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Review Article

Dentistry Section

Wheatgrass as a New-age Therapeutic Agent: A Review on Nutritional, Antioxidant and Dental Applications

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ABSTRACT

Herbal drugs are increasingly consumed today to maintain a healthy lifestyle and manage various health problems. Their popularity has grown due to their perceived safety, cost-effectiveness and long history of use since ancient times, even predating conventional medicine. Wheatgrass is a promising therapeutic herbal remedy with numerous nutritional benefits and is widely used for the prevention and treatment of various disorders. It is often referred to as "green blood" because of its high chlorophyll content, which is largely responsible for its health-promoting effects. Wheatgrass is a multi-targeted natural agent that can be used alongside conventional medicine to combat cancers and other health complications. The present review article aimed to highlight the nutritional benefits of wheatgrass and its potential antioxidant, anti-inflammatory and anti-aging properties, which contribute to its use in several disease conditions, including oral infections. Given its easy availability and minimal side-effects, incorporating wheatgrass into the daily diet may maximise its benefits in maintaining both general and oral health.

Keywords: Antimicrobial activity, Cancer, Dental caries, Green blood therapy, Periodontal disease

INTRODUCTION

Wheatgrass has long been used in traditional medicine for its diverse health benefits. It is well known for its antibacterial, antimicrobial, anti-aging, antioxidant, anti-inflammatory, anticarcinogenic and various other healing properties [1]. Wheatgrass is native to Southwest Asia and the Mediterranean region, with a total of 15-20 species documented worldwide, of which eight are reportedly found in India [2,3]. It can be consumed in the form of fresh juice, dried juice concentrate, tablets, extracts, or whole leaf powder [4].

As mentioned in the title, wheatgrass can be termed a "new-age medicine" as it complements conventional medical therapy, serving either as an adjunct or, in some cases, an alternative treatment. It contains chlorophyll, amino acids, minerals, vitamins A, C and E, as well as specific enzymes. Wheatgrass accelerates tissue repair and has been found effective in managing illnesses such as anemia, eczema, asthma, gastritis, certain cancers, obesity and ulcers [5]. Although considerable attention has been given to the nutritional properties of Triticum aestivum, its application in dentistry remains understudied. The use of wheatgrass as a remedy for oral complications appears promising. The present review highlights the nutritional benefits of wheatgrass, its mechanisms of action and its potential role in preventing cancer, dental caries and periodontal disease.

General Nutritional Assets of Wheatgrass

The primary effects of wheatgrass consumption on the human body include blood purification, colon cleansing and liver detoxification [5]. It has been traditionally used to treat a wide range of conditions such as fever, oral inflammations, skin diseases, haemorrhoids, eczema, the common cold, cough, burns and bronchitis. Wheatgrass is also referred to as "green blood" because chlorophyll, its principal constituent, exerts strong antibacterial and healing effects [6]. It has been reported to aid in the treatment of oral inflammations, advanced pyorrhoea, varicose veins and other chronic conditions.

The high magnesium content in chlorophyll contributes to the regulation of sex hormones and alleviates menopausal symptoms. Structurally, chlorophyll resembles haemoglobin and thus enhances oxygen delivery to body tissues [7]. Wheatgrass, rich in vitamins A, B, C, and E, acts as a potent antioxidant that delays cellular aging and reduces the risk of neurological and cardiovascular disorders [6].

