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Research Article

Physico-Chemical Analysis of Ash of some Medicinal Plants Growing in Tamil Nadu, India

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Abstract

Herbal medications are claimed and widely believed to be beneficial; however, there have been reports of acute and chronic intoxications resulting from their use. Hence it is necessary for the herbal companies to follow the GMP and WHO guidelines for determination of toxicological parameters while manufacturing the Herbal Medicines. In the present study, physicochemical analysis of ash of *Ammania baccifera* L. (Family: Lythraceae), *Azima tetracantha* Lam (Family: Salvadoraceae), *Melothria maderaspatana* (L.) Cogn. (Family: Cucurbitaceae) parts were carried out. Atomic absorption spectroscopy, flame photometry, UV spectrophotometry were used for quantitative estimation while chemical methods applied for qualitative estimation of minerals in plants ash. The results obtained provide justification for the usage of these plants in daily diet for nutrition as well as for medicinal usage and medicinal plants in the treatment of different diseases. The metal contents in the samples were found at different levels which play a vital role in cure of diseases. It is found that *A.baccifera*, *A.tetracantha* and *M.madaraspatana* showed maximum concentration of calcium while, *A.tetracantha* showed maximum results with potassium. *A.baccifera* and *A.tetracantha* showed the toxic elements Pb, Cd, Hg and As at BDL (Below the Detection level) (DL 0.1mg/kg) and *M.madaraspatana*, toxic elements Cd and Pb were found but at very low concentrations whereas Hg and As were found at BDL.

1.0 Introduction

Plant based drugs have been used in the treatment of various ailments ranging from common cold to cancer from long back[1] Relatively high levels of essential elements such as Fe, Mn, Zn, and Ca, have been proved to influence the retention of toxic elements in animals and human beings[2]. *Ammannia baccifera* L., Lythraceae, "Neermalneruppu" in Tamil is an erect glabrous reddish herb grows upto 60 cm in height. It is utilized in folklore medicine to relieve skin diseases as well as useful in urinary calculi[3]. *Azima tetracantha* "Mulsangu" in Tamil belongs to the family Salvadoraceae. It occurs naturally in central, eastern and South Africa as well as in the Indian Ocean islands, and extends through Arabia to tropical Asia. The roots of *Azima tetracantha* are applied directly to snakebites and is a powerfull diuretic given in rheumatism, dyspepsia and chronic diarrhea[4]. *Melothria maderaspatana* (Linn.) Cogn. "Musumusukkai" in Tamil (Family-Cucurbitaceae), is a plant drug of Siddha medicine found throughout India and in China, Taiwan, Malaysia, Australia, New Zealand and in Africa. It has antioxidant, diuretic, stomachic gentle aperients, antipyretic, antiflatulent, antibronchitis, hepatoprotective, anti-rheumatic, analgesic, antibacterial, stimulant, anti-inflammatory, anticancer, anti-hypertensive, anti-diabetic activities[5]. Only scantly reports are available on the role of micronutrients, which play an important role in the formation of active constituents responsible for their curative properties[6]. So, the quantitative estimation of various trace element concentrations is important for determining the effectiveness of the medicinal plants in treating various diseases and also to understand their pharmacological action[1].

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2.0 Materials and Methods

Ammania baccifera (Whole plant) was collected from paddy field in Orakkadam, 15km from Thambaram,Chennai, , *Azima tetracantha* (Root) which is a common element of the forest was collected from scrub jungle forest in Vandalore area near Chennai and *Melothria maderaspatana* (whole plant), is a common weed growing on the fences and small trees, it was collected from road sides of Thambaram, Chennai . The collected plants were authenticated by Prof.P.Jayaraman, Director, National Institute of Herbal Science, Chennai-45, (Ref. no: PARC/-200/1008).

2.1 Determination of Mineral Content

The glasswares were sterilized in an oven at 150-160°C for 2h. Plant material was kept at 150°C to a constant weight for the preparation of sample for mineral analysis. Dried plant material was ground to fine powder and used for the determination of ash value. Pre cleaned slica crucible was heated at 600°C until the weight of the crucible became constant. Five gram plant material was taken in the slica crucible and heated in a muffle furnace at 400°C till there was no evolution of smoke. The crucible was cooled at room temperature in a desiccators and ash was moistened with concentrated H_2SO_4 (0.5mL). Crucible was placed on hot plate and heated until fumes of H_2SO_4 ceased to evolve. The crucible with sulphated ash was then heated in a muffle furnace at 600°C till the weight of the content become constant[7]. Loss on drying value was determined as per method of Indian Pharmacopoeia 1996[8], pH value was determined as per method of Sharma and Kaur [9] and chloride sulphate and nitrate was determined as per Trivedi and Goel[10]. Among the five inorganic elements in ash, Na and K were

determined by using flame photometric method Ca and mg estimated by titration method phosphorus was determined by UV-Spectrophotometor.

