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RESEARCH ARTICLE

METAL ANALYSIS OF *TARAXACUM OFFICINALE* PLANT (WATER EXTRACTS) BY FLAME PHOTOMETRY AND ATOMIC ABSORPTION SPECTROSCOPY

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ABSTRACT

Plants are the rich source of medicine because of the presence of large amount of phytochemicals and the phytomedicines which act symbiotically. In addition plants act a rich source of minerals which have a profound effect for the continuity of life by supporting the phytomedicines in feedback manner. The *Taraxacum officinale* plant was analysed for the estimation of various metals like, (**Mn, Pb, Fe, Cu, Cr, and Cd, Zn)** by AAS and **(Na, K, Li, Ca)** by Flame photometric method. All metals were analysed in separately in three parts of the plant (viz, Stem, Root, and Flower) by the mentioned methods. The results obtained were interesting and were found with the range set up by the WHO. Among the different parts of the plant, the roots were found to posses the highest mineral content of all metals, followed by Stem extract and lesser amount of minerals were found present in the flower extracts of the plant. All the results were recorded in ppm units, and only aqueous extracts were analysed in the complete study.

INTRODUCTION

Plants are one of most important sources of medicines. Today large numbers of drugs in use are derived from plants. The medicinal plants are rich in secondary metabolites and essential oil of therapeutic importance. The important advantages claimed for therapeutic uses of medicinal plants in various ailments are their safety besides economical, effective and their easy availability. Because of these advantages the medicinal plants have been widely used by traditional medicinal practitioners in their day to day practice. According to survey of World Health Organization, the practitioners of traditional system of medicine treat about 80% of patient in India, 85% in Burma and 90% in Bangladesh. In traditional systems medicinal plants have been used in successful management of various disease conditions like bronchial asthma, chronic fever, cold, cough, malaria, dysentery, convulsions, diabetes, arthritis etc. and in treatment of gastric, hepatic, cardiovascular and immunological disorders.

An advantage of using the intact plant is that several and different components in the plant may act synergistically (together) to produce the desired effect. Medicinal plant serve as source of drugs, after extracted and purified from the plant. Herbal plants can get contaminated with heavy metals during growing in the field, processing and handling. The herbal fields should be provided with quality medicinal herbs in order to protect consumers from contamination WHO [1-3] and metals Jabeen *et al*. [4]. Herbs contaminated with hazardous metals can be toxic and produce undesirable side effects [5, 6]. The metals having specific gravity of more than about 5 g cm^{-3} considered as heavy metals. Heavy metals can be very essential in very low concentrations for the survival of all forms of life. Trace heavy metals are important in daily diets, because of their essential nutritious value.

Experimental

All the chemicals used in this investigation were of analytical reagent (AR) grade and were purchased from Sigma Merck. De-ionized water was used for the complete study. All the glass wares and equipments used for handling were stabilized properly prior to use.

Preparation of Plant Samples

The separated and segregated plant parts **(viz, Stem, Roots and Flowers)** were collected. The shade dried dirt free plant parts were powdered in the grinder and stored in the air tight container in the dark until further use.

Preparation of Plant extracts

The extraction procedure was carried out in water only by Soxhlet Extraction Procedure. The different parts of the plant

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(viz, Roots, Stem and Flowers) were extracted separately. The extract after extraction was evaporated to remove the volatile solvent and get the plant extract in solid form after being kept in an own for complete dryness. Physical properties, Percentage Yield of the extracts are mentioned in the table 1.

Metal analysis by atomic Absorption Spectroscopy (AAS)

AAS instrument (PERKIN ELMER A. Analyst 200; Germany attachable to both hollow cathode lamps and electrode less discharge lamps; variable slit width of 0.7-1.2 nm and an air-acetylene flame attaining maximum temperature up to 2300^0C was used for this work. The samples were analyzed for seven heavy metals namely Cr, Mn, Cd, Fe, Zn, Pb & Cu. Chromium was analyzed at wavelength of 357.87 nm, Manganese at 279.5 nm, Cadmium at 228.80 nm, Iron at 248.33 nm, Zinc at 213.86 nm, Lead at 283.31 nm and Copper at 324.75 nm. (7)

Sample preparation: Samples were prepared by using standard APHA (***American Public Health Association***) methods. To ensure removal of organic impurities and prevent interference during analysis, each of 50 ml volume sample was digested using 10 ml concentrated HNO3 in a 250-ml conical flask placed on a fume cupboard. The samples were covered properly with aluminum foil to avoid spillage and heated on a hot plate until the solution reduced to 10 ml. This was allowed to cool and made up to mark with distilled water before filtering into a 50-ml standard flask, labeled and ready for analysis. The blank constituted 5% HNO3.

