



CHARACTERIZATION OF PROXIMATE, MINERAL AND ANTIOXIDANT PROPERTIES OF BARLEY GRASS POWDER (HORDEUM VULGARE) AND ITS CURATIVE POTENTIAL IN OSTEOPOROTIC FEMALES

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Abstract

Osteoporosis is systematic skeleton disease that is defined by low bone mass and changes in structure of bone tissue, which leads to high risks of weak bones and fractures. According to International Osteoporosis Foundation 1 in 3 women and 1 in 5 men over the age 50 years are suffering from osteoporosis. Barley grass powder is the best functional food for supplying nutrients and removing toxins from human cells, its functional components have also provided significant health benefits because it contains many nutrients such as essential amino acids, fiber, vitamins and both micro and macro minerals. The present study was conducted to evaluate the therapeutic effect of barley grass powder in treatment and prevention of osteoporosis in females. For this purpose, characterization (proximate analysis) of barley grass powder was conducted as an initial part of study. Human efficacy was carried out on 45 osteoporotic females in 3 groups, giving them barley grass powder for 60 days with different dosages, G0 was treated as control group, G1 was group was given 5g of barley grass powder and G2 was given 10 g of barley grass powder per day before any meal. Their BMD was checked before and after the completion of study. The data obtained was subjected to statistical analysis for the evaluation of results. The results showed that barley grass powder contained moisture 16 %, ash 18.95 %, fat 3.8 %, protein 8.75 %, and fiber 8.16 %, NFE 44.34 % and dry matter 84 %. The results of BMD values of treatment groups (G1 and G2) were significantly ($p \leq (0.05)$) increased as compared to the BMD values of control group. It showed that barley grass powder can be used for the treatment of osteoporosis.

Key words: Systematic skeleton disease, chronic metabolic bone disease, Osteoporosis, Barley grass

Introduction

The global cost of chronic diseases is increasing day by day for example the treatment cost of some chronic diseases reaches to \$47 trillion from 2011 to 2030. The consumption of large amount of sodium with less consumption of fruits, vegetables, whole grains, was one of the topmost risk factors related to diet, for many chronic diseases. The micronutrient deficiencies that are at the higher risks are Zn, Fe, Ca, and vitamins. (1).

Barley grass is one of the major cereal crops in the world and contains high percentage of dietary fiber. Barley grass has high concentration of active ingredients such as potassium, calcium, selenium, tryptophan, chlorophyll, vitamin A, B1, C and E, gamma aminobutyric acid, flavonoids, saponin, lutein, superoxide dismutase, dietary fiber, polysaccharides, alkaloid, metallothionein, and polyphenols (2).

The word osteoporosis means porous bones, indicating that bone density is low, and the bones are thin. The WHO defines osteoporosis as: A systematic skeleton disorder that is defined by reduced bone mass and by micro architectural destruction of bone tissue, with the increase in weakness of bone and risks of bone fractures (3).

The prevalence of osteoporosis is increasing day by day due to increase in aging in population. Osteoporosis usually occurs in women of postmenopausal age and old men. Osteoporosis suffers approximately 200 individuals per year and approximately 8.9 individuals suffer from bone fractures due to osteoporosis. These fractures usually occur at the hip, vertebrae and distal forearm and are connected to morbidity, mortality and reduce quality of life (4).

There is strong relationship among nutrition, dietary supplements, and bone health. There are many nutrients that are involved in making bones strong and healthy, while their deficiency leads to bone fragility, porous bones and in turn osteoporosis. These nutrients include calcium, vitamin D, protein, fats, vitamins A, B, C, K, minerals such as potassium, magnesium, and silicon (5).

Materials and methodology

Collection of raw material

The barley grass was grown in farm. Then the plants of height of 7 inches were collected.

Identification and Procurement of raw material

Weight-wise, barley wins out over wheat and rye. Barley may be recognized by its long, smooth, sharply pointed auricles, which frequently clasp or overlap. Ayub Agriculture Research Institute in Faisalabad, Pakistan, was where we started while looking for our barley grass. All chemicals and reagents used were purchased from Sigma-Aldrich (6)

Chemical Characterization of Barley Grass Powder

Proximate analysis and mineral composition

Moisture content, crude protein, crude fat, crude fiber, ash, and nitrogen-free extract (NFE) were all measured by proximate analysis in barley grass using the Methods specified by the AAACC (7). Using the AOAC method, the mineral content of both grasses was determined.

