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Assessment of Trace Metals in Imported Cosmetics marketed in Nigeria

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Abstract
This work is aimed at investigating the levels of some trace metals in make-up items mainly imported into Nigeria. Ten different make-up items were analyzed for seven trace metals. Atomic adsorption Spectrophotometer (AAS) was used to quantify the presence of these heavy metals. The trace metals analyzed included Zn, Cr, Co, Cd, Mn, Pb, and Ni. The concentration of Zn (0.6866 mg/Kg) was found to be the highest in sample I followed by Mn with (0. 5485 mg/Kg) while Cr in sample C and F, and Cd in sample A where below detectable limit. These heavy metals were found to be within safe limits of Health Canada, The Japanese Standards of Cosmetic Ingredients (JSCI), FDA and The European Cosmetics Directive for healthy cosmetics free of trace metals toxicity.
Keywords: Trace metals, Imported, Nigeria, AAS, limit, and FDA.

1.0 INTRODUCTION

Cosmetic products Include skin creams, lotions, perfumes, lipsticks, fingernail polishes, eye and facial make-up preparations, shampoos, permanent waves, hair colours, toothpastes, deodorants and any material intended for use as a component of a cosmetic product [1] or any of the several preparations (excluding soap) applied to the human body for beautifying, preserving, or altering the appearance or for cleansing, colouring, conditioning, or protecting the skin, hair, nails, lips, eyes, or teeth[2]. Humans have used cosmetics for thousands of years. Although beauty consciousness of people has set the demand of cosmetics in market and as the issue of heavy metals as deliberate cosmetic ingredients has been addressed, attention of clinicians and researchers turn to the presence of these substances as impurities and their toxic effects[3]. In recent years there has been growing consumer concern that cosmetics may contain harmful levels of toxic substances. For example, in 2007 the Campaign for Safe Cosmetics published a report drawing attention to the lead content in lipsticks and lip glosses and in 2009 and 2011 the Food and Drug Administration (FDA) published its own findings on lead in lipsticks [4, 5]. The concern about the physiological and behavioral effects of trace metals in human population is very well known. The toxicity of Pb at high levels of exposure is equally well known, but a major concern of today is the possibility that continual exposure to relatively low levels of lead may also entail adverse health effects [6, 7, and 8]. Lead and cadmium are two potentially harmful metals that have aroused considerable concern. In fact, lead has been described as the most severe environmental contaminant to arise in human civilization [5 and 9]. Lead is considered the most dangerous due to the extent that it is distributed in the make-up items as a polluting element. Lead impairs the renal, homopoietic and nervous system and reports of various surveys suggest that Pb is causally related to deficiency in cognitive functioning [10, 11, and 12].

According to Health Canada, 100% of all cosmetics product tested positive for nickel and over 90% tested positive for both lead and beryllium and on the average contained at least 4 of the 8 metals of concern (arsenic, cadmium, lead, mercury, beryllium, nickel, selenium, and thallium) [13 and 14]. The complications of these products can be serious. Some studies have documented an association between some ingredients of cosmetics and various health problems [13]. Women are at greater health risk in developing countries due to inadequate nutrition, unhealthy lifestyle, and environmental deterioration [14]. Physiological changes also can alter the bioaccumulation pattern of these metals in female body. Most of the metals act as endocrine disrupters interfering with the female hormonal system [16].

Heavy metals like lead and cadmium are common contaminant in various cosmetic products. However, other metals of primary toxicological concern in cosmetics are: arsenic, mercury and antimony [17, 18]. Lead and cadmium are two potentially harmful metals that have aroused considerable concern. In fact, lead has been described as the most severe environmental contaminant to arise in human civilization [19]. Lead poisoning has been a recognized health hazard for more than 2,000 years. Characteristic features of lead toxicity, including anemia, colic, neuropathy, nephropathy, sterility and coma. Exposure to low-levels of lead has also been associated with behavioral abnormalities, learning impairment, decreased hearing, and impaired cognitive functions in humans and in experimental animals [20, 21]. Research has established that lead can cross the placenta during pregnancy and has being associated with intra uterine fetal death, premature delivery and low birth weight [22].

