CHEMICAL EVALUATION OF SEVEN BARLEY VARIETIES

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Abstract

Seven varieties of Barley (Hordeum vulgare L) Giza 123, 125, 126 as six rowed barley, Giza 127 and 128 as two rowed barley and naked barley were evaluated for their chemical composition, content of β-glucan fraction, and fatty acids of barley oil.

Unsaponifiable matter and Tocopherals were also determined. The data revealed that the total hydrolizable carbohydrates, crude protein, lipids, crude fiber and ash ranged between (63.32-66.55, 9.76-15.75, 1.28-2.66, 1.3-4.8, 2.13-3.14)% respectively. The β-glucan content ranged from 3.33 to 4.56. The most predominant fatty acids of Barley oil were palmitic C16: 0. (21.17%) stearic C18: 0 (12.12%) oleic C18:1 (20.64%) Linoleic C18: 2 (48.38%) and Linolenic C18:3 (6.22%). The major hydrocarbons of unsaponifiable matter were C24 (21.08%) and C32 (10.72%) where as the major sterols were campsterol (9.04%) and cholestrol (4.73%).

INTRODUCTION

Barley (Hordeum Vulgare L.) the fourth largest cereal crop in the world, is a cereal of world wide distribution constitute of about 12% of the world's total cereal production. It is tolerant to wide and diferent climatic conditions (DeCerck 1957) (Newman adn McGurie, 1985) reported that Barley is Suitable for use in many food products, including leavened baked foods, pasta, rice alternatives and breakfast cereals. Starch is the major component of barley and comprises about 55-65% of the grain dry weight. Merritt, (1967) found that some Barley varieties had higher amylose than normal quantities. Newman et al., (1978), found that high amylose barley had higher biological value but lower true protein digestability. Morrison (1987) reported that there are waxy mutants with over 40% amylose and elevated levels of lipids, of lysophospholipids. Matz (1991) found that the main polysaccharides, besides starch are β-D-glucan, pentosans and cellulose. Some of the β-D-glucan of very

high molecular weight are not water extractable. Ingledew *et al.*, (1995) studed the hull-less barley varieties which had high digestible energy due to thir elevated starch and reduced fiber contents. Welch (1978) found that protein content was higher in naked barlay types than in husked types but there was no significant difference between the protein content of two and six rowed types. Price (1980), believed that producers shouldn't introduce cultural practices to increase the protein percentage above 15.5%, because additional protein predominantly consisted of prolamines, and livestock do not digest nor assimilated prolamines. Victor *et al.*, (1994) stated that grinding and air classification of barley flour can result in fractions with enriched β-glucan and protein content in good yields. the combined high β-glucan air-classified fractions had a yield of the defatted flour and a β-glucan content of 31%. The combined high protein air classified fraction had a yield of 28% of the defatted flour and a protein content of 31%. Price and Parsons (1975) mentioned that the neutral lipids are the major lipid class in barley and other cereal grains, their representation ranges from about 60-90% of the total lipids content. The neutral lipid class is a complex group of compounds containing free fatty acids, glycerides, free sterols and sterol esters. William and Morrison (1988) found that there was very little lipids in the low-amylose waxy starches, while the highamylose starches contained more lipids and they added that cereal starches can be a useful dietary sources of essential fatty acid C18:2 that is commonly looked over by nutritionists.

Oscarsson *et al.*, (1966) found that Covered and naked barley genotypes differed in their contents of non-starch polysaccharides, lignin and ash. High amylose types had lower total β-glucan than waxy types. The aim of the present study is to evaluate Egyptian Barely varieties for their nutritional constituent and the variability among barley cultivars in their content of β-glucan, fatty acids, and unsaponifiable matter.

MATERIALS AND METHODS

Source of barley samples :

Seven barley cultivars obtained from Barley Research Department, Agiculture Research Center, Giza, Egypt. The seven used cultivars were Giza 123, 124, 125, 126, (six - rowed cultivars), Giza 127, 128 (twio-rowed cultivars) and naked barley.

