International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Evaluation of the Concentration of Some Heavy Metals in Hair Dyes in Baghdad

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Abstract: It ***is obvious that heavy metals toxicity to humans is as a result of long term or extreme level exposure to pollutants common in the environment including the air, water, food and many consumer products like the cosmetics and toiletries .In this study, we measured the levels of toxic metals in different hair dye products sold at local shops in Baghdad, Iraq. The hair dyes included twelve samples .These items were buying from diverse shops in different locations include Baghdad markets and from different companies and several brands. The samples of heavy metals were analyzed (lead, cadmium, iron, and copper). The selected toxic of heavy metals concentrations were determined by flame atomic absorption spectrophotometer. the samples analyzed contained a detectable amount of all the metals of interest. The concentration of the heavy metals in the samples ranged (0.41 _0.91 ppm) from lead,(0.26_0.31ppm)from copper, (0.64_1.36ppm)from iron ,and (0.11_0.16ppm) from cadmium. Obviously, the present study the use of some hair dyes exposes users to low concentrations of toxic heavy metals which could put up potential health damage to users since it has been known that heavy metals can increase in the biological system by the time and are known to generate skin problems or diseases such as cancer. Further research to better understand the various sources of heavy metals in cosmetic products and tortillas is recommended***

Keywords: Hair dye, Heavy metals, Atomic absorption spectroscopy

1. Introduction

The practice of changing the color of hair is called “Hair coloring”. The main purpose for this process are cosmetic (e.g., to cover gray hair, to change to a color regarded as more fashionable or younger, or to get back the original hair color after it has been discolored by hairdressing processes or sun bleaching). Hair dyeing, which is an ancient art involves treatment of the hair with various chemical items. Today, hair coloring is vastly popular (Wecker John 1961).

1.1 Hazardous chemicals in hair dyes

The complexity of formulas in commercial hair dye, with dozens of components, and the formulas are different between the manufacturers. In general, the components of hair dyes contain dyes, antioxidants, modifiers ,alkalizes , ammonia, soaps, fragrance, wetting agents, and a many of other chemical materials which is used in small amounts that transfer special qualities to hair (such as softening the tissue) or give a desired process to the dye (such as making it more or less enduring).Usually the dye chemical materials are contains amino compounds, and show up on hair dye components lists with such names as 4-amino-2-hydroxytoluene and m-Aminophenol. Metal oxides, such as titanium dioxide and iron oxide, may often used as pigments as well. (Balsam, 1972, Foltz-Gray, 1969). The modifiers used in hair dyes and considered as chemicals, which set the dye pigments or else act to modify the shade. The modifiers might clear the color tones, such as purple or green, which considered as an addition to the dye pigment. One of them is commonly used as modifier which is resorcinol, in spite of there are many others. The dye prevented by the Antioxidants so as not to oxidizing with air. The common chemical used frequently is sodium sulfite. The pH of the dye formula can changed by the addition of alkalizes, because the dyes work effectively in a highly alkaline mixture, the common alkalizes is ammonium hydroxide, the farther side of these basic chemical materials. Various different chemical materials are used to transfer special qualities and features to a manufacturer's formula. They may be shampoos, fragrances, chemicals that make the formula creamy, foamy, or thick, or contribute to the overall action of the formula (Balsam1972, Sardas.S, 1997). Some coal tar colors also contain heavy metal impurities, including arsenic and lead, that cause cancer if its increased and can spoil and ruin hormones. For all that in hair dyes many of the synthetic colors which used have never been tested for safety and secure, WHO considers them as possible carcinogens (Mielke.H,1997).

1.2. Heavy metals and their effect on human health

Heavy metals can poison enzyme systems in serious way, increase free radical production and displace or mix it with necessary elements that make up metalo-enzyme mixtures and combine it with the imbibitions of nutritional minerals, as a color additive lead acetate is used in "gradualist" hair dye products. These products are applied across a limit period of time to achieve a gradual coloring effect (David L.2009). In the body, lead will either increase in tissues, especially bone tissues, and in the kidneys, liver, pancreas, and lungs tissues (Health Canada2010b), Pregnant women and young children are especially vulnerable to this because in easy lead can pass the placenta and enter the fetal brain (The Campaign for Safe Cosmetics2007).also it can be transferred easily to infants via breastfeeding (Agency of Toxic Substances and Disease Registry. (2007b).and lead stored in bone serves source of fetal lead exposure. Rothenberg,(Rothenberg,2000). After immediate exposure, within two to six weeks humans are able to get rid of 50 percent of the lead, but it takes 25 to 30 years to get rid of 50 percent of lead that has increased and pile in the body by time (HealthCanada1992). Transfer process for a color to cosmetics and personal care products done by Iron Oxides. Depending on the specific Iron Oxides or mixtures of Iron Oxides used, the color variation will be from orange, red, yellow to black (Bluhm EC, 2007),Iron oxides are considered as gentle and non-toxic in cosmetic products and

