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RESEARCH ARTICLE

Evaluation of Heavy Metals contamination in Marketed Lipsticks

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Abstract

History of cosmetics spans atleast 6000 years of human history and every society on earth. The use of cosmetics in our country can be dated back to the Vedic times that are as early as 1000 B.C. The present study focuses on toxic metals in cosmetics product Lipstick and does not deal with the beneficial or detrimental effects of any other ingredients in such products. Furthermore, the choice of samples for study has been based on the most readily available cosmetics brand in the market. The main objective of the study is quantitative analysis of various toxic metals in cosmetic product Lipstick with a view to emphasize the need for pharmacovigilance of cosmetic products. The samples were analyzed according to standardized international protocols by wet digestion method, by a Flame Emission Spectrophotometer. In addition, the present studies are restricted to lipsticks sold in the Delhi region. Random sampling methodology adopted in this study, fairly indicative results have been obtained which are suggestive of which particular brands need to be more rigorously tested. The safety and toxicity assessment of cosmetic products such as lipsticks is a critical issue that is not only affected by scientific questions, but also by the responsible regulatory agencies as well as consumers, health ministry and governmental organizers. There is an urgent need to stop importing unsafe cosmetics.

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Introduction

Heavy metal toxicity to the humans and animals is the result of long term low or high level exposure to pollutants common in our environment including in air we breathe, water, food etc. Apart from these, numerous consumer products like cosmetics and toiletries have been reported as a source of heavy metal exposure to human being (Amit et al, 2010). Although beauty consciousness of people has set the demand of cosmetics in market, the side effects as well as health consciousness of people has attracted the clinicians and researchers to find out the probable reason behind their side effects. Heavy metal contamination is one of the important reasons behind the same problem. Heavy metals like lead and cadmium are common contaminant in various cosmetic products (Nnorom, et al, 2005; Al-Saleh, et al, 2009). Iran, then Saudi Arabia has the highest consumption of cosmetics in the Middle East. Total consumption of cosmetics in the Middle East in 2008 at around 7/2 billion dollars that the average growth of around eight percent a year, after Eastern Europe has the highest growth and this is because the region's population under age 30. Still, 14 million Iranian women sphere of cosmetics consumption overtaking almost countries have seized the area so that approximately 29 percent of consumers make up the Middle East. In other words, Iranian women will pay about 2/1 billion dollars of cosmetics in the Middle East cosmetics market (<http://www.8dey.ir/archives/5785>).

Pigments used as ingredients in lipsticks are regulated as color additives by the FDA and must undergo pre-market approval by the agency before they may be used in any cosmetics (Wirat Ruengsitagoon, Sorraevee

Thanasakulpasert, Karnchanok Ngiamsoombat et al, 2001). There are currently no international standards for impurities in cosmetics. FDA's legal authority over cosmetics is different from other products regulated by the agency, such as drugs, biologics and medical devices. Cosmetic products and ingredients are not subject to FDA premarket approval authority. Cosmetic firms are responsible for substantiating the safety of their products and ingredients before marketing. Although major sources of lead (Pb) contamination from leaded gasoline, lead-based paints, lead in public water systems, and lead solder for sealing canned foods have been reduced through various regulatory actions, public concerns still exist over possible sources of lead contamination. Lead from gasoline and paint can remain in soil and dust for many years, and imported foods and cosmetics may contain unsafe levels of lead (Sainio et al, 2000). The colored base is formed by pigments and pearls. Pigments give lipstick its color and covering power. The concentration of pure pigment can vary from 1% to 10% depending on the type of product (lip gloss to a dark lipstick). The most widely used pigments are mineral (titanium and iron oxides) and organic pigments (true pigments, toners and lakes) (Amparo and Alberto, 2007).

The aim of this survey was to assess the public Health risk from certain brands of lipsticks products sold at Delhi region. A total of sixteen different samples of lipsticks from different brands were studied for the presence of seven heavy metals in them. Besides the presence of heavy metals across different colours of the same brand were also sought to be detected and analyzed. Our concern arises from the safety of cheap priced lipsticks that is sold widely in stored around Delhi & NCR region. Most of these products are imported from countries which have weak regulatory inspection and screening as well as no standard conditions for manufacturing.

