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DETERMINATION OF THE LEVELS OF HEAVY METALS IN SELECTED BLOOD TONICS

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ABSTRACT: *Some selected blood tonics obtained from two geographical locations were analyzed for their levels of heavy metals: iron, lead, manganese, chromium, nickel, cobalt, arsenic, copper and zinc. The blood tonics usually in the liquid form were first digested before analyzed The analyses were performed using an atomic absorption spectroscopy (VARIAN AA240 FS) nuclear reactor at Ghana Atomic Energy Commission (GAEC) at Kwabenya. The levels of the toxic metals such as lead, arsenic, chromium and cadmium were found to be low in the selected blood tonics.*

KEYWORDS*:* determination, levels, heavy metals, selected blood tonics

INTRODUCTION

There have been numerous studies on the elemental composition of food and dietary supplements in recent times. These studies are not only relevant in terms of their nutritional compositions but also their level of toxicities. The wide interest may arise due to the health benefits obtain from these elements. Though some of these elements may be essential for the proper functioning of the human body, the toxicity of others make their presence in food and other dietary supplement a cause for concern. The sources of these metals in food and dietary supplements may range from the soil on which the plants grow to the processing conditions during the production of these foods and dietary supplements.

The use of blood tonics has gained grounds in recent times in Ghana and in the world at large. Blood tonics are dietary supplements which are usually homogenous mixture of some essential metals such as iron, cobalt, manganese etc coupled with amino acids and vitamins.

. Dietary supplements in take have being considered the major source of supply of heavy metals in the human body [3]. Dietary supplements are not alternative to the plant medicine. They are only the source of materials complementing a normal diet which exerts an advantageous effect on systemic homeostasis along with lowering of the risk of getting ill with many diseases. Many individuals take in blood tonics for different reasons which may include as nutritional supplement, remedy anaemia situations, as appetite stimulant or solve general body weakness. In many instance blood tonics are recommended for most women at the end of their menstrual period to make up for the

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loss of blood. Most of these dietary supplements are in the form of capsules, tonics (liquids), tablets or powder [1].

These are concentrated sources of energy of some nutritional supplements or other substance of nutritious or physiological character. It has been reported that most blood tonics on the market are rich in trace elements such as iron, copper, zinc, manganese which are considered heavy metals [2]. The increased exposure of many food consumed containing metals can be attributed to the expansion in industrialization in the world. Animals and plants may also contribute to the heavy metals contamination. Most of the heavy metals are considered to be essential to the human bodies when in some quantity or amount [8]. Though these heavy metals are essential for biological activities in small quantity, elevated amounts of these metals may lead to chronic toxicity. Many ailments have being associated with the exposure to these metals. As enumerated above, these ailments may include damaged or reduced central nervous and mental function; lower energy level; damage to lungs, kidney, liver and other important organs. Most of these blood tonics are either manufactured in the country or imported into the country by major pharmaceutical companies. Majority of people who use blood tonics in one way or the other normally purchase them from chemical shops without proper prescription from qualified physicians.

Aims of study

The increasing use of dietary supplements, most importantly blood tonics and the level of heavy metals need to be looked at. The aim of this project work is to assist in the determination of the levels of heavy metals in some selected blood tonics. The indication of the extent of heavy metal contamination of blood tonics imported into the country and some produced in the country.

Objectives

In order to achieve the set aims, the following objectives were observed

- determination of the levels of heavy metals in selected blood tonics.
- verification of the levels of metals stated on the blood tonics.
- determination the presence of other metals which are not stated on the blood tonics.

A review of other studies or work done on heavy metals concentration in dietary supplements and food at large is discussed in this chapter.

