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Review on Nutrient Contents and Health Benefits of Wheatgrass Juice

Abe Tullo^{1*}, Solomon Abera²

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ABSTRACT

The main aim of this review is to provide an overview of the nutrient contents and health benefits of grain wheat for wheatgrass juice. Wheatgrass juice is the young grass of the common wheat plant (*Triticum aestivum*) freshly juiced for human consumption. Wheatgrass growing and preparation of its juice in our homes in both rural and urban areas is easy and convenient. Wheatgrass is grown in trays to preserve its quality when delivered to food establishments. When the wheatgrass reached a height of above 7 inches, they are cut a half inch above the surface of the soil and harvested for wheatgrass juice production after 8 days from grain sowing or 13 days from grain soaking. The wheatgrass juice is extracted by manual or electric juicer and filtered to remove the suspended matter. Wheatgrass juice is a complete food that contains chlorophyll, proteins, minerals like K, Ca, Fe, Mg, Na, P, and S, vitamins such as A, B, C, and E, bioflavonoids, enzymes, and 17 forms of amino acids. The pH factor of the wheatgrass juice and human blood is 7.4, which may be the reason why wheatgrass juice is quickly absorbed into the blood. Wheatgrass juice is used for treating protein-energy malnutrition, micronutrient deficiency, and chronic diseases such as diabetes, cardiovascular, thalassemia, and cancer of any organ. In addition, wheatgrass juice is an excellent antioxidant due to the presence of 70% of chlorophyll.

INTRODUCTION

Wheatgrass juice is the young grass of the common wheat plant (*Triticum aestivum*) freshly juiced for human consumption (Anwar *et al.*, 2015). Wheatgrass can be grown on trays or mats to preserve its quality when delivered to food establishments (Treadwell *et al.*, 2013). The ideal conditions for wheatgrass to grow are high exposure to light, low humidity levels, and good air circulation. This is necessary and important in creating chlorophyll and reducing mold growth (Dégraff, 2011). The wheatgrass sown through the winter and harvested at the jointing stage has a maximum concentration of active principles. At this stage the plant reaches its peak nutritional value; after jointing, concentrations of chlorophyll, protein, and vitamins decline sharply. Thus wheatgrass is harvested just before this jointing stage when the tender shoots are at their peak of nutritional potency. Wheatgrass grown outdoors is harvested, dehydrated at a low temperature, and sold in tablet and powdered concentrates. Growing wheatgrass indoors usually requires the grass to be grown in small trays with the wheat grains close together for a high yield (Singh *et al.*, 2012). Variations in growth could be seen with changing conditions and environmental parameters are considered important for the growth of wheatgrass namely temperature, humidity, air circulation, and time taken to reach a target height (Ashish *et al.*, 2012).

Wheatgrass juice (*Triticum aestivum* L.) is known as a healthy drink due to its high antioxidant activity and phenolic content (Akbas *et al.*, 2017). Wheatgrass, young grass of the common wheat plant, is freshly juiced or dried into powder for animal and human consumption – both forms provide chlorophyll, minerals K, Ca, Fe, Mg,

Na, and S, vitamins such as A, B, C and E, enzymes and 17 forms of amino acids (Singh *et al.*, 2012). Two ounces (56.7 grams) of wheatgrass juice has the nutritional value equivalent to 5 pounds (2.27 kg) of raw vegetables. For example, wheatgrass has twice as much vitamin A as carrots and more vitamin C than oranges. It contains all of the B-complex vitamins, as well as calcium, phosphorus, magnesium, sodium, and potassium in adjusted ratios. Wheatgrass is a finished source of protein, providing the majority of important amino acids, and more. Wheatgrass juice has around 20% of aggregate calories originating from protein which is as polypeptides, simpler and shorter chains of amino acids that the body utilizes all more productively as a part of the circulation system and tissues (Thammana *et al.*, 2016).

