



Levels of Cd, Cr, Cu, Ni, Zn, As and Pb in Some Cosmetic Products in Jimeta – Yola Modern Market, Adamawa State, Nigeria

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ABSTRACT: Elevated concentration of heavy metals in cosmetics and toiletries is known to cause heavy metal toxicity to humans. In this work, the concentration of Cd, Cr, Cu, Ni, Zn, As, Pb obtained from selected cosmetic products sold in Jimeta – Yola modern market, Adamawa State, Nigeria were evaluated by analyzing sixteen (16) cosmetic products using the buck scientific atomic absorption spectrophotometer, model 210 VGP. Results showed that the presence of Cd, Cr, Cu, Ni, Zn, As, Pb in all the products analyzed range from 0.001 – 3.456 ppm. The data revealed that these metals were present in low quantities, however, prolonged use of these products could result in increased metal-burden through bioaccumulation and pose human health risk.

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Cosmetics are a combination of surfactants, oils and other ingredients meant to have stable, safe and long lasting effect for human use in external body parts mainly for the purpose of cleaning, perfuming, protection, changing their appearance, correcting body odours and keeping the surfaces in good condition (Oyedemi *et al.*, 2011). The products are known to constitute one important source via which toxic heavy metals are released into the environment and the human body system, necessitating the continuous investigation and monitoring of the levels of these heavy metals in cosmetic products. The use and demand for cosmetic products from around the world and in particular, Nigeria, has increased rapidly due to the growing awareness of the need for beauty and care of the human body (Ullah *et al.*, 2017; Gondal *et al.*, 2010). Along with the high global demand for these products is a great concern, even with regulation, for the safety of users and the environment and has attracted the attention of researchers, toxicologists and

regulators, with the common objective of ensuring the safety levels of ingredients in products (Al-Enazi, *et al.*, 2011). Cosmetics are commonly available in form of creams, lip sticks, powder, nail polish, perfumes and eye shadows amongst several others and are reported to contain significant levels of heavy metals (Nnorom *et al.*, 2005; Abdul Kader, 2019). The metals implicated for toxicological effects in cosmetics are lead, arsenic, cadmium, mercury, chromium and antimony (Sainio, 2000; Hamad, 2023) and are associated with varying degrees of human health hazards, ranging from poisoning, organ dysfunctions, infertility and miscarriage, cancers, dermatitis, anemia and nausea amongst others (Nibras and Huda, 2014; Ramakant *et al.*, 2014; Health Canada, 2010) and therefore present general negative health concerns. Some studies conducted to assess the levels of some heavy metals in a large number of eye shadows, lip sticks, creams and other cosmetic products elsewhere and in Nigeria were reported to contain varying amounts of heavy metals

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high enough to cause allergic symptoms and other disease conditions (Adepoju, *et al*, 2012; Suleiman and Labaran, 2017; Prakash and Manjushree, 2019; Sumiyani *et al*, 2021). In another report, females, being more accustomed to cosmetics use, are said to be at greater health risk in developing countries due to poor nutrition and unhealthy lifestyle (Prakash and Manjushree, 2019). If this statement is anything to go by, then users of these products in Nigeria and in particular Adamawa state, being one of the poorest states with low capacity of living, are indeed endangered species. To the best of our knowledge, there are no known reports in scientific literatures about the levels of these heavy metals in cosmetics in our study location, meaning that users are largely ignorant of the health hazards of these products and therefore at high risk. This forms the basis of our motivation for this work, hence the objective of this work was to evaluate the levels of Cd, Cr, Cu, Ni, Zn,

AS And Pb in some cosmetic products commonly sold in Jimeta–Yola modern market, Adamawa State, Nigeria

MATERIALS AND METHODS

Sample Collection: Sixteen (16) samples including both foreign and local in form of lotions, creams, powders and foundations were purchased from various shops from Jimeta-modern market in Yola. It was ensured that the selected samples were representatives of the most available, popular and commonly used product types. The samples were of different qualities and popular brands with different price ranges from expensive products and cheap products. The samples were collected in duplicates from the markets and stored at room temperature before further processing and analysis. They are presented in table 1.

Table 1: Brand Name and Country of Cosmetics.

Powders		Creams		Lotions		Foundation	
Name	Country	Name	Country	Name	Country	Name	Country
Imman Powder	USA	Mass Lovely	Nigeria	Perfect Whitelotion	London	Green Teapowder	China
Top Black Powder	Nigeria	Coco Belle	Nigeria	Lilies Lotion	France	Tara Powder	Nigeria
Bbalovera	PRC	White Tone	Nigeria	Silver Line	Italy	HD Blossom Powder	China
Skin Naturelle	Nigeria	Aloe Vera	Nigeria	Caro Fresh	Nigeria	HD Lucent	China

Sample Preparation

Preparation for Powders: the powders were prepared by dry ashing according to methods reported by Avenimo *et al*, 2010; Saeed *et al*, 2011 and Papadopoulos *et al.*, 2022. Exactly 3.0 g each of powders were weighed into a porcelain crucible and dry-ashed in a muffle furnace by stepwise increase of the temperature up to 550 °c for 2 h. the ashed samples were digested with a 5 ml of IM HNO₃ and then evaporated close to dryness on a hot plate in a fume hood. They were allowed to cool, filtered through Whatmann no. 42 filter paper and were diluted up to the mark (100 ml) into a calibrated flask.

