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Assessment of certain micronutrients (Zn, Fe, Ni, and Se) in some herbal snuff stocks consumed in Sokoto, Nigeria

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Abstract

The objective of this study was to assess the concentrations of Zn, Fe, Se, and Ni micronutrients present in some commonly consumed herbal snuffs in Sokoto, Nigeria using atomic absorption spectroscopy. The concentrations of zinc and iron metals present in brands of herbal snuff in Sokoto Nigeria reveal, the zinc concentration ranges from 0.12 ± 0.02 (recorded in DR Lambo special Sundu) to 0.33 ± 0.002 ppm (Hajiya Ayisha Snuff AK47 Blue cover), and iron ranges from 0.97 ± 0.6 (found in DR Lambo special Sundu) to 8.92 ± 0.2 ppm (AK 47). The concentrations of selenium and nickel metals in some selected snuff materials consumed in Sokoto, Nigeria reveal, the selenium concentration ranges from 0.05 ± 0.002 (Hajiya Ayisha snuff AK 47 green cover) to 0.12 ± 0.001 (revealed in Dr Lambo Herbal Powder) ppm. Nickel ranges from 0.02 ± 0.001 to 0.04 ± 0.002 ppm. All the determined elements are within safe levels when compared to World Health Organization (WHO) permissible limits and are probably safe for human consumption.

1. INTRODUCTION

Herbal medicines/ products/ stocks have been utilized for the cure of several ailments across various civilizations (developed, developing, and underdeveloped nations) of the world. The advocacy for the extensive use of herbal or plant products in therapy had been intensified nowadays as a result of historic and long-term reports showing efficacy through empirical and natural approach (Saeed et al., 2011; Mathew et al., 20210. Circa 2/3 of the world population are consuming herbal sticks as their source of healthcare need owing to the useful properties of the plants/ herbs such as phytochemical contents, nutrients, lesser side effect, effectiveness, cheapness and accessibility (Quds et al., 2021; Tschinkel et al., 20220).

Nevertheless, among the vital components expected and severally reported in plants/ herbs are the micronutrients. Micronutrients are present in our environment and should be present in food and other consumables as are needed by the body in minute amount, because they are essential to the body. Certainly, micronutrients play essential roles in sustaining body physiology, morphology, and metabolic processes that occur in tissues, organs, systems. Therewith, playing much role in living tissues, enzymes, transmission, bone and blood maintenance etc (Sousa et al., 2019). A lack of a micronutrient or combination of micronutrients lead to deficiency coupled with adverse effects in the body and in most cases the situation can only be relieved through supplementation of the element(s) in question through consumption (Sousa et al., 2019). Parable, zinc deficiency needs to be curtailed to avoid human adversities and rise in many diseases and morbidities in African population (Murphy et al., 2021). Significance of zinc is seen in its participation in catalytic functions, protein synthesis, cell division, DNA synthesis, growth, and development etc (Sousa et al., 2019). Selenium is essential in animal nutrition, and deficiency disrupts antioxidant system of cell, and causes brain, liver, and muscle disorders (Duborska et al., 2022). Fe is an essential element for most of the organism because of its oxygen carrying capacity, participation in DNA synthesis and engagement as cofactor to many enzymes (Sousa et al., 2019). Nickel plays

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essential role in many enzymes such as urease, hydrolase and is pertinently required by gut bacteria; therewith, excess nickel at least leads to toxicity (Awuchi et al., 2020).

Nevertheless, micronutrients elements (such as zinc, selenium, and nickel) found their ways into plants/ herbs stocks because they possess the propensity to accumulate in soils through agricultural, industrial, or other anthropogenic interventions (Duruibe et al., 2007; Benson et al., 2017; Dahlawi et al., 2021; Witlowska et al., 2021). After accumulation in soils, they are absorbed by plants and be translocated to edible parts utilized for making herbal medicines or foods, therefore passing through the food chain as well (Oliveira et al., 2015; Suosa et al., 2019; Yahaya et al., 2019). Micronutrients such as zinc, iron, nickel, and selenium with density above 6 $kgdm^{-3}$ are regarded as heavy metals and are of concern when consumed in certain excess amounts (Oliveira et al., 2015). Indeed, despite the usefulness and essentiality of micronutrients present in plant products (depending on their consumption doses/ concentrations, environmental conditions, and the likes) they may pose risk and hazards to biological system; hence, need to be monitored properly in foods and herbal products being consumed daily.

