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Determination of hydroquinone content in skin-lightening creams in Lagos, Nigeria

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Abstract

The study was aimed at investigating the concentration of hydroquinone content, if any, in various skin lightening cosmetics found in cosmetics shops in Lagos and compare the content with label claims. Twenty (20) skin lightening creams were purchased from different cosmetics shops in Mushin and Idumota in Lagos. Hydroquinone reference standard was used to prepare calibration curve. From the results obtained, Only 7 of the creams had hydroquinone in its label with four of them actually providing the value. All the twenty (20) creams contain hydroquinone with percentages ranging from 0.07% to about 4%. The product (Code 01) with the highest percentage was imported from Cote D'Ivoire. Three of the four products (01, 07 & 08) with label value of hydroquinone failed the USP specification for percentage purity of hydroquinone. In conclusion, the presence and improper labeling of hydroquinone in cosmetic creams contravenes the NAFDAC regulation. Manufacturers should be encouraged to indicate all the content of their cosmetic creams in the labels and modalities for enforcing same should be publicized.

Keywords: Hydroquinone content, skin lightening creams, USP specification, NAFDAC regulation

Introduction

The use of bleaching creams cuts across all socio-demographic strata. Research has shown that people of all religious groups, single or married, rich and poor, literate and illiterate, low, middle and upper class use these products [1]. Various reasons were given for using the products. Some of these are to look more attractive, to follow the existing fashion trend, to treat skin blemishes like acne or melasma, to cleanse or "tone" the face and body or to satisfy the taste of one's spouse/partner [2]. In a study carried out on four hundred and fifty (450) traders to ascertain use of skin lightening cosmetics, the prevalence was 77.3% comprising ninety-six males (27.6%) and two hundred and fifty two females (72.4%) [1].

Skin bleaching is a global phenomenon and self-hate is a popular explanation for this complex practice [3]. It is rather odd to argue that all the skin bleachers in the world alter their physicality for the same reason; self-hate, despite the different histories, cultures, socialization practices, personalities, individual experiences and belief systems. It is not that self-hate cannot be an explanatory factor for skin bleaching but it may be just one of many reasons why people lighten their skin around the world. The skin is in direct contact with the external environment and protects the body surface from mechanical abrasion, forms physical barrier to pathogens and foreign microorganisms; regulate body temperature, respond to stimuli for temperature, touch, pain and pressure, excretes water, sodium salts, urea and nitrogenous waste from the body and helps in the formation of Vitamin D [4]. Skin bleaching, the cosmetic application of topical ointments, gels, soaps and household chemicals to de-pigment or lighten (bleach) the skin, has emerged as an increasingly frequent practice during the past three decades [5]. According to a WHO report, the use of skin lightening creams has become a socially acceptable phenomenon widely practiced by both men and women in Africa and the Middle East [6]. The global production and marketing of skin bleaching products has become a multi-billion dollar industry, servicing all parts of the world, particularly low- and middle-income countries [7] making it one of the most common forms of potentially harmful body modification practices worldwide [5, 8, 9]. Obtaining prevalence rates on skin bleaching practices is challenging but researchers have made progress in estimating rates in different parts of the world. Estimates range from 24% of women in Japan [7] and 30% of women in Ghana [10] to alarming rates in India where 60–65% of women use skin bleaching agents [7] or even higher rates estimated in cities like Lagos, Nigeria where up to 77% of women may use skin bleaching products [11].

Although the use is global, African women are some of the biggest consumers of skin bleaching products, which include potentially harmful local concoctions made from household chemicals (e.g. automotive battery acid, bleach, laundry detergent, toothpaste) and over the-counter creams, putting them at greater risk for a variety of negative health outcomes [12]. Dermatologic consequences include skin lesions, epidermal atrophy (thinning of the skin), exogenous ochronosis (bluish black tissue discoloration), eczema, bacterial and fungal infections, dermatitis, scabies, warts, acne, sun damage and body odour [13, 14]. In addition, skin bleaching can lead to fragile skin, poor wound healing, scarring and the need for corrective surgery [14]. Other more serious health risks include hypertension, diabetes, infertility, leukaemia, skin cancer, foetal toxicity, immunosuppression, renal and liver impairment, and failure, Cushing’s syndrome (hormonal disorder), insomnia, memory loss, tremors, speech and hearing impairment [9, 13, 15-17]. These harms extend from the acute or chronic long-term exposure to the often hazardous chemical agents that are present in bleaching products. The damage from bleaching products is often exacerbated when users mix bleaching products with household chemicals such as toothpaste, laundry bleach, detergents and even automotive battery acid, a very common practice in some settings, to try to enhance their effect [18]. However, this remains an extremely understudied practice [17].

Materials and Methods

Chemicals and Reagents

Methanol Analytical grade 99.5% (JHD). The hydroquinone reference standard was procured from Sigma-Aldrich, USA.

