

UV-VIS ANALYSIS AND DETERMINATION OF HYDROQUINONE IN BODY LOTIONS AND CREAMS SOLD IN RETAIL OUTLETS IN BARATON, KENYA.

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Abstract

Hydroquinone is an organic compound of the Phenol family used in body care products for its therapeutic value as a topical agent for the treatment of certain skin conditions. Twenty four (24) body lotions and body creams were randomly sampled from the retail outlets within Baraton. The labels on the packages noticeably did not indicate the presence of hydroquinone. The creams were subjected to chemical analysis by a DR500 UV spectrophotometer. The level of hydroquinone was below 2% for all the twenty four creams, which is the upper limit for cosmetic creams. Creams with 2-4% hydroquinone concentrations are allowed as drug prescriptions and not sold as an over the counter creams and lotions. This chemical analysis indicates that despite the potential health hazards of hydroquinone, cosmetic products containing this agent are available to consumers with inadequate warning to the dangers associated with hydroquinone.

Keywords: Hydroquinone, Body care products, Carcinogenesis and UV-Vis, Chemical Analysis.

Introduction

Body care products are health and hygiene products which include dental care products, moisturizers, essential oil, shaving products, body cleansing products, body lotions, face gels, body oils and body creams. Their use can be a serious time bomb which requires proper attention to its application to the human body. Skin lightening (bleaching) cosmetics and toiletries are used to lighten the colour of darker skin. The practice, which is fuelled by racial prejudice, stems from the misconceptions that black skin is inferior and that someone with a fair skin is more attractive (Olumide 2008). The use of hydroquinone in cosmetics was banned in the European Union in 2001 and products intended for treatment of abnormal conditions containing this compound, henceforth were not generally classified as cosmetics but as drugs. Clinical preparations containing 2-4% hydroquinone are prescribed for the treatment of hyper pigmentation such as melasma, freckles, and senile lentiginos as well as chloasma.

The Kenya Bureau of Standards invoking the legal notice number 66 of 1999 and Legal Notice 155 Of 1998 (read together with legal notice 75 of 2000), issued a public notice in the media to inform and educate the consumers on the harmful effects of hydroquinone. The action was in line with these legal notices, which empower the Kenya Bureau of Standards to prohibit goods, which do not comply with Kenyan standards or any other standards. In Kenya, these products have been inappropriately used for skin lightening purposes. Despite the ban of such hydroquinone containing cosmetics, over-the-counter products containing hydroquinone in concentrations exceeding 2% in skin-lightening creams continue to be freely sold in the market. Curiously, most of these products are not appropriately labeled (Hywell 1992).

Hydroquinone is used for treating various medical conditions. These preparations are therefore classified as drugs and should be applied only upon the advice and direction of a qualified medical practitioner. The use of hydroquinone based creams is strictly on

prescription by a qualified medical practitioner and should not be used for a longer period. Hydroquinone based products could be potential carcinogens as most of the benzene metabolites & derivatives are health hazards (Joseph et al., 1998).

In 2006, the U.S. Food and Drug Administration proposed a ban on over-the-counter sales of cosmetic products containing hydroquinone, a skin-bleaching (lightening) ingredient. According to the FDA, approximately 65 companies sell over 200 different types of skin-lightening products containing hydroquinone in the U.S. Currently, products that contain up to 2 percent hydroquinone may be sold in the U.S. without a prescription, and prescription skin-lightening products may contain up to 4 percent hydroquinone (Melisa et al., 2009). Likewise in Kenya, all skin care preparations like creams, lotions, gels, soaps, e.t.c containing hydroquinone preparations should be registered by the Pharmacy and Poisons Board of the Ministry of Health for medical use. Cosmetic preparations containing hydroquinone, hydrogen peroxide, steroids and mercury should not be offered for sale as they have not been registered and approved for use in Kenya. Hydroquinone has been used for decades as a skin lightening agent. Metabolites of hydroquinone formed in the liver, e.g., p-benzoquinone and glutathione conjugates of hydroquinone are the main cancer-causing agents. In the bone marrow, hydroquinone is oxidized into p-benzoquinone because of the high myeloperoxidase activity. Topically applied hydroquinone-containing creams may give rise to accumulation of p-benzoquinone and glutathione conjugates of hydroquinone. These compounds are also responsible for the DNA damage and mutations. They also have the capability to disrupt protective mechanisms, whereby they facilitate further development of cancer (Westerhof & Kooyers, 2005).