Preparation for Creams: the creams were prepared by wet digestion following the method reported by Theresa *et al*, 2011. exactly 3.0 g creams were wet digested with a 4:1 mixture of nitric acid (65%) and perchloric acid (70%) on a hot plate in a fume hood near to dryness by slowly increasing the temperature for 3hr. the procedure was repeated through addition of mixture of acid by slow and continuous heating until the evolution of white fumes, indicating the end of the digestion process, and near to dryness. the solutions were allowed to cool, filtered by whatmann no. 42 into a calibrated flask (100 ml), and were diluted up to the mark with distilled water.

Preparation for lotions and foundations: the lotions and foundations were equally prepared by dry ashing according to methods reported by Avenimo *et al*, 2010 and Saeed *et al*, 2011. Papadopoulos *et al.*, 2022). Exactly 3.0 g each of powders were weighed into a porcelain crucible and dry-ashed in a muffle furnace by stepwise increase of the temperature up to 550 °c for 2 h. the ashed samples were digested with a 5 ml of IM HNO₃ and then evaporated close to dryness on a hot plate in a fume hood. They were allowed to cool, filtered through whatmann no. 42 filter paper and were diluted up to the mark (100 ml) into a calibrated flask.

Analysis: The prepared product samples were analyzed for their heavy metal contents according to standard methods using the buck scientific atomic absorption spectrophotometer, model 210 VGP. (Saeed *et al.*, 2011; Ayenimo *et al.*, 2010; Amartey *et al.*, 2011),

RESULTS AND DISCUSSION

Heavy Metal Concentrations in Cosmetic Products: Cosmetic products are known to constitute one important source via which toxic heavy metals are released into the environment and the human body

system. Wastes from these products are indiscriminately dumped in the environment and the heavy metal contents are deposited as pollutants in the water bodies, soils and plants thereby creating negative imbalances in ecosystem equilibrium. There is also a growing concern about the physiological and behavioral effects of these toxic metals in general on the human body. The metals implicated for toxicological effects in cosmetics are lead, arsenic, cadmium, mercury, chromium and antimony (Sainio, 2000) and are associated with varying degrees of human health hazards, ranging from poisoning, organ dysfunctions, infertility and miscarriage, cancers,

dermatitis, anemia and nausea amongst others (Nibras and Huda, 2014., 2010; Ramakant *et al.*, 2014; Health Canada, 2010). The mean values of the seven heavy metals (Cd, Pb, Cr, As, Cu, Ni and Zn) analyzed in the 16 cosmetic products in Jimeta - modern market are presented in table 2. Cadmium was found in 15 out of the 16 products that were analyzed with the highest concentration in skin natural body lotion with 1.422ppm and least concentration in aloe Vera cream with 0.027ppm as shown in table 2. The maximum value exceeds son permissible limit of 0.30 ppm. it is used as pigment, which is deep yellow to orange, in skin lightening creams.

Table 2: Heavy Metal Concentrations of Cosmetic Products

Products	Heavy Metal Concentrations (Ppm)						
	Cd	Pb	Cr	As	Cu	Ni	Zn
Iman Powder	0.520	0.061	0.725	0.320	0.226	1.825	0.651
Top Black Powder	0.321	0.043	0.575	0.563	0.311	1.297	0.481
B.B Aloe vera	1.105	0.086	1.232	0.624	2.144	3.456	1.376
Skin Naturelle	1.422	0.092	0.206	0.432	1.844	2.633	1.222
Mass Lovely	0.225	0.070	0.844	0.151	1.396	1.185	0.937
Coco Belle	0.701	0.087	1.278	0.235	1.934	1.619	0.711
White Tone	0.442	0.135	0.637	0.437	0.280	3.192	0.384
Aloe vera	0.027	0.001	0.000	0.002	0.772	0.443	0.620
Green Tea Powder	0.323	0.039	0.645	0.182	0.482	0.649	0.333
Tara Powder	0.184	0.014	0.805	0.255	0.316	0.450	0.564
HD Blossom Powder	0.730	0.067	1.084	0.057	0.712	0.900	0.427
HD Lucent	0.819	0.043	1.427	0.092	1.278	1.092	0.508
Perfect White Lotion	1.240	0.080	0.337	0.037	0.566	0.864	0.742
Lilies Lotion	0.378	0.024	0.510	0.000	0.862	0.418	0.675
Silver Line	0.006	0.000	0.279	0.000	0.223	0.054	0.433
Caro Fresh	0.042	0.002	0.125	0.000	0.458	0.021	0.131

