

**REVIEW ON: PREVENTIVE AND THERAPUTIC ROLE OF
FUNCTIONAL INGREDIENT OF BARELY GRASS FOR DISEASE IN
HUMAN BEING .*****Daware Sagar A. and Asst. Prof. Matade Rupali B.**

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Contant no:7796508624,  sagar_daware_patil, E-mail: sagardaware121@gmail.com**ABSTARCT**

Although barley grass powder is the best functional food for supplying nutrients and eliminating toxins from human cells, its functional components have been demonstrated to play a part in a number of biological processes. an important role as a health benefit. Thirty compounds found in barley and its extracts are known to help treat over twenty chronic illnesses, such as: 14 common and nine distinct chronic illnesses between grains and grass due to the primary molecular mechanism of six functional components of barley grass. (GABA, flavonoids, SOD, K-Ca, vitamins, and tryptophan) and grains (polyphenols, arabinoxylan, phytosterols, tocols, resistant starch, and β -glucans). Green barley has a wonderful medical effect and has been shown to be the most advantageous for human health. According to these results, barley grass could be among the greatest functional meals for preventing illness. GABA, flavonoids, the tryptophan mechanism of barley grass, vitamins, K-Ca, and SOD all have prophylactic and therapeutic benefits for chronic illnesses. These factors also support the development of a sizable health industry. This essay is a source of scientific information. evidence of the creation of beneficial meals and cutting-edge drugs for barley grass to prevent illnesses.

KEYWORDS: Barley Water, Green Barley, Hordeum Vulgare, Medicinal, Therapeutic, Prevention, GABA, Vitamins, Toxicity, Precaution.

1. INTRODUCTION

The fourth most significant cereal crop in the world, barley (*Hordeum vulgare* L.) has the greatest dietary fiber content and its malt is utilized for functional reasons. In addition to being the most often used ingredient in beer production globally, food is also widely utilized in Chinese herbal treatment, which employs over 300 distinct plant species. Regular consumption of whole grain barley and its hydroalcoholic extract reduces the risk of chronic conditions including diabetes, cancer, obesity, and cardiovascular disease based on phytochemicals. such as β -glucan, lignans, tocots, phytosterols, phenolic acids, flavonoids, and folate[1,2]. Barley has demonstrated efficacy against all inflammatory and cardiovascular conditions in humans. Superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px) activity increased as a result of platelet agonists blocking the cyclooxygenase and lipoxygenase pathways of arachidonic acid metabolism [3]. The ancient Tibetans' rise to 3400 meters depends on barley's resistance to cold and frost at 4000 meters [4], and the Tibetan Plateau is a major source of barley's domestication [5]. The human Flt3 ligand is a glycoprotein produced from barley that contains $\alpha(1,3)$ -fucose and $\alpha(1,2)$ -xylose. It was shown that barley grains with active protein express human growth factor [6]. Barley grass treated with artificial light (red 9 + blue) and its amino acid composition 1) has a 4% lower percentage of cyanogenic glucosides but a larger concentration of γ -tocopherol than natural light, which may be raised by 100% in red light [7]. Because sunlight's high photosynthetically active radiation significantly increases the accumulation of xanthophyll-cycle pigments, 3-feruloylquinic acid (C₁₇H₂₀O₉), and lutoarin (isoorientin-7-O-glucoside). [8] Chronic human sickness is associated with the five evolutionary phases of the primary dietary recommendations (i.e., UV exposure of barley leaves). [9] For today's population, the following are the healthiest primary dietary recommendations: fruits or vegetables, grass or Cyperaceou, cereals (rice, wheat, millet, beans, barley, and maize), polished rice or wheat. Wheat flour or white rice flour combined with grass powder[10].



Fig.1. Barly Grass.



Fig.2. Developed Barley Grass.

Ten days after the barley sprout germinates, BG has young green leaves and a stem that is in the vegetative growth stage, beginning at the seedling stage and continues to the elongation stage. (barley green) to optimize nutrition prior to the start of the barley reproductive cycle [11,12] nonetheless, Vrs2 is connected to floral architecture via regulating hormonal homeostasis. and barley slopes [13]. In addition to being a popular green beverage, BG is used to prevent chronic disorders, especially those that impact circulation [14]. problems, cholesterol reduction, anti-inflammatory, anti-cancer, anti-obesity, anti-diabetes, and anti-arthritis qualities [15]. Light can promote the breakdown of cytokinins and the production of bioactive cytokinins, which often show a positive correlation between senescence and cytokinin oxidase/dehydrogenase activity [16]. Compared to organic soil, hydroponic BG has higher amino acids and vitamin C [17]. According to spray-dried barley grass powder, which is tiny and highly soluble, has 56.7%, 68.1%, and 47.9% of the chlorophyll, flavonoids, and SOD enzyme activity of vacuum freeze-dried powder with great color and high nutritional content.[18] Even while BG has made substantial contributions to human health, coevolution, functional foods, and the therapeutic relationship between preventive chronic It's unclear if illnesses and young barley grass can be used as functional foods for people.

2. History of Barley

Since ancient times, both people and animals have consumed barley. In addition to its well-known uses, barley has been shown to offer medicinal effects throughout time. Barley originated in the Near East. Barley dates back approximately 10,500 BC, according to historical records. [19] about ancient Egypt, barley originally appeared as wild barley about 8,000 BC. Since 7,000 BC, barley has been carefully grown in the same region. Furthermore, barley has been cultivated in Central Europe since 5,000 BC [20]. Since 2,000 BC, barley has been cultivated in China and is essential for the treatment of skin, blood, liver, and gastrointestinal disorders [21]. In ancient Greece, barley was also considered the healthiest cereal grain [22].