In the bone marrow, long-term effects such as aplastic anemia and acute myeloid leukemia may occur. Most of the evidence stems from research on benzene toxicity, which appears to arise via its metabolite hydroquinone. There is no report yet demonstrating carcinogenesis or other ill-effects resulting from the application of hydroquinone-containing creams. The fact that many countries around the world have banned Hydroquinone is no coincidence - hydroquinone based products have caused disfigurement and permanent scarring to hundreds of thousands of faces around the world. Dermatologists say prolonged use of Hydroquinone

products destroys the skin's protective outer layer and may cause temporary or permanent discoloration of the skin. Ultimately, it can damage the nerves or even lead to kidney failure or skin cancer, and so prove fatal. Many women all over the world have permanent dark marks on their faces, the result of using creams containing Hydroquinone which practically make the skin peel off in strips. Neurological effects of hydroquinone include; headache, dizziness, tinnitus, delirium, muscle twitching, tremor, nausea, vomiting, and the production of green to brown-green urine may occur (Melisa et al., 2009).

Metabolization in the Bone Marrow

Because the liver is circumvented when hydroquinone is applied topically, both the free- and protein-bound hydroquinone will penetrate the whole body and hydroquinone will reach the bone marrow in a non metabolized form. The metabolism of hydroquinone in bone marrow is dependent on the peroxidase activity. Because of the high myeloperoxidase activity and strongly oxidative environment, the main metabolite of hydroquinone in the bone marrow is p-benzoquinone. Bone marrow is seen as the site where long-term effects may originate.

DNA Damage Caused by Hydroquinone

The cancer effects of benzene is attributed to its metabolites, hydroquinone and p-benzoquinone, to covalent bond with DNA and the induction of DNA oxidation via redoxcycling, resulting in the generation of reactive oxygen species (Westerhof & Kooyers 2005). P-benzoquinone a metabolite of benzene has the ability to cause changes which include; single strand DNA breaks, suppression of granulocyte/monocyte colony formation, formation of DNA adducts and inhibition of DNA/RNA synthesis. Exogenous ochronosis is related to the use of hydroquinone, and it presents as a dirty greyish brown waxy pigmentation on sun exposed areas of the skin. The primary lesion of colloid milium is a translucent flesh or cream coloured papule of 1 mm to 5 mm diameter on sun exposed areas (Olumide, 2008). The major metabolism of hydroquinone is to the sulfate and, at higher exposure, glucuronide conjugates. Oxidation to 1,4-benzoquinone results in a reactive metabolite, that may form mono- or polyglutathione conjugates.

