
Minerals and Vitamins Analysis of Two Bread Wheat Varieties for Wheatgrass Juice Content

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Abstract: The main aim of this research work is to analyze minerals and vitamins of bread wheat varieties for wheatgrass juice content of two selected wheat varieties (Ogolcho and Kingbird) grown in Ethiopia. The experiments were carried out in a completely randomized design with wheat varieties as the factor of two levels (Ogolcho and Kingbird). The results showed that the minerals (Ca, Fe, K, Mg, Na, P and Zn) contents of wheatgrass juice variety were 36.2, 0.5, 503.4, 23.18, 8.6, 72.94 and 0.32 mg/100 g, for Ogolcho variety and 35.8, 0.4, 395, 23.51, 7.8, 64.18 and 0.42 mg/100 g, respectively, for Kingbird variety. The vitamins (A, C, D₃ and E) were 0.15, 36.35, 0.018 and 0.244 mg/100 g in the juice of Ogolcho variety while for Kingbird variety they were 0.15, 31.65, 0.018 and 0.236 mg/100g, respectively. The experimental analysis clearly indicated that the amount of minerals content (Fe, Zn, Na, K and P) and vitamins content (C and E) showing the significance difference ($p \leq 0.05$) in the mean value of parameters. The result indicated that Ogolcho and Kingbird varieties wheatgrass juice were high in minerals and vitamins composition than the wheat grain. Hence, consumption of wheatgrass in the form of juice is beneficial in keeping away several of the health problems and highly recommended as a remedy to various diseases due to its high potential with medicinal values and health benefits.

Keywords: Health Benefits, Minerals, Vitamins, Wheatgrass Juice

1. Introduction

Wheatgrass juice is the young grass of the common wheat plant (*Triticum aestivum*) freshly juiced for human consumption [3]. Wheatgrass are grown in trays or mats to preserve its quality, when delivered to food establishments [21]. The ideal conditions for wheatgrass to grow are high exposures to light, low humidity levels, and good air circulation. This is necessary and important in creating chlorophyll and reducing mold growth [8].

The wheatgrass sown through the winter and harvested at the jointing stage has 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 prior to this jointing stage, when the tender shoots are at their peak of nutritional potency [20]. 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 [20]. Variation in growth could be seen with changing conditions and environmental parameters were considered important for the growth of wheatgrass namely temperature, humidity, air circulation and time taken to reach a target height [5].

Wheatgrass juice (*Triticum aestivum L.*) is known as a healthy drink due to its high antioxidant activity and phenolic content [2]. Wheatgrass, young grass of common wheat plant, is freshly juiced or dried into powder for animal and human consumption – both the 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 [20]. Two ounces (56.7 grams) of wheatgrass juice has nutritional equivalent called five pounds (2.27 kg) of the best crude natural vegetables. For instance, wheatgrass has double the measure of Vitamin A as carrots and is higher in Vitamin C than oranges [22]. It contains the all B complex vitamins, and also calcium, phosphorus, magnesium, sodium and potassium in an adjusted proportion [22]. Wheatgrass is a finished wellspring

of protein, supplying the majority of the key amino acids, and more [22]. It has around 20% of aggregate calories originating from protein [22]. This protein is as polypeptides, simpler and shorter chains of amino acids that the body utilizes all the more productively as a part of the circulation system and tissues [22].

Wheatgrass becoming a very popular green plant at present due to its several beneficial roles in a human diseases such as cancer, thalassaemia, and cardiovascular diseases. Wheatgrass juice is an impressive source of vital nutrients; antioxidants are capable of neutralizing the deleterious effects of free radicals [1]. Wheatgrass being substantial cereal grass crop in the world, copious source of nutrients with noteworthy nutritional and therapeutic value [17]. Wheatgrass was grown in indoor trays and then used as powder and in drink [17]. Wheatgrass is a complete food that contains bioflavonoids, proteins and other important nutrients and helps in maintaining body functions [13]. The WG extract from common wheat plant *T. aestivum* is also called as “green blood” as it gets immediately absorbed into the bloodstream and gives energy in about 20 min that lasts throughout the day [7, 19]. Wheatgrass juice were provide you with more energy by fulfilling nutritional deficiencies and by removing wastes that clog your cells, blood, tissues and organs [14]. Fifteen pounds (6.81 kg) of wheatgrass juice has a comparable nutritional value as 350 pounds (158.9 kg) of leafy greens and vegetables [14]. 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, 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, hemo-lytic anemia, cancer, asthma, allergy, inflammatory bowel disease and detoxification [7].