Atomic absorption spectrophotometer (Varian, AA-240, Victoria, Australia) was used to analyze the diluted wet digested samples for concentration and quantification of minerals. Atomic Absorption Spectrophotometer (Varian AA240, Australia) was used to ascertain calcium and magnesium concentrations (8, 9).

Phytochemical Analysis of Barley powder

TPC AND TFC

Following the methodology of Singleton et al. (8) we computed total flavonoids using the method of Ordonez et al. (10) and quantified total phenolic content (TPC) using the Folin Ciocalteu method.

Experimental study Design

The bio evaluation was carried out to evaluate the effectiveness of barley grass powder in osteoporotic females of ages from 18 to 50 and they were selected from the University of Faisalabad based on BMD Values along with their consent form without any pressure for being the part of study. The experimental study was carried out in 3 groups G0 were treated as control group and G1 and G2 were treated as experimental group against the dose of 5g and 10g respectively for the period of 60 days.

Study Protocol

Inclusion criteria

The females of age 18 to 50 years from the University of Faisalabad were included for the study.

Exclusion criteria

Men, lactating mother, and pregnant ladies were not included in the study.

Table I: Treatment Groups and Treatment Plan

Groups	Barley grass powder (g/day)	Time
Negative Control	Placebo	Empty capsule after Breakfast
G0 Standard Control	Cellgee tablet	After Breakfast
G1 Experimental dose Group 1	5g	Before Breakfast
G2 Experimental dose Group 2	10g	5gm Before Breakfast and 5gm Before Dinner

Comparison of effects of barley grass powder with cellgee calcium supplements on bone-on-bone mineral density

One group of females having low bone mineral density (Standard Control) were given with cellgee calcium supplement (Brand) to check its effect on bone mineral density and comparison of effects of cellgee on bone mineral density with effects of barley grass powder on bone mineral density was done. A multivitamin called Cellgee is used to both prevent and treat osteoarthritis pain and stiffness. The vitamin K2 in this tablet helps to combat cardiac issues. Vitamin K2 regulates a protein in the vascular tissues that prevents calcium from entering arteries.

Bone mineral density test

BMD was evaluated at the start of experiment and completion of study after 60 days.

Statistical analysis

Descriptive statistics were performed using the independent sample t-test in a CRD to look for statistical significance ($p < 0.05$). The results are presented as a mean S.D. IBM SPSS Statistics 20 is used for all statistical testing and analysis.

Results

This research study has been designed to determine chemical composition, phytochemical content, mineral contents, and changes in BMD values of patients before initiation and completion of study with comparison of Standard control group (cellege supplemented calcium tablets).

Proximate Composition of Barley grass powder

Moisture, crude protein, total fat, total carbohydrates, and dietary fiber are only few of the quantitative characteristics of food and food substances that may be estimated with the use of proximate analysis (Table II). Proximate analysis of barley grass powder was done to find out the percentages of crude protein, crude fat, moisture, ash, fiber, and nitrogen free content.

Proximate composition of barley grass powder is described in table 2 The barley grass powder contains 83.80% dry matter, 44.34 % NFE, 16% absolute moisture content, 18.45% total ash content, fat 3.8%, 8.75% crude fiber and crude protein 8.16%.

Table II: Proximate analysis of Barley grass powder

Proximate analysis	Composition (%)
Moisture	16%
Ash	18.45%
Nitrogen Free Extract	44.34 %
Crude protein	8.16%.
Crude Fat	3.8%
Crude fiber	8.75%
Dry matter	83.80%

Ascorbic acid or vitamin C

Ascorbic acid, or vitamin C, has several purposes in the body. These include working to preserve the health of cells and aiding in their defense. Protecting and sustaining a robust musculoskeletal system. 36.59 ppm/g of vitamin C is present in the barley grass powder (Table III).

Table III: Vitamin C content of Barley grass powder

Vitamin-C	36.59 mg/kg
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TPC and TFC of barley grass powder

In the evaluation of male infertility, the total antioxidant capacity (TAC) might be helpful as a diagnostic tool. The seminal plasma total antioxidant capacity (TAC) is quantified. As a result, the reductive potential of seminal plasma may be evaluated. Figure I. represents total flavonoids contents of barley grass powder. The TPC tests showed the presence of 458.9 mg GAE/g of Gallic acid. The TFC tests showed the presence of 102 mg QE/g of catechin.

