Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8196
JPP 2014; 3(4): 234-239
Received: 28-10-2014
Accepted: 04-11-2014

Kalsoom Qureshi
Department of Agricultural Chemistry, The University of Agriculture Peshawar, Pakistan

Farrukh Tabassum
Deptt. of Human Nutrition, The University of Agriculture Peshawar, Pakistan.

Neelam
Department of Agricultural Chemistry, The University of Agriculture Peshawar, Pakistan.

Muhammad Amin
South China Sea Institute of Oceanology, The Chinese Academy of Sciences, Guangzhou 510301 Guangdong, P. R China.

Muhammad Zain Akram
National Center for Nanoscience and Technology, Zhongguancun Beijing, The Chinese Academy of Sciences, P. R. China.

Muhammad Zafar
Directorate General (extention) Livestock and Dairy Development Peshawar, Pakistan.

Correspondence:
Muhammad Amin
South China Sea Institute of Oceanology, The Chinese Academy of Sciences, Guangzhou 510301 Guangdong, P. R China.

Investigation of Mineral Constituents of *Apium graveolens* L available in Khyber Pakhtunkhwa-Pakistan

Kalsoom Qureshi, Farrukh Tabassum, Neelam, Muhammad Amin, Muhammad Zain Akram, Muhammad Zafar

Abstract
Apium graveolens L, member of the family "Umbelliferae", is an unadventurous vegetable which is known to be beneficial in the treatment of a number of diseases. Samples of *Apium graveolens* L were obtained in the month of May-July, 2013, from its natural habitat as wild species and seeds (Celery) of the same were collected from three different markets of Khyber Pakhtunkhwa province of Pakistan i.e. Peshawar, Swat and DI Khan. In this work, the wild plant as well as the market celery was investigated for proximate composition, elemental analysis, phytochemical screening, essential oils and vitamin – C. Analysis of the study revealed average 50% moisture in the aerial parts and seeds of the plant. It was found that the leaves of the subject plant contained the maximum level of vitamin -C (60.35 mg 100^{-1} gm) while seeds were found to be containing the minimum level of vitamin- C (1.34 mg 100^{-1}gm). Elemental analysis of the data suggested that highest amount of K (5100 µg g^{-1}), P (4099 µg g^{-1}), Ca (674 µg g^{-1}), Ni (4.41 µg g^{-1}), Cd (1.94 µg g^{-1}) and Se (0.41 µg g^{-1}) was observed in the roots of the plant where as minimum level of Fe (141.23 µg g^{-1}), Mn (27.58 µg g^{-1}), and Zn (12.32 µg g^{-1}) was found in the leaves of the plant. The mean values of the data suggest that the maximum level of K was present in the roots of the plant (5100 µg g^{-1}) followed by that of stem (2321 µg g^{-1}) whereas minimum level was investigated in the leaves of the plant (1966 µg g^{-1}). The knowledge of mineral constituents of this plant could be beneficial for medicinal use and pharmacological actions.

Keywords: *Apium graveolens* L, *Mineral Constituents*

1. Introduction
From ancient times, plants have been used for treatment of human diseases. Since the time of early Neanderthal man, medicinal plants are the source of health care management [1], Extraction of bioactive compounds from medicinal plants permits the demonstration of their physiological activity. It also facilitates pharmacology studies leading to synthesis of a more potent drug with reduced toxicity [2, 3, 4], Herbal remedies might help overcome the growing problem of resistance and also the toxicity of the currently available commercial antibiotics.
The knowledge of elemental content of medicinal plants is important because they influence the production of their active constituents and pharmacological action. Active constituents of medicinal plants are metabolic products of plant cell. About 25 elements are considered essential for human metabolism [5]. Depending upon concentrations, different elements can play different roles in plant's life [6]. Potassium is the principal positively charged ion (cation) in the fluid inside cells, while Sodium is the principal cation in the fluid outside cells**.** The concentration differences between potassium and sodium across cell membranes create an electrochemical gradient which we call the membrane potential**.** Strict control of cell membrane potential is critical for nerve impulse transmission, muscle contraction, and heart function [7]. Calcium plays a role in mediating the constriction and relaxation of blood vessels, nerve impulse transmission, muscle contraction, and the secretion of hormones like insulin [8]. The mineral component of bone consists mainly of hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] crystals, which contain large amounts of calcium and phosphate (Heaney, 2000). Phosphorus is a major structural component of bone in the form of a calcium phosphate salt that is hydroxyapatite. Phospholipids. All energy production and storage are dependent on phosphorylated compounds, such as adenosine triphosphate (ATP) and creatine phosphate.

