SOME GHANAIAN HERBAL BLOOD TONICS AS SOURCES OF IRON AND OTHER TRACE ELEMENTS (Cu, Zn, Mn, Cd, Pb)

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ABSTRACT
Iron deficiency anaemia constitutes about 80 percent of all anaemia cases in developing countries. In Ghana, the 2003 Demographic and Health Survey reported anaemia prevalence of 67% for urban residents. Anaemia and loss of appetite are the common indications included in the consumer information on the labels on bottles of the numerous Ghanaian herbal blood tonics sold in retail pharmacy and chemical shops. In this study, ten brands of commonly advertised herbal blood tonics on the Ghanaian market were assessed for the levels of iron and other trace elements, wavelength of maximum absorption (λmax), pH, salinity and total dissolved solids (TDS). These physico-chemical parameters were determined using a UNICAM 929 atomic absorption spectrophotometer, CECIL 8000 uv-visible spectrophotometer, JENWAY 3020 pH meter and LF538 conductivity meter. Maximum estimated daily dosages of less than 1 mg/day of iron was obtained for all the herbal tonics, except the Madam Catherine brand which had 2.17 mg, compared with the required daily intake of 10 – 15 mg. The tonics also appear to be poor sources of the essential metals determined. Cd was detected in Adutwumwaa, Madam Catherine and Top tonics, while Pb was detected in Amingya iron tonic and Madam Catherine; but the levels of these toxic metals will not exceed the recommended safety standards, if the manufacturer's dosages are adhered to.

Keywords: *Iron-deficiency anaemia, herbal tonics, herbal remedies, toxic metals, .*

INTRODUCTION

The popularity of Ghanaian herbal blood tonics could be seen in the incredible number of these products found in chemical shops, and increasingly, on shelves of a large number of retail pharmacy shops in Ghana. This trend may be due to the affordability of these products and the aggressive advertising campaign on the claims of potency of these tonics by manufacturers; using delivery/retail vans with public address systems in the market places and electronic and print media. The common indications that run through Ghanaian herbal blood tonics, which are not used

to treat specific illness, are anaemia and loss of appetite.

Iron deficiency anaemia, afflicts about two-thirds of children and women of child-bearing age in developing nations (West, 1996). Ghana Demographic and Health Survey (2003) reported 67% anaemia prevalence for urban residents. Current estimates for anaemia in developing and developed countries respectively are: for pregnant women, 56 and 18%; school children, 53 and 9%; preschool children, 42 and 17%; and men, 33 and 5% (WHO, 2000). The WHO has suggested the following classification of countries with respect to the level of public health significance of anaemia: a prevalence of <15% is "low", 15- 40% is "medium" and >40% is "high" (ACC/SCN, 2001). Iron deficiency anaemia, which constitutes about 80% of all anaemia cases, affects majority of individuals in many developing countries because the diets in these countries are largely vegetarian. The vegetarian diet is not by choice but because meat, poultry, fish etc., with high iron (haeme iron) are too expensive for most people to afford (Yip and Dallman, 1996).

Blood loss caused by heavy menstrual blood flow, intestinal and blood-borne parasitic infections and malaria are other common causes of anaemia among poor populations (Okochi *et al.,* 2003; ACC/SCN, 2001).

The consequences of severe iron deficiency are decreased learning ability, stamina/work performance, and resistance to disease. However, many people with mild iron deficiency experience no obvious problems, other than vague symptoms of tiredness, headache, irritability, or depression. Iron-deficiency anaemia is also accompanied by high morbidity and mortality especially among children aged two years and below and among pregnant women (Wardlaw, 1999).

The adult recommended daily intake (RDI) for iron is 10 mg/day for men and 15 mg/ day for women (Ivery and Elmen, 1986). However, where dietary sources of iron are not enough for the management of iron deficiency anaemia, medicinal forms of iron, such as ferrous sulphate, need to be ingested. In adults, 150 to 200 mg/day of iron for 4 to 6 months is usually the initial treatment dose, and 3 mg/kg body weight per day is usually a starting point for infants (Ivery and Elmen, 1986).

