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Levels of Heavy Metals in Lipsticks Commonly and Commercially Available in Benin City, Nigeria

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ABSTRACT

This research was carried-out to assess the levels of heavy metals (Hg, As, Cd, Sb and Pb) concentration in selected lipsticks commonly and commercially available in Benin city, Nigeria. Ten (10) different brands of lipstick (5 each) were randomly selected across the four (04) local government areas that made up Benin city. The samples were ground and mixed to form a composite sample of each brand, digested and analyzed using Atomic Absorption Spectrophotometer (ASS). The analyses were done in triplicates and the mean concentration of arsenic were determined to be in the range of 4.90 – 369.85µg/g, mercury in the range of range of 4.99 – 60.42µg/g, antimony 4.94 – 20.39µg/g, cadmium 8.44 – 95.50 µg/g, and lead in the range of 33.17 – 69.33 µg/g. The metals concentration obtained were found be above the permissible limits set by WHO and USFDA. The results showed that the continuous use of these lipsticks brands poses a risk to the health of the users. Hence, stringent measures needs to be adopted during manufacturing to avoid the presence of these toxic metals as impurities and also, government regulations needs to be put in place to monitor the quality of lipsticks imported into the country.

Keywords: Benin city, Heavy metals, Lipsticks, Nigeria

INTRODUCTION

Cosmetics have been used right from the beginning of time. It is a personal care products used by all types of people all over the globe. According to the United States Food and Drug Administration (USFDA, 2018), "cosmetics are articles intended to be rubbed, poured, sprinkled or sprayed on, introduced into or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance".

Lipsticks are one of the cosmetics that are widely used throughout the world, most especially by the female gender. Lipsticks contain oils, silica, emollients, mica, titanium dioxide, antioxidant materials and colourants which give distinct appearances and hues to the finished product (Ezeh *et al.*, 2019). Lipstick has variety of colours cause by the introduction of organic or inorganic pigments. Heavy metals have been reported to be present in most lipsticks (Adepoju-Bello *et al.*, 2012; Oklo *et al.*, 2020; Alam *et al.*, 2019; Ezeh *et al.*, 2019; Ayuba *et al.*, 2017) and this could be introduced as part of the ingredients or impurities. Adulteration of lipstick products with heavy metals takes place during the process of production or lack of adequate purification of basic materials used for production (Ezeh *et al.*, 2019). These heavy metals can be very harmful even at low concentration and a bioaccumulation of these metals can spell doom to human health if not properly and routinely checked.

According to Sainio *et al.* (2000), the key toxic metals in cosmetics especially lipsticks are chromium, lead, antimony, arsenic, cadmium and mercury. Since lipsticks are applied on lips around the mouth, it is expected that oral exposure to these impurities present in lipsticks can occur which can lead to deterioration of health on prolong exposure. Due the report by many researchers of the availability of heavy metals in lipsticks used in many countries, the United States government in 2013 imposed limits for some metals in cosmetics; 3µg/g for As, Cd and Hg, 5µg/g for Sb, 170µg/g for Ni, Cr, Co and Cu, and 20µg/g for Pb (USFDA, 2013) while world health organization (WHO) has set 10 µg/g for Pb, 0.3 µg/g for Cd and 1 µg/g for Hg as permissible limits (WHO, 2010).

The application of cosmetics especially lipsticks by Bini women is a long aged custom and the use of this product (both locally and foreign made) by Bini women in recent times has increased in alarming rate. However, there is limited information on the level of heavy metals in lipsticks commonly found in Nigerian markets and Benin city in particular. Therefore there is need for continuous investigation and monitoring of the level of heavy metals in lipsticks commercially available in Benin city. Hence, this research is focused on the assessment of the concentration of heavy metals (mercury, lead, antimony, arsenic and

cadmium) in lipsticks commonly and commercially available in Benin metropolis, Nigeria.

MATERIALS AND METHODS

Study Area

The study area of this research was Benin city, Edo state, Nigeria. The area is situated at latitude $6^{o}2355N$ to $6^{o}2739N$ and longitude $5^{o}3618E$ to $5^{o}4430E$. The study area comprises of four (4) local government areas namely; Oredo, Egor, Ikpoba-Okha and Ovia Northeast. The map of the study area is shown in Figure 1.

