Determination of Amount of Hydroquinone in some selected Skin-lightening Creams sold in the Ghanaian Market.

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Abstract: In this study, fifty (50) samples of skin-lightening creams were analyzed for total hydroquinone by High Performance Liquid Chromatography. The concentration of hydroquinone ranged from below 0.001% to 3.45 %. It was realized that eight percent (8%) of cream samples analyzed contained amount of hydroquinone higher than the recommended WHO maximum permissible limit of (2%). The use of such creams may pose serious health hazards.

Key Terms: Hydroquinone, Concentration, High Performance Liquid Chromatography, skin-lightening, Creams, Hyperpigmentation, Health Risk.

1.0 INTRODUCTION

Hydroquinone is potentially carcinogenic and is known to be a skin and respiratory irritant (Petit et al 2006. Huang et al. 2007). It is also considered a primary topical ingredient for inhibiting melanin production. Hydroquinone is a strong inhibitor of melanin production, meaning that it prevents skin from making the substance responsible for skin colour (Lawrence et al. 1988, Palumbo et al. 1991). Because hydroquinone is carcinogenic it has been banned in some countries because of fears of a cancer risk. Some concerns about hydroquinone's safety on skin have been expressed, but research have shown that when it comes to topical application, it has negative reactions which are minor but major as a result of using extremely high concentrations. This is particularly true in Africa where adulterated skin lightening products are common. The Ghana Standards Authority (GSA) allows a maximum of two percent in skin care products but excessive concentration can cause serious health hazards such as tinnitus, dizziness and nausea (Melisa et al,. 2009 and Hutson et al. 1985). Acute animal test on rats, mice and rabbits have demonstrated hydroquinone to have high acute toxicity from oral exposure (Aldrich et al. 1990).

Hydroquinone can cause various deadly diseases such as thyroid disorder, leukemia and liver damage. Chronic occupational exposure to hydroquinone dust has resulted in eye injuries, which varied from mild irritation and staining of conjunctivae and cornea to changes in the thickness and curvature of the cornea, loss of corneal luster and impaired vision. Prolonged exposure is required for the development of severe ocular effects (Udengwu et al 2008, Olumide et al. 2008, Dadzie te al. 2009. and Petit et al. 2006). Side effects of hydroquinone are mild when used in low concentrations. Higher concentrations frequently irritate the skin and, if used for prolonged periods, cause disfiguring effects including epidermal thickening. Brown discolouration of nails has been reported occasionally when application of two percent hydroquinone is used on the back of the hand (Considine et al. 1985). If hydroquinone is accurately ingested, it seldom produces systematic toxicity. However, oral ingestion of between 5g and 15g doses has produced convulsions and hemolytic anemia (Brigs et al.

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1982). Intraperitoneal injection of hydroquinone caused chromosomal aberrations in magnitude as in mouse bone marrow cells. Cells of intoxication have been reported after ingestion of hydroquinone alone or of photographic developing agents containing hydroquinone. Deaths have been reported after ingestion of photographic developing agents containing hydroquinone (Brigs et al. 1982). Hydroquinone is an important phenolic compound used in a wide variety of biological and industrial processes. It is used principally as inhibitor in polymer industries to stop polymerization of acrylic acid, methyl methacrylate during storage and shipping processes. Hydroquinone is used as an intermediate in the manufacturing of antioxidants for rubber, dyestuffs and food products. The major use of hydroquinone is as a reducing agent in photographic developing solution which reduces silver halides to elemental silver in black-and-white photography and lithography. Hydroquinone mostly discharges from the effluents of photographic developing processes and from the arial gasification condensate water. Besides its importance it is also very much toxic and creates serious water pollution problems in many localities. Exposure to hydroquinone produces health hazard effects to humans and animals (The Merck Index, 1989).

The Ghana Standards Board limits the use of hydroquinone in soaps and cosmetics to two percent or less. Most of the skins lightening creams on the Ghanaian market are imported from Europe, USA and Cote d'voire. All these countries have restricted the use of hydroquinone to 2% or less.

Hydroquinone has acute and chronic side effects. The Ghana Standards Board allows a maximum of two percent (2%) in skin care products for hydroquinone. The Kenya Bureau of Standards banned some hydroquinone containing skin lightening creams (Aldrich et al. 1990). Despite the side effects of hydroquinone, skin lightening creams containing these harmful chemicals are still found on the Ghanaian market and are sold to the public.

Considering the toxic effect of hydroquinone, it is important to control their exposure to humans. This can only be achieved if their levels in skin lightening creams are known.

In Ghana, little work has been undertaken to determine the levels of hydroquinone in toning creams even though concern have been expressed about the wide spread of the use of skin lightening creams(Voegborlo et al 2008).

