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Reconsideration of Barley in Human Food From the Aspect of Digestive Fiber Content

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Abstract: Barley belongs to the genus *Hordeum* and can be considered one of the oldest cultivated plants, its cultivation being mentioned in the Bible. In human nutrition, barley is used in the form of flakes, sprouts, green juice, pasta, tortillas, puddings or various pastry products. Grains of barley grains (*Hordeum vulgare* L.) are a valuable source of β-glucan, and its incorporation into products on cereal base also contributes to the intake of other bioactive compounds, such as phenolic compounds. One of the most complex and complete combination of minerals and vitamins develops in young green barley plants. Regular consumption of hulless barley contributes on maintaining cholesterol at a normal level, beneficial in preventing certain types of cancer such as colon cancer and also in preventing diabetes by regulating glucose and insulin. Green barley is recommended in naturist medicine for the treatment of more than 40 conditions, from cancer, digestive, pulmonary, circulatory and serious nervous diseases. Green barley should not be missing from the diet of people with various health conditions and not only that.

Keywords: barley, β-glucans, green barley, medicine, nutrition.

Introduction

Barley belongs to the genus Hordeum and can be considered one of the oldest cultivated plants, its cultivation being mentioned in the Bible. Archaeological studies have revealed the cultivation of

double-row barley up to 8000 BC and six-rowed barley appearing around 6000 BC in Iran (Brennan and Cleary 2005). According to Tianu and Bude (1985), the supremacy of barley in agriculture is maintained until the Bronze Age (1700–1000 B.C.) when the importance of wheat and its spread begin to become greater. For the ancient Greeks and the Romans, barley was the basic grain for bread for long periods of time (Sauciuc, Săveanu 1925, Vasiliu 1970 cited in Salontai et al., 1996). Barley is the fourth cereal in the world, after wheat, maize and rice being among the top ten crops in the world (Akar et al., 2004). It is mainly used as animal feed and in brewing, but recently there is interest in increasing its use in human nutrition and various industrial purposes (Osscarson et al., 1996).

Barley was probably first used in human food in raw form or in the form of toasted bread, porridge or soups. Later, it was mainly used as animal feed , in brewing beer and distillation processes. The decrease use of barley in human nutrition is due to largely expansion in cultivation and the increase importance of the wheat and rice. Currently 55-60% of barley production is used as fodder, 30-40% for malt and only 2-3% for human consumption and approximately 5% is used as seed for re-establishment of crops (Ullrich, 2011).

Integral cereals became an ingredient of the human diet with the advent of agriculture about 10,000 years ago. For the past 3000-4000 years, for most people in the world, cereals have constituted a major proportion of their diet (Spiller, 2002).

The role of chemical components of barley grains on health

Barley grains (*Hordeum vulgare L.)* are a valuable source of β-glucan, and its incorporation into cereal-based products also contributes to the supply of other bioactive compounds, such as phenolic compounds (De Paula et al., 2017). Integral cereals contain many nutrients and phytochemicals with known health benefits. They contain a large amount of dietary fiber, starch, oligosaccharides, antioxidants, micronutrients, phenols and other compounds linked to disease prevention. The major components of barley (% of dry matter) are represented by starch (60%), dietary fiber (20%) and protein (12%). Other studies carried out regarding the chemical composition of barley show that barley grains are composed of 60-65% starch, 10-17% proteins, 4-9% beta-glucans, 2-3% lipids and 1.5-

2.5% mineral substances, soluble fibers of 3-20% (Porumb, 2018).

According to Saquib et al. (2020), barley contains a total of proteins, dietary fibers, essential amino acids, vitamins and minerals in larger quantities compared to wheat and rice. These characteristics recommend the use of barley as a food-medicine over other cereals.

The β-glucan content of barley generally varies between 2% and 11% by weight, which is higher compared to other cereals such as wheat and rye (Andersson et al. (2009), Messia et al. (2017), cited by De Arcangelis 2019). In barley, this polysaccharide is the predominant constituent of endosperm cell walls, accounting for ≈70% of the total components. β-Glucan from barley and oats demonstrates a positive impact on human health, primarily the reduction of postprandial blood glucose and LDL cholesterol in the blood. Due to these beneficial effects, barley can be considered a functional ingredient (De Arcangelis, 2019).

There are two types of barley used in the food and pharmaceutical industry: hulless barley and hulled barley. Hulless barley has higher nutritional values because it is minimally processed and therefore retains all the bran and germ. The bran is the outer layer of the barley grains that contains essential antioxidants, vitamin B and fiber (Saquib et al., 2020).

