

DETERMINATION OF LEAD AND NICKEL LEVELS IN LIPSTICKS AND POTENTIAL HEALTH HAZARDS TO USERS IN BABYLON, IRAQ^a

DETERMINACIÓN DE LOS NIVELES DE PLOMO Y NÍQUEL EN LABIALES Y LOS POSIBLES RIESGOS PARA LA SALUD DE LOS USUARIOS EN BABILONIA, IRAK

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ABSTRACT: The use of cosmetics, especially lipsticks, has raised worldwide increasing the concern about the safety of these products because of potential contamination by heavy metals. This study is focused on two different heavy metals (Ni and Pb) in lipsticks that are widely and commercially available in Hilla City, Babylon, Iraq. A total of Five brands of lipstick, five each, were randomly chosen from four local government districts within Hilla City. Each sample was digested using 3:1 of HCl / HNO₃, then determined using an atomic absorption spectrophotometer after being first combined and ground into powder form composite sample for each brand. All experiments were repeated in triplicate and mean concentrations for Pb and Ni were determined. The results shown that the concentrations of Pb and Ni were (10.4–22.7 $\mu\text{g. mL}^{-1}$ and 6.7–19.2 $\mu\text{g. mL}^{-1}$) respectively. These findings observed high concentrations in each sample exceeded the FDA limit of 3 $\mu\text{g. mL}^{-1}$, suggesting severe contamination and increasing the possibility of systemic toxicity. Additionally, safety and monitoring should be awarded to protect public health.

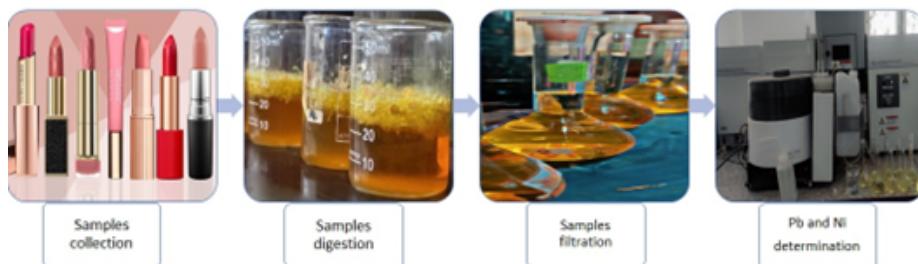
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Graphical abstract



KEYWORDS: Cosmetics; heavy metals; toxicity.

RESUMEN: El uso de cosméticos, especialmente labiales, ha aumentado en todo el mundo, lo que incrementa la preocupación sobre la seguridad de estos productos debido a la posible contaminación por metales pesados. Este estudio se centra en dos metales pesados diferentes (Ni y Pb) en labiales que están ampliamente y comercialmente disponibles en la ciudad de Hilla, Babilonia, Irak. Se seleccionaron aleatoriamente un total de cinco marcas de labiales, cinco de cada una, de cuatro distritos gubernamentales locales dentro de la ciudad de Hilla. Cada muestra fue digerida usando 3:1 de HCl / HNO₃, luego analizada usando un espectrofotómetro de absorción atómica después de ser primero combinada y molida hasta obtener una muestra compuesta en forma de polvo para cada marca. Todos los experimentos se repitieron por triplicado y se determinaron las concentraciones medias de Pb y Ni. Los resultados mostraron que las concentraciones de Pb y Ni fueron (10.4–22.7 $\mu\text{g. mL}^{-1}$ y 6.7–19.2 $\mu\text{g. mL}^{-1}$) respectivamente. Estos hallazgos observaron altas concentraciones en cada muestra que excedieron el límite de la FDA de 3 $\mu\text{g. mL}^{-1}$, lo que sugiere una contaminación severa y un aumento en la posibilidad de toxicidad sistémica. Además, se debe prestar atención a la seguridad y monitoreo para proteger la salud pública.

PALABRAS CLAVES: Cosméticos; metales pesados; toxicidad.