One of the first plants to be cultivated, barley has played an important part in the development of agronomy, physiology, genetics, plant breeding, and human civilization. For ages, barley has been grown and used all over the world as a staple food for both people and animals. One of the earliest crops to be harvested, barley has been used extensively during the hundreds or even thousands of years that it has been cultivated. the transition from hunting and subsistence on the hunt to an agricultural lifestyle [23]. The meaning of the

genus name *Hordeum*, which comes from the word beneath, also suggests the significance of barley. Roman gladiators were referred to as "barley" or "barley people" because they consumed barley to increase their strength and stamina in arena combat [24].

3. Functional Ingredients of Barley Grass

Barley grass is rich in protein (27.3%), dietary fiber (29.5%), and other useful and necessary components. Here are the primary ingredients of dried barley grass. 0.14 mg/100 g of Cr, 305.5 mg/100 g of S, 479.4 mg/100 g of Ca, 251.6 mg/100 g of vitamin C, 20.5 mg/100 g of vitamin A, and 4.57% fat Catalase: 839 U/g, SOD: 440.0 U/g, luteonarin: 342.9 mg/100 g, tryptophan: 810.0 mg/100 g, GABA: 150.5 mg/100 g, ABTS (RC50) 53.3 g/mL, total polyphenol: 1.06%, total flavonoid: 0.53%, and saponarin: 726.2 mg/100 g.

Barley grass's nutritional and functional constituent content usually varies greatly between cultivars, growth phases, and processing techniques. For example, the salt concentration fluctuates and is high in vegetable, saline, and alkaline soils but low in alpine places. During the seedling stage, there is little dietary fiber, but during the elongation stage, there is a lot. The amounts of luteonarin and saponarin in barley leaves fluctuate significantly during the growth phase, particularly during the shooting phase, when the luteonarin concentration is greater. Its concentration is 6.4 times higher than that of a single leaf period, and its saponarin level is 6.5 times higher than that of the heading period [25]. Tryptophan levels in barley leaves differ more dramatically under three light sources [26]. BG is high in folate, chlorophyll, pantothenic acid, vitamin C, calcium, iron, zinc, magnesium, and β -carotene, according to several research. Betaine, chlorophyll (SPAD value), soluble solids, and flavonoids were found in BG of 100 cultivars with average concentrations of 44.53, 70.39, and 27 mg/g fresh weight (FW), respectively [27]. BG has 30 times more thiamine ($C_{12}H_{16}N_4O_5$) and 6.5 times more calcium (2333.99 μ g/g FW and 4114.25 μ g/g FW, respectively) than cow's milk [28]. Four times as much thiamine as whole wheat flour, seven times as much vitamin C ($C_6H_8O_6$) as oranges, and five times as much iron as spinach [27, 29]. Barley grains have twice as much protein as brown rice, but its total flavonoids, alkaloids, and GABA levels are 2.1, 10.7, and 37.8 times greater, respectively [30, 31].

3.1 Amino Acids and GABA.

By acting on three receptor subclasses—relaxing, antianxiety, and—gamma-aminobutyric acid is an inhibitory neurotransmitter that reduces neuronal excitability in the mammalian central nervous system. possesses anticonvulsant qualities, lessens pain, regulates sleep, and

enhances cognitive and reproductive outcomes [32]. CaCl_2 , glutamic acid ($\text{C}_5\text{H}_9\text{NO}_4$), and GABA ($\text{C}_4\text{H}_9\text{NO}_2$) all contribute to reducing the effects of cold-induced Among the effects is the restoration of membrane integrity [33]. When it comes to producing GABA, barley bran is better than wheat bran [34]. The amount of GABA in BG is Fan 11 has a GABA level of 125–151 mg/100 g, whereas Fudamai 1 has a GABA value of 143–183 mg/100 g, according to [35]. GABA can lessen oxidative damage brought on by the toxicities of H^+ and Al^{3+} . BG contains 20 amino acids that, in particular, reduce carbonylated proteins and activate antioxidant defense to support energy synthesis, cell formation, and regeneration [36]. Eight amino acids are required [27, 37].

3.2 Flavonoids.

Increased consumption of flavonoids has been associated with a lower incidence of stomach cancer in Europe [38]. The microbiota reduces excessive secondary weight gain and lowers flavonoid levels after dieting [39]. Barley green contains 1.12% total flavonoids and is devoid of DPPH. Soluble protein, soluble total sugar, and SOD have a 78.52% capacity to scavenge free radicals, whereas betaine and total flavonoids may be kept at room temperature. could be preferably kept in cold storage [40]. The total flavonoid content in BG increased from 273.1 to 515.3 CE mg/100 g between days 13 and 56 after germination. However, lutonarin (isoorientin-7-O-glucoside) has a higher capacity to scavenge radicals than saponarin (isovitexin-7-O-glucoside), and as it develops, its antioxidant potential increases. It has also been shown to have a high total polyphenol content (44.37–55.07%) [41].

