Original Research Article

Heavy Metals Analysis of Selected Analgesic Syrups in Ibadan, Nigeria.

ABSTRACT

Some heavy metals have bio-importance as trace elements but the biotoxic effects of many of them in human biochemistry are of great concern. Hence, there is a need for proper understanding of mechanism involved, such as the concentrations and oxidation states, which make them harmful. This study determined the physical parameters and the concentrations of some heavy metals (Ni, Cd, Cr, Zn, Pb, Hg, and Ca) in some analgesic syrups. The heavy metals presence in the syrups were estimated by Atomic Absorption Spectroscopy after digestion. The physical parameters showed that the syrups are of red colour, which had a clear solution with sweet tastes. They also gave different pH and density range values. The level of nickel in the samples ranges from 0.49mg/l to 4.12mg/l, cadmium concentration ranges from 1.1mg/l to 3.5mg/l and chromium ranges from 0.04mg/l to 0.49mg/l. The concentration of zinc ranged from 0.04mg/l to 0.67mg/l, lead ranged from -0.1mg/l to 0.7mg/l and mercury concentration ranges from 0.23mg/l to 0.91mg/l. Calcium concentration was not detected in the four samples studied. The concentrations of the studied metals were lower than the W.H.O standard limits, hence the studied syrups are safe for human consumption.

Key words:*Heavy metals, Analgesic Syrup, Toxic effect, Human health*

1. INTRODUCTION

Metals are substances with high electrical conductivity, malleability, and luster, which voluntarily lose their electrons to form cations. Metals are found naturally in the earth's crust and their compositions vary among different localities, resulting in spatial variations of surrounding concentrations. The metal distribution in the atmosphere is monitored by the properties of the given metal and by various environmental factors [1].

Heavy metals are generally referred to as those metals which possess a specific density of more than 5 g/cm^3 and adversely affect the environment and living organisms [2]. These metals are quintessential to maintain various biochemical and physiological functions in living organisms when in very low concentrations, however they become noxious when they exceed certain threshold concentrations. Although it is acknowledged that heavy metals have many adverse health effects and last for a long period of time, heavy metal exposure continues and is increasing in many parts of the world. Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons [3]; [4]. The most commonly found heavy metals in waste water include arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment [5]. Heavy metals enter the surroundings by natural means and through human activities. Various sources of heavy metals include soil erosion, natural weathering of the earth's crust, mining, industrial effluents, urban runoff, sewage discharge, insect or disease control agents applied to crops, and many others [6]. In general, the toxicity of heavy metal ions to mammalians systems is due to chemical reactivity of the ions with cellular structural proteins, enzymes and membrane system. The target organs of specific metal toxicities are usually those organs that accumulate the highest concentrations of the metal in vivo. This is often dependent on the route of exposure and the chemical compound of the heavy metal i.e. its valiancy state, volatility, lipid solubility etc. The target organs and clinical manifestations of chronic exposures to the metal are given in Table 1. Besides the general toxicities of metals, we are today also concerned with the potential carcinogenicity of metal compounds. Certain metals such as chromium and nickel have been linked with cancers in exposed human populations.

Metals have been shown to causes acute as well as chronic poisoning in man and other experimental animals. Harmful effects of individual metals are presented briefly below.

Table 1: Clinical Aspects of Chronic Toxicities

Metal	Target Organs	Primary Sources	Clinical effects
Arsenic	Pulmonary Nervous System, Skin	Industrial Dusts, Medicinal Uses Of Polluted Water	Perforation of Nasal Septum, Respiratory Cancer, Peripheral Neuropathy: Dermatomes, Skin, Cancer
Cadmium	Renal, Skeletal Pulmonary	Industrial Dust And Fumes And Polluted Water And Food	Proteinuria, Glucosuria, Osteomalacia, Aminoaciduria, Emphysemia
Chromium	Pulmonary	Industrial Dust And Fumes And Polluted Food	Ulcer, Perforation of Nasal Septum, Respiratory Cancer
Manganese	Nervous System	Industrial Dust And Fumes	Central And Peripheral Neuropathies

