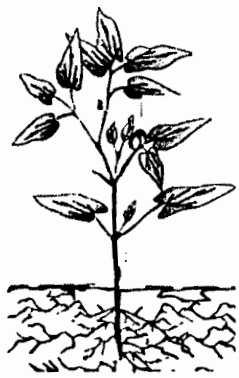

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NEW BARLEY - WHEAT FUNCTIONAL FOOD PRODUCTS: TECHNOLOGICAL, CHEMICAL AND SENSORY ASPECTS

[27]

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ABSTRACT

In this study whole meal of hull-less and hull were supplemented at levels 20%, 40 %, 60% and 80% with wheat flour (72% extraction) in order to produce flat bread and crackers. Then, chemical composition and sensory evaluation properties were studied. The stalling properties of flat bread during 8- 36 hours, were investigated Also, cooking quality for Ferik toduced from green barley was dove and compared it with the cooking quality of Ferik from green wheat. The results which has been obtained illustrated that the best cracker product was that supplemented st level of 60%, but was supplemented at level of 20% for flat bread The result showed that mineral contents in barley were more than in wheat. Also zinc, potassium and magnesium were higher in hull-less barley than that in hulled barley, The results declared that the sprouted process has no effect on mineral contents, but boiling process has decreasing effect on mineral contents. Thus, It can be noticed that the products made from hull-less barley were high in sensory evaluation than the products from hulled barley.

INTRODUCTION

Barley was added as an eligible source of beta glucan soluble fiber (**FDA, 2005**).

Sumner *et al* (1985) found that hull - less barley grain contained 10.5% protein, 3.0% ether extract, 2.7% ash, and 4.5% crude fiber. While **Osman *et al* (1998)** mentioned that total carbohydrates, crude protein, lipids, crude fiber and ash for barley grains ranged from (63.32 to 66.55%),(9.76 to 15.75%), (1.28 to 2.66%), (1.3 to 4.8 %) and (2.13 to 3.14%) respectively. **Kalra and Jood (2000)** mentioned that barley contained relatively high concentration of the mixed linkage (1-3), (1-4) β-D glucan with values 6.23% and 5.39 % for Dolma (hull-less) ; 4.60 and 2.06 for DL-88 (hull-less) and 2.18% and 1.08% for BH-33 (hull) for total β-glucan and soluble β-glucan contents, respectively. Total and soluble β-glucan content were also studied by **Lzydorczyk *et al* (2001)** for hull-less barley. On the other hand, **(El Shony *et al* 2003)** reported that the total β-glucan was 4.44 and 3.01 % for hull –less and hull barley, respectively. **Kalon *et al* (2001)** studied the effect of bran fiber and its particle size on gastrointestinal tract and they found that cecum length increased significantly due to feeding bran compared with cellulose containing diet. Similar trend was observed concerning stomach and colon. **Newman *et al* (1990)** used the Brabender viscoamylograph to measure the hot paste viscosity of

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hull, hull-less barley flour and wheat flour. They found that hull arley flour reached the peak viscosity at a lower temperature, where the values 1580, 700 and 610 B.U. for hull, hull - less barley flour and wheat flour respectively. **Mekhael (2004)** found that falling number value of barley flour was 341 sec. **Berglund *et al* (1992)** found that no significant differences were observed for flavor or overall acceptability when 25% and 35% barley flour were added to produce biscuits compared to a 100% wheat flour as control. **Mi- *and* Lee (1996)**. Studied the effect of replacement of 10, 20, or 30% wheat flour with barley flour during bread making on quality and dietary fiber content. They found that TDF (total dietary fiber) contents were 17.2 and 14.9 % in hull and hull- lass barley flour respectively and this flour increased water absorption and mixing time. **Newman *et al* (1998)** reported that no significant differences were observed when the hull-less barley flour was used in biscuit production. Moreover **Asna *et al* (1998)** studied the effect of incorporating whole barley flour at levels (5-25%) on the quality characteristic of bread including physical, rheological and sensory attribute. They found that bread containing 10% whole barley flour was acceptable.

The aim of this study was to determine the effect of sprouting and boiling hull and hull-less barley on their chemical and physical properties. The study evaluated the use of the flat bread and crackers made from wheat flour supplemented with different levels of the aforementioned barley flour. Also it determined the cooking quality of Ferik made from hull - less, hull barley and wheat to produce new functional barley food products.

MATERIALS AND METHODS

A: Materials

Hull barley kernels (Giza 123) and Hull – less barley kernels (Giza 131) were obtained from Barley Research Dept.; Crop Res., Institute, Agric., Res., Center, Giza, Egypt.

