



ASSESSMENT OF SOME HEAVY METALS IN SELECTED COSMETICS AND THEIR HUMAN HEALTH EFFECT



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Abstract

This study focused on the assessment of some toxic heavy metals Pb, Hg, Zn, Cd, Cu and Ni found in Carotone, Caro white, Skin light, Peau clair, Perfect white, Pure white, Miss Caroline, Sivo clair, Top white and Nature white cream samples. The instrument used to determine the heavy metals was Atomic Absorption Spectroscopy and the results obtained showed the concentration in mg/Kg of heavy metals in various samples of cosmetics ranges from Hg (10.53-138.87), Zn (9.67-35.23), Pb (6.87- 49.47), Ni (0.56 - 92.17), Cd (8.0-27.57) and Cu (0.6-171.23). The results showed that the highest concentration of Hg, 137.87 mg/kg was found in skin light and none concentration 0.00 mg/kg was found in Carotone, Sivo clair and Nature white. The highest concentration of Zn, 35.23 mg/kg, Pb, 49.47 mg/kg, Ni, 92.17 mg/kg, Cd, 27.57 mg/kg, Cu, 171.23 were found in carotone, Skin light, skin light, skin light and peau clair respectively. The lowest concentration of Zn was found in pure white, Pb was found in Carotone, Caro white, Nature white. Lowest concentration of Ni, Cd, Cu and Zn were found in Pure white. Nature white contained the lowest concentrations of Hg, Zn, Pb, Ni, Cu with Cd higher when compared with World Health Organization. The results showed that Nature white is a very good cosmetic to be used as it contained low heavy metals content while sample Skin light contained high amount of heavy metals content which makes the cream to possess high risk for use.

Keywords:

Cosmetics, Heavy metals, Health, Concentration, Nigeria Cream

Introduction

Cosmetics have been used as part of routine skin care by all classes of people throughout the world. Cosmetics are a mixture of some surfactants, oil, and other ingredients and are required to be effective, long-lasting, stable and safe for human use. There are concerns regarding the presence of harmful chemicals, including heavy metal in this product. Many skin care products contain heavy metals such as lead, cadmium, chromium, arsenic, mercury, cobalt and nickel as ingredients or impurities (Alam *et al.*, 2019). Recent research has reported that these metals can easily cause many types of skin problems (Nesterenko and Jones, 2013; Sainio *et al.*, 2015). The use of lead, arsenic, and mercury in skin cosmetic products has been legally prohibited due to the biological accumulation of heavy metals and their toxicity (Hostynek, 2012). Many skin problems have been reported due to heavy metal presence in skin care products (Maibach and Menne, 2012; Kerosuo *et al.*, 2014).

Since the issue of heavy metals as deliberate cosmetic ingredients has been addressed, attention is turned to the presence of these substances as impurities (Alam *et al.*, 2019). The metals of primary toxicological concern in cosmetics are lead, cadmium, arsenic, chromium, mercury and antimony (sainio *et al.*, 2000). Dermal exposure is expected to be the most significant route for cosmetic product since the majority of cosmetics are applied to the skin. Oral exposure may be possible due to the use of cosmetics around the mouth as well as from hand to mouth contact, while inhalation exposure is typically considered to be negligible (Al-Saleh *et al.*, 2013).

At higher concentration, heavy metals have been shown to have negative effects. Lead, which may be an impurity, has been reported to cause neurotoxicity linked to learning language, and behavioral problems (Ayenimo *et al.*, 2010). It has also been linked to miscarriage, reduced fertility in men and women, hormonal discharges, menstrual irregularities, delays in puberty onset in girls and deformities in children (Horowitz *et al.*, 2015). Cadmium found in the body and hair creams are absorbed into the body through dermal contact

(Ayenimo *et al.*, 2010) and stored in the kidney and the liver, although it can be found in almost all adult tissues. It is considered to be "carcinogenic to humans" and its compounds, categorized as known human carcinogens by the United States Department of Health and Human Services. Cadmium has been reported to cause stomach irritation, vomiting, diarrhea, kidney damage and bone deformity (campaign for safe cosmetics 2010). Adverse effects of the chromium on the skin may include ulceration, dermatitis and allergic skin reactions (Horowitz *et al.*, 2015). Mercury has been linked to cause nervous system toxicity, as well as reproductive, immune, and respiratory toxicity, and carcinogenic (UNEP, 2008).

Materials and Methods

Sample collection

Samples of skin lightning creams Carol White, Carotone, Top White, Skin-light, miss caroline, Sivo Claire, Pure White, Nature white, Pure Claire, Perfect White of different brands were purchased randomly in different cosmetics shops in Wukari Local Government Area Taraba State Nigeria. These categories of cosmetics are the most commonly used and were randomly selected. The samples were of different qualities and popular brands with different price ranges.

Equipment/Apparatus

Atomic Absorption Spectrophotometer (AAS) (AA-090M046 MODEL), Analytical balance, Hot Plate, wash bottle, spatula, oven, filter paper, stirrer, Fume Cupboard, Volumetric flasks, conical flasks, graduated cylinders, beakers and funnel were used for this experiment.