According to Helm (2004) the interest in the hulless forms of barley used in human nutrition has increased due to the fiber content, glucans and the higher protein content compared to other cereals. In this sense, in 2001 in India, Jood and Kalra (2001) also conducted a study on hulless and hulled barley cultivars, so they observed that hulless forms have a higher protein content (10.53%) compared to hulled barley (9.06%). The fat content of both types of barley is more or less equal (≈3.35%). The total lipid content of hulled barley ranges from 1.39% to 3.45%, while that of naked barley is between 1.61% and 2.40%. The average total sugar content o fhulless barley was 2.77%, while that of hulled barley was 3.11%. β-Glucan is a soluble fiber and an important nutrient in medicines, so also in this aspect bare barley contains a higher amount of β-glucan (≈4.73%) compared to hulled barley (≈3.05%). Likewise, the total starch content of hulless barley is also higher (≈57.45%) compared to hulled barley (≈45.74%).

The superior quality of bare barley grains compared to hulled grains is also presented by Shaveta et al., 2019 (Table 1).

Table 1.

Difference in biochemical constituents in hulled and hulless barley

S.No.	Hulless barley	Hulled barley
Energy (Cal)	370	350
Protein (%)	13	10
Carbohydrate (%)	73.9	78
Fat (%)	2.2	1
β-glucan (%)	4.1	3.9
Crude fiber (%)	1.4	5
Calcium (%)	5.0	2

The use of barley in human nutrition

Today we are witnessing the renaissance of barley in human nutrition; in advanced countries, it is used for the preparation of the so-called functional food product obtained from the valuable components of cereals. The increase in interest in the last two decades for cereals has been largely due to their acceptance as a functional, bio-active ingredient (Cui and Wood, 2000).

The positive effects of grains and whole grain products on human health have been known for a long time. However, in the 4th century BC, Hippocrates - the father of medicine - recognized the benefits of whole grain bread on human health. More recently, in the early 1800s to the mid-1900s, doctors and scientists recommended whole grains to prevent constipation (Slavin, 2004).

It is known that cereals in general have an important role and a positive influence on the general condition of the human body. Special attention is paid by specialists to barley and oats due to the high content of soluble non-starch polysaccharides (fibrous material), of which β-glucans have a dominant position in terms of health benefits (Havrlentova, 2011).

Malt extract and barley syrups are used in small amounts in some food products to give them a better taste and color. The most widespread use of barley in human consumption is in the form of fermented bakery products. Malt products are also used to make biscuits, cakes and muffins, which are non-fermented bakery products (Mahdi et al., 2008).

Regular consumption of bare barley contributes to maintaining cholesterol at a normal level, beneficial in preventing

certain types of cancer such as colon cancer and regulating glucose and insulin in preventing diabetes. Barley has a high content of β-glucan, which helps lower the glycemic index and also stimulates the intestinal health (Shaveta et al., 2019).

ß-glucans are constituents of cell walls, found especially in oat and barley grains. ß-glucans from barley (*Hordeum vulgare L.*) are important sources of water-soluble vegetabs fibres, necessary in the human diet to lower serum cholesterol. ß-glucans lower and stabilize serum glucose and insulin levels. The positive effects of beta-glucans for treating diabetes and their anticancer effects are well-known (Brennan & Cleary 2005). In human nutrition, barley is used in the form of flakes, sprouts, green juice, pasta, tortillas, puddings or various pastries (Figure 1).

Figure 1. Products obtained from barley (green juice, bread, flakes barley) (Source: www.shutterstock.com)

The activity of beta-glucan in cereals on human and animal organisms has a wide range of effects. Barley beta-glucan has been shown to be hypocholesterolemic and this property may result from its ability to increase the viscosity of intestinal contents. The hypocholesterolemic effect of beta-glucan is primarily related to its structure, molecular weight and interaction with other components. This type of dietary fiber can also modulate the glycemic index beneficial for patients with diabetes. As an active compound of soluble dietary fiber, beta-glucan has an important role in gut physiology. The increased interest in cereals with a high content of beta-glucans in the last two decades is largely due to their acceptance as a functional, bioactive ingredient (Havrlentová, 2006).

In a study carried out in 2019 by Fatma, the nutritional values of barley /100g are presented (Table 2).

Table 2.

Food values/100 gm

Protein	11.5 gm
Fat	1.3 gm
Carbohydrates	69.6 gm
Calories	336 kcal
Thiamnie	0.47 mg
Riboflavin	0.20 mg
Selenium	18.20 gm
Niacin	5.4 gm
Calcium	26 mg
Iron	1.67 mg
Magnesium	21 mg
Phosphorus	215 mg
Fiber	3.9 gm

Green barley is recommended in naturist medicine for the treatment of more than 40 diseases, from cancer, digestive, pulmonary, circulatory and serious nervous diseases. Green barley should not be missing from the diet of people with various health conditions and not only that. One of the most complex and complete compositions of minerals and vitamins develops in young green barley plants.