Instruments / Apparatus

Double Beam UV/visible spectrophotometer T80+ (PG Instruments England), Electronic analytical weighing balance (Mettler Toledo ®) Mixer, Sample Bottles (10ml) Syringe

(20ml) (Agary ®) Volumetric Flask (10ml, 100ml, 250ml. (Pyrex ®) Measuring cylinder (25ml Pyrex ®) Pipette (10ml, 5ml, 1ml Pyrex ®) Syringe Filter (Millipore ®) Aluminum Foil (Tower ®)

Experimental Sample Collection

The test materials for this study were skin lightening creams purchased from Cosmetic shops in Idumota and Mushin Market in Lagos. The procured creams were physically assessed and required information about each item was documented. This includes the product name, Manufacturer and their location, batch number as well as manufacture and expiry dates

Analytical procedure

Preparation of calibration plot and assay

Hydroquinone reference standard (10mg) was accurately weighed and transferred into a 100ml volumetric flask, about 20ml of methanol was added and mixed for about 5 minutes before making up to 100ml with methanol, to give a standard stock solution (100µg/ml). Further serial dilutions were made to obtain 5-15µg/ml calibrated concentrations. The absorbance of the gradient concentrations were obtained from the UV/visible spectrophotometric analysis 294nm wavelength and the calibration graph was plotted. The concentration of hydroquinone in each of the creams was determined by slotting the absorbance obtained from each of the cream tested into the regression equation obtained from the calibration plot. The percentage purities of all the creams tested were calculated.

Results and Discussion

Table 1 below shows the characteristics of the different cosmetic creams purchased for the study. It shows that most of the products have expiry dates, are registered with NAFDAC and are locally produced

Table 1: Source of Skin Lightening Creams Purchased

Code	01	02	03	04	05	06	07	08	09	10
Source	Cote D'Ivoire	Lagos, Nigeria	Ogun, Nigeria	Ogun, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Ogun, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria
Code	11	12	13	14	15	16	17	18	19	20
Source	Lagos, Nigeria	Guangdong, China	Cote d'Ivoire	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria	Lagos, Nigeria

Table 2 shows the labeling claims on the creams with regards to presence of hydroquinone on the label. Most of the creams

studied did not include presence of hydroquinone or percentage composition of the hydroquinone on the label.

Table 2: Label Claims on Purchased Skin Lightening Creams

Code	01	02	03	04	05	06	07	08	09	10
HQ on Label	Yes	YES	NO	YES	YES	NO	YES	YES	NO	NO
% of HQ	2.0	NS	0	NS	NS	0	1.8	2.0	0	0
Code	11	12	13	14	15	16	17	18	19	20
HQ on Label	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
% of HQ	0	0	0	0	0	0	0	0	0	2.0

Key: NS = Not Stated HQ= Hydroquinone

Figure 1 shows the calibration plot of the Hydroquinone reference standard in methanol. The equation obtained from

the plot was used to estimate the approximate percentage of hydroquinone present in the creams studied.

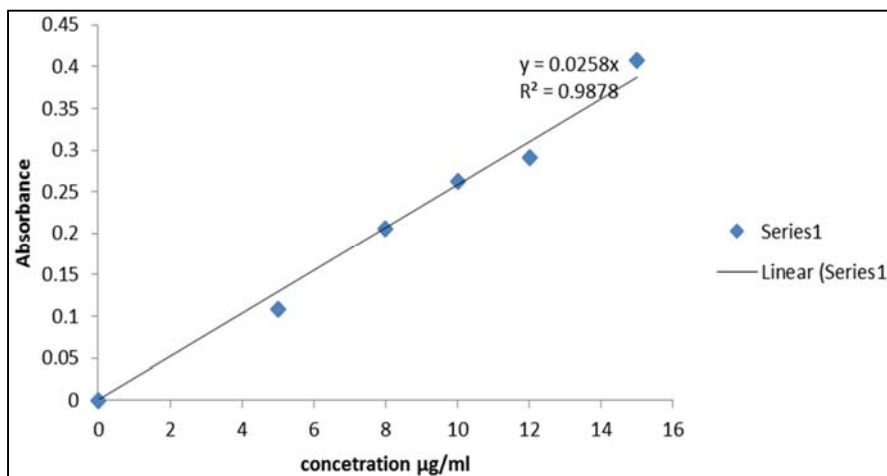


Fig 1: Calibration Plot of Hydroquinone Reference Standard in Methanol

The figure 2 shows the average percentage of hydroquinone present in the creams studied.