Wheatgrass has become a very popular green plant at present due to its several beneficial roles in regard to human ailments such as cancer, thalassemia, and cardiovascular diseases. Wheatgrass juice is an impressive source of vital nutrients; antioxidants are capable of neutralizing the deleterious effects of free radicals (Agrawal *et al.*, 2015). Wheatgrass is a substantial cereal grass crop in the world, a copious source of nutrients with a noteworthy nutritional and therapeutic value that can be grown in indoor trays and then used as powder and in a drink (Pasha *et al.*, 2018). Wheatgrass is a complete food that contains bioflavonoids, proteins, and other important nutrients and helps in maintaining body functions (Mogra and Rathi, 2013). The wheatgrass extract from the common wheat plant (*Triticum aestivum*) is also called “green blood” as it gets immediately absorbed into the bloodstream and gives energy in about 20 min that lasts throughout the day (Singhal *et al.*, 2012;

¹ Oromia Agricultural Research Institute, Addis Ababa, Ethiopia

² Food and Agricultural Engineering, Haramaya University, Ethiopia

* Corresponding author's e-mail: abesokore@gmail.com

Chauhan, 2014). Wheatgrass juice can provide the body with energy by fulfilling nutritional deficiencies and by removing wastes that clog cells, blood, tissues, and organs. Fifteen pounds (6.81 kg) of wheatgrass juice has a comparable nutritional value to 350 pounds (158.9 kg) of leafy greens and vegetables (Mujoriya, and Bodla, 2011). Wheatgrass is known to help diminish fatigue, improve sleep, increase strength, naturally regulate blood pressure and blood sugar, support weight loss, improve digestion and elimination, support healthy skin, teeth, eyes, muscles, and joints, and improve the function of our heart and lungs and reproductive organs, heal ulcers and skin sores, slow cellular aging, improve mental function, and is beneficial in arthritis and muscle cramping, thalassemia, hemolytic anemia, cancer, asthma, allergy, inflammatory bowel disease and detoxification (Chauhan, 2014).

Despite the health benefits of wheatgrass consumption, its acceptance and use is still low worldwide. This could be attributed to it being consumed only by people with poor health conditions, short shelf life, low organoleptic characteristics, and difficulty in obtaining good quality wheatgrass (Ashish *et al.*, 2012). In many countries, wheat is consumed as wheat grain products, which are made into bread, scones, and other baked or steamed products, but with the realization of the value of wheatgrass as a “functional juice”, and owing to its fast maturity, ability to be grown in a different medium and dense nutrition, there is a need to explore wheatgrass as either an alternative venture or “functional juice” resource, especially in developing countries where there is a dual nutritional burden of malnutrition and obesity. Studies have shown the need for more research to be done in this area to make wheatgrass widely acceptable as an economic activity to not only aid in the fight against malnutrition but also, improve the general population health in countries where poverty, unemployment, malnutrition, and lifestyle diseases are rapidly rising (Ashish *et al.*, 2012).

OBJECTIVE

➤ To review the nutrient contents and health benefits of wheatgrass juice

LITERATURE REVIEW

Overview of Wheatgrass Juice Production

Wheatgrass cultivation and processing are practiced in several countries at different scales, though the origin of wheatgrass is not known (Rana *et al.*, 2011). Wheatgrass is available in the form of products for healthy diets (powders, tablets) in the USA, East Asian countries, and Eastern Europe (Anwar *et al.*, 2015). Wheat (*Triticum aestivum* L.) is the widely cultivated staple food crop for the majority of the world's population. The sprouts formed by the germination of wheat grains over 6–10 days are generally termed “wheatgrass” (Akbas *et al.*, 2017). Wheatgrass juice powder (WJP) from four wheat varieties grown using soil coco-peat with nutrient solution (CNS), and water soaked for 8 hours, germinated for 36 hours, and harvested on the 10th day were examined for

proximate composition, mineral, amino acid, phenolic (free and bound) composition, and antioxidant properties (Kaur *et al.*, 2021). The yield, ash, and protein contents of WJP ranged between 4.88–7.87%, 5.18–15.93%, and 38.75–50.17%, respectively (Kaur *et al.*, 2021). The total phenolic, flavonoid, chlorophyll content (TCC) and antioxidant activity varied from 12.02 to 17.44 mg GAE/g, 4.38–10.10 mg QE/g, 3.01–5.63 mg/g, and 13.54–17.33 μ mol TE/g, respectively (Kaur *et al.*, 2021). The production method for wheat grains sprout was the tray method, using about 250 gm of wheat grain for sprouting (Anwar *et al.*, 2015). Grains of wheat were cleaned, washed, soaked in tap water, and placed in a 0.7-liter capacity glass for 15 hours. Draining of seed was carried out for 15 hours after which the seeds were found to be sprouted. Sprouted seeds were spread over the soil in the trays. After a little growth in height, the trays were transferred to a relatively warmer place with indirect sunlight and proper air circulation conditions for the development of green color. When the wheatgrass reached a height above 7 inches, they were cut and harvested for wheatgrass juice production. The wheatgrass juice is extracted from wheatgrass manually or by an electric juicer and filtered to remove the suspended matter and mixed with different flavors such as orange, mango, apple, pineapple, lemon, and sugarcane in different proportions and combinations to enhance the taste for consumption (Ashish *et al.*, 2012).