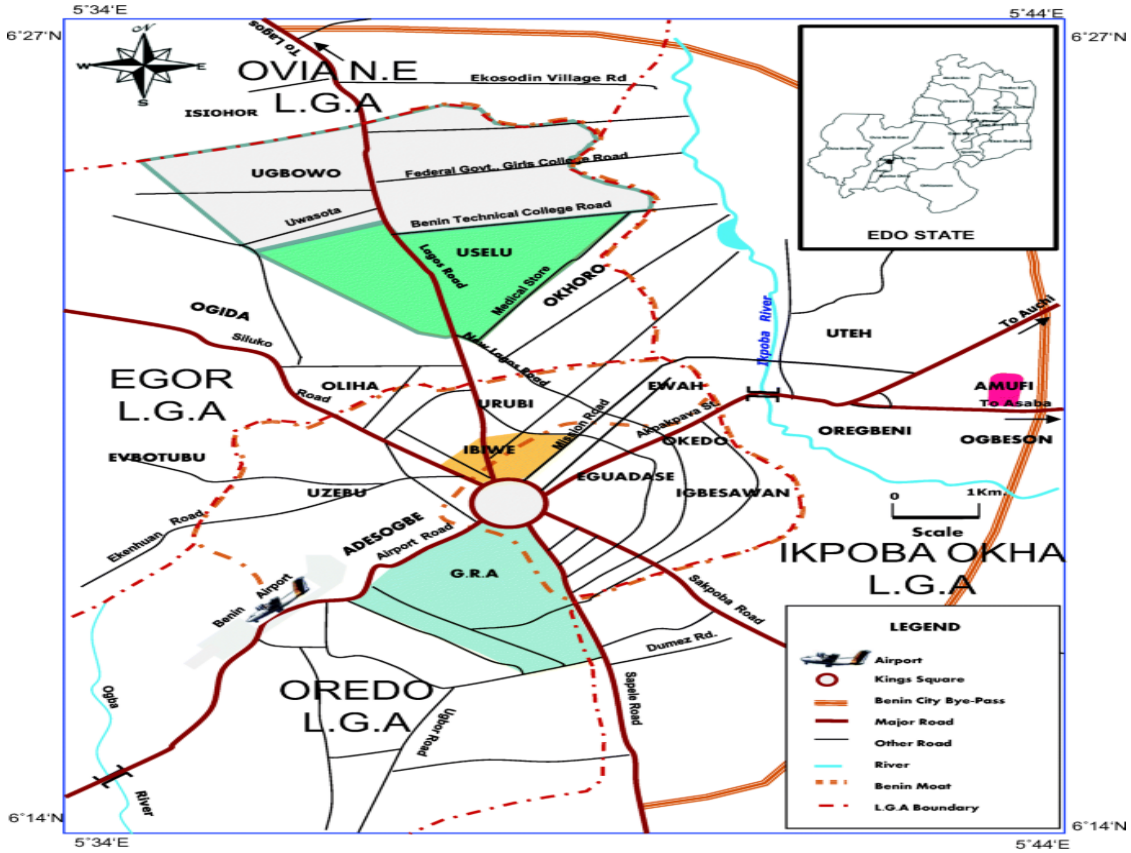

Figure 1: Map of the Study Area

Source: Ministry of Lands and Survey, Benin City, Edo State, Nigeria (2014)

Sample Collection

The commonly used lipstick samples were randomly selected from markets and shops across the four (04) local government areas that made up Benin city. Five (05) samples were obtained for each brand and a composite sample of each brand was made. The samples were coded as LS.A – LS.J for the ten brands collected to keep the brand names anonymous.

Cleaning of Glassware

All glass-wares were cleansed with soap powder and rinsed with tap water followed by deionized water, and then soaked in a diluted nitric acid bath for 24 hr. Finally, the glassware were rinsed with deionized water and air-dried at room temperature prior to use.

Sample Preparation, Digestion and Heavy Metals Determination

Lipstick samples were dried in an oven at $60^{\circ}C$ for 4 hr. The dried samples were blended with mortar and pestle. Lipstick samples (I g each) were weighed into cleaned, dried and labeled digestion flasks. The digestion for the determination of mercury was done using the method described by Heckel and Keener, (2007). Digestion of lipstick products for the determination of cadmium and lead was done using the method described by Sonawane *et al*. (2013) and the concentration of Cd and Pb were determined using buck scientific Atomic Absorption Spectrophotometer (AAS). To determine the concentration of arsenic, reduction of Arsenic (V) to (III) was necessary for the emergence of stable hydride required for Hydride Generation Atomic Absorption Spectroscopy (HGAAS) analysis. To realise this, 5 mL aliquots were taken from the filtrate (digested sample) and added to 5 mL of 1% potassium iodide and 1 M

HCl in a boiling tube. The digests were allowed to lessen for fifty minutes at room temperature before being filtered into 25 mL volumetric flasks and made up to mark with deionized water.