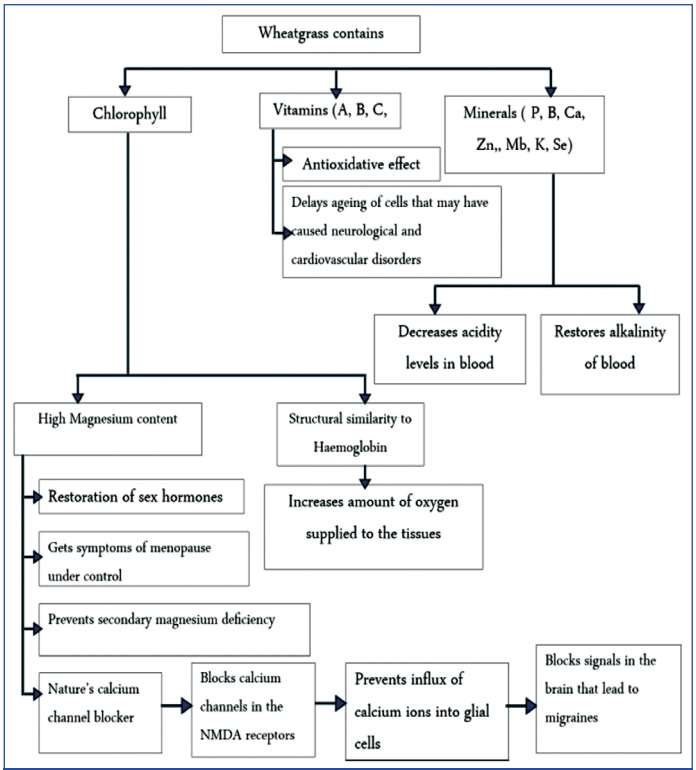
Vitamin A, C and E, carotenoids and polyphenols present in wheatgrass regulate proinflammatory cascades by acting as antioxidants to decrease oxidative stress. Vitamin C, a water-soluble reducing substance that donates electrons, helps in maintaining the equilibrium of cells' redox potential and scavenges Reactive Oxygen Species (ROS) generated by oxidative stress and thereby decreases the resultant inflammatory responses [8].

Vitamins A, C and E, along with carotenoids and polyphenols in wheatgrass, regulate proinflammatory cascades by functioning as antioxidants that decrease oxidative stress. Vitamin C, a water-soluble reducing agent, donates electrons, maintains cellular redox balance and scavenges ROS generated by oxidative stress, thereby reducing inflammatory responses [8].

From a pharmacological perspective, wheatgrass has potential applications in the prevention of diabetes, allergies, ulcers, certain cancers, bacterial infections and arthritis, as well as in the maintenance of immunity. Indole, a flavonoid present in wheatgrass, supports enzyme synthesis and assists in detoxifying carcinogens in the liver [5]. Additionally, minerals such as phosphate, boron, calcium, zinc, molybdenum, potassium, magnesium and selenium help reduce high blood acidity and restore alkalinity [6].

Apart from chlorophyll and vitamins, wheatgrass also contains antioxidant enzymes such as cytochrome oxidase and superoxide dismutase. The enzyme superoxide dismutase has gained considerable attention in recent years for its ability to inhibit cell mutation [9]. Elevated levels of these enzymes act as natural cleansers, aiding liver detoxification and bloodstream purification. The nutritional role of each individual constituent of wheatgrass has been explained in [Table/Fig-1]. Wheatgrass also contains ferulic acid (a natural phenol), which protects the liver from lipid peroxidation. A study by Durairaj V et al., demonstrated that wheatgrass effectively reduces oxidative stress induced by alcohol and polyunsaturated fatty acids. Wheatgrass extracts safeguard the liver by enhancing host cellular antioxidant enzyme responses, leading to the conclusion that wheatgrass is an efficacious hepatoprotective agent [10].

According to a study by Sanguigno L et al., evidence supports the anti-inflammatory effects of a specific extract of *Triticum vulgare* (TVE), manufactured by Farmaceutici Damor. This extract shows

