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Ethnomedicinal Uses, Phytochemistry and Pharmacology of *Hordeum vulgare*: An Overview

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Abstract

Medicinal plants have played a vital role in traditional and modern healthcare systems, offering a natural reservoir of bioactive compounds with therapeutic potential. Among them, *Hordeum vulgare* (barley) stands out due to its significant nutritional and medicinal properties. This paper explores the botany, ethnomedicinal uses, phytochemistry, and pharmacology of *Hordeum vulgare*. As a globally cultivated cereal grain belonging to the family Poaceae, barley has been an essential crop for over 10,000 years. It demonstrates remarkable adaptability to diverse climates, thriving in regions with extreme environmental conditions. Ethnomedicinal practices utilize various parts of the plant, including grains, leaves, and sprouts, for addressing ailments like digestive issues, skin conditions, and respiratory disorders. The phytochemical composition of barley reveals a wealth of bioactive compounds, such as β-glucan, phenolic acids, flavonoids, and lignans, which are attributed to its antioxidant, anti-inflammatory, and cardioprotective effects. Pharmacological studies highlight barley's potential in reducing inflammation, regulating lipid metabolism, and combating oxidative stress. Recent investigations demonstrate its anticancer, immunomodulatory, and xanthine oxidase inhibitory activities, emphasizing its therapeutic versatility. This review synthesizes existing research to underline the significance of *Hordeum vulgare* as a multifunctional plant in botany, ethnomedicine, and pharmacology, while advocating for further studies to expand its applications in modern healthcare.

Keywords: Medicinal plant, *Hordeum vulgare*, ethomedicinal uses, phytochemistry, pharmacology, etc.

Introduction

Medicinal plants have been a cornerstone of traditional medicine across the globe, serving as invaluable resources for treating a wide range of health conditions. They contain diverse bioactive compounds that exhibit therapeutic properties, making them essential for both traditional remedies and modern pharmaceutical development. For centuries, people have relied on these plants for their healing potential, using them to manage ailments such as inflammation, infections, digestive disorders, and chronic illnesses. The integration of medicinal plants into healthcare systems is particularly significant in regions with limited access to conventional medicines, underscoring their importance in achieving accessible and sustainable healthcare [1-3].

One such plant with a wealth of medicinal and nutritional properties is *Hordeum vulgare*, commonly known as barley. Widely cultivated as a cereal crop, barley is primarily recognized for its nutritional value, but it also possesses remarkable medicinal properties. Traditionally, various parts of the plant—including grains, sprouts, and leaves—have been utilized in ethnomedicine for their health benefits. Modern research has further highlighted its potential due

to its rich phytochemical profile, including polyphenols, flavonoids, and dietary fibers. These compounds exhibit antioxidant, anti-inflammatory, antidiabetic, and cardioprotective effects, making *Hordeum vulgare* an important subject of study in botany, pharmacology, and ethnomedicine [4-6].

The genus *Hordeum* belongs to the family Poaceae and comprises approximately 30 species, including wild and domesticated varieties. Among these, *Hordeum vulgare* is the most extensively cultivated species and is a staple cereal crop worldwide [7]. Native to the Fertile Crescent, barley has been cultivated for over 10,000 years, making it one of the earliest domesticated grains. Its adaptability to diverse climates and soil types has contributed to its global cultivation, from temperate regions to arid lands. Barley is an annual herbaceous plant characterized by its slender stems, narrow leaves, and elongated inflorescences known as spikes. Each spike bears rows of grains that are typically enclosed in protective hulls, although hull-less varieties also exist. The grains are rich in essential nutrients, including vitamins, minerals, and dietary fiber, particularly beta-glucan, which has been extensively studied for its health benefits. The plant's resilience and nutritional value have made it an integral part of traditional diets and agricultural systems [7-9]. Ethnomedicinally, *Hordeum vulgare* has been used in various cultures to treat ailments such as gastrointestinal disorders, skin conditions, and respiratory infections. In traditional Chinese medicine, barley water is consumed to alleviate digestive issues and promote hydration. Similarly, in Ayurveda, barley is considered a coolinggrain that supports detoxification and enhances metabolism. The young green shoots of barley, often referred to as barley grass, are particularly valued for their high concentration of vitamins, antioxidants, and chlorophyll, making them a popular ingredient in health supplements and detox diets [10,11].

