Concentrations of heavy metals and some lanthanides in human hair of population in Basrah Province /Southern Iraq.

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Abstract

Scalp hair as a biological tissue have been used as an indicators for chemical , transition and rare earth elements. Samples of hair were collected from individual volunteers of both genders male and female with different ages in Basrah Province/Southern Iraq. Hair samples were transferred to the laboratory in Marine Science Center, washed with acetone to remove grease and oil, then rinsed three times with distilled water, dried overnight at 80 ^{o}C, after cooling cut into 0.5 cm length grinding and about 0.25 g was weighted of each sample, put in a Teflon beaker for acid digestion. For each sample 3 ml of concentrated acid mixture nitric: perchloric (1:1 v:v) were added and the mixture was digested at 80 ^{o}C on hotplate until dryness, then another 3 ml of the acid mixture were added and further digestion until dryness was done, distilled water then was added to each sample and the volumes were completed to 50 ml in volumetric flask and kept for chemical elements analysis by ICP/MS Instrument at Maxxam Laboratories INC./Canada. Chemical elements determined were heavy metals: Ge, Ir, Mo, Os, Ru, Sb, Se, Sn, Sr, Te, Th, Ti, Tl, W, and Zr, and lanthanides Ce, La, and Nd. The results showed that the levels of the most concerned metals were lower than the upper limit of world wide values, and the results of this study can serve as a reference for further studies

Key Words: Human hair, Heavy Elements, Lanthanides, ICP/MS, Southern Iraq.

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Introduction

Little attention has been paid to the environmental aspects of pollution in Southern Iraq especially that dealing with chemical elements metals in human body. Measurement of the concentrations of heavy metals in the human body is achieved by different wayes, among these ways is samples of hair (Hashem and Abed, 2002).

For the past few decades, most of studies on heavy metal toxicology in human hair were focused upon the most essential heavy metals , Cu, Fe, Mn, Zn… and other nonessential metals (toxic), As, Cd, Cr, Hg, Ni, and Pb because these metals have widely polluted the environment. Recently attention has been given to study other chemical elements such as heavy metals and lanthanides with minor uses and low concentrations. In Iraq very few studies were focused upon contents of chemical elements in human hair, Karabedian et al.,(2009) determined the existence of mercury in hair samples of Iraqi population in Safwan and Al-Zubair /Southern Basrah Province. Khdhair (2014) has analyzed human hair of Iraqis living in urban and suburban in Basrah Province for certain major and heavy metals. Hussein, (2015), analyzed markets dyes used for hair dyeing in Baghdad Province.

Other studies for nearby areas were reported too, among which, Agha et al., (2012) were assessed the concentrations of trace metals, especially mercury, in hair of fishermen from Northern Persian (Arabic) Gulf and correlated them with fish diet.

Certain researchers have used hair analysis to check levels of hazardous elements as a way of monitoring environmental sources of pollution. Various techniques have been employed in the detection of trace elements present in human hair. Among which are, atomic fluorescence spectrometry (Samanta,et al., 2004), atomic absorption spectrometry (Markiewicz, et al., 2002) inductively coupled plasma atomic emission spectrometry (ICP-AES) (Sreenivasa,et al.,2002), and spectrofluorimetric (Ashraf et al., 1994).

Methodology

Hair samples were collected from different ages of both gender male and female from Basrah Province/Southern Iraq. Hair samples (0.5g) were added separately to 10 ml of concentrated nitric acid (HNO_3) and heated moderately under refluxing for complete digestion. Dilute nitric acid was used for dissolution of the ash obtained by wet decomposition and volumes were completed to 10ml with deionized water. The undissolved residue was removed by centrifugation at 700g for 5 min. and supernatant were stored refrigerated in plastic vials. Samples were measured on Electrothermal Atomization Atomic Absorption Spectrophotometer (Pye Unicam SP9) equipped with graphite Furance and Video Computer Programmer.

Results

The concentrations of chemical elements recorded in human hair of 17 volunteers(7 males and 10 females) from population in Basrah Province /Southern Iraq are listed in tables 1 and 2 respectivel, while the minimum and maximum values together with standard levels are listed in table 3.

Table 1. Mean concentrations of chemical heavy metals and some lanthanides (µg/g) in human hair samples from male with respect to age and health status in Basrah Province, Iraq.

Age years→	2	22	31	46	58	60	62	Standard Erten et al., 1978.
Health status→	Good	Good	Good	Good	Good	Diabetic	Heart disorder	
Metals↓	Mean concentrations (µg/g)							
Ce	0.0761	0.026	0.0517	0.0296	0.0158	0.0263	0.0199	0.0196
Ge	0.1049	0.1029	0.1226	0.1117	0.1074	0.0996	0.1118	0.0896
Ir	0.0012	0.0015	0.0022	0.0009	0.0008	0.0027	0.0004	0.0032
La	0.0378	0.013	0.027	0.0134	0.008	0.0115	0.0115	0.0118
Mo	0.0438	0.0349	0.0056	0.004	0.002	0.007	0.01	0.26
Nd	0.0363	0.0155	0.0246	0.0109	0.0066	0.0115	0.0118	0.009
Os	0.0007	0.0001	0.0016	0.0008	0.0007	0.0016	0.0011	0.0023
Ru^{102}	0.0103	0.0097	0.0196	0.0083	0.0071	0.0145	0.0105	0.0087
Sb	0.0473	0.0422	0.2671	0.0172	0.0576	0.0453	0.0866	0.2066
Se	0.5603	0.6114	0.5369	0.6528	0.6354	0.6315	0.57	0.8088
Sn	0.204	0.2163	0.3443	0.144	0.1313	0.0664	0.1479	0.2118
Sr	10.2149	14.2649	66.8651	11.3788	12.3705	7.3637	14.0397	4.5124
Te^{125}	0.0008	0.0002	0.0043	0.0015	0.0060	0.0101	0.0033	0.004
Th^{232}	0.001	0.0018	0.0020	0.0013	0.0013	0.0034	0.0020	0.0030
Ti^{49}	3.2022	3.3632	2.9799	3.4689	2.17	2.1549	2.2519	0.9071
Ti^{47}	3.919	3.3189	4.8005	1.9879	1.5597	4.7294	2.0656	0.3137
Tl^{205}	0.0009	0.0014	0.0010	0.0009	0.0006	0.0021	0.0003	0.0077
W^{184}	0.005	0.004	0.004	0.002	0.0222	0.002	0.0049	0.025
Zr^{90}	0.2572	0.0762	0.2875	0.1649	0.0819	0.1389	0.0899	0.4176

