*Available online at* **www.joac.info**

ISSN: 2278-1862

*Journal of Applicable Chemistry*

2019, 8 (4): 1960-1965

(International Peer Reviewed Journal)

# Toxic Metals in Selective Medicinal Plant Extracts of Nagaram Region, Andhra Pradesh, India

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**Accepted on 13th July, 2019**

## ABSTRACT

*Metals compositions in selected 10 medicinal plant species from Nagaram region, Andhra Pradesh, India were studied in order to understand their mechanism of treatment. Identified medicinal plants were Mimosa pudica, Ocimum sanctum, Allium cepa, Allium sativum, Zingiber officinale, Azadirachta indica, Calotropis procera, Capsicum frutescens, Emblica officinalis, and Curcuma longa.These plant species, especially those used in the treatment of diseases such as hypertension, diabetes and asthma may require long term usage. Samples were analysed for elemental composition by using Flame photometer (Na and K) and Atomic Absorption Spectrophotometer for metals (Ca, Mg, Mo, Co, Cu, Fe, Mn, Zn and As). The main purpose of this study was to document evidence of essential and non-essential heavy metals in these plant species, which are extensively used in the preparation of herbal products and standardized extracts.From the results of the study zinc and manganese were present in high concentrations among the plant species examined. Among the section of plants, the highest metal content was seen in the latex of Calotropis procera. Highest Na concentration was found in the latex of Calotropis procera, 280 mg $kg^{-1}$ and roots of Mimosa pudica, 8860 mg $kg^{-1}$, respectively. Mn content was very high in the rhizome of Zingiber officinale (554.20 mg $kg^{-1}$), Fruit of Emblica officinalis (182.74 mg $kg^{-1}$) and rhizome of Curcuma longa (331.82 mg $kg^{-1}$). Zn content is usually high in all samples ranged from 22.68 to 86.42 mg $kg^{-1}$, highest seen in leaves of Ocimum sanctum.*

## Graphical Abstract


Sample area location

**Keywords:** Health implications, Metals, Formulations, Medicinal plants.

## INTRODUCTION

Preserving and safeguarding methodologies and methods of medicinal plant uses is vital for traditional knowledge. Recently markets are flooded with the introduction of many medicinal plants products, most of them are without any knowledge and scientific validation of their efficacy, toxicity mechanism, and composition. Awareness of medicinal plants' usage is a result of the many years of struggles against diseases and man learned to pursue drugs in barks, seeds, rhizomes, latex, fruits, and other parts of the plants. Healing with medicinal plants is a long-standing treatment method as old as mankind itself. These medicinal plants products are in most cases commonly known home remedies used to treat specific conditions or could be complex formulation preparation often used for life-threatening diseases by the rural people.

Reports on mineral composition of medicinal plants/products are wanting, also not possible to relate the results scientifically with others. The data generated may be useful in correlating medicinal properties and mechanisms of individual plant extracts with the objective of exploiting their potential benefit on health. In this study,10 different commonly available medicinal plant species were collected from their natural habitat and studied for their metallic composition (Na, K, Ca, Mg, Mo, Co, Cu, Fe, Mn, Zn, As) in sections like root, leaves, rhizome, latex etc. Identified medicinal plants were *Mimosa pudica*, *Ocimum sanctum*, *Allium cepa*, *Allium sativum*, *Zingiberofficinale*, *Azadirachtaindica*, *Calotropisprocera*, *Capsicum frutescens*, *Emblica officinalis*, *Curcuma longa* [1-7].

## MATERIALS AND METHODS

**Geographical area:** The study area is the part of the Guntur district, Nagaram mandal consist of nearly 73 Villages and 25 Panchayats. Geographical coordinates are 15°99′22″N/80°69′31″E (Long/Latitude) (Figure 1). It is located 53 KM towards South from District headquarters, Guntur. Approximately 96 kms away towards the north-west from newly formed state capital Amaravathi, Andhra Pradesh. Nagaram is a village in Guntur district of the Indian state of Andhra Pradesh. It is located in Nagaram mandal. Thotapalle is the smallest Village and Allaparru is the biggest Village. It is in the 10 m televations (altitude). The total geographical area of the village is close to 724 hectares. Nagaram has a total population of over 5,924 peoples. Weather and Climate of Nagaram Mandal arehot in summer with summer highest day temperature is in between 40°C to 48°C. Nagaram records an average temperature of 34 °C.