From a phytochemical perspective, barley contains numerous bioactive compounds, including phenolic acids, flavonoids, and lignans, which contribute to its antioxidant and anti- inflammatory properties. Beta-glucan, a soluble fiber abundant in barley, has been shown to lower cholesterol levels, regulate blood sugar, and promote gut health. Additionally, barley's polyphenolic content provides protective effects against oxidative stress, a key factor in the development of chronic diseases such as diabetes and cardiovascular disorders.

The pharmacological potential of *Hordeum vulgare* continues to be explored in modern scientific studies. Research has demonstrated its efficacy in reducing inflammation, improving lipid metabolism, and combating oxidative stress. Its broad spectrum of applications in food, medicine, and health supplements highlights the versatility of this ancient grain, reaffirming its value in both traditional and modern healthcare systems.

Hordeum Vulgare: Botany

Hordeum vulgare, commonly known as barley, is a globally cultivated cereal grain belonging to the Poaceae family. This annual grass reaches heights of 50-120 cm, characterized by slender stems with alternating leaf arrangements. The leaves are linear and flat, exhibiting parallel venation. The inflorescence of barley is a spike, with sessile florets attached along the rachis. The grains, enclosed within a husk, are the edible component, predominantly used for food, animal feed, and brewing. Barley thrives in diverse climates, tolerating drought and salinity, making it a staple crop in many regions. It is also notable for its genetic adaptability, contributing to its widespread use in breeding programs for agricultural enhancement [12].

Table 1: Ethnomedicinal Uses of Hordeum Vulgare

S. No.	Plant Parts	Ethnomedicinal Uses
1	Grains	Used to prepare decoctions for digestive issues.
2	Leaves	Applied as poultices for wounds and skin conditions.
3	Husk	Utilized in traditional teas for detoxification.
4	Sprouts	Employed in improving appetite and reducing fatigue.

Phytochemistry and Pharmacological Activities

Barley is a reservoir of bioactive compounds, including polysaccharides, phenolic acids, alkaloids, and flavonoids. The most prominent phytochemical in barley is β-glucan, a soluble dietary fiber acclaimed for its health benefits. Other essential constituents include tocopherols, sterols, and lignans. Phenolic acids like ferulic and caffeic acid contribute to its antioxidant properties. Barley grains also contain essential vitamins (B-complex, E), minerals (selenium, magnesium), and enzymes [13].

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Pharmacological Activities

Boyina *et al.*, (2024) investigated the medicinal properties of *Hordeum vulgare*, focusing on its potential therapeutic benefits and anti-inflammatory properties of Barley Grass Hexane Extract (BGHE) and Barley grass aqueous extract (BGAQ). Both BGHE and BGAQ demonstrated significant inhibitory effects on inflammation compared to the control group. However, BGHE exhibited superior anti-inflammatory efficacy when compared to BGAQ, suggesting its role as a potential anti-inflammatory agent. *In silico* studies further supported the anti-inflammatory potential of Barley grass leaf extracts.

Farooqi *et al*., (2024) investigated phytochemical composition and *in vitro* antioxidant activity of *Hordeum vulgare* (HV) seed extracts. Researchers sequentially extracted HV seeds using various solvents with increasing polarity: hexane, dichloromethane, ethyl acetate, acetone, and methanol1. They determined the total phenolic content using a spectrophotometric technique, calculated as gallic acid equivalents (GAE)/g dry weight. The acetone extract demonstrated the highest phenolic content (0.0597 mg GAE/g). Similarly, researchers evaluated the total flavonoid content using spectrophotometry, expressing the results as rutin equivalent (RE)/g of dry weight. The dichloromethane extract exhibited the highest flavonoid content (0.09 mg RE/g). To evaluate the antioxidant activity of the extracts, the study employed two *in vitro* assays: 1,1-diphenyl-2-picryl-hydrazyl free radical (DPPH) and 2-azino-bis(3-ethyl benzthiazoline-6-sulfonic acid) (ABTS). All the extracts showed significant antioxidant activity in both DPPH and ABTS assays. At a concentration of 100 mg/ml, the methanol anddichloromethane extracts exhibited the highest DPPH radical scavenging activity (52.41% and 42.07%, respectively). Researchers further determined the IC_{50} using the acetone and methanol extracts.