Heavy metals in food and dietary supplements

The increased exposure of food consumed to most metals can be attributed to the expansion in industrialization in the world. Animals and plants may also contribute to the heavy metals contamination. Most of the heavy metals are considered to be essential to the human bodies when in small quantity or amount [8]. These may include iron, manganese, copper, zinc, cobalt. In rather elevated amount some of these heavy metals

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tend to be toxic. These heavy metals are normally referred to as non essential and may include lead, cadmium, arsenic, mercury. Dietary supplements are a considerable group of nutraceutics gaining in popularity not only in the world but in Ghana as well. They are concentrated source of energy of some nutritional supplements or other substances of nutritious or physiological character. Regarding the fact that the processed food does not provide man with the required amount of vitamins and mineral components, the application of specific dietary supplements may protect the individuals against possible insufficiencies. Dietary in take has being considered the major source of supply of heavy metals in the human body [3]. Dietary supplements are not alternative to the plant medicine. They are only the source of materials complementing a normal diet which exerts an advantageous effect on systemic homeostasis along with lowering of the risk of getting ill with many diseases [2, 4].

Metals are widely dispersed in the environment and have a number of applications in the industry [6]. The presence of heavy metals in foods and dietary supplements may not be of anthropogenic source only. Most heavy metals are usually found naturally accumulating in the earth crust, for example elemental arsenic is found naturally in the earth's crust at concentrations of 2–5 ppm [5]. This forms part of the soil on which many plants grow, hence these plants take up these heavy metals through translocation and absorption.

Arsenic is released into the environment through both natural sources (i.e., soil erosion, volcanoes) as well as anthropogenic sources (e.g., release from metal mining and smelting, pesticide application, coal combustion, waste incineration). Most arsenic released into the environment is inorganic in nature and accumulates by binding to organic soil matter [7]. The uptake of heavy metals may be increased if the levels of the heavy metals are elevated in the soil [9].

In small quantities these heavy metals such as copper, iron, manganese, zinc etc are considered nutritionally essential for healthy body [10]. These heavy metals are naturally found in fruits, vegetables and other foodstuff and form important components of some enzymes as well as involved in biological activities in humans.

For example, manganese enables the body to utilize vitamin C, B1, biotin as well as choline. It is essential in the manufacture of fat, sex hormones and breast milk in females. It is thought to also help neutralize free radicals as well as being of assistance in preventing diabetes and needed for normal nerve function. Manganese is also indicated in stimulating growth of the connective tissue and is also thought to be of importance in brain functioning [11]. Toxicity by diet is rare. Miners who are exposed to high levels of manganese, which can also be inhaled, can cause "manganese madness".

Copper is required in the formation of hemoglobin, red blood cells as well as bones, while it helps with the formation of elastin as well as collagen - making it necessary for

wound healing. A lack of copper may also lead to increased blood fat levels. It is also necessary for the manufacture of the neurotransmitter noradrenaline as well as for the pigmentation of your hair. On other hand, toxic levels will lead to diarrhea, vomiting, liver damage as well as discoloration of the skin and hair, while mild excesses will result in fatigue, irritability, depression and loss of concentration and learning disabilities [12].

Iron is needed for the production of hemoglobin and myoglobin (the form of hemoglobin found in muscle tissue). It is also needed for the oxygenation of red blood cells, a healthy immune system and for energy production. Severe iron deficiency results in anemia, and red blood cells that have a low hemoglobin concentration. Anemia in pregnancy increases the risk of having a premature baby or a baby with low birth weight. High iron content in the body has been linked to cancer and heart disease [13].

Zinc is necessary for a healthy immune system, and is also of use in fighting skin problems such as acne, boils and sore throats. It is further needed for cell division, and is needed by the tissue of the hair, nails and skin to be in top form. Zinc is further used for the growth and maintenance of muscles [14]. Elevated intake of zinc over an extended period can actually harm ones immune system instead of assisting it. Intake of zinc should be kept to under control as larger amounts may result in nausea, diarrhea, dizziness, drowsiness and hallucinations.

Chromium is an essential nutrient required for normal sugar and fat metabolism and works primarily by potentiating the action of insulin. Though these heavy metals are essential for biological activities in small quantity, elevated amounts of these metals may lead to chronic toxicity. Many ailments have being associated with the exposure to these metals. As enumerated above, these ailments may include damaged or reduced central nervous and mental function; lower energy level; damage to lungs, kidney, liver and other important organs [10].

