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Proximate analysis and elemental composition of *Salvia plebeia*

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Abstract

This work was carried out to determine the proximate and elemental composition of *Salvia plebeia*. It showed high nutritive potential. Shoot of *S. plebeias* sowed that it contained moisture (17.6%), Ash (14.5%), Organic matter (85%), Crude protein (6.16%), Crude fibers (5.75%), Crude fats (15.15%) and carbohydrates (44.69%). Similarly root sample of Salvia contained Ash (10.34%), Organic matter (89.67%), Crude protein (1.81%), Crude fibers (17.45%), Crude fats (7.68%), Carbohydrates (42.5%) and moisture content (15.6%); while seeds contained Ash (14.9%), Organic matter (85.11%), Crude protein (10.17%), Crude fibers (8.35%), Crude fats (12.37%), Carbohydrates (41%) and moisture content (10.30%). All parts of Salvia were rich in mineral and contained Calcium 37-64mg/L. Calcium is important for growth and maintance of bones and teeth. The concentration of microelements in the shoot of Salvia in mg/L were in the order of Ca>Mg>Na.Zn>Pb>Mn>Cr>Ni>Cd. Concentration in roots were in the following order Ca>Mg>Na>Zn>Mn>Ni>Pb>Cr>Ni>Cd while in seeds Ca>Mg>Na>Zn>Mn>Pb>Ni>Cr>Cd. In conclusion the shoot, root and seeds of Salvia contain nutrients and mineral elements of high nutritional value and can be used as a food source.

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Introduction

Salvia is the largest genus of the family Lamiaceae (subfamily Nepetoideae, tribe Mentheae) represents a cosmopolitan assemblage of nearly 1,000 species displaying a remarkable diversity in growth forms, secondary compounds, floral morphology and pollination biology (Muller, 1964). *Salvia plebeian* R. Br. is a cosmopolitan weed in Asia ranges from Iran, Afghanistan to China, Japan and southwards to South East Asia (Froissart, 2007). Since ancient times, *Salvia plebeia*has been used as conventional medicinal aid in Asia and there are numerous relevant Indian and Chinese references in the literature referring to its use as medicine since old days. Due to different cultivation areas and climatic conditions, its chemical constituents may vary significantly studies shows that *S. plebeia* possesses different biological activities, such as antimicrobial (Jiang *et al.,* 1987 and Jin *et al.,* 2008).

The essential oil of *S. plebeia* has been reported to have fungi toxic potential, inhibiting the growth of storage fungus *Aspergillus flavus* (Mishra and Dubey, 1990). The plant paste carries antibiotic potency while its seeds are being used to treat diarrhea, gonorrhea, menorrhagia and hemorrhoids (Bhadange, 2011). In Taiwan, *S. plebeia*is used for treatment of hepatitis (Lin & Kan, 1990). The leaves of this plant are also used in Korea to treat hepatitis, inflammation, hemorrhage and stress (Lu & Foo, 2002). Phytochemical studies on *S. plebeia* revealed that it contained flavonoids (Weng & Wang, 2000; Xiang *et al.,* 2008), diterpenes (Garcia-Alvarez *et al.,* 1986), lignan (Plattner & Powell, 1978; Powell & Plattner, 1976), and caffeic acids derivatives (Jin *et al.,* 2008 & Jin *et al.,* 2009).

To ascertain the nutritional significance of any edible plant and vegetable, its proximate/nutrient analysis is the most important factor that counts. Since, many medicinal plant species are also being used as food; therefore, examination of their nutritional significance can help understanding the worth of these plant species (Pandey *et al.,* 2006). As far as herbal drug's standardization is concerned, World Health Organization (WHO) lays lot of stress on need and importance of determining proximate and micronutrients composition of the herbal plants. Such herbal formulations must pass through standardization processes (Niranjan and Kanaki, 2008).

Various gallop surveys reveal that in rural areas, masses chiefly rely on traditional medicinal treatment by plants for cure of various diseases are met through use of herbal treatment. About 80% of the marginal communities all over the world by large depends upon medicinal plants in case of any sickness/ailment in daily life (Prajapati and Prajapati, 2002; Latif *et al.,* 2003; Shinwari *et al.,* 2006). Besides having pharmacologically important phytochemicals, each medicinal plant species bears its own nutrient composition that is substantive for the physiological functions of human body. These nutrients and biochemical's such as carbohydrates, fats and proteins play a vital role in satisfying human needs for energy and life processes (Novak and Haslberger, 2000). Fortunately, chemical composition diversity in plants also includes many compounds having medicinal value that are beneficial to humans such as vitamins, nutrients, antioxidants, anticarcinogensetc (Novak and Haslberger, 2000).

