Int.J.Curr.Microbiol.App.Sci (2018) *7*(6): 1718-1725

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com

Review Article https://doi.org/10.20546/ijcmas.2018.706.203

A Review on Products from Barley

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Keywords

Nutrition, Barley products, composition, analysis, health benefits

Article Info

Accepted:
18 May 2018
Available Online:
10 June 2018

A B S T R A C T

Barley (*Hordeum vulgare* L.), a major crop grown in the temperate regions globally is known for being one of the oldest crops being cultivated. Since then it has been used for various purposes like animal fodder, source fermentable for producing beer and other distilled beverages. Here, in this review paper, healthier products that can be produced from barley, their health benefits have been discussed. Barley can be consumed in different ways; raw or hulled barley (soaked overnight), de-hulled barley (also known as pot or scotch barley), pearl barley, baked products produced from barley flour made by pearl or de-hulled barley, etc. Thus, barley can be opted as a healthier version of other cereals in the market.

Introduction

Barley is one of the oldest cultivated cereal grains and currently ranks fourth (Newman and Newman, 2006; Fedak, 1992; Nevo, 1992) or fifth (Kent and Evers, 1994) in acreage and crop production worldwide. Indeed, it was one of the most important food grains in the ancient world. The currently accepted theory is that barley was first domesticated in the Fertile Crescent in the Near East, which spans present-day Israel, northern Syria, southern Turkey, eastern Iraq, and western Iran (Harlan, 1979). The ancestor of modern barley is believed to be identical to present-day *Hordeum spontaneum* C. Koch (Harlan, 1979; Harlan and Zohary, 1966; Zohary, 1969; Zohary and Hopf, 1988). Additionally, alcoholic beverages of various types and fermented foods prepared from barley are commonly referred to in the ancient literature. As other food grains (e.g., wheat, rye, and oats) became more abundant, barley was relegated to the status of "poor man's bread" (Zohary and Hopf, 1988).

A recent review dealing with dietary fibre and satiety (Slavin and Green, 2007) concluded that, in short-term studies, a reduction of food and energy intake at meals subsequent to dietary fibre consumption was directly correlated with the amount of fibre consumed and to its viscosity. Due to its known ability to exert health benefits and potential ability to control energy intake, viscous dietary fibre is a good ingredient to use to develop new foods. An excellent source of soluble viscous dietary fibre, namely β-glucan, is barley grain (Arndt, 2006; Lazaridou and Biliaderis, 2007). From a nutritional point of view, β-glucan is a very

interesting dietary fibre since it has been associated with lowering plasma cholesterol, improving lipid metabolism, and reducing glycemic index (Behall *et al.*, 2004; Perry, 1983). Thus, the U.S. Food and Drug Administration have recently allowed whole grain barley and barley-containing products to carry a claim that they reduce the risk of coronary heart disease (http://www.fda.gov/bbs/topics/news/2005/NEW01287.html). In this framework, a very interesting challenge for food industries is to produce β-glucan–enriched functional foods. The effects of β-glucan from barley or oats on satiety, energy intake, and weight loss have been poorly investigated. The few studies available on this topic showed inconsistent results, reporting both positive (Bourdon *et al.*, 1999; Rytter *et al.*, 1996) and negative (Kaplan and Greenwood, 2002; Saltzman *et al.*, 2001) effects.

Types of Barley Products

Biscuit

Biscuits produced from barley flour are not so commonly consumed as compared to wheat flour biscuits due various reasons like lack of knowledge about the health benefits and lack of availability. But when barley flour biscuits (BB) were made and compared 100% wheat flour biscuits (control biscuits) (CB) and given to people, the results were unlikely (Wallace, 1930).

BB were produced on a laboratory scale, using a traditional Italian recipe for krumiri-type biscuits except for replacing 100% wheat flour with a mixture of β -glucan–enriched barley flour (70%) and wheat flour (30%). CB, were produced using 100% wheat flour. To 1 kg of flour, 300 g of saccharose and margarine, as well as 200ml of milk, 3 eggs, and 15 g of ammonia, were added as ingredients. The dough was cut and the biscuits were baked.

The chemical composition of (g/100g) of BBs and CBs are reported in Table 1.