Nucleic acids (DNA and RNA), which are responsible for the storage and transmission of genetic information, are long chains of phosphate-containing molecules. A number of enzymes, hormones, and cell-signaling molecules depend on phosphorylation for their activation. Phosphorus also helps to maintain normal acid-base balance (pH) by acting as one of the body's most important buffers [10]. Magnesium plays noteworthy roles in the structure and the function of the human body. The adult human body contains about 25 grams of magnesium [11]. Magnesium is involved in more than 300 essential metabolic reactions [12]. Manganese plays a vital role in a number of physiologic processes as a constituent of some enzymes and an activator of other enzymes [13]. Iron is a key element in the metabolism of almost all living organisms. In humans, iron is an essential component of hundreds of proteins and enzymes [15]. Zinc plays important act in growth and development, immune response, neurological function, and reproduction [16]. Deficiency of zinc can result from inadequate dietary intake, impaired absorption, excessive excretion or inherited defects in zinc metabolism [17]. Nickel is also necessary to perform significant role in body functions including enzyme functions [18]. Scientific surveys of the literature revealed that Copper has a significant role in micro vessel development and cancer therapeutic intervention. It is a critical functional component of a number of essential enzymes known as cuproenzymes. The copper-dependent enzyme, cytochrome *c* oxidase, plays a critical role in cellular energy production [19]. Selenium is a trace element that is essential in small amounts but can be toxic in larger amounts. Humans and animals require selenium for the function of a number of selenium-dependent enzymes, also known as selenoprotein [20]. Trivalent chromium is recognized as a nutritionally essential mineral. A biologically active form of chromium participates in glucose metabolism by enhancing the effects of insulin [21]. It is also necessary for normal metabolism of cholesterol [22].

Apium graveolens Linn belonging to the family Umbelliferrie is an annual or biennial herb. It is in flower from June to August, and the seeds get ripen from August to September. The methanolic extract of *Apium graveolens* seeds was investigated for bioactive compounds and resulted in the isolation and characterization of mosquitocidal, nematicidal, and some other antifungal compounds [23], An essential oil obtained from the plant has a calming effect on the central nervous system. Some of its constituents have antispasmodic, sedative and anticonvulsant actions. Sedative effects of the oil [24] and the central effects of various fractions of essential oil [25] have been described in literature. Wild celery has a long history of medicinal and food use. It is an aromatic bitter tonic herb that reduces blood pressure, relieves indigestion, stimulates the uterus and is anti-inflammatory. The ripe seeds, herb and root are aperient, carminative, diuretic, emmenagogue, galactagogue, nervine, stimulant and tonic. It is used in treating rheumatism and kidney complaints. During this study, the wild plant as well as the market celery is investigated for proximate composition, elemental analysis, phytochemical screening, vitamin – C and essential oils. Seeds of *Apium graveolens* L, in Indian systems, are used as medicine for the treatment of liver ailments [26].

2. Materials and Methods

2.1 Sample collection: Wild celery was collected from its natural habitat, Palusi, from the month of May to July 2013, near The University of Agriculture Peshawar, Khyber Pakhtunkhwa, and was identified in PCSIR Laboratory Peshawar. On the other hand celery seeds were obtained from different markets of Khyber Pakhtunkhwa i.e. Peshawar, Swat and Dera Ismail Khan (DI Khan).

2.2 Proximate Analysis: Samples were analyzed for proximate composition i.e. moisture, crude fiber, ash content, nitrogen free extract and crude protein. These determinations were performed in accordance with (A.O.A.C, 2000).

