Original Article

Mercury and Lead Levels in Common Soaps from Local Markets in Mashhad, Iran

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ABSTRACT

Background: The potential toxicity of human exposure was investigated to heavy metals from diverse sources but few or none was on Iranian soaps. Hence, we aimed to determine the presence of lead and mercury in selected soaps commonly used in Mashhad, northeastern Iran.

Methods: Different common brands of cosmetic, hygiene and contraband soaps were purchased from retail market of Mashhad in 2016. Levels of these metals were determined using atomic absorption spectroscopy technique.

Results: All samples had the mercury and lead levels but did not exceed the maximum acceptable level (1 µg/g for mercury and 20 µg/g for lead) recommended by FDA. The mean levels of mercury were 0.02, 0.08 and 0.23 µg/g, respectively in cosmetic, hygiene and contraband soaps. These levels for lead were 0.10, 0.19 and 0.13 µg/g. The highest mercury and lead levels were detected in Halazoon contraband and P hygiene brands, respectively.

Conclusion: The content of mercury and lead in common soaps is currently not a concern in this city. However, as human body may be exposed to several toxic metals from different care products simultaneously, cumulative toxic effects of these metals must be considered important.

Keywords: Atomic Absorption Spectroscopy, Iran, Lead, Mercury, Soap.

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INTRODUCTION

In parallel to technology development in recent decades, human consume some products containing toxic substances added for different purposes. The body is exposed to toxic agents subsequent to the long-term use of these products that may threaten human health. For instance, anionic surfactants, such as soap are generally consumed for washing, cleaning and medicinal purposes that play a critical role in human life. Different kinds of soaps are technically produced from reaction of animal or plant oils with strong solution of NaOH/KOH to generate glycerin and relevant salt of the fatty acid, a process called saponification [1]. In this regard, heavy metals may be added to detergents as preservatives, pigments (lead), skin lightening, as well as antimicrobial agents (mercury). These substances can affect and damage human body organs [2, 3].

There has been an increased awareness about the health effects of toxic and other **trace metals** subsequent to environmental exposure [4, 5]. Mercury and lead are dangerous for health [4]. The bioaccumulation of these metals occurs via ingestion, inhalation or absorption through the skin disrupting the immune, neurological, blood cardiovascular and endocrine functions of the body. High level exposure will not necessarily produce a state of toxicity, most cases of heavy metals poisoning result from chronic low-level exposure [1].

The potential carcinogenicity of human exposure to heavy metals from diverse sources such as air, food, water, soil ceramics, gasoline, rubber toys, and personal care products (cosmetics, mouthwash. toothpaste, shampoo, and hair care products are investigated. For instance, studies on the use of skin lightening creams containing mercury in Nigeria revealed a prevalence of dermatological side effects [6].

Since some toxic metals can cause bad consequences in long-term at low levels and as the

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little is known about the exposure of human to heavy metals as for soaps, our study was aimed to investigate mercury and lead concentrations in common soaps from local markets in Mashhad, Iran.

MATERIALS AND METHODS

Three samples from four common brands of cosmetic soaps (F and D, S and L), five brands of common hygiene soaps (P and Y, T and G and A), and two brands of contraband soaps including Halazoon (two samples) and Kharchang (three samples) were selected to be investigated in terms of lead and mercury concentrations. The study was performed in 2016.

Concentrations of lead were measured by atomic absorption spectrometric method using graphite furnace (Perkin Elmer model 3030, USA) and contents of mercury were measured by a mercury/hydride system. The reliability of the method was evaluated by spiking heavy metals into five samples, determining recovery, detection limit, and accuracy parameters. The accuracy for determination of mercury and lead were 98.4% and 99.4%, respectively.

The heavy metals levels were compared to the maximum permissible levels of heavy metals in soaps and cosmetic materials set by the Food and Drug Administration (FDA) [2]. The FDA guidelines for mercury and lead in soaps and cosmetic materials are 1 and 20 µg/g, respectively.

Statistical Analysis

Data were analyzed by SPSS® for Windows® ver 11.5 (SPSS Inc, Chicago, Il, USA). Results are presented as mean±SEM. A *P*-value <0.05 was considered statistically significant.

