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A COMPARATIVE ELEMENTAL ANALYSIS OF SOME MEDICINAL PLANTS OBTAINED FROM DIFFERENT LOCATIONS IN BENUE STATE SOUTH SENATORIAL DISTRICTS OF NIGERIA

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Abstract

The leaves of A.indica (neen), Psidium Guajava (Guava), Mangifera Indica (mango), Moringa Oleifera, C. Odorota. (Siam weed), Vernonia amygdalina and Aloe barbadensis Miller (Aloe vera) collected from four locations in Benue State South Senatorial District were analysed for their elemental contents using flame photometer and atomic absorption spectrophotometer (AAS). The average concentrations of the elements were found to be: 125.59 - 1276.9 (Na), 62.385 - 1290.6(K), 4.887-805.3 (Mg), 0.037-9.126 (Mn), 0.222-0.819 (Cr), 0.135-2.704 (Cu) and 0.516-6.963 mg/100g (Zn). The values for Cu and Zn in Moringa oleifera could not be determined. The result revealed that potassium was the most abundant element in the study area and that the elements were most concentrated in the medicinal plants collected from Oju in Oju L.G.A but least concentrated in the ones collected from Orokam in Ogbadibo L.G.A., Benue State. All the medicinal plants are potential sources of raw materials for the Nutritional and Pharmacological industries.

Keywords: Azadirachta indica, Psidium guajava, Mangifera indica, Moringa oleifera, Chromolaena odorata, Elemental composition.

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1.0 INTRODUCTION

Plants are the most studied materials for traditional healings, development of pharmaceutical and nutritional intermediates, raw materials for modern drug manufacturing, insecticides and pesticides production. In many countries of the world plants leaves, fruits, flowers and seeds etc. have, not only been used traditionally as food, but have been subjected to phytochemical and mineral elements analyses Plants usually contain *phytochemicals* which are non-nutritive compounds hence do not sustain life but protect the body against diseases.

.***Azadirachta Indica:*** Azadirachta Indica is an evergreen tree purported to have originated from India. It has several names but in English language it is called neem tree. Its local name in Nigeria, "Dogonyaro" is of Hausa origin. Neem (Azadirachta indica) belongs to the family of maliceae and has several local and industrial applications. It is an important herb used in curing several diseases such as malaria, hypertension, measles (Dual et. al, 2009 and cancer control (Bart et al, 2010, Paul et al, 2011)

Psidium guajava (guava). Guava is an important medicinal plant which belongs to the family *myrtaceae*. It is widely distributed into tropical regions of the world Nigeria, India South America, Pakistan Bangladesh and Indonesia. P. guajava L. leaves, fruits, stem, roots etc, have been used in the treatment of diarrhea, stomachache diabetes by traditional medical practitioners in many parts of the world (Manoj *et al*, 2021). Modern medical uses of P. guajava L. include treatment of respiratory and gastrointestinal disorder, cough sedative anti-inflammatory and anti-diabetic agents, anti-hypertension and anti-obesity agent (Chen and Yen, 2007).

Chromoleana Odorata **(Siam Weed)**

This is a tropical and subtropical flowering plant that belongs to the sun flower family. It belongs to the genus *Eupatorium* and is native to the America but has been introduced to other nations of the world such as tropical Asia, West Africa and parts of Austria. Its common names include Siam weeds, Christmas bush, devil weed, (Abani di egwu (Igbo language) and "Anagbagbu" (Idoma language). *Chromolaena* odorata has several *phytochemicial* properties. These include anti-bacteria, anti-cancer, anti-convulsant, anti-fungal, antioxidant anti-inflammatory, anti-parasitic, anti-hemostatic, wound healing and hepatoprotective activities.