Chemical methods of analysis

Total hydrolizable carbohydrates were determined as glucose according the Phenol - sulphuric acid method described by Dbois *et al.*, (1956). Crude protein, oil, crude fiber ash were determined according to the A.O.A.C., method (1990).

Determination of β-glucan

β-glucan was determined according to the method described by Carr *et al.*, (1990). Liberated glucose determined by the glucose oxidase peroxides procedure kits (Trinder, 1969).

Identification of fatty acids and unsaponifiable matter

Fatty acids and unsaponifiable matter of barley grain oil were separated according to Farag *et al.*, (1990) and identified by GC apparatus sigma 3b gas chromatograph with dual flame ionization detector.

The degree of unsaturation (DU) was calculated using the following formula Anjum and Ali (1991).

$$Du = (\%\ oleic) + (\%\ lenoleic) + 3\ (\%\ lenolenic) / 100$$

RESULTS AND DISCUSSION

Data in table 1 shows the chemical composition of seven barley varieties grown in Egypt. The naked barley contained the highest protein content. (Declerck 1957) reported that the protein of normal malting barley ranged from 9 to 11%. Price (1980) found that the best protein percentage for good livestock nutrition ranged from 14 to 15.5%. Welch (1978) found that the oil content ranged from 1.9 - 4.1% which had positive correlation with protein and no significant correlation between oil content and malting grade. Macleod (1960) reported negative relationship between carbohydrate and protein in barley grain.

Crude fiber content ranged between 1.3 and 4.81%, these results are in agreement with Vose and Youngs (1978) who found the crude fiber content was higher in the hulled barley (3.7%) than the dehulled one (1.9%). The total β-glucan of barley varieties was determined enzymaticaly and the results are shown in table 2. The β-glucan content in different barley varieties ranged from 3.33 to 4.56% Giza 123 and Giza 124 cultivars contained 4.18 and 4.56% respectively which were

Table 1. Weight of 1000 grains and chemical composition of seven barley varieties grown in Egypt.

Varieties 0	1000 grains g	Chemical Composition (%)				
		Protein	Lipid	Carbohydrate	Ash	Fiber
Giza 123	45.71	12.89	2.46	65.91	2.58	3.52
Giza 124	36.06	13.51	2.38	64.8	3.14	3.12
Giza 125	37.42	10.65	2.33	65.97	2.68	4.05
Giza 126	39.09	12.99	2.66	63.32	2.98	3.99
Giza 127	42.51	9.67	2.30	66.23	2.71	4.35
Giza 128	39.71	13.32	2.34	66.27	3.13	4.81
Naked barley	26.45	15.75	1.28	66.55	2.33	1.30
LSD (0.01)	2.44	0.27	0.22	--	0.15	0.44
LSD (0.05)	1.65	0.18	0.15	--	0.10	0.30

higher than the other studied varieties - Bhatty and Macgrgor (1988), and Bhatty *et al.*, (1991) stated that hulled barley may typically contain 2-10% by weight nonstarchy polysaccharides, distributed largely in the endosperm cell walls.

Table 2. β-glucan content of barley varieties grown in Egypt.

Varieties	β-glucan %
Giza 123	4.18
Giza 124	4.56
Giza 125	3.93
Giza 126	3.55
Giza 127	3.65
Giza 128	3.33
Naked barley	3.42

LSD (0.01) = 0.45
(0.05) = 0.30

β-glucan enriched fraction was obtained by dry milling and sieving of dehulled barley as stated by Knuckles *et al.*, (1992). The data in table 3 show that the dehulling of barley increased the β-glucan content from 4.18 in the hulled barley. (Giza 123) to 5.58%. After milling and sieving the dehulled barley was penetrated through 335 mesh screen, to give a fraction equivalent to 16.5 of the grain weight in which the β-glucan increased to 9.6%. Knuckles *et al.*, (1992). Showed that dry milling and sieving techniques can be used to prepare barley fraction with β-glucan concentration 2.4 - 4.9 times higher than those of original grain.

Table 3. Chemical composition of hulled, dehulled barley and β-glucan enriched fraction .

