TECHNOLOGICAL EVALUATION OF THREE NEWLY RELEASED HULL-LESS BARLEY CULTIVARS IN EGYPT

SANDAK, R. N.[1], A. A. EL-SAYED[2] AND A. S. I. EL-SHAZELY[1]

1. *Food Techno. Res. Inst., Agric. Res. Center, Giza, Egypt*
2. *The Egyptian/French Hull-less Barley Project, Field Crops Res. Inst., Agric. Res. Center, Giza, Egypt*

(Manuscript received 8 February 2005)

Abstract

Three newly released hull-less barley cultivars (Giza 129, Giza 130 and Giza 131) were subjected to technology evaluation during 2004 in Food Technology Research Institute, Agricultural Research center. Chemical composition of whole meal barley was achieved. Results of this study revealed that total protein content ranged between 14.88 to 15.9%. Giza 131 cultivars recorded the highest percentage of total dietary fibers (15.3%) compared to Giza 130 (14.6%) and Giza 129 (12.9%).

Concerning the amino acids fractions, glutamic acid was the highest (20.2 g/100g protein). Meanwhile, amino acid valine recorded the lowest chemical score.

The sensory evaluation of crackers and cookies showed that using 20% wheat flour (72% extraction) plus 80% whole meal hull-less barley gave the highest total score (out of 50) for crackers (40.72) and (40.95) for cookies.

The study concluded a recommendation to use hull-less barley as healthy food in bakery products as crackers and cookies.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is the main cereal crop grown in the rainfed areas of Egypt. It occupies about 300,000 feddans (c. 126 000 ha) in the Northwest Coast (NWC) and about 50,000 (c. 21 000 ha) feddans in North Sinai (NS). The long term average annual rainfall is about 133 mm in NWC (Ferere and Popove 1984) and slightly higher in NS. This figure is below the lowest limit of semi arid areas (160 mm). In Egypt, the national production of cereals is lower than the national consumption, therefore it has been suggested to use hull-less barley as a complementary cereal crop to minimize this gap. This is based on the ability of barley to grow better than other cereals under drought conditions.

Recently, barley has been gaining a renewed interest as food component because its higher content of soluble dietary fibers and β-glucan compared to other cereals (El-Sayed, 2002). With this respect, El-Sayed *et al.,* 2003 a and b developed three hull-less barley cultivars to be grown under rainfed conditions and water shortage in the new reclaimed lands in Egypt. Hull-less barley exceeded either covered barley or wheat in protein and β-glucan contents (El-Sayed *et al.,* 2004). Protein and β-glucan contents of Giza 130 and Giza 131 (hull-less barley) as compared with Giza 123 and Giza 126 (hulled barley) and Sakha 69 (wheat cultivar) were determined. Protein contents were 13.52 and 13.13% for Giza 131 and Giza 130 compared to 12.33, 12.26 and 12.51% for Giza 123, Giza 126 and Sakha 69. Total β-glucan were 4.60 and 4.44% for Giza 130 and Giza 131, whereas, it was 3.01 and 1.80 % for Giza 123 and Sakha 69. These results show that the high protein and β-glucan contents of the two new hull-less barley varieties (Giza 130 and Giza 131) make them suitable for use in bread making and other nutritional purposes.

Hull-less barley contained more protein and starch, as two major components and total and soluble β-glucan. This was due to removal of fibers hull which has a dilution effect on these components. Also, hull-less barley contained more total dietary fiber (TDF) and pentosans which largely found in the hull (Bhatty, 1999). In one study (Edney *et al.,* 1992), grain protein varied from 13 to 17% in Condor hull-less barley variety (free of adhering hulls) grown at 2 locations in central Alberta. Hull-less barley (HB) had higher concentrations of limiting amino acids, lysine and theronine than wheat or hulled barley (Boros *et al.,* 1996). Components of HB carbohydrates include starch, cell-wall polysaccharides, β-D-glucans, (1-3) β-glucan and arabinoxylans (pentosans), cellulose and a number of simple sugars and aligosaccharides (Be Miller, 1997). Moreover, starch is the most abundant single component of HB, accounting for 60-75% of grain on a dry weight basis (Bhatty and Rossnagel, 1998).