Standard preparation*:* Standard solutions of different metals were used as supplied. Solution of 1000 ppm strength served as the stock solution. Subsequently, lower concentrations in the range 2-10 ppm were prepared from the stock by serial dilution. Standard solutions of varied concentration of a metal were aspirated into the AAS through Nebulizer for construction of online calibration plot, using which the concentration of the metal in the unknown sample could be detected automatically.

Metal analysis by flame photometry

Flames Photometer Model – 1385 is a microprocessor based unit designed for medical application. The microprocessor provides automation in operation, measurement and end-result presentation. The unit can do the estimation of Sodium (Na^+), potassium (K^+), Lithium (Li^+) and calcium (Ca^{+2}) in single aspiration of a sample.[8]

Preparation of Various Extract

For preparation of water extract, 10 mg of the extracts (Stem, Root, and Flower) were separately mixed with the 10 ml of water. The extracts were completely exhausted by adding small quantities of water and filtering off every time in a successive manner, to yield final volume of 1 liter.

Preparation of Mixed Standard Solutions

Mixed standard solution of Na^+, K^+, Ca^{+2} and Li^{+2} were prepared by dissolving 254.2 mg of NaCl, 190.6 mg of KCl, 276.9 mg of $CaCl_2$ and 184.3 mg of $Li_2SO_4.H_2O$ in 1 litre of water, so it gives 100 ppm (4.35 millimole/lit.) of Na^+, 100 ppm (2.558 millimole/lit.) of K^+ , 100 ppm (2.495 millimole/lit.) of Ca^{+2} and 20 ppm (2.88 millimole/lit.) of Li^{+2} solution. Calcium was analysed at a wavelength unit of **(622 nm),** Lithium at **(670 nm),** Potassium at **(766 nm)** and Sodium at **(589 nm).**

Observation

The plant extracts Physical properties, Percentage Yield are mentioned in the below given table.

Table 1 Represents the physical properties, yield obtained and Percentage yield of the various parts of the *Taraxacum officinale*

Solvents	Physical Properties	Yield Obtained g/1000ml	Percentage Yield
Aqueous Stem Extract (T1)	Honey Brown Powder	14.7	29.4%
Aqueous Root Extract (T2)	Honey Brown Powder	11.7	23.4%
Aqueous Flower extract (T3)	Blackish Brown Powder	15.4	30.8%

Atomic Absorption Spectroscopic analysis of metals

The metal analysis of plant has been carried out by Atomic Absorption Spectroscopy, and Flame Photometry. Various types of metals in (ppm) concentration have been analysed and are essential for the living beings. The metallic analysis of plant has been carried out only in three extracts **(T1, T2 and T3).**

Table 2 Report of AAS Analysis of Metal Ions (in ppm) in (T1, T2, and T3) Extracts of *Taraxacum officinale.*

Sample Name	Metal Ions						
	Mn	**Pb**	**Fe**	**Cu**	**Cr**	**Cd**	**Zn**
(T1) Extract	0.3594	0.5448	0.5681	0.0743	0.0971	0.0991	0.1831
(T2) Extract	0.5809	0.9007	3.037	2.6777	0.0211	0.0321	1.4821
(T3) Extract	0.5777	0.4912	0.6782	0.0689	0.0012	0.0413	0.1512

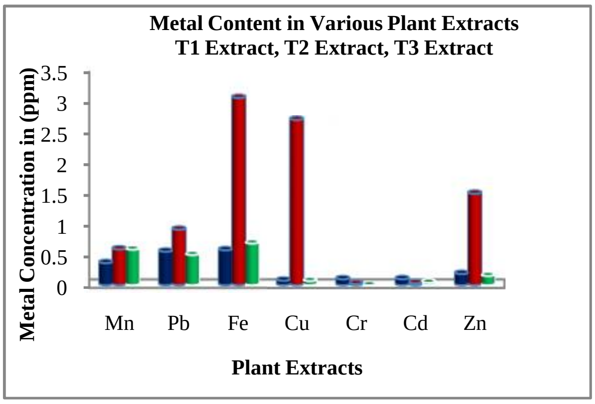

Fig 1 Represents the (Metal Content) of (T1, T2, T3) Extracts of *Taraxacum officinale* by AAS.