Following a study carried out on barley plants in different growth phases, it was concluded that the best nutritional resources for the human organism are found in the 20-30 cm plants. In the barley leaves of this phase, there are vitamins from the B group (B1, B2, B5, B6, B12), niacin (vitamin B3 or nicotinic acid), vitamin E, vitamin C and a large amount of iron, calcium, manganese, magnesium, molybdenum, zinc, copper, bioflavonoids, polysaccharides, polypeptides and chlorophyll. After a comparison of the resource content of other plants with the nutritional resources of barley it was concluded that barley leaves contain:

- more than 250 times more vitamin A than lettuce,
- more than 25 times more potassium than bananas,
- more than 11 times more calcium than milk,
- over 7 times more vitamin C than oranges,
- more than 10 times more vitamin B1 than spinach,
- more than 23 times more biotin (factor from the group of B vitamins) than milk,

- 2000 micrograms of active SOD (Superoxide Dismutase), at a proportion of 2g of green barley in powder form (https://www.sfatulmedicului.ro/Suplimente-nutritive/orzul-verde-este-considerata-planta-cu-cea-mai-mare-cantitate-de-nutrien_13131)

The use of barley for pharmaceutical purposes

Almost every part of barley plant (grains, root, leaves and whole plant) can be used as medicine (Marwat, 2012).

Barley is a natural pharmaceutical food since ancient times. In Ancient Egypt, barley was used as a purgative, applied to wounds to reduce healing time, reduce phlegm, and treat eye diseases. Roman gladiators believed that barley bread provided greater strength and endurance than other foods (Kraft, 2019).

Green barley can fight over 20 chronic diseases due to GABA, flavonoids, SOD, K-Ca, vitamins and tryptophan mechanism in young plants (Figure 2).

The concept of phytopharmaceutics – fighting disease with natural substances – is closely related to pharmaceutical nutrition. It was also found that almost 70% of the active compound discovered as a drug originates from plants, only 30% is purely synthetic Saquib et al., (2020).

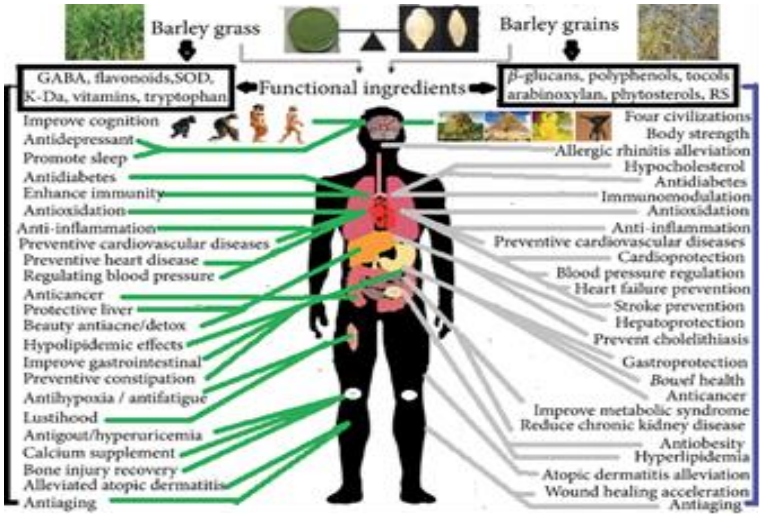

Figure 2. Barley grass and grains for preventive over 20 human chronic

diseases

Source: https://www.hindawi.com/journals/omcl/2020/3836172/fig1/7

Major support foods + barley grass powder can ensure the necessary intake of sodium (<2 g) and potassium (>3.5 g) every day. More than 30 functional ingredients in green barley can fight more than 20 chronic diseases, and 15 functional ingredients in barley grains can prevent 11 chronic diseases. Barley enhanced sterol accumulation through the action of the LTP2 gene that participates in the abiotic stress response mediating intracellular lipid transport (Zeng et al., 2020).

Conclusions

- There are two types of barley used in the food and pharmaceutical industry: hulless barley and hulled barley. Bare barley has higher nutritional values because it is minimally processed and therefore retains all the bran and germ.
- Integral cereals are high content in nutrients and phytochemicals with known health benefits. They contain a large amount of dietary fiber, starch, oligosaccharides, antioxidants, micronutrients, phenols and other compounds linked to disease prevention.
- Interest in the hulless forms of barley used in human nutrition has increased due to the content of fibers, glucans and the higher content of proteins compared to other cereals.
- Green barley should not be missing from the diet of people with various health conditions and not only that. One of the most complex and complete compositions of minerals and vitamins develops in young green barley plants.

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