2.3 Mineral Analysis

Sample Preparation: For mineral analysis acid digests of each sample was prepared according to (A.O.A.C, 2000), the procedure involved wet digestion for which 1 g of dry sample was taken in a digestion flask. Ten ml HNO_3 added to the sample and was left for overnight. Then 4 ml of perchloric acid ($HCLO_4$) was added, and heated on hot plate till the appearance of colorless solution. Heating was discontinued upon the reduction of volume to approximately 2-3 ml. The sample was then cooled and transferred quantitatively to a 100 ml volumetric flask. The volume was made up to the mark with deionized water. This digest was used for the analysis of selected minerals viz. Cr, Cd, Ni, Pt, Pb, Mn, Cu, Se, Zn, Fe, Mg, Na, P, Ca and K.

2.4 Atomic Absorption Spectrophotometric Analysis: For the determination of elements such as Chromium (Cr), Cadmium (Cd), Nickel (Ni), Platinum (Pt), Lead (Pb), Manganese (Mn), Copper (Cu), Selenium (Se), Zinc (Zn), Iron (Fe), Magnesium (Mg), Calcium (Ca) the method modified for macro-levels [28, 29] was employed using double beam Atomic Absorption Spestrophotometer (Perkin Elmer AAnalyst 200) equipped with laminar flow burner using an air acetylene gas and hollow cathode lamps. The already prepared acid digest was introduced in the atomic absorption spectrophotometer by means of a capillary tube. The device was set for analysis of specific elements by setting light source of desired element using specific element hollow cathode lamp. The wavelength set for different minerals was Cr: 357.9 nm, Cd: 228.8 nm, Ni: 232.0 nm, Pt: 265.9 nm, Pb: 283.3 nm, Mn: 279.5 nm, Cu: 324.8 nm, Se: 196 nm, Zn: 213.9 nm, Fe: 248.3 nm, Mg: 285.2 nm, Ca: 422.67 nm. Their standards were introduced to calibrate the instrument before the prepared sample was introduced to the device. The absorption reading appeared on the screen was noted. The concentration was calculated as follows:

$$\mu g\ g^{-1} \text{ of mineral} = \frac{\text{Absorbance reading} \times \text{dilution factor} \times 100}{\text{Weight of sample}}$$

2.5 Flame Photometric Analysis: Potassium (K) and Sodium (Na) contents were determined by flame photometer (Model; Flame photometer 410, Sherwood). A series of standard solutions 20 ppm, 30 ppm, 40 ppm, 50 ppm, 60 ppm, 70 ppm and 80 ppm for Potassium were prepared from potassium chloride in 100 ml flask. The emission was recorded using potassium filter with emission maxima of 768^o A. An aliquot (10 ml) from the acid digest was taken in 100 ml flask and the volume was made up to the mark with deionized water. The emission of unknown sample was noted

and the amount of K was calculated from the standard curve. Standard sodium solutions of 10 ppm, 20 ppm, 30 ppm, 40 ppm and 50 ppm were prepared from sodium chloride in 100ml flask. Flame photometric readings were noted in the standard solution using sodium filter with emission spectra of 589^{o} A. An aliquot (10 ml) from the acid digest was taken in 100 ml flask and the volume was made up to the mark with deionized water. After recording the emission, the sodium contents were calculated from the standard curve.

2.6. Spectrophotometric Analysis: Concentration of phosphorus (P) was determined by UV-Vis Spectrophotometer (Optima SP 3000+). This method is based upon the principle that Phosphorus in the sample reacts with mixed reagent containing molybdate to produce a dark blue complex. The absorbance of the complex mixture was measured at 880 nm. The mixed reagent was prepared by dissolving 6 g of Ammonium Molybdate ($(NH_4)6Mo_7.4H_2O$) in 125 ml distilled water. 146 mg Antimony Potassium Tartarate ($K(SbO)C_4H_4)_4$ $1/2H_2O$) was dissolved in 500 ml of 5N H_2SO_4 and then the two solutions were mixed together thoroughly and made to 1 L volume with distilled water. The color developing reagent was prepared by adding 370 mg Ascorbic acid to 70 ml of mixed reagent. A stock solution of Phosphorus was prepared by dissolving 439 mg KH_2PO_4 in 1 L distilled water. It contained 100 mg of Phosphorus concentration. The stock solution was then diluted to 15, 20, 25, 30 and 35 mg per 100 ml distilled water respectively. After treatment with the coloring reagent, the absorbance of all of these dilutions was determined at 880 nm against blank. Standard curve was drawn internally by the instrument. For sample assay 1 ml of the sample digest with 4 ml of distilled water was taken in 50 ml graduated flask. Then 5 ml of color developing reagent was added to it and the volume was made up to the mark with distilled water. The absorbance was noted at 880 nm against blank and the amount of phosphorus in the sample was determined using the standard curve.

