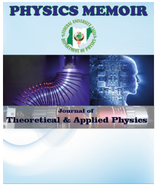

PHYSICS MEMOIR
Available online @ https://physicsmemoir.online

Phys. Memoir 1 (2018) 10–14

Journal of Theoretical & Applied Physics

Brief Report

Trace Elements Analysis of Some Herbal Plants with Antimalarial Potency in Ibadan South-West Local Government Area of Oyo State

A. A. Alade[a,*], O. O. Ogunlesi[a], A. A. Adegbile[b]

[a]*Department of Science Laboratory Technology, Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan*

[b]*Computer Science Department, Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan*

Abstract

Trace elements concentrations in twelve herbal plants with antimalarial potency in Ibadan South-West Local Government Area of Oyo State were studied using Atomic Absorption Spectroscopy (AAS) technique. The study was aimed at determining the qualitative and quantitative trace elements in these plants. Leaves, stem barks and corm of selected plants were analyzed for their trace elemental contents. The plant samples were found to contain essential trace elements such as Mn, Cu, Zn, Fe, Cr and Ni which are well known for their important roles in formulation of herbal drugs as well as toxic elements such as Cd and Pb. The concentration of Mn ranged from 0.10 ± 0.00 mg/kg in Khaya grandifoliola to 2.16 ± 0.00 mg/kg in Morinda lucida while for Zn, highest concentration of 0.31 ± 0.01 mg/kg was obtained in Lawsonia inermis. Fe concentration ranged from 0.77 ± 0.03 mg/kg in Curcuma longa to 7.22 ± 0.01 mg/kg in Azadirachta indica while for Cr, it varied between 0.01 ± 0.03 mg/kg and 0.13 ± 0.01 mg/kg for Alstonia boonei and Enantia chlorontha respectively. Ni concentration varied from 0.22 ± 0.01 mg/kg (Mangifera indica) to 0.33 ± 0.02 mg/kg (Enantia chlorontha) while Pb varied between 0.39 ± 0.05 mg/kg (Nauclea latifolia) and 0.76 ± 0.15 mg/kg (Enantia chlorontha). Cu and Cd levels were below detection limits [Cu (0.005 mg/kg and Cd (0.01 mg/kg)] of the spectrophotometer used. The concentrations of the trace elements in the samples were lower than the permissible limits set by World Health Organization (WHO). The study has shown that the herbal plants can provide antimalarial potency without leaving deteriorate effects of consuming some harmful trace elements. The study could serve a baseline for further researches on the subject matter in future.

Keywords: AAS, Trace elements, Herbal plants, Antimalarial potency

Article History :
Received 14 October 2018
Received in revised form 28 October 2018
Accepted for publication 3 November 2018
Published xx November 2018

*Corresponding author tel. no: +2348034544013
Email address: aladeadetomiwa@gmail.com (A. A. Alade)

1. Introduction

Malaria is a parasitic disease transmitted by the bites of Anopheles mosquitoes infected with Plasmodium species, four of which infect humans: Plasmodium falciparum (the most deadly one), Plasmodium vivax, Plasmodium malariae and Plasmodium ovale [1]. The disease primarily affects poor populations in tropical and subtropical areas, where the temperature and rainfall are suitable for the development of vectors and parasites [2]. It is regarded as the most common disease which has negative impact on the economy of prevalent countries [3]. The therapeutic use of natural products from indigenous plants for treatment of malaria is now common in the rural areas of developing countries where commercial drugs are mostly unaffordable or unavailable; furthermore, traditional medications are readily available and more culturally acceptable [4]. In Nigeria today, the use of herbal medicines for therapeutic purposes has increased drastically due to the fact that they are cheap, readily available and widely distributed.

Apart from the high cost of procuring available allopathic medicines for treating even common health disorders, other reasons for this shift are inaccessibility of health institutions in the rural or remote locations in the country and growing awareness of adverse reaction to some allopathic drugs. Besides, Nigeria being in the tropics, has forest that are full of cheap, easily available and sustainable medicinal plants which can be used and have always been used for the treatment of various diseases [5].However, it is worthy to note that all plants contain contaminants over a wide range of concentrations [6]. Trace elements are one type of contaminants amongst many. They can be made available to the human body through ingestion of plants and plants products [7].