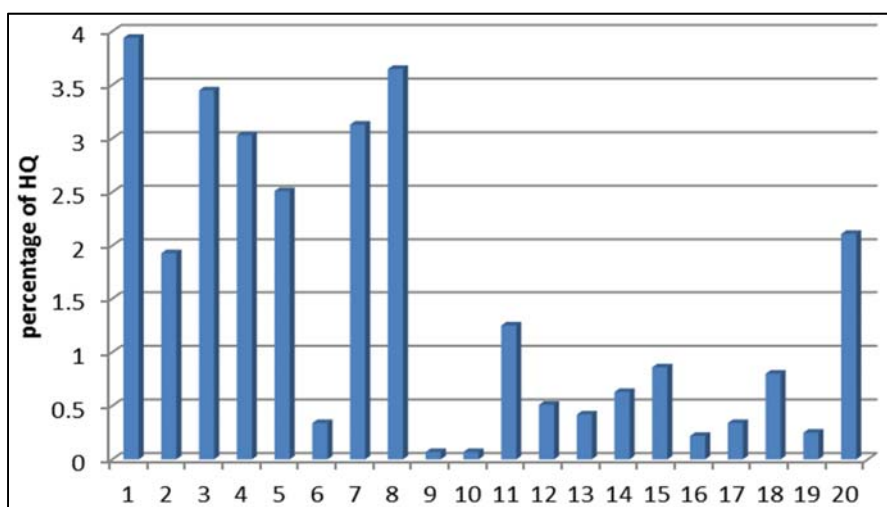


Fig 2: Average Percentage (%) of Hydroquinone in creams

Table 3 shows the percentage purity of hydroquinone on those creams that stated the amount present. Only one (1) of the cream passed the USP specification.

Table 3: Percentage Purity of Hydroquinone in creams under study

Code	Percentage (%) labelled	Percentage (%) Found	Percentage (%) Purity	Comment
01	2.0	3.99 ±	199.5	Failed
07	1.8	3.03 ±	168.3	Failed
08	2.0	3.69 ±	184.5	Failed
20	2.0	2.06 ±	103.0	Passed

(USP specification: Not less than 94% and not more than 106%)

Findings from this study revealed that all the skin lightening creams tested contain hydroquinone. This is similar to a study carried out by Odumosu and Ekwe [19].

The cream with the highest percentage is a foreign cream from Cote D'Ivoire which contains about 4% of hydroquinone. In total, 35% of the screened creams contains hydroquinone higher than 2%, which is the threshold allowed in some countries like United Kingdom, even though the concentrations of hydroquinone in skin lightening creams has been subject of study in the United Kingdom [20].

The percentage of hydroquinone found in the creams varies from 0.07% to about 4%. High levels of hydroquinone (levels higher than 2%) detected in some of the products analyzed poses potential hydroquinone related health risk to the consumers such as exogenous ochronosis [21]. The consequences of skin bleaching can be severe. Bleaching of the skin with hydroquinone has been shown to be associated with premature ageing of skin and subsequent skin cancers, higher levels of hypertension and diabetes and higher levels of depression and identity disorders [22]. In a sample of West African women using bleaching agents, seven out of ten were diagnosed with at least one dermatological problem. Another survey carried out in Senegal, the long-term use of skin bleaching agents was shown to be responsible for a high rate of cutaneous adverse effects [22]. Two cases of exogenous ochronosis in two female patients of the sub-Saharan African population were reported in people using skin care products containing high concentrations of hydroquinone and glucocorticoids [23]. In one case the lesions were characterized by an asymptomatic hyper-pigmentation of the face with gradually progressive blue-black macular patches, and in the other case in addition to dyschromic lesions, *Striae atrophicae* were present.

Skin lightening disrupts primary innate immune function of the epidermal skin bleaching skin leading to susceptibility of the users to localized or systemic infections since lightening creams used for long duration, on a large body surface area and under hot humid conditions enhance percutaneous absorption [24]. In addition, higher susceptibility to infections in these people may lead to an increase of phagocytes in response to infections which generated free radicals, increased utilization of antioxidants; thus lowering the antioxidant potential which may lead to a state of oxidative stress and increased in the rates of skin cancer [25].

Most of the screened creams are locally made and about 35% (7) of the purchased skin lightening creams included hydroquinone in the label with only 4 of these stating the percentage content. This is in contrast to a similar study carried out by Odumosu & Ekwe [19] where none of the ten (10) creams analysed indicated the levels of hydroquinone on the package. Out of the 20 creams screened, 9 (45%) has NAFDAC Registration number. NAFDAC act 1995 prohibits the inclusion of hydroquinone in cosmetic creams and yet most of the creams with NAFDAC number contain hydroquinone which contravenes the regulation. Thus, it is either the batch of products made available for registration is different from the batch produced for public use or the procedure for registration is not strictly adhered [26].

Conclusion

The outcome of the research showed that the Hydroquinone concentration for the different products ranged from 0.07% to about 4%. This contravenes the National Agency for food drug administration and control (NAFDAC) regulation which prohibits the inclusion of chemicals in cosmetic creams. Although, some of the creams did not indicate the presence of hydroquinone in the label and such practice might portend a great danger to users of the products. Again, most of the creams labeled to contain hydroquinone did not conform to the United State Pharmacopoeia (USP) specification standard (not less than 94% nor greater than 106%). Non-disclosure of every content in such formulations might portend a great danger for the users. It is therefore suggested that NAFDAC should continually monitor label claims in creams.

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