American Journal of Chemistry and Applications
2018; 5(3): 79-82
http://www.openscienceonline.com/journal/ajca
ISSN: 2381-4527 (Print); ISSN: 2381-4535 (Online)

Open Science

Elemental Analysis of Moroccan and Sudanese Medicinal Plant *Withania Somnifera (L)* Dunal by Inductively Coupled Plasma – Atomic Emission Spectroscopy

Ibrahim Abdurrahman[1, *], Mohamed Benaissa[2]

[1]Department of Basic Science, University of Zalingei, Zalingei, Sudan

[2]Department of Chemistry, University of Hassan II, Casablanca, Morocco

Email address

Moniter123@outlook.com (I. Abdurrahman)

[*]Corresponding author

To cite this article

Ibrahim Abdurrahman, Mohamed Benaissa. Elemental Analysis of Moroccan and Sudanese Medicinal Plant *Withania Somnifera (L)* Dunal by Inductively Coupled Plasma – Atomic Emission Spectroscopy. *American Journal of Chemistry and Applications.* Vol. 5, No. 3, 2018, pp. 79-82.

Received: June 3, 2018; **Accepted**: June 24, 2018; **Published**: July 26, 2018

Abstract

The present study was aimed to determine trace and major elements in Moroccan and Sudanese medicinal plants *Withania Somnifera* by using Inductively Coupled Plasma - Atomic-emission spectrometry (ICP-AES). The studies revealed that three major elements, namely, K, Ca and Mg, and four trace elements, Fe, Pb, Se and Zn were determined which are healthy for human body. The considered metals and their concentrations were found to vary in two samples. Several factors may account for variations in mineral concentration, which include different geographic areas, soil composition and environmental changes.

Keywords

Medicinal Plant, Withania Somnifera, Major and Trace Elements, ICP-AES

1. Introduction

Medicinal plant has been played for a long time very important role in health care and treatment of various diseases [1-2]. In the recent past years there has been a growing interest in medicinal plants as Traditional medicine, Complementary and Alternative Medicine (TCAM) and their relevance to public health both in the developed and developing countries for the reasons of relatively low cost, low levels of technological input and relatively low side effects [3-5].

Medicinal plants used in indigenous medicine, in crude forms contain both organic and inorganic constituents [6-7]. The efficacy of medicinal plants for curative purposes is often accounted for in terms of their organic constituents like vitamins, glycosides and essential oils among others. However, it is thought that some medicinal plants contain elements of vital importance for human metabolism, disease prevention and curative ability [8]. Furthermore the trace element plays significant roles in plant metabolism or as co-factors for enzymes. It is interesting to note that many curative effects of medicinal plants used in the traditional system of medicines are due to the presence of very minute quantities of trace element. So the quantities of the estimation in the various trace elements contents are important to determine effective and scientific validation of therapeutic uses of the medicinal plants. However, certain elements at elevated levels are toxic; such assessment would be helpful in regulating their uses [9-13].

The knowledge on the concentrations of these trace elements is important for determining the effectiveness of the plants in treating various ailments so as to understand their pharmacological actions. It also helps to develop a stronger basis for appreciating the traditional knowledge on the therapeutic potential of these plants [14]. Moreover, trace elements content in the medicinal plant varies from region to

region and different species depending on the type of soil.

Withania somnifera (L) Dunal is an erect evergreen shrub distributed throughout the drier parts of North Africa, particularly, in Morocco and east Africa in Sudan. W. somnifera, known as (Sikiaran or Inap eldip) in Morocco and Sudan, is well known for its use in Ayurvedic medicine [15-16]. The Moroccan's *W Samnifera (M-WS)* root, extract was reported as a folk remedy for adenopathy, arthritis, tumors, asthma, hypertension, conjunctivitis, inflammations, and rheumatism. The Sudanese's *W Samnifera* (*S-WS)* root powder, use as remedy against tinge [17-20]. The chemical investigations of the roots, leaves and fruits of W. somnifera resulted in the isolation and characterization of several steroidal lactones, flavonoids, alkaloids, saturated, and unsaturated fatty acids, which responsible for the wide array of pharmacological activities [21-23].