The plant powder samples were also analyzed for eight inorganic elements such as Na, K, Ca, Pb, Cd, Hg, As and Fe. Na and K was determined by using flame photometer. Ca, Pb, Cd, Hg, As and Fe were determined by Atomic absorption spectrometry.

For Atomic absorption spectrometry, 0.25g of each of the powdered plant samples digested in 6.5ml of acid solution (HNO_3, H_2SO_4 , $HClO_4$ in ratio of 5:1:0.5). The corresponding solution was heated until white fumes had appeared. The clear solution was diluted upto 50ml with distilled water and filtered with Wattmann filter paper No.1. The standard working solutions of elements of interest were prepared to make the standard calibration curve. Absorption for a sample solution uses the calibration curves to determine the concentration of particular element in that sample. A varian AA240FS atomic absorption spectrometer (AAS) was used for the determination of six metals that is Ca, Pb, Cd, Hg, As and Fe, cathode lamp used as radiation source. Air acetylene gas was used for all the experiments. This method provides both sensitivity and selectivity since other elements in the sample will not generally absorb the chosen wave length and thus, will not interfere with the measurement.

3.0 Results and Discussion

The amount and composition of ash remaining after combustion of plant material varies considerably according to the part of the plant, age and treatment. The constituents of the ash also differ with time and from organ to organ. The results of physico-chemical analysis of plant ash are given in Table No.1. The ash of all the plants was shown as fine powder. Ash usually represents the inorganic part of the plant. The percentage of the ash content is highest in *A. baccifera* (16.2%) followed by *A. tetracantha* and *M. madarasapatana* (Table No. 1). Ash contains inorganic material of the plant because ashing destroys all the organic material present in the plant sample. Percentage of ash value was highest in alcohol soluble ash than in the water soluble ash and very less in acid insoluble ash for *M. madaraspatana*. The samples of *A.baccifera* were found slightly acidic in pH (6.25), whereas the samples of *A. tetracantha* and *M. madaraspatana* were found alkaline in pH.

The inorganic elements play an important role in physiological process involved in human health. The elements composition of ash and plant materials are given Table No 2 and 3 respectively.

All plants showed maximum concentration of calcium in comparision to other elements. Trace elements play both curative and preventive role in combating diseases. Highest concentration of Ca was found in the *M. madaraspatana* is (3.0%). Calcium overcomes the problems of high blood pressure, heart attack, premenstrual syndrome, colon cancer and imparts strength and rigidity to bones and teeth and reduces the risks of osteoporosis in old age. It also acts as an activator of the enzymes phospholipase, arginine kinase, adenosine triphosphatase and adenylkinase. Excess quantity of calcium ions in extra cellular fluid induces mental depression. At the other extreme, low levels of calcium causes spontaneous discharge of nerve fibers resulting in tetany[12].

Potassium is present in all plants in good quantity. It was highest in *A.baccifera* and lowest in *M.madarasapatana*. Barthakur *et al.*, (1995) also reported highest concentration of K in fruit of *C. fistula*. *C. fistula*, is a good source of K so that 100% of the US Recommended Dietary Allowances (RDA) for adults could be met by the consumption of about 100 gm of fresh fruit[11]. Potassium is important for diuretic activity and is helpful in reducing hypertension and maintaining cardiac rhythm. High concentration of K in the medicinal Plants could be related to the diuretic action of drugs prepared from these plants[12].

The level of iron showed 0.072% in *A.tetracantha*. It is an essential mineral to prevent anemia and cough associated with angiotension converting enzyme (ACE) inhibitors[13].

Phosphorous concentration was found to be highest in *A.tetracantha* 14.66mg/kg (0.001466%) and lowest in *A.baccifera*. Phosphate ions are the major anions of intracellular fluids, phospholipids and the coenzyme NAD and NADP and especially of ATP and other high energy compounds. It helps in the process of ossification of bones by getting deposited in the form of calcium phosphate[7].