It was found that when β-glucans are consumed as barley grains or flour included in bars, biscuits or bakery products, a decrease in appetite, without any effect on energy intake, is found only after consumption of at least 2 g of the dietary fibre and starting from 2 hours up to 3.30 hours post-consumption (Schroeder *et al.*, 2009). 5g of the high viscous dietary fibre (viscosity 0.3000mPas after 20 minutes) without modifying both appetite ratings and lunch 3 hours after consumption determines the reduction of total 24-hour energy intake (Juvonen *et al.*, 2009).

Bread

Bread is a very commonly produced and consumed product made from barley flour. In this study, three different barley flours were used; covered (“Golf”), hull-less (“Hora”), and a mixture of high amylo-pectin barley (“Waxy”, containing 96% amylo-pectin). The recipe for bread included Barley flour (100g), dried yeast (2.5g), salt (1.4g), gluten (2g) and water (100g). The dough was fermented for 30min and a bun was formed from the dough, which was fermented for another 30min before baking in an oven at 225°C for 25min. The bread was cooled at room temperature before further treatment. The prepared products were divided into two batches, of which one part was frozen and the other part was frozen after keeping for 48h at 2°C in refrigerator (Birgitta Sundberg and Falk, 1994).

The flours were analyzed by standard method and the results obtained are given in Table 2.

Resistant Starch (RS) and in-vitro starch digestion rate were determined for the products. The results obtained are given in Table 3.

Barley Water

Barley water is made by boiling the barley grains and extracting the water. The effects of various temperatures between 150° and 280°C during subcritical water extraction of barley to make a barley tea-like extract, a popular summer beverage in Japan, was investigated. Each barley extract was analyzed for sensory properties, anti-oxidative activity, and the amount of residual matter, which revealed 205°C to be the best extraction parameter. 5-hydroxymethyl-2-furaldehyde was found to be the major anti-oxidative component in the 205°C extract, along with the formation of several important amino acids (Subcritical Water Extraction of Barley to Produce a Functional Drink, 2008).

Barley tea is a common drink in Japan, especially during the summer. This non-caffeinated, non-tannin drink is valued for its high percentage of β-glucans (polysaccharides) and the presence of method are the possible loss of important volatile components due to constant exposure to the air during roasting and difficulties in the disposal of the large quantities of residues after the extraction process.

Subcritical water is water in a temperature range of 100°C to 374°C atpressures between 1 and 22MPa. Under these conditions, the dielectric constant of water decreases, imparting changed polarity and thereby efficient extraction abilities. The extraction occurs in a closed chamber in water, preventing the loss of volatile compounds. Sub-critical Water Extraction presents virtually no disposal costs and can be considered a clean alternative to conventional organic solvents. SWE has received much attention recently in the extraction of natural products since this technique is environment-friendly, quick and in-expensive compared to various other solvent extraction techniques.

It was determined that the best extraction conditions for the extraction of barley was by subcritical water extraction, as far as sensory properties, antioxidant activity, and amount of residual matter are concerned. 5-Hydroxymethyl-2-furaldehyde (HMF) was found to be the component of the 205°C extract, most responsible for its high antioxidant activity, taste and odour. Furthermore, amino acid analysis revealed that asparagine, glutamine, alanine and isoleucine were among the main amino acids in the 205°C extract. These results should be useful in processing barley tea on an industrial scale in the future.

The following table shows the Amino Acid Analysis of a 205°C Extract of Barley.

Other Products

Murri (kamakh)

Perry, (1983) relates a curious ancient recipe from the medieval Arab culture that involves putting unleavened and unseasoned barley dough into closed containers and allowing it to "rot" (ferment) for 40 days.

The dough was then dried, ground into meal, and blended with salt, spices, wheat flour, and water to make a liquid condiment called *murri* (when mixed with milk, it was called *kamakh*).

Krimnitas / chondrinos

Antioxidant compounds. The present method of making barley tea involves roasting barley seeds at 280°C and then processing with hot water to yield barley tea.

The demerits of this Pliney described recipes for barley *puls*, an oily, highly seasoned paste mixture that was a popular food in ancient Greece (Tannahill, 1988).

Table.1 The chemical composition of (g/100g) of BBs and CBs

COMPONENTS	BB	CB
Proteins	6.1	18.6
Fats	13.9	13.6
Carbohydrates	61.4	63.2
Total dietary fibre	12.3	2.5
Soluble	8.3	1.2
β –glucans	5.2	-
Insoluble	4.3	1.3
Energy content(kJ)	1653	1716

BB = barley β-glucanenriched biscuit; CB = control wheat flour biscuit.