Entry via ingestion, inhalation and adsorption of cadmium into the skin is reported to cause anemia, birth defect, impairment of pulmonary function, renal dysfunction, liver damage and bone change (Jin-lin *et al.*, 2013). Lead is used as a preservative in cosmetic products and is one of the most harmful metals for which presence is a source of concern. it was found in all but one of the samples, which is silver line body cream. It was in higher concentration in white tone with 0.135 ppm and least in aloe Vera cream with 0.01ppm as in the table. This value is lower than the 0.34 ppm reported by Morshed *et al.* (2019) and within the permissible limit based on son standard of 10.0ppm. lead like any other metal can accumulate in the body over time through inhalation or ingestion that results to health issues like hypertension, kidney damage, anemia, miscarriage, disruption of the nervous system, brain damage, infertility, intellectual disorder and allergies (Morshed *et al.*, 2019). Chromium was present in 15 out of the 16 products and was the highest metal content in four of the products. In HD lucent foundation, it was found at 1.427ppm, 1.278ppm in coco belle 1.232ppm in bb aloe Vera foundation and 1.084ppm in HD blossom foundation and was completely absent in aloe Vera cream as shown in the table. The concentration of

chromium in all the samples falls within the permissible standards of son which is 5.0ppm. Chromium is used in cosmetics as a pigment. its inhalation causes irritation to the lining of the nose, nose ulcer, running nose, breathing problems such as asthma, coughing, shortness of breath or wheezing. Skin contact with cr causes ulcers, allergic reaction and bioaccumulation due to long term use is reported to cause damage to liver and circulatory and nerve tissues as well as skin irritation (WHO, 2011). Arsenic was detected in 13 samples at varying concentrations, with the highest concentration of 0.624 ppm in bb aloe Vera and least in aloe Vera body cream with 0.02 ppm as presented in the table. The highest value is lower than the 0.34 ppm reported by Morshed *et al.* (2019). Arsenic is used in cosmetics as a preservative and a colorant. Its adverse effects occur due to its undegradable and destructive nature and is said to be carcinogenic, mutagenic or teratogenic, causing damage to blood composition, lungs and kidney. Copper was detected in all the 16 samples that were analyzed. Comparing the concentration of heavy metals in each cosmetic, cu was one of the metals detected with high concentration in 6 of the samples ranging from 2.144 ppm in bb aloe Vera foundation to 0.223 ppm in silver line cream as shown in the table.

Copper is mostly used as a dye for coloration in cosmetics. Symptoms like hyper chronic anemia, leukopenia, normocytic are indications of its deficiency in humans while long term exposure to excessive levels is said to result in liver and kidney damage, immunotoxicity and oxidative damage of the macromolecules and membrane (Adepoju *et al* 2005). Nickel which is mostly used as skin lightening agent was found in all the samples with the highest concentrations in 6 products. In BB aloe Vera, 3.456 ppm, white tone, 3.192 ppm and 2.633 ppm in skin naturelle, and the least concentration of 0.021 ppm in caro fresh body cream. nickel is said to be a primary source of allergic reaction and hand eczema, occurring more frequent in women than men due to their love for and constant exposure to cosmetics and accessories (Orish *et.,al*,2013). Zinc was detected in varying concentrations in all the samples ranging from 1.376 ppm in bb aloe vera, 1.222 ppm in skin naturelle, and caro fresh with the least with 0.131 ppm as in the table. Toxicity is rare but at high concentration can lead to stomach ache, cramps, anemia, vomiting, nausea, and general discomfort. it is used in cosmetics as sunscreen an also in lightening the skin. It maintains the skin nutritional requirements as it helps eliminate stretch marks on the skin (Health Canada, 2009). The low levels of these metals in the products corroborate the fact that their presence is not deliberate as ingredients but as impurities from raw materials (Nibras and Huda, 2014). as a result they are not usually listed on labels as required by law and therefore may not be seen as potential sources of these heavy metals but only be noticed when the damage is done. Since the culprit is the raw material used, manufactures should be mandated to place labels or statements of quality certification of raw materials to ensure product compliance and reduce health risk associated with these heavy metals, especially in developing and poor nations like Nigeria as poverty is said to enhance susceptibility. Since cosmetic products are considered as source of heavy metals, the continued deposition and accumulation of these products as wastes in the environment could lead to heavy metal contamination resulting in pollution that may alter normal behavioral patterns in the ecosystem. Therefore the continuous monitoring of cosmetic products sold in the market square for these metals cannot be over emphasized, giving the adverse effects of these metals on human health and the environment. The data will enable government agencies, ngos, researchers and other regulatory bodies to create awareness, monitor and enforce control usage of these products to mitigate negative health implications and even discourage public patronage. Although environmental sites around the study area were not assayed for these metals, it is obvious that domestic waste products from

cosmetics add up to the buildup of solid wastes which end up in the environment and therefore are equally a source of concern. this is more pertinent as solid waste dump sites are littered all over many metropolitan cities with poor sanitary policies that could enhance leaching and percolation of heavy metals into the ground, polluting soil and water during raining season or incineration of the waste, generating combustion products leading to air pollution.

Conclusion: From the results above, the concentrations of the heavy metals analyzed in most of the products were present in low quantities. In conclusion however, prolonged use of these products will guaranty bioaccumulation in the body and the environment and may be hazardous since the metal components are responsible for many disease conditions in humans. It is herein recommended that the social and health implications of using these cosmetics in Jimeta-Yola on humans be monitored on a regular basis as control measures.

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