Component %	Hulled barley	Dehulled barley	β-glucan %
Carbohydrate	65.91	71.58	73.81
Protein	12.89	11.30	10.15
Lipid	2.46	2.75	0.58
Fiber	3.52	1.13	3.03
Ash	2.58	1.74	2.44
β-glucan	4.18	5.58	9.69

Table 4 and fig. 1 show that fatty acids of barley grain oil in decreasing order were : Lenoleic (46.39)%, Palmatic (21.17)%, Oleic (20.64)%, Lenolenic (6.42), Stearic (2.12), Myristic (0.39)%, Caprylic (0.119)% and lauric acids (0.031)%. The saturated / unsaturated ratio was 0.317 and the degree of unsaturation (DU) was 1.33, these findings were in agreement with those of Anjum and Ali (1991).

Table 4. The relative percentage of fatty acids in barley as analyzed by GC .

Peak No.	Fatty acid	Relative (%)
1	Caprylic acid (10:0)	0.119
2	Unknown	0.056
3	Lauric acid (12:0)	0.031
4	Unknown	0.047
5	Unknown	0.462
6	Myristic acid (14:0)	0.393
7	Unknown	0.289
8	Unknown	0.224
9	Palmitic acid (16:0)	21.17
10	Unknown	0.087
11	Stearic acid (18:0)	2.12
12	Oleic acid (18:2)	20.64
13	Linolenic acid (18:3)	46.39
14	Linolenic acid (18:3)	6.42
15	Unknown	1.539

Degree of unsaturation (DU) = 1.33
Sat / Unsat = 0.317

Data in table 5 and fig. 5 show that unsaponifiable matter fractions of the GC were : Squalene and various of saturated hydrocarbons n-Octadecane (C18), n-Nonadecane (C19), n-Eicosane (C20), n-Docosane (C22) n-Tricosane (C23), n-Tetracosane (C24), n-Hexacosane (C26), n-Octacosane (C28), n-Triacontane (C30), n-Dotriacontane (C32). While the sterols were : Cholesterol, Stigmasterol and B.Sitosterol.

Table 5. The relative percentage of unsaponifiable components of barley as analyzed by GC .

Peak No.	Fatty acid	Relative (%)
1	Unknown	0.84
2	Octadecan	2.19
3	Nonadecan	2.21
4	Etcosadecan	0.80
5	Unknown	3.07
6	Unknown	1.89
7	Docosan	1.74
8	Tricosan	7.66
9	Tetracosan	21.08
10	Unknown	3.77
11	Hexacosan	1.89
12	Unknown	1.96
13	Octacosan	7.21
14	Squalene	2.47
15	Tracontane	8.41
16	Unknown	5.64
17	Dotriacontane	10.72
18	Cholesterol	4.73
19	Campsterol	9.04
20	Stignasterol	0.68
21	B-Sitosterol	2.05