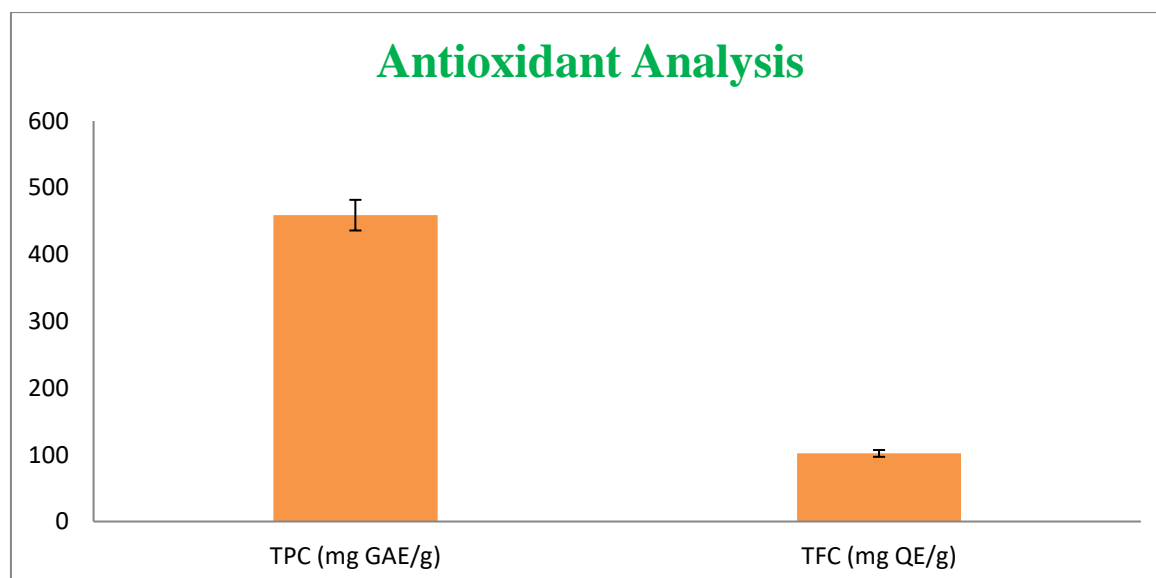


Figure I: TPC and TFC of barley grass powder.

Mineral analysis

Minerals are naturally occurring, and nutritionally essential substances found in the ground and food. Calcium, phosphorus, potassium, sodium, chloride, magnesium, iron, zinc, iodine, chromium, copper, fluoride, molybdenum, manganese, and selenium are all examples of minerals that the body needs in adequate amounts. Table IV represents the concentration of magnesium in barley grass

powder.450mg/kg of magnesium is present in barley grass powder. The concentration of calcium in 1 kg of barley grass powder was 36.59 mg/kg.

Table IV: Mineral concentrations of barley grass powder

Minerals	Concentration (mg/100g)
Ca	475.34
Mg	178.87
Fe	24.65
K	2365.87

Characterization of phenolic acids in barley grass powder

Fig II represents the characterization phenolic acids in barley grass powder along with their concentration. Qurectin was present at 13.64ppm, concentration of ferulic acid was 13.24 ppm, Gallic acid was 1.83 ppm, p-coumeric acid 0.98 ppm, sinapic acid 1.45 ppm.