2.7 Phytochemical Screening: Chemical tests were carried out on the aqueous extract. Standard procedures were used for screening of the constituents as described by Sofowara (Sofowara, 1993 [30]; Trease and Evans, 1989) [31].

2.8 Extraction with Organic solvents: The powdered plant material samples were exhaustively extracted with petroleum ether and ethanol. The solvent was evaporated at low temperature under reduced pressure in rotary evaporator to obtain crude extract. The yield percentage was calculated for petroleum ether extract and ethanol extract.

2.9 Essential oil extraction: Essential oil was extracted from *Apium graveolens* Linn using solvents and through steam distillation.

2.10 Steam Distillation: 200 g of seeds was placed in a distillation flask. 30 ml of water was added to the distillation flask and then the apparatus was assembled. Steam boiler of steel was heated until steam passed into the distillation flask. The flask was also directly heated on a burner. Heating of both steam generator and the distillation flask was controlled so that rate of distillation could be as rapid as possible, while the level of water in the distillation flask remained constant. Distillation was continued for 2 hrs. The receiver contained oil of seeds dispersed in water, on standing, the major part of the oil was separated and the water was removed. Remaining dispersed oil in the water was treated with anhydrous Na_2SO_4, which is water adsorbent. The above procedure was applied for the extraction of essential oil from wild seeds, flowers, stem, leaves, roots and cultivated seeds of *Apium graveolens* Linn.

3. Results and Discussion

The proximate composition and Vitamin C of the aerial part and seeds of the wild plant is presented in Table 1. Analysis of the study reveals that average 50% moisture was found in the aerial parts and seeds of the plant. Among the proximate composition crude protein was found in the leaves (7.53%) followed by that of seeds whereas minimum level of crude protein was found in roots (5.68%). Similarly ash content was observed in the range of 0.35 to 1.98% in different parts of the subject plant. The maximum amount of ash was present in the roots (1.98%) whereas minimum is found in the leaves of the plant. Likewise the maximum amount of crude fat was found in the seeds (2.45%) followed by that of roots (1.34%). Analysis of the data suggests that maximum amount of crude fiber was investigated in the leaves of the plant (19.28%) followed by that of stem (17.84%) whereas minimum level is found in seeds (7.37%). Likewise the maximum level of NFE was investigated in stem followed by that of roots. The vitamin C content in different parts of the *Apium graveolens* plant was determined on fresh weight basis in mg 100^{-1} gm and the analyzed data values are tabulated in Table-1. The results predicted in Table-1 showed that maximum level of vitamin C was observed in leaves (60.35 mg/ 100 gm) whereas minimum amount was found in seeds (1.34 mg 100^{-1} gm) of the subject plant. L-ascorbic acid is the trivial name of Vitamin C, the chemical is 2-oxo-L-threo-hexono-1,4-lactone-2,3-emediol, is used as food additives, antioxidants, browning inhibitors, reducing agents, antioxidants, flavor stabilizers, dough modifiers and colors stabilizers.