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 in poor health conditions, short shelf life, low organoleptic characteristics and difficulty in obtaining good quality wheatgrass [7]. In many countries wheat is consumed as wheat grain products, which are made in to 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 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 [5]. It's not popular in Egypt and lack knowledge

about growing conditions for good quality of wheatgrass [3].

Wheatgrass cultivation and processing is practiced in several countries at different scales, though the origin of wheatgrass is not clearly known [18]. The wheatgrass is available in the form of products such as healthy diets (powders, tablets) in USA, East Asian countries and Eastern Europe [3]. Wheat (*Triticum aestivum* L.) is the widely cultivated staple food crop for the majority of the world's population. The sprouts formed by germination of wheat grains over a period of 6–10 days are generally termed as “wheatgrass” [2].

Wheatgrass is very easy to grown and produce its juice in our home in both rural and urban areas. So that the information generated from this research work is very essential to introduce wheatgrass juice in Ethiopia and wheatgrass producers are understood the steps to grown wheatgrass and its juice production, and especially for wheatgrass juice consumers to get fresh, healthy, quality and flavor juice. However, there is no research work done on Ethiopian bread wheat varieties for nutritional characteristics of wheatgrass juice from this crop for human consumption. Therefore, the present research work is designed to fill this gap. Hence, the aim of present research work was to analyze minerals and vitamins of bread wheat varieties for wheatgrass juice content.

2. Materials and Methods

2.1. Experimental Location

The experiment was conducted at Oromia Agricultural Research Institute in the food science laboratory, Addis Ababa; Ethiopian Public Health Institute, Addis Ababa; Ethiopian Conformity Assessment Enterprise, Addis Ababa. Vitamins (A, D₃, E) were determined at the Ethiopian Conformity Assessment Enterprise, vitamin C was conducted at the Ethiopian Public Health Institute and minerals were determined at Oromia Agricultural Research Institute in the food science laboratory, respectively.

2.2. Experimental Materials

The samples for evaluation, 5 kg grains of each of ogolcho and kingbird bread wheat varieties were obtained from the Ethiopian Seed Enterprise (ESE), Asella. Wheat grains were cleaned manually to remove germination inhibitors like foreign materials, immature and damaged grains and were stored in polyethylene plastic bags and stored at room temperature (25°C).

2.3. Experimental Design

The experiment was planned in completely randomized design (CRD) which has one factors i.e. wheat variety. The factor was wheat (*Triticum aestivum* L.) varieties, which were Ogolcho and Kingbird. The raw wheat nutrient content standards of the two varieties were used as a control. Treatment was done in triplicate.

2.4. Wheatgrass Production Methods and Processing Techniques

Production method for wheat grains sprout was tray method as described by [5] using about 250 gm of wheat grain for sprouting. The sheet metal rectangular trays with size (40 x 24 x 11 cm) were developed in Asella Agricultural Engineering Research Center (AAERC) work shop. Grains of wheat were cleaned, washed and soaked in tap water placed in 0.7 liter capacity glass jars for each replicate for 15 hours. Wheat seeds were rinsed with tap water 3-4 times prior to soaking. Draining of seed was carried out for duration of 15 hours after which the seeds were found to be sprouted.

Wheatgrass trays were prepared using soil and cow dung manure mixed in a ratio of 2:1. Sprouted seeds were spread over the soil in which the trays preventing the overlapping and increasing proximity between the seeds. 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 was reached to a height above 7 inches, they were cut half inch above the surface of soil and harvested for wheat grass juice production after 8 days from grain sowing or 13 days from grain soaking. The wheatgrass juice was extracted by manual or electric juicer and filtered to remove the suspended matters.

