IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 13, Issue 6 Ser. II (June. 2019), PP 62-68
www.iosrjournals.org

Public Health Implications of Continuous Ethnomedical Use of Some Plant Species Encounterd in Enyigba Lead-Zinc Mining Community of Ebonyi State, Nigeria

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Abstract: ***Introduction:*** *The Public health implications of continuous ethnomedical use of some plant species encountered at Enyigba lead-zinc mining community, Ebonyi State, Nigeria were examined.*
Methodology: *Plant species growing around the mining site were identified by a Botanical Taxonomist. Well structured questionnaires designed to reflect demography, the prevalent diseases among the inhabitants of the community and some common plants used in the management of the diseases were administered. Available literature on the heavy metal contents of soil and plants in the study area and its neighbourhood was searched.*
Results: *One hundred and fifty (150) questionnaires were administered to males (48.7%) and females (51.3%) with 100% response. The age range of the respondents varied from 16 to 60 years with 31-40yrs (22.67%) being the predominant age range. The percentage of the respondents with formal education was (82.66%), and informal education was (16.66%), while (0.66%) did not indicate any educational status. All participants agreed that herbal medicine was the main source of treatment in the community. The predominant disease reported was malaria (30.67%), followed by constant headache (18.00%), and stomach ache (15.33%). Forty-nine (49) plant species were identified, out of which forty-seven (47) were found to be medicinal. Out of the 47 medicinal plants, 18(38.30%) were recognized by the respondents as the plants commonly used for the treatment of various diseases in the community. Available literature associated heavy metal pollution of the soils and plants of the study area and the neighbuoring communities with lead-zinc mining activities.*
Interpretation: *The members of Enyigba community rely mainly on herbal medicine but continuous use of the medicinal plants found in the lead-zinc mining environment may be counterproductive. There is the possibility of heavy metal intoxication of humans through herbal preparations and the attenuation of the plants'phytopotency by heavy metal interaction with the active molecules.*
Keywords: *Public health, Anthropogenic pollution, Environmental degradation*

Date of Submission: 08-06-2019 Date of acceptance: 25-06-2019

I. Introduction

The mining industry is an economically viable enterprise, with the potential to create employment opportunities for skilled and unskilled masses, lubricating livelihoods as it supports national income. The economic importance of mining to national economies has global outlook as many countries have taken to mining for economic diversification. In Nigeria, the mineral and mining act of 2007 marked the beginning of orderly and sustainable development of the solid mineral sector [1].

Solid mineral deposits were discovered in the Abakaliki division of the old Eastern Nigeria, in the forties, resulting in the granting of mining concession by the Federal Government of Nigeria to the mines Development Syndicate (WA) limited, through the mining lease of 1954, operated by its subsidiary-Nigeria Lead-Zinc Mining (NLZM) Company Limited. The Nigeria civil war of 1967-70 brought a brief interlude of mining activities as the NLZM wound up but the post war mining activities were characterized with unskilled artisanal illegal operations, with no regards to environmental safety, to the effect that mining wastes, rich in

heavy metals were carelessly discarded [2,3]. When the Mineral Property (ML 188), was formally transferred to Royal Salt Limited, by the Federal Ministry of Mines and Power in March 2010, the era of organized mining activities was reborn, but this notwithstanding, the illegal artisanal mining activities continues unabated, even with the tempo and zeal hitherto unknown, often generating to present ethnic impasse between the Royal Salt and the mining communities.

The indigenes of mining communities have taken to mining as a key player in economic empowerment. Consequently, in Ebonyi State, solid mineral mining is next to agricultural sector in the economies of many families and is one of the major sources of internally generated revenue to the government. In the Enyigba mining community, there is hardly any household without a heap of lead-zinc metals, resulting in large scale environmental degradation, unsafe mining conditions, severe environmental pollution and a cocktail of human health problems [4]. Today, the Enyigba lead-zinc mining community is witnessing continues presence of different forms of mining activities. In a culture characterized by poor economic background, high level of illiteracy, inadequate knowledge of primary hygiene, fragile ecosystem, and dispersed demography, the impacts of indiscriminate mining activities are disastrous.

