

Toxicological Effects of Chemical Constituents of Cosmetics

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ABSTRACT

The cosmetic market in Nigeria is currently flooded with a variety of cosmetic products in response to the high demands for such products. Certain chemicals that are part of cosmetic formulations have been found to be harmful, and the usage of cosmetic products containing such chemicals portends danger for human health. Sadly, in spite of the regulations put in place to prevent or minimize the presence of such ingredients in cosmetic brands, heavy metals, organic and inorganic chemical substances are still very much in them. Cosmetic and skin lightening products are in high usage in every country of the world, especially among women of all ages, but with low knowledge of hazardous effect it possess to human health. Skin rashes, multiple stretch marks, yellowish brown colouration, hypertension, diabetes mellitus, renal failure and cancer are some of the toxicological and health hazards associated with cosmetic product usage and are linked to poisonous substances used in cosmetic preparation. In many cases, cosmetic product manufacturers, importers and marketers conceal the real constituent of cosmetics by not listing them in the product label. This paper concludes that, it is imperative for the government to ensure that regulatory agencies in the country are up and doing by actively regulating and monitoring the activities of cosmetic product manufacturers, by insisting that the real contents of cosmetics are listed on the product label, while harmful ones are curtailed.

Keywords: Toxicological, Chemical, Cosmetics, diabetes mellitus, renal failure and cancer.

INTRODUCTION

Cosmetology is a very common female occupation; more than half a million women in developed as well as developing countries are employed as cosmetologists, using their skills to apply beauty treatments. Body care products are of different kinds ranging from skin moisturizers, perfumes, lipsticks, lip glosses, finger nail polishes, eye and facial makeup preparations, shampoo, hair colours and deodorant, among others [1, 2, 3, 4, 5, 6]. Certain chemicals that are part of cosmetic formulations have been found to be harmful, and the usage of cosmetic products containing such chemicals portends danger for human health. Sadly, in spite of the regulations put in place to prevent or minimize the presence of such ingredients in cosmetic brands, heavy metals, organic and inorganic chemical substances are still very much in them [7,8,9]. A reason given for this is that such substances may be a

major component of the raw materials used in cosmetic manufacture or are deliberately included in cosmetics [2; 3]. Cosmetic products appear not to be subjected to clinical trials or laboratory testing by regulatory authority in Nigeria before premarket approval, implying that safety and quality of products are monitored through post-market surveillance (PMS) activity [10,11,12]. The implication is that laboratory/clinical testing of cosmetic products by NAFDAC takes place only when a victim of hazardous effect of cosmetic is reported or an end user discovers it to be defective or have side effects on the consumers [13, 14, 15]. The guidelines prohibit mercury and its compounds, including corticosteroids [16, 17, 18, 19]. The reason is that mercury is a known cause of dermatitis and kidney damage which could manifest as hypertension [20, 21, 22, 23]. Continuous and possible

excessive application of corticosteroids through cosmetics on the skin is reported to cause recalcitrant acne, red striae, excessive hairiness, proneness to infections, insulin related ailments and cataract [4, 24, 25, 26, 27]. Creams with hydroquinone at a concentration higher or in amount in excess of two percent (2%) are under prohibition because their side effect manifests as exogenous ochronosis which is depicted as a dirty brown pigmentation or colouration on areas of the body exposed to the sun followed by the skin's loss of elasticity [4].

Accordingly, the cosmetic market in Nigeria is currently flooded with a variety of cosmetic products in response to the high demands for such products [5]. Nigerians are regarded as being highly fashionable and glamorous; hence they provide an ever increasing market for cosmetic product manufacture, marketers and importers. Cosmetic manufacturers and marketers/distributors selling products containing mercury and corticosteroids usually violate fair packaging and labelling requirements by not always listing them as ingredients of the products. Furthermore, dark-skinned African populace use cosmetic majorly in an attempt to change their skin colour in response to social pressures [5]. Society tends to associate affluence, social and professional success with physical attractiveness [10, 11, 12, 13, 14, 15]. This may suggest the rationale behind the advertising strategy of most cosmetic manufacturers and marketers whereby