Lead poisoning, especially among children can lead to damages of the central nervous system, causing mental impairment, affecting oxygen transport in the body and causing digestive problems, long term exposure to lead

can cause coma, or death [23]. Lead is a poisonous metal that can damage nervous connections especially in young children and cause blood and brain disorders. [23]. Exposure to high cadmium levels may result in a disease known as osteoporosis [24]. Cadmium target blood vessel and heart tissue as well as the kidneys, lungs, and brain, and results in heart disease, hypertension, liver damage, and suppressed immune system. Cadmium also causes bone degradation because it affects calcium metabolism [25]. Ingestion of nickel may cause hyperglyanemia, depression of the central nervous system and kidney damage [26]. Nickel metal is frequently responsible for allergic skin reactions and has been reported to be one of the most common causes of allergic contact dermatitis (ACD) as reflected by positive dermal patch tests. Nickel dermatitis produces erythema, eczema and lichenification of the hands and other areas of the skin [27].

The increasing daily use of various cosmetics products for beautification and treatment made it necessary for studies into the trace metal content of these imported cosmetic products. This study tried to establish the existence and levels of trace metals in various imported cosmetic products available locally.

2.0 MATERIALS AND METHODS

Ten Samples of different imported make-up (cosmetics) items were purchased randomly from the Sabon-Gari Market in Zaria, North western Nigeria for analysis, all of which were within shelf life. These samples are registered and considered wholesome. They are as given below in table 1. The samples were coded for easy identification. Samples were air dried to constant weight then 1g of each sample was digested using standard methods. Atomic absorption spectrophotometer modeled AA 6800; SHIDMAZU was used to analyze the concentration of the trace metals Zn, Cr, Co, Cd, Mg, Pb, and Ni in the samples. Appropriate quality assurance procedures and precaution were carried out to ensure reliability of the results.

Table 1. Samples with their Codes

S. No	Samples	Codes
1	Eye shadow	A
2	Lip/Eye liner Pencil	B
3	Foundation	C
4	Eye Liner Liquid	D
5	Eye Liner	E
6	Lip Stick	F
7	Kohl (tozali)	G
8	Lip gloss	H
9	White powder	I
10	Red powder	J

3.0 RESULTS

Table 2. Concentration of trace metals in (mg/Kg)

S.No	Samples	Zn	Cr	Co	Cd	Mn	Pb	Ni
1	A	0.0254	0.0013	0.0374	0	0.4464	0.1023	0.0079
2	B	0.1280	0.0005	0.0259	0.0009	0.5845	0.3240	0.0148
3	C	0.0438	0	0.0621	0.0010	0.1358	0.0227	0.0082
4	D	0.0213	0.0055	0.0265	0.0036	0.0213	0.0853	0.0080
5	E	0.0388	0.0060	0.0380	0.0021	0.1649	0.0569	0.0064
6	F	0.0387	0	0.0121	0.0021	0.0427	0.1308	0.0098
7	G	0.0454	0.0108	0.0133	0.0017	0.0483	0.1137	0.0114
8	H	0.0166	0.0010	0.0121	0.0032	0.0412	0.0739	0.0082
9	I	0.6866	0.0131	0.0283	0.0021	0.3755	0.0796	0.0066
10	J	0.4507	0.0018	0.0175	0.0026	0.5730	0.1137	0.0138

4.0 DISCUSSIONS

The distribution of trace metals in the cosmetics analyzed is shown in Table 2. The results obtained from this study show variations in the concentrations of heavy metals in the samples of cosmetics analyzed. Even though a high value of Zinc was obtained especially in sample I, Zinc just like Iron is not of toxicological significance [30]. Iron compounds have an established role as colorants in many cosmetic products. Evidence shows that in addition to its importance as an essential nutrient necessary for oxygen metabolism and mitochondrial function,

Fe exhibits a functional importance as a trace metal in the normal growth and functional maturation of the skin [10]. Thus the observed high values of Zn metal may not indicate any present possible health hazard. A high level of Zn (35.8%) was also reported in ornamental lead which women use to adorn their eye lashes in Nigeria [29]. The levels recorded for Zn may be due to the fact that a reasonable amount of zinc is needed to prevent dandruff.