1. INTRODUCTION

Lead, nickel and other heavy metals are concern contaminants of cosmetic products that can be absorbed by the body through the skin or mouth, long exposure to these metals as a body care routine may cause severe health consequences including nervous system damage, cancer development and internal organs damage (Dinçer *et al.*, 2023). A large number of people across the globe use beauty care and makeup products on a regular basis. Any substance that is intended to be rubbed, poured, or placed over or into the human body or any part thereof in order to clean, promote pleasant smell, refresh and beautify the appearance is referred to as a cosmetic product (Alam *et al.*, 2019). Lipsticks are typically composed of oils, waxes, emollients, and antioxidant ingredients such as silica, titanium dioxide, and mica which contribute to their texture in addition to colorants for providing hue along with other properties to end-product formulations. Tint synthesis gives very wide ranges of colors for lip products.

The consumption of lipsticks increases with an increase in willingness among human beings because they want more opportunities (Soares & Nascentes, 2013). The high demand for cosmetic products is due to the beauty consciousness of many people from all levels of standards (Chakraborty *et al.*, 2011). Over the past few decades, the usage of these products including talcum, fairness creams, face powders, kajal, lipsticks, eye makeup, mouth wash and sin door has increased drastically (Al-Dayel *et al.*, 2011).

Lipsticks are adulterated in many colors with a variety of hues often derived from synthetic organic or mineral sources which could include heavy metals such as Cu, Cd, Pb, Cr, Co, and Ni. The occurrence of these metals in lipstick formulations was attributed to the use of metallic equipment during the manufacturing process. Heavy metals are found in several lipstick formulations as impurities or additives (Allenby & Baskettter, 1993; Volpe *et al.*, 2012; Emmanuel *et al.*, 2022). Impurities with heavy metals from lipstick formulations result during the manufacturing process or due to poor quality control in the filtration of common raw materials used in the formulation as ingredients (Mohammed *et al.*, 2023). Lead, cadmium, arsenic, chromium, mercury and antimony are metalloids of major health concern in cosmetic products (Zakaria & Ho, 2015).

The exposure of consumers to both organic and inorganic impurities from lipstick products through oral route (ingestion) and dermal contact might contribute to carcinogenic and non-carcinogenic risks (Miletić *et al.*, 2023). When heavy metals get into the human body, they are absorbed and form complexes with protein amines (-NH₂), thiols (-SH), and carboxylic acids (-COOH) which results in damage to cells and/or causes different disorders (Afridi *et al.*, 2022; Amuah *et al.*, 2023). The safety of cosmetic, personal care products plus their exposure to heavy metals has received significant attention in recent times. Regarding the potential adverse effects of heavy metals' contamination, the widespread availability and use of cosmetic products has attracted the focus of researchers and clinicians (Karamali *et al.*, 2021).

Some makeup products can result in adverse outcomes such as cancer, allergic reactions, mutations, respiratory distress and growth and developmental difficulties. High levels of exposure to toxic trace elements including arsenic, lead, mercury, nickel, cadmium, antimony and chromium associated with negative effects like behavioral problems, delayed puberty in females, vomiting to the stomach along with diarrhea that is watery and frequent, dermatitis, ulcerations, Geno toxicity immunotoxicity as well as carcinogenicity (Soares & Nascentes, 2013; Servin *et al.*, 2024).

This study aims to determine the concentration of two different heavy metals (Pb and Ni) in lipsticks from Hilla city market and investigating their effect on costumers' health.

2. MATERIALS AND METHODS

2.1. Sample collection

Lipstick samples of five brands (5 test for each) were collected from the local market of Hilla city from different cosmetics shops. Samples were of different qualities of popular brands with different price ranges. Same colors were taken for each brand; the most common ones were taken. The samples were collected according to the use by the different societies. Some brands were used by the lower and middle classes and some by the upper classes.

2.2. Chemical and instruments

All chemicals that used were purchased from Sigma-Aldrich with high purity. Whoever, the calibration curves for Pb and Ni were constructed using PbCl_2 (98 %) and NiCl_2 (98 %) in the range (1- 50) $\mu\text{g. mL}^{-1}$ for Pb and Ni. Atomic absorption spectrophotometer (AA-6300) Shimadzu, Japan was used to construct and determine Ni and Pb.

2.3. Sample preparation

Lipstick samples were dried at 60°C in Stanhope-seta oven, UK for 4 hours, (1 g each) were weighed into digestion flasks, previously cleaned, dried, and labeled, samples were digested using wet digestion method (HCl (38 %) and HNO_3 (68 %) 3:1) at atmospheric pressure under open system. The digests were permitted to reduce for fifty minutes at room temperature, then diluted into 25 mL volumetric flasks with deionized water.