Vernonia amygdalina. This is a shrub which belongs to the family, asteaceae and believed to have originated from tropical Africa. It has extended to many countries of the world. Vernonia amygdalina has a characteristic bitter taste which earns it the popular name "bitter leaf". In Nigeria V. amygdalina is given several names which includes; Ogo (Idoma), Ityuna (Tiv), Onugbu (Igbo) and Ewuro (Yoruba). It is a highly respected and valued vegetable food in many parts of Nigeria particularly in the eastern and western parts. *Vernonia amygdalina* is an important medicinal plant for the traditional treatment of diseases such as malaria, pneumonia and cough (Erasto *et al*, 2007).

Moringa oleifera is a small foliage tree that is widely distributed in many parts of the world, Northwest India, Africa, South America, the Caribbean Island, Saudi Arabia and South East Asia. It belongs to the family *Moringaceae* and grows up to a height of about 8m. Common local names of *Moringa oleifera* include okweoyibo (Igbo), Zogale gandi (Hausa) and Eweigbale (Yoruba). Moringa Oleifera is used in many countries of the world , India

Pakistan, Hawaii, Philippines and South Africa because the leaves, fruits and flowers are all edible (Monica *et al* 2015). Several reports on the medicinal importance of M. oleifera are available. The plant has been found to contain some vital phytochemical and minerals that are involved in metabolic activities in the body. The presence of phytochemicals such as vanillin, omega fatty acids, carotenoids ascorbates, flavonoids etc and the minerals like magnesium, iron, selenium and zinc in moringa oleifera has been reported (Verma *et al*). The substances have been linked with the following biological activities of moringa oleifera; anti-oxidant, anticarcinogenic, immunomodulatory, antidiabetic antiatherogenic and hepathoprotective functions (Jung I. L, 2014).

Mangifera indica is an ever green tree found in Nigeria, India, Asia and Ethiopia and widely grown in both tropical and subtropical regions of the world. It belongs to the family *anacardiaceae* and has edible fruits. The seeds serve as feeds for both animals and poultry (Uzamu *et al,* 2015). Among the medicinal uses of M. indica are curing of brain fatigue, healing of heart burns, mental depression and bronchial diseases (Messay and Shimelis, 2012) .

Elements are vital constituents of both plants and animals, needed for biological, biochemical, enzymatic and metabolic activities in the body. They are usually required in definite proportions, as too little causes diseases while excess leads to toxicity. In view of the above, and environmental factors that could affect the existence of elements in a place, it is necessary to determine the elemental compositions of the medicinal plants in the study areas, which no other researcher has ever done'

2. MATERIALS AND METHODS

Sample collection: The leaves of *Azadirachta indica* (neem), Guava (*Psidium guajava), Mangifera indica* (mango), *Moringa oleifera, Chromolaena odorata* (siam weed) and *Vernonia amygdalina* were collected from four different farm lands in Benue State South Senatorial District; namely Ogobia in Apa LGA, Igwumale in Ado LGA, Oju in Obi LGA and Orokam in Ogbadibo LGA of Benue State, Nigeria.

Preparation of samples: The samples were washed with deionized water and dried in an electric oven set at 120^{o}C. After drying to constant weight, they were ground into fine powder. Each leaf powder was stored in a closed container for later use.

Elemental analysis: 0.5g of each sample prepared above was dissolved in 5ml of HNO_3/H_2O_2 (1:1) and gently heated on a hot plate until the brown fumes disappeared. 5ml of deionized water was then added to the resulting product and heated further until a colourless solution was obtained. The solution was filtered and transferred into a 100ml volumetric flask using whatman filter paper. The solution was made up to the 100ml mark using deionized water before being used for the analysis.

Determination of sodium and potassium

This was done using Flame photometer. The machine was calibrated with standard stock solution of each element of 30ppm concentration. Then 10.0ml of each sample solution was inserted into the flame photometer and analyzed.

Determination of other elements

A working standard solution of each element was prepared from a stock standard solution of 1000ppm, in $2NHN0_3$ acid and the absorbances were noted for the standard solution of each element and samples using Atomic Absorption Spectrophotometer (AAS). The calibration

curves obtained for concentration vs absorbance were statistically analyzed using fitting of straight line by least square methods. A blank reading was also taken and necessary corrections made during the calculation of the concentration of each element.

