EVALUATION OF LEAD CONTENT IN TOPICAL COSMETICS COMMONLY USED IN SUDAN

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ABSTRACT

Lead (Pb) is a toxic heavy metal that is linked to a wide spread negative environmental and public health implications in many parts of the world. Limit tests for lead content in many preparations (drugs or cosmetics) are recommended by many official authorities. Several studies have reported contamination with lead in many types of cosmetics in different countries. This study aims to determine the content of lead in the most commonly used topical cosmetics (lipsticks, foundation and face powder) in Sudan. Fifty four samples of topical cosmetics (30 lipsticks, 12 face powder and 12 foundation) were chosen according to a questionnaire previously distributed to two hundred female participants from different universities in Sudan and analyzed for lead content using atomic absorption spectrophotometer (AA-6800, Shimadzu). The result showed that the concentration of lead in the lipsticks was within the range of 0.03-3.62 μg/g with lead been detected in 83.3% of the samples tested, while the concentration of lead was in the range of 0.1- 0.17 μg/g for foundation with lead been detected in 16.7% of the tested samples. On the other hand, only one sample with lead concentration of 0.63 μg/g was detected in the category of face powder and representing 8.3% of the samples understudy. The detected lead content in all sample tested was found to be below the allowable limit by the USA food and drug administration (FDA) for lead in color additives approved for use in cosmetics (20 μg/g).

KEY WORDS: Lead, lipstick, face powder, foundations.
INTRODUCTION

Lead (Pb) is an environmentally ubiquitous toxic metal with cumulative toxicant effects that target multiple body systems, including the neurologic, hematologic, gastrointestinal, cardiovascular and renal systems. It was estimated that, 0.9% of the global burden of disease is due to Pb exposure with the highest burden in developing regions. [1] Despite the huge reduction in Pb contamination arising from major sources like leaded gasoline, paints, plumbing and solder, public concerns still exist over other possible sources of Pb contamination. Among potential sources, herbal remedies and cosmetics have been identified as sources of Pb exposure [2-10] and several warnings have been issued by the FDA regarding the use of many traditional remedies and cosmetics due to their frequent contamination with Pb. An expanded survey carried out by the FDA between February and July 2010 to investigate the Pb content in 400 lipsticks purchased from retail stores shown that the average Pb concentration was 1.11ppm with Pb detected ranged between 0.026-7.19 ppm. [11] Eye cosmetics such as kohl and surma, a type of customary cosmetic product used for eyeliner in south Asia, the Middle East, North Africa, the horn Africa and part of West Africa, have been mentioned as a suspected source of Pb exposure in a number of adults and children. [12-14] Similarly, Pb was reported repeatedly as a contaminant for lipsticks [15-19], face powder [20] as well as eye shadow. [21] The use of Pb-contaminated cosmetics has been observed to be strongly correlated with elevated blood Pb levels. [22-25] Pb is generally not a constituent of cosmetics, but contamination can results during production from ingredients that naturally contain heavy metals or as contaminants of constituent ingredients like pigments of lipsticks, eye shadows, and face powders. [6, 26] In humans, Pb can result in a wide range of biological effects depending upon the level and duration of exposure. Effects at the sub cellular level, as well as effects on the overall functioning of the body, have been noted and range from inhibition of enzymes to the production of marked morphological changes and even death. Both acute and chronic toxicity can results from exposure to Pb with diverse and different pattern of symptoms. Long-term exposure to low levels of Pb can cause disorders such as delayed or reversed brain development as well as behavioral abnormalities and decreased intelligence and can adversely affects the central nervous system, reproductive system, hematopoiesis, cardiovascular and hepatic and renal systems. [27-31] Such harmful effects occur over a broad range of doses, the children generally being more sensitive than the adult with virtually no organ system is immune to the effects of Pb poisoning. [32] Furthermore, Pb freely crosses the placenta and has been related to low birth weight. [33] In view of the wide spectrum adverse effects associated with Pb exposure even at extremely low doses,
suggest that acceptable levels of lead in adults be dropped almost to those of children.\textsuperscript{32}

With $66.55$ billion Gross Domestic Product (GDP) in 2013 and a population of 38 million, Sudan provides a big market for cosmetic products in sub-Saharan countries.\textsuperscript{34} Bearing in mind the adverse effects mentioned for consuming Pb-contaminated cosmetic products, and the fact that Pb has been detected in many types of cosmetics in many countries, the aim of this study was to investigate the concentration of Pb in the most commonly used brands of cosmetic products (lipstick, powder and eye foundation).

2. MATERIALS & METHODS

2.1. Questionnaire

To aid in selection of the most commonly used brands, a questionnaire was distributed to two hundred female participants from different Sudanese universities including: Faculty of Pharmacy, University of Khartoum, College of Medical Radiological Sciences, Sudan University for Science and Technology and Faculty of Education, Aljazeera University. Data were then statistically analyzed using SPSS-16 program (statistical package for social sciences).

2.2. Samples

Selected samples of the most commonly used brands of lipstick (30 samples), foundation (15 samples) and face powder (12 samples) were purchased from different cosmetic stores in Sudan at the time of study (July-December 2012).