Most literate consumers of the herbal medicine who are dissatisfied with modern healthcare system equate "natural" with "safe." Generally, evidence supporting an image of safety of herbal medicine is normally based on an apparent absence, even after prolonged use, of reported adverse effects or harmful constituents (Hegarty and Hegarty, 2001).

The safety, efficacy and quality control of herbal medicinal products are of major concern for governments, consumers, manufacturers and physicians. In Ghana, the Food and Drugs Board (FDB) is empowered by law to ensure that herbal medicines are safe, of good quality and effective (Ministry of Health, 2004). With respect to safety, what has raised concern are contaminants such as synthetic pharmaceuticals (especially prohibited ones), heavy metals, pesticides, fumigation agents, microbial toxins, micro-organisms, toxic botanicals and animal substances (De Smet, 1999). However in respect of efficacy data for product registration, only evidence of long use with minimum side effects is required (Ivery and Elmen, 1986).

Some attempts have been made in assessing the status of trace elements in medicinal plants (Lesniewicz *et al,* 2006; Divrikli *et al,* 2006; Ajasa *et al.,* 2004; Serfer-Armah *et al.,* 2002; and Varitika *et al.,* 2001; Abou-Arab *et al.,* 1999; and Kabelitz, 1998). Standardization of herbal medicines is the best guarantee that a product contains what it is supposed to contain in amounts sufficient to produce desired effects. However, the lack of national standards complicates the assessment of the safety and effectiveness of herbal preparations. There is therefore, the need for specifications regarding the efficacy, quality and safety of Ghanaian herbal products, setting up of

appropriate pharmacopoeia, development of baseline data on quality and "fingerprints" of Ghanaian herbal preparations.

This study will assess some of the advertised/used herbal blood tonics on the Ghanaian market to ascertain whether or not the estimated daily iron ingested using manufacturers' dosage recommendations merit their use in the treatment of iron deficiency anaemia. The levels of essential metals (zinc, copper, magnesium and manganese) in the tonics, extent of toxic heavy metal contamination (cadmium and lead) and the characteristic uv-visible spectra and other physical parameters as "finger-prints" for the tonics will also be determined.

MATERIALS AND METHODS

Sample collection

Ten brands of commonly advertised/used herbal blood tonics in 250-350 ml bottles sold on the Ghanaian market were obtained for this study from chemical shops, retail pharmacy shops and delivery vans in Kumasi, Ghana. The tonics were Abrewa Bɛbɔbɔɔl, Adutwumwaa, Amingya iron tonic, Blowman tonic, Class tonic, Fralena tonic, Hayaat, Madam Catherine, Mighty Power, and Top tonic. Two over-the- counter iron supplements, Supervitone and Vatalife tonic were also analyzed for comparison. Table 1 gives the ingredients and indications (as stated on the labels on the bottles) of the Ghanaian herbal tonics used in this work.