The objective of this research is to determine levels of hydroquinone in some selected skin lightening creams sold on the Ghanaian market and compare levels with standards and to determine if Ghanaian women are at risk.

2.0 MATERIALS AND METHODS

Fifty bleaching creams were obtained randomly from cosmetic shops in Adum Market in Kumasi and Accra Makola Market in Accra of Ghana.

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2.1 Apparatus and Equipment

All glassware used were soaked in detergent solution overnight; rinsed and soaked in 10 % (v/v) HNO3 overnight. They were rinsed with distilled water followed by 0.5 % (w/v) $KMnO_4$ and finally rinsed with distilled water before used. Reversed-phase High performance liquid chromatography was performed at ambient temperatures using a Spectrophysics SP800 solvent delivery system and a Shimadzu SPD-MIA diode-array UV spectrophotometric detector. The analytical column used was stainless steel, 5µm supelco LC-18-DB, 6×250mm. The sample injection volume was 50µl. The mobile phase was methanol and water (10+90 v/v) pumped at a flow-rate of 1.0 ml per minute. The UV detector was operated at 226 nm with a sensitivity of 0.50. A chart speed of 5 mm min^{-1} was used to record peaks.

All reagents were of analytical reagent grade (BDH Chemicals Ltd, Poole, England) unless otherwise stated. Double distilled water was used for the preparation of all solutions. The methanol used for the hydroquinone analysis was HPLC grade. Standard solution of Hydroquinone ($10gl^{-1}$) was prepared by dissolving 1.0g hydroquinone in 100ml methanol. Various HQ concentrations (0.08, 0.12, 0.16and 0.2g/l) were prepared by diluting aliquots of the stock hydroquinone standard with

methanol. The mobile phase comprised of methanol and water (90 + 10 v/v).

About 0.10g of each cream was weighed accurately and transferred into a 10ml flask and 8.0ml of methanol was added and heated at 40 ^{0}C in a water bath and shaken occasionally.

2.2 Extraction of Hydroquinone

About 0.10g of each cream was weighed accurately and transferred into a 10ml flask and 8.0ml of methanol was added and heated at 40^{0}C in a water bath and shaken occasionally until it dissolved. It was allowed to cool and made up to the mark with methanol. The solution was filtered using a membrane filter in order to have a clear solution.

Determination of hydroquinone was carried out by a chromatographic method using a High Performance liquid chromatography model Cecil CE 4200 (England). This is equipped with an analytical column responsible for the separation. It was packed with 3–10 mm porous silica particle. Standard solutions were injected to obtain a calibration curve. A syringe with a capacity of 50µl was used to inject the sample into the sample loop. After loading the sample, the injector was turned to the inject position. The sample was swept into the column by the mobile phase and then to the detector. The HPLC detector was based on spectroscopic measurements, including UV absorption, and fluorescence. The resulting chromatogram was a plot of absorbance as a function of elution time. The flow cell has a volume of 1–10 ml and a path length of 0.2–1 cm. The signals were obtained on a computer.

2.3 Recovery studies

The recovery study was determined by analyzing two samples and adding increasing concentration of both mercury and hydroquinone.

Analytical and matrix recovery studies were performed by spiking samples with 25 and 50µl of 1 µg ml-1 standard hg solution. Analytical and matrix spike recoveries of the procedure yielded results between 97% and 104% with coefficient of variation between 4% and 9%. Recoveries were performed by weighing two samples separately and a known amount of standard solution was added and analyzed. Amount present summed with amount obtained gave the percentage recoveries which was within the range of (96-106) %.

3.0 RERSULTS AND DISSCUSIONS

The amount of hydroquinone in skin-lightening creams sold on the Ghanaian market was determined using a High Performance liquid chromatography (model Cecil CE 4200) for hydroquinone. The accuracy of the technique used for hydroquinone was by recovery studies. Analytical and matrix recovery studies were performed by spiking samples with 25 and 50 µl of 1 µg ml-1 standard Hg solution. Analytical and matrix spike recoveries of the procedure yielded results between 97% and 104% with coefficient of variation between 4% and 9%. The recovery studies for hydroquinone ranged from 96 to 106 %.

Sample	Weight (g)	Amt present (g)	Amt added (g)	Amt Obtained (g)	Amt Recovered(g)	% Recovered
Caris cream	0.1223	0	0.32	0.34	0.34	106
Caris cream	0.1223	0	0.24	0.23	0.23	96
Bioclaire cream	0.1283	0.002	0.32	0.312	0.31	97
Bioclaire cream	0.1283	0.002	0.24	0252	0.25	104

Table 1. Shows the recovery of hydroquinone

Amount of Mercury in different skin lightening creams from a Ghanaian

market.

