Research Article

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The Health Benefits of Heavy Metals in Herbal Drinks, Nigeria

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Abstract

Herbal drinks are on the increase as they are being imported into developing countries like Nigeria for perceived medicinal uses. The presence of heavy metals in herbal drinks has received special attention due to their interactions with drugs and consequent effect in public health. Toxic metal contamination of soil, aqueous waste streams and groundwater causes major environmental and human health problems.

Ten brands of herbal drinks from different supermarkets in Nigeria were randomly sampled and purchased. All samples were pretreated using acid digestion and the concentration of selected heavy metals (As, Pb, Cd, Co, and Cr) and metals (Zn, Fe, Mg and Ca) were determined using Atomic Absorption Spectroscopy. For all the herbal samples analyzed, heavy metals such as arsenic (As) and Copper (Co) were the predominant heavy metals that were detected while the rest were of low significant values using the available analytical technique, also the analyzed metals that were equally present in large proportion were Magnesium and Calcium. The metals analyzed occur within varying concentrations.

In comparison with permissible levels of herbal products by World Health Organization (Pb) 10ppm, (As) 10ppm, (Cd) 0.30ppm, it can be concluded that the herbal drinks although very useful and medicinal, they can pose health risk to the consumer if not properly processed or purified.

Introduction

In the last decade there has being a steady increase in the use of herbal medicine globally. A World Health Organization (WHO) report showed that about 70-80% of the world population relies on non-conventional medicine which predominately of herbal sources in their primary health care. With the continuous proliferation and expansion of herbal remedies in the Nigerian market – both locally manufactured and imported (e.g. Tianshi, Forever, GNLD, Edmark herbal products). A number of them are registered with the National Agency for Drug Administration and Control (NAFDAC) - the Nigerian body responsible for the Regulation of drug matters. The safety and quality of these prepared herbal drugs calls for concern for health authorities, pharmaceutical industries and the public at large (that is the end user of such remedies).

A number of elements are important to plants but have harmful effect at high concentrations since their various roles in physiological processes of plant largely depend on their level in plant. Medicinal plants need special attention of their elemental composition because of their therapeutic importance. Therapeutic effects are due to the presence of the active compounds or secondary metabolites and are also influenced by the associated macro and micro elements contained in them. Due to increase in their potential effects on human health, accurate quantitative analysis of the elemental content of the plant is very important. The prevalence of herbal medicines use is high, the prevalence and factors with its use is largely unknown, even among pregnant women [1]. Although it is believed to be widespread, patients and the public have been known to self- prescribes herbal medicines for health maintenance, for the treatment or prevention of minor ailments and also for chronic illnesses [2].

In many countries, the increasing use is of special concern especially because herbal medicines are not rigorously regulated; most regulation is limited to the control of specified adulterants, and contaminants such as heavy metals and microorganisms [3]. Also, the increase use is on the high level in Nigeria [4]. The large increase of herbal use as medicines by the world population requires quality controls to ensure that toxic elements are within the maximum allowable regulation limits [5].

Human body requires both metallic and non-metallic elements for growth and development within certain permissible limits [6]. The optimum concentration needed for this purpose varies widely from one element to another, from infant to childhood to adult and from male to female [7]. The purpose of this study therefore was to evaluate the possible effects of some heavy metals in about ten selected herbal drinks that are used as medicinal supplements.

Literature Review

Traditional Herbal Bitters

Herbal medicine, otherwise known as a type of alternative medicine is reportedly used by over 75% of the world population both in the developing and developed countries where orthodox medicines are predominant [8]. The proliferating popularity as well as the usage of medicinal plants can be attributed to its acclaimed efficacy and because it is cheap. It is also thought that because herbal plants are natural there is no toxicity associated with their usage.