Table 1: Composition and indications on the labels on the bottles of tonics

Sample	Ingredients	Indications
Abrewa Bɛbɔ bɔɔl	*Anthocleista nobilis, Combretodendron macrocarpus, Khaya senegalensis, Ricinodenron heudelotil,* Sorghum bicolor	Rheumatism, anaemia, menstrual disorder, loss of appetite, general disorder, piles and fever.
Adutwumuwaa	Mahogany, honey, fruits and vitamins	Loss of appetite, general weakness and anaemia.
Amingya Iron Tonic	*Terminalia ivorensis* – 25%, *Anthocleista nobilis* -30%, *Khaya ivorensis* -15%, *Pycenthus angolensis* – 20%	Protect, restore and maintain excellent and active iron mineral in the blood; recommended for pregnant women, children, adults, stroke patients and elders.
Blowman Tonic	*Khaya senegalensis, Clausena anisata Xylopia aethiopica, Aframum melegueta, Ziginber officinale, Monodora myristica*	Anaemia, asthmatic condition, blood purification.
Class Tonic	*Khaya senegalensis, Kigelia africana, Monodora myrustica,* preservative	Loss of appetite, anaemia and general body weakness.
Fralena	*Khaya Ivorensis, Ficus Capensis, Pycenthus angolensis*	Anaemia and loss of appetite.
Hayaat	*Terminal ivorensis, Cassia alata, Khaya ivorensis, Engemia species, Aframimum malegeta,* honey	Anaemia, malnutrition, rheumatism, bodily pains, loss of appetite, menstrual disorder and general weakness.
Madam Catherine	*Carica papaya, Musa sapientum,* Glycine max, sucrose, *molasses, belladonna, sepia, Nat mur* and natural mint	A safe naturopathic preparation extracted from vegetables, fruits herbs other natural resources, containing iron, multivitamins, minerals, glucose, electrolytes, and other heal -giving homeopathic therapy for cases of anaemia, malnutrition, menstrual disorder, loss of appetite, pregnancy, convalescence, malaria, fevers and general debility

Table 1: Composition and indications on the labels on the bottles of tonics. Cont'd

Sample	Ingredients	Indications
Mighty Power	Black cohosh root -17%, Red ginseng root – 11%, Rosemary - 5%, Ginger - 2%, Pure honey - 30%, Purified water - 35%	Sexual weakness, waist and back pains, hair loss, blood purification, poor vision, dizziness and numbness.
Supervitone[+]	Vitamin B_1 – 1.5 mg, Vitamin B_2 – 0.75 mg, Vitamin B_4 – 2.25 mg, Vitamin B_{12} – 0.0075 mg, Vitamin C – 22.5 mg, Vitamin D – 3 mg, Ferrous Fumarate – 45 mg, Dessicated liver extract – 15 mg, Calcium Gluconate – 75 mg	Rich tonic syrup for vitality and energy.
Top Tonic	Dumdum, Mahogany, Nyamedua	Anaemia, purification of blood, Menstrual disorder, gonorrhea and body itching.
Vitalife Tonic[+]	Vitamin B_1 BP – 5.0 mg, Vitamin B_2 BP – 2.0 mg, Vitamin B_6 BP – 2.2 mg, Nicotinamide – 20.0 mg Calcium Pantothenate BP – 10.0 mg , Sodium Glycerolphosphate solution 50% -60.0 mg, Magnesium sulphate – 4.0 mg Ferric Ammonium citrate BP 50.0 mg, Citric Acid BP – 57.0 mg, Liver extract BP – 0.52 ml	Anaemia

[+]*Over the counter iron supplement*

Reagents

All reagents used were of analytical reagent grade (BDH Chemicals Ltd, Poole, England). Double distilled water was used for preparation of all solutions. The metal standard solutions used for the calibration were prepared by diluting stock (BDH) solutions of 1000 mgL^{-1} of Fe, Mn, Cu, Mg, Zn, Cd and Pb.

Herbal tonic samples preparation and digestion

The bottles of herbal blood tonics were shaken thoroughly before they were opened and used. Aliquots of the samples were taken and digested promptly. Ten (10) ml of each sample was pipetted into a 50 ml beaker and 25 ml of concentrated nitric acid was added slowly. After swirling gently, 3 ml of perchloric acid was added to it and the mixture was heated at 100^{o}C until it turned clear (in 30 minutes). The beaker containing the colourless solution was then removed and cooled. The content of the beaker was carefully transferred into a 50 ml volumetric flask and diluted to the mark with distilled water, for subsequent determination of metal (Fe, Mn, Cu, Mg, Zn, Cd and Pd) concentration levels. For each run, a duplicate sample, and a blank were carried through the same procedure.

