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Original Article

Determining the Contents of Chromium and Copper Metals in Some Nail Polish Samples

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Keywords
Chromium, Copper, Nail Polish, Libya.

ABSTRACT

The contents of Chromium and Copper were estimated in different samples of nail polish collected from cosmetic and pharmacies in some Libyan cities. In this study, the atomic absorption spectroscopy (AAS)Technique was used for the determination of the selected metals. The results of this study showed small variations in concentrations of Chromium and Copper. Generally, the ranges of chromium and Copper were fluctuated in the following ranges (1.43-2.01 µg/g), where the high content was recorded in sample D(none), while the low content was recorded in sample B(Top lady). On the side, the concentration of chromium ranged between (2.83-3.01 µg/g). The high content of chromium was recorded in A (Flormar), while the low value was found in sample D (None). The study concluded that the presence of toxic metals in the nail polish samples gave negative impact on human health.

Introduction

Declaring the color additives and ingredients on cosmetic product labels had been a major concern of toxicologists for many years. Some studies claim that cosmetics are one of the major sources of releasing heavy metals in the environment [1-2]. Toxic and hazardous heavy metals like arsenic, lead, mercury, zinc, copper, chromium, and iron are found in a variety of personal care products, e.g., lipstick, whitening toothpaste, eyeliner, and nail color. Some heavy toothpaste, eyeliner, and nail color. Some heavy toothpaste, eyeliner, and nail color. Some heavy toothpaste, eyeliner, and nail color. Some heavy toothpaste, eyeliner, and nail color. Some heavy toothpaste, eyeliner, and nail color. Some heavy metals are used in the cosmetics as ingredients, metals are used in the cosmetics as ingredients, metals are used in the cosmetics as ingredients, while most others are contaminants [3].

In recent years, the threat of existing contaminants and their concentration in the human body to health has become an important concern, and cosmetics, disinfectants, and other personal body care products were most focused as major sources of releasing heavy metals to human systems [3-6]. The human nail is more permeable than skin, and it consists of 10-30% water. The nails absorb the pigments of nail polishes [9], and vaporized or soluble metals can easily pass it. The FDA (Food & Drug Administration of the United States) has introduced some admissible pigments for use as additive color ingredients in cosmetics, and all other components must go for pre-market approval before could be applied in any cosmetics [7]. The maximum permissible level for some heavy metals has been fixed for synthetic and natural organic colors in the Drugs and Cosmetics Rules since 1945, while no limitation has been settled for inorganic colors, yet. The FDA has fixed a limit for lead in candy (0.1ppm) while there is no limit set for heavy metals in cosmetic products such as lipstick and nail polishes [8].

The term “ingredient” has not been defined under the Drugs and Cosmetics Act for cosmetics. For colorants to be treated as an ingredient, the term needs to be suitably defined, and the requirements of colorants need to be mentioned in the Drugs and Cosmetics Act. No guideline has been provided by the Drugs & Cosmetics Act and Rules that index coloring agents of cosmetics. Since the 1940s, scientists have known that nail polishes contain allergenic ingredients [13]. Heavy metals like lead, chromium, copper, and cadmium are common contaminants in various cosmetic products [9]. Heavy metal toxicity can result in damage to mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Allergies are common, and long-term contact with some heavy metals may even cause cancer [10]. The possibility of skin allergy and contact dermatitis may increase due to the presence of heavy metals in cosmetics. Arsenic has a pronounced affinity for skin and keratinized structures, e.g., hair and nails, and can cause a variety of skin eruptions, alopecia, and characteristic striation of the nails [11].

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Arsenic, cadmium, and their inorganic compounds are considered human carcinogens [12]. Heavy metals can be measured in different samples by using different methods, such as AAS, ICP, XRF, and others, in different samples, such as water, soils, plants, tissues, and others [13-73]. The studies on toxic compounds, such as heavy metals, hydrocarbons, pesticides, and others, were conducted in many samples [74 -119]. In this, the Atomic spectroscopy method (AAS) was used to estimate the contents of copper and chromium in different nail polish samples collected from some Libyan markets.

Methods

sampling

Four Different samples of nail polish were collected from the local markets of Al-Baida City. The samples were illustrated in the following (Table 1).

Table1. The Types of the studied samples.

Sample /properties	Colour	Source
Flormar (A)	Brown	Turkish
Top lady (B)	Rosy	P.R.C
B, O (C)	Violet	China
None (D)	Pink	Turkish

Samples preparation

5 ml of each sample was transferred into a conical flask, the samples were dried by conc HNO_3 (5ml) until dryness, then 10ml of water was added, after heating for 20 min, the samples were filtered and diluted to 100ml in a measuring flask. The estimation of the concentration of the selected heavy metals was carried out according to different studies [22-27].

