



## Safety evaluation of metal exposure from commonly used moisturizing and skin-lightening creams in Nigeria



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### ABSTRACT

The concentrations of ten metals (Cd, Pb, Ni, Cr, Cu, Co, Fe, Mn, Zn and Al) were measured in some commonly used moisturizing and skin-lightening creams in Nigeria with a view to providing information on the risk of exposure to metals from the use of these products. The metal concentrations in these products were measured by atomic absorption spectrometry after acid digestion of the samples. The measured concentrations of metals in the skin moisturizing creams ranged from <0.15 to 6.3 µg/g Cd, <0.02 to 17.5 µg/g Cu, 2.25 to 6.25 µg/g Cr, <0.25 to 124.3 µg/g Al, 0.2 to 7.3 µg/g Pb, <0.03 to 10.7 µg/g Ni, 17.3 to 372.0 µg/g Zn, <0.02 to 1.0 µg/g Co, 17.75 to 28.8 µg/g Mn, <0.1 to 89.8 µg/g Fe while the concentrations of metals in the skin-lightening products ranged from <0.15 to 16.5 µg/g Cd, <0.02 to 10.0 µg/g Cu, 4.25 to 8.0 µg/g Cr, <0.25 to 128.0 µg/g Al, 0.5 to 4.5 µg/g Pb, <0.03 to 1.65 µg/g Ni, 24.7 to 267.5 µg/g Zn, <0.02 to 2.5 µg/g for Co, 19.3 to 31.8 µg/g Mn, 9.5 to 211.63 µg/g Fe. In a significant number (>93%) of the samples investigated the concentrations of Pb, Cd, Ni and Co were below the specified limit, or the maximal limit for impurities in colour additives in cosmetics for external use. However, Cr was found at concentrations above the allergenic limit of 1 µg/g. The results also showed that skin-lightening creams contained higher concentrations of the studied metals than the moisturizing creams, except for Ni, which indicates that persons who uses skin-lightening creams in preference to moisturizing ones, are exposed to higher concentrations of metals.

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### 1. Introduction

The use of cosmetics as a part of routine body care is as old as man. The demand for cosmetic products across the globe has increased rapidly because of the increasing awareness of the need for beautification of the human body (Ullah et al., 2013) and due to the sharp rise of product advertisements in the mass media (Gondal et al., 2010). Despite the high global demand for cosmetic products, the safety of these products is of major concern and has attracted the attention of researchers, toxicologists, as well as regulatory agencies, with a common goal to ensure safe levels of the ingredients in the products (Linsey and Milnes, 2011; Al-Saleh and Al-Enazi, 2011). Modern brands of cosmetics are

being manufactured from natural products as well as synthesized products. The active ingredients of cosmetic products depend on the specific use of these products. Some of the components of these cosmetics are inadvertent, in that they are not meant to be used, such as some toxic metals and other elements, which are found in cosmetic products as a result of the manufacturing process. On the other hand, some metals are intentionally used as ingredients of cosmetics as exemplified by the use of inorganic mercury compounds in whitening creams and tattoo inks, and lead acetate in progressive hair dyes (Ababneh et al., 2013; Omolaoye et al., 2010). The intentional use of metals as active ingredients in cosmetic products is prohibited in most countries of the world due to their toxic and persistent nature, but these substances are still found in today's cosmetic products as a result of contamination during the production process. Annex II of the directive 76/768/EEC listed more than 1000 chemical substances which must not form part of the composition of cosmetic products due to their

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toxicological profiles. According to this Annex, metals such as antimony (Sb), arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), mercury (Hg), nickel (Ni) and lead (Pb) are prohibited ingredients in cosmetics because they are considered unsafe.

The use of cosmetic products could represent a possible source of population-wide daily and often long-term exposure to a variety of chemicals (Piccinini et al., 2013). Most of these cosmetic products are applied directly to human skin. While skin serves as a protective barrier against the external environment, some of the ingredients in cosmetic products can penetrate the skin and reach vital internal organs via the systemic circulation (Gondal et al., 2010) where they can exhibit short- and long-term toxicities. The exposure scenarios of cosmetics may vary from one product type to another. In some instances, the cosmetics are rinsed shortly after application (e.g., shampoos, hair relaxers, aftershaves, tooth-pastes), while in other cases, the products are “left on” (e.g., body creams, deodorants, nail polish) and may remain in contact with the skin for several hours or even days (e.g., nail polish). Unlike other cosmetic products that are applied to restricted parts of the body, body creams are applied to the entire body surface of humans thereby making exposure to contaminants in these products much greater.