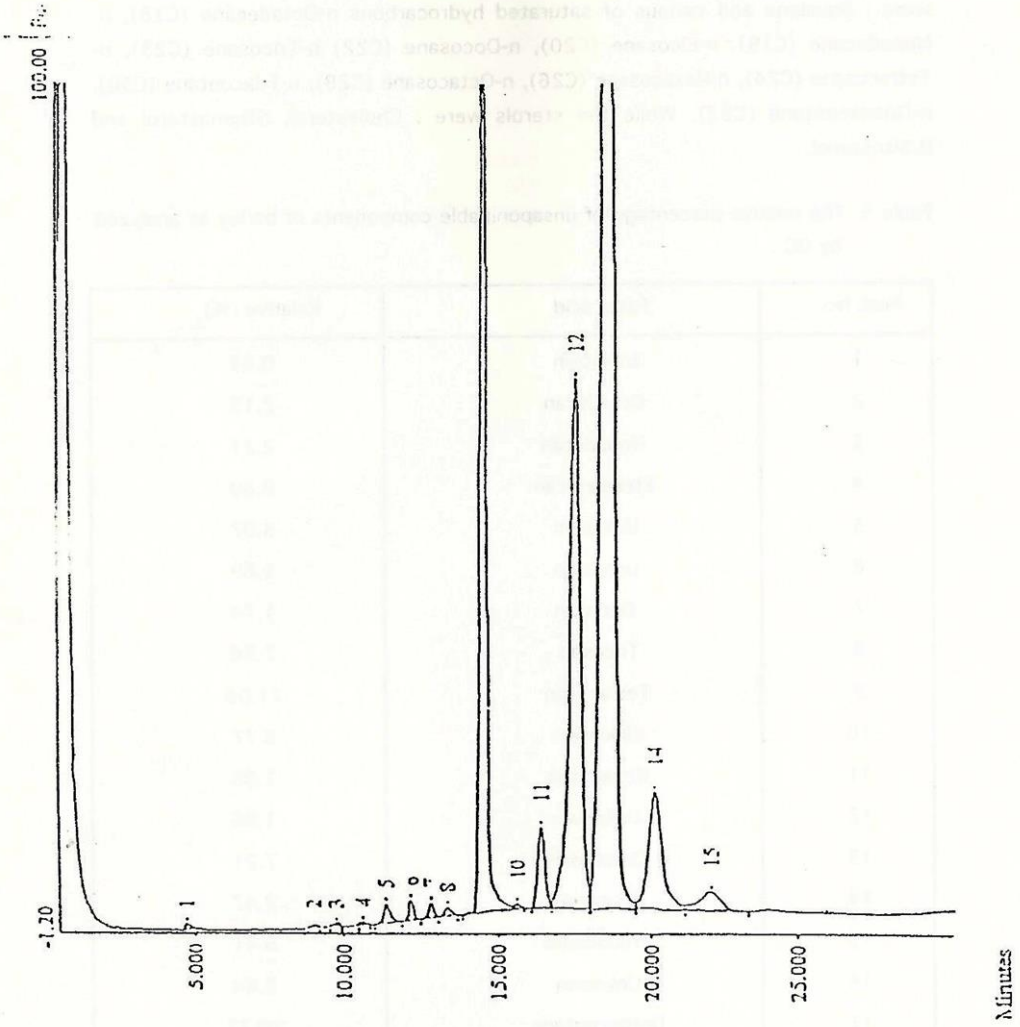

Fig. 1. GC of fatty acid methyl esters of barley oil.