Barley contains tocotrienols and tocopherol, which are ubiquitous, naturally occurring antioxidants. The essential difference between tocotrienols and tocopherols is the presence of double bonds at carbons 3, 7 and 11 in the isoprene chain of tocotrienols. Their role as inhibitors of cholesterogenesis (Qureshi *et al.,* 1986 and 1991), decreased total cholesterol and low density lipoprotein (LDL) cholesterol. These effects were also observed in human fed ingredients made from barley grain that were enriched in tocols (Weber *et al.,* 1991). Also, (Ranhotra *et al.,* 1998), reported significantly lower serum and liver cholesterol in rats fed diets containing bran or flour from hull-less barley. The reductions were related to the ratio of soluble fiber and total dietary fiber in each fraction, the greater reductions occurring with a higher percentage of soluble fiber.

The aim of this study is to produce some bakery products from hull-less barley supplemented with (5, 10, 15 and 20%) wheat flour (extraction 72%). The sensory evaluation to the products from hull-less barley were also considered.

MATERIALS AND METHODS

Materials seeds of hull-less barley varieties: Giza-129, Giza 130 and Giza 131 were obtained from the Egyptian/French Hull-Less Barley Project, Field Crops Research Institute, Agric. Res. Center, Giza, Egypt. The three cultivars were developed recently for human consumption in Egypt (El-Sayed *et al.,* 2003 a and b). Wheat flour (extraction 72%) was obtained from South Cairo Mills Company, Ministry of Supply and Trade, Egypt.

Methods hull-less barley seeds were milled in a Laboratory Mill Junior to a fine powder.

Chemical analysis protein, oil and ash contents were determined in hull-less barley whole meal using the methods outlined in the (A.O.A.C. 1990). Also, total dietary and soluble fibers were determined according to the methods described by (Prosky *et al.,* 1988) whereas, insoluble dietary fibers were given by difference. Moreover, amino acids of whole meal hull-less barley were determined according to the procedure described by (Olison *et al.,* 1978). Chemical score of essential amino acids (EAA) was relatively determined according to FAO/WHO (1990) Scoring Pattern. The lowest percentage was taken as the chemical score and the corresponding amino acids were taken as the limiting amino acids.

Addition and preparation of crackers (paton-saleh) and cookies, (menin) were made from whole meal hull-less barley which supplemented at levels: 5, 10, 15 and 20% wheat flour (72% extraction), respectively. Control crackers (paton-saleh) and cookies (menin) were made from whole meal hull-less barley.

The ingredients used crackers and cookies formulas are given in (Table 1) according to (Waode, 1988). The formulas were baked at 170-180 ^{0}C for 30-40 min. in an electric oven. The organoleptic properties of formulas were measured by a personal of ten trained judges according to A. A. C. C. (1985).

Table 1. The ingredients used in crackers (paton-saleh) and cookies (menin) formula (g/100g).

Ingredients	Crackers	Cookies
Flour	100	100
Butter	30	30
Sugar	--	7
Salt	2	0.5
Yeast	1.5	1.5

Statistical analysis:

Data collected from the results and sensory (organolyptic) evaluation were laid out in simple randomized complete design and statistically analyzed using the analysis of variance as out lined by (Steel and Torri, 1980).

RESULTS AND DISCUSSION

Chemical composition the chemical analysis of three varieties hull-less barley whole meal are presented in (Table 2). The results show that the whole meal barley varieties (Giza 129, Giza 130 and Giza 131) were high in protein content (15.13, 15.90 and 14.88%, respectively). Also, hull-less barley Giza 131 was high in total dietary fiber (15.3%) followed by Giza 130 (14.6%). Whereas, the percent of soluble fiber to total fiber was higher in variety Giza 131 (32.88%). These results means that hull-less barley is a good sources of protein and fiber. These findings are nearly in agreement with Bhatty (1999) and El-Sayed, (2004).

Table 2. Chemical composition of hull-less barley whole meal (g/100g dry basis).