Sample Preparation and Digestion

Sample containers were thoroughly washed with detergents, rinsed with water followed by deionised water before soaking in dilute HCl (0.05 M) for about 24 hours. They were then air-dried in a dust free environment. At the collection point, containers were rinsed with deionised water twice and then air dried.

Aqua regia method of digestion was adopted from Alam *et al.*, (2019). A 30 mL of HNO₃ and 10 mL of HCl were mixed together and 25 mL of the mixture was added to 3g of the sample in the digestion vessel and heated for 10 minutes until a clear solution of the sample were obtained. The solution was then filtered into separate 100 mL volumetric flask and made up to the mark with deionised water. This was transferred into a specimen bottle and stored in a cool environment. The filtrate from the sample were sent to Benue state university chemistry laboratory for AAS analysis of the following metals (Hg, Zn, Pb, Cd, Cu and Ni) using different cathode lamps for the elements of interest to be analyzed.

Preparation of Standard Solution

A standard solution is one with known concentration and is standardized through titration. Each of the below subheading indicate the concentration of heavy metal-solution which was standardized to confirm their given concentration using titration with suitable indicators.

Lead (Pb) stock solution

A stock solution of 1000 ppm of Pb was prepared by dissolving 1.5980 g of lead nitrate Pb(NO₃)₂ in a 20V/V HNO₃ and made up to the mark (1000 cm³) with de-ionized water. Several standard concentrations of (0, 2.0, 4.0 and 6.0 ppm) were then prepared from the stock solution for calibration curve by serial dilution using the formula below:

$$C_1V_1=C_2V_2$$

Where: C₁= concentration of stock solution,

C₂= the desired concentration to be prepared,

V₁= volume of stock solution taken,

V₂= volume factor to be diluted with.

At a wavelength of 217.0 nm selected, the flow- rate of air acetylene gas was adjusted to a recommended value. The standards was aspirated in an Atomic Absorption Spectrophotometer (AA-090M046), and the absorbance was recorded for the standard solution and sample solution.

Cadmium (Cd) stock solution

A stock solution of 1000 ppm of Cd was prepared by dissolving 1.6308 g of CdCl₂ in 1000 cm³ volumetric flask and made up to the mark with deionized water. Several concentrations of (0, 0.10, 0.20, and 0.30 ppm) were then prepared from the stock solution for calibration curve by serial dilution. The standard was aspirated in an atomic absorption spectrophotometer (AA-090M046) at wavelength of 228.8 nm and the absorbance was recorded for the standard solution and sample solution.

Nickel (Ni) stock solution

A stock solution containing 1000 ppm was prepared by dissolving 4.9487 g of Nickel (II) nitrate hexahydrate Ni(NO₃)₂ .6H₂O in 1000 cm³ volumetric flask and made up to the mark with deionized water. Several standard solutions of concentrations (0, 0.2, 0.4 and 0.6 ppm) were prepared from the stock solution for calibration curve by serial dilution. The standard solutions was aspirated in an Atomic Absorption Spectrophotometer (AA-090M046) at wavelength of 232.0 nm and slit width 0.1 nm using acetylene nitrous oxide and the absorbance was recorded for the standard solution and sample solution.

Zinc (Zn) stock solution

A stock solution of 1000ppm of Zn was prepared by dissolving 2.0853g of Zinc chloride ZnCl₂ in 1000 cm³ volumetric flask and made up to the mark with deionized water. Several standard solutions of concentrations (0.5, 1.0, 1.5,2.0, and 2.5ppm) were then prepared from the stock solution by serial dilution. The standards were then aspirated in an Atomic Absorption Spectrophotometer (AA-6800) at

wavelength of 213.9nm and the absorbance was recorded for the standard solution and sample solution.

Mercury (Hg) stock solution

A stock solution of 1000ppm of Hg was prepared by dissolving 1.350g of mercury (II) chloride (HgCl₂) in 1000 cm³ volumetric flask and made up to the mark with deionized water. Several standard solutions of concentrations (2.0, 4.0, 6.0 8.0 and 10.0ppm) were then prepared from the stock solution by serial dilution. The standard solutions were then aspirated in an Atomic Absorption Spectrophotometer (AA-6800) at wavelength of 232.0nm and slit width 0.1nm using acetylene nitrous oxide and the absorbance was recorded for the standard solution and sample solution.

Results and Discussion

Discussions

The results showed the individual mean concentrations of heavy metals in selected cosmetics used in Akwana Wukari Local Government Area Taraba State Nigeria presented in the table below. The results indicated the concentration of Hg, Zn, Cd, Ni, Cu, and Pb as detected by AAS for deferent samples of body creams. The concentrations mg/Kg of heavy metals in cosmetics sample range from Hg (10.53-138.87), Zn (9.67-35.23), Pb (6.87- 49.47), Ni (0.56 - 92.17), Cd (8.0-27.57), Cu (0.6-171.23).