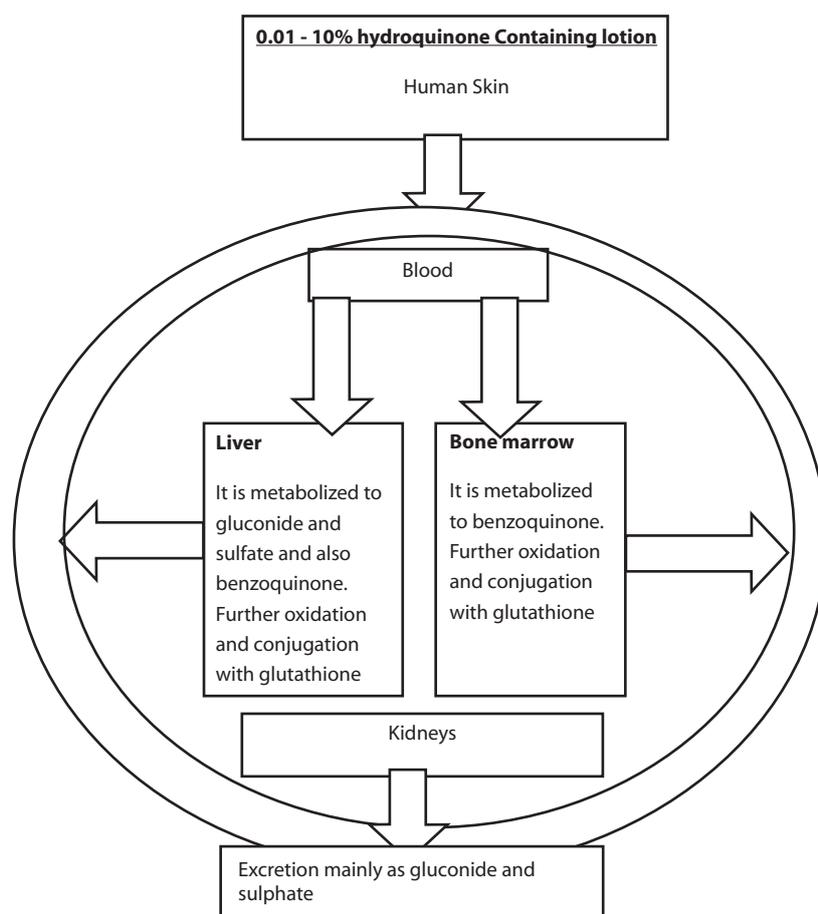


Figure 1

The schematic diagram explaining the possible metabolic pathways of hydroquinone when it enters the human body.

A study published under the joint sponsorship of the United Nations Environmental Programme, the International Labour Organisation and the World Health Organisation into the health risks of Hydroquinone in Geneva (1996) recommended that; "In view of the widespread inappropriate use of skin-lightening creams, it is recommended that over-the-counter sales of creams containing Hydroquinone be restricted.

Health Education Programmes should be developed to discourage the use of Hydroquinone-containing creams for whole body skin lightening". Even though hydroquinone concentrations less than 3% causes negligible effects when applied dermally, UNEP study indicates that there are case reports suggesting that skin lightening creams containing 2% hydroquinone have produced leukoderma, as well as ochronosis (International Program on Chemical Safety, 1994).

Hence the present investigation was aimed at determining the level of hydroquinone in the randomly selected creams and whether the concentration is within the accepted limits.

Chemical Analysis and Methodology

The method proposed by (Oyedeji et al., 2009) was used to analyze for the presence and exact concentration of Hydroquinone in 24 different brands of body lotions randomly selected from the Local retail outlets within Baraton, Kenya. The concentration of hydroquinone was determined using a UV spectrophotometer at a wavelength of 302nm. According to this method, different concentrations of hydroquinone standards were prepared by dissolving 1g of Hydroquinone in 1000 ml of 0.05 M sulfuric acid to make 1000 ppm and serially diluted to give 2, 4, 6, 8, 10 and 12 ppm. The absorbance of the solutions was measured and a calibration curve plotted.