After that all samples were filtered using Watman filter paper ash less, Grade 42, pore size 2.5 μm , Merck, Germany. Ni and Pb were determined using an atomic absorption spectrophotometer.

3. RESULTS AND DISCUSSION

The concentration of Pb and Ni in lipsticks that commercially presented in Hilla City after conducting triple examinations were 10.4 and 22.7 $\mu\text{g. mL}^{-1}$ for Pb, while 6.7 and 19.2 $\mu\text{g. mL}^{-1}$ for Ni respectively, all the results are displayed in Figures (1-5).

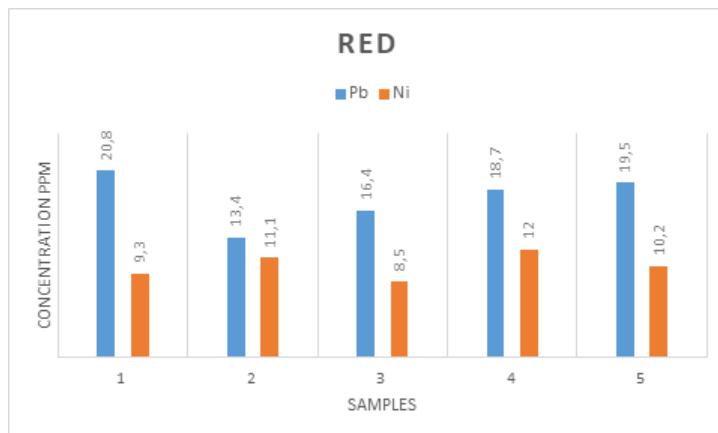


Figure 1: Concentrations of Pb and Ni in Red lipsticks brand. Author's Own Work.

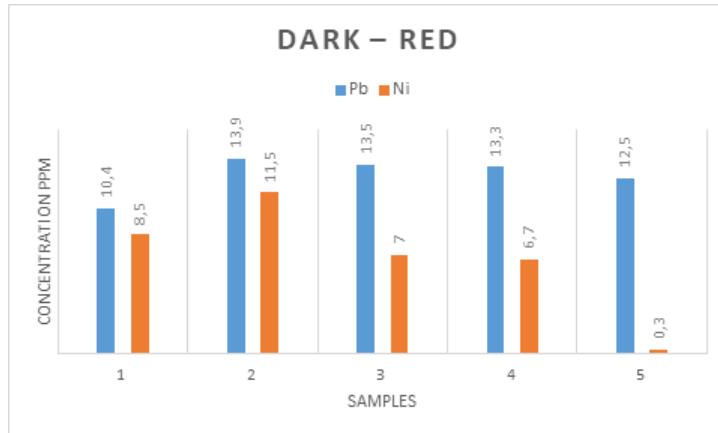


Figure 2: Concentrations of Pb and Ni in Red lipsticks brand. Author's Own Work

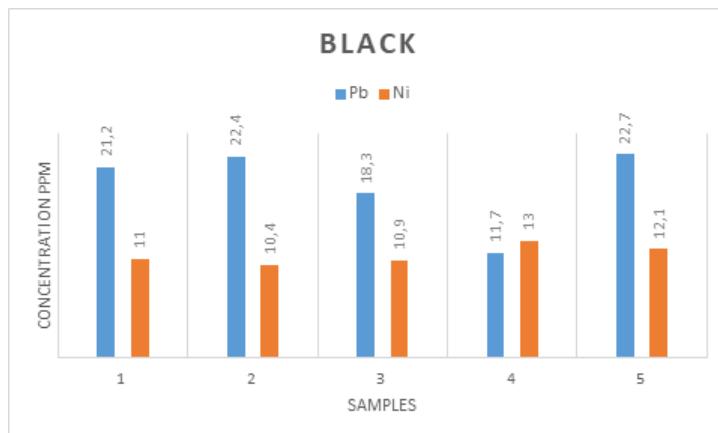


Figure 3: Concentrations of Pb and Ni in Red lipsticks brand. Author's Own Work.