Other heavy metals may be present in dietary supplement which may not be beneficial to the human body. Non essential heavy metals include arsenic, cadmium, lead, mercury etc. They are referred to as non essential metals since they have no known beneficial function and long term exposure may be toxic even at low quantities [15]. Toxicity of these non essential metals is associated with a number of diseases such as kidney, bone nervous and cardiovascular diseases [15, 16]. In addition to these diseases they are also noted in causing mutagenesis, teratogenesis and carcinogenesis [17]. The sources of heavy metals in foods vary from industrial through to agricultural processes which have been largely responsible for environmental pollution of food with metals. Most heavy metals ingested in foods may be attributed to the uptake by plants from fertilizers, sewage, manure, atmospheric deposition and sludge [18]. Anthropogenic sources such as phosphate fertilizer application, fossil fuel combustion and other industrial activities contribute to most important sources of heavy metal exposure.

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Methods of heavy metals analysis

High sensitivity and low detection limits are required in any analytical techniques in determination of metals present in many organic matrices. The methods employ in the determination of metals in biological samples may include inductively coupled plasma-optical emission spectroscopy, inductively coupled plasma- mass spectroscopy and electro- thermal atomic emission spectroscopy. Other analytical methods include neutron activation analysis, X- ray fluorescence, flame atomic absorption spectroscopy, graphite furnace spectroscopy.

Atomic absorption spectroscopy

Atomic Absorption Spectroscopy in analytical chemistry is a technique for determining the concentration of a particular metal element within a sample. Atomic absorption spectroscopy can be used to analyze the concentration of over 62 different metals in a solution [19, 20]. Typically, the technique makes use of a flame to atomize the sample, but other atomizers such as a graphite furnace are also used. Three steps are involved in turning a liquid sample into an atomic gas:

1. Desolvation – the liquid solvent is evaporated, and the dry sample remains
2. Vaporizations – the solid sample vaporizes to a gas
3. Volatilization – the compounds making up the sample are broken into free atoms.

The flame is arranged such that it is laterally long (usually 10cm) and not deep. The height of the flame must also be controlled by controlling the flow of the fuel mixture. A beam of light is focused through this flame at its longest axis (the lateral axis) onto a detector past the flame [21].

This method commonly uses a pre-burner nebulizer (or nebulizing chamber) to create a sample mist and a slot-shaped burner which gives a longer pathlength flame. The temperature of the flame is low enough that the flame itself does not excite sample atoms from their ground state. The nebulizer and flame are used to desolvate and atomize the sample, but the excitation of the analyte atoms is done by the use of lamps shining through the flame at various wavelengths for each type of analyte. In atomic absorption, the amount of light absorbed after going through the flame determines the amount of analyte in the sample. A graphite furnace for heating the sample to desolvate and atomize is commonly used for greater sensitivity. The graphite furnace method can also analyze some solid or slurry samples. Because of its good sensitivity and selectivity, it is still a commonly used method of analysis for certain trace elements in aqueous (and other liquid) samples [22, 26].

The light that is focused into the flame is produced by a hollow cathode lamp. Inside the lamp is a cylindrical metal cathode containing the metal for excitation, and an anode. When a high voltage is applied across the anode and cathode, the metal atoms in the cathode are excited into producing light with a certain emission spectra. The type of

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hollow cathode tube depends on the metal being analyzed. For analyzing the concentration of copper in an ore, a copper cathode tube would be used, and likewise for any other metal being analyzed. The electrons of the atoms in the flame can be promoted to higher orbitals for an instant by absorbing a set quantity of energy (a quantum). This amount of energy is specific to a particular electron transition in a particular element. As the quantity of energy put into the flame is known, and the quantity remaining at the other side (at the detector) can be measured, it is possible to calculate how many of these transitions took place, and thus get a signal that is proportional to the concentration of the element being measured [23, 27, 28].