Metal Analyses by Flame Photometry

The metals which have been analysed by Flame Photometry include (Na, K, Li and K). In flame photometric analysis the element to be analysed in being burnt in presence of a given flame, the burnt element gives its characteristic coloured flame which is being analysed.

Table 3 Report of Flame Photometric Analysis of Metal Ions (in ppm) in (T1, T2, and T3) Extracts of *Taraxacum officinale*

Sample Name	Metal Ions			
	Na	K	Li	Ca
(T1) Extract	340	151	31	110
(T2) Extract	310	180	25	80
(T3) Extract	120	98	11	89

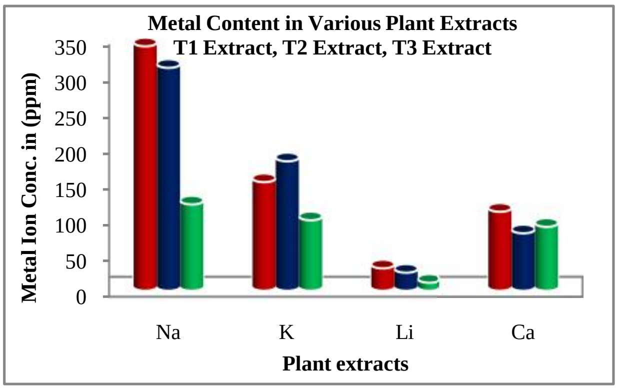

Fig 2 Represents the (Metal Content) of (T1, T2, T3) Extracts of *Taraxacum officinale* by Flame Photometry

RESULTS AND DISCUSSION

Metal Analysis by Atomic Absorption Spectroscopy

The Atomic Absorption Spectroscopy has been carried out and (Mn, Pb, Fe, Cu, Cr, Cd, Zn,) have been analysed in (T1, T2 and T3) extracts of *Taraxacum officinale.* The levels of heavy metals present in the extracts were expressed as mean of heavy metal concentration (ppm) ± S.D of three replicates. The (Mn) content has been found highest in (T2) extract followed by (T3) extract and lesser amount was found in (T1) extract (Table 2). Among the all extracts of the plant (Pb) have been found highest in (T2) extract followed by (T1) and then lesser amount was found in (T3) extracts. The AAS results for (Fe) show that (T2) extract posses the highest content followed by (T3) and little content was found in (T1) extract when compared with these two extracts (T2 and T3). The (Cu) and (Zn) content in the three extracts (T1, T2 and T3) show parallel trend in concentration. The three extracts follow the order (T2 › T1 › T3), (Fig 1). The (Cr) content was found highest in the (T1) extract followed by (T2) extract and least content was found in the (T3) extract (Table 2). Similarly the (Cd) content was determined in the plant Extracts and follow the order (T2 › T1 ›T3) ((Fig 1). The lead content of the concerned plant fall within the (0.4 – 0.9) limit set up by the WHO [WHO., 2005] prescribed limit for lead contents in herbal medicine is 10 ppm while the dietary intake limit for lead is 3 mg/week, and the lead content within the concerned plant fall within the limit set up by the WHO. The iron content of the plant was estimated to be (0.5-3.0). The concentration level of cobalt in the concerned plant extracts was found (0.04- 2.6pp) and was found highest in flower extract 2.6777, and marginally little concentration was found root and stem extracts of the plant. The permissible limit set by FAO/WHO [9] in edible plants was 3.00 ppm. The Chromium ion was found 0.0211ppm, 0.0012ppm, 0.1570 ppm respectively in the Flower, Root and Stem extracts. For medicinal plants the WHO [10] limits for Chromium have not yet been established. However, permissible limits for Chromium set by Canada were 2 ppm in raw medicinal plant material and 0.02 mg/day in finished herbal products WHO [11]. : Cadmium was found in all the three plant extracts (Flower, Root, Stem) in the concentration range of 0.0321ppm, 0.0413ppm, 0.1291ppm. Cadmium causes both acute and chronic poisoning, adverse effect on kidney, liver, vascular and immune system Jabeen *et al*. [11]. Results obtained show the high concentration of zinc in flower extract of about .4821ppm. The root extract showed about 0.0012 ppm concentration of Zinc, and 0.023 ppm concentration in Stem extract, compared to 27.4 ppm permissible limit set by FAO/WHO [9] in edible plants. Therefore the zinc concentration in the concerned plant extracts is below permissible limit set by FAO/WHO [9] in edible plants.