Table 1: Proximate composition of wild *Apium graveolens* Linn (%age)

Plant	Moisture	Ash	Crude fat	Crude protein	Crude fiber	NFE	Vitamin C mg100^{-1}g
Roots	25.31	1.98	1.34	5.68	10.25	55.44	7.15
Stem	56.32	0.98	1.21	5.94	17.84	59.87	32.98
Leaves	81.34	0.35	0.59	7.53	19.28	10.19	60.35
Seeds	38.51	1.12	2.45	6.21	7.37	44.34	1.34
Mean	50.37	1.107	1.39	6.34	13.68	42.46	25.45

Table 2 shows that the elements analyzed are in order Na> P> K> Ca> Mg> Fe> Cu> Mn> Zn> Ni> Pb> Pt> Cd> Se> Cr. The results of the study presented in Table 2 reveal that Mg, Ca, P, K and Na were present in fairly high amount (556

µg g^{-1}, 709 µg g^{-1}, 4667 µg g^{-1}, 2166 µg g^{-1} and 7000 µg g^{-1} respectively). The results showed that maximum concentration of Na is found in Peshawar Celery (7000 ± 2.60 µg g^{-1}) followed by that of Wild (5333 ± 3.29 µg g^{-1}) whereas minimum level was found in Swat Celery (4113 ± 8.58 µg g^{-1}). Ni level was observed in the range of (2.01-5.5 µg g^{-1} with an SD of 0.70). In very trace amounts, it may be beneficial to activate some enzyme systems, but its toxicity at higher levels is more prominent. However, nickel toxicity in humans is not a very common occurrence because the absorption of nickel is very low. Similarly the maximum value of Copper in all the four samples was found in wild celery (56.9 ± 0.81 µg g^{-1}) whereas minimum concentration was found in DI Khan celery (39.98 ± 1.18 µg g^{-1}). Copper is one of the essential micronutrients and its adequate supply for growing plants should be ensured through artificial or organic fertilizers, (Itanna 2002). Similarly fair amount of Zn was found in different celery (seeds) of the subject plant in the range of 11.96-15.61 µg g^{-1}. Zinc deficiency is growing concern in the developing world because of the consumption of plant foods that have inhibitory components for zinc absorption. Especially, in these populations, zinc deficiency is related to the high consumption of bread made without yeast. The highest level of zinc was in Swat seeds (15.61 µg g^{-1}) whereas Wild celery (11.96 µg g^{-1}) has lower concentration as compared to Swat and Peshawar. Iron was also found in fair amount in the celery of subject plant. The maximum level of Iron concentration was observed in the wild celery (305.2 ± 80.87 µgg^{-1}) followed by that of DI Khan celery (201.5 ± 28.05 µg g^{-1}) whereas minimum level was found in Celery of Peshawar origin (101.4 ± 0.019 µg g^{-1}). Likewise the distribution level of Mn was also studied in all the four samples of celery collected from different origin of Khyber Pakhtunkhwa and the data suggest (Table-2) that highest concentration of manganese was found in celery of Peshawar origin (39.3 ± 1.23 µg g^{-1}) whereas the lowest level was observed in the celery of DI Khan. Trace amounts of Iron, zinc, selenium, copper, and manganese in foods are probably involved in antioxidant defense mechanisms and inadequate intake of these nutrients has been associated with ischemic heart disease, arthritis, stroke and cancer, where pathogenic role of free radicals is suggested [33]. The recommended dietary allowances (RDA) as mg day^{-1} $person^{-1}$ for copper, iron, zinc and manganese are 2, 18, 15 and 5 respectively (NRC, 1989). The levels of copper, iron and manganese in the samples were higher while zinc has a similar level. Chromium showed a minimum concentration ranging from 0.11 µg g^{-1} ± 0.01 (D I Khan origin celery) to 1.37 ± 0.58 µg g^{-1} in Peshawar Celery, whereas Swat celery had trace amounts. It was also observed from the data that Cadmium was generally low in nearly all analyzed samples ranging from 0.31 µg g^{-1} ± 0.79 µg g^{-1} (DI Khan seeds) to 1.66 ± 0.30 µg g^{-1} (Peshawar celery). Cadmium is a nonessential element in foods and natural waters, and it accumulates principally in the kidneys and liver. Cadmium in foods is mostly derived from various sources of environmental contamination. Cadmium is a potent cell poison, which causes different types of damage, including cell death or increase in cell proliferation [35]. Likewise maximum level of Selenium was reported in wild celery (1.32 ± 0.46 µg g^{-1}) whereas minimum level was found in Swat seeds (0.08±0.021 µg g^{-1}).Trace amounts of Lead and Platinum were also investigated. Lead is widely distributed in spices and herbal plants and being a serious cumulative body poison, enters into the body system through air, water and food, and cannot be removed by washing the fruits and vegetables [36, 37]. The data suggested that DI Khan seeds contain higher concentrations of lead as compared to wild, Swat and Peshawar celery. Although there are no RDA value available of cadmium, lead, nickel and chromium, however some values were given by Food and Nutrition Board of the National Academy of Sciences, United States and other authorities. The recommended daily intake for chromium is 0.20 mg day^{-1}. Provisional tolerable intake for lead and cadmium is 0.21 and 0.06 mg day^{-1} respectively, whereas average daily intake of nickel from food is 0.30 mg day^{-1}. The levels of Cd, Pb, Ni and Cr were also lower than the levels given above by World Health Organization and Food and Nutrition Board of the National Academy of Sciences-United States.

