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Original Article

Adulteration of mercury in skin whitening creams – A nephrotoxic agent

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ABSTRACT

Background: Mercury is a neurotoxin which is used in the formulation of many cosmetics. When such cosmetics are used by pregnant woman, there are serious pathological manifestation in the fetus. It can also harm those children who are on breast feeds and whose mothers are using these mercurial cosmetics. Such products are used on daily basis and after absorption through the skin mercury gets accumulated in kidney and other organ system.
Aims: The aim of this study was to analyze the mercury content in commonly used cosmetic skin whitening creams by using the atomic absorption spectroscopy.
Method: Samples of mercury are prepared by CETAC Technologies of USA, wherein the method used by Clarke et al. for mercury estimation was used. Samples are analyzed and compared with standard curve by 200 series Atomic Absorption with model VGA-77 (Vapour Generation Accessory) made by Agilent Technologies.
Results: They are depicted in the tabular form that shows all skin whitening creams being taken for the analysis contain mercury. Mercury was detected in all the samples in the range of 0.004556 ppm (Skinshine Cream) to 0.009 ppm (Vaseline – menface Anti spot) as total mercury.
Conclusion: Children, pregnant women, and breast feeding women are the major population affected by mercury exposure. So these cosmetics products must be evaluated periodically and immediate actions from responsible government and business communities are expected to protect consumer health and well-being. There is lack of awareness among all active as well as passive consumers of these cosmetics. Apart from it, government and private health agencies should initiate some public awareness programs.

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Abbreviations: DCGI, Drug Controller of India; FSH, follicle stimulating hormone; FDA, Food and Drug Administration; Hg, mercury; LH, luteinizing hormone; MeHg, methyl mercury; ppm, parts per million; TrXR, thioredoxin-reductase; WHO, World Health Organisation.

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1. Introduction

Elemental mercury is the only metal that exists in liquid form at room temperature and occurs in abiotic components, i.e., atmosphere, hydrosphere, and lithosphere. It affects the human health in various ways such as agricultural and marine product consumption and mining. Through the consumption of aquatic food, people get methyl mercury in their body. This causes the severe mercury poisoning.

Drugs are used only when human beings or animals are sick, while cosmetics are used on a regular basis or day-to-day basis by all age groups of human beings such as children, adult and geriatric, and by both sexes. Cosmetic products contain heavy metals such as arsenic, lead, fluoride, and mercury. Beauty enhancing products such as mascara, lipstick, eyeliner, skin whitening cream, and soap largely contain mercury. Mercury is mainly in fairness creams as it could block melanin formation. The production of melanin occurs in intracellular ovoid organelles known as melanosomes, which are generated in dendritic melanocytes that account for <2% of epidermal cells.[1] The pigment melanin synthesized in melanosomes is carried to adjacent keratinocytes (Fig. 1) via dendrites and deposited inside keratinocytes and melanocytes in the perinuclear area as supranuclear ''caps'' that are supposed to shield DNA from UV rays.[2]

Skin disorders are very prominent among every age group of people. Discoloration or depigmentation of skin can be seen quite frequently. Mercury salts block the synthesis of melanin as it competes with copper in the action of the enzyme tyrosinase.[3] When mercury is exposed to cellular level it will result in alterations in membrane permeability, changes in macromolecular structure due to its affinity for sulfhydryl and thiol groups, and DNA damage.[4–6]

In today's world, fair or spotless skin is considered as an aesthetic symbol of personality. The labeling of these cosmetics does not specify their constituent, so the consumer may not have any idea for choosing suitable products.[7–9]

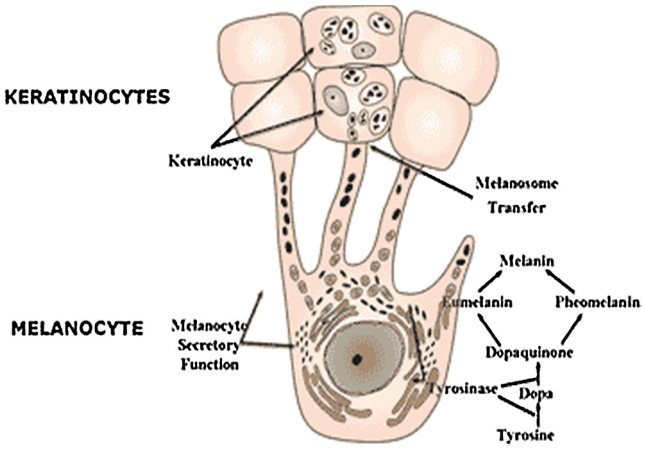

Fig. 1 – Shows the mechanism of action for melanin synthesis.

World's leading health regulators put their efforts to regulate and restrict the use of mercury in cosmetic products. Although people are aware about the adverse effects of mercury poisoning, skin whiteners are still widely used. It might be possible that pharmaceutical industries use nano-form of mercury in these preparations.

1.1. *Mercury toxicity*

Depending upon the duration of exposure and amount, mercury affects human health in various ways. If mercury exposure occurs for shorter duration, it causes nausea, cough, shortness of breath, and sore throat, while exposure for longer duration includes anxiety, tremors, variation in vision or hearing, and loss of appetite. If ingested, it is absorbed by the epithelial cells of the gastrointestinal tract, causing indigestion by preventing the synthesis and secretion of digestive enzymes trypsin, chymotrypsin, and pepsin. It also interferes with xanthine oxidase function.[10] Exposure of skin to mercurial compounds can cause irritation, dermatitis, and allergic reactions.[11] Once it enters the circulation, it accumulates in various organ systems with resultant decrease in their function.[12] Most prominently, it is known to be nephrotoxic and neurotoxic. Mercury containing cosmetic products result in accumulation of mercury in the tubules of the kidney, causing severe manifestation.[13] Evidence suggests a linkage between mercury exposure and acute tubular necrosis, chronic renal disease, renal cancer, and nephrotic syndrome.[12–14]

Being a neurotoxin, mercury may cause severe anomalies in the fetus, if mercurial cosmetics are used by a pregnant lady. World leading health regulators put their efforts to regulate and restrict the use of mercury in cosmetic products. The most disturbing effect of mercury in the nervous system is intervention with the production of energy, as it impairs cellular detoxification processes and causes cells to either die or live in a state of chronic malnutrition. It is also considered that mercury affects neuronal problems through blockage of the P-450 enzymatic process.[12] With this background, it was thought to analyze the mercury content in skin whitening creams.

2. Methodology

2.1. *Materials required*

Samples: Ten skin whitening creams were purchased in duplicate with same batch numbers (Table 1). One for analysis and the other stored sealed for possible future evidence.

Chemicals: Concentrated sulfuric acid (H_2SO_4), concentrated nitric acid (HNO_3), $KMNO_4$ (5%), hydrochloric acid (HCl) – 3%, and hydroxyl amine solution (12%) .

2.2. *Sample preparation*

One sample of cream of each brand was processed by CETAC Technologies of USA following the method used by Clarke et al. for mercury estimation.[15]

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