Many indigenous plants are being used in herbal medicine for the treatment of malaria. Such plants include Lawsonia inermis, Vernonia amygdalina, Enantia chlorontha, Azadirachta indica, Curcuma longa, Nauclea lucida, Khaya grandifoliola, Alstonia boonei, Mangifera indica, Spathodea campanulata, Dacryodes edulis and Azadirachta indica. To the best of our knowledge, no documented reports on the trace metal analysis of the above listed herbal plants used in Ibadan South-West Local Government Area (LGA) in Oyo State has been published. Therefore, this work is aimed at assessing the trace elemental contents of twelve herbal plants used for the treatment of malaria in selected areas of Ibadan South-West Local Government Area, Oyo State, Nigeria.

2. Materials and Method

2.1. Study Area

This study was conducted at Ibadan South-West Local Government Area (LGA). It is one of the thirty three LGAs in Oyo State in Nigeria and has an area of $40km^2$ and a population of 282,585 at the 2006 population census [8]. It lies between longitude 7.3694 and latitude 3.8596 with several settlements. An ethno-botanical survey was conducted in Bode market, one of predominantly herbal markets of Ibadan South-West LGA between December 2016 and January 2017. The herbal market is distinct for having a high proportion of herb sellers, aged locals or elders and traditional herbal medicine practitioners. These people treat ailments using plant remedies on the basis of their rich ethno-botanical knowledge.

2.2. Sample collection and preparation

The various plants considered are; Lawsonia inermis, Vernonia amygdalina, Enantia chlorontha, Azadirachta indica, Curcuma longa, Nauclea lucida, Khaya grandifoliola, Alstonia boonei, Mangifera indica, Spathodea campanulata, Dacryodes edulis and Azadirachta indica. The plants parts shown in Table 1 were purchased from Bode market. The samples were transferred into the laboratory after they were labelled accordingly. The samples were then first washed under running water and then with distilled water to rid it of contaminants and air-dried on trays at a room temperature of 23^oC for a period of six weeks. The samples were then grinded and filtered with a sieve so as to obtain uniformly homogenous sample matrix. The powdered materials were stored in air-tight containers prior to further analysis.

2.3. Elemental analysis

0.5g was weighed from each sample, digested in a mixture of nitric acid (HNO_3), sulphuric acid (H_2SO_4) and perchloric acid ($HClO_4$) (10:2:1, by volume) and made up to mark (25ml) with distilled water for trace metal analysis [9]. The trace metal analysed are Cu, Zn, Mn, Fe, Ni, Cr, Pb and Cd. These elements of interest were analysed using PerkinElmer Atomic Absorption Spectrophotometer, with model number [10] at the Central Multi-Disciplinary Laboratory University of Ibadan. All the determinations were done in duplicates and values were reported in $mgkg^{-1}$.

3. Results and Discussion

Twelve herbal plants that have antimalarial potency were investigated for concentrations of trace elements. The scientific names, family names, common names and part sampled are presented in Table 1. A thorough survey of data in the results (Table 2) show that the essential trace metal contents in analyzed samples plant material were found in wide range. The elements Mn, Fe, Cu, Zn, Ni and Cr are essential trace elements (micronutrients) for living organisms and well known for their role against parasitic diseases [11].

Among all essential micronutrients, Zinc is the least toxic and an essential micronutrient in human as it is required to maintain the functioning of the immune system [12]. As evident from Table 2, high concentration of Zinc was found in Lawsonia inermis with a value 0.31 $mgkg^{-1}$, followed by Vernonia amygdalina with a value of 0.25 $mgkg^{-1}$. The maximum permissible limit is 50 $mgkg^{-1}$.