The present work focuses on analysis of the levels of major and trace elements in the Moroccan's *W Samnifera (M-WS)* root and the Sudanese's *W Samnifera* (*S-WS)* root which extensively used for medicinal purpose throughout the two countries using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES).

2. Materials and Methods

2.1. Sampling

Withania Somnifera roots were collected from Safi, Morocco in October 2010 and Zalingie, Sudan in November 2010, the two samples were authenticated and voucher specimens (No. 2011-013), have been deposited in the herbarium of author′s laboratory. The roots of samples were washed using distilled water, dried in the shade, and then heated on a heating block in an oven for complete drying. They were finely powdered using an electric blender and fed through a sieve (0.50 mm) and saved until further use.

2.2. Chemicals and Reagents

All the chemicals and reagents were Analytical grade, purchased from Sigma-Aldrich Company. 65% nitric acid (HNO_3) and 32% Hydro chloric acid (HCl), were used for digestion purposes. Ultrapure-deionized water (18Ω) was used throughout the study. The glassware was soaked in 3M HNO_3 for the whole night and washed and rinsed with deionized water to minimize the chances of interferences.

2.3. Sample Preparation

The standard procedure described by the Association of Official Analytical Chemists (AOAC) was followed for the preparation of the samples for the analysis of minerals [24]. A sample (5.0 g) was weighed and transferred into a silica crucible and kept in a muffle furnace then gradually heated (50°C every 30 min) from room temperature to 550°C and a shed for 3 hours. After cooling, the residual ash (1.0 g) was dissolved in 5 ml of concentrated hydrochloric acid. Care was taken to ensure that all the ash came into contact with acid. Further, the crucible containing acid solution was kept on a hot plate and digested to obtain a clean solution. The final residue was dissolved in 0.1 M HNO_3 solution and made up to 25.0 ml with distilled water.

2.4. Instrumental Analysis

A dual viewing ICP-AES (Perkin Elmer Optima 5300 DV spectrometer, made in USA), ICP-AES equipped with a Cross Flow nebulizer and an auto sampler AS 93-plus. (CETAC, Omaha, NE, USA) was employed for the analysis of the trace and other elements. Argon C-45 (purity higher than 99.995%) supplied by Carburos Metálicos (Barcelona, Spain) was employed as plasmogen and carrier gas. The Windows 7 compatible S/W provided by Perkin Elmer was used to process the spectral data for calculating sample concentrations by comparing light intensities measured at various wavelengths for standard solutions with intensities from the sample solutions. The operating conditions set for the ICP-AES are shown in Table 1.

2.5. Detecting Wavelength and Detection Limit

Selecting spectral lines for detecting that must have high precision and less spectral interference. The detection limits was just show in Table 2.

Table 1. *Operating parameters for ICP-AES determination of trace elements in samples.*

Parameter	Value
Power	1.3 kW
Cooling gas glow	15 L/min
Auxiliary gas flow	2.0 L/min
Nebulizer type	Glass concentric K
Nebulizer flow	0.8 L/min
Pump speed	2–4 rpm
Sample uptake rate	1.1 ml/min
View	Axial
Background correction	2-Point
Number of replicates	3

Table 2. *Elemental analysis, wavelength and the detection limit.*

Elements	Wavelength (nm)	Detectionlimits (ml^{-1})
K	766.49	0.1983
Ca	317.93	0.0300
Mg	279.07	0.0900
Fe	259.93	0.0186
Zn	213.85	0.0054
Se	196.02	0.0250
Pb	220.35	0.0430

3. Results and Discussions

The concentration of the major elements (macronutrients) K, Ca and Mg and trace elements (micronutrients) Fe, Pb, Se and Zn in selected medicinal plants growing on Morocco and Sudan are presented in Table 2. The analysis reveals wide variation in the elemental concentration of the two studied samples. The concentration of K in *M-WS* was found to be 164.36 *mg/Kg*

whereas 451.41 *mg/Kg* was found in *S-WS.* The importance of K is participation in several numbers of biological processes such as acid base balance, movement of muscles, nerve impulse conduction and regulation of osmotic pressure [25]. K is the major element present in the intracellular fluid; the Deficiency of K has been associated with muscular weakness, cardiac arrhythmias, paralysis, mental and confusions [26].