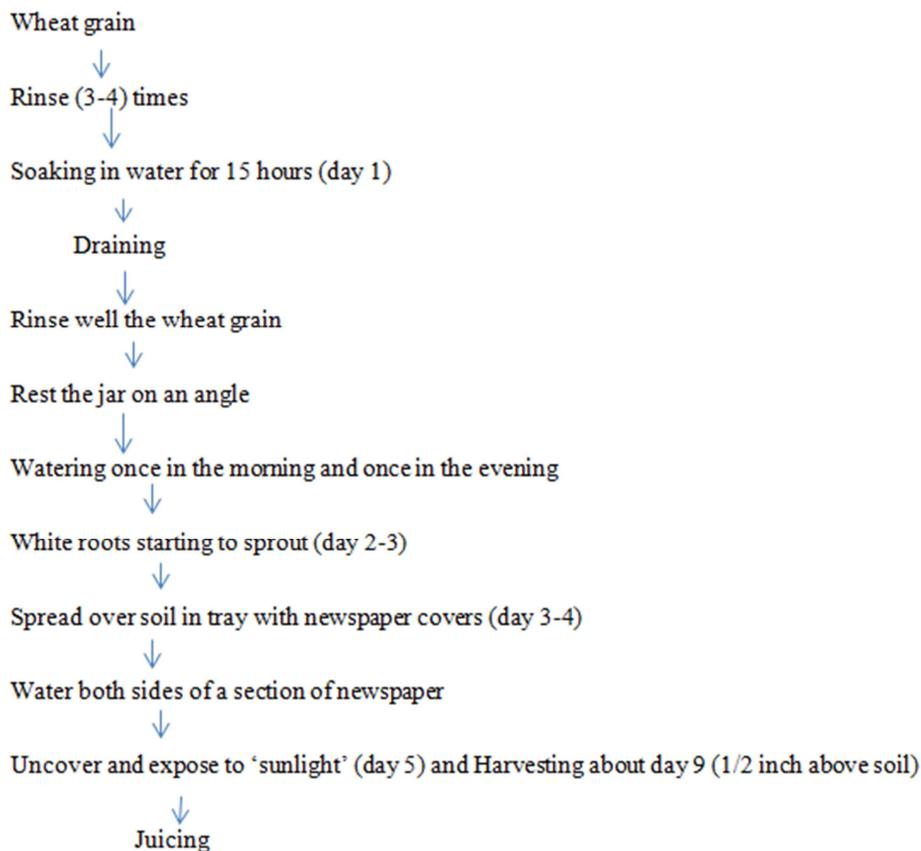


Figure 1. Flow diagram of wheatgrass growing and extracting [5].

2.5. Nutrient Composition Analysis

Collected wheatgrass juice from two wheatgrass varieties after squeezed was placed in a container for cold storage (in a common refrigerator or freezer) prior to analysis period. The minerals and vitamins that make wheatgrass a valuable food such as minerals according to [4], vitamins according to [10], were analyzed.

2.6. Statistical Analysis

Nutrient composition data were statistically analyzed using the analysis of variance (ANOVA). The statistical package used was statistical R-software (version 3.4.3, 2017). Statistical differences in samples were tested at $P < 0.05$ and

the differences between means were compared using the least significance difference (LSD). The result was expressed as the mean \pm standard deviation.

3. Results and Discussions

Nutrient composition like vitamins and minerals of the two wheatgrass varieties juice (Ogolcho and Kingbird), were determined. The wheatgrass were produced in the same geographical region and harvested during the same season; this may lessen the influence of environmental factors in the analysis. The differences reflected in these properties between two wheatgrass varieties juice can be attributed mainly to their genotypic characteristics. The results of all

the determined parameters are discussed in the following sections.



Figure 2. Wheat grass juice extraction and analyzing.

3.1. Mineral Contents of Wheatgrass Juice

The levels of calcium, iron, potassium, magnesium, sodium, phosphorus and zinc content of wheatgrass varieties juice (Ogolcho and Kingbird) are shown in Table 1. The content of calcium, iron, potassium, magnesium, sodium, phosphorus and zinc in wheatgrass varieties juice (Ogolcho and Kingbird) were 36.2, 0.5, 503.4, 23.18, 8.6, 72.94, 0.32

mg/100 g and 35.8, 0.4, 395, 23.51, 7.8, 64.18, 0.42 mg/100 g, respectively. Juice of Ogolcho wheatgrass varieties showed significantly ($P < 0.05$) higher value of iron, potassium and phosphorus contents than juice of Kingbird wheatgrass variety, whereas Ogolcho and Kingbird variety not showed significantly different ($P < 0.05$) in value of calcium, magnesium, sodium and zinc.