Herbal Bitters are most often 'polyhedral formulations made from mixtures of different plants and various plant parts. Bioactive components may have reacted in one way or the other, thus posing some levels of difficulties in their characterization. Herbal mixtures are taken over a long period of time with little or no consideration about their safety levels. Although, folkloric herbal supplements are alleged to be safe, some herbal products have been reported to be toxic at extreme doses, while some others were associated with potential adverse effects after prolonged usage. In most cases, these herbal products are not prescribed by a physician and neither were they dispensed by a pharmacist. Individual reports associated with their toxic effects are many times neglected. Therefore, the danger associated with the potential toxicity of many of these herbal products and other herbal therapies, which are being used over long period of times, demands that the practitioners be kept abreast of the reported incidence of any tissue toxicities.

Herbal Bitters are much sought after for their health benefits and they have become regular medicines in many Nigerian homes. The use of herbal Bitters is an alternative way to compensate for some perceived deficiencies in orthodox pharmacotherapy. Herbal medication has been reported ethno medically to prevent, treat, manage and cure several diseases from cough to cancer. This proven efficacy has resulted in great patronage for any product that comes with the name 'herbal'. The manufacturers of these herbal Bitters claim they are recipes for indigestion, weight loss, youthfulness, strength among others.

However, the indiscriminate use of herbal Bitters may have possible toxic effects on several organs of the body such as the spleen, pancreas, kidney and heart. In developing countries, herbal prescriptions and natural remedies are mostly used for the treatment of various disorders, such as diabetes and obesity, but there is insufficient scientific evidence as regard safety and efficacy of these herbal Bitters to back up the continued therapeutic application of their remedies.

Heavy metals in herbal drink

Heavy metals are metallic elements that have a density greater than 5 g/cm3 and can be harmful at high concentration. Heavy metals are dangerous because they tend to bio accumulate in biological organism. They are accumulated in living things any time they are taken up via food, drinking water and air and stored faster than they are metabolized or excreted. Heavy metals can be degraded or destroyed. Depending on the dose, some heavy metals could cause untoward effect which may result to death. The main sources of heavy metals in plants are their growth media, nutrients, agro inputs and soil. Other sources may include pesticides and fertilizers .Moreover, herbal drinks also contain several heavy metals such Al, Mn, Zn, Cu, Cr, Co, As, Hg, Cd, and Pb.

Materials and Methods

Nitric acid and hydrochloric acid (Analar BDH chemical limited Poole, England). All other reagents were of analytical grade and were prepared with distilled water.

Apparatus

Denver analytical balance, Crucible, Muffle furnace SM 9080, Techcomp AA 6000 atomic absorption spectrophotometer were used for the determination of metals and heavy metals in the herbal drink samples.

Sample collection

Ten (5) brands of herbal drinks were randomly sampled and purchased from supermarkets within Nigeria.

Methods

Sample treatments

A specific weight (0.5g) of each brand were digested using 10ml of a mixture of (2:1 v/v) of concentrated HNO3 and HCL. The mixture was heated on sand bath until solution turned white and gives out white fumes. The digest was transferred into 100 ml volumetric flask and volume was adjusted to mark using distilled water. Concentrations of metals and heavy metals were determined in the obtained clear solutions using Techcomp AA 6000 atomic absorption spectrophotometer.

Statistical analysis

Experimental data were presented as Mean ± Standard error of mean (SEM) as well as according to Paired Sample t-test. Statistical analysis was implemented using computer software SPSS 20 version statistical package Programme (SPSS, Chicago, IL). One-way analysis of variance was used to compare variables among the different herbal samples. Level of significance (Post hoc comparisons) of differences among the various herbal samples was determined by Duncan's Multiple Range Test. The values were considered statistically significant at $p<0.05$.

Results and Analysis

The heavy metals (As, Cd, Cu, Pb, and Cr) and metals (Zn, Mg, Ca, and Fe) were determined with Atomic absorption spectrophotometer using appropriate hollow cathode and resonance wavelength for each heavy metal and metals. The result obtained is shown in the figure below and expressed as µg/g.