Neutron activation analysis

Neutron activation analysis is the most common form of activation analysis. In neutron activation analysis, neutrons are the activating particles. Neutrons induce different kinds of nuclear reactions depending on their energy. For most applications, the delayed alpha radiation from the radioactive product is detected after activation. Neutron activation analysis techniques are usually categorized into three main groups based on whether any chemical separations are required in the procedure and if so, whether they are done before or after the irradiation. If no chemical treatment is done, the process is called instrumental neutron activation analysis (INAA). If chemical separations are done to eliminate interference or to concentrate the radionuclide of interest then the technique is called radiochemical neutron activation analysis (RNAA). A technique which involves a preirradiation chemical separation is also referred to as chemical neutron activation analysis (CNAA).

Another way of grouping neutron activation analysis techniques is according to the energy of the incoming neutrons. Thermal neutrons also called slow neutrons because their velocities are low (ie 2200m/s) are the most commonly used activation neutrons. The mean energy is only about 0.04 eV and the technique is called thermal neutron activation analysis (TNAA). Neutrons with slight higher energies (0.1 – 1.0 eV) are called epithermal neutrons and serve as the activating particles for epithermal neutron activation analysis (ENAA). Any neutron with energies greater than 0.5 MeV are called fast neutrons and area used in the technique called fast neutron activation analysis (FNAA) [24].

Basic description of NAA method

Activation analysis is a highly sensitive non destructive technique for qualitative and quantitative determination of atomic composition of a sample. It has been particularly useful for simultaneous determination of elements in complex samples like minerals, environmental samples, biological and archeological samples.

Neutron activation analysis allows one to measure the amount of a given element contained in some material of sample. The basic steps include;

- the sample is irradiated with a source of ionizing radiation so the elements to be determined are changed to radioisotopes of those elements.

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- using chemical or instrumental techniques the elements and their radioisotopes are isolated from any other elements present in the sample and their activities are measured.
- calculate the amount of the element present. The gamma rays given off by the sample reveal the identity on the trace element.

Usually a comparator method is used to calculate the amount of element present. In this method a standard containing a known amount of the element to be determined is irradiated along with the samples. It is assumed that the neutron flux, cross sections, irradiation times and other variables associated with the counting are constant for both the standard and the sample [25].

METHODOLOGY

This chapter deals with steps involved in the collection of samples, sample preparation and analysis of samples in order to obtain the concentration of heavy metals present in the selected blood samples. It also involves the equipment and chemicals employed in the project and quality assurance measures taken to ensure the reliability and reproducibility of the analytical data.

Collection of samples

The samples were purchased from the two geographical jurisdictions from different chemical shops. Ten blood tonics were purchased from different chemical shops from areas south to the main Tema motorway and another ten were also bought from different chemical shops from areas north of the Tema motorway. The samples were later transferred to the laboratory for labeling. Different labels were assigned to the samples to distinguish the sample from one sampling area from the other.

Chemicals and reagents

Analytical grade reagents were used. Digestion of the blood tonics were performed using nitric acid 69%. De-ionized water was also used for all the analytical work.

Equipment and general apparatus

Digestions of all samples were performed using 200ml beakers and hotplates in the fume chamber. Digested samples were stored in polypropylene containers. The containers were pre-cleaned by soaking in 69% nitric acid over night. All containers were washed with de-ionized water and allowed to dry. Again, all glassware was washed with detergents and water before soaking in nitric acid over night. Several rinsing of the glassware was done with de-ionized water and dried.

Analysis of heavy metal concentrations was performed by use of an atomic absorption spectroscopy (VARIAN AA240 FS) nuclear reactor at Ghana Atomic Energy Commission (GAEC) at Kwabenya.