Wheat flour (72% extraction) was obtained from milling the wheat (Gemiza 7 variety) in Brabender mill model Quadrumate senior, Germany. Both type of barley kernels were milled in laboratory hummer mill model Ika, Germany, to produce whole meal flours.

Sprouting process was carried out by germinated barley kernels for 60 hr , Then dried at 60 ± 1.0°C for 6 hrs. in electrical air draft oven and milled to produce whole meal sprouted flours. Boiling process was conducted by boiling a part of both types of barley kernels using boiling water for about 60 min. at ratio of 4 liters water for one Kg. grains.

B: Methods

Physicochemical composition

Main chemical composition and falling number were determined according to the methods described in **A.A.C.C. (1995),** carbohydrates were calculated by difference. Color was determined using color grader apparatus. Minerals content were determined in Food Technology Research Institute, using Perkins Elmer (3300) atomic absorption spectrophotometer according to **AOAC (1995)** method .Alpha amylase activity of dough was measured using amyl graph apparatus, Brabender, Germany according to the methods described in **A.A.C.C. (1995).**

Preparation of flat bread

Mixture of both barley (hulled or hull - less, either sprouting or boiling) and wheat flour (72 % extraction), with ratios of 20, 40, 60 and 80% were used to produce flat bread.

Preparation of crackers

Mixture of both barley (hull or hull - less either sprouting or boiling) and wheat flour (72 % extraction), with ratios of 20, 40, 60 and 80% were used to produce crackers according to method of **Abd–EL Rahim *et al* (2003).**

Preparation of Ferik

Ferik was made using village traditional technique as follows:

The green spikes of barley were roasted at 280°C for 3-4 minutes with continuous stirring, than dried at room temperature for about 2-3 days. The roasted spikes were pressed by hands to obtain the Ferik. Cooking quality percent of increase in volume, percent of increase in weight and percent of cooking loss were carried out according to **Walsh and Giles (1971).**

Determination of flat bread freshness (staling)

Freshness of flat bread stored at room temperature in polyethylene bags was measured by the determination of alkaline water retention capacity (AWRC) according to **Kitterman and Rubenthaler 1971).**

Sensory evaluation

Sensory evaluation of roll ability, taste, odor, color and layer separation for flat bread by 7 panelists in (food technology research institute) was carried out according to the method described by **Salem-Eman *et al* (2004)** and for crackers according to **Abd-EL Rahim (2005).**

RESULTS AND DISCUSSION

Data illustrated in **Table (1)** showed that, falling number in both hull – less and hull barley flour were higher than that in wheat flour. This finding may be due to the high content of alpha amylase in barley than wheat flour. The whole meal flour had higher content alpha amylase than it's extraction

Concerning the color, the hull barley flour was higher score than hull - les, values ranged between 12 to 15 for hull barley flour and between 5.5 to 8 for hull –les barley flour compared to 1.5 for control (wheat flour). These may be due to the high fiber content in hull barley flour than hull less barley flour.

Table 1. Physical properties of flours produced from wheat flour (72% extraction) and whole meal, sprouted and boiled hull less and hull barley

	Hull – Less Barley			Hulled Barley			Wheat flour
	Whole meal	Sprouted	Boiled	Whole meal	Sprouted	Boiled	
Falling Number (sec.)	210	110	275	260	130	290	320
Color Grade (Absolute units)	7	8	5.5	14	15	12	1.5

Table (2) showed the chemical composition for wheat flour, whole meal, sprouted and boiled barley flour for both hull - less and hull barley. It can be noticed that protein content was affected by the boiling process but sprouting process did not effect the protein content in both hull- less and hull barley. Ash content was not affected significantly by sprouting process but was affected by boiling process compared to whole meal flour.

The same trend was observed in the fiber and fat contents. The β- glucan in hull - less barley was higher than that in hull barley. The boiling process decreased β - glucan content more than sprouting process in both hull -less and hull barley flour. These finding may be due to the effect of boiling process on the soluble fraction of protein, minerals, fiber and β– glucan. These results were in agreement with **Osman *et al* (1998); Kalra and Jood (2000)** and **Lzydorczyk *et al* (2001).**

Data in **Table (3)** illustrated the minerals in hull – less, hull barley and wheat flour. It can be observed that all barley flour were higher in minerals concentrations than wheat flour, because the minerals concentrated in outer layer of kernels. Data also declared that, hull – less barley was higher in Zn, K and Mg than in hull barley. Sprouting process decreased slightly the mineral contents. On the other hand, boiling process decreased significantly the mineral contents, due to the great loss of minerals in water.