RESULTS AND DISCUSSION

Concentration of Toxic Heavy Metals in Lipsticks samples

The concentration of heavy metals (arsenic, mercury, antimony, cadmium and lead) in lipsticks commonly and commercially available in Benin city are shown in Table 1. From the results, the concentration of arsenic was found to be in the range of 4.90 – 369.85µg/g, with the lowest concentration found in sample LS.B and the highest found in sample LS.G. The allowable limit for arsenic in lipsticks and other cosmetic products as set by USDFA (2013) is 3µg/g which is an indication that all the lipstick products analyzed in this study contained arsenic at a level exceeding the permissible limit. This value (369.85µg/g) was also considered high was compared to 15.37µg/g reported by Ezeh *et al.* (2019).

Mercury (Hg) concentration in this study was found to be in the range of 4.99 – 60.42µg/g. Sample LS.C and LS.F have the lowest and highest concentration of mercury respectively. The WHO (2010) and USFDA (2013) permissible limits for mercury are 1µg/g and 3µg/g respectively. From the result obtained, mercury was found in samples LS.A, LS.D, LS.C, LS.H, LS.F, LS.G, and LS.I while samples LS.B, LS.E and LS.J were found not to content mercury. The concentrations of mercury in all samples detected were found to be above the permissible limits set by both WHO (2010) and USFDA (2013).

Antimony (Sb) was found to be in the range of 4.94 – 20.39µg/g, with sample LS.H and LS.D having the lowest concentrations and sample LS.F having the highest concentration. No trace of antimony was detected in samples LS.B, LS.C and LS.E. The USFDA (2013) permissible limit for antimony is5 µg/g which is an indication that the concentration of antimony in all the samples detected except for samples LS.H and LS.D were higher than the permissible limit.

The concentration of cadmium (Cd) in this study was found to be in the range of 8.44 – 95.50 µg/g. The lowest concentration was seen in sample LS.B while sample LS.D has the highest concentration. Cadmium was not detected in samples LS.E, LS.H and LS.I. The WHO (2010) limit for cadmium is 0.3µg/g while that of USFDA (2013) is 3 µg/g which revealed that Cd concentration in all the samples detected were above the allowable limits of both WHO (2010) and USFDA (2013). Cadmium concentration (95.50µg/g) was considered low when compared to the highest value of Cd reported by Oklo *et al.* (2020).

The concentration of lead (Pb) detected in this study were in the range of 33.17 – 69.33 µg/g with the lowest found in sample LS.H and highest in sample LS.C. There was no trace of lead detected in samples LS.E, LS.G, LS.F, LS.I and LS.J. The concentrations of lead were found to be above the permissible limits of 10 µg/g and 20 µg/g set by WHO (2010) and USDFA (2013) respectively in all the samples detected. Although the value of Pb (69.33µg/g) was low when compared to 47927 µg/g and 3920 µg/g reported by Ayuba *et al.* (2017) and Oklo *et al.* (2020) respectively.

Table 1: Concentration of Toxic Heavy Metals in Lipsticks samples

SAMPLE	ARSENIC (As) (µg/g)	MERCURY (Hg) (µg/g)	ANTIMONY (Sb) (µg/g)	CADMIUM (Cd) (µg/g)	LEAD (Pb) (µg/g)
LS.A	149.90±0.14	5.13±0.18	5.28±0.40	88.50±0.71	68.44±0.62
LS.B	4.90±0.14	ND	ND	8.44±0.62	54.95±0.08
LS.C	29.80±0.28	4.99±0.04	ND	74.99±0.01	69.33±0.47
LS.D	309.75±0.35	20.18±0.25	4.94±0.8	95.50±0.71	72.12±0.16
LS.E	4.95±0.07	ND	ND	ND	ND
LS.F	540.50±0.71	60.42±0.60	20.39±0.55	75.89±0.16	ND
LS.G	369.85±0.21	39.98±0.03	20.11±0.15	63.26±0.36	ND
LS.H	190.25±0.35	30.55±0.78	4.94±0.08	ND	33.17±0.23
LS.I	79.75±0.35	5.12±0.16	10.18±0.26	ND	ND
LS.J	4.93±0.11	ND	ND	87.83±0.25	ND