Chemical and physical analysis of herbal tonic samples

A UNICAM 929 atomic absorption spectrophotometer (AAS) was used to determine the metal (Fe, Mn, Cu, Mg, Zn, Cd and Pd) concentrations by direct aspiration of the digested sample solutions into the air/acetylene flame. The blanks and calibration standard solutions were also analysed as the digested sample solutions, and calibration curves constructed. The pH meter, JENWAY 3020 model was calibrated and used for pH determination of the freshly opened samples. The Conductivity meter LF538 was calibrated and used in the determination of total dissolved solid (TDS), conductivity, salinity and temperature of the

freshly opened samples. Samples were taken in duplicate. The UV-Visible scan was carried out on freshly opened samples in diluted sample to water ratio of 0.5 ml : 100 ml using a CECIL 8000 UV-Visible Spectrophotometer.

Determination of recovery

The recovery test of the analytical procedure was performed for some of the investigated metals (cadmium and zinc) in selected samples by spiking analysed samples with aliquots of metal (BDH) standards and then digested. The sample solutions were then analyzed by AAS. Acceptable recoveries (>85 percent) were obtained for the analyte ions.

RESULTS AND DISCUSSION

All the herbal tonics studied contained Fe, Mg, Mn, Zn and Cu, which are essential elements needed by the human body (Ivery and Elman, 1986). Table 2 shows concentrations of iron and other trace metals in the blood tonics, and it appears that generally, the different batches of the same herbal tonic had comparable elemental composition. The iron levels found in Supervitone and Vatalife (Table 2), which are between 15 – 131 times that of the herbal tonics, are characteristic of over the counter blood tonics. Figure 1 and Table 3 present the maximum daily intake of the elements calculated on the basis of their levels in the products and their recommended dosage of the herbal products (Table 2).

The major function of iron is formation of haemoglobin and other key compounds used for respiration. Iron is needed for immune function and it also plays a role in drug-detoxification pathways (Ivery and Elman, 1986). In this work the amount of iron from the herbal blood tonics that might be ingested by consumers based on the manufacturers' recommended dosages were estimated to be between 0.43 mg/day for Fralena and 2.17 mg/day for Madam Catherine (Table 3). Thus using an RDI of 10 mg/day, the herbal products had estimated iron of 5 - 23 times below the recommended daily intake (RDI). Due to the likely non compliance that will occur as a result of the 2 – 3 tablespoonfuls, 3 times daily dosage, the estimated iron intake from these herbal tonics in Table 3, appears to be a reasonable upper limit. There is therefore no basis for Amingya iron tonic (Table 3) to be labelled as such. Iron absorption in phytotherapeutic treatment of anaemia is less effective than that of animal source (haeme iron), which makes the use of these herbal tonics (non haeme source) in the treatment of iron deficiency anaemia less efficacious. However, plants' sources have the advantage of being usually accompanied by minerals, and many vitamins, including organic acids such as vitamin C which promotes the absorption of the non-haeme iron in vegetables by reducing Fe^{3+} to Fe^{2+} and the subsequent chelation (Ivery and Elman, 1986).

The significantly low iron levels in these Ghanaian herbal tonics used in treating anaemia are not peculiar, because, Chinese prescribed herbal tonics for blood loss are also poor in iron (Dharmananda, 2003); despite the general popularity and acceptance of Chinese herbs. This does not suggest that herbs cannot be rich sources of iron, because spirulina, which is a vegetable, is especially rich in iron, with 5.3 mg per 100g of edible product which compares with 2 – 3 and 11 mg per 100g contained in meat and liver respectively. Availability of iron from spirulina fed to rats is comparable to rats being fed standard ferrous sulphate (Kapoor *et al*., 1993).