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Digestion of sample

50ml each of the blood tonics samples were accurately measured into pre- cleaned 200ml beakers and 20ml nitric acid (69%) added. The resulting mixtures were placed on hotplate amidst gentle boiling in the fume chamber for 4 – 5 hours. The digests after cooling were carefully dissolved with 10ml de-ionized and transferred into 100ml volumetric flasks by filtration using Whatman no. 40 filter paper. De-ionized water was added to fill to the mark. The digest solutions were transferred and stored into pre-cleaned polypropylene containers and taken to Ghana Atomic Energy Commission for analysis. Duplicate digestions were conducted for each sample. Blank sample as well as reference sample was digested in the same way as the blood tonics.

Quality assurance

Glassware and sample containers used in the project were pre cleaned with detergent rinsed thoroughly with de-ionized water and later soaked in nitric acid over night. Prior to their use, they were washed several times with de-ionized water. A blank solution was prepared using de-ionized water and nitric acid in the same way as the samples were digested. NIST 1547 SRM certified Peach Leaves was used as reference sample to evaluate the accuracy of the method of analysis.

RESULTS AND DISCUSSION

This chapter deals with the results obtained from the analysis of some heavy metals present in selected blood tonics. This chapter also discusses a comparison of heavy metals in dietary supplements.

Table 1: Results obtained using Atomic absorption Spectroscopy

	concentration in mg/L					
Sample	**Fe**	**Zn**	**Pb**	**Cr**	**Ni**	**Co**
A	10.924	0.021	0.022	‹0.006	‹0.010	0.047
AA	11.095	0.288	0.052	‹0.006	‹0.010	0.023
B						
BB	4.403	0.019	0.057	0.065	‹0.010	‹0.005
C						
CC	12.129	0.009	0.023	‹0.006	‹0.010	0.036
D						
DD	7.789	0.066	‹0.001	‹0.006	‹0.010	0.030
E						
EE	4.899	0.067	‹0.001	‹0.006	‹0.010	0.022
F						
FF	10.926	0.017	0.020	‹0.006	‹0.010	‹0.005
G						
GG	8.427	0.097	0.093	‹0.006	‹0.010	0.056
H						
HH	4.400	0.074	0.015	‹0.006	‹0.010	0.052
I						
II	6.467	0.234	0.052	‹0.006	‹0.010	0.015

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J						
JJ	10.824	0.013	0.059	0.039	‹0.010	‹0.005
	11.452	0.065	0.077	0.038	‹0.010	‹0.005
	6.827	0.010	0.030	0.008	‹0.010	‹0.005
	7.023	0.014	0.055	0.084	‹0.010	0.046
	7.184	0.002	0.022	‹0.006	‹0.010	0.023
	13.099	0.439	‹0.001	‹0.006	‹0.010	0.130
	3.290	0.006	0.069	0.068	‹0.010	0.008
	7.515	0.149	0.047	‹0.006	‹0.010	0.032
	6.770	0.271	0.025	‹0.006	‹0.010	0.021
	10.188	0.019	0.038	‹0.006	‹0.010	0.011

Table 2. Iron concentration in mg/10ml

Sample	Manu (mg/10ml)	This work (mg/10ml)	Sample	Manu (mg/10ml)	This work (mg/10ml)
A	30.0	43.7	**AA**	30.0	44.4
B	43.7	17.6	**BB**	43.7	48.5
C	-	31.2	**CC**	-	19.6
D	16.7	43.7	**DD**	16.7	33.7
E	33.3	17.6	**EE**	33.3	25.9
F	16.7	42.3	**FF**	16.7	45.8
G	16.7	27.1	**GG**	16.7	28.1
H	64.00	28.7	**HH**	64.0	52.4
I	72.0	13.6	**II**	72.0	30.1
J	53.3	27.3	**JJ**	53.3	40.8

Levels of heavy metals in blood tonics

Iron

The concentration of iron in the selected blood tonics analyzed is shown in table 1 with table 2 showing the comparison of the iron concentration in mg/10ml with what is stated on the labels of the blood tonics (ie manufacturer's claim). Almost all the blood tonics used for the analysis have the element iron being the major element. Samples C and CC

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did not indicate any presence of the element on their labels but the analysis by this work reviewed some level of iron in them.
Again, the levels of iron in some samples were found to be more than the stated levels. For example in samples A, D, F and GG the level of iron detected were 43.7 against 30.0, 43.7 to 16.7, 42.3 to 16.7 and 28.1 as against 16.7 respectively. Notwithstanding this increase, some other samples recorded fewer amounts as against the stated levels.

