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DETERMINATION OF SELECTED HEAVY METAL LEVELS IN SOME COSMETICS SOLD IN MINNA, NIGERIA

[1]Ajai, A. I., [1]Umudjon, M. F. and [2]Inobeme, A.

*[1]Department of Chemistry, Federal University of Technology, Minna, Niger State, Nigeria.
[2]Department of Chemistry, Edo University, Iyamho, Edo State, Nigeria

*Corresponding author's email: ajai.ike@futminna.edu.ng;talk2alexajai@gmail.com

ABSTRACT

In this study, the levels of Zn, Mn, Ni and Cr in selected cosmetic products sold in some retail outlets in Minna, Nigeria were investigated using Atomic Absorption Spectrophotometer (AAS). Four cosmetic products of two different colours and brand (face powders, lipsticks, eye pencils, and eye liners) were purchased from retail shops in Minna market and used for the present study. The results revealed a significant difference in the concentration of the metals analysed among the different cosmetics. Manganese was detected in only two of the cosmetics (facial powder and eye pencil). The heavy metal concentrations in the sample analysed ranged from 10.13±0.5 to 147.03±0.95mg/kg for Mn; 11.50±0.5 to 129.6±0.71 mg/kg for Zn; 1.53±0.25 to 13.54±0.12 mg/kg for Cr and 3.00±0.10 to 40.23±0.56 mg/kg for Ni. Cadmium and lead were not detected in any of the cosmetics products. The mean concentration of the metals analysed was in the order: Zn>Mn>Ni>Cr. The concentrations of some of the metals found in this study were found to be above the safe limit given by standard regulatory bodies. There is therefore need to continually monitor the concentration of heavy metals in cosmetic products. The study also reveals that continuous use of these cosmetics could result in an increase in the heavy metal concentration in human body.

Keywords: Cosmetics, Heavy Metals, Concentrations, Cadmium, Standard.

INTRODUCTION

In recent years, the need to enhance living standard by man has led to the demand for cosmetic products, such as skin care, makeup, hair care, fragrances amongst others (Khan, 2000). Cosmetics are materials which are placed in contact with the different external parts of human body with the aim entirely or partly cleaning, perfuming, protection, changing appearance, correcting body odours and keeping the surfaces in fine condition (Oyedeji *et al.*, 2011). They are mixtures of different surfactants, oils and other ingredients and are obliged to be viable, long enduring, steady and harmless for human utilization. Depending on the ingredients with which they are made from, cosmetics can either be of natural origin and or synthetic (Conors and Altshuler, 2009).

Heavy metals such as lead and cadmium are frequent contaminants in diverse cosmetics (Sainio *et al.*, 2000). In China for example, 60 per cent of cosmetics and other products were recalled after production due to the presence of heavy metals in amounts lethal to human in the products (Onyambu, 2014). Most of the present face make ups contains heavy metals and consumers have no knowledge about their levels (Sabah *et al.*, 2013). There are various heavy metals found in cosmetic products. Cadmium, for example is a deep yellow to orange pigment and mostly present in lipsticks and face powders, its use is due to its colour, hence has been used as pigment in various industries (Chauchan *et al.*, 2010). Dermal contact with some water-soluble toxic elements and/or their compounds could result in their absorption through the skin and hence could be harmful to the body. Heavy metals when absorbed by organism through skin can be noticed in sweat, blood and urine within periods of between six hours to 45 days of skin application (Omolaoye *et al.*, 2010). Oral injestion can happen for cosmetics utilized in and around the mouth and also from hand to mouth contact after coming in contact with cosmetic products containing substantial amount of these heavy metals. Nonetheless, inward breathing of these metals is thought to be negligible (Sainio *et al.*, 2000).

Exposure to heavy metals can result in reduction of mental and central nervous function, lower energy levels and damage to blood composition, lungs, liver, kidneys and other vital organs (Banfalvi, 2011). Their presence in various cosmetic products has been reported by various researchers (Amit *et al.*, 2010). With a lot of new products released into the market every season, it is difficult to keep track of the safety of every product as some products contain carcinogenic contaminants (Peter and Viraraghanvan, 2005). The fear arises especially when there are no labels indicating either the presence or the levels of heavy metals. The growing interests in cosmetics and lack of proper regulation in Nigeria thus remain a serious issues of concern. It is therefore pertinent to continually check the heavy metal content in these products in other to ensure that the products meet the permissible levels that will not pose any health risk to human. Therefore, the aim of this study is to determine the heavy metal levels in selected cosmetics sold in Minna, Nigeria in order to establish if they are within tolerable limit that will not be harmful to the users and to make appropriate recommendations based on findings.