Analgesic syrups are group of drugs such as Paracetamol and Ibuprofen that reduces pain without inducing unconsciousness. Paracetamol N-(4-hydroxphenylacetamide) is usually simply abbreviated as APAP, for N-acetyl Para-aminophenol often more commonly known by its alternative name acetaminophen, it is widely used for management of pain and fever in a variety of patients including children, [7]. Ibuprofen, a 2-proprionic acid derivative discovered by the research arm of the British Boots Group in the 1960s, is a peripherally acting analgesic with a potent anti-inflammatory action that works through a reversible and balanced COX-1/COX-2 inhibition. Ibuprofen exists as a racemic mixture of both R (-) and S (+) enantiomers, and its anti-inflammatory, analgesic and anti-platelet effects (determined by cyclooxygenase inhibition) are related to the S (+) enantiomer. By contrast R (-) ibuprofen is less active as a prostaglandin (PG) synthesis inhibitor but has shown some pharmacological properties relevant to the anti-inflammatory actions of ibuprofen (28). However, 50-60% of the R (-) - form of ibuprofen is metabolically converted to the S (+) form in the intestinal tract and liver after oral absorption [8]. Some oral pharmaceutical drugs, if stored in a favorable environment, can serve as nutrients source for microorganisms. Humidity and high amount of sugar in the oral- liquid drugs -in particular can support the microbial growth. Oral liquid drug formulations such as aqueous solutions, suspensions, emulsions and syrups used in pediatrics are at a more risk of microbial contamination during use due to sweetening

agents, reconstitution methods, unsuitable storage and handling defects. Microbial contaminations may ultimately contribute to secondary bacterial infections in pediatric patients [9].

Heavy metal analysis of some selected soft drinks in Nigeria was studied by [10]. It revealed that 60% of the selected beverages mostly taken by children and young adults in Nigeria have either/both lead and arsenic levels above the recommended limits while 10% of the samples have both lead and cadmium concentrations above the limits. All sampled beverages had acceptable zinc, copper and iron concentration when compared with WHO limits.

Determination of selected heavy metal concentrations in an oil palm plantation soil was carried out by [11]. From the study, the soil from the oil palm plantation does not indicate seriouspollution problem. The concentration of heavy metals in soil was mainly from natural sources such as windblown dust and derivative of rock and soil. However, the application of chemical fertilizer in the oil palm soil will increase the level of heavy metal, unless it is controlled. Cu concentration in soil samples was dominant and perhaps related to the application of chemical fertilizer. The amount of chemical fertilizers that are applied to the oil palm should be controlled to avoid soil toxicity.

Assessment of Heavy Metal Pollution in a Gold Mining Site in Southwestern Nigeria was done by [12]. From the study, the concentration levels of heavy of metals (Zn, As, Cd, Pb, Ni, Cr, and Cu) in the soil and plants samples from Ijana mining site were generally low and found to be within the World Health Organization (WHO) permissible levels. This could probably be due to the fact that most mining operations in the site are low scale and artisanal in operation unlike other sites where mechanized mining techniques could predispose release of more pollutants and tailings.

The present study was to determine the level of zinc, nickel, chromium, mercury, lead, calcium and cadmium found in some brands of analgesic syrups marketed in Ibadan, Oyo state, Nigeria. The study also helped to know if the various syrups are within W.H.O. standard limits for human consumption.

2. MATERIALS AND METHODS

2.1. Samples collection

Five samples of analgesic syrups of five companies having different manufacturing dates were collected from various retail pharmacies in Ibadan, Oyo state, Nigeria and labeled with the code A, B, C, D, and E. The sample syrups were stored at conditions similar to those of pharmaceutical shops. Absorption Spectrophotometer (AAS) was used to determine the heavy metal contents of this analgesic syrups.

2.2.Physical Analysis of Sample

The color was assessed in each sample by visual examination, whereas the taste was evaluated by using the appropriate, relevant sense organs. The pH value was measured once by a Metrohm pH meter

instrument (Switzerland) model (827pH Lab). The density measured by density instrument (Mettler Toledo, Japan) model (DA-100M) [13].

2.3. Preparation of Sample

Digestion of Sample

Two ml (2ml) of each sample was weighed into a 250ml beaker, 10ml mixture of nitric acid and hydrochloric acid in a ratio of 1:3 was added. The solution was then heated on hot plate in a fume cupboard until a brown dense fume was observed. The solution was allowed to cool after which 10ml of 30% hydrogen peroxide solution was added. The solution was then filtered into a 100ml volumetric flask and made up to the mark with distilled water.

