.38	1.80	3.90	6.30	57.20
80% W.F. (72% ext.) + 20% A.M.	374	18.52	66.28	2.25	4.60	7.10	53.20

W.F. = Wheat flour A.M. = Amaranths meal

Table (6): Effect of amaranth meal addition with different levels to wheat flour on extensograph parameters of dough.

Dough mixture	Extensograph parameters			
	Resistance to extension (B.U.)	Extensibility (m.m.)	Proportional number (R / E)	Energy (cm^2)
Control 100% W.F (82% extraction)	881.25	177.50	4.96	127.50
95% W.F. (82% extraction) + 5% A.M.	820.00	173.80	4.72	113.75
90% W.F. (82% extraction) + 10% A.M.	786.25	155.00	5.07	110.00
85% W.F. (82% extraction) + 15% A.M.	748.75	143.80	5.21	107.50
80% W.F. (82% extraction) + 20% A.M.	691.25	128.30	5.39	105.00
Control 100% W.F (72% extraction)	724.00	154.00	4.70	135.20
95% W.F. (72% extraction) + 5% A.M.	683.00	145.00	4.71	115.80
90% W.F. (72% extraction) + 10% A.M.	670.00	130.00	5.15	106.40
85% W.F. (72% extraction) + 15% A.M.	662.00	122.80	5.39	96.00
80% W.F. (72% extraction) + 20% A.M.	634.00	119.00	5.33	90.80

W.F. = Wheat flour A.M. = Amaranths meal

Table (7): Sensory evaluation of balady bread made from blends of wheat flour (82% extraction) with amaranths meal. (scores mean values ± SE)

Samples of balady bread	Sensory attributes							
	General appearance 20	Taste 20	Crust color 15	Separation of layer 15	Roundness 10	Distribution of crumb 10	Odor 10	Overall acceptability 100
Control 100%W.F. (82% ext.)	19.83^{a} ±0.07	19.50^{a} ±0.12	14.67^{a} ±0.11	14.71^{a} ±0.11	9.79^{a} ±0.10	9.71^{a} ±0.11	9.79^{a} ±0.10	97.17^{a} ±0.59
95% W.F. (82% ext.) + 5% A.M.	19.42^{b} ±0.10	19.21^{a} ±0.14	14.13^{b} ±0.09	14.42^{ab} ±0.14	9.42^{b} ±0.12	9.42^{a} ±0.10	9.58^{ab} ±0.12	94.00^{b} ±0.98
90% W.F. (82% ext.) + 10% A.M.	18.50^{c} ±0.11	17.79^{b} ±0.17	13.79^{b} ±0.20	14.00^{b} ±0.17	8.54^{c} ±0.17	8.42^{b} ±0.19	9.46^{b} ±0.14	90.42^{c} ±0.36
85% W.F. (82% ext.) + 15% A.M.	16.88^{d} ± 0.15	17.54^{b} ±0.14	12.20^{c} ±0.16	13.13^{c} ±0.21	8.21^{c} ±0.11	7.67^{c} ±0.15	9.25^{bc} ±0.17	87.75^{d} ±0.64
80% W.F. (82% ext.) + 20% A.M.	15.13^{e} ± 0.15	15.08^{c} ±0.17	10.87^{d} ±0.20	12.96^{c} ±0.13	7.25^{d} ±0.13	6.75^{d} ±0.18	8.95^{c} ±0.17	82.50^{e} ±1.10
LSD	0.336	0.419	0.435	0.431	0.355	0.424	0.394	2.174

W.F. = Wheat flour   A.M. = Amaranths meal

Sensory evaluation of Shamy bread produced from blends of wheat flour (72% ext.) with amaranth meal

Table (8) shows the sensory characteristics, i.e. appearance, crumb, odor, crust, color, taste, and overall acceptability for shamy bread produced from wheat flour (72% ext.) blended with whole-meal of amaranth at the levels of 5, 10, 15 and 20%. The obtained data reveal that, the addition of 5% whole-meal of amaranth meal had the highest scores after control sample (wheat flour 72% ext.) followed by 10, 15 and 20%. In spite of there are significant differences ($P<0.05$) between control sample and other blends, it could be recommended to use 20% level of addition for whole-meal of amaranth to make shamy bread (overall acceptability scores 89.15%). Moreover, all blends gave high overall acceptability.

Sensory evaluation of pan bread produced from blends of wheat flour (72% ext.) with amaranth meal

The sensory characteristics, i.e. general appearance, taste, odor, spong, crust color, crumb color, distribution of crumb and overall acceptability for pan bread produced from wheat flour 72% extraction containing different ratios of 5, 10, 15 and 20% of whole-meal of amaranth were evaluated by panelists. The obtained data are presented in Table (9).

Statistical analysis indicated significant differences between control (wheat flour 72% ext.) and 10, 15 and 20% of whole-meal of amaranth blends. On the other hand, no significant difference ($P>0.05$) was shown for the control and 5% blend of whole-meal of amaranth blends. Any how amaranth meal could be incorporated in wheat flour dough at level of 20% that overall acceptability was 82.5%.