Heavy metals and metals present in Eva power syrup

The analysis of Eva power syrup using atomic absorption spectrophotometer shows that all the following heavy metals (Arsenic, Cadmium, Copper, Lead, and Chromium) as well as metals (Calcium, Magnesium, Iron and Zinc) were present in the herbal drink products. However Arsenic (8.76 µg/g) and Copper (4.043 µg/g) are the predominant heavy metals that are present

in the herbal drink and the other heavy metals shows a very insignificant amount in the herbal drinks. Also Metals such as Calcium (27.53 µg/g) and Magnesium (6.35 µg/g) are of higher concentration in the herbal drink product as well as shown in the figure below.

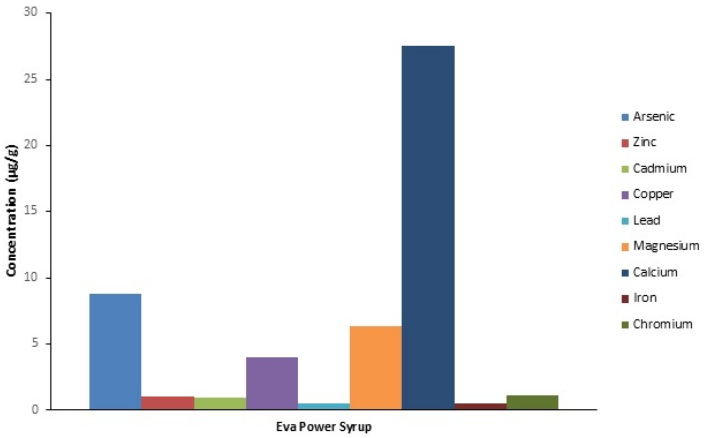

Figure 1: Determination of Heavy metals and metals present in Eva power syrup.

Heavy metals and metals present in Eva flusher syrup

The various heavy metals and metals analysis of Eva flusher syrup was carried out using atomic absorption spectrophotometer. The following heavy metals were detected (Arsenic, Cadmium, Copper, Lead and Chromium) while the following metals were also detected (Zinc, Magnesium, Calcium and Iron). Arsenic (7.02 µg/g) and Copper (4.1 µg/g) are more prominent as heavy metals in the herbal drink product whereas other heavy metals were of minimal amount. Furthermore, Calcium (17.26 µg/g) and Magnesium (6.83 µg/g) were significantly present in the herbal drink products and the other metals were of low concentration as shown in figure 2 below.

Arsenic (µg/g)	Cadmium (µg/g)	Copper (µg/g)	Lead (µg/g)	Chromium (µg/g)
7.02	17.26	4.1	<0.5	<0.5

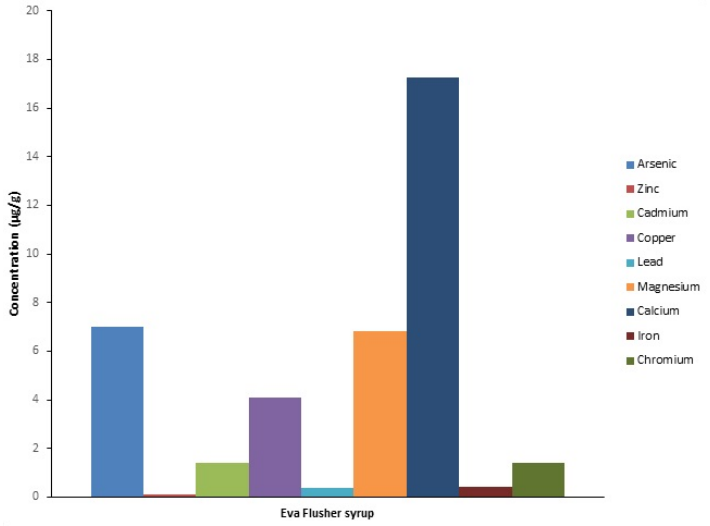

Figure 2: Determination of Heavy metals and metals present in Eva flusher syrup.