ND = Not Detected

The results of this study indicated the presence of arsenic in 100%, mercury and cadmium in 70%, antimony in 60% and lead in 50% of the samples analyzed. This high level of contamination shows that there was a lot of recklessness during the production process of these lipsticks without considering the control measures and safety of the end users. The variation in the levels of these metals would be due to the differences in materials used in tinting the desire colours of the lipstick of which these metals are presence as impurities. According to Zainy (2017), lipsticks are categorized as high class and low class, and high class lipsticks are of high quality, expensive and safer for users while low class lipsticks are of lower quality, cheap and are less-safe for the users. This

showed that the commonly used lipsticks in Benin city are of low class and as such tends to contained heavy metals as impurities. This is because Benin city is in a poor developing country where many people cannot afford high class lipsticks. These poses as a threat to the end users as the continuous use of these lipsticks could leads to serious health defects through bioaccumulation. Many researchers have as well reported the presence of heavy metals in lipsticks products commercially present in other cities in Nigeria (Ayuba *et al.*, 2017; Ezeh *et al.*, 2019; Oklo *et al.*, 2020).

CONCLUSION

This study has provided up to date information on the level of heavy metals in lipstick products commonly and commercially available in Benin city, Nigeria. Heavy metals were found to be present in all the lipstick samples analyzed. The results of this study showed that out of the ten (10) lipstick samples analyzed, arsenic was presence in 100%, mercury and cadmium in 70%, antimony in 60% and lead in 50% of the samples. This calls for stringent measures in manufacturing/packaging process and urgent enactment of regulations and monitoring by Nigerian government to limit the concentration of heavy metals in lipsticks available in Nigeria. This will safeguard the end users from possible health hazards caused by bioaccumulation of heavy metals.

REFERENCES

Adepoju-Bello, A. A., Oguntibeju, O. O., Adebisi, R.A., Okpala, N. and Coker, H. A. (2012): Evaluation of the Concentration of Toxic Metals in Cosmetic Products in Nigeria. *African Journal of Biotechnology*, 11: 16360-16364.

Alam, M. F., Akhter, M., Mazumder, B., Ferdous, A., Hossain, M. D., Dafader, N. C., Ahmed, F. T., Kundu, S. K., Taheri, T. and AtiqueUllah, A. K. M. (2019): Assessment of some heavy metals in selected cosmetics commonly used in Bangladesh and human health risk. *Journal of Analytical Science and Technology, 10(2):* 1-8.

Ayuba, S., Halima, Z. L. and Gevevieve, O. (2017): Assessment of level of toxic heavy metal (Pb) in local and foreign brands of lipsticks in FCT, Abuja, Nigeria. *Bayero Journal of Pure and Applied Sciences*, 10(1): 318-322.

Ezeh, E., Okeke, O., Aniobi, C. C., Ikedinobi, C. S. and Alieze, A. B. (2019): Analysis of heavy metals in different brands of lipsticks sold in Enugu metropolis, Nigeria and their potential health risks to users. *Journal of Chemical, Biological and Physical sciences*, 9(4): 402-411.

Heckel, P. F. and Keener, T. C. (2007): Sex differences noted in mercury bioaccumulation in *Magicicada cassini. Chemosphere*, 69: 79-81.

Oklo, A. D., Enenche, D. E. and Mary-Ann, M. A. (2020): Heavy metals in some lipstick products marketed in Makurdi metropolis, Benue state Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, 5(2): 342-346.

Sainio, E. L., Jolanki, R., Hakala, E. and Kanerva, L., (2000): Metals and arsenic in eye shadows. *Cont. Dermat*, 42: 5-10.

Sonawane, N. S., Sawant, C. P. &Patil, R. V. (2013): Soil Quality and Heavy Metal Contamination in Agricultural Soil in and around Toronmal (Triable Region) Of Maharashtra. *Archives of Applied Science Research*, 5(2): 294-298.

United States Food and Drug Administration (2013): Food and drugs, chapter II – food and drug administration, department of health and human services. Part 74 – listing of colour additives subject to certification office of cosmetics and colours, Sec. 74. 1306 D&C. Investigation D.C. 400-408.

United States Food and Drug Administration (2018): Federal Food, drugs, and cosmetics acts. Title 21 chapter 9.

World Health Organization (2010): Standard limits for pollutants in cosmetic products. *Public Health and Environment*, WHO, Geneva, 540-549.

Zainy, F. M. A. (2017): Heavy Metals in Lipstick Products Marketed in Saudi Arabia. *Journal of Cosmetics, Dermatological Sciences and Applications*, 7: 336-348.