Table 1. Mineral contents (mg/100 g) of wheatgrass juice.

Variety	Calcium	Iron	Potassium	Magnesium	Sodium	Phosphorus	Zinc
Ogolcho	36.2 ^a ±3.6	0.5 ^a ±0.04	503.4 ^a ±31.8	23.18 ^a ±1.83	8.6 ^a ±0.84	72.94 ^a ±2.19	0.32 ^a ±0.02
Kingbird	35.8 ^a ±2.9	0.4 ^b ±0.01	395 ^b ±21.8	23.51 ^a ±2.09	7.8 ^a ±0.37	64.18 ^b ±1.3	0.42 ^a ±0.01
CV	9.15	6.92	6.08	8.42	7.93	2.63	3.82
LSD	7.48	0.07	61.96	4.46	1.48	4.09	0.03

CV=coefficient of variation; values are mean ± SD and mean values followed by the same letter in a column are not significantly different at 5% level of significance; LSD=least significance difference.

The calcium content in Ogolcho and Kingbird wheatgrass juice were 36.2 and 35.8 mg/100 g, respectively. Those values are greater than 24.2 mg/100 g and 29 mg/100 g of the wheatgrass juice reported by [16, 19]. 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 [18]. The content of Ca of wheatgrass juice was found to be higher. On the other hand, grown wheatgrass on open field caused an increase on its content of Ca over grown wheatgrass in laboratory [3].

The content of iron in Ogolcho and Kingbird wheatgrass juice

were 0.5 and 0.4 mg/100 g, respectively. The values were significantly different ($P < 0.05$) from each other and the values of iron content for both varieties were in agreement with the values 0.61 mg/100g iron in the wheatgrass juice reported by [8]. The levels of iron of wheatgrass juice of both varieties were much less than the 77.2 mg/100 g of the wheatgrass powder reported by [12].

The content of potassium in Ogolcho and Kingbird wheatgrass juice were 503.4 and 395 mg/100g, respectively and were significantly different ($P < 0.05$) from each other. The levels of potassium of wheatgrass juice of both varieties were

greater than the 147 mg/100 g of the wheatgrass juice reported by [16] and the 363 mg/100 g of potassium contents in the wheatgrass juice by [19].

The magnesium contents in Ogolcho and Kingbird wheatgrass juice were 23.18 and 23.51 mg/100g, respectively. The level of magnesium content in both wheatgrass juice varieties are comparable with the 24 mg/100g magnesium content in the wheatgrass juice reported by [9]. Magnesium in wheatgrass is as much as magnesium in broccoli, brussels' sprouts, beets, carrots, or celery. This mineral is also responsible for drawing fat out of the liver, in cases of fatty infiltration there [19].

The values of sodium in Ogolcho and Kingbird wheatgrass juice were 8.6 and 7.8 mg/100g, respectively. These values were less than the 10.3 mg/100g observed in the wheatgrass juice reported by [16]. The values observed in both varieties are also much less than the 655.33 mg/100g of wheatgrass juice powder reported by [12]. Hence, wheat grass was excellent source of sodium.

The content of phosphorus in Ogolcho and Kingbird wheatgrass juice were 72.94 and 64.18 mg/100g, respectively and were significantly different ($P < 0.05$) from each other with Ogolcho having higher than that of Kingbird. The level of phosphorus content in both wheatgrass juice varieties are comparable with the 75.2 mg/100g in the wheatgrass juice reported by [16]. The levels of phosphorus of wheatgrass juice of both varieties were much less than the 260.86 mg/100 g of the wheatgrass powder reported by [12].

The zinc contents in Ogolcho and Kingbird wheatgrass juice were 0.32 and 0.42 mg/100g, respectively. The level of zinc content in both wheatgrass juice varieties are comparable with the 0.33 mg/100g in the wheatgrass juice reported by [16]. The levels of zinc of wheatgrass juice of both varieties were less than the 4.41 mg/100 g of the wheatgrass powder reported by [12].