The metal content measurements

The concentration of Chromium and Copper was measured by using (Atomic absorption type thermo at Central Lab of Omer EL-Mukhtar University, El-Baida, Libya). The concentration was expressed as µg/g.

The results

The concentrations of copper and Chromium of the selected nail polish samples are illustrated in (Table 2). The concentration of copper ranged between (1.43-2.01 *µg/g*), where the high content was recorded in sample D(none), while the low content was recorded in sample B(*Top lady*). On the side, the concentration of chromium ranged between (2.83-3.01 *µg/g*), The high content of chromium was recorded in A (*Flormar*), while the low value was found in sample D (*None*).

Table 2. The concentrations of Copper and Chromium of the studied samples

MetalsSample	*Cu µg/g*	*Cr µg/g*
Flormar(A)	1.4893	3.0199
Top lady (B)	1.4347	2.9801
B, O (C)	1.5037	2.9717
None (D)	2.0111	2.8306

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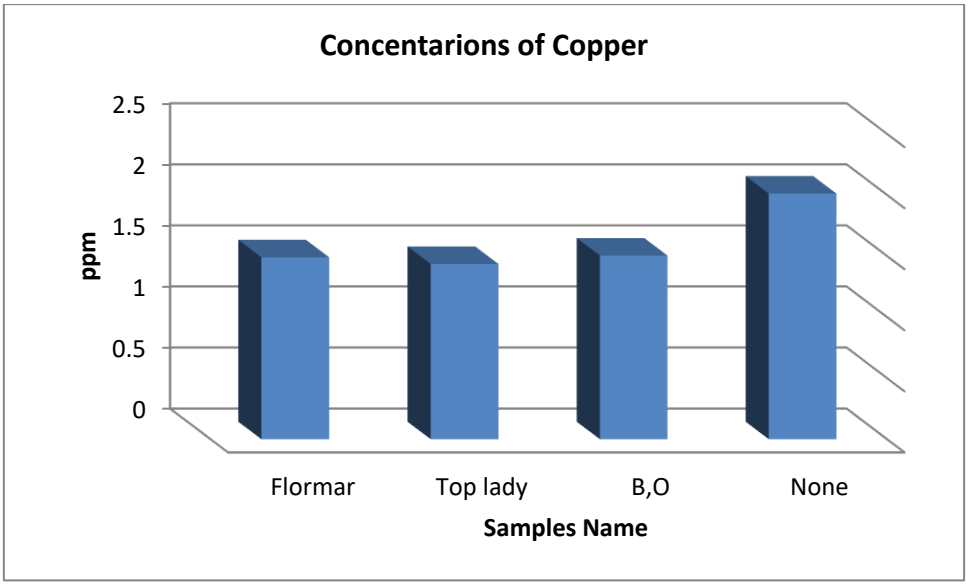

Figure1. The concentrations of copper in the studied nail polish samples.

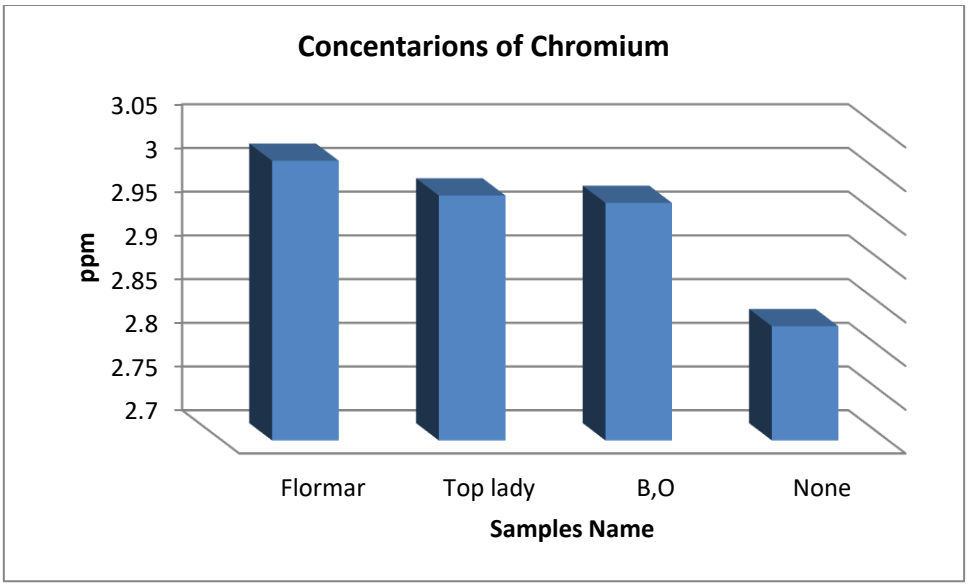

Figure 2. The concentrations of Chromium in the studied nail polish samples.