Chemical composition	Hull-less barley whole meal		
	Giza 129	Giza 130	Giza 131
Protein	15.13	15.9	14.88
Oil	2.01	2.12	2.31
Ash	2.51	2.61	2.91
Total dietary fiber (TDF) (A)	12.9	14.6	15.3
Soluble fiber (SF) (B)	3.7	4.8	4.2
Insoluble fiber (ISF) *	9.2	9.8	11.1
SF/TDF	28.68	32.88	27.45

* Values given by difference (A-B).

Amino acids of hull-less barley protein are presented in Table 3. The results showed that the glutamic acid was the highest (20.2 g/100g protein) compared to the total amino acids. Gystine and methionine acids were the lowest (1.5 and 1.9 g/100g protein, respectively) compared with the total amino acids. The same table indicated the amino acids score of hull-less barley. Valine acid was found to be the first limiting ones. From these results, hull-less barley protein showed high biological value.

Sensory evaluation of crackers and cookies:

Table 4 show the sensory evaluation of cracker (paton-saleh) made from hull-less barley whole meal and supplemented with wheat flour 72% extraction at different levels: 5, 10, 15 and 20%, respectively. The results reported that the addition of 20% wheat flour to 80% whole meal barley had the higher total score (40.72) followed by 15% wheat flour plus 85% barley was 38.38 for the sensory evaluation parameters, also exhibited the highest acceptability (appearance, color, texture, flavor, taste) compared with control and other treatments.

Table 3. Amino acids content and score of hull-less barley whole meal (g/100g protein).

NEAA	Barley	EAA	Barley	FAO/WHO Professional pattern (1985)	Amino acids score
Aspartic	9.3	Lysine	4.7	5.5	85.45
Serine	5.4	Theronine	4.2	4.0	105.50
Glutamic	20.2	Gystine	1.5	Cystine +	97.14
Proline	11.4	Methionine	1.9	Methioine 3.5	
Glycine	5.2	Valine	3.3	5.0	66.00
Alanine	5.6	Isolaucine	3.5	4.0	87.50
Histidine	2.6	Leucine	6.7	7.0	95.71
Arginine	5.0	Tyrosine	2.5	Tyrosine +	102.86
		Phenyl alanine	4.7	Phenylalanine 7.0	

NEAA = Non-essential amino acids

EAA = Essential amino acids without treptophan.

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 (1985).

Table 4. Sensory evaluation of crackers (paton-saleh) processed from hull-less barley.

Addition Limits (%)	Appearance 10	Color 10	Texture 10	Flavor 10	Taste 10	Total score 50
Control	6.0	5.67	5.87	6.10	5.36	29.0
WF HB						
5 95	6.51	6.33	5.91	6.33	6.15	31.23
10 90	7.33	6.67	6.82	7.51	7.25	35.58
15 85	7.85	7.31	7.15	797	8.1	38.38
20 80	8.45	7.87	7.63	8.35	8.42	40.72
LSD at 5%	0.954	1.03	0.863	0.512	0.835	-

Control made from whole meal hull-less barley.

WF = Wheat flour HB = Hull-less barley

Table 5 illustrated the sensory evaluation of cookies (menin) made from whole meal barley and supplemented with 5, 10, 15 and 20% levels of wheat flour extracted 72%. The highest score of sensory evaluation were recorded upon adding 20% of wheat flour, while, addition of wheat flour at 15% level to 85% barley whole meal, the resultant was better in the sensory evaluation score.

From the aforementioned results, it can be suggested that the addition of wheat flour at 15 and 20% levels to 85 and 80% whole meal hull-less barley to produce cookies and crackers had significant acceptability and better sensory evaluation than other treatments.

Table 5. Sensory evaluation of cookies (menin) processed from hull-less barley.

Addition Limits (%)	Appearance 10	Color 10	Texture 10	Flavor 10	Taste 10	Total score 50
Control	6.67	6.25	6.12	6.34	6.05	31.43
WF HB						
5 95	7.33	6.67	6.33	7.33	7.33	34.33
10 90	7.67	7.35	7.00	7.51	7.51	36.87
15 85	8.25	7.49	7.32	8.17	8.17	38.92
20 80	8.95	7.82	7.73	8.33	8.33	40.95
LSD at 5%	0.831	0.759	0.772	0.651	0.651	--

Control made from whole meal hull-less barley.

