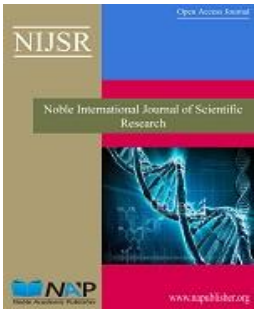
Noble International Journal of Scientific Research
ISSN(e): 2521-0246 ISSN(p): 2523-0573
Vol. 04, No. 02, pp: 11-16, 2020

Published by Noble Academic Publisher
URL: http://napublisher.org/?ic=journals&id=2



Open Access

DETERMINATION OF HEAVY METALS IN NATURAL HAIR DYE SELECTED FROM IRAQI PLANTS

Wedad H. Al-Dahhan*

* Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq

ABSTRACT: The major threats to human health from heavy metals are associated with exposure to highly toxic heavy metals such as arsenic, lead, cadmium, chromium, mercury, as well as some other elements. Heavy elements are important in the formation of living organisms and play an important role in their growth they are toxic. High concentrations of heavy metals may cause health problems. A natural hair dye called (Henna) extracted from a famous plant in Iraq also called henna plant from Basra Governorate. Acid digestion was carried out to Henna sample using nitric acid with hydrochloric acid in a ratio of 2.5:1. The main purpose of acid digestion is to free the elements by destroying the organic components in order to be analyzed in atomic absorption. For the same purpose, water extraction was carried out for henna sample using deionized water. Large proportion of the sulfur element was identified using EDX analysis method for hair dye sample, while atomic absorption analysis shows that acid digestion which was carried out to henna sample was not effective enough to dissolve all the elements. This conclusion was proved according to the presence of some elements in the precipitation resulting from acid digestion. Several treatments may be needed to insure the optimum extraction for the elements from the selected samples.

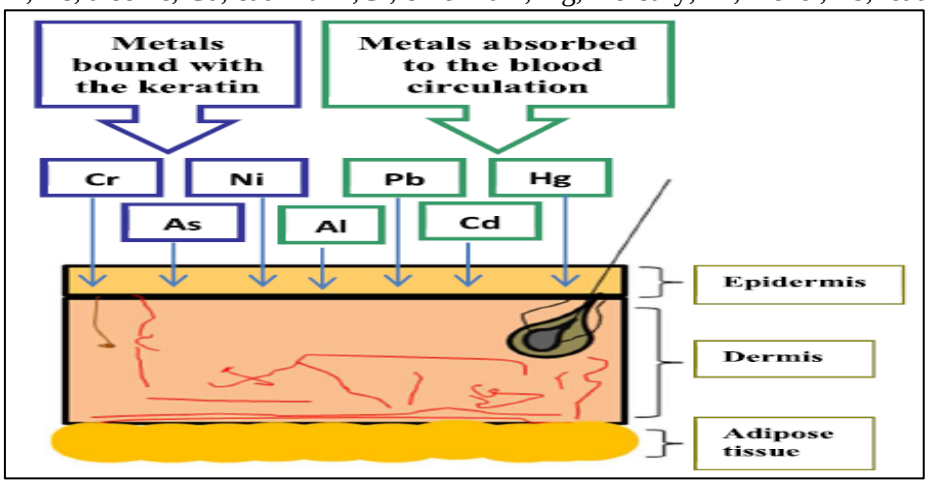
Keywords: Heave Metal, Hair Dye, Henna, Toxic Element.

1. INTRODUCTION

Heavy metals are a term that covers a group of elements with similar chemical properties. Some heavy elements can be harmful if they have high concentrations. [1]. Hair and oily tissue can be considered as storage of toxic elements. Chemical analysis are very important to know the concentration of heavy metals and their accumulation and then to know their effects on the organism [2].Hair is employed as a biomarker of environmental and occupational exposure to essential and trace elements [3, 4]. Make-up materials can be defined as those that improve a person's appearance [5]. Herbal cosmetics are a kind of cosmetics contains useful minerals. Although they are used worldwide since ancient time, but in the last decade, there has been a renewed craze of herbal cosmetics and personal care products, especially in the skin care [6, 7]. The World Health Organization (WHO) states the heavy metals concentration of medicines contains herbal constituent must be controlled [8]. In this case, Health Canada has taken the initiative and implemented a few measures to control heavy metal concentration in cosmetics and determined the maximum acceptable limits. This includes Lead to (10ppm), Arsenic to (3ppm), Mercury to (3ppm), Cadmium to (3ppm) and Antimony to (5ppm). Cosmetics include hair dyes consider as an important pollutant of heavy metals. [9].