Name	Country of origin	HQ(%)
White Mark Cream	Italy	0.52
Skin Maxitoner Cream	Italy	ND
Fair and Beautiful Cream	Italy	0.21
Biotone Toning Lotion	Ghana	3.08
Nivea Night Whitening Milk	Thailand	0.12
Surfaz Cream	India	0.01
Epiderm Cream	India	0.42
Amiderm Cream	India	0.21
Closol Cream	India	0.37

Name	Country of origin	HQ(%)
Betasol Cream	India	0.19
Dove silk Cream	Nigeria	0.41
Jergens Soothing Cream	USA	ND
Niuma Skin Lightening	spain	3.45
Nivea Intensive Lotion	Spain	ND
Nivea Smooth Lotion	Spain	0.83
Dermatological E45 Lotion	U.K	ND
Dove Hydro Fresh Cream	U.K	0.11
Dove Seidige Lotion	U.K	0.51
Zarina Cream	U.K	1.63
Lemonvate Cream (SWISS)	Switzerland	0.10
Diva Maxotone Cream	Cote d'voire	0.65
Akagni Cream.	France	3.36
Fair and White Exclusive	France	1.94

Name	Country of Origin	Hg(%)
Movate Cream	Italy	0.17
New Age Cream	Italy	ND
Swiss Formular Cream	Italy	0.02
Claire Dark Cream	Italy	ND
Skinicles Cream	Italy	0.20
Cream A3 Lotion	Italy	ND
Skin Solution Cream	Italy	0.50
Clear Spot Cream	Italy	ND
Maprovate Cream	Italy	0.34
Clear White Cream	Italy	0.98
Bioclaire Cream	Italy	2.03
Clear Essence Cream	Italy	ND
Lemonvate Cream	Italy	0.13
Fade out Cream	Italy	0.15
Clear and Smooth Cream	Italy	0.80
Skin Success Cream	Italy	0.27
Neo-vate Cream	Italy	0.43
Maxi-clear Cream	Italy	0.13
Visible Difference Cream	Italy	0.21
Caris Cream	Italy	ND
Clear Dark Spot Cream	Italy	0.07
Oranvate Cream	Italy	0.13
Aloe Vera Cream	Italy	0.24
Clean and Clear Cream	Italy	0.34
Tenovate Cream	Italy	ND
P&C Cream	Italy	0.50
Natural Lemon Cream	Italy	0.39

Table 2. The amount of Mercury in different skin lightening creams from a Ghanaian market

Country of origin	Number of samples	Hydroquinone levels, Range(%), Mean(%)
Italy	30	0.00-2.03, 0.30
Ghana	1	3.08-3.08, 3.08
Thailand	1	0.12-0.12, 0.12
India	1	0.01-0.01, 0.01
Nigeria	1	0.41-0.41, 0.41
USA	1	0.00-0.00, 0.00
Spain	3	0.00-3.45, 2.14
U.K	4	0.00-1.63, 0.75
Switzerland	1	0.10-0.10, 0.10
Cote d'voire	1	0.65-0.65, 0.65
France	2	1.94-3.36, 2.652.

Table 3. Mean values of hydroquinone levels

The results of this study showed that the 44 (88%) creams analyzed for hydroquinone contains up to 1.0% of hydroquinone. Total of 2 (4%) creams analyzed namely Fair and white exclusive lotion and Zarina cream recorded 1.94% and 1.63% of hydroquinone respectively, Bioclaire cream recorded 2.03% of hydroquinone. Niuma skin lightening lotion recorded the highest hydroquinone conentrations of 3.45% while Biotone skin lotion and Akagni cream contains 3.08% and 3.36% respectively. Bioclaire lightening cream contains 2.03% which is also above the recommended value. New age cream, Claire dark cream, Cream A3 lotion, Dermatological E45 lotion, Nivea intensive lotion, Jergens soothing cream, Skin maxitoner cream, Tenovate cream, Clear essence cream, and Clear spot cream recorded no amount of hydroquinone. In total, 92% of the creams analysed do not have more than 2% hydroquinone content which is the threshold limit and 8% of the creams analysed contains more than 2% hydroquinone content which falls above the threshold limit. Side effects of hydroquinone are mild when used in low concentrations of about 1% tingling or burning on application and subsequent erythma and inflammable were observed in eight percent of patients using a two percent concentration and thirty two percent of patients using a five percent hydroquinone concentration (Ash and Ash, 1998).This implies that creams containing more than 1% hydroquinone are likely to pose health hazards to the users even though the recommended limit is 2%.