WF = Wheat flour HB = Hull-less barley

REFERENCES

1. A. A. C. C. 1985. American Association of Cereal Chemist. Approved Method 11th ed St. Paul., Minn. U.S.A.

2. A. O. A. C. 1990. Official Methods of Analysis. 15th ed. Association of Official Analytical Chemists. Arlington Virginia., P. 22201, U.S.A.

3. BeMiller, J. N. 1997. Starch modification: Challengers and prospects. Starch/Staerke 49: 127-131

4. Bhatty, R. S. 1999. The potential of hull-less barley. Cereal Chem. 76: 589-599

5. Bhatty, R. S. and B. G. Rossnagel. 1998. Comparison of pearled and unpearled Canadian and Japanese barleys. Cereal Chem. 75: 15-21

6. Boros, D., B. Rek-Cieply and M. Cyran. 1996. A note on the composition and nutritional value of hull-less barley. I. Animal Feed Sci. 5: 417-424

7. Edney, M., R. Tkachuk and A. W. Mac Gregor. 1992. Nutrient composition of hull-less barley cultivar. Condor. J. Sci. Food Agric. 60: 451-456

8. El-Sayed, A. A. 2002. Improvement of food hull-less barley in Egypt. Paper presented in the Food Barley Workshop organized by ICARDA and FAO, 14-17 January, 2002 Hammamet, Tunisia.

9. El-Sayed, A. A., R. A. Abo El-Enein, A. S. El-Gamal, M. A. El-Moselhy, A. M. El-Sherbiny, M.A. Megahed, A.A. El-Hag, A. M. O. El-Bawab, M.A. Mahmoud, Kh.A. Amer, H.A.Ashmawy, Sh.I. Abaas, M.Z. Shendy, M.A. Said, A.A. Attia, A. A. Badwi, R. A.Rizk and M.I El-Hawary. 2003 a. Giza 129 and Giza 130, two newly released hull-less barley varieties for irrigated lands in Egypt. The Third Conference of Plant Breeding Organized by the Egyptian Society of Plant Breeding and Agronomy Department, Fac. Of Agric. Cairo University. April, 26, 2003. Cairo, Egypt. 7 (1): 387-398

10. El-Sayed, A. A., R. A. Abo El-Enein, A.S. El-Gamal, M. A. Megahed M. A., El-Moselhy, A. A. El-Hag, A. M. O. El-Bawab, H.A.Ashmawy, Sh. I. Abaas, M. Z. Shendy, M.A. Said, S. Desouky and M.I El-Hawary. 2003b. Release of two new hull-less barley varieties for rainfed areas in Egypt. The Third Conference of Plant Breeding Organized by the Egyptian Society of Plant Breeding and Agronomy Department, Fac. of Agric. Cairo University. April, 26, 2003. Cairo, Egypt. 7 (1): 375-385

11. El-Sayed, A. A., R. A. Abo El-Enein, A. S. El-Gamal, A. A. El-Sherbiny, M. A., El-Moselhy, M. A. Megahed, A. A. El-Hag, A. M. O. El-Bawab, M. T. Abdelhamid, K. A. Amer, R. A. Rizk, S. Grando, M. A. Said, H.A. Ashmawy, S. I. Abaas, M. Z. Shendy and M. I El-Hawary. 2004. Two new food hull-less barley varieties for rainfed in Egypt. Proceedings of the 4th International Crop Science Congress, Brisbane, Australia, 26 Sep-1 Oct. 2004

12. FAO/WHO/UNU 1985. Energy and Protein Requirements, Report of a Joint FAO/WHO/UNU Expert Consultation. World Health Organization Technical Report series 724. WHO, Geneva.

13. Ferere, M. and G.F. Popove. 1984. Agro climatological data for Africa. Vol. 1. Countries North the Equator, FAO, Rome.

