

Technical note

Lead evaluation in children's lipsticks through atomic absorption spectrometry

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Lead is a metal with recognized toxicity and it is known that it may be a contaminant in lipsticks. In Brazil, the Health Regulatory Agency (ANVISA) determines that the maximum limit allowed for the presence of lead in lipsticks is 20 ppm. Children are more vulnerable to lead toxicity. The objective of this study was to evaluate the presence of lead in infant lipsticks. Nineteen samples from four different brands sold in Brazil were evaluated. After sample extraction, analyses were performed by graphite furnace atomic absorption spectrometry. Lead was not detected in any of the tested lipsticks. Considering the presence of lead in adult makeup, the present study reinforces the need to use products intended for children considering kids are more vulnerable to lead toxic effects.

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Introduction

Infant skin is sensitive, thin and presents greater skin absorption (1). Children are more sensitive to cosmetic products such as perfumes, lipsticks and eye shadows (2, 3), however, even so, the use of cosmetics by children is high (4).

The components of these products that usually cause irritations are metals, fragrances, preservatives, petroleum-derived chemicals and dyes which usually contain metals. Cosmetic products used in mucous membranes such as lipsticks are the most dangerous, since they present a higher risk of ingestion by children (3). Hence, the exposure to lead through the use of lipsticks is of great concern, both by gastrointestinal ingestion and percutaneously. Dermal exposure to metals may result in the absorption of inorganic lead ions, but with lower efficiency compared to other absorption pathways. However, considering that children present the hand-to-mouth behavior (habit of carrying contaminated hands to the mouth), the exposure might be more severe by combining dermal and oral ingestion. Furthermore, the possibility of contact dermatitis might increase when metals as lead are present in cosmetics (5). Regarding its pharmacokinetics, lead is excreted mainly by urine, but with considerable excretion in the feces (6). The Brazilian Health Regulatory Agency (ANVISA) is responsible for establishing the allowed limits of contaminants in products that must undergo health surveillance. It is its responsibility to ensure the safety of cosmetic products manufactured in Brazil or imported

from other countries (7). According to ANVISA regulation through the RDC 44/2012, the maximum limit of lead allowed in lipsticks (both infant and adult) is 20 ppm (parts per million) (8). On the other hand, the U.S. Food and Drug Administration determines a maximum amount of 10 ppm of lead as impurity in cosmetic products for lips and externally applied cosmetics (9). FDA determined this limit due to lead analysis in hundreds of US marketed lipsticks, and observed lead levels up to about 7 ppm (9). Considering the concern of lead contamination in infant lipsticks, this study aimed to analyze the amount of lead in different brands of children's lipsticks available in Southern Brazil.

Experimental section

Materials

Nitric acid 65% (Merck®), hydrogen peroxide 30% (Química Moderna®), and triton X-100 (Synth®) were purchased from Pró Análise. Analyses were performed in Laborplan (Laboratório de Análises de Água do Planalto Médio Ltda, Passo Fundo, RS, Brazil).

Sampling

Nineteen samples of children's lipsticks were analyzed, which were purchased from pharmacies in the city of Passo Fundo, RS, Brazil, as shown in the Table 1.

Table 1. Brands and colors of lipsticks used in this study.

Sample	Brand	Lipstick color
1	Disco Teen	Pink with glitter
2	Disco Teen	Light pink with glitter
3	Disco Teen	Dark pink with glitter
4	Disco Teen	Red
5	Disco Teen	Pink
6	Frutillita	Pink (Apple)
7	Frutillita	Red (Vanilla)
8	Frutillita	Red (Grapes)
9	Safira (production line teen unicórnio)	Red with glitter (color n. 01)
10	Safira (production line teen unicórnio)	Purple (color n. 06)
11	Safira (production line teen unicórnio)	Lilac (color n. 07)
12	Safira (production line teen unicórnio)	Red (color n. 03)
13	Safira (production line teen unicórnio)	Nude (color n. 04)
14	Safira (production line teen unicórnio)	Pink (color n. 02)
15	Magia das princesas	Light pink (intelligent)
16	Magia das princesas	Pink (intelligent)
17	Magia das princesas	Pink (loving)
18	Magia das princesas	Lilac (courageous)
19	Magia das princesas	Purple (courageous)

Lead quantification in lipsticks

All glassware and materials used were previously cleaned with distilled water and decontaminated with nitric acid for 24 hours. For the digestion process, each lipstick sample was weighted (0.025 g) and added 5 mL of nitric acid and 1 mL of triton x-100 and incubated for 3.5 hours at 80 °C. After cooling at room temperature, 2 mL of hydrogen peroxide 30% were added. After 5 minutes, samples were centrifuged at 1300 g (2). The supernatant was analyzed by graphite furnace atomic absorption spectrometry, as previously described (2). As controls we used two adult lipsticks, one with 2.2 ppm of lead as positive control and one without lead as negative control. Analytical protocol employed by us was previously validated (2). Analyses were performed in triplicate.