Magnesium and sodium concentration were found to be highest is *M. Madarasapatana* and lowest in *A.tetracantha.* Sodium is involved in the production of energy, transport of amino acids and glucose into the body cells. The highest sodium concentration was 0.34% found in the *A.tetracantha.* Magnesium is the fourth abundant cation in the body. Much of the Mg is present in the bones in association with Ca and phosphate and rest in soft tissues and body fluids. The chloride, sulphate and nitrate concentrations were found highest in *A.baccifera*.

A.baccifera and A.tetracantha showed the toxic elements Pb, Cd, Hg and As at BDL (BDL-Below the Detection level; DL 0.1mg/kg) and *M.madaraspatana* showed toxic elements Cd and Pb but at very low concentrations *viz*., Pd concentration as 9.62mg/kg and Cd at 1.78mg/kg, whereas Hg and As were found at BDL. Lead is toxic metal and it causes a rise in blood pressure, kidney damage, miscarriages and subtle abortion, brain damage, declined fertility of men through sperm damage, diminished learning abilities of children and disruption of nervous system. Cd, As, Hg are also toxic and were found at below detectable level in all the plants and could be considered safe to consume[13].

The absence of these heavy metals in all the samples suggested that most of the plants were collected from unpolluted natural habitats and therefore reflects their natural levels of heavy metals.

4.0 Conclusion

All the three plants may be a good source of minerals to treat number of diseases that are mainly caused due to the deficiency of these minerals and can be utilized to cure diseases. The observed results of present study will be helpful in the synthesis of new modern drugs with various combinations of plants which can be used in the cure of many diseases ethnomedicinally. However, more detailed analysis of chemical composition of the medicinal plants is required.

Table 1: Physicochemical constants of plant drugs and ash

Physico chemical constants	*Ammania baccifera*	*Azima tetracantha*	*Melothria madaraspatana*
% of Loss on Drying	13.3± 0.01	13.5±0.01	11.5±0.01
% of Ash content	16.20± 0.21	15.4± 0.11	14.78± 0.12
% of Acid insoluble Ash	0.8 ± 0.11	1.55± 0.12	1.476± 0.14
% of water soluble ash	48.23 ±3.32	45.81± 2.24	77.64±3.53
% of Alcohol soluble ash	8.20 ± 0.74	1.55± 0.42	83.43±1.84
Alkalinity of water soluble ash	0.98±0.14	0.74± 0.16	0.85±0.15
pH of Ash water soluble	6.25± 0.01	4.78± 0.22	8.87±0.10
% of Alcohol soluble extractive value	10.25± 0.01	8.35± 0.16	14.5± 0.04
% of water soluble extractive value	14.02± 0.02	16.24± 0.01	12.5± 0.01
% of Chloride (Cl)	1.34± 0.21	0.71± 0.19	1.10±0.08
% of Sulphate (SO_4)	0.63 ±0.08	0.32±0.01	0.46±0.04
% of Nitrate (NO_3)	(94.72±0.18 mg/kg) 0.0094	(74.6± 0.06 mg/kg) 0.007467	(81.26±0.02 mg/kg) 0.008126

Table 2: Elemental composition of plant ash

S. No	Elements	Plants		
		Ammania baccifera	***Azima tetracantha***	***Melothria madarespatana***
1	Sodium	0.27 %	0.04 %	0.23 %
2	Potassium	0.74 %	0.12 %	0.38 %
3	Calcium	0.87 %	0.26 %	3.0 %
4	Magnesium	0.41 %	0.09 %	1.37 %
5	Phosphate	0.00146 % 14.66mg/kg	0.00245 % 24.5 mg/kg	0.00195 % 19.5mg/kg

Table 3: Elemental composition of plant powders

S. No	Elements	Plants		
		Ammania Baccifera	***Azima tetracantha***	***Melothria maderaspatana***
1	Sodium(Na)	0.34 %	0.09 %	0.24 %
2	Potassium(K)	0.52 %	0.19 %	0.40 %
3	Calcium (Ca)	0.95 %	0.48 %	3.02 %
4	Lead(Pb)	BDL	BDL	9.62mg/kg (0.000962%)
5	Cadmium (Cd)	BDL (DL: 0.1mg/1kg)	BDL	BDL
6	Mercury (Hg)	BDL	BDL	BDL
7	Arsenic (As)	BDL	BDL	BDL
8	Iron (Fe)	0.0165 % 165.4 mg/kg)	0.072 % (720.5 mg/kg)	0.025 %

BDL : Below Detection Limit
DL : Delection limit.

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