Additionally, herbal snuffs hail from plants and are consumed via the oral or nasal cavity by many individuals and groups in Sokoto and other parts of Nigeria. They are made from several plants and their parts or from a single plant source and utilization of these products is virtually on the rise and getting much popularity among the youths and adults population. Several brands of herbal snuffs are in the market without much scientific evidence divulging the contents therein. Parable, an Indian study by Mathew et al., (2021) determined some metals contained in herbal products and toxic levels of mercury, arsenic, lead, and mercury were observed. Saeed et al., (2011) observed that, selected heavy metals present in some Pakistani herbal medicines and there are observed high levels of metals therein. Similarly, Quds et al., (2021) studied heavy metals in predominantly used herbal stuffs and all the metals were below the limits set by WHO. In an Ondo state, Nigeria study, the observation of six different herbal plants shows the presence phytochemicals, and rich proximate values that might be the reasons for using the stuffs in therapy as found by Olanipekun et al., (2016). Thus, this current study would invariably help in giving a baseline information for further studies and taking appropriate measures or making policies. It will also indeed provide a source of awareness to herbal practitioners and the public. The study is indeed important because, there are still scarce and little information about micronutrients metals concentration in herbal stocks around the world, let alone in Nigeria (Oliveira et al., 2015; Tschinkel et al., 2020; Ngumah et al., 2022). The objective of this study was to assess the concentrations of Zn, Fe, Se, and Ni micronutrients present in come commonly consumed herbal snuff in Sokoto.

2. MATERIALS AND METHOD

2.1 The study area

Nigeria is a country located in the West Coast of Africa; lying 5^0 North Equator and between 3^0 and 4^0East of the Greenwich Meridian. The research was conducted in Sokoto, Sokoto state, government Areas or Council (LGAs). Nigeria is made up of thirty-six (36) states, with federal system of Government with three levels; the Federal, the state and the local government areas; Abuja being the Federal Capital Territory (FCT). Nigeria has seven hundred and thirty-four local government area (Hamza et al., 2023).

Sokoto is the name of the capital of Sokoto state and the name of the whole state which has common borders with the Niger Republic to the North, Kebbi state to the southwest; and Nigerian Muslim leader; the Sultan of Sokoto. Sokoto state which lies to the northwestern part of the country and is located in the extreme north-western part of Nigeria, near the confluence of Sokoto and Rima rivers. The Federal Neuro-Psychiatric Hospital is located in Kware. The UDUTHS is the only hospital that is teaching hospital which is the Usmanu Danfodiyo University. There are two women and children's hospitals and several private hospitals as well as Primary hospitals, one specialist hospital, one orthopaedic hospital. In the state there is a total population of 4,427,760 according to 2006 Census. Sokoto is the modern-day capital Sokoto North, Sokoto South, Wamakko and Dange-Shuni. The state has a land mass area of about 32,000 Sqkm and twenty-three (23) local government areas (Sarkingobir et al., 2023; Sarkingobir et al., 2022ab).

2.2. Sample Collection

The sample herbal stocks utilized in this study were bought in Sokoto Metropolis. Six specific different stock used for snuffing by the portion of Sokoto population and nearby were used for this study.