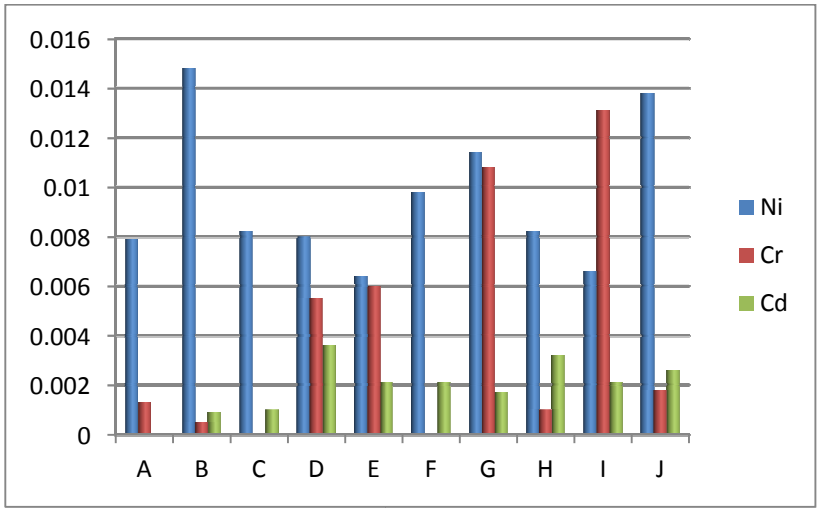

Figure 1. Distribution of Ni, Cr, Cd metals

As can seen from figure 1, Chromium concentrations in each of the samples analyzed were all detected except in samples C and D which were below the detectable limit of 0.001 mg/Kg. Since there are no available internationally acceptable maximum limits for these elements including Co, Mn, and Ni in cosmetic products [30]. However, exposure over long periods might cause accumulation of the elements in the body and even at low concentration some metals could initiate allergic reactions. Among the known allergenic metals (Cu, Cr, Ni, and Co) Ni and Co was detected in all the analyzed samples (100%) and Cr was detected in 80% of the samples.

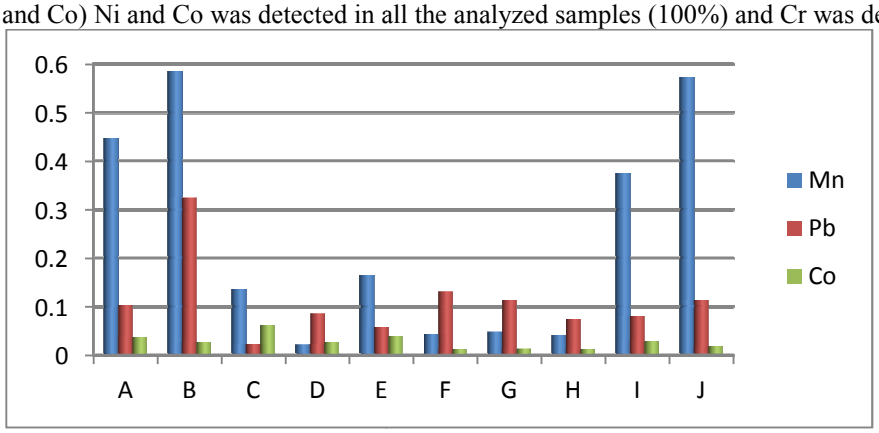

Figure 2. Distribution for Mn, Pb, Co metals.

The concentration of Pb ranged between 0.0064-0.0148 mg/Kg in all sample. This reasonably falls within safety gap as provided by the German safe maximum permissible limit of lead in cosmetics [28]. Cadmium with a maximum limit of 3 mg/Kg according to Health Canada indicates the samples are safe of any Cd toxicity. Compared to other similar studies conducted, the quantity of this trace metals was not found to significant enough to cause health hazards. In Ghana [30] and Jordan [31] studies reveal trace metals present in various cosmetics products are within safe limit of the various standard organization bodies and therefore safe for use. However, there is the fear that these metal will accumulate over long period of usage of these products. This study shows the trace metals analyzed to be within safe limits set for their presence in cosmetics by various International standard organisations. However, more research is needed to actually ascertain the effect these product have on the body after long periods of Usage these cosmetics products.

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