Chromium
Almost all the manufacturers did not indicate the presence of the element chromium in their products. Table 1 shows that the level of chromium in the blood tonics detected were below the detection limit of the instrument. This notwithstanding, some samples contained some amount of chromium but were in very limited amount. For example the level of chromium in samples F, FF and GG were found to be 0.039, 0.038 and 0.084 respectively.

Nickel
From the analysis performed in this study, the levels of nickel present in the selected blood tonics showed out to be below the detection limit of the instrument (ie ‹0.010). This gives an indication that the levels of nickel in all the selected blood tonics used in the analysis are not toxic.

Cobalt
In as much as most of the manufacturers did not indicate the presence of the element cobalt in the products, there were some presence of cobalt as shown by the results presented in table 1. Whiles some of the sample showed detections which are below the detection limit of the instrument other samples also showing slight presence of the element cobalt. For example samples A, BB, C, DD, E showed an appreciable level of cobalt that is, 0.047, 0.036, 0.030, 0.056 and 0.052 respectively which are far above the detection limit of 0.005.
A second look at table 1 reviews that there was a substantial level of cobalt present in the sample labeled HH (ie 0.130)

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Results obtained using Nuclear Activation Analysis for some elements

	concentration in mg/L				
Sample	**Mg**	**Cu**	**Al**	**Mn**	**Ca**
A	4.94±0.54	14.41±4.20	13.30±0.26	0.76±0.11	3.66±0.25
AA	4.49±0.32	1.31±0.12	8.28±0.25	1.23±0.35	6.07±0.13
B	1.83±0.20	7.93±0.87	9.14±0.24	8.46±0.51	3.95±0.34
BB	0.87±0.09	6.67±0.73	8.42±0.23	2.33±0.37	5.64±1.49
C	1.25±0.13	4.06±0.44	4.61±0.26	0.31±0.06	‹0.01
CC	0.19±0.06	‹0.01	11.54±0.27	0.42±0.09	3.54±0.19
D	0.56±0.10	19.39±3.38	5.05±0.19	40.67±0.90	2.43±0.29
DD	3.38±0.40	0.70±0.09	9.99±0.28	32.98±0.85	2.59±0.31
E	4.08±0.18	3.71±0.26	13.04±0.26	1.31±0.29	5.37±1.46
EE	0.28±0.03	6.56±0.52	6.92±0.22	4.45±0.41	0.31±0.05
F	‹0.01	2.63±0.41	14.15±0.31	29.51±1.01	2.21±0.18
FF	0.68±0.10	‹0.01	11.19±0.35	37.56±1.16	4.91±0.28
G	3.41±0.26	0.72±0.08	7.78±0.30	33.14±1.10	4.12±0.19
GG	‹0.01	7.75±0.62	7.98±0.29	56.34±1.20	0.79±0.10
H	‹0.01	5.96±0.43	18.54±0.34	35.32±0.95	7.37±0.96
HH	4.82±0.84	0.92±0.12	7.56±0.26	52.96±1.26	5.70±0.63
I	1.96±0.22	26.49±4.68	12.31±0.28	40.49±1.01	0.68±0.08
II	0.99±0.11	28.33±4.76	24.33±0.42	32.66±0.96	2.38±0.13
J	0.79±0.09	18.69±6.25	10.21±0.32	19.93±0.89	6.29±0.68
JJ	0.80±0.08	1.86±0.20	3.14±0.22	10.83±0.66	1.85±0.20