A study of the effects of diet preparation of *Telfaria occidentalis* on some haematological indices of male albino rats (Okochi *et al.,* 2003) showed dose-dependent increases in all the measured haematological indices (packed cell volume, haemoglobin concentration, red and white blood cell counts). Tetteh (1997) in an 84-day haematological and histopathological studies on rabbits also found Madam Catherine, one of the herbal blood tonics in this work, to be haematinic and non-toxic. Consequently, the low levels of iron found in Madam Catherine in this study suggest the possible role of some organic constituents of these herbal blood tonics, in the stimulation of blood production.

Table 2: Average concentrations of some essential and toxic metals in the blood tonics

Sample	Batch NO	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)	Mg (ppm)	Cd (ppm)	Pb (ppm)	Daily Total Dosage (ml)
Abrewa Bebɔ bɔɔl	02	1.47 ±0.00 (3)	0.38 ±0.00 (3)	0.31 ±0.01(3)	BDL	5.42 ±0.00 (3)	BDL	BDL	90
Adutwumuwaa	00/02	1.47 ±0.00 (3)	0.46 ±0.01(3)	0.24 ±0.00(3)	0.05 ±0.00 (3)	15.20 ±0.00 (3)	0.01±0.00(3)	BDL	90
Amingya iron Tonic	3	1.12 ±0.02(3)	0.38 ±0.05(3)	0.38 ±0.05 (3)	BDL	6.5 ±0.05 (3)	BDL	0.08±0.05(3)	90
Blowman Tonic	F30048	1.55±0.01 (3)	0.16 ±0.01(3)	0.33 ±0.00(3)	BDL	14.50 ±0.01 (3)	BDL	BDL	90
Class Tonic	T6/03/MX3	2.03 ± 0.00(3)	0.23 ±0.00 (3)	0.27 ±0.00(3)	0.07 ±0.00 (3)	13.00 ±0.00 (3)	BDL	BDL	45
Class Tonic	T11/11/MX3	2.04±0.05 (3)	0.21 ±0.00 (3)	0.26 ±0.00(3)	0.07 ±0.00 (3)	13.63 ±0.00 (3)	BDL	BDL	45
Fralena	1003FHP03	0.96 ±0.07 (3)	1.15 ±0.06(3)	0.16 ±0.06(3)	0.06 ±0.00 (3)	49.45±0.07(3)	BDL	BDL	90
Fralena	1006FHP03	0.92 ±0.03 (3)	1.14 ±.0.00 (3)	0.14 ±.0.00(3)	0.05±.0.01(3)	49.51±0.03(3)	BDL	BDL	90
Hayaat	101	1.66 ±0.01 (3)	0.07 ±0.07 (3)	0.63 ±0.07(3)	BDL	23.65±0.02 (3)	BDL	BDL	90
Hayaat	102	1.71 ±0.04 (3)	0.06 ±0.00 (3)	0.61±0.00(3)	BDL	23.61±0.04 (3)	BDL	BDL	90
Madam Catherine	03-Apr	4.84 ±0.00 (3)	0.05 ±0.01(3)	0.9 ±0.00(3)	0.02 ±0.00 (3)	1.60±0.00 (3)	0.02±0.00(3)	0.09±0.00(3)	90
Madam Catherine	03-Sep	4.83 ±0.00 (3)	0.06 ±0.00 (3)	0.04 ±0.00 (3)	0.02 ±0.00 (3)	1.28 ±0.03 (3)	BDL	0.09±0.00(3)	90
Mighty Power	DVL00106	1.02 ±0.00 (3)	0.18 ±0.01(3)	0.08 ±0.01 (3)	0.03 ±0.01 (3)	16.92 ±0.00 (3)	BDL	BDL	90
Mighty Power	DVL00105	1.02 ±0.00 (3)	0.12 ±0.04(3)	0.08 ±0.00 (3)	0.04 ±0.00 (3)	16.71 ±0.05 (3)	BDL	BDL	90
Supervitone	845703	121.05±0.00(3)	6.22 ±0.02 (3)	0.3 ±0.00 (3)	BDL	9.38 ±0.00 (3)	BDL	BDL	45
Supervitone	745703	121 ±0.07 (3)	5.86 ±0.10 (3)	0.25 ±0.00 (3)	0.02 ±0.00 (3)	9.38 ±0.18 (3)	BDL	BDL	45
Top Tonic	103	2.00 ±0.00 (3)	0.49 ±0.00(3)	0.32 ±0.01 (3)	0.02 ±0.01 (3)	21.00 ±0.00 (3)	0.01±0.00(3)	BDL	90
Vitalife Tonic	V201	73.54 ±0.00 (3)	0.62 ± 0.01(3)	0.37 ±0.00 (3)	0.07 ±0.01 (3)	1.28 ±0.07 (3)	BDL	BDL	60