Table (4) showed the total scores of flat bread made from supplementation of 72%. Extraction rate wheat flour with hull-less and hull barley flour at levels of 20%, 40%, 60% and 80% of whole meal, sprouted and boiled barely flours. The results indicated that the best sensory evaluated flat bread was the bread made from whole meal, sprouted and boiled barley at 20% supplementation. Total score gradually decreased when the barley flour levels was increased. This result was in agreement with **Mi and Lee (1996)** and **Asna *et al* (1998).**

Table 2. Chemical composition of whole meal flours produced from wheat and kernel, sprouted and boiled from hull –less and hulled barley

Component (%)	Hull – Less Barley			Hulled Barley			Wheat flour
	Whole meal	Sprouted	Boiled	Whole meal	Sprouted	Boiled	
Moisture	10.6	11.1	11.4	12.2	11.2	13.8	13.2
Ash content	1.9	1.83	1.44	2.16	2.01	1.81	0.54
Protein	11.82	11.12	9.92	12.22	11.74	11.82	10.8
Fat	1.82	1.54	1.06	2.32	1.92	1.82	0.88
Fiber	7.2	5.5	6.1	11.37	9.3	10.21	0.72
Total Carbohydrates	66.66	69.31	70.08	59.73	63.83	60.54	73.86
Total β - Glucan	6.11	5.77	3.27	2.28	1.85	1.01	--

Table 3. Minerals content (mg/100g.) of whole meal hull – less, hull barley flour and wheat flour (72% extraction)

Element	Hull – Less Barley			Hulled Barley			Wheat flour
	Whole meal	Sprouted	Boiled	Whole meal	Sprouted	Boiled	
Zn	4.21	4.11	3.15	2.64	2.62	1.87	0.56
Mn	1.22	1.12	0.88	1.82	1.80	1.11	0.61
Fe	2.94	2.82	2.01	3.78	3.72	3.21	1.1
Ca	34	33.4	24	37	36.6	28	14
K	620	614	480	480	4.71	364	122
Se (mcg)	34	33.6	21	37.1	36.4	23	26.8
Mg	137	136	106	126	122	98	22

Table 4. Total scores of sensory evaluation for flat bread prepared from different levels of hull - less and hull barley flour mixture with wheat flour (72 % extraction) rate

Flour mixture %	Hull – Less Barley			Hulled Barley		
	Whole meal	Sprouted	Boiled	Whole meal	Sprouted	Boiled
W – 100	97	97	97	97	97	97
B 20 + W 80	92.5	93	92	89	89.5	90
B 40 + W 60	87	90	90.5	84.5	86.5	85.5
B 60 + W 40	81	83.5	86	76.5	82.5	81.5
B 80 + W 20	73	70.5	81.5	70.5	75	77.5
B – 100	68	69	77	64	66.5	73.5

B = barley flour. W = wheat flour.

Table (5) showed the total score of the sensory evaluation of crackers prepared from supplementation of 72% Extraction rate wheat flour with hull-less and hull barley flour at levels of 20%, 40%, 60% and 80% of whole meal, sprouted and boiled barely flours It can be noticed that total score for crackers made from 60 % whole meal, sprouted and boiled was higher than all another ratios followed by 40 % 20% and finally 80 %. The same table also illustrated that crackers made from hull – less barley flour had higher total score than that made from hull barley flour. This may be due to the high fiber and protein contents in hull barley flour which have adverse effect on the crackers technology compared with hull – less barley flour. These results were in agreement with **Berglund *et al* (1992) and Newman *et al* (1998).**

Table (6) showed the amylograph parameters for dough prepared from 60 % supplemented of whole meal with sprouted and boiled hull - less and hull barley flour. It can be noticed that sprouting process decreased significantly the viscosity. This can be due to the high enzymatic activity specially alpha amylase during the sprouting process which had adverse effect on viscosity. On the other hand, boiling process had slightly effect on viscosity, due to the partial increasing in enzymatic activity during the first stage of boiling up to 50°C. Maximum viscosity values were 630, zero and 375 B.U. for whole meal, sprouted and boiled hull - less barley flour, respectively. While, they were 420, zero and 250 B.U. for the same flours of hull barley respectively compared with 685 B.U. for wheat flour. The same trend was observed with falling number values. These results were in agreement with **Kim and D'Appolonia (1977).**

Data in **Table (7)** showed that the AWRC (alkaline water retention capacity) of fresh flat bread at zero time did not show significant differences between both hull - less or hull barley. Data also pointed out that there are negative relationships between the increase in storage time and freshness of flat bread. Flat bread prepared from boiled barley was fresher than bread prepared from sprouted barley then finally that prepared from whole meal barley. AWRC values were 283, 271 and 254 after 36 hours of storage for boiled, sprouted and whole meal,hull - less barley respectively, compared with 348, 345 and 340 for the same above mentioned barley at zero time. The same trend was observed with hull barley but with more freshness than hull - less, this finding may be due to high fiber content in hull than hull - less barley. These results were in agreement with **EL-Tawil (1998) and Abd-EL Rahim (2005).**

Table 5. Total scores of sensory evaluation for crackers prepared from different levels of hull - less and hull barley flour mixed with wheat flour (72 % extraction) rate .