Plants are also known to have high amounts of essential nutrients, vitamins, minerals, fatty acids and fibre (Gafar and Itodo, 2011). The nutritious value as well as the toxicity of the medicinal plants is due to their chemical composition. The trace heavy metals like Fe, Cu, Zn, Cu, Mn, and Ni are essential nutrients but they become harmful and toxic when their concentration exceeds the recommended standards. Lead and cadmium are nonessential heavy metals. They are extremely toxic even in very minute amounts (Khan *et. al.*, 2008). A total of 9 elements Ni, Pb, Zn, Cr, Cd, Mg, Na, Mn and Ca have been measured using Atomic Absorption Spectroscopy. Rhizosheric and non-rhizospheric soil was also anaylzed to check effect of plant on elemental composition. The undertaken studies will facilitate physician, health care professional, planners and general public to use this plant in a significant manner.

So, the aims of this study was to determine the proximate analysis and mineral composition of the *S. plebeia* seed, shoot and root for the first time. This will help us to identify its nutritional potentials and elemental analysis.

Materials and method

Collection and Treatment of Sample

The samples were collected and treated by the methods recommended by Trease and Evans (1989) and Williamson *et al.,* (1996). The entire plant comprising, root, steam and leaves, of Salvia plebeia collected near wheat fields of Badragga, Malak and Agency in plastic bags. Plants were dried at room temperature (25-30°C). The dried shoots and roots were grinded into fine powder and then stored in paper bags for further analysis. The plant was identified according to the Flora of Pakistan (Nasir and Ali, 1970-1979; Nasir and Ali, 1980-1989; Ali and Nasir, 1989-1992; Ali and Qaiser, 1993-2009).

Proximate Analysis

For proximate analysis samples were raised in triplicates and the results were taken in average values. The estimation of the various food parameters in *Salvia plebeia* shoot, root and seed was carried out using the methods of AOAC (1990). The total nitrogen (N) content in the digests were determined as total Kjeldahl nitrogen by the microkjeldhal method. The crude proteins were obtained according to the AOAC (1990) protocol. Crude fats was determined by extracting the samples with petroleum ether in a soxhlet extractor, while crude fiber was estimated from the loss in weight on ignition of dried residue following digestion of fat-free samples. Soluble carbohydrate was obtained by the difference method. Ash was determined by incineration of the samples in a muffle furnace at 600°C for 3 hours.

Elemental Composition

Sample for elemental composition were prepared by mixing 2g powdered with 10ml of a mixture of nitric acid and perchloric acid (2:1 v/v). The digest was allowed to cool overnight and then transferred into a 100ml standard flask.

The elemental analysis was done at Centralized Resource Laboratory (CRL), Department of Physics, University of Peshawar, using Energy Depressive X-Rays spectrometer (EDX), Model (Inca-200), Company Oxford Instruments (U.K). The elemental analysis was done for roots, shoots and seeds of *Salvia plebeia.*

Statistical Analysis

Results were expressed as the mean ± standard deviation.

Results and discussion

The proximate analysis of *S. plebeia* shoot is given in Table 1, which shows that it contains carbohydrate (27.09%), crude protein (6.16%), ash (15.15%), crude fibre (5.75%), fat (15.18%) and moisture (17.60%). Results of analysis show higher value for organic matter whereas crude fibers have the least.

In light of the proximate analysis, dietary fiber is found extremely useful nutrient with ability to reduce the serum cholesterol level, risk of coronary heart disease, hypertension, constipation and diabetes (Ishida *et al.,* 2000; Rao and Newmark, 1998).

The *Salvia* shoot contained 15.18% Crude fats that is higher than 11% in water spinach leaves, 12% in *Senna obtusfolia* and 1.60% in *Ameranthus hybridus* leaves (Nwaogu *et al.,* 2000).

Table 1. Proximate Composition of *Salvia plebeian* shoot.