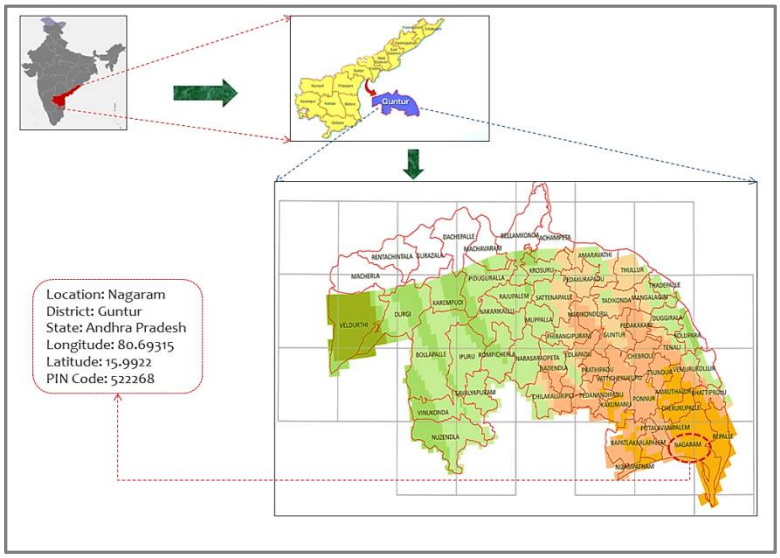



**Figure 1.** Sample area location

**Instruments:** Samples were analysed for elemental composition by using Systronics-Digital Flame photometer with Compressor (Type: 130) (Na and K) and Atomic Absorption Spectrophotometer (AAS), Shimadzu AA-6300 was used for the analysis of essential and non-essential metals (Ca, Mg, Mo, Co, Cu, Fe, Mn, Zn and As).With AAS lamp absorbance wavelengths for metals analysed given in table 1. Identified medicinal plants were *Mimosa pudica, Ocimum sanctum, Allium cepa, Allium sativum, Zingiberofficinale, Azadirachtaindica, Calotropisprocera, Capsicum frutescens, Emblica officinalis,* and *Curcuma longa.* Selected commonly available medicinal plants of the region and their uses given in table 2.

**Table 1.** Chosen AAS lamp absorbance wavelengths for metals

| S. No. | Metal | Wavelength (nm) | Slit width (nm) |
|---|---|---|---|
| 1 | Ca | 422.7 | 0.7 |
| 2 | Mg | 285.5 | 0.2 |
| 3 | Mo | 320.9 | 0.2 |
| 4 | Co | 346.6 | 0.2 |
| 5 | Cu | 324.8 | 0.7 |
| 6 | Fe | 248.3 | 0.2 |
| 7 | Zn | 213.9 | 0.7 |
| 8 | As | 193.7 | 0.7 |

**Chemicals and standards:** All the chemicals were of analytical reagent grade (purity > 99%), purchased from Sigma–Aldrich Co., Inc., USA/Ranbaxy, India/Merck, India, unless otherwise mentioned. All the chemicals were used as received All aqueous solutions were freshly prepared using deionized water (Resistivity, $\rho \geq 18$ MΩ cm) from ElgaPurelab Option-Q system (ELGA LabWater, UK).

**Sample collection and preparation procedure:** A total of 10 different commonly available medicinal plant species were collected from their natural habitat. The section of plant material was washed, cleaned, air-dried to total dryness for four days and later pulverized to powder form. The dried material was weighed digested with 5-10 ml of 1:3mixtures of $HNO_3$ and $HClO_4$ and subjected for Flame photometric analysis and Atomic absorption spectrophotometric analysis. Appropriate working standard solutions were prepared for each element. The calibration curves were obtained for concentration versus absorbance. The trace elements were determined using standard methods from literature with some small modifications.