Effect of adding amaranth meal to wheat flour (72 and 82% ext.) on some baking properties of balady, shamy and pan breads

Data in Table (10) show the effect of adding whole-meal of amaranth with different different levels to wheat flour on the weight, volume and specific volume of balady and shamy breads compared with control (wheat flour).

The control balady bread which prepared from wheat flour (82% ext.) showed a specific volume of 2.42 cm^3/g. The data showed a gradual decrease in specific volume according to the added ratio of amaranth whole meal.

Concerning the effect of adding amaranth meal on the physical properties of shamy and pan breads, it behaved nearly in the same trend as in balady bread.

The replacement of amaranth meal resulted in decreasing the specific volume. The obtained data were in agreement with Song Hwan and Chul (1999). From the above mentioned data, it could be noticed that fortification with 20% amaranth meal decreased the specific volume by 10.74, 1.26 and 7.17% for the balady, shamy and pan bread, respectively.

Table (8): Sensory evaluation of shamy bread made from blends of wheat flour (82% extraction) with amaranth s meal. (scores mean values ± SE)

Samples of shamy bread	Sensory attributes						
	Appearance 20	Crumb 20	Odor 15	Crust 15	Color 15	Taste 15	Overall acceptability 100
Control 100%W.F. (82% ext.)	19.65 ^{a} ±0.12	19.58 ^{a} ±0.12	14.58 ^{a} ±0.12	14.81 ^{a} ±0.09	14.58 ^{a} ±0.17	14.69 ^{a} ±0.11	97.85 ^{a} ±0.61
95% W.F. (72% ext.) + 5% A.M.	19.42 ^{a} ±0.14	19.38 ^{a} ±0.15	14.04 ^{a} ±0.18	14.50 ^{a} ±0.14	14.27 ^{a} ±0.16	14.12 ^{ab} ±0.16	95.23 ^{b} ±0.93
90% W.F. (72% ext.) + 10% A.M.	18.35 ^{b} ±0.14	18.12 ^{b} ±0.18	12.58 ^{b} ±0.21	12.27 ^{b} ±0.25	12.69 ^{b} ±0.30	13.54 ^{b} ±0.15	92.77 ^{c} ±0.79
85% W.F. (72% ext.) + 15% A.M.	17.27 ^{c} ±0.23	17.00 ^{c} ±0.33	11.31 ^{c} ±0.29	11.42 ^{c} ±0.28	11.50 ^{c} ±0.27	12.54 ^{c} ±0.39	90.46 ^{d} ±0.75
80% W.F. (72% ext.) + 20% A.M.	15.00 ^{d} ±0.17	14.88 ^{d} ±0.34	10.42 ^{d} ±0.38	11.42 ^{c} ±0.25	11.31 ^{c} ±0.41	12.42 ^{c} ±0.43	89.15 ^{d} ±0.99
LSD	0.456	0.674	0.668	0.595	0.764	0.786	2.283

*W.F. =Wheat flour A.M. = Amaranths meal

Table (9): Sensory evaluation of pan bread made from blends of wheat flour (72% extraction) with amaranths meal. (scores mean values ± SE)

Samples of pan bread	Sensory attributes							
	General appearance 15	Taste 15	Odor 15	Sponge 15	Crust color 15	Crumb color 15	Distribution of crumb 10	Overall acceptability 100
Control 100%W.F. (72% ext.)	14.67 [a] ±0.14	14.63 [a] ±0.18	14.67 [a] ±0.13	14.62 [a] ±0.13	14.67 [a] ±0.14	14.58 [a] ±0.15	9.58 [a] ±0.12	97.33 [a] ±0.80
95% W.F. (72% ext.) + 5% A.M.	14.25 [ab] ±0.20	13.96 [a] ±0.23	14.13 [a] ±0.21	14.58 [a] ±0.12	14.46 [a] ±0.19	14.00 [a] ±0.17	9.17 [a] ±0.19	94.42 [b] ±1.00
90% W.F. (72% ext.) + 10% A.M.	13.54 [b] ±0.34	13.00 [b] ±0.24	12.38 [b] ±0.36	13.17 [b] ±0.25	13.04 [b] ±0.27	13.17 [b] ±0.26	8.46 [b] ±0.17	93.33 [b] ±1.06
85% W.F. (72% ext.) + 15% A.M.	12.75 [bc] ±0.41	11.38 [c] ±0.23	12.33 [b] ±0.24	12.31 [c] ±0.28	11.63 [c] ±0.42	12.21 [c] ±0.33	8.21 [b] ±0.22	89.50 [c] ±0.88
80% W.F. (72 % ext.) + 20% A.M.	12.58 [c] ±0.36	11.42 [c] ±0.59	11.12 [c] ±0.22	11.49 [d] ±0.37	11.41 [c] ±0.56	11.42 [d] ±0.36	7.36 [c] ±0.21	87.83 [c] ±0.78
LSD	0.852	0.914	0.674	0.693	0.975	0.745	0.507	2.523

