

Research Article

Estimation of Lead and Cadmium Concentration in Different Hair Dyes

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Abstract | Cosmetic and hair dye has been one of the pollution resources of heavy metals. Hair dyes are now part of the rapidly growing beauty products catering to both men and women to enhance youth, beauty and following fashion trends. The present study was conducted in order to find out different concentration of lead and cadmium in different hair dyes. Thirty samples of hair dyes both local and imported were collected from the different market of Lahore. The lead and cadmium concentration in samples was determined using atomic absorption spectrophotometry (AAS). Mean conc. of Pb was highest 7.8mg/l in local brown shade and lowest value of Pb 1.0mg/l was present in local black shade. Mean conc. of Cd was highest 0.7mg/l in branded black shade which was lowest as compared to standards. Lead and cadmium concentrations were lower in branded hair dyes and higher in locally available hair dyes than permissible limit prescribed by FDA. People should prefer branded hair dyes instead of local hair dyes because of higher lead and cadmium toxicity found in local hair dyes. The Government should work towards the making and implementation of standards within Pakistan. Therefore, it was concluded that lead is one of most lethal toxic heavy metals but cadmium was under the allowable limit. The constant use of hair dye products polluted with such heavy metals may cause slow release of these metals into the human body and thus show their harmful and serious effects.

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1. Introduction

A large variety of chemicals are used either as ingredients or preservatives in cosmetic products making them an important source of heavy metals. Presence of harmful chemicals such as heavy metals and other contaminants in final product cosmetic is of

serious concern. (Salama, 2016). Both men and women now commonly use hair dye products irrespective of economic and education status to enhance their youth, beauty and to follow fashion trends making hair dyes part of the rapidly growing beauty and personal care industries. People dye their hair to emphasize the importance given

to appearance; however hair dyeing is mostly done for cosmetic purposes (Kim *et al.*, 2016). The complexity of formulas in commercial hair dye, with dozens of components, and the formulas are different between the manufacturers. In general, the components of hair dyes contain dyes, antioxidants, modifiers, alkalizers, ammonia, soaps, fragrance, wetting agents, and a many of other chemical materials which is used in small amounts that transfer special qualities to hair (such as softening the tissue) or give a desired process to the dye (such as making it more or less enduring).

Certain metal oxides such as iron oxide and titanium dioxide are often used as hair dye pigments (Balsam and Sagarin, 1972). Hair dye poisoning has been emerging as one of the important causes of intentional self harm in the developing world. Hair dyes contain paraphenylenediamine and a host of other chemicals that can cause rhabdomyolysis, laryngeal edema, severe metabolic acidosis and acute renal failure. Intervention at the right time has been shown to improve the outcome. The various manifestations, clinical features and treatment modalities for hair dye poisoning (Sampathkumar and Yesudas, 2009).

Some coal tar colors also contain heavy metal impurities, including arsenic and lead that cause cancer if it's increased and can spoil and ruin hormones. For all that in hair dyes many of the synthetic colors which used have never been tested for safety and secure, WHO considers them as possible carcinogens (Mielke *et al.*, 1997). Ingredients used in hair dyes have been associated with moderate to low acute toxicity, however accidental human poisoning due to hair dyes is rare except in reported cases of oral ingestion. Contact sensitization may occur as a consequence of unprotected professional exposure (Nohynek *et al.*, 2004). Keeping all these facts in mind, the present study was designed to screen the status of lead and

cadmium content in different hair dyes sold across markets in Lahore.

2. Materials and Methods

Thirty samples of hair dyes both local and imported were collected from the market after 4 weeks visit. The hair dye samples collected were taken to the Research Laboratory and stored prior to analysis at room temperature. After sample collection the hair dyes were categorized with respect to colors and brands. The hair dye samples 2g each were placed in beaker and weighed it by using digital weighing balance.

The hair dye samples were wet digested with a mixture of Nitric Acid and Perchloric Acid (ratio 4:1), the mixture was heated for 2-3 hours on hot plate at 37°C until complete digestion of samples took place. The solutions were allowed to cool and were filtered in 100ml volumetric flask by Whatmann No 42 filter paper, and diluted up to the mark with deionized water (Goswami and Mazumdar, 2016).

The treated samples were then stored in 100ml test tubes and stored in laboratory at 25°C room temperature. Samples were tested on atomic absorption spectrophotometer using hollow cathode lamp of lead and cadmium. The values of standard solution, references, absorbance and concentration were noted.

3. Results

The mean concentration of lead and cadmium of all shades of hair dye samples was compared with standard value as recommended by FDA (5 mg/l) for lead and (2 mg/l) for cadmium respectively (as shown in Figure 1 and Figure 2). Mean concentration of Pb was highest 7.8mg/l in local brown shade and lowest value of Pb 1.0mg/l was present in local black shade. Mean concentration of cadmium in local black and brown shade was lowest as

compared to standard. Highest Mean concentration of Cd 0.7mg/l was found in branded black shade which was lowest as compared to standards. Results revealed that in international hair dyes lead and cadmium were in safe limits as recommended by FDA while in local hair dyes lead limits exceed among brown shade and cadmium limits were in safe limits as recommended by FDA. Although cadmium was not found but their constant use poses their harmful and serious effects.