The analysis of the heavy metals and metals present in Swedish bitters herbal drink was determined using Atomic Absorption Spectrophotometer. The heavy metals determined are Arsenic, Cadmium, Copper, Lead and Chromium while the metals determined are Zinc, Magnesium, Calcium and Iron. The analysis reveals that Arsenic (8.01 µg/g) and Copper (3.90 µg/g) were conspicuously present while the other heavy metals were of lower concentration. The analysis also shows that the following metals such as Calcium (32.44 µg/g) and Magnesium (5.86 µg/g) were visibly present in high proportion while the other metals were of lower concentration.

Arsenic (µg/g)	Cadmium (µg/g)	Copper (µg/g)	Lead (µg/g)	Chromium (µg/g)
8.01	32.44	3.90	<0.5	<0.5

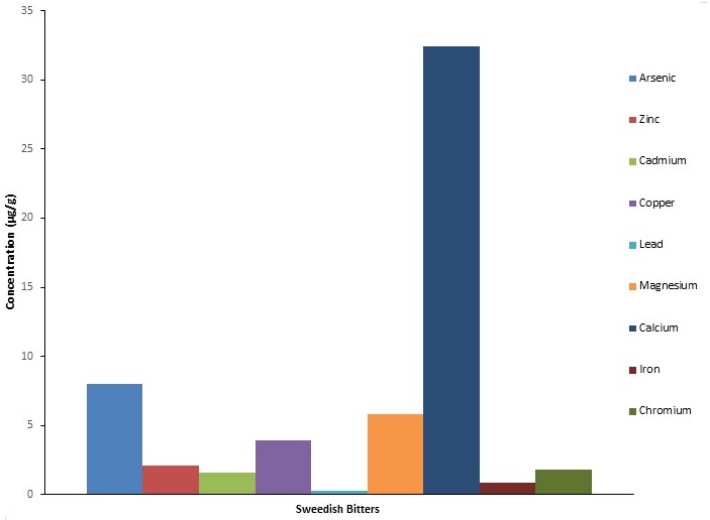

Figure 3: Determination of Heavy metals and metals present in Swedish Bitters.

Heavy metals and metals present in Darasi Bitters

Darasi bitters heavy metals and metal analysis was determined using the Atomic Absorption spectrophotometer. The following heavy metals were determined; Arsenic, Cadmium, Copper, Lead, and Chromium while the following metals were determined; Zinc, Magnesium,) Calcium and Iron. The heavy metals that are predominantly present are Arsenic (9.74 µg/g), and Copper (3.98 µg/g) while the rest of the heavy metals were present in a small concentration. Furthermore, Calcium (23.66 µg/g) and Magnesium (3.19 µg/g) are equally metals that are significantly present while the rest of the metals are of minute quantity as shown in figure 4 below:

Arsenic (µg/g)	Cadmium (µg/g)	Copper (µg/g)	Lead (µg/g)	Chromium (µg/g)
9.74	23.66	3.98	<0.5	<0.5

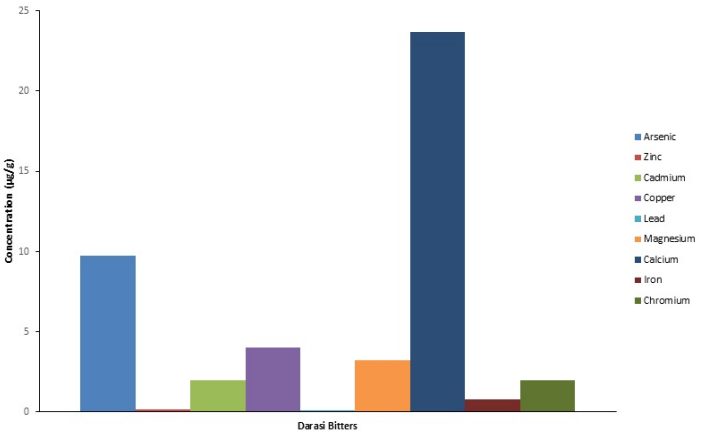

Figure 4: Determination of Heavy metals and metals present in Darasi Bitters.