Figure 1: Flow diagram of wheatgrass growing and extracting (Abe Tullo, 2022)

Nutrient Contents and Health Benefits of the Wheat Grass Juice

Wheatgrass juice (WGJ) is an extract squeezed from the mature sprouts of wheat seeds (*Triticum aestivum*). Wheatgrass, young grass of the common wheat plant,

is freshly juiced or dried into powder for animal and human consumption – both forms provide chlorophyll, minerals K, Ca, Fe, Mg, Na, and S, vitamins such as A, B, C and E, enzymes and 17 forms of amino acids (Singh *et al.*, 2012). Wheatgrass juice provides more energy by fulfilling nutritional deficiencies and by removing wastes that clog your cells, blood, tissues, and organs (Mujoriya and Bodla, 2011). Wheatgrass is a complete food that contains bioflavonoids, proteins, and other important nutrients and helps in maintaining body functions (Mogra and Rathi, 2013).

Total Chlorophyll

Wheatgrass juice is one of the best sources of chlorophyll and most of its health benefits are attributed to this chlorophyll, besides other vital nutrients (Mogra and Rathi, 2013). Wheatgrass juice is a good source of chlorophyll (70% of the total chemical constituents) and antioxidants known for numerous health benefits (Ghumman *et al.*, 2017). Chlorophyll has been proposed as an important dietary chemopreventive agent (Vaňková *et al.*, 2018). Devi Sowjanya *et al.* (2015) found 42.2 mg/100g of total chlorophyll in the juice of wheatgrass. Abe Tullo (2022) also obtained 62.68 and 71.47 mg/100g chlorophyll of kingbird and ogolcho grain varieties for wheatgrass juice, respectively. According to Kumar *et al.* (2016), the pH factor of human blood is 7.4. The pH factor of the wheatgrass juice is also 7.4 which may be the reason why wheatgrass juice is quickly absorbed into the blood. Chlorophyll, the main constituent of wheatgrass was analyzed at 7.46 mg/g (Thakur *et al.*, 2019).

The analogy between chlorophyll and hemoglobin can be demonstrated concerning the structure of their porphyrin heads. The structure of both the compounds depicts a striking similarity in having a tetra pyrrole ring, the only difference between the two being is the nature of the central metal atom – magnesium (Mg) in chlorophyll and iron (Fe) in hemoglobin (Padalia *et al.*, 2010).

Health wise chlorophyll present in wheatgrass can protect from carcinogens; it strengthens the cells, detoxifies the liver and bloodstream, and chemically neutralizes the polluting elements (Rana *et al.*, 2011).

Protein

Wheatgrass powder contains 21.6% protein and 50.95% nitrogen-free extract (Pasha *et al.*, 2018). The various enzymes responsible for its pharmacological actions are protease, amylase, lipase, cytochrome oxidase, transhydrogenase, and superoxide dismutase (SOD). The other notable feature of wheatgrass is its high proportion of amino acids such as aspartic acid, glutamic acid, arginine, alanine, and serine (Padalia *et al.*, 2010). The protein content of wheatgrass juice powder and pulse juice powder varied from 22.01% to 25.77% and 37.3–47.4%, respectively (Ghumman *et al.*, 2017). Abe Tullo (2022) reported 3.3 and 3.59% protein of ogolcho and kingbird wheat varieties for wheatgrass juice, respectively. Proteins

are essential for muscular strength and physical elegance. Plasmas, hormones, and antibodies are obtained through proteins. Amino acids aid digestion, and blood formation and provide potency to the heart (Mujoriya, 2011).

The Precious contribution of plants in the field of medicine is very well known (Parit *et al.*, 2018). Wheat (*Triticum aestivum*) seeds and seedlings are an important source of food and feed due to the presence of various health-promoting compounds (Parit *et al.*, 2018). A total of 297 proteins were identified and their functional annotation revealed that a majority of them were involved in preventing many diseases, oxidative stress, primary metabolism, storage, and energy-related mechanisms. Particularly to mention, peroxidases, superoxide dismutases, and cytochromes are abundantly present in wheatgrass (Parit *et al.*, 2018).