Ca was highest concentration in the *M-WS* 456.17 *mg/Kg* while (320.85 *mg/Kg* in the *S-WS*. High concentration of Ca is important for its role in muscles system, heart functions, bones and teeth; deficiency of Ca can cause low bone mass (osteopemia), bone fractures, numbness, tingling in the fingers and abnormal heart rhythms [27].

The concentration of Mg in *M-WS* was found to be 333.56 *mg/kg* and that in *S-WS* was 252.422 *mg/kg*. Magnesium act as catalyst of many enzymes involved protein synthesis, in energy metabolism, RNA and DNA synthesis, and maintenance of the electrical potential of nervous tissues and cell membranes [28]. Deficiency of Mg maybe related to the hypertension, etiologies of cardiovascular problems, diabetes, and atherosclerosis in humans [29].

Fe concentration was found as 12.39 *mg/Kg* in *M-WS*, whereas in *S-WS* was detected as 15.49 *mg/Kg*. Iron is an important for human body, it is part of hemoglobin, responsible for oxygen transport, maintains a healthy immune system and being a constituent of several enzymes, it is responsible for energy production, But accumulation of iron in the body typically damages cells in the heart and liver which can cause cancer, coma, metabolic acidosis, liver failure, circulatory shock and long-term organ damages; deficiency of iron results in anemia [30].

The concentration of Zn in *M-WS* was found as 3. 98 *mg/Kg* whereas in *S-WS,* was found to be 2.*195 mg/Kg*. Zn is an essential component of over 200 enzymes, thereby, influencing immune system, has an anti-diarrhea activity and regulates fertility [31]. Also is an extremely important part of insulin and it is known to improve the sensitivity of insulin in the management of diabetes [32]. Furthermore, Zinc has an essential role in polynucleotide transcription and thus in the process of genetic expression.

M-WS showed 0.024 *mg/kg* of Se whereas *S-WS* was found to contain 0.012 *mg/kg.* The trace element Selenium is of fundamental importance and is a major constituent of enzymes and seleno-proteins; it is an active enzyme in the production of the thyroid hormone and the development of virulence, which inhibits the development of the HIV hormone to AIDS [33]. Due to its antioxidant properties, Se might be able to prevent the development of diabetes and associated complications [34].

The concentration of lead in *M-WS* was found to be 0.032 *mg/kg* and in *S-WS* was found as 0.081 *mg/kg*. This element has no beneficial function neither in human nor in plants; it is considered as very dangerous for plants and particularly for microorganisms; the presence of lead in plant may be due to absorption of lead from the environment, the main sources of plant lead are lead mines, fuel combustion and farmyard manure [35].

Table 3. *The concentration of elements found in M-WS and S-WS (mg/kg).*

Sample	Trace elements *(mg/Kg)*						
	K	Ca	Mg	Fe	Zn	Se	Pb
M-WS	164.36	456.17	333.56	12.39	3.981	0.024	0.032
S-WS	451.41	320.85	252.42	15.49	2.195	0.012	0.081

4. Conclusion

It is concluded that this study established method to simultaneously determine seven kinds of elements K, Ca, Mg, Fe, Zn, Se, Pb in Moroccan and Sudanese medicinal plant. ICP-AES is one of sensitive techniques used under optimized condition to determine major and trace elements. Our present studies of elements with respect indigenous medicinal plant support the therapeutic usage of *W. somnifera (L)* Dunal in the traditional medicine for curing a variety of human ailments and diseases.

References

[1] Phillipson, J. David. "Phytochemistry and medicinal plants." *Phytochemistry.* 2001, *56*, 237-243.