2.3. Sample preparation and analysis

Samples were prepared for analysis by using the method of dry ashing\textsuperscript{35} where 10 grams of the sample were digested with 3 ml of 50% w/v Mg (No\textsubscript{3})\textsubscript{2}, evaporated to dryness on a water bath. The residue was ashed in a heating mantle until no more fumes were evolved, before heating on muffle furnace at 500 C\textsuperscript{0} for 3 hours. The digest was taken up in 12.5 ml of 5 M Hcl acid, filtered with Whatman No 4 filter paper into 25 ml volumetric flask and made up to mark with distilled H\textsubscript{2}O.

This was subsequently analyzed for Pb concentration using atomic absorption spectrophotometer (AA-6800, Shimadzu) by the standard calibration technique. The Pb content in the cosmetic products was reported as microgram per gram (\mu g/g) on the basis of
wet weight. Statistical analysis (SPSS-16) was conducted to determine the relation of Pb concentration among the cosmetic products. The P value of 0.05 was considered as significant.

3. RESULTS AND DISCUSSION
Fifty four samples of cosmetics that most commonly used in Sudan including lipstick (30 samples), face powder (12 samples) and foundation (12 samples) were investigated and analyzed for their Pb content in the current study. The samples analyzed showed that Pb was detected in all brands of the cosmetics under study with varying frequencies (Table 1). As seen, most of the Pb-contaminated samples fall in the category of lipsticks where 83.3% of the samples analyzed were contaminated with Pb, while two samples (16.7%) of the foundation samples were found contaminated with Pb and with the least percentages of contamination found in the face powder category (8.3%).

Table (1): Frequency (%) of cosmetic products with Pb contamination

<table>
<thead>
<tr>
<th>Brand</th>
<th>Total Number of Samples</th>
<th>Samples contaminated with Pb</th>
<th>Sample with no Pb detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipstick</td>
<td>30</td>
<td>25 (83.3%)</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>Face powder</td>
<td>12</td>
<td>1 (8.3%)</td>
<td>11 (91.7%)</td>
</tr>
<tr>
<td>foundation</td>
<td>12</td>
<td>2 (16.7%)</td>
<td>10 (83.3%)</td>
</tr>
</tbody>
</table>

The concentration of Pb detected in the lipsticks and foundation were within the range of 0.03–3.62 μg/g and 0.1–0.17 μg/g respectively. On the other hand, only one sample with a concentration of 0.63 was detected in the category of face powder (Table 2). Based on the results shown in Table 2, the average Pb content in lipstick products was higher than that detected in foundation and face powder samples. The average Pb content in lipsticks was significantly higher than those detected in the products of foundation (p = 0.001).

Table 2: concentration of Pb in different brands of cosmetic products

<table>
<thead>
<tr>
<th>Brand</th>
<th>Min</th>
<th>Max</th>
<th>St.dev</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipstick</td>
<td>0.03</td>
<td>3.62</td>
<td>0.77</td>
<td>0.74*</td>
</tr>
<tr>
<td>Face powder</td>
<td>-</td>
<td>0.63</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Foundation</td>
<td>0.10</td>
<td>0.17</td>
<td>0.05</td>
<td>0.14</td>
</tr>
</tbody>
</table>

* P=001
Chronic toxicity due to bioaccumulation of Pb following long-term low level exposure is of considerable importance. Although Pb in topical cosmetics represents a minor source of Pb exposure compared to other sources, applying Pb-containing cosmetics several times a day or every day, can potentially add up to significant exposure levels. So it seems important to evaluate the content of heavy metals including Pb in cosmetic products of daily use like lipsticks, foundations and face powders. The absence of regulations relevant to the marketing of cosmetics in Sudan may allow selling of contaminated products that jeopardizes consumers' health. On the other hand, the US Food and Drug Administration (FDA) have set a limit of less than 20 μg/g for Pb in color additives used in cosmetics.[11] The results of this study shown in Table 2 are far away lower than those specified by the FDA and in comply with the FDA previous findings which confirm that the amount of Pb found in lipstick is very low and doesn't pose safety concerns when lipstick is used as intended.[11] On the other hand, the Campaign for Safe Cosmetics (CSC) has set a limit of 0.1 μg/g as a maximum permissible content of Pb in cosmetics. Our results demonstrated an average Pb contamination in lipsticks at levels much higher than those specified by the CSC[16], (Table 2). Since the CSC limit has been assumed that lipstick may be directly taken in via the mouth similar to candy from which the limit has been extrapolated, it is seen that this is not a valid standard as long as lipsticks used as intended.

In the contrary to the findings of this study, a high Pb content was detected in lipstick and powder.[17,19,36] Similar results to our findings were reported by a previous study conducted in Sudan to assess the level of Pb content in powder and eyeliner products with Pb been detected in 9.1% of the powder products analyzed.[20]

4. CONCLUSION

This study has revealed that the concentration of Pb in the cosmetics under study was much lower than those specified by FDA. Despite being a negligible source for heavy metals, cosmetics repetitive application can exposes users to low levels of heavy metals of which Pb is of paramount toxicological concern. Therefore, effort should be made at enlightening the users and the general public especially pregnant women and children of the danger involved.

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