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UTILIZATION OF BARLY AND *AMARANTHUS* SEEDS IN BISCUIT PROCESSING

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Abstract

Amaranth seeds variety (*Amaranthus vietmeyer*) whole meal was added at different levels of10,20,30,40% to two varieties of barley whole meal (maked and Giza 123), and to wheat flour (72% extraction). The chemical composition of the amaranth, barley, wheat flour and their mixture was determined. Amaranth whole meal contained the highest percentage of portein 14.41% followed by naked and Giza 123 barley (14.22 and 13.15%) and wheat flour 9.52% Amaranth was rich in the essential amino acids lysine, leucine, and isoleucine. While, glutamic, aspartic, and glycine acids constituted the highest value of nonessential amino acids. Moreover, tyrosine plus phenylalanine amino acids were the first limiting amino acids. Biscuits was prepared from whole meal barley and wheat flour supplemented with amaranth and the product was subjected to senosry evaluation. The sensory evaluation showed that amaranth at levels of 20% and 30% added to barley and wheat flour respectively, gave the best color and at levels of 10,20% gave the best biscuits taste.

INTRODUCTION

Amaranth seeds are diminutive lenticular in shape, usually less than 1.6 mm in diameter, these grains are field crops similar to wheat, oats and barley (Lehmann, 1996).

Arellano, *et al.*, (1996) assessed the compoition of amaranthus standleyanus seeds as a potential food. Raw seed flour contained (g/kg): portein (NX5.85)142, crude fat 67, crude fiber 110, ash 59, and starch 475. Raw seed flour contained anti-nutritional factors including phytic acid, trypsin inhibitors and tannins, and had significant haemagglutination activity. The nutritional value was relatively low 44%, true digestibility 71% and bilogical value 62%. This may be due to high fiber content and significant haemagglutination activity.

Jamriska, (1996) found that the contents of total nitrogen substance in four varieties of two species of amaranths seeds were 176.7-213 g/kg.

Ravindran, *et al.* (1996) cited that amaranth grain contained (g/kg): crude portein 168, crude fat 58, crude fiber 60, ash 26; lysine 10 and methionine 3.5.

Dodok, *et al.*, determined the amino acid content in whole flour from amaranth. Compared to wheat flour, amaranth flour had a higher concentration of lysine (5.95 vs. 2.90 g/16 g N) and higher content of essential amino acids (27.1 vs 25.1 g/16g N). Results indicated that amaranth flour could be valuable in the enrichment of foods such as cereal products.

Bejosano and Corke (1998) reported that water soluble porteins of amaranth seeds amounted (48%) and was manily of low molecular weight albumins, while the insoluble fractions (52%) were mostly glutelins consisting of high and low molecular weight subunits.

Akingbala *et al.*, (1994) evaluated the suitability of amaranth grains for making ogi (a fermented food product). The yield of ogi produced from amaranth grain was lower than that from maize (70 and 80% respectively). Ogi produced from amaranth grain had a higher protein content (12.2%) than ogi produced from maize (6.7%). Their results suggested that amaranth grains would be suitable for ogi production.

Hozova *et al.*, (1997) examined the biscuits and crackers containing 20% amaranth whole grain flour for changes in microbiological quality, lysin content and sensory properties during 4 months of storage at 20 + 2oC. Results showed that from a microbiocial and nutritional perspective, crackers showed better storage properties than biscuits. Sensory properties were generally evaluated favorably. It was concluded that shelfstable amaranth products can be recommended for use in both normal and gluten-free diets.

Tosi, *et al.*, (1996) developed the biscuits formulations suitable for patients with celiac disease from a basic gluten free mix., using whole meal amaranthus flour. Proximate composition of the preferred biscuits was 5.8% moisture, 5.7% protein, 15.1% fat, 1.1% fiber and 1.2% ash. It was concluded that amaranthus flour could be used in the manufacturing of gluten free biscuits with a higher protein content than similar products for celiac patients.

The objective of this study is to produce biscuits from wheat and barley meal supplemented with amaranth whole meal to increase the protein content.

MATERIALS AND METHODS

Materials

Wheat variety Sakha 69 and barley (naked and Giza 123) cultivares were obtained from Filed Crop Institute, Agricultural Research Center, Giza - Egypt.

Amaranth seeds (Amaranthus vietmeyer) cultivar was obtained from International Center of Potatoes, Kafr El-Zayat - Gharbeia Governorate, A.R.E.

Methods

Wheat barley and amaranth seeds were milled in a Laboratory Quadramate Mill Junior (50 mesh).

Chemical analysis

Protein, oil, ash, fiber and total carbohydrate contents were determined in wheat flour (72% extraction), whole meal barley (naked and Giza 123), and raw meal amaranth by using the methods outlined in the AOAC (1990). Amino acids of amaranth whole meal were determind according to the procedure described by Olson *et al.*, (1978).

Addition of amaranth to wheat and barley:

Whole meal amaranth was added at different levels of 10, 20, 30 and 40%, to wheat flour (72% extraction), and whole meal of two barley varieties (naked and Giza 123). After addition of amaranth the chemical compostion was determind in all samples according to the AOAC (1990).