Total flavonoid content The extraction rate in BG is 94.66 mg/100 g [42]. Among the 37 flavonoids found in BG, the hydroxycinnamates include isoorientin ($\text{C}_{21}\text{H}_{20}\text{O}_{11}$), lutonarin, saponarin ($\text{C}_{27}\text{H}_{30}\text{O}_{15}$), isoscoparine ($\text{C}_{22}\text{H}_{21}\text{O}_{11}$), O-diglycosyl flavones, O-glycosylC-glycosyl flavones, C-glycosyl flavones, and isoscoparin-7 Oxidative Medicine. and derivatives of 7-O-[6-acyl]-glucoside, Cellular Longevity O-glucoside, and 7-O-[6-acyl]-glc-4'-glucoside of isovitexin [43]. Isoviteixin-7-O-glucoside (54.17%) and isoorientin-7-O-glucoside (33.36%) are the primary flavonoids found in BG extract [44]. The three most significant flavonoid antioxidants in BG are lutonarin, saponarin, and flavone-C-glycosides [45]. The two most significant flavonoid antioxidants for BG are lutonarin and saponarin, which account for 71–75% of the ten phenolics. According to [46, 47], Syrian BG contains 14.0 mg/100 g of saponarin and 24.0 mg/100 g of lutonarin, as well as derivatives of the flavonols quercetin ($\text{C}_{15}\text{H}_{10}\text{O}_7$) and isorhamnetin. Methanolic extracts from different

regions of the world include flavonoids with glycosylation and acylation (C₁₆H₁₂O₇) in addition to hydroxycinnamate glycosides, esters, and amides [48].

3.3 Enzymes

The body utilizes 300 enzymes found in BG, including superoxide dismutase (SOD), catalase (CAT), guaiacol peroxidase (POD), ascorbate peroxidase (APX, cellular imaging), and aspartate aminotransferase (association). peroxidase, nitrogen oxyreductase, nitrate reductase, deoxyribonuclease, fatty acid oxidase, malic dehydrogenase (allosteric regulation), RNase, cytochrome oxidase and hexokinase (association with mitochondria), and P4D1 (with vitamin B6) including glycosyl isovitexin, peroxidase catalase, phosphatase, phospholipase, polyphenol oxidase, and transhydrogenase; but there are no enzymes in cooked foods [49, 50]. The initial enzyme in the production of phenylpropanoid-derived plant molecules such as flavonoids, coumarins, and the cell wall polymer lignin is L-Phenylalanine ammonia lyase [51]. Oxidative biomarkers in BG that react to antioxidant enzymes include SOD, CAT, POD, APX, lipid peroxidation, protein oxidation, DNase activity, and DNA damage. stress from Al³⁺ [52]. One example of superoxide dismutase's (SOD) strong anti-inflammatory action is the antioxidant enzyme CAT, which may offer protection against cancer and other diseases [53]. Erythrocyte zinc concentration and SOD activity are influenced by body mass index, waist size, metabolic syndrome, and plasma glucose levels [54]. Barley leaves typically have an average SOD activity of 4.11 1.31 U/mg [55]. Zn²⁺ and Cu²⁺ can also significantly inhibit CAT and SOD at higher amounts, as can Cd²⁺, Hg²⁺, and Mn²⁺. Pb²⁺ dramatically inhibits SOD and CAT in BG at varying doses [56]. Both plants and animals use H₂S as a signaling molecule; H₂S treatment maintains increased POD activity in barley aleurone layers treated with gibberellic acid and increased SOD, POD, CAT, and APX activity in layers not treated with GA [57].

3.4 Minerals

Increasing K⁺ intake by reducing inflammation and oxidative stress is one of the main dietary methods for reducing heart disease, Alzheimer's disease, hypertension, and improving cognitive performance [31,58]. Although hypocalcemia can be fatal in those with heart failure, chronic renal disease is linked to vascular calcification and abnormal electrolytes, which can result in cardiovascular disease and mortality [59]. Because of their quercetin and sulfide mechanism in treating chronic illnesses, garlic and onions have anti-cancer properties. They also help prevent heart and cardiovascular disorders, have anti-inflammatory properties,

reduce obesity, have antidiabetic, antioxidant, antibacterial, neuroprotective, and immunological effects, among other things [60]. BG has the highest mineral content, particularly in terms of calcium, potassium, and other minerals. Compared to brown rice, it has 14.3 times more K, 33.2 times more Ca, 13.4 times more Fe, and 3.3 times more sulfur [61]. It includes iron and sulfur. It has been shown that the qK1/qMg1/qCa1 region on chromosome 1H between markers Bmag0211 and GBMS0014 significantly increases the contents of Mg, Ca, and K in grains [62].

3.5 Chlorophyll.

The two pigments that are necessary for life are heme and chlorophyll. The biochemical pathways that generate methane include heme, vitamin B12, and chlorophyll [63]. As planting increased, BG's soluble protein and chlorophyll content declined. In barley leaves heated at a rate of 1°C per minute, the photosystem II core dimers began to split into monomers at 40–50°C, and protein complexes containing chlorophyll appeared at 57–60°C [64]. [65]. The rate of CO₂ fixation and chlorophyll content dropped when barley seedlings were etiolated at UV-B, whereas flavonoids, carotenoids, and enzyme activity rose. Chlorophyll contains anti-inflammatory and antioxidant properties and reduces body, urine, and fecal odor [27]. exposing it to 312 nm radiation for five hours [66]. Since chlorophyll has an antimutagenic action similar to that of 3-methylcholanthrene [67], chlorophyll derivatives may be involved in anti-cancer activity. Barley grass has a chlorophyll value of 542.9 mg/100 g. Table 1 displays the total flavonoids and chlorophyll content of barley grass under optimal combination drying conditions. The comparable results are 569.5 ± 14.5 and 600.6 ± 19.2 mg/100 g, respectively [69].