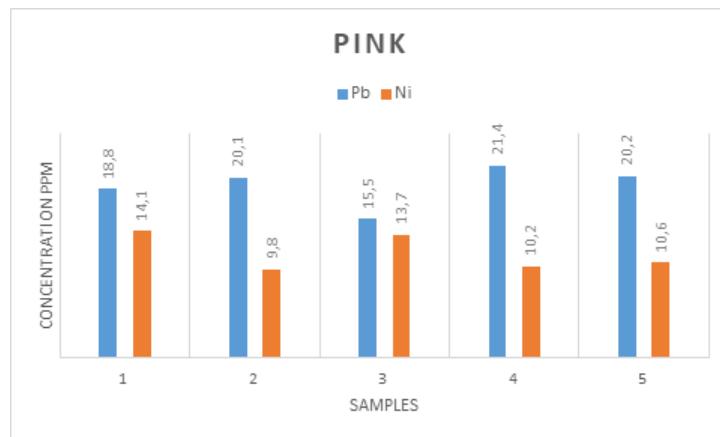


Figure 4: Concentrations of Pb and Ni in Red lipsticks brand. Author's Own Work

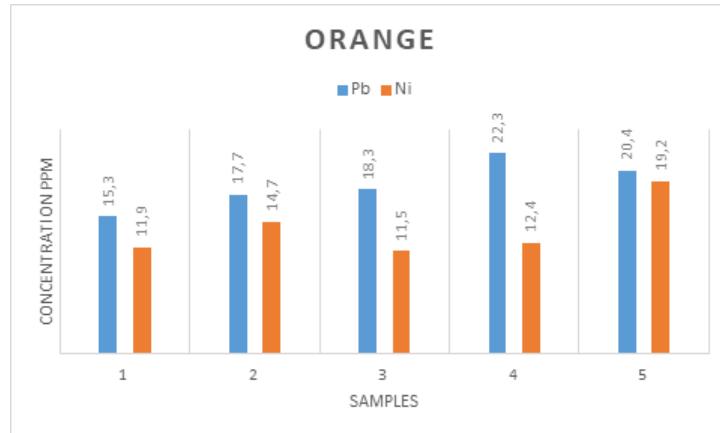


Figure 5: Concentrations of Pb and Ni in Red lipsticks brand. Author's Own Work.

It can be clearly seen from figures (1-5) that the Pb and Ni concentrations in some samples are higher than the allowed limit (20 and $10 \mu\text{g. mL}^{-1}$), respectively, according to Abdulkareem *et al.* (2022). According to the EPA, the safe level of lead is $0.5 \mu\text{g. mL}^{-1}$. Based on these values, all brands were found to have lead levels exceeding the limits set by the CSC (Campaign for Safe Cosmetics) and the EPA (Environmental Protection Agency) (Khalid *et al.*, 2013) and nickel concentrations above $1 \mu\text{g. mL}^{-1}$ can cause contact dermatitis (Basketter *et al.*, 1993).

The high concentrations of these metals indicate how much imprudent and irresponsible of these lipstick manufacturing processes and companies. The differences between these values prove that those lipsticks have low quality due to high metals as impurities. On the other hand, the concentrations of these metals in luxurious products is shown in Figure (3). The results showed that the concentrations of the Pb and Ni in expensive products are significantly higher than other products.

All in all, when the amounts of heavy metals in cosmetics are relatively low, their frequent and daily application to delicate and delicate skin areas like the lips, eyelids, and face makes them one of the sources that pose a health risk to humans. The human body experiences high levels of toxicity due to the everyday buildup of these compounds and skin absorption. According to studies, a woman eats 350 g of lipstick in her lifetime. The harm that lipstick caused, particularly classic lipstick, on the human health and linked to several hazardous materials, including lead, nickel, aluminum, cadmium (Abd Elnabi *et al.*, 2023).

4. CONCLUSIONS

The valuation of each heavy metal concentration in each lipstick sample for all five brands collected from Hilla city market observed a significant increase when compared to acceptable FDA limits. The results indicated that an expensive product has a higher concentration in comparison to cheap ones. High consuming of these product can lead to harmful effect on human health.

Therefore, strict rules and control of cosmetic manufacturing from which government legislation is a crucial need to avoid any damage from these metals. Moreover, consumers should be learned about the possible risks of exposure levels far of acceptable limit.

Authors' contributions

Ahmed Ali Alkarimi, project design experiments, and writing. Salam Mohammed Nasser, data analysis and some experiments. Sarah Abdul raheem Ali made editing and proof reading. Amjad J. Al-dabi and, Sumaya Suwady Hussain, samples collection.

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