Minerals

Wheatgrass juice contains a plethora of minerals like calcium, phosphorus, magnesium, alkaline earth metals, potassium, zinc, boron, and molybdenum (Padalia *et al.*, 2010). Wheatgrass is a good source of mineral nutrients as it contains significant amounts of iron, phosphorus, magnesium, manganese, copper, and zinc (Chauhan, 2014). Wheatgrass juice powder (WJP) had significantly higher K and Mg content as compared to pulse juice powder (PJP). Powders with relatively higher K and Mg content had higher radical scavenging capacity and chlorophyll content (Ghumman *et al.*, 2017).

Calcium

Wheatgrass is a good source of calcium, which helps build strong bones and teeth and regulates heartbeat, in addition to acting as a buffer to restore balance to blood pH (Mujoriya, 2011). Calcium is the prime instigator of vital activity. It strengthens the bones and provides alkaline for the children and vitality for the old. It is helpful in the treatment of the diseases like hemorrhage, distension of the body, slow movements, coldness, varicose veins, etc. The content of Ca of wheatgrass juice at the second cut was found to be higher than that in the first cut. On the other hand, growing wheatgrass in the open field caused an increase in its content of Ca over the laboratory either first or second cut (Anwar *et al.*, 2015). Padalia *et al.* (2010) and Roshan *et al.* (2021) found 24.2 mg/100 g and 29 mg/100 g of calcium contents in the wheatgrass juice, respectively. Abe Tullo (2022) also reported 36.2 and 35.8 mg/100g Ca of ogolcho and kingbird grain varieties for wheatgrass juice, respectively.

Iron

Iron is an essential element of life. Iron deficiency creates a shortage of hemoglobin in the blood. It is helpful in pregnancy, for excessive sweating, pale complexion, laziness and lethargy, and insomnia. Inorganic iron is often constipating, but the iron salts in wheatgrass have no side effects (Mujoriya, 2011; Roshan *et al.*, 2021). Devi

Sowjanya *et al.* (2015) found 0.61mg/100g of iron content in the wheatgrass juice. The highest Fe content (133.9 mg/L) of wheatgrass juice was observed under field conditions after the second cut followed by the first cut in the laboratory (63.6 mg/L). Fe concentration of juice from the first cut (field) and second cut (laboratory) were found to be almost constant around 44.0 mg/L (Anwar *et al.*, 2015). Abe Tullo (2022) reported 0.5 and 0.4 mg/100g Fe of ogolcho and kingbird wheat varieties for the grass juice, respectively.

Potassium

Potassium, called the youth mineral by some nutritionists, helps maintain a smooth mineral balance and balanced body weight. It also tones the muscles, firms the skin, and promotes overall beauty (Mujoriya, 2011). Potassium is helpful for the radiance and luster of youth, hypertension, dementia, palpitation, tiredness, suicidal instincts, depression, etc. (Roshan *et al.*, 2021). Padalia *et al.* (2010) and Roshan *et al.* (2021) found 147mg/100 g and 363 mg/100 g of potassium contents in the wheatgrass juice, respectively. Abe Tullo (2022) also reported 503.4 and 395 mg/100g potassium in wheatgrass juice of ogolcho and kingbird varieties, respectively.

Table 1: Average nutrient content in the grass juice of two wheat varieties

Nutrient Content	Wheat Varieties	
	Ogolcho	Kingbird
Chlorophyll (mg/100g)	71.47	62.68
Protein (%)	3.30	3.59
Ash (%)	1.40	1.03
Calcium (mg/100g)	36.2	35.8
Iron (mg/100g)	0.5	0.4
Potassium (mg/100g)	503.4	395
Magnesium (mg/100g)	23.18	23.51
Sodium (mg/100g)	8.6	7.8
Phosphorus (mg/100g)	72.94	64.18
Zinc (mg/100g)	0.32	0.42
Vitamin A (mg/100g)	0.15	0.15
Vitamin C (mg/100g)	36.35	31.65
Vitamin E (mg/100g)	0.244	0.236

Source: Abe Tullo (2022)

Magnesium

Magnesium in wheatgrass is as much as in broccoli, Brussels' sprouts, beets, carrots, or celery. Magnesium is important for good muscle function and bowel health, as it aids eliminative functions. This mineral is also responsible for drawing fat out of the liver, in cases of fatty infiltration there (Mujoriya, 2011). Devi Sowjanya *et al.* (2015) found 24 mg/100g magnesium content in the wheatgrass juice Abe Tullo (2022) reported 23.18 and 23.51 mg/100g Mg for wheatgrass juice of ogolcho and kingbird varieties, respectively.