MATERIALS AND METHODS

Sampling Method

Four cosmetic products of two brands each (face powders, lipsticks, eye pencils, and eye liners) purchased from Abdulkadir Kure and Tunga Markets in Minna were used for this Study. These cosmetic samples were coded for safety reasons.

Sample digestion

One gram (1 g) of each sample was weighed and introduced into a 100 cm^3 beaker, and 5 cm^3 mixture of concentrated Nitric acid (HNO_3) and Perchloric acid ($HClO_3$) in 3:1, was added to it. The beaker was placed on a hot plate in a fume hood and then heated gently until brown coloured

appeared; then 3.0 cm^3 of mixture of the concentrated acids was added and left until a white coloured was observed. The digested samples were left to cool, after which filtered with the help of Whatman No.1 filter paper into a 100 cm^3 conical flask and made up to the 100 cm^3 mark with distilled water. The same procedure was repeated twice in order to ensure precision in the digestion procedure and analytical instrument. Blank digestion was also carried out to correct for reagent impurities and other environmental contaminants (Muhammed *et* al., 2014). The clear filtered solutions were used for the heavy metal analysis. All necessary precautions were taken to ensure that possible contamination of samples was avoided.

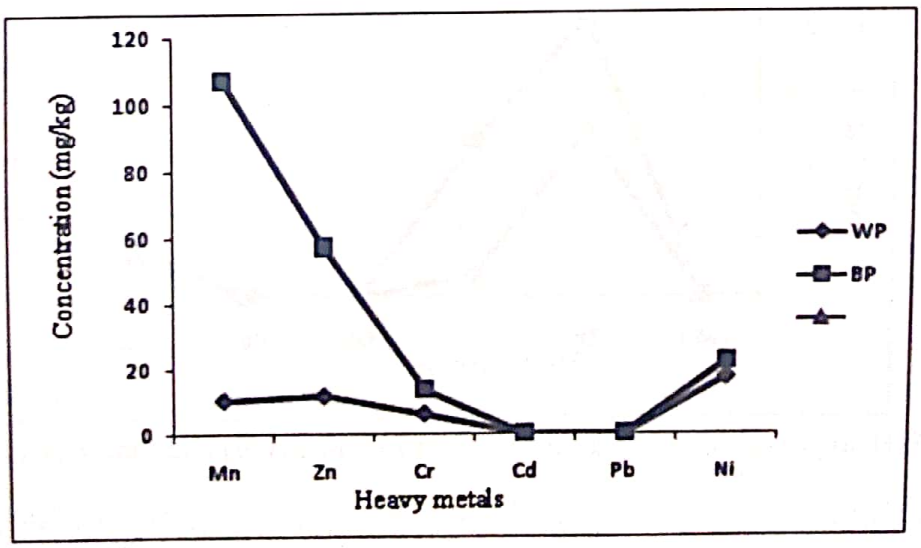
Metal Analysis

The atomic absorption spectrophotometric analysis for heavy metal levels in the digested samples were carried out at the Central Laboratory, University of Ibadan, Nigeria, using atomic absorption spectrophotometer, Buck Scientific Model 210VGP.

RESULTS AND DISCUSSION

The results obtained from the study are presented in Figures 1-4:

Figure 1 shows the heavy metal content in white and brown facial powder with brown facial powder (BP) having higher concentrations of Mn (107.00 ± 1.00 mg/kg), Zn (57.00 ± 1.00 mg/kg) Cr (13.54 ± 0.12 mg/kg) and Ni (22.0.3 ± 0.68 mg/kg) compared to white facial powder (WP) of 10.13 ± 0.05 mg/kg Mn, 11.50 ± 0.50 mg/kg Zn, 5.97 ±0.21 mg/kg Cr and 17.10 ± 0.53 mg/kg Ni respectively.



According to Figure 2, the concentration of the heavy metals in pink lipstick (PL) and red lipstick (RL) shows that the pink lipstick has higher concentration of 87.50 ± 0.50 mg/kg Zn, 10.50 ± 0.50 mg/kg Cr and 37.03 ± 0.14 mg/kg Ni compared to the red lipstick of 27.46 ± 0.84 mg/kg Zn, 3.50 ± 0.40 mg/kg Cr and 9.00 ± 0.15 mg/kg. While Pb and Cd were below detectable limits in the analysed samples.