The principal minerals of interest are lead and zinc, though there are handout of other elements such as copper and quartz in some quarters. The total lead mine area is about 21.8sq.km, consisting of three Local Government Areas – Enyigba in Abakaliki LGA, Ameka in Ikwo LGA, and Ameri in Ezza LGA. The area is generally referred to as Abakaliki lead mining area. In this study, Enyigba was selected because of its history of long mining activities and it also hosts the biggest numerical mining sites among the three mining communities.

Studies so far on the impacts of lead-zinc mining in Abakaliki lead-zinc mining area have focused mainly on water, soil and plants metal loads[2,5], their health and environmental impacts [6,7]. The impacts of lead-zinc mining on plant physiology, anatomy and biochemistry are also available in local and international literature [8,9]. Otuu et al [4] reported the impacts of the lead-zinc mining activities on the qualities of some staple food plants located in the mining environment. Wlberforce and Nwabue [7] implicated lead-zinc mining in the heavy metal contamination of food plants, soil and water within the study area.

There is neither literature on the plant profiling of the plant species growing in the Enyigba mining community nor is there any literature on the possible public health implications of using the plant materials for ethnomedical purposes. This study was prompted by the need to fill this gap.

II. Methodology

2.1 Description of the study area

Ebonyi State of Nigeria occupies a landmass of approximately 5,935km^2, and lies on approximately latitude 7^0 30^1E to $8^0 30^0$E and longitudes $5^0 40^0$N to $6^0 45^1$N. The State is bounded to the East by Cross River State, to the West by Enugu State, to the South by Abia State and to the North by Benue State of Nigeria (Aloh et al 2017). Abakaliki is the Capital City of Ebonyi State. The City is in the mid of the South Eastern Nigeria and lies within the mineralized zone of lead - zinc deposits of the River Benue trough, which stretches for hundreds of kilometers north-easterly from Zurak. The Benue trough is one of the known major areas with lead-zinc (Pb-Zn) deposit in West Africa. Abakaliki, especially the Enyigba area which is about 14 Km south of Abakaliki urban, is overlain with tropical rocks which constitute gneisses, granites, shales, sphalerite and crustal rocks. The prevailing climate is tropical with high rainfall, high temperature, high atmospheric humidity and precipitation usually exceeding evapotranspiration for more than half the year. The Enyigba Pb-Zn Mine was intermittently mined for lead from 1925 though mining operations ceased during the Nigerian Civil War (1967-1970) that badly affected the industry, but has recently been activated with artisanal mining activities highly pronounced.

2.2 Ethical and Environmental Consideration

The protocol for the study was reviewed by the Ethics Review Committee of the Ebonyi State Ministry of Health, Abakaliki. Peaceful community entry was achieved by seeking the permission of the Community leaders through an official application. Thereafter, the voluntary, first person Informed Consent of the participants involved in the study was obtained. The research assistants consisting of community youth leader, five literate indigenes, two herbal practitioners, two nurses and a Medical Doctor explained to each participant the study aim and objectives, methods, the nature of their involvement and the length of time of involvement, discomforts or risks, benefits, usefulness of the study, and plans for the use of the study findings. The informed consent was read to the participants in the local dialect, the Igbo language.

2.3 Study design

This study was carried out on 150 inhabitants who have lived in the community from 2 years to above 25 years. The inhabitants comprised of both sexes between the ages of 16yrs and 60yrs. The sampling size was calculated according to the formula for calculation of minimum sample size as reported in Aloh et al [10]. The

study design was cross-sectional and assessed the most common diseases suffered by the inhabitants. The questionnaire captured background variables (bio-data) and questions that were aimed at providing answers to the objective of the study.

2.4 Plant profiling

Samples of plants growing around the mining sites were randomly selected. While grasses were uprooted with shovel to preserve the roots and flowers where necessary, the tree plants were disbranched at the stalk. The plants were carefully labeled, packed in air-vented sacks and taken to the Department of Plant Science and Biotechnology of the University of Nigeria, Nsukka for identification by botanical Taxonomists. Voucher samples were kept in the herbaria.

III. Results

The results of the study are presented in Tables 1and 2 and Figure 1. One hundred and fifty (150) questionnaires were administered to males (48.7%) and females (51.3%) with 100% responses. The age range of the respondents varied from16 to 60years with average age bracket of 31-40yrs (22.67%) being the predominant age range. The percentage of the respondents with formal education was 82.66%, and informal education was 16.66%, while 0.66% did not indicate any educational status. All (100%) agreed that herbal medicine was the main source of treatment in the community.