its placed on the surface of the skin, although they aren't suitable for permanent cosmetics placed into the coetaneous layer of the skin since they can be absorbed and spoiled by blood vessels and lead to color changes process .Usually They're not vexing to the skin and aren't known that they cause allergenic. Several reports of allergic reactions to iron oxides have brightened up to cause an allergy to nickel instead. Basically people with sensitive skin problems are not affected by Iron oxides. Altogether, they're safe and non-vexing in the amounts found in cosmetic products (Corbett JF (2000), iron excessive may led to hemo chromatosis, a severe disease that can damage the body's organs. Recently symptoms include fatigue, weight loss, and joint pain, but if hemo chromatosis is not treated and handled, it can cause heart disease, liver problems and diabetes. A blood test can identify iron excessive (.Karen S. Garvin, 2014).In lipsticks and face powders mostly present used is Cadmium which is a deep yellow to orange pigment. The use of cadmium in cosmetics products are according to its color property as it has been used as a color pigment in many industries(AmitSChauhan,2010) cadmium is absorbed and imbibed into the body, increasing in the kidney and the liver ,Practically it can be exist in almost all adult tissues (Elinder, C.-G. (1995).Oral exposure to high levels of cadmium has causes to severe stomach vexation, and leading to vomiting and diarrhea, meanwhile; by time the exposure to lower levels has been discovered recently that it might causes kidney damage, bone deformity, and the ability of bones to break easily. While, lung cancer has been associated with breathing cadmium in humans exposed occupationally and in rats (Environmental Defense Canada2011). If copper is carcinogenic or not that has not been determined yet ,vexation of the nose, mouth and eyes and it causes headaches, stomachaches, dizziness, vomiting and diarrhea if the body expose to Long-term exposure of copper. Intentionally and the related high imbibitions of copper may cause liver and kidney damage and even death. There are several scientific articles that point out a connection between long-term exposure to high concentrations of copper and a downgrade in intelligence with young teenagers. Whether this should be of main point is a topic for further investigation.Industrial exposure to copper fumes, dusts, or mists may result in metal fume fever with atrophic changes in nasal mucous membranes. Chronic copper poisoning results in Wilson's disease, featuring by a hepatic cirrhosis, brain damage demyelization, and renal disease (BetriceDarko2010). The target of this study was to determine the concentrations of heavy metals including (lead, cadmium, copper, and iron) in hair dyes sold in different shops in Baghdad with a view of assessing the potential risks that such cosmetic may pose to consumers.

2. Materials and Methods

2.1. Sample Collection

Twelve sample of hair dye were bought from various sources and shops in different locations in Baghdad, Iraq.

2.2. Reagents and Standards

Analytical grade per chloric acid (70%, Sigma Aldrich) and nitric acid (65%, Sigma Aldrich) were used for sample preparation. Calibration standards for each heavy metal were prepared each day from the certified standard stock solution(1000ppm-manufactured under ISO 9001 Quality Assurance system-shimadzu7000AA) in the range from 0.5 to 10ppm. All the solutions were prepared in double distilled water. Dilution Correction was applied for samples diluted or concentrated during analysis.

2.3. Sample Preparation and Analysis

Samples were wet digested with a 4:1 mixture of nitric acid (65%) and per chloric acid (70–72%) on a hot plate in fuming hood near to dryness by slowly increasing the temperature for 2–3 h because oily compounds are exothermic and burns with flame. In case brown or black color appeared then again the same procedure was repeated by adding the mixture of concentrated acid by slow and continuous heating until the evolution of white fumes (marking the end of the digestion process)and near to dryness. The solutions were allowed to cool and filtered into a calibrated flask (100mL) by whatman no. 42, and were diluted up to the mark(Hussain Ullah , Shamsa Noreen2013). To analyze heavy metals contamination in hair dye is Flame atomic absorption spectrophotometer (FAAS) (Amartey et al., 2011; Saeed et al., 2011).

Therefore, this study was carried out on a Flame Atomic spectrophotometer (Shimadzu700) for lead, cadmium, copper, and iron.

2.4. Statistical Analysis

The Statistical Analysis System- SAS (2012) was used to effect of different factors in study parameters. Least significant difference –LSD test was used to significant compare between means in this study (SAS. 2012).

3. Results and Discussion

Table (1) gives a summary of the statistical analysis of the concentrations of heavy metals in (12) hair dyes sampled from various origins and shops in different locations in Baghdad.