BDL : Below detection limit

± (X) : ± is the standard deviation; X is the number of bottles analysed.

The first line of conventional treatment of iron deficiency anaemia is through the oral treatment with medicinal forms of ferrous salts such as ferrous sulphate, fumarate and gluconate, at initial adult dosages of 150 to 200 mg/day. Consequently, the use of the herbal tonics by local people for the treatment of iron-deficiency anaemia may not be appropriate since the iron levels found

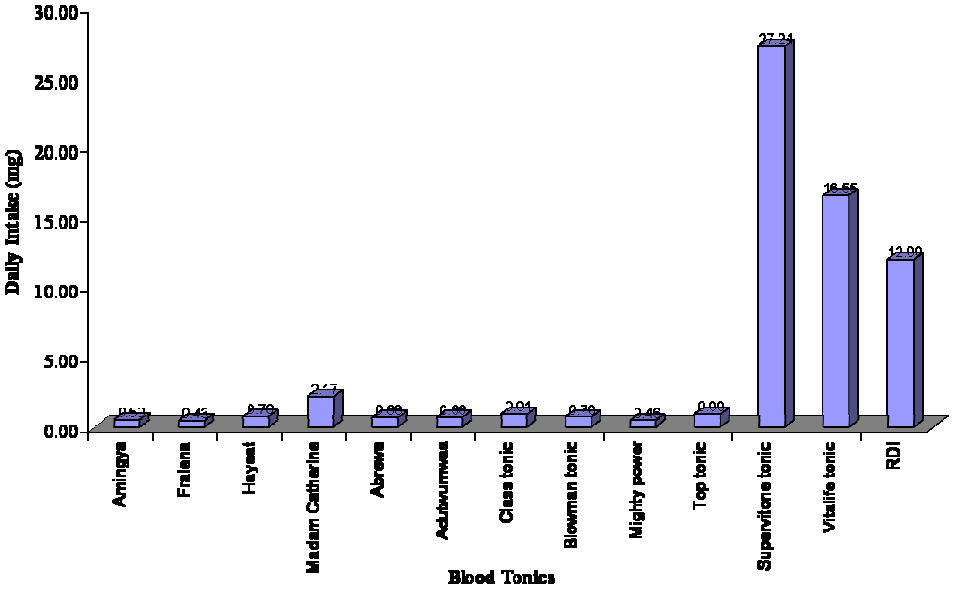

Figure 1. Estimated Maximum Daily Intake of Iron in Some Blood Tonics

Table 3: Estimated daily intake of essential and toxic metals in blood tonics (mg/daily)