Mercury (Hg) was not detected in samples (Carotone, Sivo clair and Nature white) while the concentrations of mercury (Hg) in sample (Caro white, Skin light, Peau clair, Perfect white, Pure white, Miss caroline, and Top white) were given as (18.50, 138.87, 77.53, 19.23, 18.50, 10.53, and 15.30) which were above 1.0 mg/Kg permissible limits of the World Health Organization (WHO) standard. This High concentration of Hg could cause Fatigue, Cancer, diarrhea, headache, vomiting, miscarriage (Tcounwou *et al.*, 2008). Zinc (Zn) concentrations detected in all the samples were below 99.4 mg/Kg permissible limit of WHO standard. From the results, Lead (Pb) was not detected in sample (Carotone, Caro white, Pure white, and Nature white) while sample (Skin light, Peau clair, Perfect white, caroline, Sivo clair, Miss Caroline and Top white) contained the given concentration (49.45, 24.7, 30.97, 37.77, 38.57 and 6.87) mg/kg respectively which were higher when compared with the WHO permissible limits (0.3 mg/Kg). Its showed that high concentration of Pb could cause loss of appetite , abdominal pain, headache, renal dysfunction , fatigue, sleeplessness and hallucination, birth defect, mental retardation psychosis.(Robert *et al.*, 2017)

Nickel (Ni) concentrations in sample (Carotone, Caro white, Peau clair, Perfect white, Miss caroline, Sivo clair, Top white, and Nature white) were below the permissible limit of the WHO while sample skin light with 92.17 concentration was above the allowable limit of (67.9 mg/Kg). This concentration could cause lungs fibrosis, kidney and cardiovascular disease and cancer of respiratory tract (McGregor *et al.*, 2014) and in sample F, Ni was not detected. The concentration of Cadmium (Cd) that was measured in all the samples were higher than 0.2 mg/Kg WHO permissible limit as (10.7, 10.83, 27.57, 19.4, 13.3 , 10.0 , 17.83, 16.2, 8.0, and 18.67) respectively which indicated their potential hazard. This concentration of Cd could cause damage of Lungs on higher inhaling levels as well as stomach irritation, vomiting and diarrhea (Richter *et al.*, 2017). Copper (Cu) in sample (Carotone, Perfect white, Sivo clair and Top white) were below the WHO permissible limits while sample (Caro white, Skin light, Peau clair and Miss caroline) were given as (73.83, 736.6, 171.23 and 82.9)

and were above the limiting value and could cause retardation, cancer, respiratory diseases (Brains *et al.*, 2007) and in sample Pure white and Nature white Cu was not detected.

Skin light contained the highest concentrations of Hg (138.87 mg/Kg), Cu (736.6 mg/Kg), Pb (49.47 mg/Kg), Ni (92.17

mg/Kg) and Cd (27.57 mg/Kg) and Carotone showed highest value of Zn (35.23 mg/Kg). The lowest concentration of Hg (10.53 mg/Kg), Zn (9.67 mg/Kg), Pb (6.87 mg/Kg), Ni (0.56 mg/Kg), Cd(8.0 mg/Kg), Cu (0.6 mg/ Kg) were found in sample Miss caroline, Pure white, Top white, Sivo clair, Top white, and Sivo clair respectively.

Table 1: Mean results of heavy metals in various Skin care samples

Samples	Hg (mg/Kg)	Zn (mg/Kg)	Pb (mg/Kg)	Ni(mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)
Carotone A	ND	35.23	ND	5.53	10.70	26.2
Caro White B	18.50	12.13	ND	7.27	10.83	73.83
Skin Light C	138.87	22.37	49.47	92.17	27.57	736.6
Peau ClairD	77.53	13.83	24.70	22.17	19.40	171.23
Perfect-white E	19.23	14.23	30.97	5.57	13.30	2.10
Pure White F	18.50	9.67	ND	ND	10.00	ND
Miss-Caroline G	10.53	14.70	37.77	10.83	17.83	82.90
Sivo Clair H	ND	11.03	38.57	0.56	16.2	0.6
Top White I	15.30	22.73	6.87	3.03	8.00	0.07
Nature-White J	ND	26.57	ND	3.37	18.67	ND
Mean	24.12	18.25	13.542	15.027	15.25	109.32
WHO	1.0	99.4	0.3	67.9	0.2	73.7

Conclusion

The results obtained from ten different cosmetics samples used such as Carotone, Caro white, Skin light, Peau Clair, Perfect white, Pure white, Miss Caroline, Sivo clair, Top white and Nature white showed that sample skin light contained the highest concentrations of Hg (138.87 mg/Kg) and Cu (736.6 mg/Kg), Pb (49.47 mg/Kg), Ni (92.17 mg/Kg) and Cd (27.57 mg/Kg) while sample A showed the highest value of Zn (35.23 mg/Kg). Sample nature white contained lowest concentrations of Hg, Zn, Pb, Ni, Cu with highest concentration of Cd.

The results showed that Nature white is a very good cosmetic to be used as its contained low heavy metals content while sample Skin light contained high amount of heavy metals content which makes the cream to possessed high risk for used.

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