Table 2: Different constituents of wheatgrass per 100g

Basic Nutrients	Minerals	Vitamins
Calories: 21.0 Cal	Iron: 0.61mg	Vitamin C: 3.64mg
Water: 95g	Magnesium: 24mg	Vitamin A: 427 IU
Fat: 0.06g	Potassium: 147mg	Vitamin B1: 0.08mg
Carbohydrates: 2.0g	Phosphorous: 75.2mg	Vitamin B2: 0.13mg
Dietary Fiber: <0.1g	Zinc: 0.33mg	Vitamin B3: 0.11mg
Chlorophyll: 42.2mg	Calcium: 24.2mg	Vitamin B5: 6.0mg
Choline: 92.4mg	Sodium: 10.3mg	Vitamin B6: 0.2mg
Glucose: 0.80g	Selenium: <1 ppm	Vitamin B12: <1 mcg
		Vitamin E: 15.2 IU
		Folic Acid: 29mcg

Source: Padalia *et al.* (2010)

Zinc

Zinc is helpful in prostate gland disorders and nourishes hair (Mujoriya, 2011; Roshan *et al.*, 2021). Devi Sowjanya *et al.* (2015) found 0.33 mg/100g zinc content in the wheatgrass juice. Abe Tullo (2022) also reported 0.32 and 0.42 mg/100g Zn in wheatgrass juice of ogolcho and kingbird varieties, respectively.

Vitamins

Wheatgrass juice is a rich source of Vitamins A, C, E, and B complex (Padalia *et al.*, 2010). The constituents of Vitamins A, C, and E of wheatgrass juice were discussed in the following subtitles.

Vitamin A

Young barley grass (BG) is very valuable due to its high content of beta carotene, and provitamin A, which acts as a powerful antioxidant and protects the body against harmful effects of free radicals and sun rays either externally or internally (Brezinová *et al.*, 2010). Vitamin A in wheatgrass enhances the skin luster and provides a fair glow to the outer skin and makes it free from disease. It helps to cure the black spots and blemishes below the eyes and improves eyesight. It is also helpful in checking eyes, nose, and throat disorders. It nourishes hair and helps fight the problems of pollution. It is also used as a beautifying material. Vitamin A is essential for normal growth and development, good eyesight, and reproduction (Roshan *et al.*, 2021). Padalia *et al.* (2010) found 427 IU of vitamin A in wheatgrass juice. Abe Tullo (2022) also reported 0.15 mg/100g of each vitamin A of ogolcho and kingbird varieties for wheatgrass juice, respectively.

Vitamin C

Wheatgrass contains more vitamin C than an orange (Mujoriya, 2011). A powerful antioxidant, vitamin C helps recover from sickness including the common cold, and prevents diseases such as scurvy. It is a vital substance for healthy gums and teeth and the maintenance of bones (Roshan *et al.*, 2021). Furthermore, it is believed to be essential for health and vitality and the healing of sores and wounds (Mujoriya, 2011). Vitamin C is usually associated with citrus fruits, such as lemons, limes, and oranges. However, wheatgrass contains more vitamin C than orange (Roshan *et al.*, 2021). It is also a natural source of antibiotic elements (Roshan *et al.*, 2021). Padalia *et al.* (2010) and Chauhan (2014) found 3.64 and 25.2 mg/100 mL, respectively, of vitamin C contents in the wheatgrass juice. Abe Tullo (2022) also reported 36.35 and 31.65 mg/100g of vitamin C in wheatgrass juice of ogolcho and kingbird varieties, respectively.