Table 1: Statistical summary of heavy metals concentration in hair dyes samples

Sample	Origin	Mean ± SE			
		Pb (ppm)	Cu (ppm)	Fe (ppm)	Cd (ppm)
1.Xiucai _black	China	0.56 ± 0.03	0.28 ± 0.005	0.84 ± 0.13	0.013 ± 0.0004
2.Xiucai_blonde	China	0.74 ± 0.06	0.30 ± 0.012	0.92 ± 0.20	0.014 ± 0.0002
3.Lana_red	China	0.75 ± 0.02	0.31 ± 0.004	0.92 ± 0.16	0.015 ± 0.001
4.Garnier_blonde	polanda	0.41 ± 0.03	0.25 ± 0.007	0.64 ± 0.11	0.012 ± 0.0006
5.Aquarelyblonde	Italy	0.76 ± 0.03	0.26 ± 0.005	0.76 ± 0.09	0.013 ± 0.0004
6.Derio_blonde	France	0.71 ± 0.04	0.26 ± 0.005	0.96 ± 0.11	0.015 ± 0.0002
7.Waves_brown	Syria	0.61 ± 0.02	0.29 ± 0.002	0.88 ± 0.06	0.012 ± 0.0004
8.Waves_black	Syria	0.81 ± 0.05	0.28 ± 0.011	1.01 ± 0.09	0.016 ± 0.0005
9.Koleston_blond	Lebanon	0.91 ± 0.03	0.32 ± 0.004	1.36 ± 0.10	0.017 ± 0.0001
10.Koleston_brown	Lebanon	0.83 ± 0.03	0.33 ± 0.002	1.32 ± 0.07	0.016 ± 0.0015
11.ENPR_blond	_____	0.81 ± 0.02	0.27 ± 0.004	0.76 ± 0.12	0.011 ± 0.0004
12.ENPR_brown	_____	0.92 ± 0.04	0.28 ± 0.002	1.36 ± 0.07	0.016 ± 0.0002
LSD value		0.209 *	0.016 *	0.251 *	NS
* (P≤0.05).					

The concentrations of 4 metals (lead, cadmium, copper, and iron) were determined in 12 samples of hair dye. all the products contained lead ranging from(0.56_0.92) ppm ,the highest concentration of lead obtained in Koleston _blond was 0.91 ppm and the lowest concentration which in Xiucai _black was 0.56 ppm , According to the Centers for Disease Control and Prevention(CDC)and many other experts agree that lead exposure is not safe at any level(Sanders 2009, Bellinger2008,Gavaghan2002,CDC's 2005), the current threshold blood lead levels is 10 micrograms of lead per deciliter (microgram/dl) of blood, the level at which it recommends public health actions be initiated(CDC2009) . But even today the CDC is contemplating whether to further lower the screening threshold to 5 microgram/dl blood since impacts have now been documented at these lower levels (Lanphear2000,Jusko2008),Lead is banned from cosmetics in Canada66and Europe(European Union's Cosmetics Ingredients and Substance).

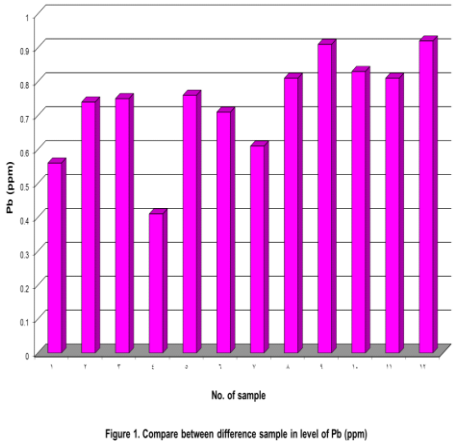

Figure 1: Level of lead in different type of hair dyes

All samples contain copper at trace amount, the highest concentration obtained in Koleston _brown was 0.33 ppm and the lowest concentration which in Garnier_blonde was 0.25 ppm, Although the level of Cu measured was below the reference value, excessive amount in the soft tissue of the body has adverse effect, The most common ones are hair loss chiefly in women (Amartey, E.O2011).

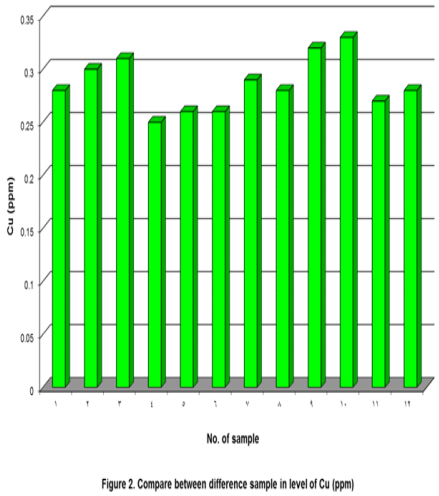

Figure 2: Level of Copper in different type of hair dyes.