3. RESULTS AND DISCUSSION

Results; The results of this work are presented in tables 1, 2, 3, 4 and 5.

Table 1: Concentrations of the elements in the medicinal plants from Ogobia (mg/100g) dry leaf.

Element	Neem *(A. indica)*	Guava (*Psidium guajava)*	Mango *Mangifera indica*	*Moringa oleifera*	Siam weed *(C.odorata)*	*Vernonia amygdalina*
Na	1452	543.0	280.1	80.23	202.6	140.0
K	1532	965.4	357.2	20.28	320.5	267.3
Mg	1220	10.24	8.702	2.456	98.52	102.2
Ca	820.0	808.0	242.5	5.332	63.56	50.43
Fe	0.422	1.012	12.32	8.524	3.562	4.186
Mn	1.327	0.632	2.245	12.26	0.563	0.042
Cr	0.124	0.897	0.286	0.625	0.418	ND
Cu	0.156	0984	0.0423	ND	4.524	0.628
Zn	3.250	2.870	6.263	ND	1.982	0.498

Table 2: Concentration of elements in the medicinal plants from Oju (mg/100g) dry leaf.

Element	Neem (*A.indica)*	Guava (*Psidium guajava)*	Mango *Mangifera indica*	*Moringa oleifera*	Siamweed *(C.odorata)*	*Vernonia amygdalina*
Na	1520	442.0	380.0	161.2	112.3	132.0
K	1680	869.1	488.1	4.250	212.6	258.1
Mg	1140	10.10	9.811	1.237	102.3	98.03
Ca	1460	132.0	265.3	4.352	52.47	48.24
Fe	0.236	1.022	8.521	6.362	4.670	5.673
Mu	3.270	0.731	3.021	10.430	0.660	0.025
Cr	0.245	0.842	0.298	0.532	0.524	ND
Cu	0.389	1.520	0.0216	ND	5.203	0.715
Zn	5.550	3.770	14.00	ND	2.176	0.423

Table 3: Concentration of elements in the medicinal plants from Orokam (mg/100g) dry leaf.

Element	Neem (*A.indica)*	Guava (*Psidium guajava)*	Mango *Mangifera indica*	*Moringa oleifera*	Siamweed *(C.odorata)*	*Vernonia amygdalina*
Na	1155	47.53	291.2	170.5	200.4	120.4
K	929.1	98.25	182.4	271.3	265.1	1.623
Mg	110.9	12.69	1-.72	12.37	98.24	99.52
Ca	420.5	50.65	238.5	11.24	31.56	70.36
Fe	0.226	1.264	2.956	5.231	4.236	4.728
Mn	1.406	0.634	2.582	3.542	4.381	0.040
Cr	0.456	0.752	0.312	0.423	1.026	ND
Cu	0.046	0.857	0.052	ND	0.586	1.538
Zn	0.430	4.321	2.352	ND	0.412	0.626

Table 4: Concentration of elements in the medicinal plants from Igwumale (mg/100g) dry leaf.

Element	Neem (*A.indica)*	Guava (*Psidium guajava)*	Mango *Mangifera indica*	*Moringa oleifera*	Siam weed *(C.odorata)*	*Vernonia amygdalina*
Na	950.5	48.25	123.5	196.3	139.0	1.451
K	1020.5	79.61	240.2	42.57	314.4	256.3
Mg	750.3	8.923	9.402	3.486	101.25	120.3
Ca	625.3	122.8	320.7	6.423	70.65	60.28
Fe	0.423	0.984	5.982	4.385	3.142	5.285
Mn	0.934	0.828	1.524	10.27	0.038	0.039
Cr	0.062	0.785	0.364	0.536	0.406	ND
Cu	2.035	0.002	0.425	ND	0.502	0.427
Zn	4.128	2.572	5.236	ND	0.468	0.516