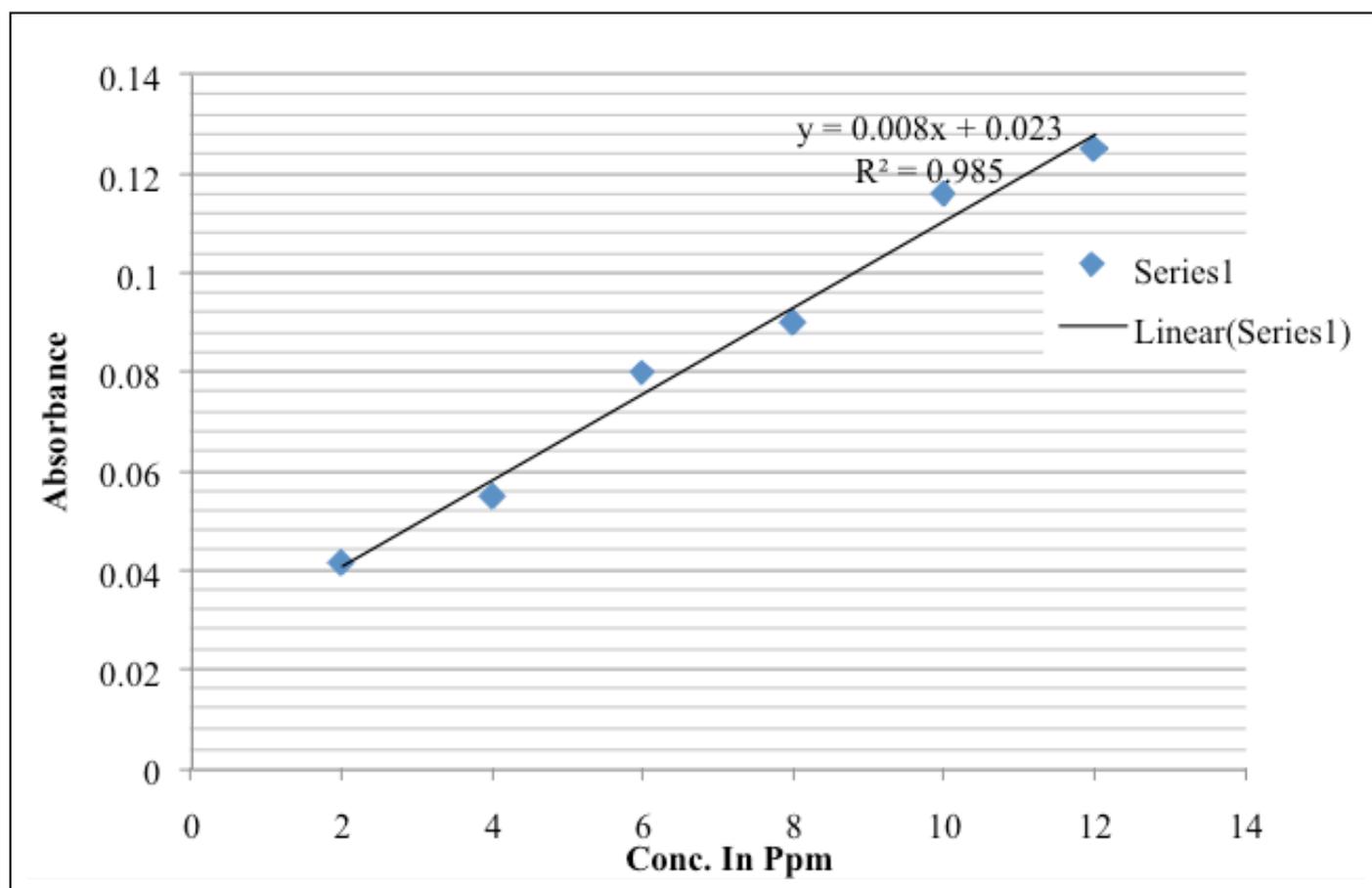
Standard calibration curve

For the samples, 1g of each sample was dissolved in 20 cm³ of 0.05M Sulfuric acid in a water bath. This solution was then transferred into 25cm³ standard volumetric flask and made to volume with the 0.05M

sulfuric acid. The solution was then filtered with a filter paper then discarded the first 5 cm³. The filter paper was then rinsed with additional 5 cm³ of sulfuric acid to remove any retained sample. The absorbance was then taken at a wavelength of 302 nm and traced on the calibration curve to give the concentration hydroquinone in each sample. The mean absorbance

of the best two replica readings was recorded for each sample.

