

■ ORIGINAL ARTICLE

# Evaluation of the Concentration of Heavy Metals in Kohl (Kajal) using ICP-OES

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## ABSTRACT

**CONTEXT:** Kohl or *kajal* is an ancient and popular eye cosmetics. In its simplest form, it is a fine black or gray powder that contains high level of lead (usually in the form of lead sulphate). *Kohl* is a popular eye product and is prepared in ultra-fine form using galena along with some other ingredients. Presently, most of the women and adolescents use it in their daily make up regime to enhance their beauty. However, it is known to contain varying levels of toxic compounds in the form of additives making it highly unsafe for use.

**AIMS:** In the current study, an attempt has been made to determine the concentration of lead, nickel, and cobalt in kohl samples.

**MATERIALS AND METHOD:** Ten different Kohl samples of different brands were bought from online and nearby markets. The evaluation of heavy metals such as lead, nickel and cobalt were determined from the samples using Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES).

**RESULTS:** Results obtained in the study have been alarming especially in the case of lead which was found to be as high as 8 ppm, nickel 5ppm and cobalt 4 ppm in different brands.

**CONCLUSIONS:** Regular application of kajal with excessive high content of heavy metals leads to serious health hazards.

**KEY MESSAGES:** Kohl containing heavy metals can have health hazards with long term usage and hence should be used judiciously.

KEYWORDS | Kohl, heavy metals, ICP-OES, toxicity

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## INTRODUCTION

**K**AJAL (KOHL) IS ONE OF THE EASILY available and most common eye cosmetics. And it has been used since ancient times. It is prepared by using a specific powder known as “*kohl stone*” (Galena) which is later processed with other ingredients. The purpose of this powder was to keep the eyes cool and clean, improve vision and strengthen the eyes. It was believed that it could protect the eyes from direct sun light and were used to line the upper and lower lashes.<sup>1,5</sup> Apart from being widely used since ancient times, it was also used by other tribal communities, who

used it for drawing distinct lines around the forehead, nose, and other body parts as well.<sup>2,4</sup> It comprises of other chemicals like galena (PbS), minium (Pb<sub>3</sub>O<sub>4</sub>), amorphous carbon, magnetite (Fe<sub>3</sub>O<sub>4</sub>), and zincite (ZnO). Due to its composition, it is considered unsafe for use and as an illegal substance to be imported or sold in the United States by FDA.<sup>3,7,8</sup>

The US Food Drug and Cosmetic Act<sup>8</sup> defines cosmetics as any articles which are intended to be rubbed, poured, sprinkled, or sprayed on, introduced into or otherwise applied to the human body or any other part for

beautifying, promoting attractiveness or altering the appearance.

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#### MATERIALS AND METHOD

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##### OBJECTIVE

Analysis and estimation of Lead, Nickel and Cobalt in kohl samples purchased from local markets.

##### HYPOTHESIS

1. Kohl samples collected from the local market would contain lead, nickel & cobalt that can cause skin diseases.
2. Quantitative estimation of lead, nickel and cobalt can be done using ICP-OES.

##### SAMPLE TYPE AND SIZE

Kohl samples for the study were bought from the local market. Post-purchase, all the Kohl samples were photographed in their original packaging, the purchase bills secured and the composition, if any, were noted down. In all ten branded kohl, samples were taken for analysis of lead, nickel and cobalt.

##### SAMPLE PREPARATION

All the apparatus were thoroughly washed and rinsed using normal water followed by immersing the same in 5% solution of Nitric Acid (HNO<sub>3</sub>) overnight, later by rinsing with deionized water before using the same.

1. 1 gm/ 1 ml of kohl was taken in a beaker.
2. The beaker was then heated in muffle furnace at 450°C.
3. After the sample was turned to ash, the digestion was done.
4. For acid digestion, hydrochloric acid and nitric acid was taken in a ratio of 1:3.
5. 25 ml of acid digestion was added to the beaker and heated on a tripod stand till the solution was clear.

##### INSTRUMENT USED

The Vista-MPX simultaneous ICP-OES with axially viewed plasma was used for this work. The instrument was fitted with the 3-channel peristaltic pump which further helps in easy introduction of ionization buffer to the sample via a post-pump Y-piece.

##### WORKING PRINCIPLE

- First of all, the sample is introduced into

the chamber, in a liquid form which is sprayed using a nebuliser. Due to the high temperature inside, the chamber atomizes and ionizes the sample, creating positively charged atomic ions.