[2] Kong, J. M.; Goh, N. K.; Chia, L. S.; Chia, T. F. Recent advances in traditional plant drugs and orchids. *Acta Pharmacologica Sinica*. 2003, *24*, 7-21.

[3] Cragg, G. M.; Newman, D. J. Biodiversity: A continuing source of novel drug leads. *Pure and applied chemistry*. 2005, *77*, 7-24.

[4] Dias, D. A.; Urban, S.; Roessner, U. A historical overview of natural products in drug discovery. *Metabolites.* 2012, *2*, 303-336.

[5] Payyappallimana, U. Role of Traditional Medicine in Primary Health Care. *Yokohama Journal of Social Sciences*. 2010, *14*, 57-78.

[6] Obianjunwa, E. I.; Adeleke, C.; Adebajo, O. and Omubuwajo, O. Essential and trace element contents of some Nigerian medicinal plants. *Journal of Radioanalytical and Nuclear Chemistry***.** 2004, 252 (3): 473-476.

[7] Rajurkar, N. S. and Damame, M. M. Elemental analysis of some herbal plants used in the treatment of cardiovascular diseases by NAA and AAS. *Journal of Radioanalytical and Nuclear Chemistry.* 1997, 219 (1): 77-80.

[8] Shirin, K., Imad, S., Shafiq, S. and Fatima, K. Determination of major and trace elements in the indigenous medicinal plant Withania somnifera and their possible correlation with therapeutic activity. *Journal of Saudi Chemical Society*. 2010*, 4* (1), 97-100.

[9] Rajan, J. P., Singh, K. B., Kumar, S. and Mishra, R. K. Trace elements content in the selected medicinal plants traditionally used for curing skin diseases by the natives of Mizoram, India. *Asian Pacific journal of tropical medicine*. 2014, *7*, 410-S414.

[10] Jabeen, S., Shah, M. T., Khan, S. and Hayat, M. Q. Determination of major and trace elements in ten important folk therapeutic plants of Haripur basin, Pakistan. *Journal of Medicinal Plants Research*. 2010, *4* (7), 559-566.

[11] Khan, S. A., Khan, L., Hussain, I., Marwat, K. B. and Akhtar, N. Profile of heavy metals in selected medicinal plants. *Pakistan Journal of Weed Science Research*. 2008. *14* (1-2), 101-110.

[12] Sharma, R. K., Agrawal, M. and Marshall, F. M. Heavy metals in vegetables collected from production and market sites of a tropical urban area of India. *Food and chemical toxicology*. 2009*, 47* (3), 583-591.

[13] Armah YS, Nyarko BJB, Akaho EHK, Kyere AWK, Osae S, Boachie KO, Osae EK. Activation analysis of some essential elements in five medicinal plants used in Ghana. *J. Radioanalytical. Nuclear. Chem.* 2001, 250 (1), 173-176.

[14] Anal, J. M. H. and Chase, P. Trace elements analysis in some medicinal plants using graphite furnace-atomic absorption spectroscopy. *Environmental Engineering Research*, 2016, *21* (3), 247-255.

[15] Khan, M. T. J.; Ashraf, M.; Tehniyat, S.; Bukhtair, M. K.; Ashraf, S.; Ahmad W. Antibacterialactivity of Withania coagulans*. Fitoterapia*. 1993, 64, 367-370.

[16] Ray AB, Gupta M. Withasteroids, a growing group of naturally occurring steroidal lactones. *InFortschritte der Chemie organischer Naturstoffe/Progress in the Chemistry of Organic Natural Products*. 1994**,** 63, 1-106).

[17] Matsuda, M.; Murakami, T.; Kishi, A.; Yoshikawa, M. Bioorg. Med. Chem. Structures of withanosides I, II, III, IV, V, VI, and VII, new withanolide glycosides, from the roots of Indian Withania somnifera DUNAL. and inhibitory activity for tachyphylaxis to clonidine in isolated guinea-pig ileum**.** 2001**,** 9, 1499–1507.