Preparation of biscuits

The ingredients used in biscuit formulas are given in Table 1 according to Waode (1988). The biscuits were baked at 150°C for 20 min in an electric oven and tested by ten panelists according to the AACC (1985). The results were statistically analyzed by using the method reported by Steel and Torri (1980). Chemical score of essential amino acids (EAA) was relatively determined according to FAO/WHO scoring pattern (1990). The lowest percentage was taken as the chemical score, and the corresponding amino acids were taken as the limiting amino acids.

RESULTS AND DISCUSSION

Chemical composition:

The chemical analysis of whole amaranth meal, two varieties of barley (naked and Giza 123), and wheat flour (72% extration) are presented in Table 2.

The results show that the whole amaranth meal was higher in protein, oil, ash, and fiber contents and their contents were 14.41, 5.25, 3.75 and 8.51% respectively. Protein content in the two varieties of whole barley meal (naked and Giza 123) were 14.22 and 13.15% respectively. Wheat flour showed the lowest protein content (9.52%) and the highest total carbohydrate content. Raw grain amaranth is good source of protein and fiber. These results are nearly in agreement with Arellano *et al.*, (1996) and Ravindran *et al.*, (1996).

Amino acids of amaranth protein are presented in Table 3. Results show that the glutamic and lysine amounted to (14.57 and 9.90% of the total amino acids respectively), while, cystine showed the lowest content 1.95%. Amaranth is considered a rich source for lysine and some other essential maino acids (44.82% of total amino acids) Dodok *et al.*, (1997). Tyrosine plus phenylalanine amino acids were found to be the first limiting ones Table 4. Amaranth protein has a high biological value (Arellano *et al.*, 1996), which means that the amino acids content are meeting the essential maino acids requirments of animals.

Addition of amaranth to barley and wheat

Addition of amaranth to two barley varieties and wheat flour was carried out at different levels of 10, 20, 30 and 40% respectively. The chemical composition of these mixtures are recorded in Table 5. The results show that the addition of amaranth increased the protein content. The protein content was increased by adding amaranth at the four used levels (10, 20, 30 and 40%) to wheat flour from 9.52% to a rising level that ranges from 10.11 to 11.31% respectively. The same trend occured when amaranth was added to naked and Giza 123 barley since prorain was increased to 15.01 and 14.15% respectively by adding 40%. These results are supported by the work of lee et al 1996. who identified amaranth as a very promising food crop.

Production of biscuits and sensory evaluation

Table 6 show the sensory evaluation of the biscuit varieties made up from wheat flour (72% extraction) or whole barley meal (naked and Giza 123). Biscuits made up

Table 1. The ingredients used in biscuits formula.

Ingredient	Weight / g
Flour	100
Sugar	20.8
Vegetable Oil	16.1
Skimmed milk powder	2.5
Salt	0.36
Sodium bicarbonate	0.54
Ammonium bicarbonate	0.54
Sodium meta bisulphite	0.022
Water	17.9

Table 2. The Chemical composition of amaranth, wheat and barley flour (g/100g dry basis).

Chemical composition	Amaranth raw grain	Weat flour 72% extraction	Barley whole meal	
			Gizal 123	Naked
Protein	14.41	9.52	13.15	14.22
Oil	5.25	1.02	2.72	2.13
Ash	3.75	0.71	2.48	2.25
Fiber	8.51	0.84	2.46	1.83
Total corbohydrate	60.08	87.91	79.19	79.57

from wheat had the highest scores for the sensory evaluation parameters (44.93), and also exhibited the highest acceptability compared to cookies made up from barley.

Sensory evaluation of biscuits made up of amaranth added to wheat and barley (naked and Giza 123) at different levels are shown in Table 7. The lower score of sensory evaluation were recorded upon adding 40% amaranth. While addition of amaranth at 20% and 30% levels to barley and wheat meal resulted in better seasory evaluation scores.

From the aforementioned results, it can be suggested that the addition of amaranth had significant improvement on biscuit characterstics when added at a level of 30% in case of wheat flour and 20% in the two varieties of barley whole meal.

Table 3. Amino acids content of amaranth seed (g/100g amino acids mixture).

NEAA *	Amaranth seed	EAA**	Amaranth seed	FAO/WHO professional pattern. (1990)
Aspartic	8.34	Lysine	9.90	5.50
Serine	5.00	Theronine	4.62	4.00
Glutamic	14.57	Cystine	1.95	Cystine +
Proline	3.06	Methionine	2.22	3.5 Methionine
Glycine	8.45	Valine	6.12	500
Alanine	4.45	Isoleucine	5.00	4.0
Histidine	2.50	Leucine	7.78	7.0
Arginine	6.67	Tyrosine	2.50	Tyrosine +
		Phenylalanine	4.73	7.0 Phenylalanine

NEAA *: Non essential amino acids
EAA**: Essential amino acids.