2.3. Principle of Atomic Absorption Spectroscopy (AAS)

In Atomic Absorption Analysis, the absorption of light uses an instrument called Atomic Absorption Spectrophotometer (AAS). In This process, flame system is generally employed to dissociate element from their chemical bonds. The atoms absorb light at characteristic wavelength chemical bonds. The atoms absorb light at characteristic wavelength when present in their ground state. A mixture of air and acetylene produce a flame which is of a sufficient high temperature to ensure the presence of free atoms of most elements. The use of nitrous oxide in place of air result in a higher temperature and this is necessary for the estimation of certain elements. The narrow spectral line of the sample necessitates the use of line source as well as high resolution monochrometer. This help to prevent interference from adjacent spectral lines of other species on the sample matrix. AAS in conjugation

with flame atomizer will be used to determine specific metals in a liquid sample, the availability of a spectrometer equipped with a lamp turret will facilities the measurement of multiple metals in a sample (Umar et al., 2022; Umar et al., 2023).

2.4. Procedure for AAS quality index calculation

After the digestion has been completed, the AAS machine was used to determine the present and concentration in the sample containing the metals analyte is aspirated into air-acetylene flame causing evaporation of the solvent and vaporization of free metal atoms this method is called atomization, a line source (hallow cathode lamp) operating in the Uv-visible spectra region is used to cause electronic excitation of the metal and the absorbance is measured with a conventional Uv-visible dispersive spectrometer with photomultiplier detector (Umar et al., 2022).

2.5. Estimation of Human Risk

Human Health risk was calculated using three different equations shown in this section. CDI=CP×IR×EF×ED/Bw×AT

Where, CDI= Chronic Daily Intake, CP+ concentration of metal in herbal snuff, IR=Ingestion Rate=1, EF= Frequency of Exposure=90 days, ED=Exposure Duration=30 days, Bw=weight=70 kg, AT= 2700 days.

Hazard Quotient= CDI/RfD

Where, RfD= Chronic Oral Reference Dose, Zn=3.5, Ni=2.5, Fe=8.0, Se= 0.005. (Olagunju et al., 2020; Tschinkel et al., 2020)

2.6 Statistical Analysis

The descriptive statistics and one-way analysis of variance (ANOVA) were carried out at ($p<0.05$) significance level using Microsoft excel version 7.

3. RESULT AND DISCUSSION

The results showing different concentrations of micronutrients zinc, iron, nickel and selenium in herbal snuff consumed in Sokoto were revealed in Tables 1-4. Table 1 shows the concentrations of zinc and iron metals present in brands of herbal snuff in Sokoto Nigeria. The zinc concentration ranges from 0.12 ± 0.02 (recorded in DR Lambo special Sundu) to 0.33 ± 0.002 ppm (Hajiya Ayisha Snuff AK47 Blue cover), and iron ranges from 0.97 ± 0.6 (found in DR Lambo special Sundu) to 8.92 ± 0.2 ppm (AK 47). To appreciate the concentrations of zinc and iron determined in the herbal stocks, it is imperative to compare them with the set limits. Parable, the zinc and iron are within the permissible limits of metals set by WHO (Saeed et al., 2011) and lower than the levels of allowed in cigarette drugs (Iwuoha et al., 2013). However, these concentrations (in Table 1) are still lower than the concentrations of Zn and Fe determined in different herbal products in Pakistan (Saeed et al., 2011). Parable, the zinc and iron are within the permissible limits of metals set by WHO (Saeed et al., 2011) and lower than the levels of allowed in cigarette drugs (Iwuoha et al., 2013). However, these concentrations (in Table 1) are still lower than the concentrations of Zn and Fe determined in different herbal products in Pakistan (Saeed et al., 2011).