Copper is an essential enzymatic element for normal growth and development but can be toxic at excessive levels. In this study, it was not detected in all the samples. The maximum permissible limit set by WHO [13] is 10 $mgkg^{-1}$. Manganese is an essential trace element which plays an important role in all mental functions and aids in the transfer of oxygen from lungs to cells. Manganese concentration of the study ranged from 0.10 $mgkg^{-1}$ to 2.16 $mgkg^{-1}$; the least value obtained in Khaya grandifoliola and Alstoniea boonei while the highest was obtained in Morinda lucida. According to WHO [13], the toxic limits was set at 200 $mgkg^{-1}$.

Iron is an essential component of haemoglobin. It facilitates the oxidation of carbohydrates, protein and fat to control body weight, which is very important in diabetes [14]. Results in Table 2 revealed that maximum concentration of iron was found in Azadirachta indica, followed by Morinda lucida while minimum concentrations was found in Curcuma longa. The limit set by WHO [13] in medicinal plants is 20 $mgkg^{-1}$. Low iron content causes gastrointestinal infection, nose bleeding and myocardial infection [14].

Chromium is an essential micronutrients needed in carbohydrate metabolism. It is an important element required for the maintenance of normal glucose metabolism [14]. The concentration of Cr found in the herbal plants of the study was in the range of 0.02 $mgkg^{-1}$ in Morinda lucida, Mangifera indica and Spathodea campanulata to 0.13 $mgkg^{-1}$ in Enantia chlorontha. The toxic effect of chromium intake is skin rash, nose irritations, bleeds, stomach upset, kidney and liver damage. The permissible limit of chromium set by WHO [13] is 2.0 $mgkg^{-1}$.

Nickel plays some role in body functions including enzyme functions [15]. It activates some enzyme systems in trace amount but its toxicity at higher levels is more prominent [16]. The Ni levels in the samples are presented in this study. This varied between 0.220.33 $mgkg^{-1}$. The highest concentration was obtained in Enantia chlorontha. The recommended limit set by WHO [13] is 1.5 $mgkg^{-1}$.

The presence of non-essential (toxic) elements, such as Cd and Pb are in some considerable concentrations in the herbal samples. The presence of this toxic elements shows that the environment where the plant materials were bought is not free of pollution. Lead is a physiologic and neurological toxin that can affect several organs and organ system in the human body [11]. The highest concentration of 0.76 $mgkg^{-1}$ was recorded for lead in Lawsonia inermis and Enantia chlorontha while the least value of 0.39 $mgkg^{-1}$ was observed in Nauclea latifolia. The maximum permissible limit set by WHO [13] is 10 $mgkg^{-1}$.

Cadmium is a highly toxic element in foods and natural waters and it accumulates principally in the kidneys and liver [16]. It does not have a role in biological process in living organisms. Thus even in low concentration, Cd could be harmful to living organisms [17]. Cadmium was not detected in all the samples. The permissible limit is 0.3 $mgkg^{-1}$.

4. Conclusion

This study assessed the trace elemental compositions of twelve herbal plants used for the treatment of malaria of Ibadan South-West LGA. The concentrations of six essential micro elements (Fe, Zn, Cu, Mn, Ni and Cr) and two toxic elements (Pb, Cd) were determined by AAS method. The concentrations of the trace elements in the samples lower than the permissible limits set by World Health Organization (WHO) could imply its safe use in treatment of malaria and other various ailments. Although most of the trace metals of the study were within the safe limits and therefore may not pose any immediate health hazards to the populace, but for long term exposure, regular monitoring should be conducted as the accumulation can be hazardous to man. However, the study could serve a baseline for further researches on the subject matter in future.

Table 1. Herbal plants examined including their scientific names, family names, common names and part sampled