3.6 Vitamins

Higher blood vitamin levels, especially those of antioxidants and B vitamins, have been associated with a diet high in fruits and vegetables (400 g/day) [70]. Even if oxidative inflammatory stress is the cause of diabetes, it's crucial to monitor their vitamin B12 levels [71]. A high vitamin C concentration keeps the brain's microglia in a condition of equilibrium [72]. Worldwide, vitamin D insufficiency is prevalent and may have a role in the development of diabetes, cancer, depression, and other illnesses. [73]. Aphthous stomatitis (VB12), gallstones (VC), nonalcoholic steatohepatitis (VE), and chronic hepatitis C virus (VB12 and VD) can all be treated with vitamin treatment. Sebastian has a greater vitamin content than those with other illnesses.[74] The vitamin content is composed of 73.06 mg/kg

of vitamin E and 0.52% of vitamin C. that the greatest BG levels are seen in Malz (0.50%, 61.84 mg/kg) and AF Lucius (0.51%, 6.78 mg/kg) [75]. The content of vitamin A is 20.5 mg per 100 g, but the concentration of VB1 is 0.61 mg per 100 g. VB2, VB6, VE, and VC had corresponding values of 1.56 mg/100 g, 1.12 mg/100 g, 15.0 mg/100 g, and 251.6 mg/100 g.

3.7 Polyphenols.

Dietary polyphenols can help avoid chronic conditions including diabetes, heart disease, and the like. Numerous foods include 500 different types of polyphenols. cancer [76] because of its anti-inflammatory and antioxidant qualities, as well as its capacity to raise insulin resistance, lower blood pressure and cholesterol, and perhaps reduce the chance of death from all causes [77]. The total polyphenol concentration in BG increased from 776.6 to 1060.1 GAE mg/100 g between days 13 and 40 after germination, but then decreased at days 56 to 982.6 GAE mg/100 g. The antioxidant activity peaked 40 days after germination; the RC50 values of the ABTS+ scavenging experiment showed that the concentration of BG decreased from 111.0 to 53.3 µg/mL between days 56 and 55.3 µg/mL [78]. 56 days after planting, BG's total phenolic content is 13.91 mg/100 g, and 23 days later, it is 26.55 mg/100 g. There are derivatives of orientin, isoorientin, isovitexin, and important hydroxycinnamic acid [47].

4. Preventive Chronic Disease of Barley Grass

The eight essential amino acids, vitamins, minerals, chlorophyll, superoxide dismutase, luteonarin, and saponarin are all present in BG [79, 80]. However, heat will significantly reduce the nutritional value of BG. Antioxidant, hypolipidemic, antidepressant, and antidiabetic are just a few of the positive health effects of BG [81]. Saponarin-containing barley sprouts showed antioxidant and anti-inflammatory qualities. In order to stabilize grass powder, barley leaves are organically squeezed, juiced at a low temperature, and then spray-dried for three seconds [79]. BG is in excellent health. hypolipidemic, hypoglycemia, constipation prevention, and anti-inflammatory, antioxidant, and anticancer properties [79]. Frequent consumption of barley grass powder improves sleep, regulates blood pressure and blood sugar, strengthens the immune system and liver, cleanses skin prone to acne, supports gastrointestinal health, prevents gout and hyperuricemia, lessens constipation, has anti-inflammatory and anticancer properties, relieves atopic dermatitis, encourages weight loss and hypolipidemia, prevents heart disease, has bone injury recovery, lustihood, It also offers anti-aging effects, memory restoration, and anti-fatigue characteristics [82].

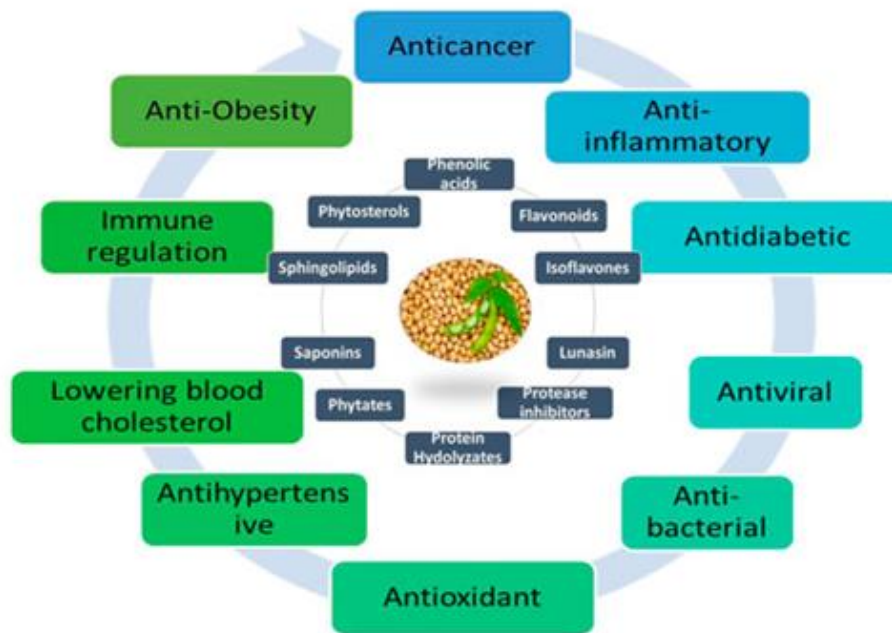


Chart 1: Therapeutic Role Of Barley Grass.