It is believed that the availability of various elements in wild medicinal plants is attributed to the composition of the soil, water and atmospheric condition as well as permissibility selectivity and absorbability of plants for the uptake of different elements. The minerals Na, K, P, Ca, Mg are classified as macroelements and their daily requirements for human bodies is more than 100 mg whereas Fe, Zn, Mn, Cr, Se are grouped in microelements and they are needed by living organisms in small and trace amounts (less than 100 mg day^{-1}).

Table 2: Analysis of different minerals in *Apium graveolens* Linn collected from different Districts of Khyber Pakhtunkhwa

Element	Wild	Peshawar	Swat	DI Khan
Cr	0.73 ± 0.04	1.37 ± 0.58	Traces	0.11± 0.01
Se	1.32 ± 0.46	0.28 ± 0.021	0.08 ± 0.021	0.31 ± 0.141
Cd	1.55 ± 0.42	1.66 ± 0.30	0.91 ± 0.12	0.31 ± 0.79
Pt	2.13 ± 0.44	2.63 ± 0.17	Not detected	1.83 ± 0.05
Pb	3.51 ± 0.74	2.37 ± 0.58	4.96 ± 0.82	5.12 ± 0.7
Ni	5.5 ± 0.31	3.76 ± 0.55	2.55 ± 0.02	2.01 ± 0.21
Zn	11.96 ± 1.28	14 ± 1.41	15.61 ± 1.84	14.5 ± 1.41
Mn	38.6 ± 1.13	39.3 ± 1.23	35.3 ± 0.91	32.13 ± 0.18
Cu	56.9 ± 0.81	42.4 ± 0.68	51.43 ± 1.29	39.98 ± 1.18
Fe	305.2 ± 8.87	101.4 ± 0.019	184.6 ± 1.33	201.5 ± 28.05
Mg	490 ± 209.9	556 ± 190.13	243 ± 89.81	316 ± 1.41
Ca	709 ± 35.65	513 ± 4.65	547 ± 77.18	403 ± 215
K	2166 ± 816	1400 ± 216	1426 ± 81.2	1235 ± 80.4
P	4667 ± 7.07	3243 ± 5.07	4543 ± 8.16	4623 ± 8.16
Na	5333± 3.29	7000 ± 2.60	4113 ± 8.58	4877 ± 3.77

* The results are given as an average of three replicates with SD

Selected elemental composition in essential oil of *Apium graveolens* Linn wild and market Celery (seeds) was determined in µgg^{-1} on dry weight basis using Atomic absorption spectrophotometer and flame photometer. Data presented in Table 3 revealed that Na, K, and Fe were found in fairly high amount (491 ± 163 µg g^{-1}), (59 ± 1.05 µg g^{-1}), (49.6± 0.77 µg g^{-1}). Selenium, Chromium, Platinum, Cadmium and Magnesium were found to be present in lowest concentration among the analyzed elements. Selenium content ranged from 1.35 ± 0.79 to 1.77 ± 0.82 µg g^{-1} in D.I. Khan and wild seeds. Platinum ranged from 0.11 ± 0.01 µg g^{-1} to1.25 ± 0.82 µg g^{-1}. The level of magnesium among the samples was in the range of 71 ± 0.77 µg g^{-1}. Chromium concentration in DI Khan seeds was in the range of 0.91 ± 0.12 µg g^{-1} to 1.38 ± 0.82 µg g^{-1} in wild seeds.