There is a conviction among scientists that hair pigments can lead to cancer, especially when using dark colors [10]. Metals present in cosmetics may be accumulated in the skin or absorbed by this route (Fig. 2). Allergic contact dermatitis can be caused by elements such as Ni, Co and Cr [11], whereas, the elements (Hg, Pb, Cd and Al) cause toxic effects by passing through the layers of skin to the blood vessels [12]. In people with permanent use of cosmetics, an increase in elements (Pb, Cd, Hg and Al) was observed through blood and urine tests [13]. Although absorption of these metals by the skin is less effective than by the gas trointestinaltract or inhalation. Hg may enter the skin mainly through appendages. Metals present in cosmetics may be accumulated in the skin or absorbed by this route (see figure. 1) [14].

Figure 1. The scheme represents the accumulation and the absorption of metals in the skin Al, aluminum; As, arsenic; Cd, cadmium ;Cr, chromium; Hg, mercury; Ni, nickel; Pb, lead [14].



One of the most important hair problems is the loss of sulfur, which can be done when adding hydrogen peroxide to ammonia to increase hair bulge and improve its acceptance of the dye. [15].Researchers focused on topics directly related to human health and safety and published many articles in this regard, several important recommendations was stated in these articles [16-26].

This work aims to determine the toxic metals in natural hair dye called (Henna) using (EDX) and atomic absorption instruments.

2. EXPERIMENTAL SECTION

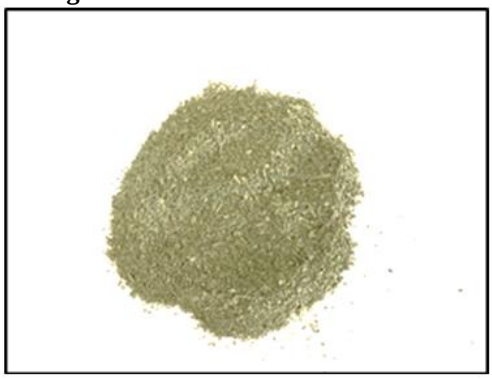
2.1. Sampling

A sample which is a natural product called (Henna) which is natural substance previously used for coloring hair. The henna leaves were cut from a henna tree from the city of Faw in Governorate of Basra in Iraq as shown in figure 2. The leaves dried at room temperature (see figure.3).The dried leaves crashed by hand (see figure .4) and prepared for acid digestion and water extraction.

Figure-2. Henna leaves

Figure-3. Dried Henna leaves

Figure-4. Hand crashed Henna leaves



2.2. Reagents and Chemicals

Nitric acid (65%) and hydrochloric acid (37%) both from Sigma Aldrich were used for sample preparation. Standard solutions for calibration of Magnesium, Zinc, Potassium, Copper, Chromium, Nickel, Cobalt, Cadmium, Lead and Iron were prepared from 1000 mg/l standard stock solution of AAS reference standard from GFS Fishers using deionized water for dilution. Dilution correction was applied for samples diluted or concentrated during analysis

2.3. Henna Acid Digestion

A 3.04g of hair dye natural product (Henna) sample was weighted and placed into 150ml beaker. 15ml of 65% HNO_3 with 10ml of HCL was added [27]. These contents were mixed by stirring and placed on a hot plate. Heating continued until the contents dissolved then filtered (use Whatman filter paper No.41) .The filtrate solution diluted with de ionized water to 100ml. The resulting solution was used for spectrophotometric determination of various metal analyses. According to safety rules in chemical laboratory, this procedure was carried out in fume hood.

2.4. Water Extraction of Henna

A 3.00g of henna was weighted and placed into 150ml beaker .100ml of deionized water was added. The contents were mixed well by stirring thoroughly and placed on a hot plate until the contents completely dissolved. Filtration must carried out (use Whatman filter paper No.41). The filtrate solution poured in volumetric flask and dilute to 250ml with de ionized water. The resulting solution was used for spectrophotometric determination of various metal analyses.