their products are promoted majorly by exposing the populace to pictures of good-looking and even slightly above-average-looking females. It may also suggest the reason why Nigerian women were ranked high on a list of African countries known for patronizing skin lightening products [3]. Despite of their social-economic background, several Nigerians attach a lot of importance to their looks and actively seek to improve such regardless of the cost or implications [5]. The choice of product usage is further compounded by ignorance, illiteracy and make-believe lifestyle. According to the Nigeria's National Literacy Survey (2010) carried out by Nigeria's National Bureau of Statistics, the study revealed that the adult literacy level rate in English language stands at 57.9%. This makes it difficult for a large segment of the population (42.1%) to even read and comprehend the inscriptions on the label of cosmetic product, leaving them ignorant of the actual benefits and risks associated with the cosmetics they have decided to use. That aside, the quest for survival makes even the literate populace to pay little attention to information on content and instruction on direction of use that are contained on the product labels. Thus, this review is geared toward an assessment of the toxicological content and effects of harmful chemicals present various cosmetic products the in Nigerian market, and its impact of consumers.

Types of Cosmetics

Cosmetic products exist in different forms: some are in liquid form, semi-liquid, solid, granular and volatile form; examples include skincare creams, hair creams, toothpaste, soaps, perfumes,

lipsticks, fingernail and the toe polish, eye and facial makeup, towelettes, permanent waves, hair colours, hair sprays and gels, deodorants, hand sanitizer, etc. [6].

Harmful Constituents in Cosmetics

Nnorom et al. [7] analysed the content of trace metal of several cosmetics in Nigeria for the presence of lead, cadmium, zinc and iron; three groups of facial cosmetics were used, such as eye pencil, eye liners and mascara, lipstick and lip gloss and native eyeliner (tiro and uhie). The result from this study showed that the range of Pb levels for lipsticks is higher in

concentration than that for local eyeliners, with the geometric mean value for the local eyeliners being 120.5 $\mu\text{g/g}$. Comparative amounts of Pb were found in the local eyeliners and pencil. Cd was generally low, being much less than 3 $\mu\text{g/g}$, while chromium was much higher than the corresponding levels of nickel and cadmium in each sample group. Cr,

Fe and Zn were much higher in the samples than those of the non-essential metals, Pb, Ni and Cd. Zinc and Fe were in the highest concentration. The research concluded that the continuous use of these cosmetics could result in an increase in the trace metal levels in human body beyond acceptable limits. Similarly, Amit et al. [8] determined lead and cadmium in cosmetic products, like soap, face cream, shampoo and shaving creams, using atomic absorption spectrophotometer. In samples consisting of a total of three different brands (coded A-C) of each product and total five samples of one brand of each sample collected from various retail shops from local market of Gwalior, India, the highest concentration of lead was detected in soap with brand code B (1.59 mg g⁻¹), while face cream, brand code C (0.07 mg g⁻¹) and talcum powder and brand codes B and C (0.24 and 0.25 mg g⁻¹) showed lowest lead content. For comparison between same products with different brands, mostly brand A showed the highest concentration (soap, 4.63 mg g⁻¹; face cream, 0.03 mg g⁻¹; shampoo, 1.49 mg g⁻¹; shaving cream, 0.69 mg g⁻¹; and talcum powder, 0.38 mg g⁻¹) followed by brand B (soap, 4; face cream, 0.05; shampoo, 1.59 mg g⁻¹; shaving cream, 0.66 mg g⁻¹; and talcum powder, 0.25 mg g⁻¹). The highest concentration of cadmium was detected in shampoo with brand code A (0.042 mg g⁻¹) followed by soap with A and B brand (0.04 and 0.037 mg g⁻¹). The findings showed that lead is a major toxic heavy metal in cosmetic products. In the same vein, Oyelakin et al. [8] assessed the level of mercury in soaps by the use of cold vapour fluorescence spectrophotometric analysis in Gambia; a total of 16 brands of soaps were analysed. These brands of soap were grouped under four categories: medicated, toilet, skin lightening and laundry soaps. The soaps, purchased from different supermarkets in the Gambia, were used for analyses. They showed that all 16 soap brands contained mercury with concentration ranging from 2.87ng/g to 12.61 ng/g.