Prolonged exposure to lead can result in brain damage, nerve damage and neurological disorders, among other

problems. The slow release of cadmium results in heart diseases, hypertension and liver damage. Human exposure to heavy metals causes health problems and use of cosmetic products; especially lipstick and hair dye contaminated by metals is considered a way of exposure to these agents (Mansouri *et al.*, 2018). In this study, a simple, reliable, sensitive and convenient AAS method has been developed for quantitative estimation of Pb and Cd which can currently be utilized for the quality control of cosmetic preparation at industrial level.

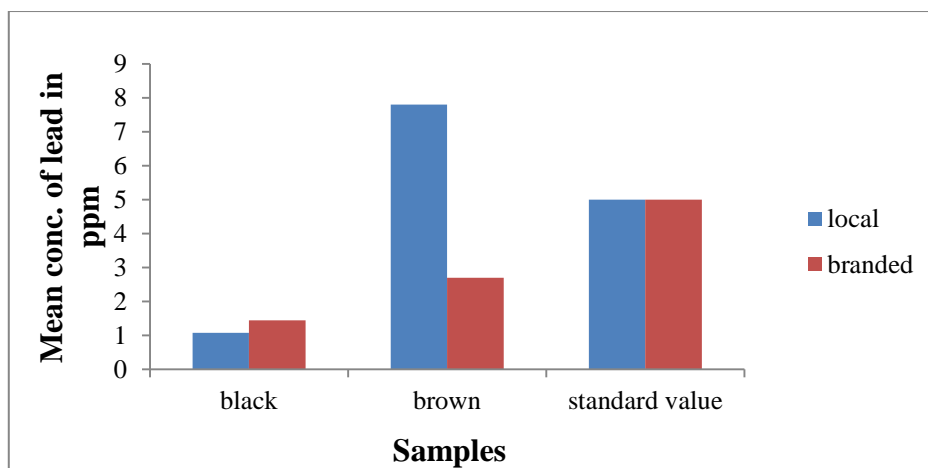


Figure 1: Bar graph showing Comparison of mean conc. of lead with standard among all hair dyes

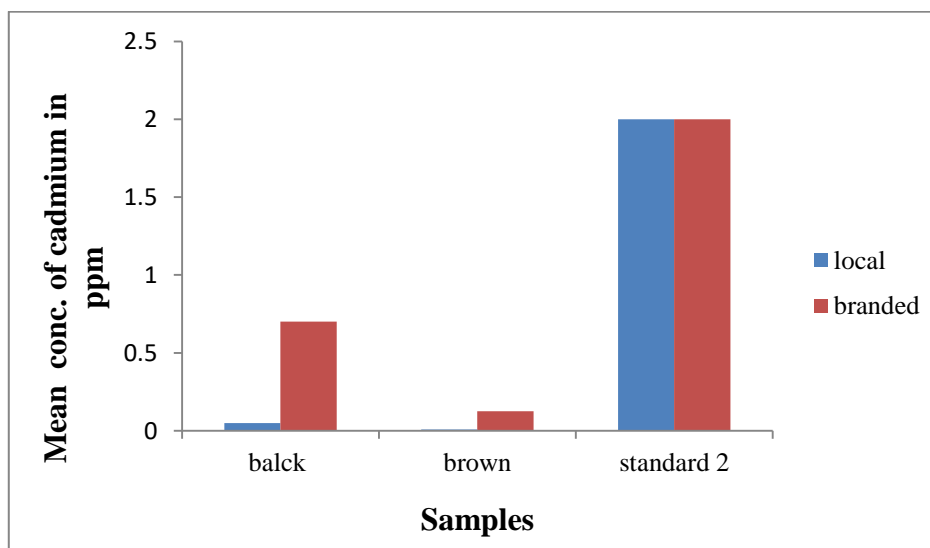


Figure 2: Bar graph showing Comparison of mean conc. of cadmium with standard among all hair dyes

4. Discussion

The present study determined the presence of heavy metals in hair dyes. The flame atomic absorption spectrometry method used for determining the concentrations of the heavy metals in hair dyes is rapid, precise and implies cost effective method. This study also provides data regarding the lead and cadmium concentrations in some locally and branded available hair dyes found from local markets of Lahore and it also can help to evaluate the consumer's risk of exposure to the levels of toxic metals which were presented. Lead and cadmium concentrations were lower in branded hair dyes and lead concentration was higher in locally available hair dyes than permissible limit as prescribed by FDA.

5. Conclusion

People should prefer branded hair dyes instead of local hair dyes because of higher lead and cadmium toxicity found in local hair dyes. The Government should work towards the making and implementation of standards within Pakistan.

6. Acknowledgments

Authors would like to acknowledge Environmental Sciences Department for providing lab and facilities in conducting present work.

7. Author's Contribution

All authors have made a substantial contribution to the concept, design, analysis and interpretation of data for the article.

8. Conflict of Interest

There was no conflict of interest among authors regarding the publication of this article.

9. Novelty Statement

Several studies have reported cases of acute and chronic toxicity due to cosmetic use. Present study was designed to estimate metallic lead and cadmium contamination in local and International hair dye brands sold in Pakistan. Results clearly indicate that although both local and International brands had traces of lead and cadmium in them, their concentration in International brands was in accordance with International standards set by the FDA as compared to local brands which not only violated these standards but are harmful to consumers.

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