S/N	Scientific Name	Family Name	Common Name	Part sampled
1	Lawsonia inermis	Lythraceae	Henna plant (Ewe laali)	Leaf
2	Enantia chlorontha	Annonaceae	African yellow wood (Yanni)	Bark
3	Curcuma longa	Zingiberaceae	Tumeric (Atale pupa)	Corm
4	Nauclea latifolia	Rebiaceae	African peach (Egbesi)	Bark
5	Dacryodes edulis	Rosaceae	Weeping pear (Ewe pear)	Leaf
6	Morinda lucida	Rubiaceae	Brimstone tree (Oruwo)	Bark
7	Khaya grandifoliola	Neliaceae	African mahogany (Oganwo)	Bark
8	Alstonia boonei	Apocynaceae	Stoolwood (Ahun)	Bark
9	Mangifera indica	Ancardiaceae	Mango (Mongoro)	Bark
10	Vernonia amygdalina	Asteraceae	Bitter leaf (Ewuro)	Whole plant
11	Spathodea campanulata	Bigloniaceae	Family tree/tree of life (Akoko)	Leaf
12	Azadirachta indica	Meliaceae	Neem tree (Dongoyaro)	Bark

Table 2. Trace elemental profile of the herbal plants (mg/kg) of the study

Scientific Name	Fe	Zn	Cu	Mn	Ni	Cr	Pb	Cd
Lawsonia inermis	5.08 ± 0.04	0.3 ± 0.00	BDL	0.42 ± 0.01	0.26 ± 0.01	0.12 ± 0.04	0.76 ± 0.00	BDL
Enantia chlorontha	3.85 ± 0.00	BDL	BDL	0.12 ± 0.00	0.33 ± 0.01	0.13 ± 0.00	0.76 ± 0.00	BDL
Curcuma longa	0.78 ± 0.02	0.18 ± 0.00	BDL	1.37 ± 0.01	0.22 ± 0.00	0.10 ± 0.02	0.59 ± 0.00	BDL
Nauclea latifolia	5.51 ± 0.11	BDL	BDL	0.27 ± 0.01	0.26 ± 0.01	0.08 ± 0.01	0.39 ± 0.00	BDL
Dacryodes edulis	6.12 ± 0.00	0.19 ± 0.00	BDL	1.08 ± 0.00	0.26 ± 0.00	0.05 ± 0.02	0.56 ± 0.00	BDL
Morinda lucida	6.31 ± 0.02	0.19 ± 0.00	BDL	2.16 ± 0.00	0.23 ± 0.00	0.02 ± 0.01	0.68 ± 0.00	BDL
Khaya grandifoliola	2.28 ± 0.01	0.05 ± 0.00	BDL	0.10 ± 0.00	0.23 ± 0.01	0.02 ± 0.01	0.68 ± 0.01	BDL
Alstonia boonei	2.23 ± 0.01	BDL	BDL	0.10 ± 0.00	0.28 ± 0.01	0.01 ± 0.00	0.67 ± 0.00	BDL
Mangifera indica	5.38 ± 0.01	BDL	BDL	0.64 ± 0.01	0.22 ± 0.01	0.05 ± 0.01	0.68 ± 0.00	BDL
Vernonia amygdalina	5.75 ± 0.01	0.25 ± 0.00	BDL	0.35 ± 0.01	0.23 ± 0.00	0.03 ± 0.02	0.73 ± 0.00	BDL
Spathodea campanulata	5.59 ± 0.24	0.07 ± 0.00	BDL	0.37 ± 0.00	0.25 ± 0.00	0.01 ± 0.00	0.75 ± 0.00	BDL
Azadirachta indica	7.22 ± 0.01	BDL	BDL	0.19 ± 0.00	0.28 ± 0.01	0.04 ± 0.02	0.72 ± 0.00	BDL
WHO limit[1]	20 $mgkg^{-1}$	50 $mgkg^{-1}$	10 $mgkg^{-1}$	200 $mgkg^{-1}$	1.5 $mgkg^{-1}$	2.0 $mgkg^{-1}$	10 $mgkg^{-1}$	0.3 $mgkg^{-1}$

Acknowledgments

We thank the referees for the positive enlightening comments and suggestions, which have greatly helped us in making improvements to this paper.

References

[1] J. O. Adebayo & A. U. Krettli, “Potential Antimalarials from Nigerian Plants: A review”, Journal of Ethnopharmacology: **133** (2011) 289.

[1] WHO limit = World Health Organization (WHO), 2005;BDL = Beyond Detectable Limit. (Detection limits of Cu, Cd and Zn are 0.005 mg/kg, 0.01 mg/kg and 0.005mg/kg respectively).

