

Identification of Hazardous and Non Hazardous Commonly Used Skin Lightening Agents in Owerri, Nigeria through the Analyses and Determination of their Chemical Compositions

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ABSTRACT

Bleaching creams produced by registered companies have regulated concentrations of chemicals used. But various skin lightening agents and non-registered producers of creams especially in West Africa, circulate bleaching creams with no identified active ingredient, and incidentally, these creams remain the highly purchased cosmetics in Nigeria because of their low cost and quick actions. This study analyzes the various chemical components present in some of these readily available and commonly used bleaching creams found in Owerri, Imo State, Nigeria, vis-a-viz, Perfect white bleaching cream, Caro white bleaching cream, JRA Cosmetic bleaching cream, Ima Beauty Skin Lightener, BB Lightening cream, Clinic Clear lightening cream and Stay young bleaching cream. These seven creams were collected/bought locally from cosmetic stores within Owerri municipal and surroundings. They were subjected to elemental analysis by using X-ray fluorescent spectrophotometer and to GC-MS analysis to find out the elements and percentages of organic compounds respectively present in the creams. The results of the analysis show that all the creams contain metals such as Cr, Zn, V, Cu, Sr, Ti, etc, some at near toxic level. Also present are seemingly non harmful compounds like, 1-hexanol, 2-butanol, cyclohexanol and glycerine. Five of these creams - Perfect white bleaching cream, Caro white bleaching cream, BB Lightening cream, Clinic Clear lightening cream, Stay young bleaching cream contain hydroquinone with percentages of 4.42%, 1.2%, 4.42%, 0.49%, 7.23% respectively, Two of the creams as indicated above with 4.42% and another with 7.23% of hydroquinone are therefore hazardous when compared with the limit set by NAFDAC. Excess hydroquinone causes skin burning, stinging, redness, dryness, inflammation of skin cells and by accumulation may affect the organs. JRA Cosmetic bleaching cream appears safer as it contains no hydroquinone and inconsequential amount of heavy metals. The onus lies on the Government and the Government Scientists to avert the risk and consequences of hydroquinone and metal toxicity on the users of these lightening creams especially, perfect white, BB and most especially stay young bleaching creams, by monitoring and educating these roadside manufacturers in Owerri on the potential risks associated with higher levels of such metals and compounds.

KEYWORDS

Bleaching cream, Chemical Composition, Hydroquinone, Hazardous

I. INTRODUCTION

As far back as the dawn of civilization, cosmetic products were seen as one of the effective ways of caring for the body. During the past recent years, cosmetics grew to be the order

of the days for human beings especially for beautification, these cosmetic products were, care creams, talcum and face powders, lipsticks, kajal, sindoor, eye makeup, mouthwashes, etc ^[1]. Various persons in the world practise different types of skin treatment, done however for various reasons ^[2]. Common among them is the skin bleaching. This skin bleaching is the act of using products/chemicals to lighten the skin to gain a partial or total lighter colour. These products could be soaps, creams, herbs, and some other substances that are strong enough to effect an immediate change of the skin complexion. Skin lightening practice, cuts across many countries and cultures in this globe, all ages, races, beliefs, and ideologies⁽³⁾. Though it is mainly common in areas or cultures where having fair skin is associated with being beautiful, acquiring social status, and having advantages over others, studies have shown that the use of bleaching creams is prevalent in countries such as India, Nigeria, South Africa, and Jamaica. ^(4, 5, 6). Male and female inclusive, are engaged in this skin lightening practice; though, the female counterpart takes the lead in the practice ^[7]. A glaring example, was observed in a research carried out by one Olumide et al. (2008), where out of "450 Nigerians who confessed to the use of lightening creams, 73.3% were women, and 27.6% were men"^[8]. Anyway, it is a practice done for decades among women mainly in Africa and Asia and the reason given by 61 % of the respondents to a survey on a similar research is that they felt ever younger when with a fair complexion. ^[9]. Another research by Adebajo (2002) and then Ravichandran (2013), pointed out that younger women who aged between 21 to 30 years appear very active in the use of skin bleaching creams^[10,11] and the World Health Organization (WHO), reported in 2013 that 77% of Nigerian women engaged in skin lightening (Fihlani, 2013).^[12]