As for the iron has been determined in the samples and found that the concentration ranges (0.64_1.36) ppm , the highest concentration in was detected in Koleston_blond and ENPR_brown ,and lowest concentration on Garnier_blonde, iron overload can lead to hemochromatosis, a severe disease that can damage the body's organs. Early symptoms include fatigue, weight loss, and joint pain, but if hemochromatosis is not treated, it can causes liver problems, heart disease, and diabetes (.Karen S.2014).

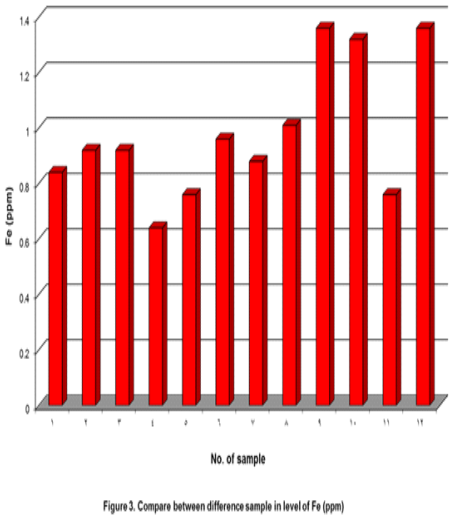

Figure 3: Level of Iron in different type of hair dyes

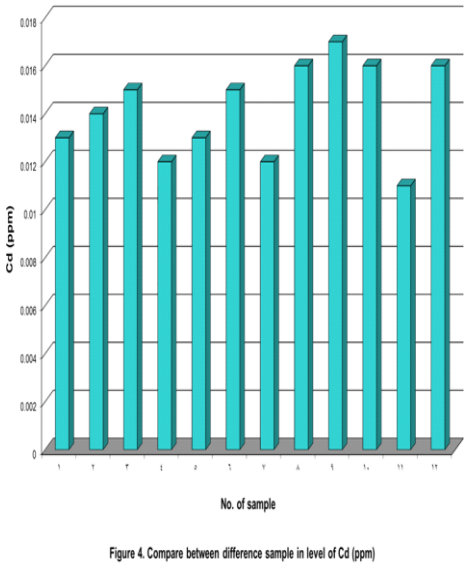

Figure 4: Level of Cadmium in different type of hair dyes.

Cadmium was detected in small amount at all samples ranging from (0.011_0.016) ppm, Although the presence of cadmium in the samples were in trace amount Available data on Cd in cosmetic puts the permissible limit at 3 ppm (3 mg/kg) and 5 ppm (5 mg/kg) for Canada and Germany (HealthCanada,2009) respectively(31), but the slow release of cadmium with low amount may also cause harmful effects to the human body, results from tests showed that it was minor exposure that caused high blood pressure. So the small amounts are not safe. It targets blood vessel and heart tissue as well as, the kidneys, lungs and brain, and results in heart disease, hypertension, liver damage (AmitSchauhan2010).

4. Conclusion

In this study, the lead, cadmium ,copper ,and iron in various hair dyes of different brands were determined , according to the results, it's concluded that lead is one of most lethal toxic heavy metals; but lead ,copper, cadmium and iron were under the allowable limit. The constant use of products polluted with such heavy metals may cause slow release of these metals into the human body and thus show their harmful and serious effects. On the other hand the prolonged uses of such products should be avoided, nonetheless, one should not overlook the fact that both essential and toxic elements increase in the body with time according to the frequency of their usage. If these elements are not eliminated at the rate at which they bioaccumulation they pose and become a serious health risk to their consumers and it will be a real danger on them. Many literatures available prove that the heavy metals are used in large quantity in cosmetics during different time period depending on the products of cosmetics they wanted to use constantly. And these cosmetics that have been prepared as heavy metals as there components has high toxic risks to health. It may cause many problems like damage in brain, kidney, nervous system, reproductive system and even cause a cancer and death .The lack of appropriate permissible limits for most of these elements in Iraq, regular inspection and laboratory analysis of this elements content of such products on the market exposes the population to avoidable health risks. Whereas, in the USA lay the responsibility on the cosmetic manufacturers to ensure the safety of their products and ingredients before introducing them to the market. As part of the manufacturing and import inspections, and follow-up to complaints of adverse reaction from cosmetic and related products samples are examined and analyzed regularly for(compliance to safety regulations US FDA, 2005) It is therefore important to expand the scope of the this study to cover wider consuming public, additional toxic elements of significant interest to health.

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