Results obtained using Nuclear Activation Analysis for some elements

	concentration in mg/L				
Sample:	**Hg**	**As**	**Cd**	**Na**	**K**
A	‹0.01	‹0.01	0.08±0.01	48.81±0.22	21.40±6.69
AA	‹0.01	‹0.01	‹0.01	68.04±0.24	22.70±4.81
B	0.58±0.09	0.20±0.03	0.51±0.08	40.84±0.15	5.93±0.88
BB	0.64±0.10	‹0.01	‹0.01	22.49±0.14	2.25±0.33
C	‹0.01	‹0.01	‹0.01	340.63±0.75	2.67±0.35
CC	‹0.01	‹0.01	‹0.01	58.46±0.26	23.66±10.64
D	‹0.01	‹0.01	0.04±0.01	23.89±0.15	0.83±0.12
DD	‹0.01	‹0.01	‹0.01	38.59±0.13	4.11±0.61
E	‹0.01	‹0.01	‹0.01	43.83±0.19	6.83±1.02
EE	1.65±0.24	‹0.01	‹0.01	22.41±0.51	0.25±0.04
F	0.94±0.14	‹0.01	‹0.01	82.28±0.29	12.62±1.89
FF	‹0.01	‹0.01	‹0.01	77.61±0.28	13.68±2.04
G	‹0.01	‹0.01	0.26±0.04	49.74±0.26	6.46±0.96
GG	‹0.01	‹0.01	0.06±0.01	45.35±0.23	‹0.01
H	‹0.01	‹0.01	0.40±0.06	49.59±0.22	‹0.01
HH	‹0.01	0.11±0.02	‹0.01	s45.18±0.19	1.42±0.21
I	‹0.01	‹0.01	0.12±0.02	36.26±0.18	34.00±5.26
II	0.76±0.11	‹0.01	‹0.01	37.24±0.20	23.66±5.47
J	‹0.01	‹0.01	‹0.01	185.88±0.47	‹0.01
JJ	‹0.01	‹0.01	‹0.01	107.59±0.36	‹0.01

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Other elements (Potassium, Sodium, manganese, Zinc, Copper, Calcium

The levels of these elements most of which are considered relatively non toxic or essential in living organisms were found to be in quite substantial amount as compared to the elements referred to as toxic elements. Most of these elements were analyses using a nuclear reactor since they are sometimes difficult to be determined using the atomic absorption spectroscopy. Because most of these elements are regarded relatively as non essential, their levels are not of significant health implications especially at low concentration. However at elevated level beyond requirements they may become toxic by interfering with the normal functions of the essential elements.

From table 3 and 4 reviewed that the concentrations of manganese, aluminum, sodium and potassium were particularly high as compared to some other elements detected. The level of potassium in samples GG, H, J and JJ were below the detection limit of the instrument. Notwithstanding this outcome, there were rather higher levels in some samples. For 21.40± 6.69, 22.70± 4.81, 23.66± 10.64, 34.00± 5.26 and 23.66± 5.47 were detected for the samples A, AA, CC, I and II respectively.

Again, from the results obtained from the analysis by neutron activation, the presence of mercury and arsenic which are considered toxic were detected. But surprisingly, their levels were below the detection limit of the instrument.

CONCLUSION

The analysis of heavy metals such as As, Fe, Zn, Cr, Co, Mn, Cd, Cu and Pb in some selected blood tonics were performed by the use of an atomic absorption spectroscopy and a nuclear activation reactor after digestion with nitric acid. The use of standard reference materials were employed to increase the reliability of the procedure.

From the result of the analysis, particularly that of the nuclear reactor show higher concentration of elements normally considered as non essential or toxic. Elements such as potassium, sodium, manganese and calcium were found to be high. Nevertheless, their presence in these blood tonics cannot be said to pose any health implications.

The levels of these metals detected were found to be higher from one part of the two geographical jurisdictions. Samples that were collected from the north of the main Tema motorway were found to contain higher concentration of the metals as against the samples collected from the south. Emphasis should be made that the concentration of the metals found in the blood tonics with regards to this work were well below the recommended maximum limits by World Health Organization (WHO).

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