Table.2 Chemical Composition of barley flour from three different types of Barley (% of Dry Matter)

COMPONENTS	GOLF	WAXY	HORA
Starch	74.1	68.3	71.0
Crude Protein	10.9	11.2	10.8
Crude Fat	2.4	3.1	2.7
Dietary Fibre	14.7	15.8	11.6
β-glucans	4.2	4.3	3.8
Ash	1.4	1.7	1.6

Table.3 Content of Ash, Starch and Resistant Starch (RS) in bread made from three different barley flours (% dry matter)

TYPE	ASH	STARCH	RS
Golf	2.4	66.6	0.8
Golf*	2.5	67.4	0.8
Waxy	3.0	64.0	0.2
Waxy*	3.0	63.4	0.2
Hora	2.6	66.2	0.8
Hora*	2.6	66.7	0.8

*stored in refrigerator at 2°C for 48h.

Table.4 Amino Acid Analysis of a 205°C Extract

AMINO ACID	AMOUNT (n mol/ml)
Asp	162.1
Thr	19.7
Ser	3.0
Glu	110.8
Gly	71.5
Ala	97.2
Val	34.1
Ile	87.2
Leu	32.4
Tyr	12.7
Phe	21.0
Lys	19.6
His	10.6
Arg	31.1
Pro	46.5

A bread roll claimed by Archestratus in the 5th century B.C. to be the "best barley" was prepared in Lesbos and Thebes by "rounding the dough in a circle and pounded (by hand)" prior to baking. This bread was called *krimnitas* or *chondrinos*, which are terms describing coarsely milled barley (Nevo, 1992).

Paximadia

A twice baked barley biscuit called *paximadia*, is a favorite Greek food item, was soaked in broth prior to eating (Kremezi, 1997).

Ini and Buza

Barley has been widely cultivated in the Caucasus Mountains of Eastern Europe for thousands of years (Percival, 1921). A product capable of being stored, called *ini*, was made by frying hul-less barley kernels on a special brazier, then grinding and storing the product in a large earthenware vessel. Ini could be stored for many months, requiring only the addition of water and salt for preparation. The resulting barley dough was then rolled into a ball and was ready to eat. Although not necessary and used only if available, butter and/or cheese sometimes were added to the mixture prior to eating.

A beverage containing about 4% alcohol, called *buza*, was a traditional drink made from fermented hulless barley cakes and malt (Percival, 1921).

Bolon or Boulon

According to Davidson (Davidson, 1999), an ancient barley bread survives in Jura, a mountainous region of France. This bread, called *bolon*or *boulon*, is prepared in small loaves that are very hard and require soaking in milk or water prior to eating.

Drylur

In the Faroe Islands, dough balls made with milled barley were first placed on an open fire to form a crust, and the baking was completed

by placing crusted barley dough balls in warm ashes. This ancient type of bread was called *drylur*. (Newman and Newman, 2006) Abraded barley kernels and barley grits were used in many foods, including soups, porridges, meat blends, sausages, and blood mixtures and, in many instances, were blended with legumes and other cereals. In Dalarne, Sweden, pea meal and oats were commonly blended with barley meal for baking. Sour beer was often used in food preparation, especially in baking barley or mixed-grain breads (Li *et al.,* 2003).

Tsamba

Barley has been and continues to be a mainstay in the diet of the Tibetan people. For many years the Tibetan diet consisted mainly of two food items, *tsamba* and yak butter tea. To make *tsamba*, barley was parched, ground into very fine flour, and made into flat cakes. (Newman and Newman, 2006) Butter tea was made from a strong Chinese tea that was strained into a churn and to which varying amounts of stale butter and salt were added. The mixture was then churned into an emulsion. After drinking some of the tea, *tsamba* was added, kneaded into lumps, and eaten. *Tsamba* could be taken on journeys and eaten dry or with some type of liquid, such as water or milk (Subcritical Water Extraction of Barley to Produce a Functional Drink, 2008).

Kong Bori Bob

Barley has been grown in Korea for many years and in the southern part of the peninsula as a rotation crop with rice; the latter was planted in the summer season, while barley was planted in the winter season. Itis believed that barley was first cultivated in Korea around 100 B.C. (Bae, 1979).