II. STRUCTURE OF THE SKIN

Describing the structure of the skin, Simmons ⁽¹³⁾ said the skin is made up of two layers - the dermis and the epidermis. Melanocytes are normally located at the basal layer of the skin and this separates the dermis from the epidermis. Visible pigmentation, like dark spots on the skin found in humans and in mammals in general is as a result of the synthesis and next the distribution of melanin in the skin, but these whitening creams work by reducing the appearance of the hyperpigmentation. According to John V. Simmons, the epidermis is "the outer layer forming the frontier to the outside world and is a fraction of a millimeter thick, as such a slight scratch on it reaches to the blood vessels of the dermis and bleeding occurs. This supports the fact that any strong chemical or cream applied to the epidermis, which is the outer layer of the skin can bleach, by changing the colour and eventually damage it if care is not taken because that layer is very thin".

Simmons ^[14] explained that, "There are four layers of the epidermis. The stratum corneum or the horny layer which is a dead cell that protects the living cell within the body, stratum granulosum or the granular layer which contains a lot of keratin and later takes the place of a new innermost layer of the horny layer, stratum spinosum or the prickly cell layer which allows rapid transfer of materials from cell to cell and stratum germinativum or the basal layer which is always involved in cell division to help the thickness of the horny layer to remain constant.

He further said that the horny layer which is the stratum corneum is greatly involved in protecting the body against the ultraviolet rays of the sun, which if in excess can be deadly

to the living cells of the body. This therefore emphasizes the fact that taking off the outer skin by the practice of, exposes the skin to excess exposure to ultraviolet rays which is lethal to the cells of the skin".

Skin lightening is a purposeful bleaching of the skin by removal of pigments and this can lead to temporary or permanent alteration or disfigurement of the color of the epidermis that is the skin's outer layer. Those who ignorantly apply these bleaching creams supposed that the bleaching agents are simply meant "for cleansing, beautification, promoting attractiveness, or altering the appearance of the users without affecting the body's structure and function" [15]. These skin lightening creams or whitening creams generally work by inhibiting the production of melanin, which is the pigment responsible for the colour of the skin. In short, bleaching agents work by either suppressing the production of melanin or temporarily peeling off the darker skin. Human skin colour is rooted at the epidermis - outermost layer of the skin, where melanocytes, the pigment-producing cells are localized to produce melanin.

Al-Ghamdi (2010), a Saudi Arabian observed that "20.8% of women were ready to use any bleaching cream that gives fast results, even if the components were unknown.[16] Among them, 30% used more than 100g of bleaching creams monthly, while 10.3% continued applying the lightening products during pregnancy and 20.8% did so during lactation. Africa has significantly high prevalence rates for skin bleaching". [17]

Several bodies have given the allowed limits of skin lightening agents in cosmetics. These includes: The world health organization (WHO), Association of South Eastern Asian Nations (ASEAN), Scientific Committee on Consumer Safety (SCCP), United States Food and Drug Administration (USFDA), Department of Health Executive (DHEY). These are shown in the Table 2 with their recommended levels.

Table 1: Recommended Limits for Skin Lightening Agents By Various Bodies [18]

Bleaching Agent	Limits	Reference
Mercury (Hg)	1.0 µg/g	(ASEAN, 2008)
Hydroquinone (HQ)	2.0 % (20,000 µg/g)	(USFDA, 2010)
Arbutin (ART)	7.0 % (70,000 µg/g)	(SCCP, 2008)
Kojic Acid (KA)	2.0 % (20,000 µg/g)	(SCCP, 2012)
Magnesium Ascorbyl Phosphate (MAP)	3.0 % (30,000 µg/g)	(DHEY, 2000)
Ascorbic Acid (AA)	10 % (100,000 µg/g)	Elmore, 2005

The skin whitening practice among youths of this generation is in the increase and incessant. This study therefore tries to highlight the effects / hazards of the active lightening ingredients on the human health by identifying the active chemicals in the commonly used Lightening creams in the Eastern part of Nigeria, particularly Owerri such that those involved in the practice of bleaching their skin become aware of these dangerous effects

III. MATERIALS AND METHOD

A. *Collection of Samples*

The bleaching creams were bought from famous and non-famous cosmetic stores, including local stores but where people troop in to make purchases in the urban city of Owerri –Imo State, Nigeria. It was ensured that the shelf lives lie well within the expiration date and was properly labeled. They were thereafter stored at appropriate room temperature

B. *Preparation of Sample Solution*

Sample preparation was done using AR grade chemical. The composition of various samples of the skin bleaching cosmetics were analyzed by mixing each of the samples with ethanol to initiate preparation of a solution. This was done by weighing out accurately 2g of each sample which was next added to 50cl of ethanol each and thoroughly vortexed or shaken to ensure proper mixtures.