Heavy metals and metals present in FIJK Flusher

The heavy metal and metal analysis of FIJK Flusher was carried out using Atomic Absorption Spectrophotometer. The heavy metals determined are; Arsenic, Cadmium, Copper, Lead, and Chromium while the metals determined are; Zinc, Magnesium, Calcium and Iron. The concentrations of the heavy metals are as follows; Arsenic (5.78 µg/g), Cadmium (2.13 µg/g) Copper (4.0 µg/g) and Chromium (2.02 µg/g) while the other heavy metals were of lower concentration. In addition, the metals prominently detected are Calcium (6.17 µg/g), Magnesium (4.9 µg/g) and Iron (2.43 µg/g) while the rest of the metals are very low in their concentrations as shown in figure 5 below.

Arsenic (µg/g)	Cadmium (µg/g)	Copper (µg/g)	Lead (µg/g)	Chromium (µg/g)
5.78	2.13	4.0	<0.5	2.02

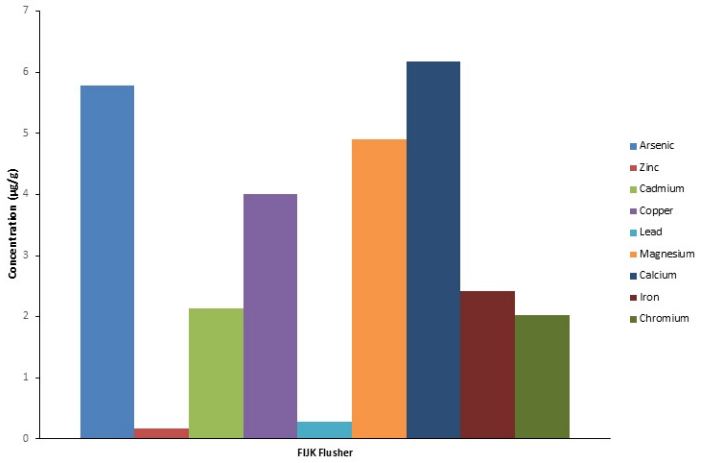

Figure 5: Determination of Heavy metals and metals present in FIJK Flusher.

Discussion

Ten brands of herbal drinks marketed in Nigeria were tested for heavy metals (As, Pb, Cd, Cr, and Cu) and metals (Zn, Ca, Mg and Fe) using the Atomic Absorption spectrophotometer. The heavy metals analyzed occurred within varying concentration ranges in all of the samples studied. The world health organization (W.H.O) and United State Food and Drug Administration (F.D.A) set permissible limit for toxic heavy metals in heavy metals in herbal drinks and in this study, the heavy metals concentration in the herbal sample were significant lower when compared to the mineral metals after detection from the atomic absorption spectrophotometer. Arsenic, Cadmium and Lead are among the thirteen elements of highest concern within the European community.

They are known to be carcinogenic or toxic affecting among others, the central nervous system (Mercury, lead and Cadmium) or skin, bones or teeth (Cadmium). However, the major heavy metals that were more predominantly exposed are Arsenic and copper while the mineral metals that were predominantly present as well are Magnesium and Calcium. The toxic effects of arsenic depend specially on oxidation state and chemical species, among others. Inorganic arsenic is considered carcinogenic and is related mainly to lung, kidney, Bladder and skin disorders (ATSDR, 2003a). The toxicity of arsenic in its inorganic form has been known for decades under the following forms: acute toxicity, sub chronic toxicity, genetic toxicity, developmental and reproductive toxicity, immunotoxicity, biochemical and cellular toxicity, and chronic toxicity, Schwarzenegger. Drinking water is one of the primary routes of exposure of inorganic arsenic National Research Council, 2001.