In the Korean language, cooked cereal, which is usually rice, is called *bob* and mixed *bob* is prepared by cooking rice and precooked barley as a mixture. (Newman and Newman, 2006) *Bori*is the Korean word for barley, and when only barley is used for *bob*, the dish is called *kongbori bob* (Byungkee Baik, *personal communication*).

Barley Tea

Barley tea has a long history in Asia and is still in many parts of the continent, including Korea, China, (especially Tibet), Japan, and India. Barley tea is prepared from roasted barley kernels that are steeped to make a mild non-alcoholic drink that is consumed both hot and cold, with and without meals, like water. (Newman and Newman, 2006)

In the past, kernels were prepared at home for use in tea. Today, however, roasted kernels for making barley tea are available in many food stores in modern cities and towns in Asia. There are many anecdotal references to the medicinal value of barley tea throughout the literature.

In a section titled, “Recipes for the Sick” in *The Rumsford Complete Cookbook* (Wallace, 1930), a recipe for barley water for the sick is given as follows: 2 Tbsp of pearl barley, 1 qt of cold water, 1/3 tsp of salt, juice from half a lemon, and a little sugar; soak washed barley, add salt, and cook about 3 hr; strain through cheese cloth; and flavour with the lemon juice and sugar as desired.

Various studies that have been conducted on barley and it have been found that it can be as an excellent source of dietary fiber. Further studies also help us to understand the influence of β-glucan sources on modulating the satiating effect of β-glucan-enriched bakery products made from barley flour. Today in the United States, the majority of barley is used for animal feed (65%) and malt and alcohol production (30%), and the

remainder consumed as food (1.5%) or used for other purposes (Lazaridou and Biliaderis, 2007).

Ajgaonker, (1972) describes how ancient Indian physicians effectively stabilized type II diabetics some 2,400 years ago. The treatment was remarkably simple and not really different from recommendations that are given to diabetic patients today, i.e., lose weight, change diet, and increase exercise. In the case of diet, the major changes were reduced caloric intake and substitution of barley for white rice.

References

Ajgaonker, S. S. Diabetes mellitus as seen in the ancient Ayurvedic medicine. Pages 13-20 in: *Insulin and Metabolism*. J. S. Bajaj, ed. Association of India, Bombay, 1972.

Arndt EA: Whole-grain barley for today's health and wellness needs. CFW Res 51: 20–22, 2006.

Bae, S. H. Barley breeding in Korea. Pages 26-43 in: *Proc. Joint Barley Utilization Semin.* Korea Science and Engineering Foundation, Suweon, 1979.

Behall KM, Scholfield DJ, Hallfrisch J: Lipids significantly reduced by diets containing barley in moderately hyper-cholesterolemic men. J Am CollNutr 23: 55–62, 2004.

Birgitta Sundberg and H Falk; The American Journal of Clinical Nutrition 1994: 59 (suppl):780S. Printed in USA.

Bourdon I, Yokoyama W, Davis P, Hudson C, Backus R, Richter C, Knuckles B, Schneeman BO: Postprandial lipid, glucose, insulin, and cholecystokinin responses in men fed barley pasta enriched with beta-glucan. Am J ClinNutr 69:55–63, 1999.

Davidson, A. *The Oxford Companion to Food.* Oxford University Press, Oxford, 1999.

Fedak G. Inter-generic hybrids with *Hordeum*. Pages 45-70: Barley: Genetics, Biochemistry, Molecular Biology and Biotechnology. P.R Shewry ed. CAB International, Wallingford, England, 1992.

Harlan, J. R. On the origin of barley. Pages 10-36 in: *Barley: Origin, Botany, Culture, Winter Hardiness, Genetics, Utilization, Pests.* USDA Agric. Handb. No: 338, 1979.

Harlan, J. R., and Zohary, D. Distribution of wild wheats and barley. Science 153:1074, 1966.

Juvonen KR, Purhonen AK, Salmenkallio-Marttila M, La¨hteenma ¨ki L, Laaksonen DE, Herzig KH, Uusitupa MI, Poutanen KS, Karhunen LJ: Viscosity of oat bran–enriched beverages influences Gastro-intestinal hormonal responses in healthy humans. J Nutr 139:461–466, 2009.

Kaplan RJ, and Greenwood CE: Influence of dietary carbohydrates and glycaemic response on subjective appetite and food intake in healthy elders persons. Int J Food SciNutr 53:305–316, 2002.