Table 5: **Mean concentrations of the elements in the medicinal plant leaves from the four locations** (mg/100g) dry leaf**)**
Concentration of elements

Element	Neem (*A.indica)*	Guava (*Psidium guajava)*	Mango *Mangifera indica*	*Moringa oleifera*	Siamweed *(C.odorata)*	*Vernonia amygdalina*
Na	1276.9	270.20	268.69	125.59	177.9	132.9
K	1290.6	503.09	364.5	62.385	279.7	261.7
Mg	805.3	10.73	9.629	4.887	100.1	105.1
Ca	831.5	278.36	267.0	5.505	67.06	57.33
Fe	0.327	4.282	7.445	6.126	3.903	4.968
Mn	1.734	0.548	2.343	9.126	1.411	0.037
Cr	0.222	0.819	0.316	0.529	0.595	ND
Cu	0.657	1.088	0.135	ND	2.704	0.827
Zn	3.340	3.383	6.963	ND	0.889	0.516
Total	4,360.58	1,0725	927.05	214.143	634.26	563.28

DISCUSSION

Several studies have been conducted on plants leaves, fruits, stems and banks etc with a view of assessing their chemical and phytochemical compositions, therapeutic and pharmaceutical potentials. Reports have been given on the proximate and mineral compositions of *Azadirachta indica* (Otache and Agbajor, 2017), *Mangifera Indica* (Uzama et al, 2015) and *Moringa oleifera* (Monica et al, 2015) just to mention but a few. However, reports that compare and contrast the elemental compositions of the medicinal plants obtained from Benue State South Senatorial District are not in existence.

The result of this work revealed obvious variations in the elemental constituents of the medicinal plants collected from four farm lands in the district, with the medicinal plants from Oju collections centre having the highest values (0.025-1680 mg/100g) (tables 1,2,3,4). The second position went to Ogobia collection centre (0.040-1520mg/100g) while the plants obtained from Orokam had the lowest concentrations of the elements (0.040-1155mg/100g). These variations may be attributed to the cumulative effect of long term application of Agrochemicals. The two areas, Oju and Ogobia, are known for extensive agricultural

activities and the marketing of large quantities of farm products in the zone. Other factors may be climate, soil type, plants maturity (age) and natural selection.

The use of medicinal plants in the treatment of typhoid and malaria fever and control of other ailments is a common practice by the people of Benue State South Senatorial District. This could be, among other things, due to the availability of these elements in appreciable concentrations in the plant leaves. A. indica has been reportedly used in the treatment of diabetes and this has been liked to its chromium, manganese, iron, zinc and vanadium contents (Garg et al, 2010). As an fungicide and material for personal hygiene *A. indica* is an important raw material for the cosmetic industries as well as the insecticides and pesticides industries.

Table 5 gives the average concentrations of the elements from the four geographical locations in the region. The result revealed high concentrations of sodium in all the medicinal plants, being highest in *A. Indica* (1277) and lowest in *M. Oleifera* (125.6) mg/100g. This indicates the ability of the medicinal plant to serve in the control of muscular contractions and relaxation (US Dept of Health and Human Services, 2015-2020). The concentrations obtained in this work bear similarities to those reported by Sahito *et al*, (2003).

Potassium was detected in all the medicinal plants leaves and found to be the most abundant in *A. indica*. The order of decreasing concentrations of potassium in the plants is, *A. Indica* (1290)>*P. guajava* (503.1)>*V. amygdalina* (261.7)> and *M. Oleifera* (62.39) mg/100g. From this result, *A. indica* would obviously be a rich source of potassium for the control of high blood pressure, prevention of stroke, osteoporosis and kidney stones (Newberry et, al, 2018).