Materials and Methods

A. Sampling

16 samples from different brands made from different countries were randomly purchased for analysis but a single brand may contain several colors which have been analyzed separately. Besides, the presence of heavy metals across different colours of the same brand were also sought to be detected and analyzed. For this, the brand Elle-18 was chosen and Lipsticks of the commonly used colours pink, red, brown, purple and maroon shades were chosen for studies. They are very popular and most of them are imported mainly from developing countries where no quality control measures are applied.

B. Estimation of Lead, Arsenic, chromium, Cobalt, Cadmium and Nickel and copper

All glassware and plastic containers used were washed with liquid soap, rinsed with water, soaked in 10% volume/volume nitric acid for 24hrs, cleaned thoroughly with distilled water and dried in such a manner to ensure that any contamination does not occur. Blanks and samples were also processed and analyzed simultaneously. All the chemicals used were of analytical grade (AR). For heavy metal analyses 1 gram of each sample was weighed on electronic balance (Shimadzu LIBROR AEX 200G). The samples were analyzed according to standardized international protocols by wet digestion method, (Using HNO₃ and HClO₄ (3:1) and H₂O₂), analyzed by a Flame Emission Spectrophotometer Model AA-6300 (Shimadzu, Japan) using an air-acetylene flame for heavy metals, using at least five standard solutions for each metal. All necessary precautions were taken to avoid any possible contamination of the sample as per the AOAC guidelines (AOAC, 1998).

III. RESULTS

A total of 16 different samples of lipsticks from different brands were studied for the presence of Heavy metals. Besides, the presence of heavy metals across different colours of the same brand were also sought to be detected and analyzed. For this, the brand Elle-18 was chosen and Lipsticks of the commonly used colours pink, red, brown, purple and maroon shades were chosen for studies.

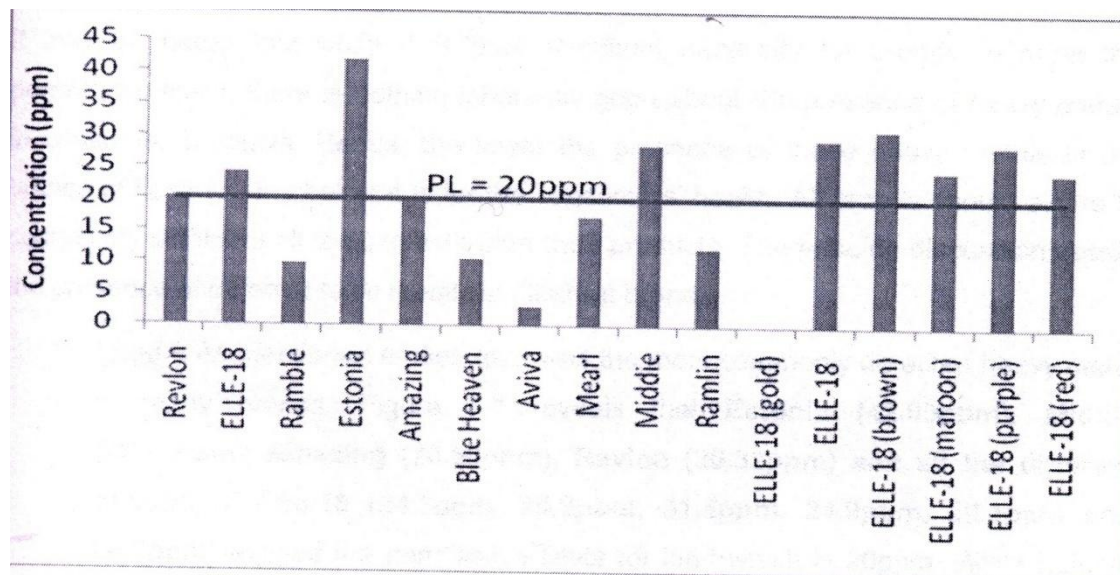
Table 1:-Results of analysis of different brands of lipsticks