**Table 2.** Selected commonly available medicinal plants of the region and their uses

| S. No. | Botanical name | Family | Section of Plant | Medicinal Uses | Sample Code |
|---|---|---|---|---|---|
| 1 | *Mimosa pudica* | Mimosaceae | Whole plant | Snake bites, speed healing in wounds and to treat eczema | MPE-1 |
| 2 | *Ocimum sanctum* | Lamiaceae | Leaves | Coughs, colds, bronchitis; gastric disorder, earache, ringworm, leprosy and itches | MPE-2 |
| 3 | *Allium cepa* | Liliaceae | Bulb | Cough, asthma, rheumatism, colic and insect bites. | MPE-3 |
| 4 | *Allium sativum* | Liliaceae | Bulb | Fevers, bronchitis, rheumatism, inflammation, indigestion, gas formation and pain in the abdomen | MPE-4 |
| 5 | *Zingiberofficinale* | Zingiberaceae | Rhizome | Stomach upset, motion sickness, nausea, and vomiting | MPE-5 |
| 6 | *Azadirachtaindica* | Meliaceae | Leaves, Bark | Bark Fever, thirst, cough and bad taste in the mouth | MPE-6 |
| 7 | *Calotropisprocera* | Asclepiadaceae | Root, Bark | Dyspepsia, flatulence, constipation, loss of appetite, indigestion | MPE-7 |
| 8 | *Capsicum frutescens* | Solanaceae | Leaves, Fruit | Headache, night blindness, pain, adenitis, sores, dysuria and bronchitis | MPE-8 |
| 9 | *Emblicaofficinalis* | Euphorbiaceae | Fruits | Against liver toxins, high blood cholesterol, and age-related kidney disorders | MPE-9 |
| 10 | *Curcuma longa* | Zingiberaceae | Rhizome | Scabies, itches, boils, eczema, leucoderma, eye diseases, bruises and sprains; internally for cough, cold, fever. | MPE-10 |

## RESULTS AND DISCUSSION

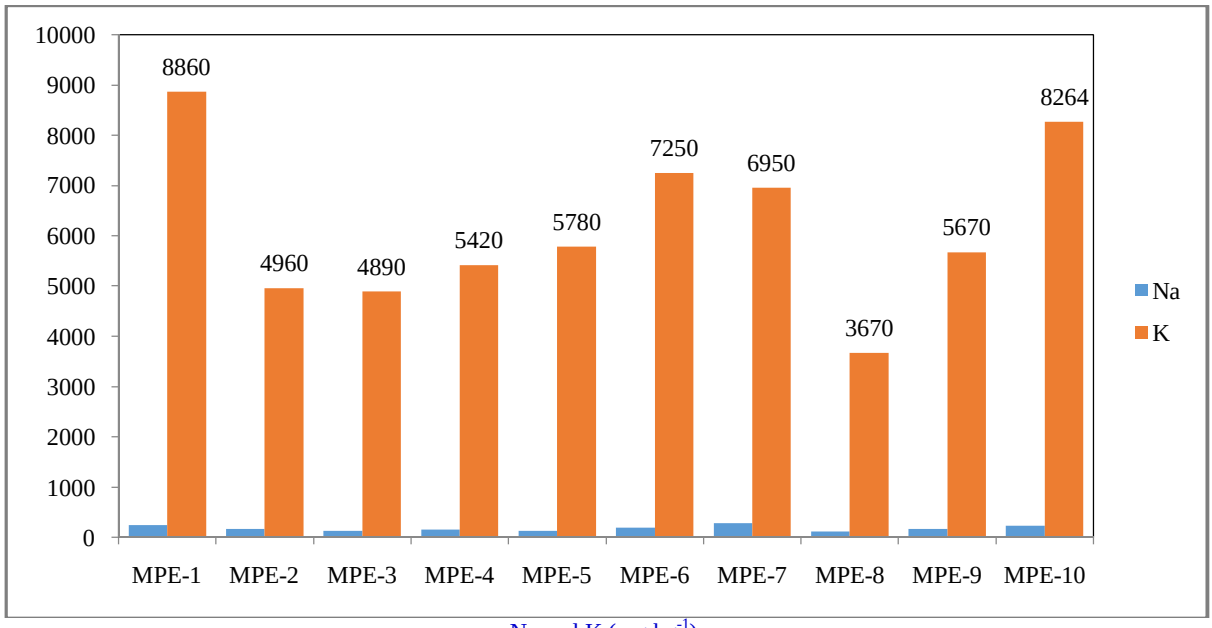
Samples were analysed for elemental composition by using Systronics-Digital Flame photometer (Na and K) and Atomic Absorption Spectrophotometer for metals (Ca, Mg, Mo, Co, Cu, Fe, Mn, Zn andAs). Metal composition in mg/kg in some of the selected commonly available medicinal plant extracts was given in table 3 and comparative illustration was given in figure 2.