All the medicinal plants contain magnesium in relatively high concentrations with *A.Indica* having the highest mean concentrations of the elements (805.3) mg/100g, followed by *Vernonia amygdalina* (105.1)mg/100g. The medicinal plant that contains the lowest concentrations of magnesium according to this report is *Moringa oleifera* (4.886) mg/100g. Magnesium is important for the control of high blood pressure (Otsuki *et al*, 2010), maintaining a steady heart rhythm and strong teeth, bones and prevention of diabetes (Rajendra *et, al*, 2007). Magnesium is a major ingredient in most anti-acids and laxatives.

Calcium was detected in all the medicinal plants and found to be most abundant in *Azadirachta indica* (831.5) mg/100g followed by *Psidium Guajava* (278.4) mg/100g. The calcium content of the medicinal plants decreases in the order; *A. indica* >*P. guajava*>*C. Odorata* (67.06)>*M. oleifera* (5.505) mg/100g. The high calcium contents of the medicinal plants suggest that they are potential sources of the nutrients for the formation of strong bones and teeth. Calcium is also involved in the regulation of nerve and muscles functions and milk production (Aremu and Ibrahim, 2014). The result showed that calcium and sodium are the most prevalent elements in *M. indica*, 267.0 and 268.7 mg/100g respectively, showing that the plant is a good potential for the regulations of plasma volume and acid-base balance.

The most important micronutrients captured in this report were; iron, manganese, chromium, copper and zinc, of which iron and zinc occurred in higher concentrations than the other elements. The mean concentrations of iron in the plants were: A. indica (0.327), P. guajava (4.282), *M. indica* (7.445), *M. oleifera* (6.126), *C. odorata* (3.903) and *V. amygdalina* (4.968) mg/100g. The high Iron contents of *M. Indica* and *M. oleifera* suggest that the plants are important sources of hemoglobin iron for the transport of oxygen to the tissues, oxidation-reduction reactions and as enzyme co-factors (Rajendian et al, 2007).

The mean concentrations of manganese in the medicinal plants (table 5) were lower that the iron concentrations with the exception of *A. indica* and *M. oleifera* in which the manganese concentrations were higher than the iron concentrations (1.734 and 9.126 mg/100g respectively for *A. indica* and *M. oleifera*). The concentration of manganese in *Moringa oleifera* was the highest (9.126mg/100g). The high manganese content indicates the suitability of the medicinal plants for the provision of metallo-enzyme activators. Metallo-enzymes are important for the structural and functional integrity of living cells. Diabetes has been linked to manganese deficiency in the blood of experimental animals.

Chromium's mean concentrations in the plants were relatively lower than those of the other elements; *A.indica* (0.222) *P. guajava* (0.819), *M. indica* (0.316), *M. oleifera* (0.529) and *C. odorata* (0.595) mg/100g. Chromium was not determined in *V. amygdalina*. As micro elements are only needed by the body in low concentration, the observed concentrations for chromium are adequate for the metabolic activities of the element. It is involved in the breakdown of carbohydrates and fats. The element also stimulates fatty acid synthesis and enhances the production of cholesterol.

The result also revealed low mean concentrations of copper in the medicinal plants with *C. Odorata* having the highest copper content (2.704), followed by *P. guajava* (1.088) mg/100g while *M. indica* had the lowest value (0.135mg/100g).This indicates the ability of the medicinal plants to serve as important sources of copper for use in metabolic activities. The element was not detected for *M. Oleifera*. Copper is vital for the absorption of iron and transport of oxygen in the body. As a powerful pro-oxidant, copper catalyzes the oxidation of unsaturated fats, oils and ascorbic acid (Uzama et al, 2015). As a constituent of many enzymes, it catalyzes the oxidation of ferrous iron to ferric iron (Rajendiam *et al*, 2007).

Zinc was detected in appreciable concentrations in all the medicinal plants with the exception of *M. oleifera.* It was present in the highest concentration in *M. indica* (6.963), followed by *P. guajava* (3.383) and closely followed by *A. indica* (3.340) mg/100g. According to this report, the plants could be potential sources of zinc which is a co-factor for insulin in diabetes. Zinc enhances the efficiency of insulin and is involved in the synthesis and degradation of carbohydrate, lipids, proteins and nucleic acids (Uzama, et al, 2015). Zinc plays a key role in cells division and wound healing.