2.4.1. Acid Digestion for Precipitates Resulting from Water Extraction

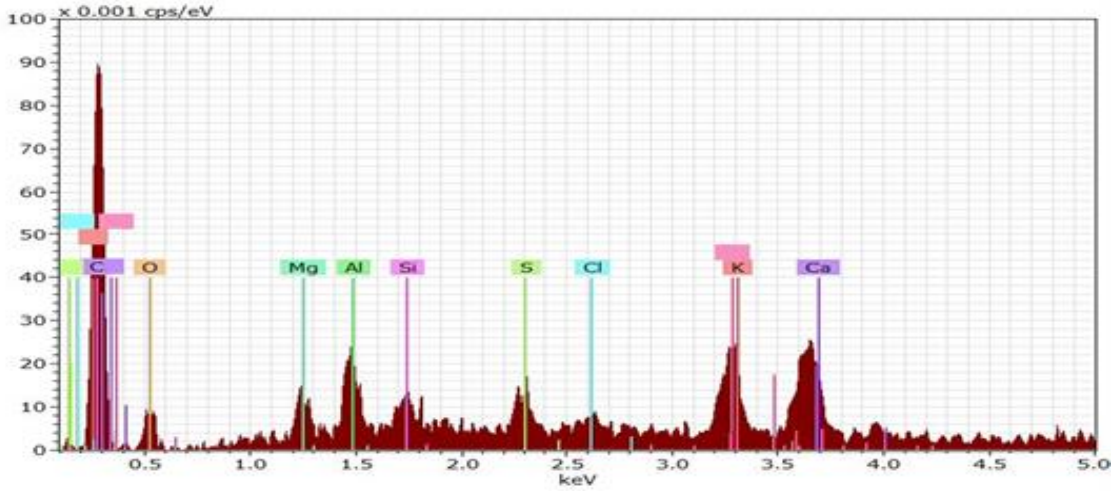
A 1.39 g of henna precipitate resulting from water extraction, as explained in section (2.4) and 0.60 g of henna precipitate resulting from acid digestion, as explained in section (2.3) were weighted and placed into 150ml beaker separately .Acid digestion was carried out for the samples exactly as what was described in section (2.3) above. Various metal analyses was carried out for the resulting solutions.

3. RESULT AND DISCUSSION

3.1. Edx Analysis

Bruker, Energy-dispersive X-ray spectroscopy (EDX), XFlash6I10 model is an analytical technique used for the elemental analysis or chemical characterization of a sample. Hair dye sample (henna) was tested in this instrument. Figure 5 shows EDX spectrum.

Figure 5. EDX spectrum for natural product called (Henna)



In cosmetics and personal care products Sulfur is used to enhance the appearance and reducing flaking and restoring suppleness. Sulfur primarily acts as oxygen transporter which leads to cellular regeneration. Any type of cellular regeneration requires the transportation of oxygen, and sulfur is one of only three minerals that facilitate this process [28]. Henna, a natural product EDX result shows that it contains the elements (Mg, Al, Si, S, K and Ca), which are all useful and nourishing to the hair. No toxic elements found in the hair dye used in this study which is the natural product (henna).

3.2. Atomic Absorption Analysis

Some selected elements were tested using AAS Agilent FS240 model atomic absorption apparatus (see tables 1, 2, 3 and 4) for the prepared solutions as explained in sec. 2.

Table 1. Some prepared samples with a brief description

Sample No.	Sample description	Extracted solution(ml)
1	Henna acid digestion	100
2	Henna water extraction	250
3	Henna acid digestion for ppt. from water extraction	100
4	Henna acid digestion for ppt. from acid digestion	50

Table 2. Concentration of selected elements in mg/kg (p.p.m) for some prepared samples

Sample No.	Zn	Pb	Cd	Fe	Mg	Cu	K	Cr	Ni	Co
1	0.40	none	none	15.75	2.71	0.30	8.33	1.15	1.00	none
2	0.14	none	none	none	2.46	none	5.00	none	none	none
3	0.16	none	none	10.00	1.64	0.20	5.00	none	none	none
4	0.07	none	none	2.50	1.44	none	3.67	none	none	none

Table 3. Weight of selected elements in (mg) for some prepared samples in the total extracted solutions