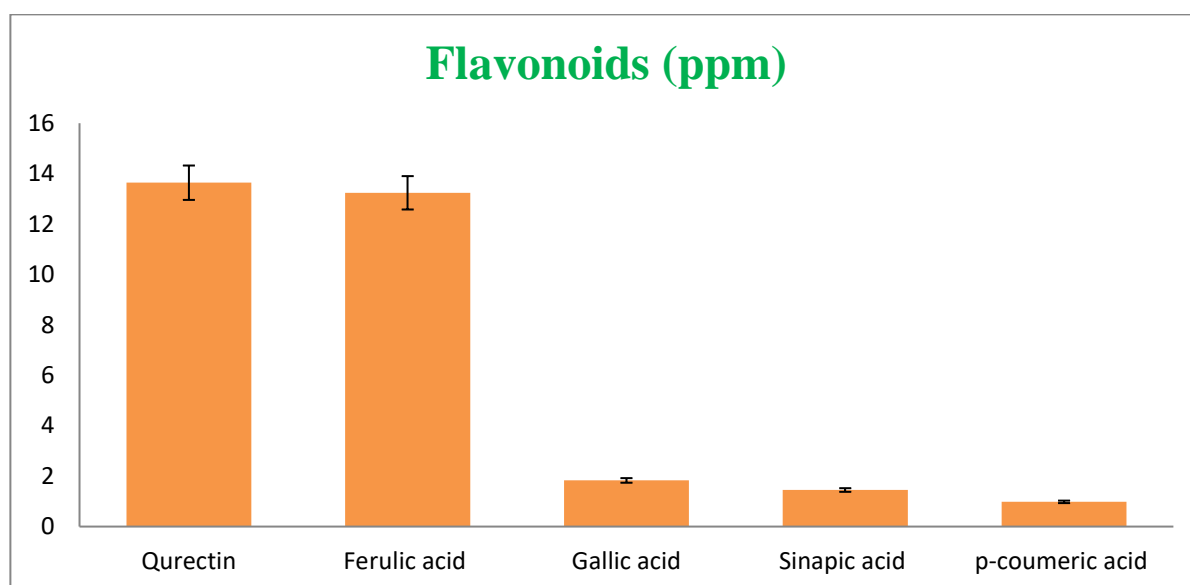


Figure II. Characterization of phenolic acids in barley grass powder

Bone Mineral Density

The results of this efficacy study demonstrated that the BMD (Bone Mineral Density) of females of G1 group had significantly increased in 2 months as compared to the females of group G2 who were taking 10 g of barley grass powder per day because the females of G2 group had shown some side effects like diarrhea, so their BMD were not significantly increased.

Osteopenia and osteoporosis are mostly diagnosed with a bone density test. The likelihood of fracture in the future is also estimated using it. Typically, the heel is the site of the testing technique to gauge bone density. Because just one bone site is checked, portable testing is less accurate than nonportable testing because it can only test the radius, one of the two bones of the lower arm, the wrist, the fingers, or the heel.

Comparison of cellgee supplement with the barley grass powder

One group of females having low Bone Mineral Density was given Cellgee calcium supplement for duration of 60 days. Their BMD were also significantly increased but some of them had shown some side effects like constipation, the calcium supplement has only one benefit shown in body that is increase in concentration of calcium (Figure III).