Table 4. Amino acids score of amaranth seed.

Amino acids	Amino acids score
Lycine	180
Cystine + Methionine	119.4
Theronine	115.5
Isoleucine	125.0
Leucine	111.14
Valine	122.4
Tyrosine + Phenylalanine	103.28

Chemical Score was calculated using the following equation:

$$\text{Chemical score \%} = \frac{\text{EAA in crude protein}}{\text{EAA of FAO/WHO}} \times 100$$

According to FAO/WHO scoring pattern (1990)

Table 5. Chemical composition of barley whole meal and wheat flour (12% extraction) with different added levels of amaranth.

Addition	Wheat flour (72% extraction)				Whole meal barley							
					Giza 123				Naked Barley			
Analysis	10	20	30	40	10	20	30	40	10	20	30	40
Protein	10.11	10.53	10.97	11.31	13.13	13.84	13.97	14.15	14.52	14.73	14.80	15.01
Oil	1.82	2.34	2.86	3.01	2.94	3.25	3.793.	3.95	2.54	2.92	3.13	3.47
Ash	1.12	1.45	1.73	1.98	2.27	2.95	36	3.59	2.41	2.63	3.15	3.35
Fiber	2.15	2.96	3.34	3.92	2.91	3.27	3.82	4.05	2.24	3.13	3.51	3.87
T.C.*	84.8	82.72	81.1	79.78	78.12	76.69	75.09	74.26	78.29	76.59	75.41	74.3

T.C.* : Total carbohydrate (by difference)

Table 6. Effect of making up biscuit from wheat flour and two barley varieties whole meal on their properties.

Flour	Appearance (10)	Color (10)	Texture (10)	Flavor (10)	Taste (10)	Total score (50)
Wheat	9.00	9.27	8.47	9.33	8.87	44.93
Giza 123 barley	7.80	7.00	6.80	7.13	7.40	36.13
Naked Barley	7.07	6.53	6.27	6.80	6.80	33.47
L.S.D at 5%	0.53	0.45	0.46	0.46	0.43	1.08

Table 7. Sensory evaluation of biscuits made up from wheat and barley supplemented with different rations of amaranth raw flour.

Cultivare	Amaranth (%)	Appearance (10)	Color (10)	Texture (10)	Flavor (10)	Taste (10)	Total score (50)
	Control	9.33	8.67	7.33	9.00	8.67	43.00
Wheat	10	9.67	9.33	8.33	9.67	9.33	46.33
flour	20	10.00	9.67	9.00	10.00	10.00	48.67
	30	8.67	10.00	9.67	9.67	8.67	46.67
	10	7.33	8.67	8.00	8.33	7.67	40.00
	Control	7.33	6.33	6.33	6.67	7.33	34.00
	10	8.33	7.00	6.67	7.67	8.33	38.00
Barley	20	9.00	7.67	7.67	7.67	7.67	39.67
Giza 123	30	7.67	7.33	7.00	7.33	7.33	36.67
	10	6.67	6.67	6.33	6.33	6.33	32.33
	Control	6.33	6.33	5.67	6.33	6.67	31.33
Barley	10	7.33	6.67	6.67	7.33	7.33	35.33
maked	20	8.33	7.33	6.33	7.33	7.67	37.67
	30	7.33	6.67	5.67	7.00	6.67	34.00
	10	6.00	5.67	0.87	6.00	5.367	29.00
	L.S.D.5%	0.92	0.85		0.88	0.80	2.41

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تصنيع بسكويت من دقيق القمح والشعير المدعم ببذور الامرانس

رأفت نجيب سندق ، آمال عبد الله الحوفي

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تم إضافة بذور الأمرانس الكاملة بنسب مختلفة ١٠ ، ٢٠ ، ٣٠ ، ٤٠٪ علي صنفين من الشعير الكامل الطحن (المعري وجيزة ١٢٣) ودقيق القمح استخلاص ٧٢٪. وتم تقدير التركيب الكيماوي لكل من الأمرانس والشعير والقمح وأيضا الخلطات وقد وجد أن محتوي الأمرانس الكامل الطحن مرتفع في نسبة البروتين ١٤,٤١٪ يليه الشعير المعري وجيزة ١٢٣ (١٤,٢٢ ٪ ، ١٣,١٥٪) أما دقيق القمح فكان ٩,٥٢٪. الأمرانس غني بالأحماض الأمينية الأساسية مثل الليسين والليوسين والايزوليوسين وأيضا مرتفع في الأحماض الأمينية الغير أساسية كالجلوتاميك والاسبارتيك والجليسين.

تم تصنيع البسكويت من الشعير الكامل الطحن ودقيق القمح بتدعيمهم بالامرانس والمنتج تم تقييمه حسيا وقد وجد أن إضافة الأمرانس بنسبة ٢٠٪ و ٣٠٪ علي ودقيق القمح أعطت بسكويت مفضل من حيث اللون وكذا إضافة ١٠٪ و ٢٠٪ أعطت البسكويت المفضل من حيث الطعم.