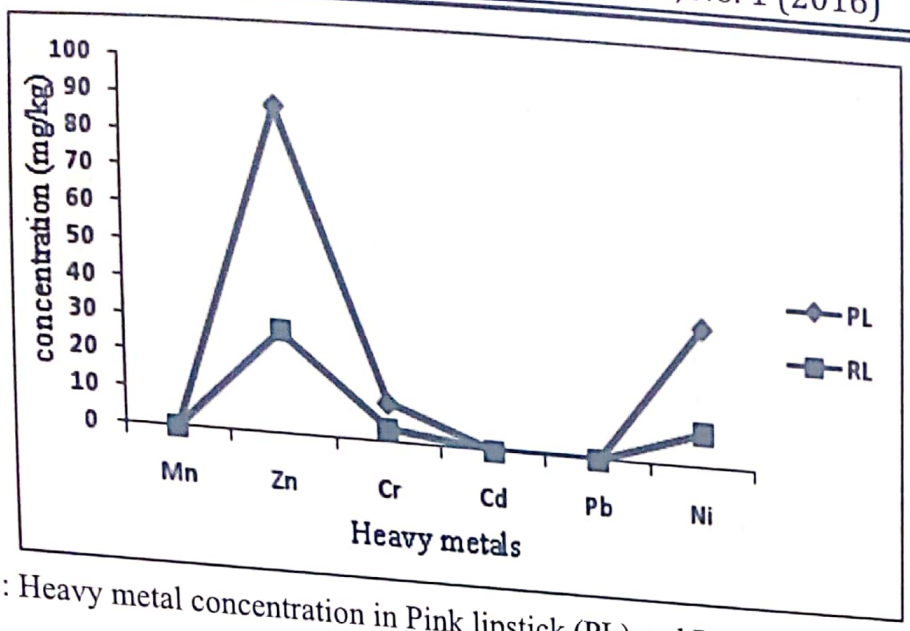


Fig. 2: Heavy metal concentration in Pink lipstick (PL) and Red Lipstick (RL)

Figure 3 shows the concentrations of green eyeliner (GE) and pink eye liner (PE) with the pink eyeliner having higher concentrations of 20.99 ± 0.90 mg/kg Zn, 11.63 ± 0.31 mg/kg Cr and 4.03 ± 0.06 mg/kg Ni compared to the green eyeliner with 12.57 ± 0.40 mg/kg Zn. 1.53 ± 0.25 mg/kg Cr and 3.00 ± 0.10 mg/kg Ni respectively. While other metals were below detectable limits.

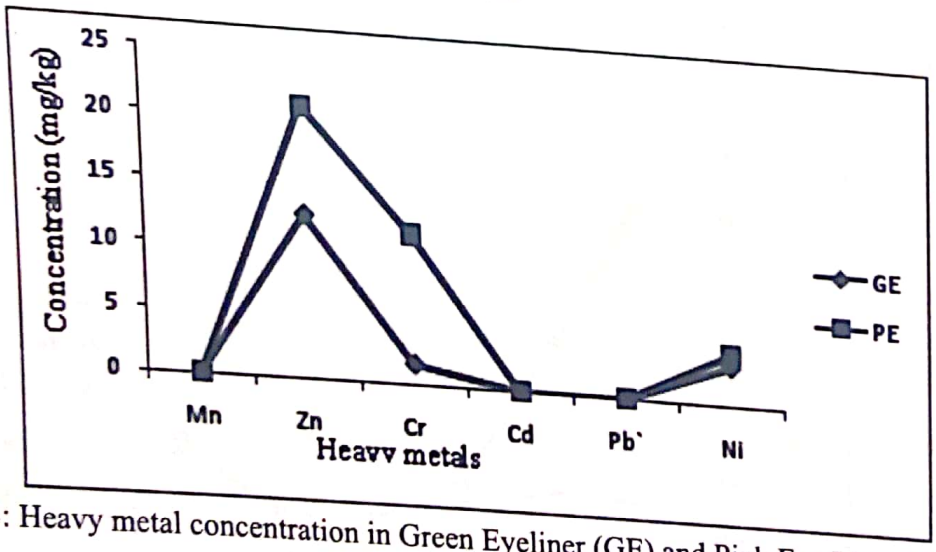


Fig.3: Heavy metal concentration in Green Eyeliner (GE) and Pink Eye Liner (PE)

The concentrations of heavy metals in black and brown eye pencils are shown in Figure 4. From the result, the heavy metal concentrations range from 0.98 ± 0.06 to 147.03 ± 0.95 mg/kg. However, the brown eye pencil (BV) has higher concentrations of all metals with the exception of manganese where the black pencil has the highest concentrations 147.03 ± 0.95 mg/kg Mn compared to the brown eye pencil with 116.70 ± 0.71 mg/kg Mn.