Flour mixture%	Hull – Less Barley			Hulled Barley		
	Whole meal	Sprouted	Boiled	Whole meal	Sprouted	Boiled
W 100	88	88	88	88	88	88
B 20 + W 80	90	91	89.5	88	89.5	86.5
B 40 + W 60	91.5	93	91	89	91	88
B 60 + W 40	92.5	95	91.5	90	92.5	89
B 80 + W 20	88	90.5	86.5	84.5	89	83
B 100	80	86	84.5	77	84	75.5

B barley flour. W wheat flour

Table 8. Cooking quality of Ferik made from hull – less. hull barley and wheat

Cooking time (min.)	Hull – less barley			Hulled barley			Wheat		
	Weight increase %	Volume increase %	Cooking loss %	Weight increase %	Volume increase %	Cooking loss %	Weight increase %	Volume increase %	Cooking loss %
4	27	35	0.1	22	24	0.7	11	14	1.7
8	65	88	0.8	68	81	1.4	41	54	2.1
12	85	132	1.4	82	106	2.7	64	94	4.6
16	104	150	2	100	123	3.5	84	107	5.7
20	162	222	6	155	196	9	128	176	12

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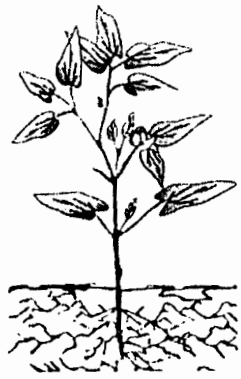

منتجات غذائية وظيفية جديدة من الشعير والقمح والخصائص التكنولوجية والكيميائية والحسية

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تم اجراء تحليل كيميائى شامل لكل نوع من انواع طحين الشعيربنوعيه (العارى والمغطى) وكذلك دقيق القمح استخلاص ٧٢% .

تم اضافة كل من مطحون الحبة الكاملة والحبة المنبتة و الحبة المسلوقة من صنفى الشعير العارى والشعير المغطى بنسب ٢٠ و٤٠ و٦٠ و٨٠% الى دقيق القمح ٧٢% ثم استخدمنا الخلطات السابقة فى تصنيع الخبز المسطح و المقرمشات ، بعد ذلك درسنا تأثير نسب الاحلال المختلفة فى الخلطات المستخدمة (فى صناعة الخبز المسطح و المقرمشات) من كل من مطحون حبوب الشعير العارى والمغطى ودقيق القمح ٧٢% على الخـواص التكنولجية والحسية للمنتجات المخبوزة (الخبز المسطح والمقرمشات).

ايضا تم دراسة خاصية الطزاجة للخبز المسطح لزمن ٨-٣٦ ساعة واخيرا تم دراسة خصائص جودة الطبخ للفريك المصنوع من حبة الشعير الخضراء (لكل من صنفى الشعير العارى والمغطى) وقارناها بجودة الفريك المطبوخ المصنع من القمح الاخضر، وكانت صفات الطبخ متمثلة فى (الزيادة فى الوزن والزيادة فى الحجم والنسبة المئوية للفقد) .

وقـد أوضحت النتائج المتحصل عليها أن أفضل نسب احلال عند صناعة المقرمشات هى ٦٠%، كما أن أفضل نسبة فى اعداد الخبز هى ٢٠%. كما أوضحت أن نسبـة المعادن أعلى فى كلا من صنفين الشعير عنه فى القمح ، وأن الشعير العارى أعلى فى نسبة الزنك والبوتاسيوم والماغنسيوم عنه فى الشعير المغطى. كذلك لم تتأثـر نسبـة المعادن فى صنفين الشعير عند اجـراء عملية الانبات و على العكس من ذلك فـى حالـة اجـراء عملية السلق التى أدت الى تناقص ملحوظ فى نسبة المعادن بهما.

لذلك يمكن الاستفادة بتدعيم القمح بالشعير لانتاج منتجات مرتفعة فى الالياف الذائبة والمعادن .

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