The World Health Organization [9] review on mercury in skin lightening products

revealed that mercury is a common ingredient found in skin lightening soaps and creams as well as other cosmetics such as eye makeup, cleaning products and mascara. It stated that skin lightening soaps and creams are more commonly used in certain African and Asian nations and also among dark-skinned populations in Europe and North America. It further stated that mercury salts inhibit the formation of melanin, resulting in lighter skin tone. The review showed countries of greatest cosmetic use in Africa, Mali, Senegal, South Africa, Togo and Nigeria in order of increasing usage by women as 25, 27, 35, 59 and 77% are reported to use skin lightening products on a regular basis. Close to 40% of women surveyed in China, Malaysia, the Philippines and Republic of Korea in the year 2004 were reported to have used skin lighteners, while in India, 61% of the dermatological market were made of skin lightening products. The result also showed that skin lightening products are manufactured in many countries such as the Dominican Republic, Lebanon, Mexico, Pakistan, the Philippines, Thailand and the United States, and mercury-containing skin lightening products are available for sale over the internet, while individuals from Brazil, Kyrgyzstan, Mexico, and the Russian Federation believe that mercury-containing skin lightening products are easy to obtain. Furthermore, the result revealed that skin lightening products come in different forms, including soap and creams, with the soap containing approximately 1-3% mercury iodide, and the cream is composed of 1-10% mercury ammonium (some soap products tested contained mercury at concentrations of up to 31 mg/kg, whereas cream products had mercury at concentration as high as 33,000 mg/kg).

Oyedeji et al. [10] ascertained hydroquinone, chromium and aluminium levels in cosmetics marketed in Nigeria, with the aim of proving that they contained poisonous substances at levels harmful to the populace; 80 cosmetic emulsions were purchased from a wholesale supermarket in Ibadan, Southwest Nigeria. The various cosmetic

emulsions country of manufacture was determined by inspection of labels on the cosmetic packaging. The concentration of hydroquinone (HQ) was determined using a UV spectrophotometer. Heavy metals in the emulsion were determined by atomic absorption spectrophotometer. The study concluded that most of the cosmetic emulsion did not contain hydroquinone at levels that are detrimental to the skin, while the heavy metals were within acceptable values. Nduka et al. [11; 12] assessed the cancer and no cancer risk of heavy metals, steroids, hydroquinone, nitrosamines and nitrites in 42 cosmetic brands purchased from cosmetic shops in Southeastern Nigeria through dermal exposure pathway; the total cancer risk value for both the cosmetic products manufactured in Nigeria and the cosmetic

Toxicological Effect of Harmful Substances in Cosmetics

The acute poisoning effects of cadmium are nausea, vomiting, diarrhoea, headache and shock; inhalation of its dust and fumes can cause cough, respiratory distress, congestion of lungs and bronchopneumonia [14]. The metal accumulates in the liver and kidneys, damaging these organs when the exposure is chronic. Biological half-life of cadmium in humans is estimated at 20-30 years. Cadmium is listed by the United States Environmental Protection Agency [15] as one of the priority pollutant metal [16]. Absorption of lead into the skin is governed by chemical structure; therefore, skin organic lead absorption into the body tissues is more rapid than with inorganic lead compounds because of greater lipid solubility; large amounts of lead gain access to nerve tissue [17]. Acute effects of lead intake are ataxia, headache, vomiting, stupor, hallucination, tremors and convulsions. Chronic cases include weight loss, anaemia, kidney damage and memory loss. Lead bioaccumulates in bones and teeth, and it is classified as an environmental priority pollutant by the US EPA. The safe level for drinking water is 15 µg/L [14].