LIPSTICKS	Code	Colour	Lead (ppm)	Arsenic (ppm)	Chromium (ppm)	Cobalt (ppm)	Cadmium (ppm)	Nickel (ppm)	Copper (ppm)
Revlon	L ₁		20.3227	0.325	NIL	0.1484	0.0132	NIL	0.1237
ELLE-18	L ₂		24.2928	0.135	0.0153	0.0263	0.0029	0.4585	0.1044
Ramble	L ₃		9.9295	0.9392	0.1739	0.0031	0.0222	0.1602	1.9716
Estonia	L ₄		42.0323	2.1809	0.2832	0.3092	0.0126	NIL	7.0782
Amazing	L ₅		20.5567	0.1802	0.0035	0.2473	0.0114	NIL	0.1414
Blue Heaven	L ₆		10.6966	1.1872	0.0576	0.0928	0.0152	NIL	0.1366
Aviva	L ₇		3.1076	0.2016	0.0071	NIL	0.0023	NIL	0.1125
Mearl	L ₈		17.3582	1.4943	0.0059	NIL	0.0138	NIL	0.0723
Middie	L ₉		28.7266	0.7961	NIL	0.4483	0.0246	0.0721	0.7874
Ramlin	L ₁₀		12.4866	4.5733	0.0388	0.0572	0.0082	0.741	0.0691
ELLE-18	LA	golden	NIL	3.9997	0.0247	0.1252	0.0076	1.0626	0.0868
ELLE-18	LB	pink	29.9011	0.0359	0.0693	0.1128	0.012	0.0624	0.1109
ELLE-18	LC	brown	31.4614	0.0829	NIL	0.0541	NIL	NIL	0.1896
ELLE-18	LD	maroon	24.9602	0.3245	0.067	NIL	0.0023	0.2604	0.0498
ELLE-18	LE	Purple	29.1036	0.2932	0.0588	NIL	0.0006	0.3729	0.1414
ELLE-18	LF	red	24.7652	0.0319	0.0776	0.0572	0.005	0.2238	0.1205
PERMISSIBLE LIMITS			20 ppm	3 ppm	2 ppm	5 ppm	15 ppm	5 ppm	50 ppm

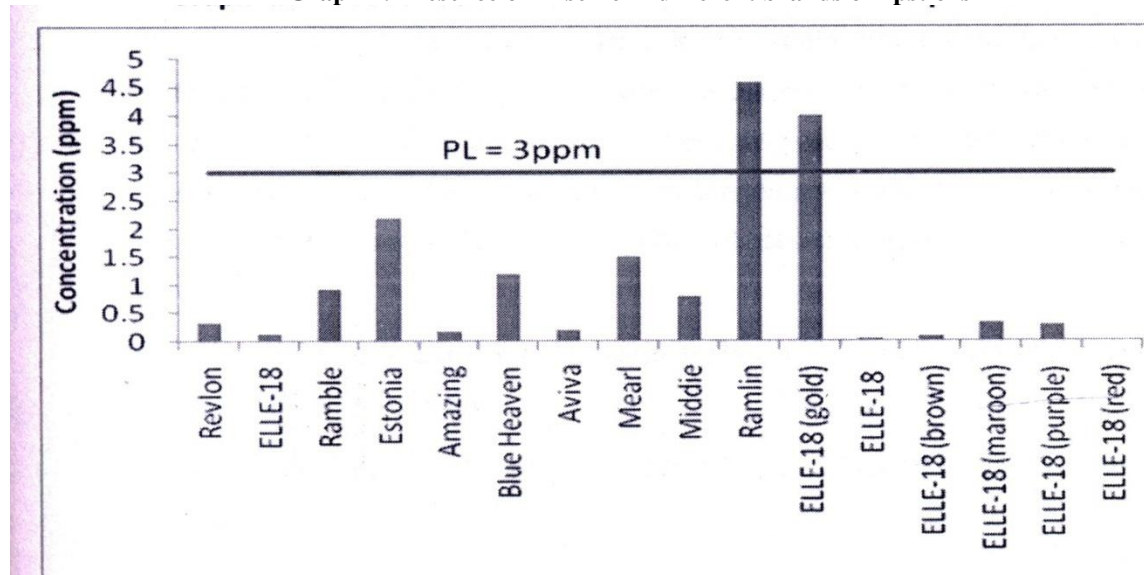
The levels of metals found in ten brands and six different colours of Elle -18 taken for the studies are given in Table 1. It was found that all the products have shown variable levels of all the metals, some being within the permissible limits and some well out of the safe range.