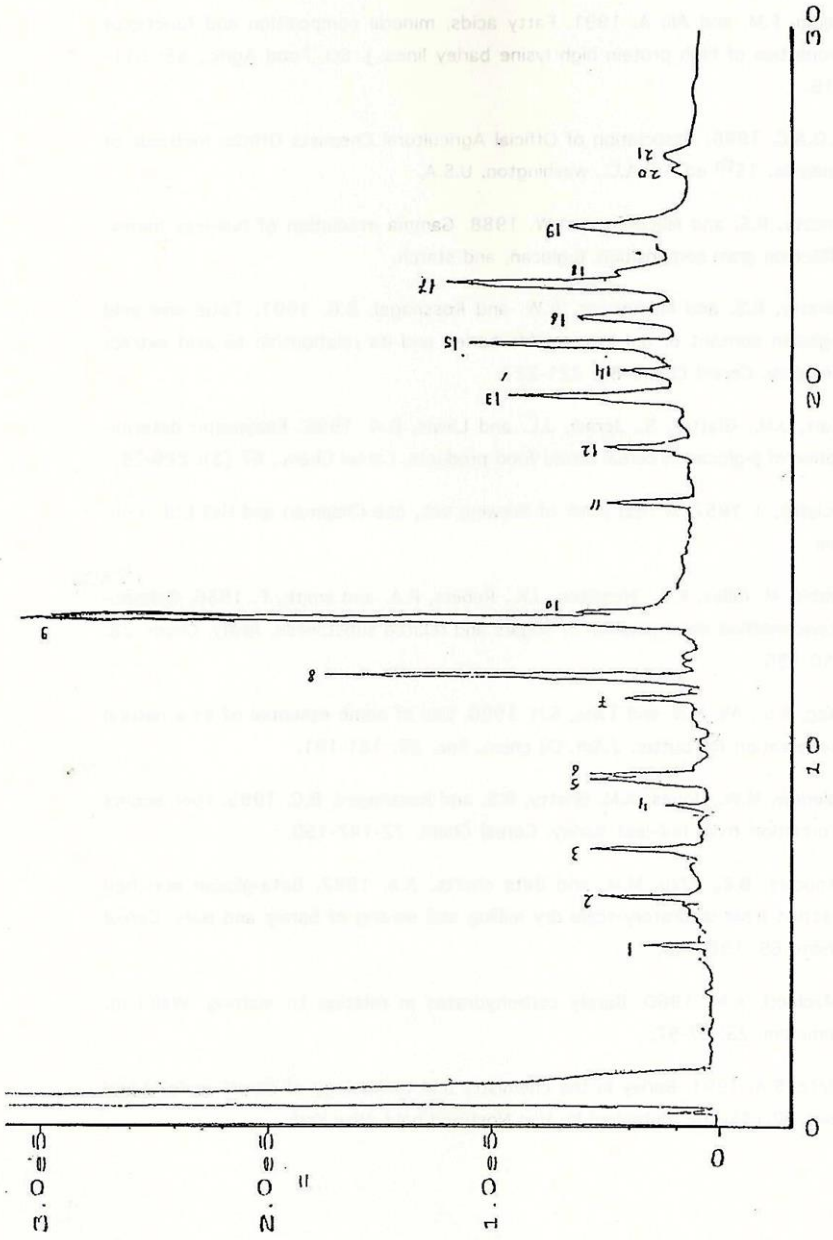

Fig. 2. GC of unsaponifiable components of barley oil.

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التقييم الكيماوى لبعض اصناف الشعير المنزرعة فى مصر

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أجريت هذه الدراسة لتقييم ٧ اصناف من الشعير المصرى والتى تشمل اصناف ذات ست صفوف وهى جيزة ١٢٣ ، ١٢٤ ، ١٢٥ ، ١٢٦ واصناف ذات صفين ١٢٧ ، ١٢٨ كذلك تم تقييم صنفين من الشعير العارى وكان تقييم هذه الاصناف من ناحية التركيب الكيماوى وكذلك محتواه من البيتا جلوكان. وقد وجد ان نسبة الكربوهيدرات فى اصناف الشعير المختلفة تتراوح من ٦٣,٣٢ الى ٦٦,٥٥٪والبروتين من ٩,٧٦ الى ١٥,٧٥ ٪ والدهون من ١,٢٨ – ٢,٦٦٪ والالياف من ١,٣ – ٤,١٨ ٪ والرماد من ٢,١٣ – ٣,١٤٪ كذلك وجد ان نسبة البيتاجلو كان تراوحت بين ٣,٣٣ الى ٤,٥٦٪ ووزن الالف حبة من ٢٦,٤٥ – ٤٥,٧١ جم كما وجد أن نسبه البيتاجلوكان تراوحت بين ٢,٢٣ – ٤,٥٪ محتوى البيتاجلوكان فى الشعير المقشور قد زاد من ٤,١٨ ٪ الى ٥,٥٨٪ نتيجة عملية التقشير بينما ارتفع الى ٩,٦٩٪ نتيجة عملية الطحن والنخل.

وقد تم التعرف على الاحماض الدهنية وكذلك المواد الغير متصبنة فى زيت حبة الشعير صنف جيزة ١٢٣ بواسطة جهاز التحليل الكروماتوجرافى ووجد انها تحتوى على الاحماض الدهنية بالمتيك (٢١,٧١ ٪)، استياريك (٢,١٢٪) ، اوليك (٢٠,٦٤٪)، اللينوليك (٤٦,٣٩٪) وحمض اللينولينك (٦,٢٢٪) كما انها كانت تشتمل ايضاً على الموارد الغير متصبنة مثل الكولستيرول، الكابيسترول ، وسيجاسيترول والبيتاسيتوسيترول.