Research Article

DETERMINATION OF METAL CONTENT OF *GYMNEMA SYLVESTRE* USING X-RAY FLUORESCENCE SPECTROSCOPY (XRF)

Shirish Pingale ^{1*}, Shobha Rupanar ¹, Manohar Chaskar ²

¹Department of Chemistry, A. C. S. College Narayangaon, Junnar, Pune, Maharashtra, India

²Baburaoji Gholap College, New Sangavi, Pune, Maharashtra, India

*Corresponding Author Email: drsspingale@gmail.com

Article Received on: 13/04/17 Approved for publication: 02/05/17

DOI: 10.7897/2230-8407.08574

ABSTRACT

The Metal content of *Gymnema sylvestre* medicinal plant was determined by using X-ray Fluorescence Spectroscopy (XRF). The leaf /stem/root has the highest concentration of metals like Ca, K, Si, Mg, P and Al. The concentration of Ca (45690ppm) in root is higher than leaf (35640 ppm) and stem (31330 ppm). The amount of K is 24060 ppm, 25320 ppm and 11180 ppm in leaf, stem and Root respectively. The *G. Sylvestre* also contains metals like Si and Mg in higher amount. The results obtained in this study suggest that the use of this plant can be beneficial to the users in cases of nutrient deficiency. The information provided in this study could be helpful in standardization of herbal drugs since the *Gymnema sylvestre* medicinal plants play an important role in maintenance diabetes of Type I and II.

Keywords: X-ray Fluorescence, metal content, *Gymnema sylvestre*, Leaf, Stem, Root.

INTRODUCTION

World Health Organization (WHO) encourages, recommends and promotes traditional/herbal remedies in natural health care programmes because these drugs are easily available at low cost, and safe. The WHO has highlighted the need to ensure quality control of medicinal plant products by using modern techniques and applying suitable standards¹.

Many medicinal plants contain secondary metabolite like glycosides, alkaloids, phenolic compounds and essential oils². Along with these active secondary metabolites, they also contain metals which may not have adverse effect on human health³. Medicinal plants containing trace elements are widely used to treat many human diseases.

Gymnema Sylvestre belonging to the family Asclepiadaceae has been used by Indian Healers for nearly 2000 years as a part of Ayurvedic traditional system. The extracts of *Gymnema sylvestre* have been used as a treatment for Diabetes⁴. The Plant is known to possess various pharmacological activities like antidiabetic⁵, hypolipidemic⁶ and antiinflammatory⁷. The plant is widely used in Traditional Indian system and studies on this plant were started as early as 1930. The *G. Sylvestre* was found to contain olenane type of glycosides known as Gymnemic acid⁸.

Physiochemical & phytochemical analysis of *G.sylvestre* root and antioxidant activity of water extract was reported⁹. The *G.Sylvestre* plant extract shows antioxidant and antimicrobial activity¹⁰. The present study was aimed to determine the presence of metallic elements and their quantification in different parts of *G. Sylvestre* plant using XRF technique.

MATERIALS AND METHODS

Plant Materials

The plant of *G. sylvestre* was collected from Pune from Maharashtra state in India. The plant was authenticated by Botanical Survey of India, Pune (BSI). The material has been deposited at AHMA herbarium at BSI (Voucher No.SVS-1/783).

Sample Preparation

The plant parts were separated and washed thoroughly in water to remove soil, foreign particles and all other surface contamination. The plant materials are allowed to dry at room Temperature. The air-dried plant materials were cut into small pieces and ground into fine powder using grinder. Each plant part powdered sample was sieved through a 0.5 mm diameter sieve. 5.0 gram powdered sample was used for XRF Studies. Triplicates of each sample were done.

X-Ray Fluorescence (XRF) analysis

The powdered plant material was analysed for content of trace elements by Energy Dispersive X-ray Fluorescence (XRF) spectroscopy. The analysis was carried out from Department of Geology, SPPU, Pune, India. The elemental composition was determined by using SPECTRO XPOS (Ametek material analysis division, Germany) with silicon drift detector SDD with resolution of 145 eV at 10 000 pulses. The elemental range for XRF spectroscopy is from Sodium to Uranium. Triplicate experiments were performed for each sample.