In *V. amygdalina*, iron was the most abundant micro element detected (4.968) followed be copper (0.827), zinc (0.516) and manganese (0.037) mg/100g. This trend was also observed by (Mokogwu et al; 2014) in *V. amygdalina*. Potassium was the most abundant macro element detected in *V. amygdalina* (261.7), followed by sodium (132.9), magnesium (105.1) and calcium (57.53 mg/100g

The most prevalent element in the medicinal plants is potassium, which occurred in the highest concentration in all the plants with the exception of *M. oleifera* in which it was second to sodium. The high potassium contents may be responsible for the great use of the plants as food and in medication.

The medicinal plants are recommendable sources of ingredients for the control of high blood pressure and water retention, prevention of body weakness, fatigue, muscle cramps, osteoporosis, kidney stone, heart palpitation, breathing difficulties, muscles aches and stiffness, tingles, numbness and mood changes.

Conclusion

The result of this work revealed the prevalence of the macro- and microelements in appreciable concentrations in all the medicinal plants, but with relatively higher values for the medicinal plants obtained from Oju in Oju Local Government Area of Benue State than those from the other locations. It also showed that the medicinal plants collected from Orokam in Ogbadibo Local Government Area had the lowest mean elemental concentrations. The values obtained in this work are in close approximation with what obtains in literature. Therefore, the medicinal plants can serve as potential sources of raw materials for the pharmaceutical industries in the formulations and production of drugs and for the food and nutrition industries. It is however necessary to undertake the phytochemical analysis of the medicinal plants in order to vividly assess their medicinal potentials.

Reference:

Aaron, K. J., Sanders, P.W. (20913): Role of Dietary salt and potassium in cardiovascular Health & Disease: A Review of the evidence. Mayo Clin Proc: 88(a); 987.

Abdullahi, A.A, Aremu, B.A, Atunwa S.A., Usman, S.O., Attah, F.A.U; Lawal, B.A & Njinga, N.S (2020): Nig J. Pharm. Res.S (1)

Aremu, M.O. and Ibrahim, H. (2014): Mineral Contents of Some Plant Foods Grown in Nigeria; A Review; Food Science And Quality Management 29;2224-6088.

Bala, M. and Bashar J.B (2017): Proximate and mineral elements composition of five locally consumed fruits in Kano State, Nigeria: Bayero J of pure and applied sciences, 10 (2): 172-176.

Bart, R. N., Sarkar, K., Mandal - Ghosh, 1. and Bose, A. (2010); Relevance of Neem leaf Glyco protein as a New vaccine Adjuvant for cancer immunotheraphy: Houston, Tx, Studium Press LLC.

Catherine M. (2020); Chronic disease outcomes and related risk factors: Medical Review. Attro Publication; 18 Ectc - Ef. www.healthline.com.

Cogswell, M.E., Loria, C.M., Terry, A.L; Zhao, L. Inang, C. Y.; Chen, T.C. (2018): Estimated 12-hour urinary sodium and potassium Excretion in US Adults: JAMA: 319 (12): 1-12

Cook, N R., Obarzanek, E. Catter, J.A., Buring, J.E. Rexrole, K.M., Kumanyika, S.K. (2009): Joint effects of sodium and potassium intake on subsequent cardiovascular disease: Trials of Hypertension prevention follow-up study: Arch.Intern.Med.:169(1):32-40

Debra, R. W. (2017): Health Benefits and Risks of Copper: www.medicalnewstoday.com.

Garg, A. N.; Verma, K.; Choudhurg, R. A.; Reddy, A. V. R. (2010); Elemental contents in leaves and barks of neem (A. indica) a versatile medicinal plant by neuron activation analysis; Fouth international symposium on nuclear analytical chemistry ;;Book of abstracts ; Numbai (India) 15-19 Nov. (366) pg 234.