The shaded cells in Table 1, show brands with lead and Arsenic, which were found to be in excess of the permissible limits prescribed for human consumption, as per the International Purity specifications (IPS) of the FDA. For instance, most shaded cells in Table 1, show the presence of lead and arsenic in excess of the prescribed limits. This shows that while almost all brands maintained safe levels of Cadmium, Chromium, Nickel, Copper, Cobalt but in several case the presence of lead and arsenic exceeded permissible limits rendering the product unsafe for human consumption and cosmetic application. This lop-sided presence of one metal in excess reflects some lack on the part of cosmetic manufacturing companies as they probably pursue a satisfying or simply a “good enough” approach towards testing. Once they are satisfied that most metals are within permissible ranges, they tend to be easy on meeting standards for one or two metals. It is possible that testing and meeting standards for lead is expensive and raises products costs. The masses are poor and in order to cater to cheap mass consumer demand, companies may be tempted to not ensure the highest standards.

Graph 1: Presence of Lead in different brands of lipsticks



Graph 2: Presence of Arsenic in different brands of lipsticks



From the Graphs 1 and 2, it may be seen clearly that Estonica, Middie, Amazing, Revlon and all the tested different colours of Elle-18 (Gold) exceed permissible limits for arsenic.

It may be noted that while it is bare minimum necessity for brands to meet the permissible limits, there is nothing inherently good about the presence of heavy metals in consumer products. Hence, the lower the presence of these heavy metals in the brands of lipsticks, the better it is for the consumers health. All brands should aspire to completely eliminate all toxic metals from their products. The ensuing discussion details the presence of different toxic metals in different brands.

a) Lead

As mentioned earlier, lead was the most commonly detected heavy metal in many brands. Graph 1 reveals that Estonia (42.03 ppm), Middie (28.73ppm), Amazing (20.56ppm), Revlon (20.32ppm) and all the different colours of Elle -18 (24.3ppm,29.3 ppm,31.5 ppm,24.9 ppm,29.1ppm and 24.7 ppm)exceed the permissible limits for lead which is 20ppm. While Estonia has the highest concentration of lead at over 40ppm(which is double the permissible

limit), Middle and Elle 18 had lead in concentrations between 20-35 ppm. It was alarming to find 20.32 ppm of lead in a globally renowned brand Revlon. Similarly, Elle-18 is a global brand which consistently has excess lead concentrations in the different colored lipsticks like red, brown, pink, purple, golden and maroon colours. These findings cast doubts over the quality control processes in these brands. In contrast, brands like Aviva, Blue heaven, Ramble and Ramlin showed far lower concentrations of lead. It is notable that across the brands there are significant variations in the concentrations of lead. This means that while some brands are doing exceptionally well in keeping down lead concentration levels in their products, other brands are doing little in this respect. The lead concentrations in various brands of lipsticks in decreasing order is as following:-

Estonia> Middle>Elle-18>Amazing>Revlon>Mearl>Ramlin>Blue Heaven>Ramble>Aviva

The lead concentration in various Elle-18 in the decreasing order is as under:-

Brown>Pink>Purple>Maroon>Red>Golden

b) Arsenic

As mentioned earlier, barring two brands namely Ramlin and the gold colored Elle-18, all other brands have arsenic lower than the permissible limit. Ramlin has 4.57ppm of arsenic which Elle-18 (gold) had 3.99 ppm. This was quite in excess of the permissible limits given the high toxicity of arsenic. While other brands had arsenic concentrations within permissible limits, brands like Estonia and Mearl had arsenic concentrations above permissible limits which is alarming as it is well known that arsenicals are widely used as rodenticides. In contrast, brands like Aviva, Amazing, and Elle 18 had negligible presence of arsenic. The arsenic concentrations in various brands of lipsticks in decreasing order are as under:

