Radiation Physics and Chemistry xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Radiation Physics and Chemistry

journal homepage: www.elsevier.com/locate/radphyschem

Studies on uptake and retention of trace elements by medicinal plants in the environs of Hassan of South India

B.G. Jagadeesha[a,*], Y. Narayana[a], M. Sudarshan[b], Shamayita Banerjee[b]

[a] Department of Studies in Physics, Mangalore University, Mangalagangothri 574 199, India
[b] UGC-DAE Consortium for Scientific Research, Kolkata Centre, Bidhan Nagar 700 098, India

ARTICLE INFO

Keywords:
Medicinal plants
Soil
Trace element
Transfer factor
ED-XRF Spectrometer

ABSTRACT

The transfer factors of trace elements from soil to medicinal plants were determined in the region of Hassan district of south India. The trace element concentration was determined using the Energy Dispersive X-ray Fluorescence (ED-XRF) spectrometer. The transfer factors were found in the order Rb > Sr > Ca > K > Zn > Cu > Mn. The transfer factors were found to be high, for most of the plants. The concentration of Rb and Sr was found to be high in medicinal plants, which can be attributed to the mineralogy of the region and plant morphology.

1. Introduction

Trace elements are the essential micro nutrients which are essential for the healthy growth of plants. The plants accumulate trace elements either from root uptake or through foliar absorption. However, the foliar absorption becomes significant only under atmospheric pollution. In the normal environment, the trace elements present in plants essentially comes from root uptake. Some plants preferentially uptake and retain certain essential elements. These plants are used for various medicinal applications. In the formation of chemical constituent present in medicinal plants, trace elements play a significant role, since it is responsible for the medicinal properties (Rajan et al., 2014). Therefore, the estimation of various trace element contents in medicinal plants is important, to determine the effective and scientific validation of the therapeutic uses of these medicinal plants. Further, as certain elements at elevated levels are toxic, such assessment would be helpful in regulating their uses (Rajan et al., 2014). The uptake of elemental concentration from soil depends on age of the plant, type of the plant, metabolic process, morphology, the rooting system, physical and chemical properties of the soil (IAEA, 2006).

Hassan and its surrounding areas of south Karnataka have different rock formations such as granitic gneiss, granulites, granites, feldspar, dharwarian schists, and dyke rocks. The mineral deposits like chromate, titaniferous magnetite, chalcopyrite, kaolin, asbestos, and quartz are also available in the same region (Geological Survey of India, 2006). The region has a large number of chromite mining areas as evidenced by the recent finding of native gold from chromate (Babu et al., 2013). The geological study shows that the region consists of trondhjemitic gneisses and feldspars. In trondhjemitic gneisses, the content of Rb and Sr is found to be high (Bhaskar Rao et al., 1991), whereas in feldspar, the content of K and Ca is high (David, 2010). The remaining elements like Zn, Mn and Cu are essential for plant growth. Therefore, it is interesting to find out the trace elements present in the medicinal plants. In the present work, an attempt has been made, for the first time, to assess trace element concentration in medicinal plants and that of the rooting zone soil, in the region of Hassan district. The uptake of trace elements by medicinal plants was also assessed.

2. Materials and methods

A total of nine medicinal plants and their rooting zone soil samples were collected from Hassan district (Fig. 1). The samples were collected keeping in view of local geology such as different rock formations and mineral deposits in the region. As most part of the study area comes under 'reserve forest', all areas were not accessible. The medicinal plants were collected and processed using standard prescribed methods (BARC, 2008). The Ayurvedic medicinal practitioners of this region normally collect the samples from naturally grown pastures and forest regions. To ensure collected material to be representative of the plants, leaves were collected randomly at different parts of the plant at different heights and from different branches. In the same location, composite samples of leaves were collected from neighbouring plants belonging to the same species. The same procedure was adopted in the present study for sampling and handling medicinal plants. The images of the nine medicinal plants used in the study, namely, as *Ficus racemoosa, Zizipus mauritiana, Achyranthes aspera, Moringa oleifera,*

* Corresponding author.
E-mail address: jagguphysics@gmail.com (B.G. Jagadeesha).

http://dx.doi.org/10.1016/j.radphyschem.2017.09.005
Received 14 July 2016; Received in revised form 10 September 2017; Accepted 11 September 2017

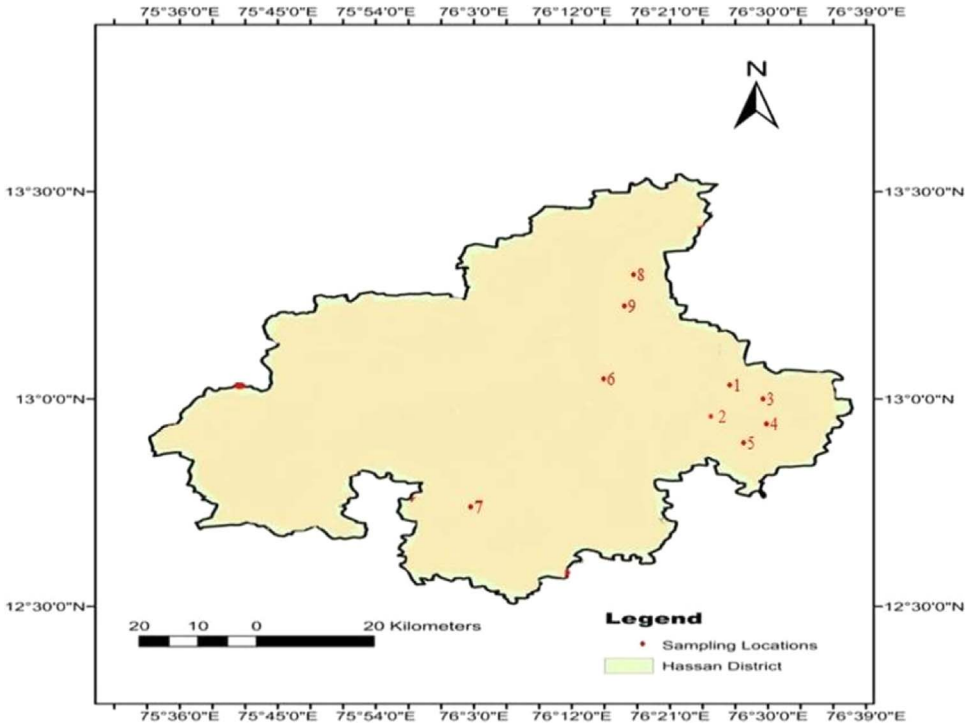

Fig. 1. Map Showing Sampling Locations.

Fig. 2. Medicinal plants studied. Ficus racemoosa (MP1), Zizipus mauritiana (MP2), Achyranthes aspera (MP3), Moringa oleifera (MP4), Jasminum officinale (MP5), Costus igneus (MP6), Madhuca longifolia (MP7), Lawsonia Intermis (MP8) and Aegle marmelos (MP9).

Jasminum officinale, Costus igneus, Madhuca longifolia, Lawsonia intermis, and *Aegle marmelos* are shown in Fig. 2.

In the present study approximately 2 kg of soil samples were collected from an area of 1 m^2 in the rooting zone of a particular medicinal plant up to the depth of 20 cm following standard procedure (IAEA, 2009). The soil samples were dried at about 110 °C to remove the moisture content. The dried samples were crushed and sieved using a 250 μm sieve to reduce particle size effect. Approximately 2 kg of each