Table 1: Concentrations of zinc and iron metals in some herbal snuff consumed in Sokoto, Nigeria

Type/ name of herbal snuff	Zinc (ppm)	Iron (ppm)
Snuff Herbal powder	0.24 ± 0.005	2.70 ± 0.47
Hajiya Ayisha snuff AK 47 green cover	0.13 ± 0.005	5.34 ±1.68
DR Lambo special Sundu	0.12 ± 0.02	0.97 ± 0.6
Hajiya Ayisha Snuff AK47 Blue cover	0.33 ± 0.002	4.01 ±0.5
Dr Lambo Herbal Powder	0.32 ± 0.03	4.29 ± 0.2
AK 47	0.31 ± 0.002	8.92 ±0.2

A contrary report to this finding (Table 1) was reported from India showing that several herbal medicines were contaminated with metals as a result of pollution and in turn can harm the health of the consumers (Mathew et al., 2021). Indeed, Fe presence at low levels in this herbal stock is a portend of goodness because, iron is required nutritionally by the human body. Fe is involved in making and stocking of neurotransmitters, uptake, and degradation of neurotransmitters and other proteins that affect brain. Iron is a pertinent component of haemoglobin, transferrin, ferritin, and hemosiderin. In turn deficiency can occur when there is low iron intake in humans and mostly affects brain function. Likewise, zinc is required for various metabolic processes in the human body (Garba et al., 2013). For example, low zinc intake can spur deficiency effects such as anaemia, stomach problem, intestine problem, weakness, poor growth and development. However, excess zinc could spur vomiting, irritation, weak immunity, and low good lipid in humans (Garba et al., 2013).

Table 2: Concentrations of selenium and nickel metals in some herbal snuff consumed in Sokoto, Nigeria

Type/ name of herbal snuff	Se (ppm)	Ni (ppm)
Snuff Herbal powder	0.07 ± 0.001	0.03 ± 0.001
Hajiya Ayisha snuff AK 47 green cover	0.05 ± 0.002	0.03 ± 0.002
DR Lambo special Sundu	0.06 ± 0.001	0.02 ± 0.001
Hajiya Ayisha Snuff AK47 Blue cover	0.11 ± 0.001	0.04 ± 0.002
Dr Lambo Herbal Powder	0.12 ± 0.001	0.04 ± 0.001
AK 47	0.08 ± 0.001	0.02 ± 0.001

The concentrations of selenium and nickel metals in some selected snuff materials consumed in Sokoto, Nigeria were shown in Table 2. The selenium concentration ranges from 0.05 ± 0.002 (Hajiya Ayisha snuff AK 47 green cover) to 0.12 ± 0.001 (revealed in Dr Lambo Herbal Powder) ppm. Nickel ranges from 0.02 ± 0.001 to 0.04 ± 0.002 ppm. nickel and selenium elements are important in diverse functions in biological system. All the two elements are within safe levels when compared to limits reported in Al-Thani et al., (2023). Thus, might be safe for consumption by humans. It is a good omen finding micronutrients (as well as heavy metals) nickel and selenium in snuff commonly consumed at low concentrations. Therein, the Ni and Se are lower than the values reported in herbal stocks in Pakistan (Saeed et al., 2011). Nevertheless, nickel in Table 2 is higher than 35 microgram Recommended Dietary Limit (Saeed et al., 2011). The concentration of the metal needs to be monitored because at excess amount it causes effect on liver, stomach, kidney, immune system and reproductive system (Saeed et al., 2011). Likewise, selenium levels in is another important element required in human nutrition as it mediates many functions in the body. For example, Se improves glutathione peroxidase and CD4 in HIV positive patients, reproduction function, cardiovascular health, and endocrine functions among others (Zhou & Wang, 2011).

Table 3: Showing Chronic Daily Intak**e** pertaining concentrations of zinc and iron metals in some herbal snuff consumed in Sokoto, Nigeria

Type of herbal snuff	Zinc (ppm)	Chronic Daily Intake for Zn	Iron (ppm)	Chronic Daily Intake for Fe
Snuff Herbal powder	0.24 ± 0.005	0.0343	2.70 ± 0.47	0.0386
Hajiya Ayisha snuff AK 47 green cover	0.13 ± 0.005	0.0019	5.34 ± 1.68	0.0760
DR Lambo special Sundu	0.12 ± 0.02	0.0017	0.97 ± 0.6	0.0139
Hajiya Ayisha Snuff AK47 Blue cover	0.33 ± 0.002	0.0047	4.01 ± 0.5	0.0573
Dr Lambo Herbal Powder	0.32 ± 0.03	0.0046	4.29 ± 0.2	0.0613
AK 47	0.31 ± 0.002	0.0044	8.92 ± 0.2	0.1275