Table 1 represents the dominant plants species growing around the Enyigba lead-zinc mining community. Forty nine (49) plant species were collected, out of which, 48(97.96%) plants were identified by the Taxonomist, and they were grouped into 22(45.83%) trees, 15(31.25%) shrubs, 7(14.58%) herbaceous plants and 4(8.33%) grasses. Out of 48 plants identified, 47(97.92%) were found in literature to be medicinal plants.

Table 1: The dominant plant species encountered in the community

TREE	SHRUB	HERB	GRASS
Nuclear latifolia	Chromolena odorata	Gloriosa superba	Andropogon gayanus Spondias
mombin	Napoleonaea imperialis	Dissotus rotundifolia	Cyperus digitatus
Syzygium guineense	Bridelia ferruginea	Amorphophallus johnsonii	Eleusine
indica			
Vitex doniana	Ixora coccinea	Tacca leontopetaloides	Cymbopogon citratus
Daniellia oliveri	Byrsocarpus coccineus	Eriosema laurentii	
Holarrhena floribunda	Urena lobata	Crotalaria retusa	
Alchornea cordifolia	Cissus populnea	Aspilia africana	
Ficus thonningii	Hymenocardia acida		
Newbouldia laevis	Chamaecrista mimosoides		
Azadirachtha indica	Triumfetta cordifolia		
Erythrophleum suaveolens	Dalbergia hostiles		
Gmelina arborea	Uvaria chamae		
Parkia biglobosa	Desmodium velutinum		
Parinari curatellifolia	Mimosa pudica		
Albizia lebbeck	Spigelia anthelmia		
Dichrostachys cinerea			
Margaritaria discoidea			
Anthocleista djalonensis			
Lophira lanceolata			
Cassytha filiformis			
Lonchocarpus cyanescens			
Khaya senegalensis			

Table 2 represents the plants commonly used for ethno-medical purposes in the community. Among the 47 medicinal plants 18(38.30%) were recognized by the respondents as the plants commonly used for the treatment of various diseases in the community.

Table 2: Ethnomedical uses of some plant species encountered in the community

S/NO	Plants	Ethno medicinal uses
01	Chromolaena odorata	Anti-bleeding agent and is commonly used in the community for treatment of cuts sustained during farming and other activities.
02	Cassytha filiformis	Treatment of African trypanosomiasis and gonorrhea
03	Napoleonaea imperialis	Antibacterial activity, wound healing properties.
04	Nauclea latifolia	Treatment of malaria, epilepsy, pain, fever, Diabetes, cough, and gastroenteritis.
05	Bridelia ferrugenia	Treatment of arthritis, bruises, boils, dislocation, burns, urethral discharge, dysentery, diarrhea, fevers, headache, stiffness, rheumatic pain and edema.
06	Spondias mombin	Treatment of gonorrhea, diarrhea, dysentery, hemorrhoids, wounds, stomachache, urethritis, cystitis, eye and throat inflammations.
07	Byrsocarpus coccineus	Treatment of venereal disease, pile, swellings, tumor, diarrhea, and to arrest bleeding.
08	Syzygium guineense	Treatment of diarrhea, dysentery, skin diseases, worms, and as purgative and remedy for stomach ache, malaria, cough and asthma.
09	Vitex doniana	Treatment of anemia, gonorrhea, improvement of fertility, treatment of jaundice ,