4.1 Promote Sleep and Functional Ingredients of Barley Grass.

Barley grass powder is a very powerful functional food for promoting sleep since it contains higher tryptophan, calcium, potassium, and GABA [83]. Sleep issues are associated with specific dietary nutrient intake, such as Ca (OR = 0.83) and K (OR = 0.70) [84]. Powdered barley grass for The Yungong brand has 31 times more K, 62 times more GABA, and 99 times more Ca than polished rice [83]. Refined rice or wheat flour mixed with BG powder and its derivatives is the most effective diet for improving sleep for modern people [83].

4.2 Antidiabetes and Functional Ingredients of Barley Grass.

BG and its extract may improve health, prevent vascular illnesses, scavenge oxygen free radicals, and damage diabetics' pancreatic endocrine systems [85]. Its dietary fiber considerably reduces blood glucose and fasting blood glucose [87]. The saponarin present in BG has the ability to control postprandial blood glucose [86] of diabetes [88]. Barley grass powder (1.2 g/day) can significantly lower fasting blood glucose, glycated hemoglobin, total cholesterol, and low-density lipoprotein (LDL) within two months. but also significantly increases HDL (high-density lipoprotein) cholesterol levels [89]. Barley leaves contain hexacosanol, which can improve cholesterol metabolism by reducing cholesterol synthesis [90]. Adenosine The 5'-monophosphate-activated protein kinase in barley seedlings can

regulate cell glucose, which is a target for drugs that treat obesity and diabetes. But the concentration of policosanol is just 10. The quantity of polyamines in barley cells can triple after sprouting (3.437 g/kg) compared to 5 days (1.097 g/kg) [91]. In some circumstances, it functions similarly to insulin and has an antiglycating effect; however, at high glucose levels, polyamine elevation prevents the glycation process [92].

4.3 Regulating Blood Pressure and Functional Ingredients of Barley Grass.

The comparison of hemoglobin (Fe) and chlorophyll (Mg) to porphyrin heads has a major therapeutic effect for chlorophyll in hemoglobin insufficiency [79]. The synthesis of heme and chlorophyll is regulated to support plant development and the environment. 5-Tetrapyrrole synthesis (Mg and Fe) is supported by aminolevulinic acid, but it is rapidly inhibited in the dark. of 5-aminolevulinic acid (C₅H₉NO₃) synthesis in BG [93]. BG contains saponarin, a flavonoid with potent blood pressure-regulating properties [94]. Barley grass is associated with superoxide dismutase, lutoxin, and saponarin, all of which contribute to the overall detoxification of the human body [79]. as well as digestion and blood flow. In addition to lowering blood pressure, grass powder contains more minerals (K, Ca, and GABA) but less Na [95]. Autumn planting at a cold, high altitude (2010 m) revealed amounts of 3110, 845, and 377.46 mg/100 g, respectively [83]. The quantity of total free amino acids varied significantly, whereas BG showed a greater shift from glutamate to GABA and promoted GABA gene expressions under frost tolerance and cold acclimation[96].

4.4 Enhance Immunity and Functional Ingredients of Barley Grass.

The complex structure of arabinoxylan in polysaccharide may be responsible for the immunomodulatory effect in young barley leaves [97]. Cultivars at elevations between 1200 and 3500 meters showed higher levels. Arabinoxylan (39.8–68.6%), anthocyanin (11.0–60.9%), β -glucan (7.5–30.8%), and metal chelating activity (16.6–43.2%) are all higher than in plains (97–126 m) [98]. One important component of cell wall accumulation is β -1,3-1,4-glucan. because of the relationship with macrophages, BG [99]. With an immunostimulatory arabinogalactan II side chain, the production of rhamnogalacturonan-I polysaccharide and glucuronoarabinoxylan may be important. stimulation of barley leaves [100].

4.5 Protective Liver and Functional Ingredients of Barley Grass

Barley sprouts high in saponarin have a liver-protective effect by reducing the inflammatory response caused by alcohol [81]. Studies conducted both in vitro and in vivo have shown that

saponarin offers hepatoprotection and antioxidant activity against CCl₄-induced liver damage. [101] Each of the three types of SOD enzymes has a unique gene. such as SOD3 (extracellular SOD), SOD2 (Mn-SOD), and SOD1 (CuZn-SOD) in animals. Over the course of a person's life, a SOD1 (CuZn-SOD) deficit may cause extensive damage from free radicals and the emergence of liver cancer [102].

4.6 Beauty Anti-Acne/Detox and Functional Ingredients of Barley Grass

Malathion (100% C₁₀H₁₉O₆PS₂) is more effective than chlorpyrifos (100% C₉H₁₁Cl₃NO₃PS) when used as a 15% solution of young green barley leaves for three hours at 37° C and pH 7.4, according to some intriguing research, but it can only degrade six organophosphate pesticides at 10 mg/L. Guthion (41%, C₁₀H₁₂N₃O₃PS), diazinon (54%, C₁₂H₂₁N₂O₃PS), and parathion (75%, C₁₀H₁₄NO₅PS) have higher percentages than methidathion (23%, C₆H₁₁N₂O₄PS₃). The expression of barley metallothioneins (MTs) varies in how they control the intracellular homeostasis of metal ions, especially in the detoxification of Cu, and the majority of MTs are downregulated by increased Zn or Cd. The levels of MT1a, MT2b1, MT2b2, and MT3 in barley leaves rose by more than 50 times in the ten days after germination [103].