Table 4 shows the Chronic Daily Intake values determined in snuff in Sokoto to estimate possible human risk. Because of the possibility of herbal stocks to have (heavy) micronutrient metals at concentrations that might cause adverse effects in humans, it is pertinent to assess rese stocks and assess possible health risks to safeguard public health. In order to estimate the possible risk due to consumption of micronutrients Zn, Fe, Ni, and Se the Chronic Daily Intake (CDI) calculated should be lower than 1, and fortunately all the concentrations calculated shows that the values are lower than 1. This in turn might probably rule out the possibility of occurrence of non-carcinogenic effect on consumers (Mafuyai et al., 2020; Olagunju et al., 2020).

Table 4: Showing Chronic Daily Intake pertaining concentrations of selenium and nickel metals in some herbal snuff consumed in Sokoto, Nigeria

Type of herbal snuff	Se (ppm)	Chronic Daily Intake for Se	Ni (ppm)	Chronic Daily Intake for Ni
Snuff Herbal powder	0.07 ± 0.001	0.0010	0.03 ± 0.001	0.0004
Hajiya Ayisha snuff AK 47 green cover	0.05 ± 0.002	0.0071	0.03 ± 0.002	0.0004
DR Lambo special Sundu	0.05 ± 0.001	0.0071	0.02 ± 0.001	0.0006
Hajiya Ayisha Snuff AK47 Blue cover	0.12 ± 0.001	0.0071	0.04 ± 0.002	0.0006
Dr Lambo Herbal Powder	0.12 ± 0.001	0.0071	0.04 ± 0.001	0.0006
Dr Lambo Herbal Powder	0.12 ± 0.001	0.0071	0.04 ± 0.001	0.0006

Table 5: Hazard quotient pertaining concentrations of selenium, iron, zinc and nickel metals in some herbal snuff consumed in Sokoto, Nigeria

Type of herbal snuff	**Zn**	**Ni**	**Fe**	**Se**
Snuff Herbal powder	0.00980	0.00016	0.00495	0.02
Hajiya Ayisha snuff AK 47 green cover	0.00054	0.00016	0.00950	0.142
DR Lambo special Sundu	0.00049	0.00024	0.00173	0.142
Hajiya Ayisha Snuff AK47 Blue cover	0.00134	0.00024	0.00766	0.142
Dr Lambo Herbal Powder	0.00342	0.00024	0.01594	0.142

Table 5 shows the Hazard Quotient values for various micronutrients determined in snuff in Sokoto, Nigeria. the aim of this assessment (in Table 5) was to measure the possibility of non-carcinogenic effects due to consumption of the metals in question. However, the results show that the HQ is less than 1 in all the values of Zn, Ni, Fe and Se recorded. Thus, at the examined concentrations probably there are no non-cancer adverse effects on human consumers due to the metals observed.

However, when the concentration/ doses rises or exposures are increased or due other components (apart from micronutrients metals) of the herbal stocks there might be a possibility of risk on humans (Olagunju et al., 2020; Umar et al., 2022).

4. CONCLUSION

Herbal snuffs are part of the traditional medicine that is on the rise in our communities. It has believed to do a lot in helping the healthcare system. However, in many cases information showing an empirical evaluation of metal contents in these stuffs is limited. These stuffs are made from plants, plants might have absorbed excess metals from soils, the containers of stuffs might have excess metals, and production activities might cause metals pollution. Albeit, Zn, Fe, Se, and Ni act at minute concentrations to help the body, excess concentrations cause harm to the human body. Thus, this study determined zinc, iron, selenium, and nickel in common snuffs in Sokoto, Nigeria. All the elements were within safe levels when compared to World Health Organization (WHO) Permissible limits. Therefore, are expectedly safe for human consumption (pertaining heavy metals).

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