Exposure to low concentrations of Pb can cause disorders such as behavioural abnormalities, decreased learning and hearing, permanent neurological damage, and may have adverse effects on the reproductive, hepatic and renal systems. Cadmium is a cell poison, which causes different types of damage, including cell death or an increase in cell proliferation. For this reason, the International Agency for Research on Cancer (IARC) has categorized Cd as a group 2A carcinogen (WHO, 2004). Other metals such as Ni, Cr, Fe, Mn, Zn and Al are essential to humans since they are involved in many biological processes, even though, there are still some controversies surrounding Cr. For example, iron is important in oxygen transport and storage, electron transport, in hydrogenase and many other redox active enzymes, while manganese is present in superoxide dismutases as well as catalases. Cobalt is a component of vitamin B12 which is essential for many processes including various rearrangement and methylation reactions. Copper is essential for electron transfer (azurin and plastocyanin), oxygen atom transfer (e.g., oxygenases), and respiration (cytochrome C oxidase). Nickel is essential for the function of acetyl coenzyme synthase, urease, and many hydrogenases. Zinc plays important roles in many enzymes including carbonic anhydrase and a group of proteases, such as carboxypeptidase A. Zinc is involved in the transfer of genetic information through the zinc finger protein (Ababneh et al., 2013). Despite the importance of these metals to humans and other organisms, the presence of some of these metals in cosmetic products constitutes a serious health challenge, one of which is allergy. Nickel, chromium and cobalt are well known allergens, while copper, manganese and zinc are regarded as weak allergens.

The objective of this study was to determine the concentrations of metals in some popular types of moisturizing and skin-lightening creams in Nigeria with a view to providing information on the health hazards associated with the use of these cosmetic products.

## 2. Materials and methods

### 2.1. Samples and sample collection

Samples of commonly used body creams (that is, moisturizing and skin-lightening creams) were purchased from markets in Abraka, Warri, Benin-City and Lagos, Nigeria. A total of 60 brands were collected; these included brands manufactured in Nigeria as well as those imported from other countries. The choice of brands was carefully made to reflect the brands used by different income

classes. Within each type or brand, a total of 5 samples with different batch numbers and dates of manufacture were collected in order to study the variations in elemental concentrations within a particular brand. The studied samples were within their specified usage periods (shelf-life). Information regarding the creams analyzed and their country of origin is displayed in Table 1.

**Table 1**  
Information regarding the sampled body creams and skin-lighteners.

Brand name	Colour	Country of origin
<i>Body creams</i>		
Familia cream	White	Togo
Dove body cream	White	UK
Zenon cocoa butter	Yellow	Nigeria
5 ways body cream	Light pink	China
Swiss collagen	Pink	Switzerland
Venus lotion	Light pink	Nigeria
Passion body lotion	White	Nigeria
Estee skin care	Light pink	Nigeria
Balilla beauty cream	White	Nigeria
Body treat cream	Light pink	Nigeria
Cussion body lotion	White	Nigeria
Looking good body cream	Light pink	Nigeria
Vaseline lotion for men	White	Argentina
Tony montana	White	Nigeria
Revion body lotion	White	Spain
Jergens body lotion	White	USA
te' body line lotion	White	Nigeria
Vanilla essence lotion	White	England
Pears lotion	Pink	Nigeria
Aloe vera lotion	White	USA
Active woman cream	White	USA
Forever living product with aloe vera lotion	White	USA
Rejuvenating cream	White	South Africa
Nivea body lotion with almond oil	White	Thailand
Queen Elizabeth cocoa butter	Light orange	Cote d' Ivoire
One love body cream	White	Nigeria
Pears moisturizing cream	White	Nigeria
Skin success lotion	White	Nigeria
Nivea body lotion	White	Spain
Imperio affection lotion	Lemon green	Nigeria
<i>Skin lighteners</i>		
Lightening body lotion	White	China
Peau claire	White	Abidjan
Miss caroline	White	China
Otentika	White	Switzerland
Maxi light	White	Cote d' Ivoire
Tempovate gel	White	Indonesia
Visita plus	White	Nigeria
Diva	White	Abidjan
Pure skin	Light pink	Cote d' Ivoire
Lait edguard	White	Cote d' Ivoire
Carotone nature	White	Ghana
Swiss collagen	White	USA
H <sub>2</sub> O jours	White	Abidjan
Body white	White	Cote d' Ivoire
Total claire	White	Cote d' Ivoire
Carotone white	White	Paris
Dermatone	White	Ghana
Epiderm creme	White	Togo
Glow and white	White	Cote d' Ivoire
Skin white	White	Philippines
Dawmy	Milky white	Cote d' Ivoire
Skin light	White	Cote d' Ivoire
Idole	White	Spain
Precious skin	White	Nigeria
Carrot oil	White	DR Congo
G & G	White	Paris
Fair and white	White	France
Erato	White	Nigeria
Skineal	White	China
Doctor clear	White	Cote d' Ivoire

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