Kent, N. L., and Evers, A. D. *Kent's Technology of Cereals* 4th ed. Elsevier Science Ltd., Oxford, 1994.

Kremezi, A. Paximadia (barley biscuits): Food for sailors, travellers, and poor islanders. In: *Food on the Move: Proc. Oxford Symp. Food Cookery 1996*. H. Walker, ed. Prospect Books, Devon, England, 1997.

Lazaridou A, and Biliaderis CG: Molecular aspects of cereal β -glucan functionality: physical properties, technological applications and physiological effects. J Cereal Sci 46:101–108, 2007.

Li J, Kaneko T, Qin LQ, Wang J, Wang Y: Effects of barley intake on glucose tolerance, lipid metabolism, and bowel function in women. Nutrition 19: 926–929, 2003.

Nevo E. Origin, evolution, population genetics and resources for breeding of wild barley, *Hordeumspontaneum*, in the Fertile Crescent. Pages 19-43 in: *Barley: Genetics, Biochemistry, Molecular Biology and Biotechnology*. P. R. Shewry, ed. CAB International, Wallingford, England, 1992.

Newman C.W, and Newman R.K Newman Associates Inc. Bozeman, MT. A Brief History of Barley Foods. Cereal Foods World, Jan-Feb-2006, vol.51 no. 1.

Percival, J. *The Wheat Plant*. Duckworth Publishers, London, 1921.

Perry, C. A nuanced apology to rotted barley. In: *Petits Propos Culinaires.* Prospect Books Ltd., London, 1983.

Rytter E, Erlanson-Albertsson C, Lindahl L, Lundquist I, Viberg U, Akesson B, Oste R: Changes in plasma insulin, enterostatin, and lipoprotein levels during an energy-restricted dietary regimen including a new oat-based liquid food. Ann NutrMetab 40:212–220, 1996.

Saltzman E, Moriguti JC, Das SK, Corales A, Fuss P, Greenberg AS, Roberts SB: Effects of a cereal rich in soluble fiber on body composition and dietary compliance during consumption of a hypocaloric diet. J Am CollNutr 20: 50–57, 2001.

Schroeder N, Gallaher DD, and Arndt EA, Marquart L: Influence of whole grain barley, whole grain wheat, and refined rice-based foods on short-term satiety and energy intake. Appetite 53: 363–369, 2009.

Slavin J, and Green H: Dietary fibre and satiety. Br Nutr Found Nutr Bull 32:32–42, 2007.

Subcritical Water Extraction of Barley to Produce a Functional Drink. Aditya KULKARNI, United Graduate School of Agricultural Science, Gifu University, 1-1 Yanagido, Gifu 501-1193, Japan, Faculty of Agriculture, Shizuoka University, 836 Ohya, Suruga-ku, Shizuoka 422-8529, Japan; Tadashi YOKOTA, Shin'ichi SUZUKI, Aichi Gakusen University, 28 Kamikawanari, Hegoshi-cho, Okazaki, Aichi 444-8520, Japan; Hideo ETOH, Yagisho Corporation, 4-6 Takaoka, Fujieda, Shizuoka 426-0062, Japan. (doi:10.1271/bbb.70520). Received August 14, 2007; Accepted October 11, 2007; Online Publication, January 7, 2008.

Tannahill, R. *Food in History*. Rev. ed. Penguin, London, 1988.

US Food and Drug Administration: Accessed at http://www.fda. gov/bbs/topics/news/2005/NEW01287.html .

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Wallace, L. H. Barley water. Page 222 in: *The Rumford Complete Cookbook.* The Rumford Co., Rumford, RI, 1930.

Zohary, D. The progenitors of wheat and barley in relation to domestication and agricultural dispersal in the Old World. Pages 47-66 in: *The Domestication and Exploitation of Plants and Animals.* P. J. Ucko and G. W. Dimbleby, eds. Duckworth, London, 1969.

Zohary, D., and Hopf, M. *Domestication of Plants in the Old World: The Origin and Spread of Cultivated Plants in West Asia, Europe, and the Nile Valley*. Clarendon Press, Oxford, 1988.

How to cite this article:

Madhulika Dutta, Soumyadeb Bhattacharyya, Prajesh Nandy and Anju Paul. 2018. A Review on Products from Barley. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 1718-1725.
doi: https://doi.org/10.20546/ijcmas.2018.706.203