Vitamin E

Vitamin E dilates the capillaries and helps in the free flow of blood. It is helpful for women during pregnancy, it prevents miscarriage and it is a helpful substance in the treatment of sexual impotency, diabetes, cancer, heart disorders and dysmenorrhea, etc. (Roshan *et al.*, 2021). Without enough of this fat-soluble vitamin, we would face muscle degeneration, sterility, and slower healing of wounds and infections (Roshan *et al.*, 2021). Vitamin E, an antioxidant and fertility vitamin is also a protector of the heart (Mujoriya, 2011; Roshan *et al.*, 2021). Vitamin E content of juices of Triticum species (especially the Durum cultivar) was found to be higher as compared to that of other grasses (Özköse *et al.*, 2016). At the same time, wheatgrass of einkorn contains a higher amount of total vitamin E than emmer, durum, and bread wheat (Karakas *et al.*, 2021). Roshan *et al.* (2021) found 1.01 mg/100gm vitamin E in the wheatgrass juice. Abe Tullo (2022) also reported 0.24 and 0.23 mg/100g of vitamin E in the wheatgrass juice of ogolcho and kingbird wheat varieties, respectively.

Therapeutic Potential of the Wheatgrass Juice

Reducing sugars, anthraquinones, saponins, flavonoids, tannins, alkaloids, and terpenoids phenolics, are some of the phytochemicals present in wheatgrass that are responsible for a variety of medicinal properties of wheatgrass (Tandon *et al.*, 2011).

Chlorophyll as Green Blood

At the germinated stage, the leaves of wheat over 6-10 days are commonly called wheatgrass. It contains a very good quantity of chlorophyll, known to play a significant role in reducing blood deficiency diseases such as thalassemia and myelotoxicity in cancer patients during chemotherapy (Sharma *et al.*, 2013).

Wheatgrass contains 70% chlorophyll, which is chemically nearly identical to hemoglobin and is useful in a variety of clinical conditions, including hemoglobin deficiency

and other chronic diseases that are ultimately considered green blood (Chauhan, 2014). The apparent resemblance between the two is thus considered to be responsible for the therapeutic effects shown by chlorophyll in conditions involving the deficiency of hemoglobin (Padalia *et al.*, 2010). Hemoglobin and its congeners are protein bodies that act as the oxygen carrier in higher animals by binding two electrons attached to the oxygen molecule, whereas chlorophyll is the active metabolic agent in plants that assimilates carbon from the carbon dioxide of the atmosphere by producing two electrons which are then transmitted through electron transport chain (Padalia *et al.*, 2010). The structural similarity between the two compounds is stipulated to be the reason behind the use of chlorophyll as a blood substitute in conditions like chronic anemia, tissue hypoxia, thalassemia, and other hemolytic disorders, etc (Padalia *et al.*, 2010). Chlorophyll also removes carbon dioxide and carbon monoxide from the body and has been found to reduce fecal, urinary, and body odor. In addition, it has anti-inflammatory and antioxidant properties (Subramoniam *et al.*, 2012).

Anti-Diabetic Activity

Wheatgrass contains a good amount of fibers that can maintain blood sugar levels; chlorophyll present in wheatgrass is shown to perform as an anti-diabetic agent (Ashok, 2011). Shaik *et al.* (2011) reported that wheatgrass juice shows a hypoglycemic effect on induced diabetic rats.

The reduction of fibrous foods in a man's normal diet has been cited as one of the factors leading to the development of type two diabetes (Mohan *et al.*, 2013). This may further affect the normal metabolic processes of fat, carbohydrates, and proteins in the body. Wheatgrass comes as juice, tablet, or powder as a handy fibrous food product that may be used to cure diabetic-related complications (Rana *et al.*, 2011). The high amount of fibrous material and chlorophyll in wheatgrass is very important in the optimization of blood sugar levels in the body and acting as anti-diabetic agents, respectively. Thus, stimulate metabolism, restore blood alkalinity due to the abundance of alkaline minerals, and act as an anti-diabetic agent and a detoxificant to restore healthy cells (Rana *et al.*, 2011). The antidiabetic potential of wheatgrass extract was done on diabetic rats and showed significant anti-hyperglycemic and hypolipidemic effects due to the presence of lipase, cytochrome oxidase, and superoxide dismutase enzymes responsible for the pharmacological properties of wheatgrass (Mohan *et al.*, 2013).