Parameters	Composition (%)
Ash	14.15±0.08
Organic Matter	85.85±0.07
Crude Protein	6.16±0.02
Crude Fibres	5.75±0.01
Crude fats (EE)	15.18±0.07
Carbohydrates (NFE)	44.69±0.04
Moisture	17.60±0.02

Results are mean of triplicate determinations ± SD.

Roots of *Salvia* contains Ash (10.34%), crude protein (1.81%), Fibres (17.45%), Fats (&.68%), Carbohydrates (42.55%) and moisture content (15.60%) Table 2. Organic matter has the highest value, while protein has the least.

Table 2. Proximate composition of *Salvia plebeian* root.

Parameters	Composition (%)
Ash	10.34±0.01
Organic Matter	89.67±0.09
Crude Protein	1.81±0.04
Crude Fibres	17.45±0.07
Crude fats (EE)	7.68±0.05
Carbohydrates (NFE)	42.55±0.06
Moisture	15.60±0.02

Results are mean of triplicate determinations ± SD.

Table 3 showed that *S. plebeian* seed contained highest value of organic matter (85%) while lowest crude fibres (8.35%). *Salvia hispanica* seed oil contained protein (15%-25%), fats (30%-33%), carbohydrates (26%-41%), high dietary fiber (18%-30%), and ash (4%-5%) (Ixtaina *et al.* 2008).

Table 3. Proximate composition of *Salvia plebeian* seed.

Parameters	Composition (%)
Ash (%)	14.90±0.07
Organic Matter (%)	85.11±0.02
Crude Protein (%)	10.17±0.03
Crude Fibres (%)	8.35±0.04
Crude fats (EE) (%)	12.37±0.01
Carbohydrates (NFE) (%)	41.2±0.03
Moisture (%)	10.30±0.02

Results are mean of triplicate determinations ± SD.

Mineral Composition

Salvia plebeia shoot, root and seed were analyzed and evaluated for mineral composition through Atomic Absorption Spectrophotometer. Shoot of *Salvia* contains the highest value of Ca and lowest of cd (Table 4).

Table 4. Mineral composition of *Salvia plebeia* shoot.

Minerals	Concentration (mg/L)	Std Dev
Ni	0.133	±0.0583
Pb	0.214	±0.0339
Zn	1.543	±0.0023
Cr	0.239	±0.0059
Cd	0.023	±0.0065
Mg	8.438	±0.1387
Na	4.622	±0.0304
Mn	0.882	±0.0047
Ca	63.34	±0.563

Table 5 illustrates that root of Salvia contains high level of Ca (64.98 mg/L). The amount of Cd was same in root, shoot and seeds. Roots have Lead and Chromium in same concentration (0.156 mg/L).

Table 5. Mineral composition of *Salvia plebeia* root.

Minerals	Concentration (mg/L)	Std Dev
Ni	0.185	±0.0451
Pb	0.156	±0.0087
Zn	4.21	±0.0151
Cr	0.156	±0.0041
Cd	0.023	±0.0112
Mg	8.31	±0.1755
Na	7.658	±0.0434
Mn	1.038	±0.0039
Ca	64.98	±0.212

Mineral analysis of seeds showed high level of Calcium (37.59mg/L) and Magnesium (9.007mg/L). The concentration of Ca in seeds was low compared to roots and shoot (Table 6).

Table 6. Mineral composition of *Salvia plebeia* seeds.

Minerals	Concentration (mg/L)	Std Dev
Ni	0.176	±0.059
Pb	0.188	±0.059
Zn	1.493	±0.0096
Cr	0.156	±0.0073
Cd	0.023	±0.0065
Mg	9.007	±0.0329
Na	7.271	±0.0443
Mn	0.898	±0.0017
Ca	37.59	±4.741

Nickel is available in nature in abundance. Research studies show that almost every edible food item found on our dining tables contains amount of Nickel no matter up to what extent. Resultantly, by making these food items as part of our daily meal, we actually start absorbing amount of Nickel that eventually residues in our body. The concentration of Ni in this study ranges from 0.133- 0.185mg/L. The permissible limit of Ni in plants is 1.49mg/L (Markert, 1994); that means that all samples of our research project are within the standard limits. The data shows that the highest concentration of lead is present in shoot (0.214mg/L) followed by seeds (0.188mg/L) and root (0.156mg/L). The permissible limit of World Health Organization for lead in medicinal plants is 9.98mg/L (WHO, 1998).