- The larger droplets are then removed from the gas chamber, and the remaining smaller droplets are transferred into the central passage of an argon plasma.
- The droplets are then dried, deteriorated, and dissociated into an individual atom in the chamber.
- These atoms are then converted into cations via interface before they enter the vacuum system.
- Electrostatic lenses keep the ions focused, as they pass to the chamber and the outcome were recorded by the detectors. It uses a higher thermal energy which discrete the cations from the photons and neutral particles.
- Analyte ions are then separated & scanned using multiplier detector. The spectrometer will measure the spectrum of each ion.
- The light intensity on the wavelength is measured and with the calibration calculated into a concentration.

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#### RESULTS

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This research was performed in triplicate analysis. The number of selected kohls were ten which were collected from the cosmetic shops in the local market and via online. The data presented in Table 1 and Graph 1, shows remarkably high concentration of lead in all the brands, the least being in Patanjali estimated at 3ppm. The maximum was observed in Colorescence at 12 ppm. The findings obtained in the present study indicate that kohl products available in the markets contain heterogeneous chemical composition and contain significant amounts of toxic elements other than lead such as nickel and cobalt which are bound to cause deleterious effects on the body.

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#### DISUCSSION

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The results obtained in the present study

BRAND	LEAD (PPM)	NICKEL (PPM)	COBALT (PPM)
Avon	8	4.5	4
Attitude	4	2	2
Colorbar	3.7	2	2
Colorescence	12	5	4
Loreal	5.5	4.5	2.8
Maybelline	6	4	3
Oriflame	4	3.7	2.4
Mac	4.4	2.8	3.7
Faces	2.8	3.2	2
Patanjali	3	2.6	2.2

Table 1: The concentration of lead, nickel, and cobalt in Kohl brands.

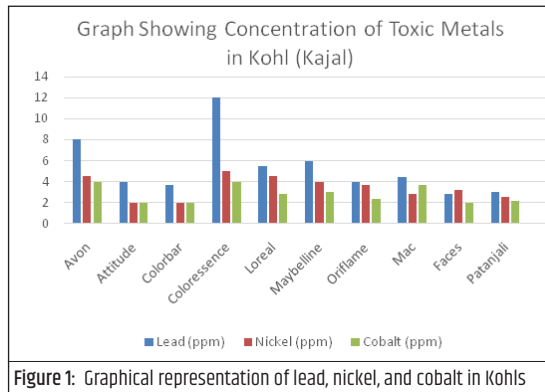


Figure 1: Graphical representation of lead, nickel, and cobalt in Kohls

confirm the findings published in previous studies that have analyzed kohl. The findings in the present study are a definite cause for concern considering that kohl is a very commonly used cosmetic product used by almost all age groups varying from infants to the adult. The easy availability of this product at retail outlets and online purchases adds to the concern. The problem however gets magnified as some of these products contain significant amount of lead and other heavy metals such as nickel and cobalt. Additionally, some of these products also do not provide the requisite information regarding the qualitative and quantitative composition.<sup>9</sup> The study also emphasizes the need for a quality control in the product manufacture.

#### CONCLUSION

In earlier times, women preferred to prepare Kohl at home. Nowadays people purchase them from the market. The study has revealed that the presence of higher amount of lead may be due to the factitious elements in the samples as there are no proper awareness in the production and distribution of these products. However, the chances of mixing of sub-standard elements can't be ignored. The result clearly shows

that improvements need to be conducted of these toxic metals which are used in cosmetic products. The permissible limits of potential impurities in cosmetics such as the *kajal* must be strictly enforced. The companies can take steps to minimize the impurities in their products by following good manufacturing practices. There is an urgent need for a thorough evaluation of health risks to the users from these cosmetics which are adulterated with harmful heavy metals. It was concluded from the result that most of the brands of were tainted with a high concentration of lead. It was inferred from the result that most of the brands of kajals were contaminated with high concentrations of lead. Manufacturers can help minimize impurities in cosmetics by following good manufacturing practices. This includes testing of ingredients and the finished products to make sure they meet certain manufacturing standards. Removal of toxic metals is not possible after the product has been manufactured. However, if the contents are carefully chosen while keeping in mind the toxicity of heavy metals, we can surely improve the quality of these products to protect the consumers using these products.

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