Skin contact with nickel can cause dermatitis, and a type of chronic eczema known as 'nickel itch' is caused by hypersensitivity reactions of nickel on the

products manufactured outside Nigeria was less than the regulatory purpose acceptable or tolerable risk level of 10⁻⁶ to 10⁻⁴ set by USEPA [13]. This implies that the low levels of these carcinogenic elements to which users of these cosmetics are continually exposed to through the dermal exposure pathway alone over their lifetime are unlikely to pose a non-cancer and cancer risk. This therefore confers a measure of safety and no toxicological concern, but the values for total cancer risk and non-cancer risk subsist entirely on the risk contributed by the heavy metals and do not contain any risk that may be contributed by other hazardous substances as well as from other more common exposure pathways such as inhalation and ingestion.

skin [18]. Oral toxicity of nickel is very low, but ingestion results to hyperglycerine and depression of the central nervous system. Large dose inhalation of nickel dust can cause lung and sinus cancer in humans. Nickel and certain of its compounds are listed by International Agency for Research on Cancer (IARC) under group 2B carcinogens as possibly carcinogenic to humans [18]. Mercury can cause both chronic and acute poisoning. Case control studies have shown effects such as tremors, impaired cognitive skills and sleep disturbance in workers with chronic exposure to mercury vapour even at low concentrations in the range 0.7-42 µg/m³ [19; 20]. A study has shown that acute exposure (4-8 hours) to calculated elemental mercury levels of 1.1-44 mg/m³ resulted in chest pain, dyspnoea, cough, haemoptysis, impairment of pulmonary function and evidence of interstitial pneumonitis. Occupational exposure has resulted in broad-ranging functional disturbance, including erythrim, irritability, excitability, excessive shyness and insomnia. In regular and consistent use, a fine tremor develops and may escalate to violent muscular spasms. Long-term, low-level exposure has been associated with more subtle symptoms of erythrim, including fatigue, irritability, loss of

memory, vivid dreams and depression [21].

In 2006, the United States Food and Drug Administration revoked the approval of the use of hydroquinone and proposed a ban on all over-the-counter preparations (2006), because it felt that hydroquinone cannot be ruled out as a potential carcinogen. The reason was based on the absorption in humans and the incidence of neoplasm in rats shown by several studies in which adult rats showed increased rates of tumour development [22]. Extensive literature documentation reveals that hydroquinone can cause exogenous ochronosis, a disease that deposits blue-black coloration on the skin, if taken orally; but skin preparations containing the ingredient are administered topically. Although proper use of hydroquinone as skin lightening agent can be effective, it causes skin

sensitivity. The effect can be minimized by daily use of sunscreen with a high persistent pigment darkening (PPD) rating. Hydroquinone can be combined with alpha hydroxy acids which exfoliate the skin to quicken the lightening process. In the United States, skin creams usually contain up to 2% of hydroquinone, but higher amounts up to 4% or above should be prescribed and used with caution. Studies further reveal that minor constituents of other chemicals such as phthalates, parabens and phenols in personal care products (shampoos, toothpaste, soap, etc.), can cause early puberty in young girls and boys. The chemicals can enter the body by cutaneous penetration through the skin, inhalation or accidental ingestion. A worrisome aspect is that exposure is very much possible through mothers during pregnancy and breastfeeding [7].

CONCLUSION/RECOMMENDATION

Cosmetic and skin lightening products are in high usage in every country of the world, especially among women of all ages, even with the knowledge of the hazardous effect it possess to human health. Skin rashes, multiple stretch marks, yellowish brown colouration, hypertension, diabetes mellitus, renal failure and cancer are some of the toxicological and health hazards associated with cosmetic product usage

and are linked to poisonous substances used in cosmetic preparation. It is therefore imperative for the government to ensure that regulatory agencies in the country are up and doing by actively regulating and monitoring the activities of cosmetic product manufacturers, by insisting that the real constituent of cosmetics are listed on the product label, while harmful ones are curtailed.

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