Atomic Absorption Spectrum

An atomic absorption spectrometer with graphite furnace AA 7000 from Shimadzu (GFA-7000A) was used. Lead detection and quantification limits are 5 ppm to 25 ppm, respectively. A calibration curve was performed with increasing concentrations of lead on the day of the analysis, as shown in figure I. The analyses were carried out in the Laboratório de Análises de Água do Planalto Médio Ltda (Laborplan), Passo Fundo, RS, Brazil.

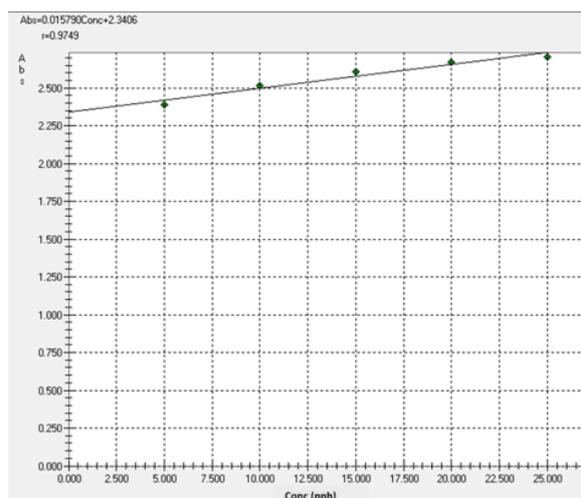


Figure 1. Lead calibration curve (5 to 25 ppm). Standard curve was done in triplicate.

Results and Discussion

The greatest contribution of this study is to show that none of the infant lipsticks evaluated presented detectable levels of lead.

Lead is a heavy metal that presents considerable toxicity when in excess in the body. Lead contamination in lipsticks and other cosmetics may occur due to the use of components that naturally contain this contaminant, as dyes extracted from nature. Generally, lead removal is not performed during the manufacturing process (4).

In this study, we evaluated children's lipsticks and lead was not detected. The limit of detection of the method employed here is 5 ppm. Therefore, we evidence that if traces of lead are present in the lipsticks studied, these residues do not extrapolate the maximum limit allowed by ANVISA, which is 20 ppm.

The amount of lead in lipsticks marketed in Iran is around 0.00008 to 0.0052 ppm (10). Although present, this metal is at trace values, below the limits determined by FDA (9). In lip products (gloss and lipstick) from the European Union, 78% contained lead at less than 1 ppm, 4% presented lead above 2 ppm, and the remainder contained between 1 and 2 ppm of lead (11). However, the lead content found in lipsticks is about twice what is found in gloss (11). Lead limits in lipsticks recommended for Germany and for Canada are 20 ppm and 10 ppm, respectively (9). Samples of lipsticks, body paints and eye shadows from the United States showed a lead content of 0.15 to 9.3 ppm (12). Still in the United States, after testing 400 lipstick samples, the maximum lead concentration found was 7.19 ppm (13).

In Brazil, a study conducted by the Laboratory of Inorganic Analysis of Inmetro and the Food Laboratory - Inorganic Elements Sector of the National Institute of Quality Control in Health - INCQS/Fiocruz showed that among 15 samples tested, most of the samples had between 0 and 1 ppm of lead. Only one sample presented 4.3 ppm of lead content, which was the highest amount found but still below the limit allowed by ANVISA (14).

As discussed above, lead levels in infant lip products are often below the limits allowed by regulatory agencies. However, it is important to consider that chronic poisoning by residual lead levels might occur in children who exhibit hand/mouth behavior and consequently ingest lipstick and other cosmetic products. Lead poisoning is called saturnism (2), a condition that occurs in people daily exposed to lead and may affect the whole body (15). Children are more sensitive to damage to the central nervous system due to their period of neurological immaturity (2). The absorption of lead through gastrointestinal route is slow and may vary according to physiological and nutritional conditions of the subject exposed. For instance, low calcium or iron content in diet increases the absorption of lead ions (4,5). Regarding neurotoxicity, it can be expressed as decreased reasoning and neuropathy, and the increase in circulating aminolevulinic acid may be responsible for some of the behavioral disorders observed in patients with lead toxicity (16). Other symptoms that are commonly observed are nephropathy and hypertension (17, 18). Also, hematological disorders that lead to anemia might happen, as consequence of lead toxicity on red cells and erythropoiesis in the bone marrow (4, 19). Hyperuricemia can happen as well, which causes the saturnine gout (4,17).

Conclusions

This study shows the absence of lead in children's lipsticks or even the presence in concentrations lower than 5 ppm, suggesting the quality of the raw material about the presence of heavy metals and the final product marketed in Brazil, thus showing that industries follow the formulation criteria in this issue. Considering the presence of lead in adult makeup, the present study reinforces the need to use products intended for children considering kids are more vulnerable to lead toxic effects.

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