Among the section of plants, the highest metal content was seen in the latex of *Calotropis procera*.Na and K concentrations were as a usual present very high and as expected. Highest Na concentration was found in the latex of *Calotropis procera*, 280 mg/kg and roots of *Mimosa pudica*, 8860 mg $kg^{-1}$, respectively. Ca, Mg, Mo and Co content was high in the latex of *Calotropis procera*. 210, 45.88, 6.28 and 78.28 mg $kg^{-1}$ respectively. Cu content was found in leaves of *Ocimum sanctum*, 16.52 mg $kg^{-1}$. Fe content was high in the latex of *Calotropis procera*. 38.22 mg $kg^{-1}$. Unlike other results, Mn content was very high in the rhizome of *Zingiber officinale* (554.20 mg $kg^{-1}$), Fruit of *Emblica officinalis* (182.74 mg $kg^{-1}$) and rhizome of *Curcuma longa* (331.82 mg $kg^{-1}$). Zn content is usually high in all samples ranged from 22.68 to 86.42 mg $kg^{-1}$, highest seen in leaves of *Ocimum sanctum.*

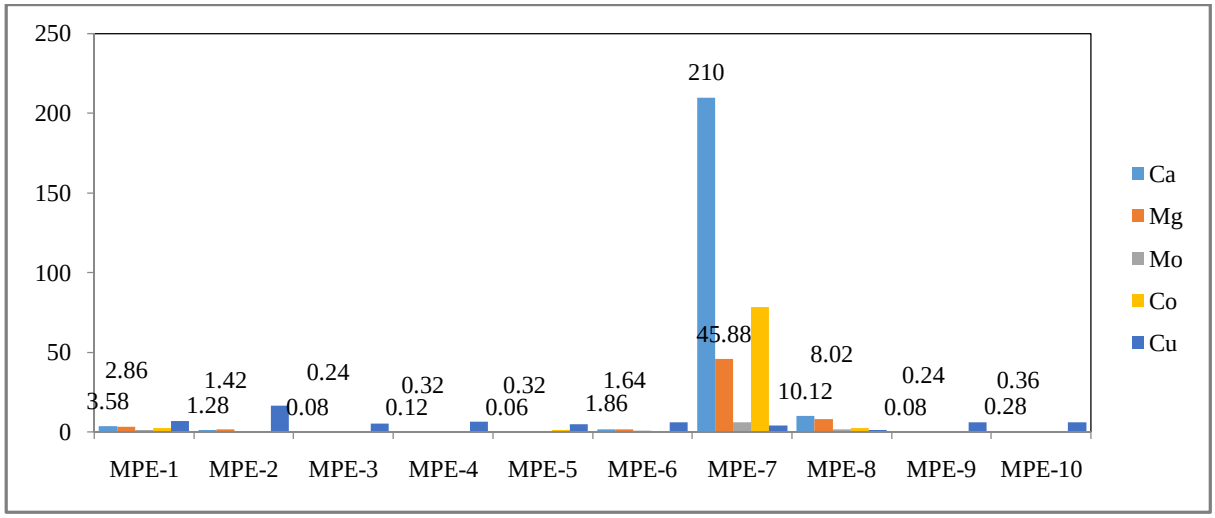
**Table 3.** Metal composition in mg $kg^{-1}$ in some of the commonly available medicinal plant extracts

| S.No. | Botanical name | Sample Code | Part | n | Na | K | Ca | Mg | Mo | Co | Cu | Fe | Mn | Zn | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Mimosa pudica* | MPE-1 | Roots | 3 | 240 | 8860 | 3.58 | 2.86 | 1.28 | 2.36 | 6.82 | 4.26 | 28.36 | 68.28 | ND |
| 2 | *Ocimum sanctum* | MPE-2 | Leaves | 3 | 170 | 4960 | 1.28 | 1.42 | 0.10 | 0.06 | 16.52 | 2.83 | 82.42 | 86.42 | ND |
| 3 | *Allium cepa* | MPE-3 | Bulb | 3 | 130 | 4890 | 0.08 | 0.24 | 0.08 | 0.12 | 5.20 | 0.62 | 38.32 | 28.14 | ND |
| 4 | *Allium sativum* | MPE-4 | Bulb | 3 | 150 | 5420 | 0.12 | 0.32 | 0.06 | 0.08 | 6.24 | 1.12 | 44.26 | 22.68 | ND |
| 5 | *Zingiber officinale* | MPE-5 | Rhizome | 3 | 130 | 5780 | 0.06 | 0.32 | 0.42 | 1.08 | 4.82 | 5.86 | 554.20 | 43.18 | ND |
| 6 | *Azadirachta indica* | MPE-6 | Leaves | 3 | 186 | 7250 | 1.86 | 1.64 | 1.02 | 0.08 | 6.12 | 2.54 | 29.36 | 52.40 | ND |
| 7 | *Calotropis procera* | MPE-7 | Latex | 3 | 280 | 6950 | 210.00 | 45.88 | 6.28 | 78.28 | 3.86 | 38.22 | 12.44 | 28.36 | ND |
| 8 | *Capsicum frutescer* | MPE-8 | Leaves | 3 | 110 | 3670 | 10.12 | 8.02 | 1.82 | 2.36 | 1.02 | 8.28 | 28.46 | 26.54 | ND |
| 9 | *Emblica officinalis* | MPE-9 | Fruits | 3 | 160 | 5670 | 0.08 | 0.24 | 0.12 | 0.08 | 6.12 | 0.33 | 182.74 | 36.22 | ND |
| 10 | *Curcuma longa* | MPE-10 | Rhizome | 3 | 232 | 8264 | 0.28 | 0.36 | 0.18 | 0.09 | 5.84 | 2.14 | 331.82 | 62.42 | ND |