Table 1: Metal content in powdered leaf, stem and root of *Gymnema sylvestre*

<i>Gymnema Sylvestre</i>			Concentration (ppm)		
Z	Symbol	Element	LGS	SGS	RGS
14	Si	Silicon	20110	10980	18900
13	Al	Aluminum	4654	3383	8560
19	K	Potassium	24060	25320	11180
20	Ca	Calcium	35640	31330	45690
22	Ti	Titanium	749	539	1618
11	Na	Sodium	140	140	140
12	Mg	Magnesium	19800	6960	5350
15	P	Phosphorus	5467	5647	3190
25	Mn	Manganese	332.7	442.3	265
26	Fe	Iron	3752	4038	7481
16	S	Sulfur	4244	4642	2909
17	Cl	Chlorine	3033	4892	4063
23	V	Vanadium	< 9.5	< 10	< 9.9
24	Cr	Chromium	5.5	4.9	12.3
27	Co	Cobalt	14.4	7.3	7.4
28	Ni	Nickel	6.9	8.2	12.8
29	Cu	Copper	20.6	21.8	24.3
30	Zn	Zinc	41.9	37.1	28.3
31	Ga	Gallium	1.7	1.1	1.9
32	Ge	Germanium	< 0.5	< 0.5	< 0.5
33	As	Arsenic	< 0.5	< 0.5	< 0.5
34	Se	Selenium	2.8	1.2	1.1
35	Br	Bromine	16.8	12	7.8
37	Rb	Rubidium	6.9	14.9	11.4
38	Sr	Strontium	47.7	61.3	91.6
39	Y	Yttrium	1.3	2	2.9
40	Zr	Zirconium	2	< 1.0	3.8
41	Nb	Niobium	< 1.0	< 0.1	< 1.0
42	Mo	Molybdenum	1.2	2.1	2.5
47	Ag	Silver	< 1.1	6.2	5.1
48	Cd	Cadmium	< 2.0	1.5	1.7
50	Sn	Tin	8.7	3.9	1.7
51	Sb	Antimony	4.6	< 3.0	< 3.0
52	Te	Tellurium	2.9	< 3.0	< 3.0
53	I	Iodine	< 3.0	3	< 3.0
55	Cs	Cesium	< 4.0	< 4.0	< 4.0
56	Ba	Barium	< 2.0	< 2.0	< 2.0
57	La	Lanthanum	< 2.0	< 2.0	17.8
58	Ce	Cerium	< 2.0	< 2.0	< 2.0
68	Er	Erbium	< 5.1	< 5.1	< 5.1
70	Yb	Ytterbium	< 2.0	< 2.0	< 2.0
72	Hf	Hafnium	1.8	1.4	1.2
73	Ta	Tantalum	< 1.0	< 1.0	< 1.0
74	W	Tungsten	1.3	< 1.0	< 1.0
80	Hg	Mercury	0.6	0.8	0.9
81	Tl	Thallium	0.5	1.1	0.6
82	Pb	Lead	4.8	3.9	4.3
83	Bi	Bismuth	0.7	1.3	0.9
90	Th	Thorium	1.3	1.3	1.7
92	U	Uranium	1.5	1.2	1.2

Figure 1 (a): Major metal elements in leaf of *G. sylvestre*

Figure 1 (b): Major metal elements in stem of *G. sylvestre*

Figure 1 (c): Major metal elements in root of *G. sylvestre*

RESULTS AND DISCUSSION

Knowledge of metal content is also essential to evaluating the quality of herbal products. Elements present in medicinal plants play important role in fighting diseases¹¹. Recently various analytical techniques used for metal content determination. One of these is X-ray fluorescence (XRF), in which a source of X-ray photons is used to study the elemental composition of materials. XRF is one of the well-known rapid analytical techniques used to study the elemental composition of medicinal plants¹². This technique is also useful for Quantitative and qualitative analysis of trace and heavy elements. In this report concentration of elements ranging from sodium to uranium were determined in the powdered plant material of *G. Sylvestre* by using XRF spectroscopy. The concentrations of major elements Calcium, Potassium, Silicon, Magnesium, Phosphorous and Aluminium in plant samples were performed using X-ray fluorescence spectrometry as given in Table 1. The concentration and percentage of total ninety-two (92) elements were determined in the leaf, stem and root extract of *G. Sylvestre* by using XRF spectroscopy. The leaf /stem/root has the highest concentration of metals like Ca, K, Si, Mg, P and Al. The plant also contains other elements like Fe, Mn, Zn, Cl, S in moderate amount. Figure 1 (a), 1 (b) and 1 (C) shows major element content in leaf, stem and root of *G.sylvestre* respectively. In view of the above facts, the medicinal plant *G. Sylvestre* studied is a source of biologically active elements, which may play part in the observed biological properties of this plant.

