Available online at www.sciencedirect.com
ScienceDirect
Spectrochimica Acta Part A 71 (2008) 31–38
SPECTROCHIMICA ACTA PART A
www.elsevier.com/locate/saa

Characterisation of *bhringaraj* and *guduchi* herb by ICP-MS analysis, optical absorption, infrared and EPR spectroscopic methods

S. Lakshmi Reddy [a,*], Md. Fayazuddin [b], N.C.G. Reddy [c], Adeel Ahmad [b], G. Siva Reddy [c], P. Sambasiva Rao [d], B. Jagannatha Reddy [e], R.L. Frost [e]

[a] *Department of Physics, S.V.D. College, Kadapa 516003, India*
[b] *Department of Physics, Osmaniya University, Hyderabad 500001, India*
[c] *Department of Chemistry, Y.V. University, Kadapa 516003, India*
[d] *Department of Chemistry, Pondicherry University, Pondicherry 605014, India*
[e] *Inorganic Materials Research Program, Queensland University of Technology, PO Box 2434 GPO, Brisbane, Queensland, Australia*

Received 31 May 2007; received in revised form 7 November 2007; accepted 15 November 2007

Abstract

Leaves of *bhringaraj* and *guduchi* herb of Kadapa district of Andhra Pradesh, India, are dried and powdered. ICP-MS analysis of samples indicates that copper is present in both the samples. An EPR study of *guduchi* sample also confirms the presence of Fe(III) whereas *Eclipta alba* confirms the presence of Fe(III), Mn(II) and Cu(II). Optical absorption spectrum of *guduchi* indicates that Cu(II) is present in rhombically distorted octahedral environment. NIR and IR results are due to carbonate fundamentals.

Keywords: *Bhringaraja*; *Guduchi*; EPR; Optical absorption; Middle infrared; Infrared spectroscopy

1. Introduction

Demand on medicinal plant products such as pharmaceuticals, phyto-chemicals, nutraceuticals, cosmetics and other products on worldwide are increasing day by day [1]. Herbal medicinal products may vary in composition and properties unlike conventional pharmaceutical products. Correct identification and quality assurance of the starting material is therefore an essential prerequisite to ensure reproducible quality of herbal medicine which contributes to its safety and efficiency [2]. Transition metal ions present in herbs play a major role in medicine.

In order to elucidate the composition, structural properties of trace metal ions present in medicinal plants several techniques such as CHNS, inductively coupled plasma mass spectrometric (ICP-MS) analysis, electron paramagnetic resonance (EPR) and optical absorption studies are employed in the present investigation. The common transition metal ion that occurs in many herbs is iron. In the present study, the quantitative determination of carbon, nitrogen and hydrogen was carried out using CHNS scan. The transition metal ions present and their valance states were determined by ICP-MS analysis, EPR and optical absorption spectroscopic techniques were carried out to study the site symmetries.

1.1. Guduchi

It belongs to the family of Menispermaceae. Its botanical names are *Tinospora cordifolia* (TC), *Menisper mum cordifolium* and *Cocculuc cordifolia*. This herb is found in the Himalayas and in many parts of southern India. It has the following medicinal applications. This herb is used to treat HIV/AIDS, jaundice, digestion, constipation, hemorrhoids, dysentery and cancer (strengthens persons before and after chemotherapy). It is also used as a blood purifier and for recovery from fevers. [3].

Tinospora cordifolia has been reported to contain a wide variety of antioxidants and known to exhibit strong free radical scavenging properties against reactive oxygen and nitrogen species as revealed by ESR spectroscopy [4].

1.2. Bhringaraj

It belongs to the family of Compositae or Astaraceae. Its botanical name is *Eclipta alba* (EA), *Eclipta erecta*. The name

* Corresponding author.
E-mail address: slreddy_in@yahoo.com (S.L. Reddy).