Lantos *et al.*, (2023) performed the antioxidant activity of young barley *(Hordeum vulgare)* leaf extracts. Researchers prepared methanolic and aqueous extracts and evaluated their free radical scavenging capacity using DPPH and ORAC

assays. They also examined the extracts' ability to inhibit xanthine oxidase, an enzyme implicated in gout. The results suggest that barley extracts, particularly the aqueous extract, exhibit moderate xanthine oxidase inhibitory activity. However, the antioxidant activity of the extracts was relatively low compared to standard compounds like ascorbic acid, rutin, and quercetin.

Lemieszek *et al.*, (2022) investigated the immunomodulatory properties of a polysaccharide- rich young green barley (*Hordeum vulgare*) extract (YGB). Researchers evaluated its influence on natural killer (NK) cell viability and proliferation, and the ability of YGB-activated NK cells to kill human colon cancer cells (LS180). They also assessed the potential cytotoxic effects of YGB on both normal (CCD841 CoN) and cancerous colon cells, using LDH, MTT, and BrdU assays. The results demonstrated that YGB enhanced the cytotoxic activity of NK-92 cells against colon cancer cells while exhibiting no adverse effects on normal colon epithelial cells. Additionally, YGB showed a direct anticancer effect on LS180 cells, further supporting its potential for colon cancer prevention.

Czerwonka *et al.*, (2017) investigated the anti-cancer potential of young barley (*Hordeum vulgare*) extracts in human colon and lung cancer cell lines *in vitro*. Researchers prepared a water extract (HWE) and juice extract (HJE) of young barley and evaluated their effects on cell proliferation, viability, and cell death, using MTT, NR, and propidium iodide/Hoechst staining. They also examined the extracts' free radical scavenging activity using the DPPH assay and their impact on cell cycle progression. The results demonstrated that both extracts inhibited the proliferation of cancer cells, particularly colon cancer cells (HT-29), while showing minimal cytotoxicity to normal human colon cells. HWE also induced necrosis in HT-29 cells and exhibited antioxidant activity. These findings suggest that young barley extracts, particularly HWE, may hold potential as safe dietary agents for colon cancer prevention.

Summary

The exploration of *Hordeum vulgare* underscores its remarkable role as both a nutritional staple and a medicinal resource. Its diverse ethnomedicinal applications, supported by traditional knowledge, highlight its importance in addressing common health conditions such as gastrointestinal disturbances, skin ailments, and metabolic disorders. The plant's robust phytochemical profile, including β-glucan, phenolic acids, and flavonoids, offers a foundation for its wide-ranging pharmacological activities. These include potent antioxidant, anti-inflammatory, and anticancer properties, as evidenced by both in vitro and in vivo studies.

Barley's adaptability to harsh environments and its ease of cultivation make it an invaluable crop for sustainable agriculture and health promotion. The therapeutic potential of its extracts, particularly in modulating immune responses and reducing oxidative stress, suggests promising avenues for clinical applications. Additionally, emerging evidence on its anticancer and xanthine oxidase inhibitory effects indicates its potential in the prevention and management of chronic diseases. In conclusion, *Hordeum vulgare* serves as a bridge between traditional wisdom and modern scientific advancements, offering a sustainable and effective resource for improving human health. While current studies highlight its multifaceted benefits, future research should focus on isolating and characterizing its active compounds, conducting clinical trials, and exploring its synergistic effects with other therapeutic agents to maximize its contributions to global healthcare.

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