In over all comparison among the different parts of the plant, the highest metal content was found in (T2) extract followed by (T1) extract and little metal content was found in the (T3) extract (Fig 1).

Metal Analyses by Flame Photometry

The metals which have been analysed by Flame Photometry include (Na, K, Li and K). In flame photometric analysis the element to be analysed in being burnt in presence of a given flame, the burnt element gives its characteristic coloured flame which is being analysed.

The concentration of (Na) in various plant extracts follows the order (T1 › T2 › T3). The highest concentration of (Na) was being found present in (T1) extract and least in (T3). The (K) content in the plant extracts (T1, T2, T3) shows that highest (K) concentration is present in (T2) extract. The (T1) extract posses (K) content more than the (T3) extract, but less than the (T1) extract. The (Li) concentration was found highest in the (T1) extract followed by T8 and least content was found present in the (T3) extract. The highest (Ca) ion content was found present in (T1) extract and least in the (T2). The extract (T2) posses the (Ca) ion content in between the (T1) and (T3) extracts. All the metal concentrations are in (ppm) units and are tabulated in (Table 3). The graph traced between metal ion concentration and plant extracts are shown in (Fig 2).

Potassium (K): Potassium (K) is the major cation found inside of cells (12). The proper level of potassium is essential for normal cell function. An abnormal increase of potassium (hyperkalemia) or decrease of potassium (hypokalemia) can profoundly affect the nervous system and heart, and when extreme, can be fatal. The normal blood potassium level is 3.5 - 5.0 millimole/liter (mmol/l). the K ion concentration was found to 98-180ppm permissible within the range set up by WHO. The concentration of sodium ion with the concerned plant was found in the range (120-340ppm).

Sodium is important in maintaining human body fluid volume and maintaining electric potential in the animal tissue [13] Calcium strengthens your bones, particularly before you are 35 years old. Most (99%) of calcium is found in bones and teeth [14] with the remaining 1 % in the soft tissues and watery parts of the body where calcium helps to regulate normal processes of the body [**14**]. The calcium content of the plant was estimated to be (80-110ppm), Calcium helps to control blood pressure, nerve transmission, and release of neurotransmitters, to transport ions (electrically charged particles) across the membrane, to reduce the incidence of premature heart disease, especially if adequate intakes of magnesium are also maintained, to reduce the occurrence of osteoporosis, maintaining all cells and connective tissues in the body, may help to prevent periodontal disease (gum disease).[14].

Lithium ion is an important element for the treatment of manic depression and the lithium battery. Considering such applications, rapid and accurate methods for the determination of lithium ion and its separation in recycling are receiving intensive attention [15] Because the high concentration of sodium ion exists in blood and sea water, an excellent selectivity of Li^+/Na^+ is required for the determination and separation of lithium ion in biological and environmental systems. The Li ion concentration was found to be (11-31ppm).

CONCLUSION

The results obtained are quite interesting for the concerned plant. The metal analysed in all the three parts are within the range set up by the WHO. The metals in their limit are useful for the living beings, their increase or decrease from the limiting value could cause a defect. The metal ions are very essential for all type of metabolic chains like respiration, reproduction, absorption of nutrients, etc, so their deficiency or over accumulation is seen with a direct effect. As per this plant is taken into consideration, it is mineral rich so should be consumed with a good amount.

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