1386-1425/$ – see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.saa.2007.11.026

Table 1
Elemental analysis by CHNS of *bhringaraj* and *guduchi*

Name of the sample	Nitrogen (%)	Carbon (%)	Sulphur (%)	Hydrogen (%)
Guduchi (*Tinospora cordifolia*)	1.40	41.91	Not found	5.32
Bhringaraj (*Eclipta alba*)	Not found	37.27	Not found	5.19

means "ruler of the hair". This herb is found throughout India as well as in the southwestern part of the United States.

The authors have under taken the study of structural properties of transition metal ions present in them as trace elements.

2. Experimental

Leaves of *guduchi and bhringaraj* herb samples collected from Kadapa district of Andhra Pradesh, India, are used in the present work. To know the organic composition of the compounds carbon, hydrogen, nitrogen and sulphur (CHNS) analyses were carried out on both the samples. The results are presented in Table 1.

Microanalysis by ICP-MS was carried out using a Perkin Elnier Sciex, Model ELAN DRC II ICP-Mass Spectrometer (ICP-MS) (Toronto, Ont., Canada). The methodology of preparation of the sample, internal standards and optimization procedure already available in the literature is used [5] in the present investigations. EPR spectra of both *guduchi* and *bhringaraj* sample in powder form were recorded at room temperature (RT) on a Varian E-112 EPR spectrometer operating at X-band frequencies ($\upsilon = 9.42107$ GHz for *guduchi* and $\upsilon = 9.42531$ GHz for *bhringaraj*) having 100 kHz field modulation and phase sensitive detection to obtain first derivative spectra. The optical absorption spectra of the *guduchi* sample and *bhringaraj* sample were recorded at room temperature on Carey 5E UV–vis-NIR spectrophotometer in mull form in the range 200–2500 nm. The spectra were transformed according to the Kubelka–Munk algorithm. NIR spectrum of the sample was recorded on a Nicolet Nexus FT-IR spectrometer with a Nicolet near IR fibreport accessory. A white light source was employed with a quartz beam splitter and TECNIR.

Band component analysis was undertaken using the Jandel "PEAKFIT" software package which enabled the type of

Table 2
Trace element concentrations (ppm) in *guduchi* and *bhringaraj* herb obtained by ICP-MS

Element/analyte	Mass	Standard: blank concentration mean (ppm)	*Guduchi* concentration mean (ppm)	Standard: SO-1 concentration mean (ppm)	*Bhringara* concentration mean (ppm)
Sc	45	1.177	1.359	16.972	2.434
V	51	77.261	11.095	135.195	19.816
Cr	52	12.594	9.888	167.856	17.558
Co	59	0.211	0.546	28.956	1.921
Ni	60	6.520	8.133	92.679	10.997
Cu	63	8.139	22.924	60.688	26.074
Zn	66	32.350	89.389	144.256	87.330
Ga	71	0.119	0.243	23.263	1.868
Rb	85	0.654	11.197	138.880	52.203
Sr	88	3.278	141.987	322.673	77.395
Y	89	0.075	0.327	23.993	2.760
Zr	90	0.741	1.591	83.094	8.386
Nb	93	0.032	0.159	11.496	1.444
Cs	133	0.008	0.041	5.080	1.009
Ba	137	14.368	89.086	870.783	125.720
La	139	0.115	0.466	53.503	5.047
Ce	140	0.216	0.780	101.862	9.437
Pr	141	0.025	0.095	11.712	1.047
Nd	146	0.076	0.335	43.901	3.952
Sm	147	0.014	0.063	7.836	0.775
Eu	151	0.005	0.036	1.570	0.149
Gd	157	0.018	0.055	6.168	0.664
Tb	159	0.002	0.009	0.883	0.098
Dy	163	0.014	0.059	4.399	0.510
Ho	165	0.004	0.014	1.104	0.127
Er	166	0.005	0.024	1.999	0.227
Tm	169	0.001	0.005	0.418	0.044
Yb	172	0.004	0.028	2.298	0.243
Lu	175	0.001	0.003	0.321	0.034
Hf	178	0.019	0.043	2.465	0.251
Ta	181	0.004	0.012	0.687	0.121
Pb	208	5.483	6.807	20.215	7.069