Hansa, D. and Bhargava, M.D. (2020): www.webmd.com: magnesium.

Jillian,K.(2018): Everything you need to know: Nov.14: www.healthline.cbmT

Jung, I. L. (2014); Soluble Extract from Moriga oleifera leaves with a new anticancer activity; PLOS ONE vol. 9 no 4. Article ID e 95492: view at published site/google scholar

Kerri - An, J. (2018): Top 15 calcium Rich foods: www.healthline.com.

Messay, B.L. and Shimelis, A.E. (2012); Functional and Pytochemical Properties of Mango Seed Kernels and Wheat Flour and their Blends for Biscuits Production; African Journal of Science and Technology (3)9: 193-203

Mokogwu, A.T,H.; Okorie, U.P. Degban, K.A.; Abubakar, A. and Mokogwu, E.E. (2014); Phytochemical and Trace Element Analysis Of Vernonia Amygdalina (Bitter Leaf) In Different Locations in Nigeria. African journal of cellular pathology 3: 44-50.

Monica, A.V.S.; Veronica, Y.M-G.; Alfredo, T.V.; Guadalupe, G.A.; Jose, S.P.; Jose, A.R. and Erick, S.C. (2015): Nutritional content and elemental and phytochemical analyses of Moringa oleifera growth in mexico. Journal of Chemistry; vol. 2015

Muhammed, A, Dangogo, S.M, Tsafe, A.J, Itodo, A.U and Atiku, F.A (2011): proximate, minerals and anti nutritional factors of Gardenaagulla (Gauden dutse) fruit pulp, Pakistan Journal of Nutrition 10(6):577-581.

Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2000); Harper's illustrated Biochemistry, 25th Edition, Mcgraw-Hill, Health Professional Division USA.

National Institute of Health (May, 2018); How too little potassium may contribute to cardiovascular disease: https://www.nihigov/news- events/nih- research matters.

Newberry, S.J., Chung, M., Anderson, C. A. M., Chem, C.,Fu, E., and Tang, A. (2018): Effects of Dietary sodium and potassium intake on Chronic Disease Outcomes and Related Risk Factors. Agency for Health Research and Quality; US Dept of Health & Human Services The Whitehouse.

Otsuki, N.; Dan, N.H.; Kumagai, E.; Kondo, A.; Iwata, S. and Morimoto, C. (2010); Aqueous Extracts of Carica Papaya Leaves Exhibit Anti-tumor activity and Immunomodulatory Effects. Journal of ethnopharmacology 127:760-767.

Owyele, V.B., Adediji, J.O.; Soladoye A.O. (2005) Anti-Inflamatory activity of aqueous extracts of Chromolaena Odorata; Inflammopharmacology. B:479-484

Paul, R. Prassad, M,, Sah, N.K. (2011) Anticancer Biology of Azadirachta Indica (neem); a mini review. Cancer Biology and Therapy; 12(6): 467-476

Rajendran A.V, Nwayanan, V and Granavel, I (2007): Study on the analysis of trace element in Aloe vera and its biological importance. Journal of applied science research, 3(11): 1476-1478.

Sahito, S. R.; Memon, M. A.; Kazi, T. G.;Kazi, G. H.;Jakhrani, M. A.; Haque, Q. U.; SharG. Q. (2003);Evaluation of mineral contents in medicinal plant Azadirachta indica (neem); Journal chem. Soc. Pak. (25) 2.

Trumbo, P., Yates, A.A., Schlicker, S. and Poos, M. (2001): Dietary Ref. Intakes Vit A, Vit K, Arsenic, Boron etc. J. Am Diet. Asso. 101; 294-301.

Umar, K.J, Hassan, L.G, Ado, Y. (2007): mineral composition of detoriumruicrocarpum growth in kwatarkwashir, Zamfara state Nig. International Journal of Pure and applied science 1(2):43-48