4.7 Antidepressant and Functional Ingredients of Barley Grass.

One of the most prevalent mental diseases in the world, depression has also been associated with an increased risk of acquiring it. cancer, blood pressure, diabetes, obesity, dementia, stroke, epilepsy, and atherosclerosis. The pathophysiology of depression is significantly influenced by GABAergic, glutamatergic, and cholinergic receptors [104, 105]. They protect dementia and reduce epilepsy [82]. The young green barley leaf has antidepressant properties as well as vitamins that assist control the hippocampus's high nerve growth factor levels [106]. Furthermore, BG's minerals can aid in preventing depression and other stress-related psychological disorders [107].

4.8 Improve Gastrointestinal Function and Functional Ingredients of Barley Grass.

Young barley leaf powder's water-insoluble dietary fiber lowers pH, which stimulates the digestive system and increases fecal volume and laxative effects. [108] BG is a very successful therapy for pancreatitis, ulcerative colitis, and other gastrointestinal disorders [108, 109]. Selenium-enhanced barley grass, a germinated barley food product, significantly reduces ethanol-induced stomach ulcers in rats [11] and promotes the proliferation of probiotics, which can reduce ulcerative colitis and alleviate symptoms [110].

4.9 Anticancer and Functional Ingredients of Barley Grass

BG inhibits the growth of cancer cells by the combined effects of high alkalinity, strong antioxidants, phytochemicals, flavonoids, and chlorophyll [112, 113]. Breast cancer can be effectively treated with the phytochemical combination of BG [113]. Based on the absorbed exogenous functional components that are given externally, BG can be utilized as a health meal for dialysis patients. [114] Green barley extract's antiproliferative and proapoptotic mechanisms target human breast cancer cells, leukemia, and lymphoma. [115] Melanin production in melanoma cells can be inhibited by the hydroxyl group at the C-4' position and the methoxy groups at the C-3',5' position of BG tricin. the sites of the tricin skeleton. [116] Shanghai is in China, yet Yunnan is the province that produces the most anticancer barley and has the lowest cancer death rate in the country. Having the highest cancer death rate, which is connected to the notable decline in barley output. [117]

4.10 Anti-Inflammation and Functional Ingredients of Barley Grass.

BG is used to treat gastrointestinal disorders, pancreatitis, convalescing illness, and ulcerative colitis because it has anti-inflammatory properties and heals the intestinal lining. [108, 109, 118]. Saponarin from barley sprouts is a crucial functional element of natural anti-inflammation [119]. Barley grass extract works incredibly well in the While SOD intake can be utilized as an adjuvant therapy in the treatment of gynecologic and urologic disorders, rheumatoid arthritis is handled differently [120, 121]. Airway infections and other conditions can be treated naturally using BG extract, which has anti-inflammatory and antioxidant properties [79]. Treatment for rheumatoid arthritis involves scavenging reactive oxygen species and reducing the production of TNF- α from patients' peripheral blood and synovial fluid [121]. However, green barley juice is used to cure arthritis [122].

4.11 Antioxidants and Functional Ingredients of Barley Grass.

Among the naturally occurring antioxidants present in plants are polyphenols, flavonoids, vitamins, and volatile chemicals [123]. The same genes that create antioxidant metabolites also control the amount of γ -tocopherol, glutathione, and succinate in barley's flag leaf, making it one of the most resilient crops [124]. Among the antioxidant phytonutrients present in barley grass are protoheme, superoxide dismutase, and 2-O-glucosyl isovitexin (2-O-GIV) [125–126]. It has been determined that the flavonoids luteonarin and saponarin possess antioxidant characteristics. isolated from young barley [112, 127], where UV radiation increases the amounts of luteonarin and saponarin in barley grass [128]. Saponarin, a potent

antioxidant found in barley grass, can help prevent disorders including cardiovascular disease, inflammation, and many types of cancer that are linked to oxidative damage [94]. Oriorientin and isorientin demonstrated high antioxidant activity with IC₅₀ values of 20.765 ± 651.1 and 27.565 ± 657.36508 M (DPPH) and 5.765 ± 650.3, respectively. [129] 8.265 650.36508 M (ABTS). [126] In the food industry, barley leaf methanol and ethanol extracts might serve as substitutes for artificial antioxidants. Barley leaf powder can be added to raw minced pork as a natural way to lessen oxidation [130]. By increasing the content of unsaturated oleic and gondoic acids in feeds, barley leaves, which are rich in antioxidants, might increase the quality of pork [131].

4.12 Hypolipidemic and Functional Ingredients of Barley Grass.

Barley green can improve the vascular endothelium, reduce atherosclerosis, regulate lipid metabolism, and stop lipid peroxidation [132]. It has been demonstrated that barley leaves can prevent hyperlipidemic atherosclerosis by thirty percent. When it comes to reducing plasma lipids and boosting antioxidative ability, 2-O-glycosyl isovitexin from BG is more effective than [86] α-tocopherol. higher amounts of fatty acid esters [133]. Barley sprouts have substantial levels of fat (4.97%), polysaccharides (52.6%), protein (34.1%), vitamins, minerals, and polyphenols, all of which have been demonstrated to dramatically reduce blood lipid levels [90].

4.13 Antigout/Hyperuricemia and Functional Ingredients of Barley Grass.

Barley grass lowers blood uric acid, which benefits human liver function, feces, lipid metabolism, and the antioxidant system [134]. SOD and alkaloid are mostly used to treat bursitis, arthritis, and other conditions, however a fermented barley extract can reduce the effect of uric acid on hyperuricemia [135]. gout [136, 137]. By increasing the excretion of uric acid in the urine, a fermented barley extract P reduces serum uric acid levels [138].

