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Evaluation of the Concentration of Heavy Metals in Sindoor using ICP-OES

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Abstract

Sindoor has been considered as auspicious and is put on the centre parting of the head (*maang*) by married women in India. Presently, most sindoor manufacturers use synthetic materials and dyes to make these products. In the present study an attempt has been made to determine the concentration of heavy metals especially lead and mercury in the sindoor samples. These sindoor samples were purchased from the local markets in two forms, i.e. in liquid and powder forms. The heavy metals were determined using ICP-OES. The results obtained in the study has been alarming specially in case of lead which was found to be as high as 382.3ppm in some powder sindoor brands and 34.6ppm in the liquid sindoor brands. Though meant for topical application this cosmetic product with excessively high content of lead can be taken as a storehouse for heavy metal toxicity which may take a dermal route for entry in to the human system causing serious health hazards.

Keywords: Sindoor; Lead; ICP-OES; Toxicity.

Introduction

Sindoor, also known as kumkum or vemillion in India, is meant for use as a forehead mark, referred to as tilak, bindi or pottu, put on the spot between the brows or put on the centre parting of the head which is considered as a sign of a married woman in India. In earlier times, sindoor was made with a special type of red marble stone, covered with turmeric and a little oil and left undisturbed for a few days, after which it turned into red powder. Today most modern cosmetic product manufacturers produce sindoor from synthetic materials, lead, zinc and industrial dyes. It is also called red lead (Pb_3O_4). Manufacturers follow no single method. Some mix oxidized metals and substandard oil to bring about the texture (Kapoor, 2007). Now sindoor is also available in liquid form. Red is also being derived from mercury sulphite, which can cause skin cancer. All these toxic substances can trigger hair loss, edema and erythema. Branded sindoor and kumkum, even the liquid sindoor marketed by some reputed cosmetic company, does not carry the mandatory label of ingredients. The toxicity problems are manifold as a flood of unbranded products are available in the local markets (Alkhwajah, 1992). Studies have shown that sindoor can cause local irritation and skin toxicity. The nature of sindoor or kumkum can change with exposure to the environment over time and this can result in blisters, itching, rashes, pigmentation and, at times, serious dermatological disorders.

Material and Methods

Objective

Analysis and estimation of Lead and Mercury in

sindoor samples (powder & liquid form) available in local market.

Hypothesis

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

Sample Type & Size

Sindoor samples in liquid & powder form were collected from the local markets for the study. In all 11 vermillion samples (7 liquid and 4 powder forms) were taken for analysis of lead and mercury.

Sample Preparation

All plastic and glassware were washed, rinsed many times with tap water and then soaked in 5% HNO_3 solution for a minimum of 24 h and were followed rinsing with deionized water before use.

Lead

1. 1 gm/ 1 ml of sindoor 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.

Mercury

1. 1 gm/ 1 ml of sindoor 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, digestion was done.
4. For acid digestion, 25 ml of nitric acid was added to it.
5. The solution was heated on a tripod stand till the solution became clear.

Instrument Used

Vista-MPX simultaneous ICP-OES with axially viewed plasma was used for this work. The instrument was fitted with the 3-channel peristaltic pump option for easy introduction of ionization buffer to the sample via a post-pump Y-piece. Instrument operating conditions were as follows:

Power	1.4 kW
Plasma gas flow	15.0 L/min
Auxiliary gas flow	1.5 L/min
Nebulizer type	Glass concentric
Sample tubing	Grey/grey
Internal standard tubing	Orange/white
Drain tubing	Purple/black Pump
Speed	15 rpm
Sample delay	35 s
Stabilization time	15 s
Rinse time	60 s
Replicate time	60 s
Replicates	2