Hepatoprotective and Cardio-Protective Activity

A significant hepatoprotective role of wheatgrass has been seen in CCL4-treated rats, with a dose of 80 mg/100g by weight in drinking water for 4 weeks leading to a decrease in oxidative stress and an increase in antioxidant (Kamboj *et al.*, 2011). Wheatgrass also has 33.26 g potassium/100g which plays an important role in maintaining normal blood pressure. In a study, it was found that wheatgrass juice at

doses of 5 and 10 ml/kg can reduce total cholesterol, LDL (low-density lipoprotein), and triglyceride levels in induced hypercholesterolemia rats (Kothari *et al.*, 2008). A study conducted on 30 animal subjects noted that wheatgrass was able to reduce total blood cholesterol levels and increase good HDL (high-density lipoprotein) cholesterol and vitamin levels (Sethi *et al.*, 2010).

Antioxidant Activity

Chlorophyll is a key active component in wheatgrass that is involved in the inhibition of the metabolic activation of carcinogens (Aydos *et al.*, 2011). Plant-based food products including wheatgrass contain phytochemicals such as flavonoids which help the human body free radicals. The grass is rich in the following antioxidant enzyme systems; cytochrome oxidase, transhydrogenase amylase, and superoxide dismutase (SOD), which converts dangerous free radical reactive oxygen species (ROS) into hydrogen peroxides (having extra oxygen molecules to kill cancer cells) and an oxygen molecule, and phytochemical (Mohan *et al.*, 2013). In addition, wheatgrass extract has been found to exhibit antioxidant activity as it inhibits DNA oxidative damage and suppresses superoxide radicals due to the presence of redox enzymes including catalase in wheat which prevents various diseases in humans (Ashish *et al.*, 2012). Analysis of aqueous extracts from wheatgrass also revealed the presence of alkaloids, saponin, tannins, amino acids, protein, carbohydrates, coumarin, phenols, alkaloids, terpenoids, and cardiac glycosides (Durairaj *et al.*, 2014).

The antioxidant activity of wheatgrass extract has been studied based on its chemical content and found to contain phenolic compounds such as polyphenols and flavonoids, which have been found to inhibit free radical-induced membrane damage (Chauhan, 2014). Wheatgrass is a rich source of minerals which include magnesium, selenium, zinc, and chromium. The antioxidant properties of wheatgrass can be explained by the fact that wheatgrass contains various sources of antioxidants which include beta-carotene (pro-vitamin A), vitamin E, and vitamin C (Zendehbad *et al.*, 2014). Wheatgrass contains 17 amino acids of which aspartic acid, glutamic acid, arginine, alanine, and serine have been found to constitute a higher proportion (Singh *et al.*, 2012).

Adjuvant Therapy in Hemolytic Anemia

The therapeutic effect of wheatgrass has been applied in the treatment of anemia, and thalassemia among other diseases because wheatgrass contains higher proportions of various nutritional elements as discussed above; such as chlorophyll, amino acids, minerals, phytochemicals, vitamins, and enzymes (Chauhan, 2014). By consuming foods rich in chlorophyll the hemoglobin levels of subjects have been found to increase (Rana *et al.*, 2011; Ch, and Davinder, 2015). Wheatgrass is used in managing anemia and has got the name 'green blood' owing to its effectiveness in treating anemia (Mujoriya and Bodla, 2011).

CONCLUSIONS

Wheatgrass is the young grass of the common wheat plant (*Triticum aestivum*) and is grown in all ecological areas. Wheatgrass juice is immediately absorbed into the blood due to the high content of chlorophyll in it and the similarity of the pH value of wheatgrass juice and human blood, which makes wheatgrass juice more valuable for human consumption. Wheatgrass juice consumption is beneficial for health due to its higher amount of protein, bioflavonoids, chlorophyll, minerals like Ca, Fe, Mg, Zn, Na, K, and P, and vitamins such as A, C, B, and E contents and 17 forms of amino acids. Wheatgrass juice is preferable in keeping away health problems for any age group who are suffering from protein-energy malnutrition, micronutrient deficiency, and chronic diseases like diabetes, cardiovascular, blood hypertension, thalassemia, and cancer of any organ and is highly recommended as a remedy to various health problems due to its high potential with medicinal values and health benefits. In developing countries like Ethiopia, wheatgrass juice is the best alternative for the treatment of various diseases such as blood pressure, diabetes, malnutrition, etc. because of its medicinal properties. Extensive research work is needed to introduce its characteristics and health benefits or therapeutic application in various diseases in Ethiopia and on fortifying food products with wheatgrass products.

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