		leprosy, dysentery.
10	Daniellia olveri	Used as analgesic to treat general body pain, sedative, arthritis, rheumatism, oral treatment(Gum), Pulmonary & stomach troubles, skin infections, as a laxative for treatment of constipation and as antidotes for venomous stings.
11	Holarrhena floribunda	Treatment of dysentery, diarrhea, fever, snake bite, infertility, venereal disease, diabetes, malaria, arrow poison
12	Alchornea cordifolia	Used as sedative and antispasmodic activities to treat variety of respiratory problems such as sore throat, cough, bronchitis, also for treatment of genital urinary problems, female sterility, and treatment of gastric ulcers, diarrhea, amoebic dysentery, worms, blood tonic to treat anaemia, Epilepsy, pains, eye infection and as blood purifier.
13	Ficus thonningii	Used for treatment of diarrhea, gonorrhea, diabetes mellitus, wounds, bronchitis, urinary tract infection, urinary schistosomiasis, stomach pain, gastritis, gastric ulcer, liver disorders, jaundice, ring worm, scabies.
14	Aspilia Africana	It is used as anticoagulant to stop bleeding and facilitate wounds healing, as anti-inflammatory to treat rheumatism, used to treat ulcers, gonorrhea, skin diseases, tuberculosis.
15	Newbouldia laevis	Used as analgesic to treat body pains, stomach ache, chest pain, uterine colic dysmenorrhoea, headache, sinusitis, as purgative to treat constipation. Other uses include treatment of pile, septic wounds, abscesses and ulcers, snake bite, diarrhea, dysentery, hernia and syphilis, epilepsy, convulsion, arthritis, rheumatism, swellings, edema, tumour, cancers, eye and ear infections, induction of labour, treatment of toothache, and malaria.
16	Azadirachtha indica	Used in the treatment of leprosy, eye problem, epitaxis, intestinal worms , anorexia, skin ulcers, analgesic, bile suppression, piles, rheumatism, chronic syphilis, diabetes, wounds, diabetics and malaria.
17	Erythrophleum suaveolens	Used as anthelmintic agent against tapeworm, treatment of heart failure, general body pain/headache, excellent local anaesthetic activity on eye and skin, as a diuretic, anti-fungal agent for treatment of eczema and ringworms as well as treatment of filarial disease.
18	Urena lobata	Used in the treatment of diarrhea, wounds diabetics, and improvement of sperm abnormality.

The Figure represents the prevalent diseases the respondents agreed were common in the community. The most prevalent disease reported was malaria (30.67%), followed by constant headache (18.00 %,) stomachache (15.33%), and ring worm and hair loss (6.00%).