The calibration curve was obtained from Hydroquinone standard by serial dilutions of concentrations 2 to 12 parts per million.



Spectroscopic assay: Calibration curve (Wavelength max = 302 nm).

Figure 2

A calibration curve for the hydroquinone standards showing absorbance against concentration in ppm.

Table 1

The sample average absorbance values for three trials at 302 nm, concentration in ppm and the percentage concentration

BRAND NAME	ABSORBANCE	Conc. in ppm	% Conc.
Apricot	0.296	3.700	0.00037
Baseline Perfumed P. Jelly	0.178	2.225	0.00023
Big Love	0.940	11.750	0.00120
Big Love Natural Honey	0.166	2.075	0.00021
Blue Magic	0.620	7.750	0.00078
Clere	0.420	5.270	0.00053
Fair & Lovely Herbal	0.068	0.850	0.00009
Fair & Lovely Multivitamin	0.263	3.290	0.00033
Fair & Handsome	0.376	4.700	0.00047
GG Cream	2.780	34.750	0.03475
Ingram	0.075	0.930	0.00009
Johnson's Baby Oil	0.656	8.200	0.00082
Joy	0.295	3.680	0.00037
Naturally Fair	0.154	1.930	0.00019
Nice & Lovely C. Butter	0.296	3.700	0.00037
Nivea Sun Lotion	0.204	2.550	0.00026
Pure Glycerine	0.075	0.934	0.00009
Queen E. Body Lotion	0.076	0.950	0.00010
Queen Elizabeth Luxury	0.082	1.025	0.000025
Vaseline Firming lotion	0.157	1.963	0.00020
Vaseline Petroleum	N.D	-	-
Zoe Body Milk	1.151	14.39	0.00144
Zoe Cocoa Butter	1.684	21.05	0.00211
Zoe Petroleum Jelly	0.095	1.19	0.00012

Results and Discussion

The Uv- Vis analysis results confirmed the presence of hydroquinone in most of the creams and body lotions at varying levels. Twenty three out of twenty four tested samples contained some traces of hydroquinone. According to the Kenya Bureau of Standards Kenya gazette of November 2000, the use of hydroquinone should be on clinical prescription only. Nevertheless the concentration was less than 2% which is permitted by WHO. In Vaseline petroleum jelly the concentration were below the detectable limits. Though hydroquinone is allowed for certain dermatological conditions, its presence in creams meant to serve as emollients, gives cause for concern as to the potential health implications more so, as it

is being used on intact skin for skin lightening and not for therapeutic purposes. Also the labels do not give adequate warning to users about the levels of hydroquinone present.

According to the Sunday Nation Newspaper lifestyle article of Jan 23rd 2011, it is common to find beauty products with 25% hydroquinone on sale in Kenya, Tanzania and DRC. The hydroquinone works within the deeper part of the upper skin layer to destroy the melanocyte cells which produce the melanin pigment. The melanocyte cell functions get depressed such that no pigment forms when the new layer of skin appears on the surface, it is lighter and when exposed to sun the skin reacts by developing dark stains.

This study has for the first time established the presence of hydroquinone in most of the creams and lotions that are popularly used as healthcare products. Our idea and aim of creating awareness to consumers and other concerned parties on the ill-health effects of some healthcare products in popular and regular use can now be done on scientifically established information base. Specifically, it has been established in this research that commonly used products such as GG cream, Zoe cocoa butter and blue magic contain hydroquinone in appreciable concentrations and there is need to strictly control the use and distribution of such products to prevent long term health effects.

Conclusion

From the investigation, it is evident that most of the body lotions and creams sold within Baraton contain small amounts of hydroquinone that are within the acceptable range. Therefore these levels may not cause permanent skin damage, disfigurement nor are carcinogenic.

Recommendation

1. A long term research work should be done to ascertain the effects of exposure to hydroquinone containing body lotions and creams and other benzene metabolites.
2. High performance liquid chromatography could be used to validate the results gotten from UV-vis analysis.

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