14. Olison, J. B., O. Sosulstensen and D. A. Christensen. 1978. Protein nutritive value of lower rape seed concentrates in blend with cereal, legumes and meat proteins. Can. Inst. Food Sci. Technol. 4, 1193-1198

15. Prosky, L., N. G. Asp, T. F. Schweizer, J.W. Devries and I. Furda. 1988. Determination of insoluble and soluble and total dietary fiber in food products: Inter laboratory study. J. Assoc. Off. Anal. Chem. 71: 1017-1023

16. Qureshi, A. A., W. C. Burger, D.M. Peterson and C. E. Elson. 1986. The structure of an inhibitor of cholesterol biosynthesis isolated from barley. J. Biol. Chem. 261: 10544-10550

17. Qureshi, A. A., N. Qureshi, J. O. Hasler-Rapacz, F. E. Weber, V. Chaudhary, T.D. Crenshaw, A. Gapor, A.S.H. Ong, Y.H. Chong, D. Peterson and J. Rapacz (1991). Dietary tocotrienols reduce concentrations of plasma cholesterol, alipo protein B, thromboxane B2 and platelet factor 4 in pigs with inherited hyper lipidemias. Am. J. Clin. Nutr. 53: 10425-10435

18. Ranhotra, G. S, J.A. Gelroth, S. D. Leinen and R. S. Bhatty. 1998. Dose response to soluble fiber in barley in lowering blood lipids in hamsters. Plant Foods Hum. Nutr. 52: 329-336

19. Steel, R. G. and J. H. Torrie. 1980. Principal and producers of statistical. Biometrical approach. McGraw Hill Book company 2nd Ed. New York.

20. Waode, P. 1988. Biscuits cookies and crakers. Vol. 1. Applied Science publishers, ltd., London, UK, PP. 10-40

21. Weber, F.E., V. Chaudhary and A.A. Qureshi. 1991. Suppression of cholesterol biosynthesis in hyper cholesterolemic subjects by tocotrienol of barley ingredients made from brewer's grain. Cereal Foods. World 36: 680-685

تقييم تكنولوجى لثلاثة أصناف من الشعير العارى مستنبطة حديثاً فى مصر

رأفت نجيب سندق[1]، عبد الفتاح أحمد السيد[2]، عبد المنعم صالح إبراهيم الشاذلى[1]

١ معهد بحوث تكنولوجيا الأغذية– مركز البحوث الزراعية– جيزة

٢ المشروع المصرى الفرنسى لتنمية إنتاج الشعير العارى– معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية– جيزة

إستخدم فى هذه الدراسة ثلاثة أصناف من الشعير العارى مستنبطة حديثاً وهــى: جيــزة ١٢٩، جيزة ١٣٠ وجيزة ١٣١ وتم التحليل الكيماوى لهذه الأصناف واتضح من الدراسة أن الشعير العارى يتميز باحتوائه على نسبة عالية من البروتين، كما وجد أن نسبة الألياف الغذائية الكلية مرتفعــة فــى صنف جيزة ١٣١ (١٥,٣%) مقارنة بالصنفين الآخرين.

قدرت الأحماض الأمينية فى الشعير العارى فوجد أن أعلى نسبة من الأحماض الأمينيــة هــو حمض الجلوتاميك (٢٠,٢ جم/ ١٠٠ جم بروتين).

تم تقدير التقييم الحسى للمقرمشات والمخبوزات فوجد أن إضافة نسبة ٢٠% من دقيــق القمــح (إستخلاص ٧٢%) الى نسبة ٨٠% من الشعير العارى كامل الطحن أعطت أعلى نسبة قبول بالنسبة للمقرمشات والمخبوزات فكانت (٤٠,٧٢ – ٤٠,٩٥) على التوالى من إجمالى ٥٠ درجة.

خلصت الدراسة توصية لاستخدام الشعير العارى كمحصــول غــذائى صــحى فــى صــناعة المخبوزات حيث يفيد ذلك فى تحسين جودة المخبوزات وتوفير القمح لصناعة الخبز.