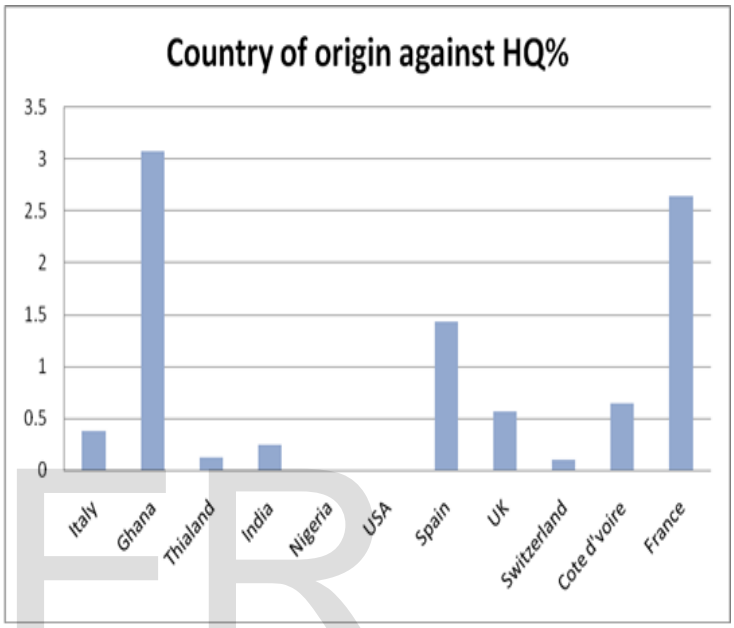

Figure 1.0 Graph of Country of origin against hydroquinone mean values.

Figure 1.0 indicates mean values of hydroquinone levels against the country of origin. Ghana recorded the highest hydroquinone level in Biotone toning lotion while USA and Nigeria recorded the lowest. France recorded the second highest mean value of 2.65%. Hence, Ghana and France falls above the threshold limit of two percent (2%) whiles Italy, Thailand, India, Nigeria, USA, Spain, UK, Switzerland, and Cote d'voire fall below the threshold value.

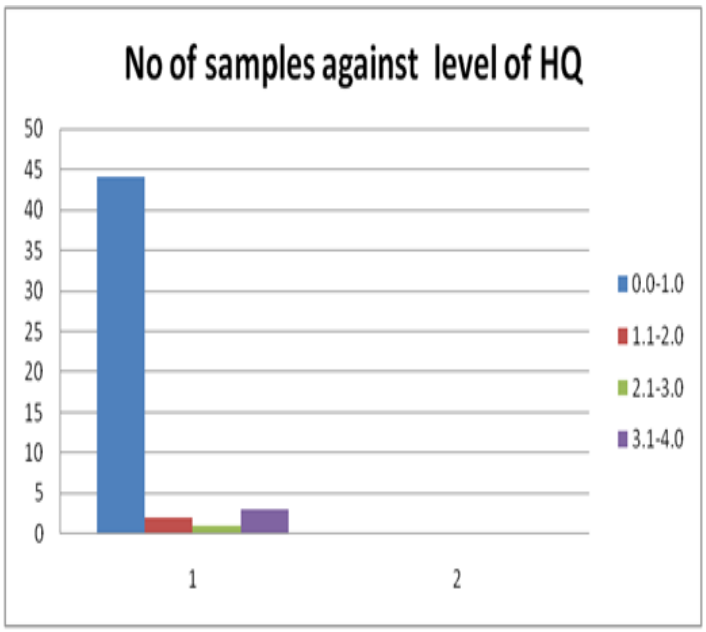

Fig 2. Graph of number of samples against mean values of Hydroquinone (%).

Fig 2. indicates mean values of number of samples against mean values of hydroquinone. It was realized that 44 (88%) of the samples recorded mean values from 0.0-1.0 % and 3 (6%) of the samples recorded mean values from 3.1-4.0%. Total of 2 (4%) of the samples recorded mean values from 1.1-2.0%. Only one sample recorded mean values from 2.1-3.0%. This implies that 8% of samples analyzed had hydroquinone levels more than the recommended threshold limit of 2%.

4.0 CONCLUSIONS

From the outcome of this research it can be concluded that 8% of the creams analyzed had hydroquinone concentration above the WHO threshold limit of 2%. In general the level does not pose significant health threat to the entire population in exception of those that has levels above the threshold limit. Excessive use of products containing should be avoided.

5.0 RECOMMENDATIONS

It can therefore be recommended that, the population should be educated on the implications of using skin toning creams and soaps. This should be targeted at all ages through work-shops that can be organized by Food and Drugs Authority, Media and other stake holders. The levels of hydroquinone in toning creams on the market should be investigated before allowed into the country. Routine analysis should be conduct-ed to ascertain the levels of hydroquinone in creams sold in Ghana.

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