3.2. Vitamin Contents of Wheatgrass Juice

Vitamin A, C, D₃ and E contents of wheatgrass varieties juice are presented in Table 2. The Ogolcho variety wheatgrass juice contained 0.15 mg/100 g vitamin A, 36.35 mg/100 g vitamin C, 0.018 mg/100 g vitamin D₃ and 0.244 mg/100 g vitamin E. Similarly, the Kingbird variety wheatgrass juice had 0.15 mg/100 g vitamin A, 31.65 mg/100 g vitamin C, 0.018 mg/100 g vitamin D₃ and 0.236 mg/100 g vitamin E. Juice of Ogolcho wheatgrass variety showed significantly ($P < 0.05$) higher value of vitamin C content than juice of Kingbird wheatgrass variety.

The vitamin A contents of both wheatgrass variety juice were 0.15 mg/100 g. The level of vitamin A content in both wheatgrass juice varieties are comparable with the 427 IU or 0.128 mg/100g in the wheatgrass juice reported by [16]. Young barleygrass (BG) is very valuable due to high content of beta carotene, provitamin A, which acts as a powerful anti-oxidant and protects the body against harmful effects of free radicals and sunrays either externally or internally [6].

The vitamin C content of the two wheatgrass varieties juice were significantly ($P < 0.05$) different from each other.

The values of vitamin C in Ogolcho and Kingbird wheatgrass juice were 36.35 and 31.65 mg/100g, respectively. These values were much greater than the 3.64 mg/100g observed in wheatgrass juice varieties reported by [16] and also [7] reported 25.2 mg/100 mL vitamin C contents in the wheatgrass juice. Vitamin C is usually associated with citrus fruits, such as lemons, limes and oranges. However, wheatgrass contains more vitamin C than an orange [19].

Table 2. Vitamin contents (mg/100g) of wheatgrass juice.

Variety	Vitamin A	Vitamin C	Vitamin D ₃	Vitamin E
Ogolcho	0.15 ^a ±0.01	36.35 ^a ±0.90	0.018 ^a ±5.7	0.244 ^a ±0.01
Kingbird	0.15 ^a ±0.01	31.65 ^b ±0.24	0.018 ^a ±1.0	0.236 ^a ±0.01
CV	3.60	1.95	0.45	4.81
LSD	0.01	1.51	0.00	0.02

CV=coefficient of variation; values are mean ± SD and mean values followed by the same letter in a column are not significantly different at 5% level of significance; LSD=least significance difference.

The vitamin E content in Ogolcho and Kingbird wheatgrass juice were 0.244 and 0.236 mg/100g, respectively. These values were less than the 1.01 mg/100g observed in wheatgrass juice varieties reported by [16, 19] reported 15.2 IU vitamin E contents in the wheatgrass juice. Vitamin E (especially Durum cultivar) content was found to be higher in the juices of *Triticum* species as compared to the other grasses [15]. At the same time, wheatgrass of *einkorn* contains higher amount of total vitamin E content than emmer, durum, and wheat bread [11].

4. Conclusions and Recommendations

4.1. Conclusions

Wheatgrass is young grass of the common wheat plant (*Triticum aestivum*), is grown in all ecological area. Wheatgrass growing and preparation of its juice in our home in both rural and urban area is easy and convenient. Wheatgrass are grown in trays to preserve its quality when delivered to food establishments. When the wheatgrass reached to a height of above 7 inches, they are cut half inch above the surface of 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 matters. Wheatgrass juice consumption is beneficial for health due to its higher amount of minerals like Ca, Fe, Mg, Zn, Na, K and P, vitamins such as A, C, B and E contents. Wheatgrass juice is preferable in keeping away the health problems for any age group who are suffering from protein energy malnutrition, micronutrient deficiency and in chronic disease 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 treatment of various diseases such as blood pressure, diabetes, malnutrition, etc. because of its medicinal properties.

4.2. Recommendations

Extensive research work is needed in order to:

- a) Characterize and evaluate Ethiopian wheat grain for wheatgrass powder;
- b) Introduce health benefits or therapeutic application in various diseases in Ethiopia;
- c) Fortify wheatgrass juice with other food product and;
- d) Evaluate activity of wheatgrass juice in patients with COVID 19 disease outbreak.

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