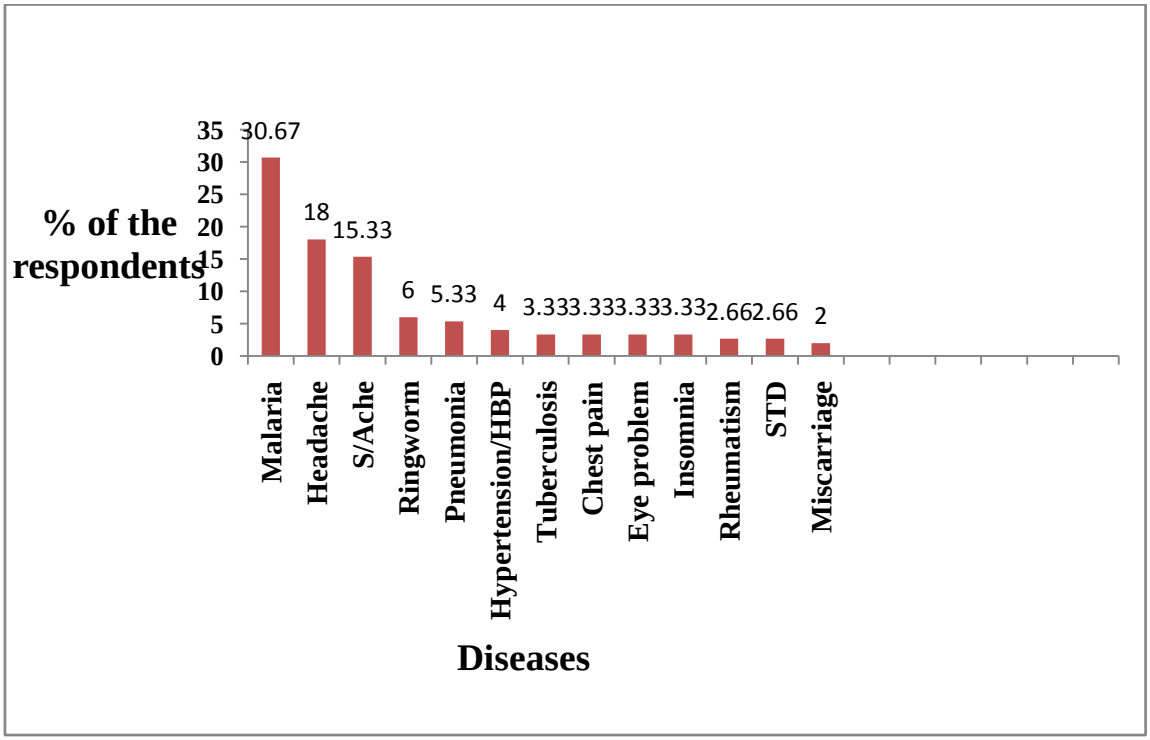

Figure: Prevalent Diseases in the community

IV. Discussion

Ethnomedical practice is a common feature in Enyigba lead-zinc community as all the participants (100%) agreed that herbal medicine was the main source of diseases management. The study agrees with Iwu [11] who reported that over 3.5milion people in the developing world rely on plants for health care because plants constitute a viable source of biological active substances for the development of new therapeutic agents.

C. odorata is known by all the participants as anti-bleeding agent and is commonly used in the community for treatment of cuts sustained during farming and other activities. The plant is reported to have other phytotherapeutic applications such as antibacterial, antifungal, antioxidant properties, anti-inflammatory, anti- mycobacterial, activities. The flavonoids from the flower have Cytotoxicity property. Nwinuka and Nwiloh [12] reported that the plant is used among the Igbo communities for the treatment of various diseases as reported in the Enyigba lead-zinc mining community. C. odorata leaf when crushed and applied topically is used as a blood-clotting agent, thereby making it an important agent in the treatment of wounds, skin abrasions and cuts [13].

N. latifolia is used in the community for treatment of malaria, epilepsy, anxiety, pain, fever, diabetes, cough, diarrhea (gastroenteritis), and fever (antipyretic). Germain et al [14] reported that the roots decoction possessed antipyretic, analgesic and anticonvulsant properties, justifying the use of the plant by the community in the treatment of the prevalent diseases. The use of the other plants by the community is also supported by several other studies. Chah et al [15] reported the antibacterial activity and wound healing properties of N.imperialis, Mythitis and Gaja [16] reported the use of C. filiformis in the treatment of cancer, African trypanosomiasis, gonorrhea, kidney ailment as well as being used as anti-platelet, vasorelaxant, alpha-adrenoreceptor antagonist, anti-trypnosomal and diuretic agent. N. latifolia has been reported as been effective in the treatment of malaria, epilepsy, pain, fever, diabetes, cough, and gastroenteritis [14], while B. ferrugenia has been used in the treatment of arthritis, bruises, boils, dislocation, burns, urethral discharge, dysentery, diarrhea, fevers, headache, stiffness, rheumatic pain and edema [17] and S. mombin is indicated in the treatment of gonorrhea, diarrhea, dysentery, hemorrhoids, wounds, stomachache, urethritis, cystitis, eye and throat inflammations [18]. B.coccineus is used in the treatment of venereal disease, pile, swellings, tumor, diarrhea, and to arrest bleeding [19], S. guineense is used to treat diarrhea, dysentery, skin diseases, worms, and as purgative and remedy for stomach ache, malaria, cough and asthma [20]. V.doniana is reported in the treatment of anemia, gonorrhea, jaundice, leprosy dysentery and improvement of fertility. D. olveri is used as analgesic to treat general body pain, sedative, arthritis, rheumatism, oral treatment (gum disease), pulmonary and stomach troubles, skin infections, as a laxative for treatment of constipation and as antidotes for venomous stings. H. floribunda is used to treat dysentery, diarrhea, fever, snake bite, infertility, venereal disease, diabetes, malaria and arrow poison [21]. A. cordifolia is used as sedative and antispasmodic activities to treat variety of respiratory problems such as sore throat, cough, bronchitis and also for treatment of genital urinary problems, female sterility, gastric ulcers, diarrhea, amoebic dysentery, worms, blood tonic to treat anaemia, epilepsy, pains, eye infection and as blood purifier. F. thonningii is used for treatment of diarrhea, gonorrhea, diabetes mellitus, wounds, bronchitis, urinary tract infection, urinary schistosomiasis, stomach pain, gastritis, gastric ulcer, liver disorders, jaundice, ring worm, scabies [22]. A. Africana is used as anticoagulant to stop bleeding and facilitate wounds healing, as anti-inflammatory to treat rheumatism, it is also used to treat ulcers, gonorrhea, skin diseases, tuberculosis [23]. N. laevis is used as analgesic to treat body pains, stomach ache, chest pain, uterine colic dysmenorrhoea, headache, sinusitis, as purgative to treat constipation. Other uses include treatment of pile, septic wounds, abscesses and ulcers, snake bite, diarrhea, dysentery, hernia and syphilis, epilepsy, convulsion [24, 25], arthritis, rheumatism, swellings, edema, tumour, cancers, eye and ear infections, induction of labour, treatment of toothache, and malaria. A. indica is used in the treatment of leprosy, eye problem, epitaxis, intestinal worms, anorexia, skin ulcers, analgesic, bile suppression, piles, rheumatism, chronic syphilis, diabetes, wounds, diabetics and malaria. E. suaveolens is used as, anthelmintic agent against tapeworm, treatment of heart failure, general body pain/headache, excellent local anaesthetic activity on eye and skin. It also used as a diuretic, anti-fungal agent for treatment of eczema and ringworms as well as treatment of filarial disease. U. lobata is used in the treatment of diarrhea, wounds diabetics, and improvement of sperm abnormality [26].