Salvia root contain the highest level of Zinc (4.21mg/L) followed by shoot 1.543mg/L) and seeds (1.493mg/L). The toxic limit of Zn in most of the plants is between 100-500mg/L (Macnicol and Beckett, 1985).

The Recommended Dietary Allowance (RDA) of Zn for children is 3-8 mg/day and for adult it is 11mg/day (Food and Nutrition Board, 2001). The permissible limit of zinc in medicinal plant is 49.9mg/L (50ppm) (Markert, 1994). The results obtained in the present study showed that Chromium level ranges from present in same concentration in all samples (0.156-0.239mg/L). Shoot contain the highest level of Cr. The RDA of Cr is 0.035mg/day for adults and for children is 0.011-0.025mg/day according to the Food and Nutrition Board, 2001.

Salvia plebeia all parts contain the same level of Cadmium (0.023mg/L). Deficiency of Cd can cause reduction in growth rate and excess of it can result in hypertension and nephritis (Stoker, 1976). The permissible level of cadmium (Cd) is 0.003mg/L in packaged and unpackaged potable water (SON, 2003). Magnesium in Salvia ranges from 8.31-9.007mg/L. Seeds contain the highest level (9.007mg/L), followed by shoot (8.438mg/L) and root (8.31mg/L). Sodium is very important mineral. The RDA, According to National Research Council (1974), for sodium is 1100-3300mg/100g for adults. Roots of *Salvia* contains the highest content of Na (7.658mg/L) followed by seeds (7.271mg/L) and shoot (4.622mg/L). Manganese content of *Salvia plebeia* ranges from 0.882-1.038mg/L. Roots contain the highest level of Mn (1.038mg/L). WHO has no permissible limits for Mn, however in literature the RDA for Mn is between 2-8mg/kg (Jones *et al.,* 1985).

Trace elements like copper, iron, manganese are found present in every balanced diet that we use in our day to day life. Some of these trace elements have been proved by studies as micronutrients and if not found in proper ratio; these trace elements could pose injurious effect on plants as well human body.

The results revealed that the shoot of *Salvia plebeian* contains 63.34mg/L of Calcium. Calcium is an important nutritional element for healthy growth of bones, muscles and teeth (Dosummu, 1997 and Turan *et al.,* 2003). Root contains the highest content of calcium (64.98mg/L) followed by shoot (63.34 mg/L) and seeds contain the lowest 37.59mg/L.

Mineral Analysis of Rhizospheric & Non-rhizospheric soil

Rhizospheric and non-rhizospheric soil of *Salvia plebeian* showed variation in concentration (Table 7). The upper soil chemistry and physics is effected by microorganisms and roots association (Brimhall *et al.* 1991; Richter and Markewitz 1995). Rhizospheric soil of *Salvia* contained more Calcium (70.4mg/L) compared to non-rhizospheric soil (65.335). Excess calcium in the soil may interfere with phosphorus and boron nutrient and thus encourage chlorosis because of reduction of soil manganese, iron, and zinc (Brady, 1974). In the present investigation Mg, Na, Mn concentration was significantly changed while Ni, Cr, Pb and Zn values were slightly altered. Both the rhizospheric and non-rhizospheric soil has same concentration of Cd (Table 20).

Table 7. Elemental composition of Soil.

Minerals	Rhizospheric Soil (Conc.) mg/L	Non-Rhizospheric Soil (Conc.) mg/L
Ni	1.116±0.0188	1.078±0.0702
Pb	0.264±0.0185	0.247±0.0019
Zn	1.464±0.0166	1.453±0.0112
Cr	0.701±0.0203	0.785±0.0052
Cd	0.03±0.0048	0.035±0.0097
Mg	10.88±1.088	9.383±0.1687
Na	3.457±0.0094	4.922±0.0407
Mn	6.438±0.0317	6.536±0.0129
Ca	70.4±0.364	65.33±0.588

Conclusion

In conclusion the shoot root, root and seeds of Salvia contain nutrients and mineral elements of high nutritional value. Proximate composition indicate that is a very rich source of energy and can be used as a food source. Concentration of mineral elements in the analyzed samples are enough to meet the daily recommendation.

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