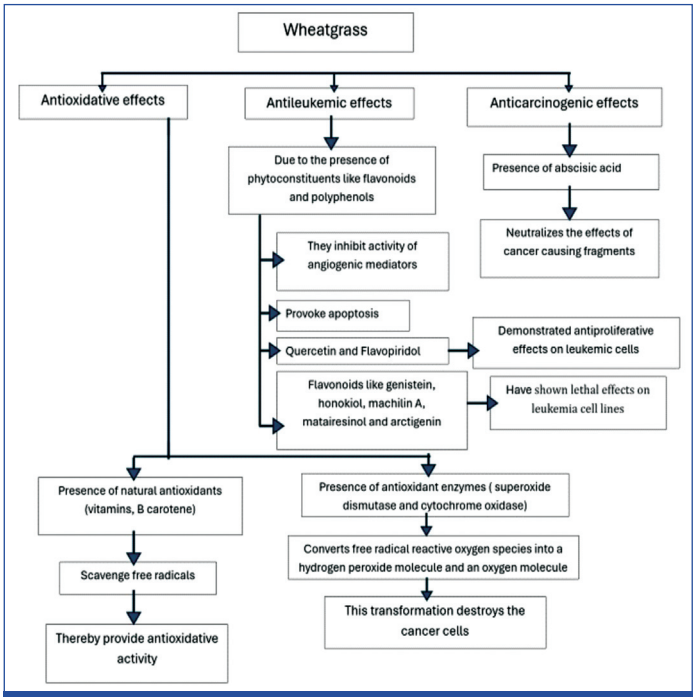


[Table/Fig-1]: Nutritional role of the individual components of wheatgrass (original).

therapeutic potential as an anti-inflammatory agent in conditions such as ulcers, burns, certain peripheral nerve inflammations and folliculitis. Its ability to inhibit inflammation highlights its possible application in the treatment of these pathological conditions [11].

Use of Wheatgrass in Chemoprevention

Cancer is a life-threatening multifactorial disease. While chemotherapy may successfully treat cancer, it is associated with numerous toxic side-effects and painful manifestations that compromise patient health. The mode of action of wheatgrass in chemoprevention has been described in [Table/Fig-2]. Fresh wheatgrass juice has been shown to scavenge free radicals, neutralise carcinogens and toxins, reduce chemotherapy-induced myelotoxicity and regulate the levels of certain proinflammatory cytokines such as Interleukin (IL)-6, IL-8 and IL-10. These findings suggest that wheatgrass may serve as a potential therapeutic agent in treating premalignant lesions of the oral cavity [12].



[Table/Fig-2]: Mode of action of wheatgrass in chemoprevention (original).

Flavonoids present in wheatgrass suppress excessive proliferation of cancer cells by inhibiting the Epidermal Growth Factor Receptor (EGFR) or the Mitogen-Activated Protein Kinase (MAPK) pathway. Cancer cells are often resistant to apoptosis (programmed cell death), but flavonoids can activate apoptotic signalling cascades, thereby stimulating cell death pathways [12]. Wheatgrass has shown potential benefits in breast cancer, lung cancer, colorectal cancer, oral cancer, laryngeal cancer and ovarian cancer. Studies also indicate that wheatgrass inhibits metastasis and angiogenesis in Hepatoblastoma (HEp2) cell lines—an important breakthrough since angiogenesis facilitates cancer cell migration to other organs [13,14].

According to a study by Dey S et al., wheatgrass therapy is an essential component of the macrobiotic diet within the complementary and alternative medicine approach to anticancer therapy. Selenium and laetrile, both present in wheatgrass, exhibit anticancer properties. Selenium, in particular, plays a vital role in strengthening the immune system, thereby reducing cancer risk [15].

Wheatgrass and Dental Caries

Dental caries, commonly known as tooth decay, is one of the most widespread chronic diseases worldwide (Selwitz RH, 2007) [16]. It is defined as a biofilm-mediated, diet-modulated, multifactorial, non communicable, dynamic disease that results in the net mineral loss of dental hard tissues [17]. The overall prevalence of dental caries in the Indian population is approximately 54.16% {National Institutes of Health (NIH), 2021} [18]. Dental caries significantly affects quality of life by causing masticatory problems and impairing communication in both adults and children [19]. Furthermore, individuals who develop caries during childhood are at a higher risk of developing recurrent caries later in life [20].