RESULTS

Mercury and lead concentrations in all cosmetic, hygiene and contraband soap samples did not exceed the maximum permissible levels of FDA. There were significant increases in mercury levels of contraband soaps in comparison to internal brands, cosmetic ($P<0.01$) and hygiene ($P<0.05$) soaps. On the other hand, there were no statistically differences among lead levels of different brands (Table 1). Among the various brands of cosmetic soaps, there were no significant differences in light of levels of lead and mercury (Table 2). Evaluation of the different brands of hygiene soaps showed that P soap significantly had higher levels of lead as compared to T brand ($P<0.05$) (Table 3). Moreover, the amounts of lead and mercury in contraband soaps did not show any statistical differences between Halazoon and Kharchang brands (Table 4).

Table 1. Levels of metals analyzed in soap samples.

Soap	Lead level (µg/g)	Mercury level (µg/g)
Cosmetic	0.10 ± 0.01	0.02 ± 0.004
Hygiene	0.19 ± 0.04	0.08 ± 0.013
Contraband	0.13 ± 0.04	0.23 ± 0.122**#

** $P<0.01$ indicates significant changes compared to the cosmetic soap group.
# $P<0.05$ indicates significant changes compared to the hygiene soap group.

Table 2. Levels of metals analyzed in cosmetic soap samples.

Cosmetic soap	Lead level (µg/g)	Mercury level (µg/g)
F	0.12 ± 0.020	0.016 ± 0.006
D	0.08 ± 0.003	0.03 ± 0.005
S	0.08 ± 0.006	0.013 ± 0.003
L	0.12 ± 0.012	0.03 ± 0.011

Data are shown as mean ± SE.

Table 3. Levels of metals analyzed in hygiene soap samples.

Hygiene soap	Lead level (µg/g)	Mercury level (µg/g)
P	0.36 ± 0.205	0.14 ± 0.026*
Y	0.14 ± 0.006	0.07 ± 0.028
T	0.12 ± 0.014	0.03 ± 0.011
G	0.21 ± 0.027	0.11 ± 0.018
A	0.12 ± 0.035	0.08 ± 0.003

Data are shown as mean ± SE.
* $P<0.05$ indicates significant changes compared to the T soap.

Table 4. Levels of metals analyzed in contraband soap samples.

Contraband soap	Lead level (µg/g)	Mercury level (µg/g)
Halazoon	0.19 ± 0.105	0.39 ± 0.320
Kharchang	0.09 ± 0.003	0.12 ± 0.032

Data are shown as mean ± SE.

DISCUSSION

Heavy metals have relatively high densities (> 3 g/cm^3) known to cause adverse effects on human body at concentrations that exceed the maximum acceptable levels recommended by

FDA [7, 8]. A number of these occur as natural constituents of the earth crust including arsenic, cadmium, chromium, lead, mercury, manganese and so on [7, 9, 10].

Through dermal contact, heavy metals can be absorbed via a moist skin. For instance, lead was increased in 7 out of 9 adult males in hair and other parts of their body after applying a hair dye containing lead acetate [11]. Lead is a common contaminant in different eye and face cosmetics identified as a suspected source of its exposure [12, 13]. Moreover, mercury is added to soaps and creams to lighten human skin (6). In these products, it exists in two forms as organic and inorganic. While the organic compounds do not use in cosmetics, the inorganic mercury forms such as mercury chloride play a key role in skin lightening. If it is absorbed through the skin, mercury might cause effects ranging from dermal to renal, neurological (weakness, headache, insomnia, memory loss, and irritability) toxicity [14].

With getting through the reliable scientific databases such as PubMed, ISI, and Scopus, many studies (2, 11-13) have reported the presence of heavy metals in cosmetic products especially in lipsticks and nail polish; however, the data of presence of lead and mercury in soaps was scanty. Nevertheless, being released of heavy metals from cosmetics in the environment are of the utmost importance.

CONCLUSION

The highest levels of mercury and lead were detected in Halazoon contraband and P hygiene brands, respectively. Both mercury and lead of all soaps were under the FDA maximum permissible levels. However, as human body may be exposed to several toxic metals from different care products simultaneously, cumulative toxic effects of these metals must be considered important. Finally, since the Halazoon soaps contained the highest amount of mercury compared to other brands, it is recommended regularly determining the mercury content of contraband soaps.

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