Sample	Fe	Mn	Zn	Cu	Mg	Cd	Pb
Abrewa Bɛbɔbɔɔl	0.66	0.17	0.14	BDL	2.44	BDL	BDL
Adutwumwaa	0.66	0.21	0.11	0.02	6.84	0.004	BDL
Amingya iron tonic	0.50	0.17	0.17	BDL	2.92	BDL	0.04
Blowman tonic	0.70	0.07	0.15	BDL	6.52	BDL	BDL
Class tonic	0.91	0.05	0.12	0.02	2.92	BDL	BDL
Fralena	0.43	0.52	0.07	0.03	22.25	BDL	BDL
Hayaat	0.76	0.03	0.27	BDL	17.19	BDL	BDL
Madam Catherine	2.17	0.02	0.40	0.01	0.72	0.01	0.04
Mighty power	0.46	0.08	0.04	0.01	7.61	BDL	BDL
Supervitone tonic+	27.24	1.40	0.07	0.01	2.09	BDL	BDL
Top tonic	0.90	0.22	0.14	0.01	9.45	0.004	BDL
Vitalife tonic+	16.55	0.14	0.08	1.59	0.28	BDL	BDL
RDI	10-15	2-5	12-15	1.5-3.0	280-350	0.06	0.21

RDI: Required daily intake
BDL: Below detection limit
+ Over the counter iron supplement

were too low, compared with the recommended levels. The elderly often experience decreased production of stomach acid, which can lower their iron absorption (Wardlaw, 1999). Thus, it appears that the elderly who suffer from iron deficiency are not likely to benefit from phyto-therapeutic treatment with these herbal tonics.

Magnesium which is an important mineral in connection with circulatory diseases and calcium metabolism in the bone is the element of the highest concentration in all the herbal tonics. Its estimated intake ranged from 0.72 mg/day for Madam Catherine to 22.25 mg/day for Fralena. Generally, the levels of magnesium found in the tonics confirm the herbal nature of the tonics, since magnesium is found mostly in the plant pigment chlorophyll, an important Mg-complex used during photosynthesis in plants. However, these apparently high concentrations of Mg were generally found to be below 8 mg/day (except in Fralena and Hayaat which are estimated to be above 17 mg/day) and do not meet the RDI of 280 - 350 mg/day. Zinc functions as a cofactor for more than 300 enzymes that are important for growth, sexual development, immune function, wound healing, and taste sensation (Prasad, 1995). The estimated zinc intake of 0.04 – 0.40 mg/day in the herbal tonics is far below 12-15 mg/day RDI. Copper which aids iron metabolism, and manganese which aids the action of some enzymes such as those involved in carbohydrate metabolism and bone formation, appears to be low in the herbal tonics, with estimated intake of below detection limit and 0.03 mg/day, and 0.02 – 0.52 mg/day for copper and manganese respectively (Table 3). These concentrations of copper and manganese are very low, compared with the RDIs of 1.5 - 3.0 mg/ day and 2.0 - 5.0 mg/day respectively.

Lead and cadmium accumulate in body tissue because the body excretes them slowly (Hamilton and O'Flaherty, 1995; Godt *et al.,* 2006). The presence of cadmium and lead in herbal remedies can pose clinically relevant problems (De Smet, 1999). Cadmium has been found to decrease iron absorption and metabolism (Peraza *et al.,* 1998). In a recent study of herbal samples collected in India (Ernst, 2002), significant amounts of toxic metals were found; the percentages of samples with toxic metals were 64 for lead, 64 for mercury, 41 for arsenic, and 9 for cadmium. Cadmium was detected in three of the preparations in this study; the highest intake of 0.01 mg/day in Madam Catherine, and the lowest of 0.004 mg/ day found in Adutwumwaa and Top tonic. Lead was found at a level of 0.04 mg/day in two (Amingya and Madam Catherine) out of the ten herbal tonics studied (Table 2). The potential of exposure to these toxic metals from this work, compared with the provisional tolerable daily intake values of 0.06 mg /day and 0.21 mg /day for cadmium and lead respectively (FAO/WHO, 1993) shows that if taken as recommended by the manufacturers, most of the herbal products would not significantly contribute to exposure of cadmium and lead, while those with these metals cannot reach toxicity levels.