Given the global burden of dental caries, naturally healing foods with antioxidant and antibacterial properties should be considered as preventive measures—and wheatgrass plays an important role in this regard. General dental diseases can arise from dietary mineral deficiencies, reduced levels of essential vitamins such as A, D, E and K, or impaired nutrient absorption. Regular consumption of wheatgrass may help prevent these conditions owing to its high nutrient concentration and enzyme content, which enhance nutrient absorption and digestion [6].

The major causative organism of dental caries is *Streptococcus mutans*, along with plaque formation. Wheatgrass extract has demonstrated antibacterial activity against *Streptococcus mutans* and *Lactobacillus* species at minimum inhibitory concentrations of 5% and 1.25% in ethanol extract, respectively, as reported by Rajpurohit L et al., [21]. Hence, wheatgrass could be considered for the prevention and treatment of dental caries. Certain phytochemicals such as flavonoids and alkaloids present in wheatgrass also possess antibacterial properties. Das A et al., found that 80% acetone extracts of wheatgrass were effective against foodborne microorganisms including Bacillus cereus, *Staphylococcus aureus*, *Escherichia coli*, *Shigella flexneri* and the fungus *Aspergillus niger* [22].

Triticum aestivum significantly inhibited the growth of *E. coli* and is therefore considered a good alternative to chemical antibiotics [23]. *E. coli* is a Gram-negative facultative anaerobe frequently found in infected root canals. From the abovementioned research, it can be extrapolated that wheatgrass may be useful in treating such infections prior to root canal therapy. Many secondary metabolites such as alkaloids, tannins, terpenoids and flavonoids have demonstrated in-vitro antimicrobial properties. Wheatgrass extracts are particularly rich in bioflavonoids, which contribute to its antimicrobial effects [24].

The antimicrobial mechanism of terpenoids is primarily attributed to their lipophilicity, which enables them to disrupt bacterial cell

membranes. They also inhibit Adenosine Triphosphate (ATP) and related enzymes, thereby impairing the primary energy source of microorganisms. The antibacterial activity of flavonoids is largely related to the presence of hydroxyl groups on their aromatic framework and the nature of their substituents. Their antimicrobial mechanism includes increasing bacterial cell membrane permeability, reducing bacterial motility, downregulating virulence factor expression to weaken pathogenicity and decreasing bacterial energy metabolism [25].

Wheatgrass also accelerates red blood cell production, which in turn promotes healing and recovery from dental conditions [1]. This property makes it a valuable therapeutic option in the treatment of oral ulcers. A study by Sundaresan A et al., reported that the antimicrobial activity of wheatgrass depended on both the plant's age and the solvent used for extraction [26]. Therefore, harvesting wheatgrass at the appropriate stage is crucial to maximise its antimicrobial potential for dental applications.

Wheatgrass and Periodontal Disease

Periodontal disease encompasses a group of chronic inflammatory conditions affecting the supporting structures of the teeth, including the gingiva, alveolar bone, periodontal fibres and connective tissue. It is among the most prevalent and burdensome oral diseases worldwide [6]. Nearly half of Indian adults are affected by some form of periodontal disease [27] and its global prevalence is estimated to range between 20% and 50% [28].

Conventional treatment strategies include antibiotic therapy and surgical procedures aimed at eliminating the pathogenic subgingival microflora that drive periodontal disease [6]. However, long-term antibiotic use can promote the emergence of resistant microbial strains, creating the need for alternative therapeutic options such as wheatgrass [6]. Due to its antimicrobial properties, wheatgrass may help reduce microbial colonisation within periodontal pockets [6]. In a study by Babitha GA et al., preliminary evidence supported the antimicrobial activity of wheatgrass powder against key periodontal pathogens, including *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia* and *Fusobacterium nucleatum* [6].