Ramlin>Estonica>Mearl> Blue Heaven>Ramble>middle>Revlon>Aviva>Amazing>Elle-18

c) Chromium

Chromium was present in trace amounts in all tested samples. However, it was within permissible limits for all of them. While the permissible limit for chromium under the IPS of US FDA is 2ppm, almost all the tested samples had chromium in concentrations less than 1ppm. This reveals that the industry in general has succeeded in maintaining the levels of chromium in their products. However, considerable variation was observed across the industry with brands like Estonia (0.28 ppm) and Ramble(0.17ppm) having much higher concentrations than the rest of the brands. Given that these concentrations are within limits, one cannot question these levels in absolute terms but can certainly point out that given the existing technology it is possible for even the outliers to tighten their quality control even further since some of their peers have successfully done so.

d) Cobalt

Cobalt like chromium was detected in trace amounts in all the samples. Cobalt too, was present within permissible limits across all the samples suggesting that the commonly used brands have managed to control the presence of this metal in their lipsticks. However, here too, a cross sample comparison revealed that Estonia (0.31ppm), Middle (0.45 ppm) and Amazing (0.24 ppm) were industry outliers with presence of cobalt far in excess of their peers. While this finding does not indicate these brands, it suggests that these brands can improve their quality control to reach the level of their peers.

e) Cadmium

Cadmium too, was present in only trace amounts across all samples. Only Ramble (0.022ppm) and Middle (0.025ppm) had cadmium concentrations substantially higher than their peers. Overall, the industry seems to have contained the concentrations of cadmium fairly well.

f) Copper

None of the brands tested had copper concentrations beyond the permissible limits. However Estonia (7.07ppm) is somewhat of an outlier relative to other brands with copper concentrations far in excess of its peers. Nevertheless, this was far below the permissible limit of 50ppm.

g) Nickel

Nickel was detected in trace amounts in only 9 out of 16 samples studied. In all cases nickel was within permissible limits suggested that most brands have managed to successfully eliminate this toxic metal from their products.

The study reveals that there are variations across brands in meeting the permissible limit targets for heavy metals. Even global brands like Revlon and Elle-18 have not managed to meet high quality standards for keeping lead concentrations down in their lipsticks.

Analysis of Variance (ANOVA) was done on each brand of the lipsticks to find out if there is significant variation in the concentrations of heavy metals in different colors of each brand.

IV. DISCUSSION

The primary ingredients found in lipstick are wax, oil, alcohol, and dye. Though, lead is not an ingredient of the lipsticks, it might be present as impurities in the color additives. According to Us FDA trace amount of lead in cosmetics is unavoidable under conditions of good manufacturing practice (Al-Saleh, et al, 2009).

The heavy metal contents in lipsticks and probably other cosmetics may cause harm to consumers. This research demonstrates that ingredients may contain or absorb heavy metals. For this reason, there is currently a potential global danger to the health and well-being of people. This risk can be reduced by international cooperation between toxicologists to investigate of the safety of cosmetic and personal care products and their ingredients on a daily basis.

It must be borne in mind that permissible limits are primarily guidelines for containing the presence of toxic metals in consumer products. The best case is always to minimize their presence or completely eliminate if technology permits.

CONCLUSION

The probable causes that may be inferred for the presence of these toxic metals can be stated as following:-

- a) Contamination at the raw materials stage. Use of substandard raw material in order to save the cost, ignorance created by non technical and under skilled manpower for which there exists no regulation.
- b) Use of improper grade of water. Faulty water system and both.
- c) Leaching by the container and the machinery employed.
- d) Lack of skilled Labor.
- e) Lack of compliance by small scale cosmetic manufacturers.
- f) Lack of strict regulatory compliance.
- g) Adverse effect cases due to cosmetics use are under reported and poor documentation which gives a free hand to the manufacturers.
- h) Pre market testing is not at all mandatory for cosmetics even by FDA.
- i) Disjointed legislation at the national and international level.

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