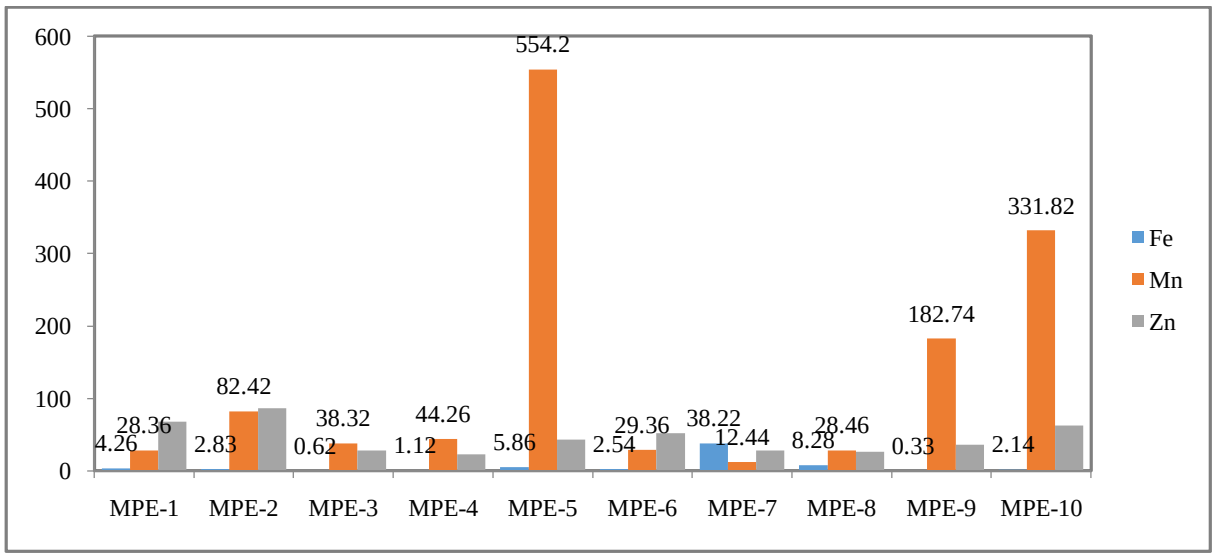
ND = Not Detected




Na and K (mg $kg^{-1}$)




Ca, Mg, Mo, Co and Cu (mg $kg^{-1}$)




Fe, Mn and Zn (mg $kg^{-1}$)

**Figure 2.** Comparative information on metallic content (in mg $kg^{-1}$) shown here a) Na and K, b) Ca, Mg, Mo, Co and Cu and c) Fe, Mn and Zn

## APPLICATION

It is an important as human health is directly affected by the application of this as medicine.

## CONCLUSION

The results reported here confirm that the plant extract samples contained metal contents. The highest metal content was seen in the latex of *Calotropisprocera*. Highest Na concentration was found in the latex of *Calotropisprocera*, 280 $mgkg^{-1}$ and roots of *Mimosa pudica*, 8860 mg $kg^{-1}$, respectively. Unlike other results, Mn content was very high in the rhizome of *Zingiberofficinale* (554.20 mg $kg^{-1}$), Fruit of *Emblica officinalis* (182.74 mg $kg^{-1}$) and rhizome of Curcuma *longa* (331.82 mg $kg^{-1}$). Zn content is usually high in all samples ranged from 22.68 to 86.42 mg $kg^{-1}$, highest seen in leaves of *Ocimum sanctum.*

## ACKNOWLEDGEMENTS

Authors acknowledge the financial support of the UGC, New Delhi, India for funding the Minor Research Project, No. F MRP-6646/16 (SERO/UGC).

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