Much as these herbal plants may be useful in the management of the prevalent diseases among the inhabitants of Enyigba community, the negative public health implications cannot be ruled out as evidences of heavy metal consternation of soil, water and plants in the community are available in the local literature [2, 4, 5-7, 9].

Toxic metal species such as lead and cadmium can bind to proteins and affect the biological functions of the target molecule. These metals may denature proteins by interacting strongly with their thiols and disulphides, causing disruption of the biological activity of certain proteins that contain sensitive S groups [27, 28]. The destruction of sensitive thiol groups by metal interaction may negatively affect the protein folding/ or binding of apoenzymes by cofactors, resulting in deformation of the normal biological activity of the proteins

[29]. Some of these metal pollutants from the mining tails are transition metals which can participate in catalytic reactions, known as Fenton-type reactions that produce Reactive Oxygen Species, setting the cell under an oxidative stress which may result in DNA damage, destructions of lipids and proteins through a wide range of biochemical routes [30]. Heavy metal species may also get into cells through various transport routes, or penetrate the cellular membrane to bind to lipophilic carrier. This transporter-mediated uptake of toxic heavy metals interferes with the normal transport of essential substrates, resulting in competitive inhibition of the transport process necessary for bioactive synthesis in the plants. Significantly, transportation of heavy metals across the conducting routes may require acquisition of energy from the proton motive force or ATP pool [31]. Microbial agents such as nitrogen fixing bacteria and oxidoreductases are often involved in a lot of biochemical processes essential in plants bioactive synthesis. Some metal oxy-anions are reduced by the oxidoreductases that are able to draw electrons from the bacterial transport chain through the quinone pool [32]. Specific heavy metals can cause starving of microbial cells indirectly by siphoning electrons from respiratory chain [33]. hindering their catalytic activities in bioactive synthesis. After heavy metal is taken up into the cell, the toxic effect appears to be associated with extracellular interactions which ultimately results in deformation of cell morphology [34], alteration in DNA composition and destructions of proteins and lipids. These effects may eventually affect the quality and quantity of secondary metabolites that confer phytopotency to the medicinal plants, making the continuous use of the plants for ethnomedical purposes counterproductive.

V. Conclusion and Recommendations

Lead-Zinc mining activities in Enyigba mining community contaminate the soils, water and plants with heavy metals and pose serious threat to ecosystems and consequently to human health. Several studies by researchers in the study area have focused mainly on the prevalence of heavy metal contamination from mining activities and speculated health implications, but without due attention on the specific areas of health that may be so affected. One of such areas is the ethno medicine. In a culture characterized by fragile economic base, illiteracy and poor knowledge of environmental hygiene continuous use of plant materials with attenuated phytoconstituent qualities will pose public health challenges. So many functional dieses are now linked to heavy metal intoxication through dietary and environmental exposure. It is necessary to create public awareness about metal toxicity and draw attention from government body to carefully monitor and regulate the discharge of mining waste to the environment and to dissuade indigenes from using herbal plants within the vicinity of mining environment as both the plants and the consumers are exposed to adverse health impacts associated with environmental metallation.