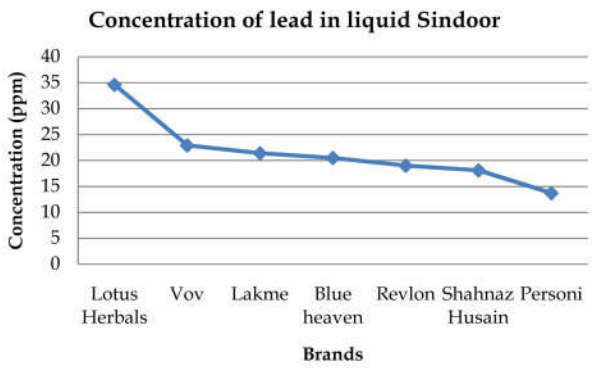
Result and Data Analysis

This research was performed in triplicate analysis. The number of selected sindoor was seven in case of liquid form and four in powder form collected from the cosmetic shops and local market. The data presented in Table 1 shows remarkably high concentration of lead in all the brands, the least being in Personi estimated at 13.7ppm. The maximum was observed in Lotus Herbals at 34.6ppm. However, Mercury was found to be less than 1 ppm in all these products.

In the four powdered forms of sindoor that was taken up for the study, the concentration of lead was found to be the highest at 382.3 ppm in the Suhag Shingar brand and the least was found in the brand

Table 1: Shows the concentration of lead and mercury in liquid sindoor

Brand	Lead	Mercury
Lotus Herbals	34.6 ppm	< 1.0 ppm
Vov	22.9 ppm	< 1.0 ppm
Lakme	21.4 ppm	< 1.0 ppm
Blue heaven	20.5 ppm	< 1.0 ppm
Revlon	19.0 ppm	< 1.0 ppm
Shahnaz Husain	18.1 ppm	< 1.0 ppm
Personi	13.7 ppm	< 1.0 ppm



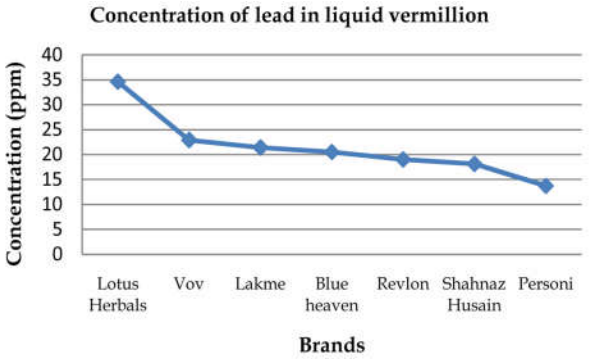


Table 2: Shows the concentration of lead and mercury in powder sindoor

Brand	Lead	Mercury
Suhag shingar	382.3 ppm	< 1.0 ppm
Milap	32.6 ppm	< 1.0 ppm
Drolias	31.7 ppm	< 1.0 ppm
Shingar	27.2 ppm	< 1.0 ppm

Shingar at 27.2 ppm. Mercury in this case as well was found to be less than 1 ppm. An overall assessment of these two forms of sindoor shows that the liquid form is comparatively better than the powder form, though the toxicity of bothese forms cannot be ignored and in both cases the lead content is much higher than that is prescribed in the FDA limit.

Conclusion

In earlier times, women preferred to prepare sindoor at home. Now, most of them buy the readymade sindoor from the market. A traditional component of the sindoor is powdered red lead and other ingredients are alum and turmeric. Sindoor is considered to be very auspicious by Indians and thus, used for various purposes on special occasions like wedding and festivals. The study has revealed that very high values of lead among samples may be due to the spurious nature of the samples as there are no proper safety regulations in the production and distribution of these cosmetic products. However, the possibilities of spuriousness of these products cannot be ignored. The data obtained clearly showed that further studies are also needed of these heavy metals in cosmetic products of daily use. Acceptable limits of potential contaminants in cosmetics such as the sindoor must be enforced. The principle of good manufacturing practice must be followed. There is need for an assessment of human risk from the exposure to cosmetics which are highly contaminated with heavy metals. It was inferred from the result that most of the brands of sindoor were contaminated with very high concentrations lead. Removal of heavy metals from personal care products after manufacture is not possible, however if careful selection of the raw material is made keeping in view the heavy metal contents we can improve the quality of the products and save the beauty of the environment.

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