4.14 Preventive Cardiovascular Diseases and Functional Ingredients of Barley Grass.

BG antioxidation may prevent metabolic disorders, cancer, and cardiovascular diseases [127]. By increasing blood flow and viscosity, BG can avoid thrombosis and cardiovascular disorders [139]. The proper tryptophan metabolism of barley grass is a viable therapy for cardiovascular disease symptoms [140].

4.15 Antihypoxia/Anti-Fatigue and Functional Ingredients of Barley Grass.

The 17.0% total luteolin and saponarin content of BG is very rich in flavones that help people avoid exhaustion and hypoxia [141]. The barley seedling (1 g/mL) significantly reduces fatigue in mice, especially during the exhausting swimming and antianoxic time with a much longer duration. This reduced blood glucose is a major contributor to diabetes caused by alloxan (C₄H₄N₂O₅) and alcohol-induced stomach ulcers [142].

4.16 Preventive Constipation and Functional Ingredients of Barley Grass.

Young barley leaf powder has several health advantages, including the prevention of constipation [143]. By promoting the growth of beneficial bacteria in the colon, the dietary fiber in germinated barley relieves constipation. The colonic crypts of rats given loperamide (C₂₉H₃₃ClN₂O₂) do not comprise the 29.5% dietary fiber content of BG [144].

4.17 Alleviated Atopic Dermatitis and Functional Ingredients of Barley Grass.

The GABAA receptor is a new therapeutic for inflammatory skin conditions [145]. By regulating the Th1/Th2 balance to promote a Th1-immune response, the combination of GABA and fermented barley extract P. decreased atopic dermatitis [146]. Yungong BG has a GABA content of 377.46 mg/100 g, which is 37.8 times higher than polished rice and 62.5 times higher than brown rice [82, 83].

4.18 Preventive Heart Disease and Functional Ingredients of Barley Grass.

In contrast to stroke and diabetes in Asian countries, coronary heart disease is more common in Western countries due to the loss of K. magnesium and dietary fiber from whole wheat to wheat flour, a primary food source [82]. Because heart illness is associated with reduced oxidative stress and inflammation, increasing K⁺ intake may help prevent heart disease [82, 147]. Yungong has 3110 milligrams of K per 100 grams. The cost of polished rice is 31 times higher than that of BG [82, 83].

4.19 Calcium Supplement and Functional Ingredients of Barley Grass.

Both physiological and pathological processes in both health and illness depend on calcium homeostasis [148]. Osteoporosis can be prevented or treated using BG [149]. Yungong BG has a positive impact on health because of its high Ca content (845 mg/100 g), which is 99.6 times that of polished rice [82, 83].

4.20 Improve Cognition and Functional Ingredients of Barley Grass.

GABA and K have stronger impacts on cognition because of their larger concentrations [82, 150, 147]. These effects are caused by the amounts of K (3110 mg/100 g) and GABA (377.46 mg/100 g). Yungong BG is 31 times and 62.5 times that of polished rice, respectively [82,83].

4.21 Preventive Other Diseases and Functional Ingredients of Barley Grass.

Additionally, the Yungong brand BG offers anti-aging, lustihood, blood fat reduction, weight loss, and bone damage rehabilitation [82]. The retina, lungs, gastrointestinal tract, brain, and immune system all depend on the fat-soluble vitamin carotene [151]. The digestive, neurological, and cardiovascular systems benefit from daily intake of 2.0 mg of the water-soluble vitamin B1 [152].

Number	Chronic disease	Functional ingredients
1	Promote sleep	GABA, Ca, K, tryptophan, vitamin C
2	Antidiabetes	Saponarin; dietary fiber, Ca; AMP-activated protein kinase, polyamines; GABA; SOD
3	Regulating blood pressure	Saponarin; lutanarin, K, Ca; GABA
4	Enhance immunity	Arabinoxylan; polysaccharide; GABA
5	Protective liver	Saponarin; SOD; GABA
6	Beauty anti-acne/detox	Metallothioneins
7	Antidepressant	GABA; saponarin; vitamins and minerals
8	Improve gastrointestinal	Dietary fiber; selenium; GABA
9	Anticancer	Alkaline, flavonoids, chlorophyll; tricin; SOD
10	Anti-inflammation	Chlorophyll; saponarin; SOD; GABA; tryptophan
11	Antioxidants	Chlorophyll; lutanarin, saponarin; isoorientin and orientin; γ -tocopherol, glutathione; SOD, flavonoid, protein P4D1; GABA
12	Hypolipidemic	Saponarin; α -tocopherol; 2''-O-glycosyl isovitexin, polysaccharide
13	Antigout/hyperuricemia	Alkaloid, SOD
14	Preventive cardiovascular diseases	Saponarin; tryptophan; vitamins (A, B1, C, E), SOD; K, Ca; GABA
15	Antihypoxia/anti-fatigue	Flavones (lutanarin, saponarin)
16	Preventive constipation	Dietary fiber
17	Alleviated atopic dermatitis	GABA, SOD
18	Preventive heart disease	K, GABA
19	Calcium supplement	Ca
20	Improve cognition	GABA, K, SOD

Table.1: Functional ingredients of barley grass for therapeutic disease.