Table 3: Selected elemental analysis of essential oil of *Apium graveolens* Linn seeds collected from different Districts of Khyber Pakhtunkhwa

Element	Wild	Peshawar	Swat	DI Khan
Ca	8.23 ± 2.10	4.27 ± 0.82	5.28 ± 0.81	4.92 ± 0.74
Mg	1.72 ± 0.77	1.71 ± 0.77	1.98 ± 0.09	1.43 ± 0.13
Na	491 ± 163	465 ± 246	397 ± 82.47	353 ± 79.2
K	59 ± 1.05	58 ± 0.98	49.63 ± 0.79	50.55 ± 0.80
Fe	39.31 ± 1.22	37.52 ± 0.36	49.6± 0.77	33.55±0.81
Cu	5.60 ± 0.92	5.46 ± 0.81	5.57 ± 1.73	4.49 ± 0.82
Mn	7.82 ± 1.62	7.79 ± 0.79	6.91 ± 0.83	7.01 ± 0.81
Pt	1.25 ± 0.82	1.24 ± 0.82	0.11 ± 0.01	0.21 ± 0.15
Cd	1.65 ± 0.86	1.71 ± 0.77	1.32 ± 0.47	1.45 ± 0.81
Se	1.77 ± 0.82	1.67 ± 0.83	1.48 ± 0.45	1.35 ± 0.79
Cr	1.38 ± 0.82	1.55 ± 0.42	Not detected	0.91 ± 0.12

* The results are in given as an average of three replicates with SD

For many of medicinal plants of current interest, a primary research to date has been focused on the area of phytochemistry. [38] The phytochemical screening of the subject plant was carried out to investigate the presence of medicinally active constituents and it was found to be in correlation with the results in literatures. It was found that in all the four samples collected from the natural habitat (wild) and from different areas of Khyber Pakhtunkhwa contained Steroids, Terpenoids, Flavonoids, Saponins, and Tannins whereas Cardiac glycosides was absent in all the samples (Table- 4). The plants and herbs contained secondary metabolites have established medicinal activity as well as exhibiting physiological activity. The presence of steroidal compounds is of great importance and interest in pharmacy due to their relationship with such compounds as sex hormones. This could be related to the fact that the leaves of *Apium graveolens* Linn are used as vegetable for expectant mothers or breast feeding mothers to ensure their hormonal balance, since steroidal structure could serve a potent starting material in synthesis of these hormones [39].

Table 4: Phytochemical Screening of *Apium graveolens* Linn seeds collected from different Districts of Khyber Pakhtunkhwa.

Plant portion	Steroids	Terpenoids	Flavonoids	Saponins	Tannins	Cardiac glycosides
Wild	+	_	+	Traces	+	_
Peshawar	+	-	+	Traces	+	-
D I Khan	+	-	+	+	+	-
Swat	+	-	+	+	+	-

4. Conclusions

The results reveal that average 50 % moisture was found in the aerial parts and seeds of the plant. Also from elemental analysis of the data it was concluded that the roots of the plant contains highest amount of K, P, Ca, Ni, Cd and Se whereas the leaves of the plant possess minimum level of Fe, Mn and Zn. The mean values of the data suggest that the maximum value of K content was present in the roots of the plant followed by that of stem while minimum level of the mineral was seen to be in the leaves of the plant. 7.53% crude protein was found in the leaves of *Apium graveolens*, also the leaves were found rich in Vitamin C, whereas the maximum amount of crude fat was found in seeds while roots of the plants contained maximum amount of ash. The seeds from Swat were found to be rich in Zn whereas wild celery had comparatively lower concentration of Zn than that of samples from Swat and Peshawar. All samples collected from the natural habitat and from different areas of Khyber Pakhtunkhwa were found containing Steroids, Terpenoids, Flavonoids, Saponins, and Tannins.

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