Attempt at exploring the possible uniqueness of physical parameters as a means of standardization ("finger-print") of tonics is shown in the preliminary results presented in Table 4. The pH measurement (Table 4) gave a range of 2.0 – 8.0; five of the herbal tonics Adutwumwaa, Blowman, Hayaat, Madam Catherine and Mighty Power tonics studied were found to be outside the recommended acceptable pH limits of herbal preparations for internal use, which is 4.0 – 7.0 (Ministry of Health, 2004). The two over the counter irons supplements Supervitone and Vatalife tonic were also found to be outside the recommended acceptable pH range.

The comparatively high salinity for Hayaat and Madam Catherine (Table 4) suggests the likely high concentration of sodium ions in these products, which hypertensive patients should be mindful of.

Different batches of the same herbal tonic appeared to have the same UV λ_{max} but the other physical parameters were found to be the same

Table 4: Physical properties of the blood tonics

Sample	Batch No	Sal.	TDS mg/l	Temp °C	pH	UV Measurements (nm
Abrewa Bɛbɔbɔɔl	O2	5.5	403	24.1	6.7	190, 200*
Adutwumuwaa	00/02	2.4	202	23.5	3.7	180, 190, 197*
Amingya	3	4.2	321	23.5	6.2	196*, 274
Blowman Tonic	F30048	4.7	466	26.4	3.7	202*
Class Tonic	T11/11/MX3	3.4	261	25.0	6.1	190, 201*
Class Tonic	T6/03/MX3	6.1	527	24.1	6.2	190, 201*
Fralena	1003FHP03	4.9	336	23.6	5.9	109, 197*, 222
Fralena	1006FHP03	5.7	398	25.2	6.2	109, 197*, 222
Hayaat	101	24.7	1821	24.1	8.0	190, 192*, 207, 220
Madam Catherine	03-Apr	18.2	1280	24.4	8.0	196*, 222, 282
Madam Catherine	03-Sep	18.4	1421	23.7	7.5	196*, 222, 282
Mighty Power	DVL00106	1.1	413	23.8	2.0	194, 212, 224, 281*, 300
Mighty Power	DVL00105	1.2	513	25.2	2.1	194, 212, 224, 281*, 300
Supervitone^{+}	845703	2.7	1159	25.1	3.9	199*, 222, 230, 280
Supervitone^{+}	745703	2.7	391	25.2	2.5	199*, 222, 230, 280
Top Tonic	103	4.6	352	24.8	4.3	190, 200*
Vitalife Tonic^{+}	V201	8.3	739	23.5	3.2	197*, 255

* : λ_{max}
Sal. : salinity
TDS: Total dissolved solids
$^{+}$ *: over the counter iron supplement*

only in few instances (Table 4). These might be due to poor quality control measures during formulation and processing of the tonics or the different sources of wild-harvested plant raw materials in the formulation. Generally, the constituents of herbal preparations and quality have been found to be influenced by factors such as the genetics of the herbs, the use of fresh plants, temperature, light exposure, water availability, nutrients, period and time of collection, drying, packaging, storage and transportation of raw material, age and part of the plant collected, method of extraction and contamination with microorganisms, heavy metals, pesticides, among others (Calixto, 2000).

CONCLUSION

The maximum estimated intakes of the ten (10) commonly advertised/used herbal blood tonics studied are not more than 2.2 mg/day, compared with the RDI of 10 – 15 mg/day and the 150-200 mg/day required for the treatment of iron deficiency anaemia. Consequently, the intake of iron supplements might be appropriate for the users of these herbal tonics in the treatment of iron deficiency anaemia. These Ghanaian herbal tonics also appear to be poor sources of essential elements (Mg, Cu, Zn and Mn) studied. Cadmium (Cd) was detected in Adutwumwaa, Madam Catherine and Top tonic, while lead (Pb) was detected in Amingya iron tonic and Madam Catherine; but the levels of these toxic metals found will not exceed the recommended safety standard if manufacturer's dosages are adhered to. The different batches of the same tonic were found to be comparable only in trace metals composition and UV λ_{max} values.

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