C. *XRS-FP Analysis*

XRS-FP analysis was conducted using SKYRAY INSTRUMENT EDX3600B XRF spectrometer to obtain the elemental composition of the different samples of skin whiteners. This high-resolution X-ray fluorescence spectrometer with a high-purity germanium detector (XRS) coupled with fundamental Parameters (FP) analysis yet under controlled conditions yielded distinct results.

D. *GC-MS Analysis*

Each sample solution was subjected to GC-MS analysis to identify their composition. The Volatile Organic Compounds (VOCs) in each sample were determine using agilent GC-MS (Agilent 19091-433HP, USA) coupled with a mass spectrophotometer. The starting column temperature been 35°C maintained a hold time of 3-4 mins. This temperature was designed in a way that it rose by 8°C/min to get to a final temperature - 250°C. A standard method of a gas chromatograph-mass spectrometer (GC-MS) system, equipped with a suitable capillary column and mass spectrometer detector, was used for the analysis. The obtained mass spectra were compared to a reference database for compound identification.

E. *Statistical Analysis*

Descriptive statistics, such as means, frequencies and standard deviations, were calculated for a coherent analysis of the samples' composition. The identified compounds from the GC-MS analysis were reported in terms of their retention times and percentages (concentration). The elemental composition results from the XRS-FP analysis were expressed as weight percentages (%wt) for each identified element.

IV. RESULTS AND DISCUSSION

Table 2: GC-MS Results of the Different Samples Analyzed (Major Components Listed in Abridged Form)

SAMPLE	COMPOUNDS FOUND	RETENTION TIME (RT)	AREA PCT
Stay Young	2-Propanol	6.6573	0,0192
	Glycerin	13.7739	4.9529
	Hydroquinone	17.5109	7.2188
	Hydroquinone	22.6018	0,0136
	Hydroquinone	22.7976	0,0158
	Isopropyl	24,8888	0.0569
JRA	Glycerin	12.3338	25.6712
	1-Hexadecanol	25.8739	28.2711
	1-Octadecene	29.5537	4.9731
	Nonadecene	35.1513	15.1024
Caro White	Glycerin	12.6458	-0.0002
	Hydroquinone	17.598	1.2265
	Hydroquinone	24.7427	0. 1143
	1-Octadecene	28.3788	0.0479
	Isopropyl	28.7973	10.1025
	1-Tetradecene	26.4575	11.3875
Ima Ligthener	1-Propanol	6.8537	0.007
	Glycerin	14.9649	2.2538
	Glycerin	15.1131	1.2843
	Niacinamide	20.005	0.04403
	Niacinamide	23.057	0.0555
	1-Octadecene	29.4906	2.4519
	Oleic Acid	34.7705	0.8963
Clinic Clear	Ethanol	7.6636	-0.5892
	Hydroquinone	17.5598	0.3994
	Hydroquinone	17.6388	0.2803
	Hydroquinone	22.5167	0.4904
	1-Octadecene	32.6096	0.1725
	Carbonic acid	33.0761	0.2191
BB White	2-Propanol	9.2355	0.0413
	Hydroquinone	17.396	0.0108
	Hydroquinone	18.6393	4.4181
	Cyclopentaneacetic acid	21.0371	0.3441
		12.5918	1.6475
	1-Hexadecanol	26.2948	3.426
Perfect White	1-Hexanol	5.4329	0.1327
	1-2- Butanol	9.0463	0.3176
	Hydroquinone	17.2111	0.6983
	Hydroquinone	18.6393	4.4181
	Cyclohexanol	11.7757	0.5573
	Glycerin	12.5918	1.6475

Table 3: Results of x-ray fluorescence analyses indicating the concentration in percentage of the elements present in each of the 7 samples