Sample	Zn	Pb	Cd	Fe	Mg	Cu	K	Cr	Ni	Co
1	0.040	none	none	1.57	0.27	0.03	8.33	0.15	0.10	none
2	0.035	none	none	none	0.62	none	5.00	none	none	none
3	0.016	none	none	1.00	1.16	0.02	5.00	none	none	none
4	0.004	none	none	0.13	0.07	none	3.67	none	none	none

Table 4. Weight % of selected elements for some prepared samples with respect to total sample weight

No.	Sample wt. (g)	Zn	Pb	Cd	Fe	Mg	Cu	K	Cr	Ni	Co
1	3.04	0.001	none	none	0.05	0.27	0.001	0.03	0.005	0.003	none
2	3.00	0.001	none	none	none	0.02	none	0.04	none	none	none
3	1.39	0.001	none	none	0.07	0.01	0.001	0.04	none	none	none
4	0.60	0.0007	none	none	0.02	0.01	none	0.03	none	none	none

From Table-4 we can conclude the following:

The method of extracting elements with hot water for henna (sample-2) is less effective than acid digestion method for the elements (Fe, Zn and Mg) while for potassium element it was dissolved in water more efficiently.

The presence of elements (Zn, Fe, Mg and K) in large percentages in the precipitate resulting from the further digestion by acid of henna (sample-4) indicates that the main digestion process was not very effective.

4. CONCLUSION

A sample of hair dye natural product called (Henna) was selected to be tested for heavy metals determination. Digestion acids was used to free several elements from organic components in henna sample in order to be tested as prepared solutions for elemental determination (EDX) and atomic absorption. From EDX analysis for natural hair dye (henna), results showed that it contains the elements (Mg, Al, Si, S, K and Ca), which are all useful and nourishing to the hair. Results obtained from atomic absorption analysis shows that acid digestion by means of a mixture of nitric acid and hydrochloric acid was not effective enough to dissolve all the metals. We conclude that due to the presence of some metals in acid digestion precipitate. For optimum elemental extraction from the selected sample several acid digestion treatments may be needed to insure the best metal extraction.

5. ACKNOWLEDGMENT

The author thanks all those who contributed to the success of this work at Al-Nahrain University.

6. CONFLICT OF INTERESTS

The author asserts that there is no conflict of interest in publishing this article**.**

7. REFERENCES

[1] D. Puntaric, M. Miskulin, and J. Bosnir, "Health ecology, Medicinskanaklada Zagreb," 2012.

[2] K. Chojnacka, H. Gorecka, A. Chojnacki, and H. Goreck, "Inter– Element interactions in humanhair," *Environmental Toxicology andPharmacology*, vol. 20, pp. 368-374, 2005.

[3] W. Altaf, O. Akanle, L. Adams , D. Beasley , C. Butler, and N. Spyrou, "The University ofSurrey database of elemental composition of human hair". Journal of Radioanalytical andNuclear Chemistry," vol. 259, pp. 493-498, 2004.

[4] V. Bencko, "Use of human hair as a biomarker in the assessment of exposure to pollutantsin occupational and environmental settings," *Toxicology*, vol. 101, pp. 29-39, 1995.

[5] A. Salvador and A. Chisvert, "General Concepts and Cosmetic Legislation.in Analysis of cosmetic products". Elsevier, Kidlington, Oxford, UK," pp. 1-42, 2007.

[6] P. Kapoor, "Herbal cosmetic for skin and hair care," *Nat. Prod. Radiance*, vol. 4, pp. 306-312, 2005.

[7] E. Ernst, "Toxic heavy metals and undeclared drugs in Asian herbal medicines," *Trends Pharmacol. Sc*, vol. 23, pp. 136-139, 2002.

[8] WHO., "Environmental Health Criteria: International Programme on Chemical Safety. World Health Organization, Geneva," p. 165, 1995.

[9] Z. Wei, Y. Y. Rui, and L. L. Shen, "Effects of hair dyeing on the heavy metals content in hair", GuangPuXue Yu GuangPu Fen Xi.," vol. 28, pp. 2187-8, 2008.

[10] M. Gago-Dominguez, "Use of permanent hair dyes and bladder-cancer risk," *International Journal of Cancer*, vol. 91, pp. 575-579, 2001.

[11] F. Larese, A. Gianpietro, M. Venier, G. Maina, and N. Renzi, "In vitro percutaneous absorption of metal compounds," *Toxicol. Lett.*, vol. 170, pp. 49-56, 2007.