CONCLUSION

Elemental Profile of *Gymnema sylvestre* medicinal plant were determined using XRF technique. All of the detected elements in leaf, stem and root of *G. Sylvestre* are below the WHO permissible levels. The Concentration of CA, Al, Mg, P and K indicate that the plant is source of nutrient elements. The results obtained in this study may helpful for standardization of herbal drug.

ABBREVIATIONS

LGS: Leaf of *G.sylvestre*
SGS: Stem of *G.sylvestre*
RGS: Root of *G.sylvestre*

REFERENCES

1. Muthamizhe SK, Prakash YG, Gopal V. Standardization of Traditional medicine: Need and Urgency, International Journal of Phytotherapy, 2013;3: 5-10.
2. Giovanni DF, Romanucci V, Marco AD, Zarrelli A, Triterpenoids from *Gymnema sylvestre* and Their Pharmacological Activities, Molecules, 2014;19:10956-10981.
3. Street RA, Heavy Metals in medicinal plant products-An African Perspective, South African Journal of Botany, 2012;82:67-74.
4. Arunachalam KD, Arun LB, Annamalai SK, Arunachalam AM, Potential anticancer properties of bioactive compounds of *Gymnema sylvestre* and its biofunctionalized silver

- nanoparticles, International Journal of Nanomedicine, 2015;10:31-41.
5. Gupta SS, Experimental studies on pituitary diabetes Part III. Effect on indigenous antidiabetic drugs against the acute hyperglycemic response of anterior pituitary extract in glucose fed albino rats. Indian journal of medical Research, 1963; 51:716-723.
 6. Kanetkar P, Singhal R, Kamat M, *Gymnema sylvestre*: A Memoir. Journal of Clinical biochemistry and Nutrition, 2007; 41:77-81.
 7. Malik JK, Manavi FV, Alagawadi KR, Noolvi M, Evaluation of anti-inflammatory activity of *Gymnema sylvestre* leaves extract in rats. International Journal of Green Pharmacy, 2008;114-115.
 8. Maeda M, Iwashita T, Kurihara Y, Studies on taste modifiers. II. Purification and structure determination of Gymnemic acids, antisweet active principle from *Gymnema sylvestre* leaves. Tetrahedron Letter, 1989;30:1547-1550.
 9. Pingale S, Rupanar S, Chaskar M, Physiochemical composition, Phytochemical analysis & In-vitro antioxidant activity of *Gymnema sylvestre* root, Journal of Natural Product and Plant resources, 2016;6:1-7.
 10. Rupanar S, Pingale S, Dandge C, Kshirsagar D, Phytochemical Screening and In vitro evaluation of Antioxidant and Antimicrobial activity of *Gymnema sylvestre*,. International Journal of Current Research, 2016;8:11.
 11. Gjorgieva D, Kadifkova-Panovska T, Baceva K, Stafilov T, Metallic Trace elements in medicinal plants from Macedonia, Middle-East journal of Scientific Research, 2011;7:109-114.
 12. Sarma B, Goswami BC, Qualitative elemental analysis of some selected antidiabetic medicinal plants of Assam using X-ray Fluorescence (XRF) technique, Asian Journal of Plant Science and Research, 2016;6:71-79.

Cite this article as:

Shirish Pingale et al. Determination of metal content of *Gymnema sylvestre* using X-ray fluorescence spectroscopy (XRF). Int. Res. J. Pharm. 2017;8(5):61-64 <http://dx.doi.org/10.7897/2230-8407.08574>

Source of support: Nil, Conflict of interest: None Declared

Disclaimer: IRJP is solely owned by Moksha Publishing House - A non-profit publishing house, dedicated to publish quality research, while every effort has been taken to verify the accuracy of the content published in our Journal. IRJP cannot accept any responsibility or liability for the site content and articles published. The views expressed in articles by our contributing authors are not necessarily those of IRJP editor or editorial board members.