Conflict of Interest: All the authors declare that there is no conflict of interest.

Funding Statement: This work was supported by the Tertiary Education Trust Fund through the Institution Based Research Fund [TETFUND/UNN/NSUKKA/ARJ/1&5].

References

[1]. Ministry of Mine and Steel Development (MMSD). Federal Government of Nigeria official reports on mineral deposits, Federal Secteriate, Abuja, Nigeria (2010).
[2]. Edeogu CO, Ekuma CE, Okaka ANC, Ezeonu FC, Uneke CJ and Elom SO. Public Health Significance of Metals Concentration in Soils, Water and Staple Foods in Abakaliki South Eastern Nigeria; Trends in Applied Sciences Research 2 (2007): 439-444.
[3]. Aloh, OB. Assessment of Environmental Impact of Lead-Zinc Mining in Abakaliki Pb-Zn Mining Area (Ameka, Ameri and Enyigba); Ph.D Thesis, Dept. of Geography and Meteorology, Enugu State University of Science and Technology (ESUST), Enugu, Nigeria (2014).
[4]. Otuu FC, Shu EN, Aloh O. Environmental Pollution and Food Quality - Impact of Lead-Zinc Mining on Four Staple Foods. ISBN 978-613-9-83461-7; Lambert Academic Publishing, Brivitbas gatve, Lv-103 9 Riga, Latvia (2018).
[5]. Ezeh HN and Chukwu E. Small scale mining and heavy metals pollution of Agricultural soils: The case of Ishiagu Mining District, South Eastern Nigeria. J Geology and Mining Res 3(4) (2011): 87-104.
[6]. Utumoh, EJ, Uraku AJ, Omaka ON, Nwabue FI. Global J Bio-Scs Bio-technol 1 (2) (2012): 320-323.
[7]. Wilberforce JO and Nwabue FI. Heavy metals effect due to contamination of vegetables from Enyigba Lead Mine in Ebonyi State, Nigeria. Environ Pollut 2(1) (2013): 19-26.
[8]. Suruchi K, Pankaj K. Assessment of Heavy Metal Contamination in Different vegetables grown in and Around Urban Areas. Res J Environ Toxicol 5(3) (2011): 162-179.
[9]. Okogbue C and Ukpai S. Evaluation of trace element contents in groundwater in Abakaliki metropolis and around the abandoned mine sites in the southern part, South Eastern Nigeria. Environ Earth Scs 70 (2013): 3351-3362.
[10]. Aloh OG, Aloh HE, Obasi NA, Chukwu K. Evidence of heavy metal contamination of agricultural soil in Ameri, Abakaliki lead-zinc mining area, Ebonyi state Southeast Nigeria: An indication for phytoremediation. Nutr Food Tech 3 (2017): 1-5.
[11]. Iwu M.M. Practical Pharmacognosy Manual; Vol. 2, Natural Products, Department of Pharmacognosy, UNN (1983).
[12]. Nwinuka N, Nwiloh B, Eresama J. Nutritional and potential Medicinal value of Chromolaena odorata leaves. International Journal of Tropical Agriculture & Food Systems 3(2) (2009):
[13]. Otuu FC, Obidiegwu C, Nwadinigwe AO; Ani GU, Aloh Obianuju, and Okorie Augustine. Evaluation of Oxidative Stress on Five Medicinal Plants at Gas Flaring Site, using Foliar Photomicrography. NISLT 30th Scientific Conference/Workshop, Akure, Conference Proceedings (2014) pp. 9.
[14]. Germain S, Elizabeth NB, Emmanuel T, Theopile D, Nobert W. Antipyretic and antinociceptive effect of Nauclea latifolia root. J Pharmacol Biol 49(1) (2011): 15-25.