[2] B. M. Greenwood, D. A. Fidock, D. E. Kyle, S. H. I. Kappe, P. L. Alonso, F. H. Collins & P. E. Duffy, "Malaria: Progress, Perils, and Prospects for Eradication", Journal of Clinical Investigation: **118** (2008) 1266.
[3] African Summit on Roll Back Malaria, "Summit on Roll Back Malaria Abuja, Nigeria", Abuja Malsum: (2011)
[4] H. Okatch, B. Ngwenyas, K.M. Raletamo & K. Andrae-Marobela, "Determination of Potentially Toxic Heavy Metals in Traditionally used Medicinal Plants for HIV/AIDS Opportunistic Infections in Ngamiland District in Northern Botswana", Analytical Chem. Acta **730** (2012) 42.
[5] O. M. Oni, G. A. Isola, F. G. O. Oni & O. Sowole, "Natural Activity Concentrations and Assessment of Radiological Dose Equivalents in Medicinal Plants Around Oil and Gas Facilities in Ughelli and Environs, Nigeria", Canadian Centre of Science and Education: **1** (2011) 201.
[6] M.A. Radwan & A.K. Salama, "Market Basket Survey for Some Heavy Metals in Egyptian Fruits and Vegetables" Food Chemistry Toxicology: **44** (2006) 1273.
[7] I. Queralt, M. Ovejero, M. L. Carvalho, A. F. Marques & J. M. Llabres, "Quantitative determination of essential and trace element content of medicinal plants and their infusions by XRF and ICP techniques", XRay Spectrometry: An International Journal **34** (2005) 213.
[8] O. O. Makinde, O. B. Adegbokan, N. T. Fadele, O. J. Akinola & D.O. Aremu, "Assessment of Consumption Rate, Packaging and Storage System of Cassava Products in Ibadan South-West Local Government, Oyo State, Nigeria", New York Science Journal **9** (2016) 81.
[9] N. Zafar, M.A. Khan, N. Ahmad & Z. Rehman, "Element Analysis of Some Medicinal Plants used in Traditional Medicine by Atomic Absorption Spectrometer", Journal of Medicinal Plants Research **14** (2010) 1987.
[10] Association of Official Analyst Corporation, "Official Methods of Analysis of AOAC International" 18th Edn. AOAC International, Gaithersburg, MD (2005) 45.
[11] M. Diallo, A. Traore, P. E. O Gueye, A. Wague, P. Lutgen, O. Sarr & S. Mboup, "Characterization of Element and Mineral Content in Artemisia annua and Cameliasinensis Leaves by Handheld X-ray Fluorescence", African Journal of Biotechnology **12** (2013) 4179.
[12] I.K. Shuaibu, M. Yahaya & U.K. Abdullahi, "Heavy Metal Levels in Selected Green Leafy Vegetables Obtained from Katsina Central Market, Katsina, North-Western Nigeria", African Journal of Pure and Applied Chemistry **7** (2013) 179.
[13] WHO, "Quality Control Methods for Medicinal Plant Materials", World Health Organization, Geneva, Switzerland.
[14] S. Moscow & K. Jothivenkatachalam, "Study on Mineral Content of Some Ayurvedic Indian Medicinal Plants", International Journal of Pharma Sciences and Research **3** (2012) 0975.
[15] O. P. Sobukola, O. M. Adeniran, A. A. Odedairo & O.E. Kajihausa, "Heavy Metal Levels of Some Fruits and Leafy Vegetables from Selected Markets in Lagos, Nigeria", African Journal of Food Science **4** (2010) 389.
[16] U. Divrikli, N. Horzum, M. Soylak & L. Elci, "Trace Heavy Metal Contents of Some Spices and Herbal Plants from Western Anatolia, Turkey", International Journal of Food Science & Technology **41** (2006) 712.
[17] G. Ambedkar & M. Muniyan, "Analysis of Heavy Metals in Water, Sediments and Selected Freshwater Fish Collected from Gadilam River, Tamilnadu, India", International Journal of Toxicology and Applied Pharmacology **2** (2012) 25.