5. Toxicity

While eating barley grass is generally harmless, some people may have negative side effects including bloating, gas, or diarrhea, especially if they take excessive amounts. Supplements should be avoided by those with celiac disease or gluten sensitivity due to the potential for cross-contamination or the presence of gluten. Certain supplements include high levels of

potassium or vitamin K, which might be dangerous for people with underlying medical conditions or those on certain drugs. It is always advisable to see a healthcare professional before consuming barley grass supplements, especially if you are taking any drugs or have any underlying medical conditions.

Possible Adverse Effects

- **Digestive Issues:** Because of its high fiber content, consuming large amounts of barley grass might result in gas, bloating, and diarrhea.
- **Allergic responses:** Barley allergies can cause allergic skin responses in certain individuals.
- **Drug Interaction:** Barley grass may lower blood glucose levels, which may call for modifications to diabetic care. Its high fiber content may make it more difficult for the body to absorb other oral medications.

Groups Who Should Be Wary

- **People with celiac disease or gluten sensitivity:** Although barley grass is naturally devoid of gluten, supplements may contain gluten due to the barley plant's seeds.
- **Due to the high potassium level of some barley grass products,** those with renal problems may need to limit their use.
- **Drug Users:** Certain medications, particularly those used to treat diabetes or conditions where potassium or vitamin K intake is an issue, may interact with barley grass.

Suggestions for Healthy Eating

- **Consult a Healthcare Professional:** You should always consult a physician or other healthcare professional before starting barley grass supplements, especially if you are on any drugs or have any underlying medical issues.
- **Start with modest Doses:** Before increasing your consumption, start with a modest amount of barley grass to observe how your body responds.
- **Choose Superior Products:** Obtain supplements from reliable producers and look for independent testing to ensure quality and safety.[153]

6. Precautions

Breastfeeding with pregnancy: Barley is PROBABLY safe to eat orally during pregnancy in the amounts typically seen in meals. However, pregnant women shouldn't eat too many barley sprouts since they could be dangerous. There isn't enough reliable information on barley's

safety for nurses. Don't use it to protect yourself. Celiac illness or gluten sensitivity: Barley contains gluten, which can make celiac disease worse. Avoid using barley.

Cereal grain allergies: Eating barley may trigger an allergic reaction in certain people who are allergic to rye, wheat, oats, maize, rice, and other cereal grains. Barley may help reduce blood sugar if you have diabetes. Your diabetic medication regimen may need to be adjusted by your physician. Surgery: Barley may cause blood sugar levels to drop, and there is worry that this might affect how well blood sugar is regulated both during and after surgery. Stop using it. Barley, at least two weeks before a scheduled procedure. [154]

7. Chemical Composition and Medicinal Uses of Barley

Barley is considered a low-GI food since its glycemic index (GI) is less than 55. Those who are gluten intolerant can now eat barley-based meals due to its glycemic index. For those with diabetes. For people with type II diabetes or prediabetes, barley is an excellent dietary source. This grain is an excellent source of soluble dietary fiber, especially beta glucans, and contains essential nutrients, vitamins, and minerals [155]. According to studies on barley's chemical composition, the grain contains 60–65% carbohydrate, 10–17% protein, 4–9% beta-glucans, 2–3% lipids, 1.5–2.5% mineral components, and 3–20% soluble fibers [156,157]. The chemical composition of barley grain is different from that of green barley.



Fig. 4. Barley Grass Nutrition Powder.



Fig. 5. Barley Grass Nutrition Water.

Green barley's metabolic composition delays cell aging, giving it a unique therapeutic benefit. Green barley contains the best nutritious resources for human cells when it reaches a height of 20 to 30 cm. Iron, calcium, manganese, vitamin C, vitamin E, and B vitamins (B1, B2, B6, and B12) are all abundant in barley leaves at this phenophase. bioflavonoids, polysaccharides, polypeptides, lithium, copper, zinc, germanium, molybdenum, and magnesium. Barley supports healthy bodily functions since it is so rich in these nutrients.

Barley is utilized in therapeutic and medical applications as barley water (Fig. 5), powder (Fig. 4), or fresh juices (green barley). Physician Dr. Yoshihide Hagiwara found that green leaves had a major effect on human health after examining 150 different plants. Green barley has a powerful therapeutic effect and is the most advantageous to the human body of all the kinds [158,159].

8. CONCLUSION

Barley is the oldest and most nutrient-dense functional food found in the planet. β -glucan, polyphenols (phenolic acids, flavonoids, and anthocyanins), polysaccharides (arabinoxylan), phytosterols (β -sitosterol, campesterol), tocopherols (β -tocotrienol, α -tocotrienol, β -tocopherol, α -tocopherol), resistant starch, alkaloid, phytate, linoleic acid, folate, GABA, and other substances. The anti-diabetic, anti-obesity, anti-cancer, antioxidant, anti-inflammatory, immunomodulatory, cardioprotective, gastroprotective, and hepatoprotective qualities of barley grains are also highlighted in this review article. Blood pressure can be lowered, cardiovascular problems can be avoided, cholesterol levels can be maximized, metabolic syndrome and intestinal health can be improved, heart disease can be avoided, and chronic renal disease may be lessened with barley grains. reduce atopic dermatitis and allergic rhinitis, hasten the healing of wounds, and prevent stroke. Barley is rich in several elements, which are necessary for the body to operate properly. Another technique to fully benefit from barley is to drink barley water. Innovative nutraceuticals, functional foods, or complementary and alternative medicine treatments targeted at improving or controlling the chronic diseases in barley grass might be developed based on this assessment.

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