[15]. Chah KF, Eze CA, Emuelosi CE, Esimone CO. Antibacterial and wound healing properties of methanolic extract of some Nigerian Medicinal plants. J Ethnopharmacol 104(1-2) (2006): 164-167.
[16]. Mythitis S, Gaja S. Pharmacological activities of Cassytha filiformis: A Review. Asian J Plant Sc Res 1(1) (2011): 77-83.
[17]. Adewale A, Winston AM, Olivia C. Antibacterial, antioxidant and fibroblast growth stimulation activity of crude extracts of Bridelia ferruginea leaf, a wound-healing plant of Nigeria. J Ethnopharmacol 133(1,7) (2011): 116-119.
[18]. Abiodun O.A, Rufus A.O, Stephen A, Ukponmwan S. Medicinal and Economic value of Spondias mombin. African J Biomedical Res 11(2) (2008): 129-136.
[19]. Akuodor GC, Udia PM, Akpan JL, Azeakpo BC. Ulcer protective effect of B.coccineus leaf extract in different experimental animal models. J Coastal Life Med 3(9) (2015): 728-732.
[20]. Ahmadu AA, Hassan HS. Flavonoids,Glycosides from B. coccineus leaves. African J Trad, Complementary & Alternative Med 4(3) (2007): 257-260.
[21]. PROTA. Medicinal plants. Plant Resources of Tropical Africa, PROTA. World dictionary of medical & poisonous plants (2008) 329-332.
[22]. Rachael Dangarembizi, Kennedy Erlwanger, Davison Moyo, Eliton Chivandi. Phytochemistry, Pharmacology and Ethnomedicinal Uses of Ficus Thonningii (Blume Moraceae): A Review. African J Trad, Complementary and Alternative Med 10(2) (2013): 203-212.
[23]. Abii TA, Onuoha E. The Chemical Constituents of the Leaf of Aspilia africana as a Scientific Backing to its Tradomedical Potentials. Agricultural J 6(1) (2011): 28-30.
[24]. Akunyili DN. Anticonvulsant activity of the Ethanolic Extract of Newbouldia Laevis; 2nd NAAP Conference, Kannel W.B. (2000): 155-158.
[25]. 25. Usman H.; A.H. Yaro; M.M. Garba; (2007); Phyto-chemical and Anti-convulsant of the Newbouldia Laevis (Bignoniaceae) in Mice; J.Pharmacol. Toxicol
[26]. Adeloye AA, Akinpelu AD, Ogundaini OA and Obafemi AC. Studies on antimicrobial, antioxidant and phytochemical analysis of Urena lobata Leave extract. Physical and Natural Scs 1(2) (2007): 234-237.
[27]. Foulkes EC. Biological membranes in toxicology. Taylor and Francis, Philadelphia (1998).
[28]. Geslin C, Llanos J, Prieur D, Jeanthon C. The manganese and iron superoxide dismutases protect Escherichia coli from heavy metal toxicity. Res Microbiol 152(2001): 901-905.
[29]. Samanovic MI, Ding C, Thiele DJ, Darwin KH. Copper in microbial pathogenesis: meddling with the metal. Cell Host Microbe 11 (2012): 106-115.
[30]. Borsetti F, Francia F, Turner RJ, Zannoni D. The thiol:disulfide oxidoreductase DsbB mediates the oxidizing effects of the toxic metalloid tellurite (TeO32-) on the plasma membrane redox system of the facultative phototroph Rhodobacter capsulatus. J Bacteriol 189 (2007): 851-859.
[31]. Lohmeier-Vogel EM, Ung S, Turner RJ. In vivo 31P nuclear magnetic resonance investigation of tellurite toxicity in Escherichia coli. Appl Environ Microbiol 70 (2004): 7342-7347.
[32]. Su L, Deng Y, Zhang Y, Li C, Zhang R, et al. Protective effects of grape seed procyanidin extract against nickel sulfate-induced apoptosis and oxidative stress in rat testes. Toxicol Mech Methods 21 (2011): 487-494.
[33]. Macomber L, Hausinger RP. Mechanisms of nickel toxicity in microorganisms. Metallomics 3 (2011): 1153-1162.
[34]. Nies DH. Microbial heavy-metal resistance. Appl Microbiol Biotechnol 51(1999): 730-750.

Otuu Fred C.," Public Health Implications of Continuous Ethnomedical Use of Some Plant Species Encounterd in Enyigba Lead-Zinc Mining Community of Ebonyi State, Nigeria" IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) 13.6 (2019): 62-68.