Discussion

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Examples of heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb). Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. To a small extent, they enter our bodies via food, drinking water, and air. As trace elements, some heavy metals (e.g., copper, selenium, zinc) are essential to maintain the metabolism of the human body. However, at higher concentrations, they can lead to poisoning. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g., lead pipes), high ambient air concentrations near emission sources, or intake via the food chain. Heavy metals are dangerous because they tend to bioaccumulate.

Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater. Chromium is used in metal alloys and pigments for paints, cement, paper, rubber, and other materials. Low-level exposure can irritate the skin and cause ulceration. Long-term exposure can cause kidney and liver damage, and

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damage to circulatory and nerve tissue. Chromium often accumulates in aquatic life, adding to the danger of eating fish that may have been exposed to high levels of chromium [1].
Copper is an essential substance to human life, but in high doses it can cause anemia, liver and kidney damage, and stomach and intestinal irritation. People with Wilson's disease are at greater risk for health effects from overexposure to copper. Copper normally occurs in drinking water from copper pipes, as well as from additives designed to control algal growth [1].
The use of some heavy metals in cosmetics has been controversial due to the biological accumulation of those metals and their toxicity in the human body. In most countries, it is legally prohibited to use lead, arsenic, and mercury in skin cosmetic products; for example, lead is prohibited as part of cosmetic compositions in Korea, the European Union, and China. The maximum allowable level of lead is 20 ppm in those jurisdictions. There are no specific rules on other heavy metals, such as cobalt, nickel, and copper [120]. It is also reported that those metals can cause allergic contact dermatitis or other skin problems [121]. Acceptable limits for heavy metals vary according to the subpopulation of interest (for example, children are more susceptible to heavy metal toxicity than adults). Assessment of dermal absorption by a single component in a cosmetic product is complex and depends on factors such as the concentration in the product, the amount of product applied, the length of time left on the skin, and the presence of emollients and penetration enhancers in the cosmetic product. Given this complexity and the lack of well-conducted dermal absorption studies incorporating these factors, the determination of heavy metal limits in cosmetics based on human health risk alone is a challenge [122].
Heavy metals are found naturally in the environment in rocks, soil, and water; therefore, they exist in the manufacture of pigments and other raw materials in all industries, including the cosmetics industry. Some of these metals have been used as cosmetic ingredients in the past. Examples include the preservative thiomersal (mercury), the progressive hair dye lead acetate, and several tattoo pigments such as red cinnabar mercuric sulfide. Since the issue of heavy metals as deliberate cosmetic ingredients has been addressed, attention is turned to the presence of these substances as impurities. The metals of primary toxicological concern in cosmetics are lead, arsenic, cadmium, mercury, and antimony. Dermal exposure is expected to be the most significant route for cosmetic products since the majority of cosmetics are applied to the skin. Dermal absorption of heavy metals is minimal, with absorption of individual elements influenced by several fundamental physical-chemical properties of the mixtures. Oral exposure can occur from cosmetics used in and around the mouth, as well as from hand-to-mouth contact after exposure to cosmetics containing heavy metal impurities. However, inhalation exposure is typically considered to be negligible [123].
At higher concentrations, heavy metals have been shown to have negative effects. Cancerous breast biopsies show higher accumulations of nickel, chromium, cadmium, mercury, and lead than non-cancerous biopsies, and several metals act like estrogen in the presence of some breast cancer cells. Lead, which may be an impurity, is a proven neurotoxin linked to learning, language, and behavioral problems [124]. It has also been linked to miscarriage, reduced fertility in men and women, hormonal changes, menstrual irregularities, and delays in puberty onset in girls. At puberty, boys developing testes may be particularly vulnerable to lead. Pregnant women and young children are also vulnerable because lead crosses the placenta and may enter the fetal brain. Mercury is linked to nervous system toxicity, as well as reproductive, immune, and respiratory toxicity. Mercury is also found in thimerosal, which is a mercury-based preservative. Mercury is particularly hazardous during fetal development and is readily absorbed by the skin. Neither mercury nor thimerosal is highly common as a direct ingredient or impurity, but the high toxicity of this metal means that the presence of mercury in any cosmetic is a concern. Other heavy metals show a similar tendency to be toxic [125].

Conclusion

In the present study, Copper and chromium were determined in various brands of nail polish. From the results, the toxic metals were present in low quantities. It is feared, however, that the continuous use of cosmetic products contaminated with such heavy metals may cause slow release of these metals into the human body and cause harmful effects to consumers over time. Extensive use of such products should be avoided until the situation is adequately addressed.

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