Wheatgrass also acts as a stimulator of fibroblastic activity, a topical anti-inflammatory immunomodulator and a haemostatic agent. These properties make it beneficial in managing periodontal diseases such as periodontitis and gingivitis [6]. Patients with periodontitis often exhibit elevated salivary nitrite concentrations [29]. Nitric Oxide (NO) synthesis is significantly upregulated in inflamed periodontal tissues [29], with higher salivary NO levels observed in periodontitis patients compared to healthy individuals [29]. Periodontal diseases, which are chronic inflammatory infections associated with Gram-negative bacteria, further stimulate NO production. During the inflammatory response, lipopolysaccharide-induced macrophage activation leads to the excessive production of inflammatory mediators such as NO and ROS [30].

Nuclear transcription factors Nuclear Factor-kappa B (NF-κB), and Activator Protein-1 (AP-1) play a significant role in the progression of inflammatory conditions involving proinflammatory cytokines. The expression of proinflammatory proteins, such as Inducible Nitric Oxide Synthase 2 (iNOS-2) and Cyclooxygenase-2 (COX-2), remains upregulated during the inflammatory process. Inducible Nitric Oxide Synthase (iNOS) catalyses the conversion of substrates O_2 and L-arginine into nitric oxide (NO) and L-citrulline. Wheatgrass extracts have been shown to significantly reduce the levels of iNOS-2 and COX-2, thereby demonstrating their anti-inflammatory potential [30].

Wheatgrass also functions as a natural antibiotic with bactericidal activity against pathogens that contribute to dental caries, halitosis, periodontitis, gingivitis and other oral infections [6]. Using wheatgrass to rinse and wash the mouth helps reduce toxins in the gingival region, thereby improving overall oral health [7]. Consequently, wheatgrass juice can serve as an effective mouthwash for sore throats and pyorrhoea, while also helping prevent tooth decay and toothaches [5].

A study conducted by Bello et al., investigated the effects of an oral spray containing an aqueous extract of *Triticum vulgare* on dental plaque and gingival inflammation in school-aged children [31]. There is a direct correlation between plaque accumulation and the development of gingivitis, the most common form of periodontal disease in adolescence and childhood. While traditional antimicrobial agents, such as chlorhexidine digluconate, have been widely used in mouthwash formulations for gingivitis prevention and treatment, a specific extract of *Triticum vulgare* demonstrated similar antioxidant and anti-inflammatory properties. It promoted tissue regeneration and controlled inflammation.

The study reported a statistically significant reduction in the percentage of plaque-accumulated sites and in the severity of gingival inflammation. The extract promoted tissue repair and wound healing through stimulation of fibroblast chemotaxis and maturation, accelerated protein synthesis and exhibited mitogenic effects. It also reduced the release of proinflammatory mediators, including IL-1β, IL-6, Prostaglandin E (PGE) and Tumour Necrosis Factor (TNF)-α, thereby further reducing inflammation. The study concluded that herbal mouthwashes were as effective as chlorhexidine-containing mouthwashes in decreasing gingival inflammation, plaque scores and the salivary count of *Streptococcus mutans* in children's oral cavities. Moreover, these herbal formulations had minimal side-effects and were gluten-free, making them suitable for paediatric use [31].

Another study comparing the efficacy of wheatgrass mouthwash with chlorhexidine mouthwash in children found that wheatgrass mouthwash was equally effective in maintaining saliva pH and buffering capacity [32].

CONCLUSION(S)

Wheatgrass and its extracts, as natural medicines, offer substantial benefits for treating a wide range of health conditions, from minor skin abrasions to complex cancers. It is a rich source of chlorophyll, proteins, vitamins, minerals and active enzymes. The antioxidant and antimicrobial properties of wheatgrass extracts have recently attracted research attention due to their potential to replace synthetic antioxidants and antimicrobial agents. Wheatgrass also demonstrates chemopreventive effects through its antioxidative and antiproliferative activity. Its antimicrobial properties help reduce food-borne pathogens in the oral cavity, supporting the prevention and treatment of dental complications. Wheatgrass appears to be a highly suitable candidate for alternative medicine, particularly for managing dental caries, periodontal diseases and other oral infections. There is significant scope for further research on the use of wheatgrass juice and extracts in dentistry.

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