Analysis of Heavy Metals

The concentration of the heavy metals like Cadmium (Cd), Lead(Pb), Zinc (Zn), Mercury (Hg), Calcium (Ca), Nickel (Ni), Chromium (Cr) in digested syrups were analyzed using Smart spectrophotometer.

3.0. RESULTS AND DISCUSSION

3.1. Physical Parameters of the Sample

In this study, the results showed that the analgesic syrup samples appearance were light red with a sweet taste, and this agreement with [8].

Liquid preparations for oral use may contain suitable excipients such as stabilizing, flavoring and sweetening agents and coloring matter, authorized by the competent authority [13].

From the results of Table 2, the pH value results were within the acceptable range according to [13] standards.

The density results in the analgesic syrup samples were 1.149–1.184 g/ml. The density of a substance is the ratio of its mass to its volume at 20°C.

Table 2: Physical parameters of the different brands of the analgesic syrups.

Code	Name of Sample	Colour	Description	Taste	pH	Density (g/mL)
A	PANADOL SYRUP	Red	Clear Solution	Sweet	4.62 – 4.70	1.18 – 184
B	BONABE SYRUP	Red	Clear Solution	Sweet	5.61 – 5.67	1.15 – 1.16
C	PARACETAMOL SYRUP	Red	Clear Solution	Sweet	4.44 – 4.48	1.15 – 1.16
D	IBUPROFEN SUSPENSION	Red	Clear Solution	Sweet	5.81 – 5.88	1.15 – 1.15
E	REXIFEN SUSPENSION	Red	Clear Solution	Sweet	5.71 – 5.92	1.14 – 1.15

3.2. Concentration of Heavy Metals in the Sample

The concentrations of all the metals studied in the five analgesic syrups are presented in Table 3. The concentration of nickel in the samples ranges from 0.49mg/l to 4.12mg/l, cadmium concentration ranges from 1.1mg/l to 3.5mg/l and chromium ranged from 0.04mg/l to 0.49mg/l. The concentration of zinc ranges from 0.04mg/l to 0.67mg/l, lead concentration ranges from -0.1mg/l to 0.7mg/l and mercury ranges from 0.23mg/l to 0.91mg/l. The level of calcium is 62.0mg/l in Bonababe syrup and not detected in other syrups.

Bonabe Syrup has the lowest concentration of nickel while the concentration of nickel in Paracetamol syrup is higher. Also, cadmium concentration is very high in Ibuprofen suspension and lowest in Bonababe syrup. Chromium concentrations is higher in Panadol syrup and lower in Bonababe syrup as well as zinc concentrations is higher in Panadol syrup and also lower in Bonababe syrup. Lead concentration is negative in Bonababe syrup and Panadol syrup which means lead is very harmful and the concentration of mercury is higher in Panadol syrup and lower in Paracetamol syrup. Calcium was not detected in Rexifen suspension, Panadol syrup, Ibuprofen suspension and Paracetamol. The concentrations of the studied metals were lower than the WHO standard limits. Hence the studied syrups are safe for human consumption.

Table 3: The concentration of heavy metals in five different analgesic syrups

Code	Name of Sample	Ni (mg/l)	Cd (mg/l)	Cr (mg/l)	Zn (mg/l)	Pb (mg/l)	Hg (mg/l)	Ca (mg/l)
A	PANADOL SYRUP	0.94	1.8	0.49	0.67	-0.1	0.91	ND
B	BONABE SYRUP	0.49	1.1	0.04	0.04	-0.2	0.55	62.0
C	PARACETAMOL SYRUP	4.12	1.3	0.24	0.15	0.7	0.23	ND
D	IBUPROFEN SUSPENSION	0.60	3.5	0.18	0.15	0.3	0.36	ND
E	REXIFEN SUSPENSION	2.60	1.7	0.31	0.48	0.2	0.54	ND

4. CONCLUSION

The heavy metal level determined was based on the digested syrup samples. Levels of Nickel and Cadmium were observed to be highest for the samples, while the level of Lead appears to be lowest in the samples. Calcium was not detected in four (4) of the samples. The physical analysis done also showed that all the syrups are red in colour, having a sweet taste and are of clear solution. Heavy metals have a deleterious effect on human beings, Lead Pb, being a serious cumulative body poison enters into the body system through air, water and food. Also, the pH values feel within thespecifications for a product to be passed. Therefore, the selected analgesic syrups are very suitable for infant consumption.

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