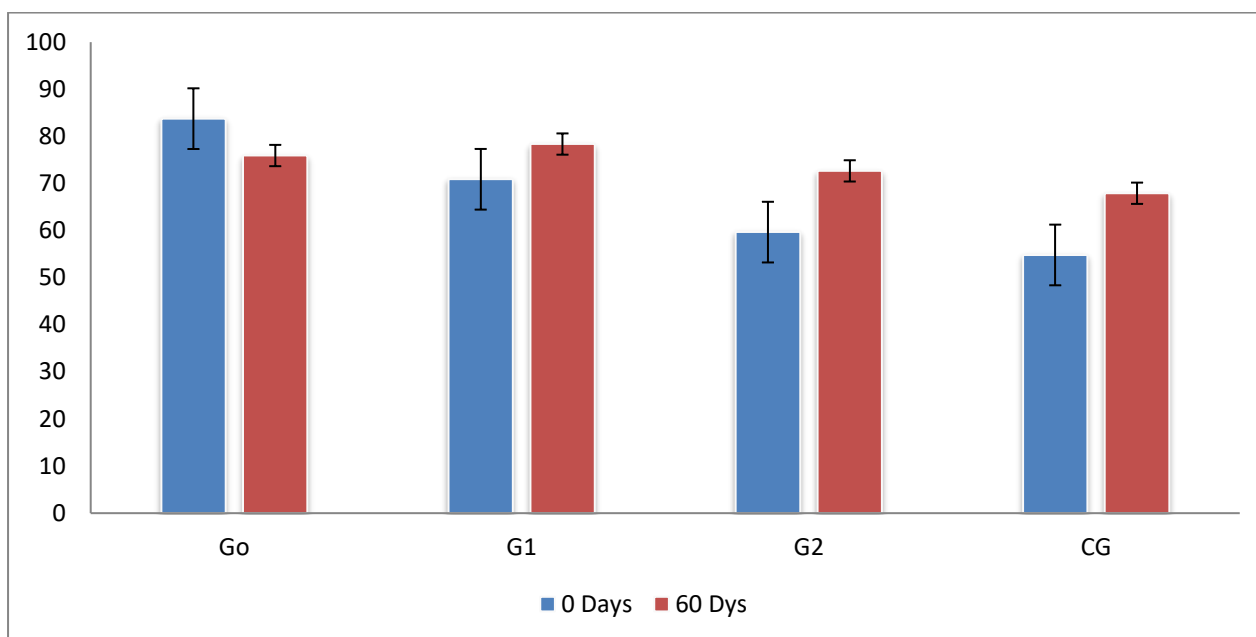


Figure III: Comparison of Cellgee supplement with the barley grass powder

Discussion

The current study reported that the proximate composition of barley grass powder. The results showed that barley grass powder contained 16.20% moisture, dry matter 83.80%, crude protein 8.75%, ash 18.95%, crude fat 3.80%, and crude fiber 8.16%, nitrogen free content was 44.34%. Like the current study in which proximate analysis of barley grass powder was done which showed that 11.887%, ash 7.433%, fat 2.56%, protein 20.213%, SDF 3.110% and IDF 54.720% (9, 10).

In this study it was determined that the 100 g of barley grass powder contained 13.64 ppm Qurectin, ferulic acid 13.24 ppm, 1.83 ppm Gallic acid, 0.98ppm, p-coumeric acid.

1.45 ppm sinapic acid. Similarly in a study it was determined that barley grass powder contained high contents of phenolic acids such as benzoic acid, caffeic acid, Gallic acid, synergic acid, p-hydroxybenzoic acid and ferulic acid in concentrations of 73.84ug/g, 86.61ug/g, 6.33ug/g, 170.46ug/g, 42.52ug/g and 1560.3ug/g respectively (10).

The present study showed that 100g of barley grass powder contain 36.59ppm of calcium. Calcium is the major building block of bones, which increased the bone mineral density and reduces the risks of osteoporosis. Similarly in a study it was determined that barley grass powder contained 730mg/100g of calcium. Calcium plays many roles in body in which the most important one is bone mineralization. Barley grass due to its high content of calcium in it has a beneficial effect in increasing bone mineral density (11). In one recent study the proximate composition, vitamin and mineral analysis, and antioxidant profile were done of green grass including barley grass.it was found that that the barley grass powder had high antioxidant properties and flavonoids content. It was also found out that the scavenging activity of free radicals were high of barley grass powder (12). The extracts of barley grass had shown in one study high total phenolic content and total flavonoid content that had the solid relationship with antioxidant activities. The methanolic extract and ethyl acetate extracts of barley grass powder had shown the anti- inflammatory effects (13).

The bone mineral density of treatment groups (G1 and G2) was significantly increased as compared to bone mineral density of control group (G0). The primary effect for length shows a notable difference between day zero and the final day after two months. Similarly, the bone mineral density of group taking cellgee supplement was greatly increased. The barley grass powder not only increase the bone mineral density of females but also showed other beneficial effects in body such as strengthen the hair, made skin fresh and gave glow, removed constipation, and reduced weight. The cellgee calcium showed only the one effect of increasing the bone mineral density of females of cellgee group (14, 15).

The balance of calcium in body is vital in maintaining the health of muscles and bones. Barley grass powder contains a high amount of calcium 845g/100g and is used for treatment and prevention of osteoporosis (16). In this study it was found that barley grass powder when consumed 5g/day increases bone mineral density of females having low bone mineral density. The barley grass powder can be easily grown in home garden and can be consumed by drying and making powder or can be used directly in smoothies and shakes or juices (17). It not only treats osteoporosis but many more other health benefits which were also seen in females of treatment groups.

Conclusion

Recent research found that barley grass powder significantly improves bone mineral density, eliminates constipation, and has other positive effects on the females of treatment groups (G1 and G2). The best functional food for osteocyte nutrition and detoxification is barley grass powder.

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