S/N	Elements	Stay young	JRA	Caro White	Clinic Clear	BB White	Perfect White	Ima Light
1	O	42.445	43.529	42.83	40.23	38.11	46.49	39.081
2	Mg	-	0.000	11.78	-	6.00	0.000	-
3	Al	3.980	10.381	6.96	4.467	4.90	6.681	6.236
4	Si	12.008	13.298	13.56	8.099	5.63	21.145	11.052
5	P	0.000	0.000	0.00	0.000	0.00	0.000	0.000
6	S	-	11.742	5.89	-	0.00	0.000	5.022
7	Cl	13.354	17.302	7.09	8.056	7.02	12.646	9.233
8	K	0.000	0.000	0.00	0.000	0.00	0.000	0.000
9	Ca	10.090	0.461	10.38	7.903	34.05	0.025	3.206
10	Ti	-	0.264	0.04	0.054	0.04	0.025	0.055
11	V	0.000	0.000	0.00	0.000	0.01	0.037	0.000
12	Cr	0.112	0.048	0.06	0.209	0.02	0.031	0.041
13	Mn	0.255	0.071	0.06	0.272	0.04	0.071	0.056
14	Fe	1.054	0.478	0.48	0.601	0.38	0.005	0,062
15	Co	-	0.011	0,00	0.005	0.03	0.047	0.006
16	Ni	0.021	0.008	0.00	0.035	0.01	0.005	0.009
17	Cu	0.920	0.596	0.45	0,634	0.63	0.660	0.792
18	Zn	0.121	0.096	0.04	0.045	0.05	0.141	0.060
19	Sr	0.302	0.054	0.02	0.051	0.00	0.003	0.000
20	Zr	0.221	0.035	0.02	0.072	0.02	0.037	0.074
21	Nb	0.021	0.167	0.12	0.061	0.05	0.141	0.514
22	Ag	0,105	0.385	0.11	0,141	0.07	0.301	0.102
23	Sn	0.000	0.000	0.00	0.000	0.00	0.000	0.000
24	Ba	0.000	0.000	0.07	0.000	0.00	0.000	0.000
25	Ta	0.000	0.000	0.00	0,000	0.00	0.000	0.000
26	w	0.002	0.074	0.05	0.050	0.03	0.138	0.067

V. DISCUSSION

Table 2 shows the GC-MS analyses results for the seven samples. Prominent among all compounds identified is Hydroquinone which actually is considered to be the main depigmenting agents of the bleaching cream. Hydroquinone is generally found in most bleaching agents but as 'the dose makes the poison' high dose of the chemical is hazardous and endangers the users. It follows that considering this very hydroquinone alone, creams like BB white, Perfect white and Stay young lightening agents should go into extinction or the producers go back to the 'drawing board' as its high level/concentration of; BB white = 4.4, Perfect white = 4.4 and stay young = 7.2 as against 2% by weight of each sample appear non ecofriendly but hazardous. According to Owolabi et al, 'hydroquinone can easily penetrate the human skin and even small amounts of hydroquinone can increase the overall risks of obtaining adverse effects' ⁽¹⁸⁾. The above creams as seen in table 3, contains no excessive level of heavy metals even though copper in each three is pre-high, but still within limit. An increment in copper level will be dangerous as hydroquinone interacts with copper at the active site of the enzyme tyrosinase, thus decreasing its activity by nearly 90%. It not only limits tyrosinase but also oxidizes membrane lipids and proteins through generation of reactive oxygen species. The radicals generated inhibit cellular metabolism by affecting DNA and RNA synthesis.⁽¹⁹⁾ From this research only JRA bleaching cream scales through among the seven sample tested as it contains no trace of hydroquinone and yet just very little and inconsequential levels of heavy metals. JRA Cream is therefore safe.

VI. CONCLUSION

Skin lightening especially when applied for a long time, is said to disable primary innate immune function of the epidermal skin bleaching leading to susceptibility of the users to localized infections. This research has revealed that, most of the creams sold in Owerri - Nigeria, especially the conventional bleaching creams contain hydroquinone and heavy metals at a level that is close to being deleterious to human health. This research seems to points towards the hypothesis which says that "Prolonged use of skin bleaching has resulted in prevalence of the following disorders among users: hypertension, diabetes, skin and liver cancers, kidney failure, depression, blindness, and obesity. In pregnant women, these products also result in: stillbirths, high rates of neonatal infection, low birth weight. Severe dermatological ramifications stemming from acne, scarring to severe hyper-pigmentation, infection and irritations have been reported" Users of any type of bleaching cream therefore, should desist from it unless chemically analyzed to ascertain to be eco friendliness.

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