W.F. =Wheat flour A.M. = Amaranths meal

Table (10): Effect of adding amaranths meal to wheat flour (82% and 72% extraction rate) on some baking properties of balady, shamy and pan breads

Dough mixture	Type of bread	Physical properties		
		Weight (gm)	Volume (cm^3)	Specific Volume (cm^3/gm)
Control 100% W.F (82% ex.)	Balady	120.11	291	2.42
95% W.F. (82% ex.) + 5% A.M.		123.08	289	2.35
90% W.F. (82% ex.) + 10% A.M.		125.27	287	2.29
85% W.F. (82% ex.) + 15% A.M.		127.78	285	2.23
80% W.F. (82% ex.) + 20% A.M.		130.57	282.5	2.16
Control 100% W.F (72% ex.)	Shamy	118.37	188	1.59
95% W.F. (72% ex.) + 5% A.M.		121.09	191.5	1.58
90% W.F. (72% ex.) + 10% A.M.		123.81	195.5	1.58
85% W.F. (72% ex.) + 15% A.M.		126.34	200	1.58
80% W.F. (72% ex.) + 20% A.M.		129.15	203	1.57
Control 100% W.F (72% ex.)	Pan Bread	148.65	600	4.04
95% W.F. (72% ex) + 5% A.M.		150.70	593	3.93
90% W.F. (72% ex.) + 10% A.M.		151.95	589	3.88
85% W.F. (72% ex.) + 15% A.M.		153.15	584	3.81
80% W.F. (72% ex.) + 20% A.M.		155.05	581	3.75

W.F. = Wheat flour   A.M. = Amaranths meal

Conclusion

From the obtained data, the amaranth meal had the highest content of chemical composition including essential amino acids. The blendes dough from wheat flour and amaranth meal had good characteristic in rheological properties. More over the sensory evaluation were acceptable. So, it could be recommend adding of 20% amaranth meal to wheat flour in production of balady, shamy and pan breads. Also, more research must be carried out in using amaranth meal as substitute with wheat flour in most bakery products by different levels.

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صفات الجودة لبعض أنواع الخبز المصنع من خلطات دقيق القمح ومطحون الأمارنتس

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فى هذه الدراسة تم الاستفادة من مطحون الحبة الكاملة لنبات الأمارنتس القليل الاحتياج للماء و الذى يصلح للزراعة فى الأرض الفقيرة والأراضى القاحلة والأراضى المستصلحة والكثيف الإنتاجية فى إنتاج نوعيات مختلفة من الخبز المصرى (البلدى، الشامى وخبز القوالب).

حيث تم استبدال دقيق القمح بنسب ٥، ١٠، ١٥ و ٢٠% بمطحون الحبة الكاملة لنبات الأمارنتس لتصنيع أنواع الخبز السابق ذكرها. وأوضحت النتائج ما يلى: أن مطحون الحبة الكاملة الأمارنتس تميز بارتفاع مكوناته من البروتين والدهن والعناصر المعدنية والألياف عن دقيق القمح باستخراجاته المستخدمة فى الدراسة (٧٢ -٨٢%)- وتميز أيضا فى الأحماض الأمينية بجانب العناصر المعدنية الضرورية.

وأوضحت اختبارات الفارينوجراف والأكستنسوجراف تميز دقيق الأمارنتس بخواص مشابهة لدقيق القمح القوى والذى يصلح لصناعة الأنواع الجيدة من الخبز بعكس استخدام دقيق الذرة الذى أوضحت الدراسات السابقة تأثيره على أضعاف الدقيق وعدم صلاحية استخدامه بنسب كبيرة. وأدى إضافة مطحون الأمارنتس إلى زيادة نسبة التشرب وذلك لارتفاع محتواه من البروتين والألياف. وأدت الإضافة أيضا إلى انخفاض درجة الضعف.

وعند دراسة رقم السقوط أوضحت زيادة نسبته عن العينات الكنترول وكانت نسبة الإضافة ٢٠% أعلى قيم فى رقم السقوط فى نوعى الدقيق المستخدمين.

كذلك أظهرت النتائج أن الصفات الحسية لأنواع الخبز المختلفة والمصنعة من جميع الخلطات تحت الدراسة كانت مقبولة عند جميع نسب الخلط وكانت إضافة نسبة ٥، ١٠% قريبة من العينة الكنترول المصنعة من دقيق القمح فقط. وحسنت جميع الإضافات من الخواص الطبيعية للخبز الناتج تحت الدراسة حيث كانت هناك علاقة طردية بين وزن الأرغفة ونسبة الإضافة. ولهذا يخلص البحث إلى أهمية إضافة مطحون الأمارنتس لدقيق القمح عند صناعة الخبز والمخبوزات وأيضا استكمال الدراسات على استخدامه فى مصنعات ومنتجات أخرى نظرا لتميز مكوناته وصلاحيته للزراعة فى الأراضى المستصلحة المصرية.