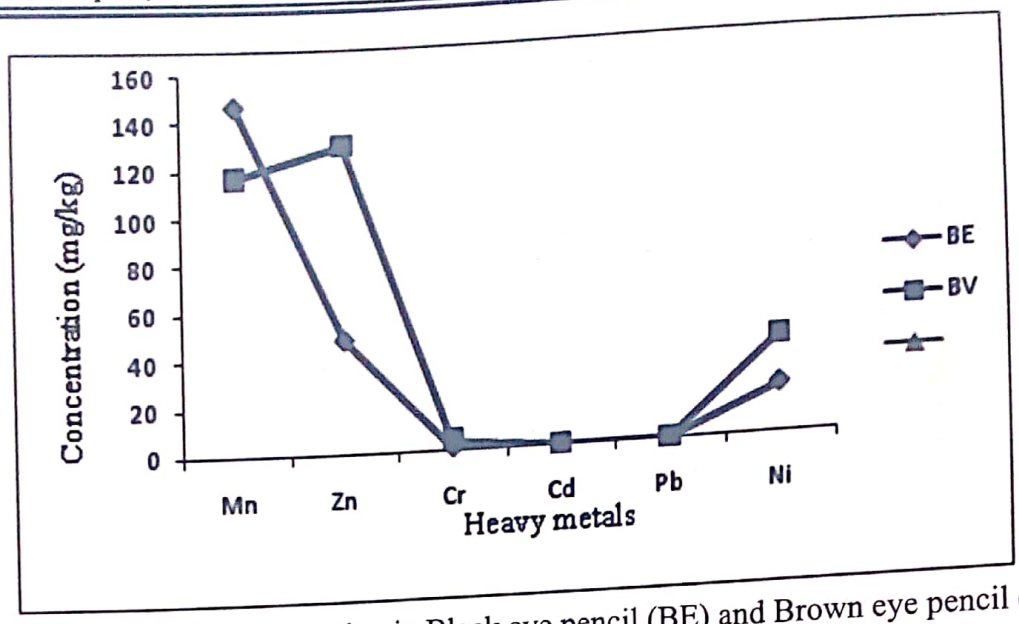


Fig.4: Heavy metal concentration in Black eye pencil (BE) and Brown eye pencil (BV)

Manganese

From table 1, the mean concentration of Mn is all the samples analysed was 47.60±61.13 mg/kg. Mn was not detected in the Pink lipstick, Red lipstick, Green eyeliner and Pink eyeliner. Black eye pencil (BE) has the highest concentration of Mn while the least concentration was found in White powder (WP) (10.13±0.05 mg/kg). The order of the concentration of Mn in the study is BE>BV>BP>WP. The concentration of Mn obtained in this study is higher than the maximum concentration of 0.06±0.01 mg/kg reported by Onyambu (2014) in a similar study. Considering the concentration of Mn in the colour between the individual cosmetics, it was observed from the study that for facial powder, brown had higher concentration than white; for eye pencil, black had higher concentration than brown. While for lipstick and eye liner Mn was not detected. The mean concentration of Mn obtained in this study is high when compared to the permissible limit of 0.26mg/kg documented in Reena *et al.* (2011). When compared to results from similar studies, the concentration of Mn is higher than the range of 0.0213 to 0.585mg/kg reported by Yebpella *et al.* (2014), but lower than 15.00 to 270.56 mg/kg reported by Omolaoye *et al.* (2010) for cosmetic products imported into Nigeria from China.

Zinc

The results show that zinc has the highest mean concentration (49.33±39.62mg/kg) among the metals analysed. The highest concentration of zinc was found in brown eye pencil (BV) (129.6±0.71 mg/kg). This is 11 times higher than the least concentration (11.50±0.5 mg/kg) found in white powder (WP). The concentration of Zn in BV was significantly higher than those in other samples. Also, considering the concentration of zinc in the colour between the individual cosmetics, the table shows that for facial powder, brown has a higher concentration than white; for lipstick, pink had

higher concentration than red. This may imply that certain colours of the cosmetics tend to have higher concentration of the metals than others. The concentration of Zn among the cosmetics is in the order BV>PL>BP>BE>RL>PE>GE>WP.