[12] J. Stauber, T. Florence, B. Gulson, and L. Dale, "Percutaneous absorption of inorganic lead compounds," *Sci. Total Environ.*, vol. 145, pp. 55-70, 1994.
[13] M. Warle , P. Blackledge, and P. Gorman, "Lead poisoning from eye cosmetic," *Br. Med. J.*, vol. 1, p. 117, 1968.
[14] B. Sylwia and M. Malgorzata, "Metals in cosmetics: implications for human health" ,J. Appl. Toxicol ,Review Article," 2015.
[15] C. Sherwood, "Permanent Hair Dye Ingredients, Ingram Publishing, Availalbe at: https://www.livestrong.com/article/70682-permanent-hair-dye-ingredients/," 2017.
[16] R. Shireen, W. Al-Dahhan, A. Al-Zuhairi, F. Hussein, K. Rodda, and E. Yousif, "Fire and explosion hazards expected in a laboratory," *Journal of Laboratory Chemical Education*, vol. 4, pp. 35-37, 2016.
[17] W. Al-Dahhan, A. Al-Zuhairi, F. Hussein, K. Rodda, and E. Yousif, "Laboratory biological safety cabinet (BSC) explosion," *Karbala International Journal of Modern*, vol. 2, pp. 276-279, 2016.
[18] A. Al-Zuhairi, W. Al-Dahhan, F. Hussein, K. Rodda, and E. Yousif, "Teaching laboratory renovation," *Oriental Journal of Physical Sciences*, vol. 1, pp. 31-35, 2016.
[19] A. Ali, N. Shaalan, W. Al-Dahhan, and E. Yousif, "For a safer working environment with hydrofluoric acid in iraqi industrial plants," *Open Journal of Safety Science and Technology*, vol. 6, pp. 77-80, 2016.
[20] F. Hussein, W. Al-Dahhan, A. Al-Zuhairi, E. Rodda, and E. Yousif, "Maintenance and Testing of Fume Cupboard," *Open Journal of Safety Science and Technology*, vol. 7, pp. 69-75, 2017.
[21] A. Ibrahim, E. Yousif, A. ALShukry, and A. Al-Zuhairi, "Hazard Analysis and Critical Control Point HACCP System," *Iraqi National Journal of Chemistry*, vol. 16, pp. 172-185, 2016.
[22] A. Ali, W. Al-Dahhan, F. Hussein, K. Rodda, and E. Yousif, "A Vision to Promote the Forensic DNA Facility at Al-Nahrain University in Terms of Safety Measures," *Oriental Journal of Physical Sciences*, vol. 2, pp. 37-41, 2017.
[23] A. Ali, N. Shaalan, W. Al-Dahhan, N. Hairunisa, and E. Yousif, "A technical evaluation of a chemistry laboratory: A step forward for maintaining safety measures," *Oriental Journal of Physical Sciences*, vol. 2, pp. 68-71, 2017.
[24] E. Yousif, W. Al-Dahhan, A. Ali, A. Rashad, and E. Akram, "Mind What You Put in a Furnace: A Case Study for a Laboratory Incident"," *J Environ Sci Public Health*, vol. 1, pp. 56-61, 2017.
[25] E. Yousif, W. Al-Dahhan, A. Ali, N. Jber, and A. A. Rashad, "A Glimpse into Establishing and Developing Safety Measures in the Department of Chemistry", College of Science, Al-Nahrain University in 2016.," *Orient J Phys Sciences*, vol. 2, 2017.
[26] E. Yousif, W. Al-Dahhan, R. Abed, A. Al-Zuhairi, and F. Hussein, "Improvement of a chemical storage room ventilation system," *Journal of Progressive Research in Chemistry*, vol. 4, pp. 206-210, 2016.
[27] A. Massadeh, M. El-khateeb, and S. Ibrahim, "Evaluation of Cd, Cr, Cu, Ni, and Pb in selected cosmetic products from Jordanian, Sudanese, and Syrian markets" publichealth," vol. 149, pp. 130-137, 2017.
[28] L. Pietroluongo, "What Is Progressive Color, Ingram Publishing, Available at: https://healthyliving.azcentral.com/effects-of-sulfur-on-the-hair-12570164.html," 2017.