Ingestion of groundwater with elevated arsenic concentrations and the associated human health effects are prevalent in several regions across the world. Arsenic toxicity and chronic arsenicrosis is of an alarming magnitude particularly in South Asia and is a major environmental health disaster, Chakraborti. Chronic arsenic ingestion from drinking water has been found to cause carcinogenic and non-carcinogenic health effects in humans. The growing awareness of arsenic-related health problems has led to a rethinking of the acceptable concentration in drinking water. Arsenic detected in this study in all of the herbal drink sample was shown in the range of (5.78 µg/g – 9.74 µg/g).Based on the finding above, it we may therefore conclude that the presence of Arsenic of the herbal drink sample is something that poses a serious health implication to the various consumers as this perhaps that lead to severe health disorder if not properly looked into for an effective management as well as proper evaluation of the preparatory steps and procedures adopted in the preparation of these sets of herbal drinks or perhaps a complete ban should be placed on them if the appropriate organization refuses to take proper action. The presence of Arsenic might have been occurred during the process of harvesting the herbal plants and also handling. The Copper content of all the herbal samples were below the upper limit imposed on herbal drinks by various countries. China (60 µg/g), Japan (60 µg/g) and Australia, Iran, The United Kingdom and the United States (150 µg/g).

However, the Cu content of the tested herbal brands was generally lower than the values reported by, 29.3mg/Kg and 8.9 mg/Kg for local and imported herbal drinks with values of 16.16 µg/g with values of 58.66 µg/g and 17.41 µg/g for tea and herbal drinks

respectively compared well with the values reported by which was less than 1.00 mg/Kg. The variation of Cu content in the herbal drinks could be attributed to different types, grades and producing areas of the herbs. Living organisms require varying amounts of heavy metals. Irons, cobalt, copper, manganese, molybdenum and zinc are required by humans. However, magnesium and calcium are also useful minerals that were readily present in the all of this herbal drinks in a good proportion with calcium really very high.

Magnesium is required for bone formation and influences the activities of both the osteoblasts and the osteoclasts Magnesium also affects the concentrations of both parathyroid hormone and the active form of vitamin D, which are major regulators of bone homeostasis. Several population-based studies have found positive associations between magnesium intake and bone mineral density in both men and women [2]. Although limited in number, studies suggest that increasing magnesium intakes from food or supplements might increase bone mineral density in postmenopausal and elderly women. The findings from this study indeed reveal that the ranges of magnesium detected (3.19 µg/g – 10.92 µg/g) compares favorably with other findings and this shows that despite the presence of Arsenic in all of these herbal drinks, there are still great benefit these herbal drinks can pass across to the consumers knowing full well of the great role that Magnesium play in the body.

In addition, Calcium is the most abundant mineral element in the body: in adults it accounts for about 2% of bodyweight, which is equivalent to about 1200 g of calcium. The majority (~99%) of calcium is found in the skeleton and teeth, mainly as hydroxyapatite, an inorganic crystalline structure made up of calcium and phosphorus [Ca10(PO4)6(OH)2], which provides rigidity. The remainder is present in soft tissues and body fluids, and accounts for less than 1% of total body calcium. Calcium is an essential nutrient, not only for the mineralization of bones and teeth but for regulating intracellular events in most, if not all, body tissues. Calcium plays a role in muscle contraction and nerve function, for example. Therefore, seeing the large ranges of calcium (6.17 µg/g-41.40 µg/g) in all of the herbal drinks is a good indication that the herbal drinks are actually very good and useful for the maintenance of health related challenges.

Conclusion and Recommendations

Thus in the present study, it is clearly indicated that all the herbal drinks possess a great nutritional value in helping to manage health related challenges, however, proper processing procedures and purification should be strictly followed, so as to reduce the high exposure to some deleterious toxic heavy metals that hampers health and a formidable standard regulatory body should also be set up in Nigeria to screen the various herbal drink before been allowed to get into the market.

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