Table 1: Heavy metal concentration in the samples analysed (mg/kg)

Samples	Mn	Zn	Cr	Cd	Pb	Ni
WP	10.13±0.05^{b}	11.50±0.50^{d}	5.97±0.21^{d}	ND	ND	17.10±0.53^{d}
BP	107.00±1.00^{c}	57.00±1.00^{e}	13.54±0.12^{g}	ND	ND	22.03±0.68^{f}
PL	ND	87.50±0.50^{f}	10.50±0.50^{e}	ND	ND	37.03±0.14^{g}
RL	ND	27.46±0.84^{c}	3.50±0.40^{c}	ND	ND	9.00±0.15^{c}
GE	ND	12.57±0.40^{a}	1.53±0.25^{b}	ND	ND	3.00±0.10^{a}
PE	ND	20.99±0.90^{b}	11.63±0.31^{f}	ND	ND	4.03±0.06^{b}
BE	147.03±0.95^{e}	48.03±0.95^{d}	0.98±0.06^{a}	ND	ND	20.03±0.05^{e}
BV	116.70±0.71^{d}	129.60±0.71^{g}	4.00±0.10^{c}	ND	ND	40.23±0.56^{h}
Mean	47.60±61.13	49.33±39.62	6.45±4.65			19.09±13.37

Results are expressed as mean ± SD. Values with same superscripts in the same column do not differ significantly.

Keys:

Red lipstick: RL Red Lipstick: PL Green Eyeliner: GE
Facial white powder: WP Facial brown powder: BP Black eye pencil: BE
Pink Eye Liner: PE Brown eye pencil: BV Not Detected: ND

The highest concentration of Zn obtained in this study is higher than 0.04±0.01ppm reported by Onyambu (2014) on heavy metal in body lotion; 56.57 mg/kg by Kumar *et al.* (2012) in cosmetics in India and 39.80 mg/kg reported by Muhammad *et al.* (2014) on cosmetic products in open market in Kaduna. The result is however lower than 200 mg/kg documented in Al-Dayel *et al.* (2011) in their study on cosmetic sold in Saudi Arabia markets. It is also within the range of 128.5 mg/kg reported by Nnorom *et al.* (2005) in a similar study. Various studies have similarly reported a high concentration of Zn in some cosmetics. The toxicity of Zn is rare; however at a concentration of 40 mg/kg, it becomes very toxic

Chromium

Chromium has the least mean concentration in the samples analysed. Among all the samples collected for this study, Black eye pencil (BE) recorded the lowest concentration of Cr (0.98±0.06 mg/kg) while Brown powder (BP) has the highest (13.54±0.12 mg/kg). There is a significant difference in the concentration of Cr in all the samples analysed. The concentration of Cr in Red lipstick (3.5±0.40 mg/kg) and Brown eye pencil (4.00±0.10 mg/kg) where however not significantly different. Umar *et al.* (2013) reported a range of 0.15 to 6.29 mg/kg in Abuja, Nigeria;

Nnorom *et al.*, 2005 recorded a range of 33.5 to 43.10 mg/kg, Omolaoye *et al.* (2010) reported 16.67 to 133.33 mg/kg while Al-Dayel *et al.* (2011) reported a range of 5.89 to 7000 mg/kg. The result from this study is higher than that of Umar *et al.* (2013) but lower than the results obtained by the other researchers cited above. This may be due to variation in the process of production

Nickel

Nickel (Ni) has a mean concentration of 19.09±13.37 mg/kg among the cosmetics analysed. There is a significant difference in the concentration of Ni in all the samples analysed. The concentration of Ni in the study ranged from 3.00±0.10 to 40.23±0.56 mg/kg. The highest concentration (40.23±0.56 mg/kg) was found in Brown eye pencil (BV) while the lowest (3.00±0.10mg/kg) was in Green eyeliner (GE). The concentration of Ni was in the order: BV> PL> BP BE> WP> RL >PE >GE. Based on the concentration in different colours of the cosmetics, for facial powder, brown had higher concentration than white; for lipstick, pink had higher concentration than red while for eye liner, pink had higher concentration than green. The highest concentration of Ni (40.23±0.56 mg/kg) obtained in this study is higher when compared to 0.28 to 29.90 mg/kg reported by Umar and Caleb (2013) and 0.0064 to 0.0148 mg/kg as reported by Yebpella *et al*, (2014) respectively. It is within the range of 6.01 to 46.80 mg/kg reported by Al-Dayel *et al* (2014).

CONCLUSION

The present study has investigated the content of heavy metals in selected cosmetics. The results shows that for the concentration of the metals was in the order: Zn>Mn>Ni>Cr. The level of heavy metal detected in this study is alarming, as they are above the allowed limit given by some standard organizations. Manufacturers should endeavour to indicate the heavy metal contents of cosmetics in the label so that consumers would be aware of what they purchase. Also, using of some of these cosmetics continually would make the user prone to toxicity from heavy metals.

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