[18] Stoller, E. W.; Stohs, S. J.; El-Olemy, M. M.; Yu, P. C.; Tarng, C. S. Fatty acid composition of lipids of *Corchorus, Yucca, Dioscorea, Withania* and *Rivea* tissue cultures. *Loydia*. 1974, 37, 309–312.

[19] Monika, P.; Rathee, P. S.; Mishra, S. N. PS, M. P. and Mishra, S. N. The seed oil of Withania somnifera WS-20 variety. *Asian J. Chem*. 1994, 6, 442–444.

[20] Sharma, R. *Agro-Techniques of Medicinal Plants*; Daya Publishing House: New Delhi, India, 2004; 31-33.

[21] Panwar, J.; Tarafdar, J. C. Distribution of three endangered medicinal plant species and their Colonization with arbuscular mycorrhizal fungi. *J. Arid Environ*. 2006, *65*, 337-350.

[22] Anonymous. In *The Wealth of India,* (*Raw Materials*); CSIR: New Delhi, India. 1976; *10*, 580-585.

[23] Asthana, R.; Raina, M. K. 1989, Pharmacology of *Withania somnifera* (L.) Dunal-a review. *Indian Drugs* 1989, *26*, 199-205.

[24] Ranđelović, S. S., Kostić, D. A., Zarubica, A. R., Mitić, S. S. and Mitić, M. N. The correlation of metal content in medicinal plants and their water extracts. *Hemijska industrija*. 2013, *67* (4), 585.

[25] Hassan, W., S. Rehman, H. Noreen, S. Gul, and S. N. Z. Kazmi. "Metallic Content of One Hundred (100) Medicinal Plants." *J Nutr Disorders Ther***.** 2015, 1779, 2161-0509.

[26] Streeten, D. H. P., and E. M. Williams. "Loss of cellular potassium as a cause of intestinal paralysis in dogs." *The Journal of physiology*. 1952, 118, 149-170.

[27] Bahadur, Ali, Zubeda Chaudhry, Gul Jan, Mohammad Danish, Atta ur Rehman, Rafiq Ahmad, Shah Khalid et al. "Nutritional and elemental analyses of some selected fodder species used in traditional medicine." *African Journal of Pharmacy and Pharmacology*. 2011, 5, 1157-1161.

[28] Classen, H. G. "Magnesium and potassium deprivation and supplementation in animals and man: aspects in view of intestinal absorption." *Magnesium*. 1984, 3, 257-264.

[29] Ma, Jing, Aaron R. Folsom, Sandra L. Melnick, John H. Eckfeldt, A. Richey Sharrett, Azmi A. Nabulsi, Richard G. Hutchinson, and Patricia A. Metcalf. "Associations of serum and dietary magnesium with cardiovascular disease, hypertension, diabetes, insulin, and carotid arterial wall thickness: the ARIC study." *Journal of clinical epidemiology*. 1995, 48, 927-940.

[30] De Maeyer, E. M., and M. Adiels-Tegman. "The prevalence of anaemia in the world= la prévalence de l'anémie dans le monde." 1985; 38, 302–316.

[31] Ikeda, Sayono, and Tomomi M. I. "Zinc chemical form in some traditional soy foods." *Journal of food science*. 1995, 60, 1151-1156.

[32] Shankar, Anuraj H., and Ananda S. Prasad. "Zinc and immune function: the biological basis of altered resistance to infection." *The American journal of clinical nutrition*. 1998**,** 68, 447S-463S.

[33] Siddiqui, K., Bawazeer, N. and Scaria Joy, S., 2014. Variation in macro and trace elements in progression of type 2 diabetes. *The Scientific World Journal*, *2014*.

[34] Wiernsperger, Nicolas, and JeanRobert Rapin. "Trace elements in glucometabolic disorders: an update." *Diabetology & metabolic syndrome 2*. 2010, 1, 70.

[35] Emsley, John. *Nature's building blocks: an AZ guide to the elements*. Oxford University Press, 2011.