Table 2. Mean concentrations of heavy metals and some lanthanides (µg/g) in human hair samples from

female with respect to age and health status in Basrah Province, Iraq.

Age years →	**4 ***	**9**	**20**	**33**	**35**	**36**	**45**	**55**	**60**	**80**	**Standard Erten et al., 1978.**
Health status→	**Good**	**Ashma**	**Good**	**ashma**	**Rhumatoid**	**Good**	**Good**	**diabetic**	**Diabetic**	**Good**	
Metals↓	**Mean concentrations (µg/g)**										
Ce	**0.0324**	**0.0997**	**0.0342**	**0.032**	**0.0535**	**0.0171**	**0.0274**	**0.0566**	**0.0 163**	**0.0243**	**0.0196**
Ge	**0.1019**	**0.0852**	**0.1024**	**0.1133**	**0.0808**	**0.1015**	**0.1071**	**0.1197**	**0.0893**	**0.108**	**0.0896**
Ir	**0.0007**	**0.0029**	**0.0009**	**0.0024**	**0.0024**	**0.0015**	**0.0011**	**0.0025**	**0.0015**	**0.0009**	**0.0032**
La	**0.0181**	**0.0702**	**0.0191**	**0.0217**	**0.0273**	**0.0082**	**0.0158**	**0.0407**	**0.0115**	**0.0208**	**0.0118**
Mo	**0.0765**	**0.0471**	**0.298**	**0.0218**	**0.01**	**0.0098**	**0.3466**	**0.0488**	**0.0094**	**0.0059**	**0.26**
Nd	**0.0165**	**0.039**	**0.013**	**0.051**	**0.0217**	**0.0097**	**0.0126**	**0.0266**	**0.011**	**0.0107**	**0.009**
Os	**0.0015**	**0.0006**	**0.0006**	**0.0006**	**0.0023**	**0.0011**	**0.0011**	**0.0021**	**0.0014**	**0.0041**	**0.0023**
Ru^{109}	**0.0096**	**0.0212**	**0.0136**	**0.0177**	**0.0212**	**0.0115**	**0.0154**	**0.0215**	**0.0091**	**0.017**	**0.0087**
Sb	**0.3541**	**0.1192**	**0.1284**	**0.3861**	**0.1074**	**0.0552**	**0.1249**	**0.1478**	**0.0184**	**0.0172**	**0.2066**
Se	**1.2151**	**0.5216**	**0.4428**	**0.6272**	**0.5208**	**0.6185**	**0.4028**	**0.5921**	**0.7936**	**12.5935**	**0.8088**
Sn	**0.2712**	**0.4386**	**0.295**	**0.4208**	**0.1682**	**0.2995**	**0.264**	**0.1512**	**0.0296**	**0.144**	**0.2118**
Sr	**9.2957**	**5.0294**	**53.1617**	**51.9297**	**65.4011**	**53.5701**	**66.8511**	**77.7908**	**23.7207**	**76.3089**	**4.5124**
Te^{125}	**0.0033**	**0.0081**	**0.003**	**0.0097**	**0.0125**	**0.0056**	**0.0015**	**0.0041**	**0.0064**	**0.0075**	**0.004**
Th^{232}	**0.0017**	**0.0039**	**0.0011**	**0.002**	**0.004**	**0.0017**	**0.0015**	**0.0024**	**0.0017**	**0.0021**	**0.003**
Ti^{49}	**2.2368**	**3.933**	**3.1454**	**2.3514**	**2.5103**	**1.8281**	**2.2519**	**2.9411**	**2.3604**	**1.5539**	**0.9071**
Ti^{47}	**3.0433**	**6.5831**	**3.4478**	**5.1346**	**6.2797**	**1.9301**	**2.209**	**4.03**	**2.5776**	**2.6197**	**0.3137**
Tl^{205}	**0.0014**	**0.0023**	**0.0004**	**0.0013**	**0.0019**	**0.0005**	**0.0006**	**0.0006**	**0.0009**	**0.0008**	**0.0077**
W^{184}	**0.0088**	**0.0016**	**0.0052**	**0.005**	**0.003**	**0.003**	**0.0018**	**0.005**	**0.002**	**0.0037**	**0.025**
Zr^{90}	**0.562**	**0.1624**	**0.1219**	**0.265**	**0.1789**	**0.1011**	**0.0829**	**0.3354**	**0.1391**	**0.1534**	**0.4176**

*4 months old baby female

Table 3. Min and Max. values of heavy element concentrations (µg/g) in human hair of male and female of different ages from Basrah Province/Southern Iraq.

Heavy Metal	Male		Female		Standard
	Min	Max	Min	Max	
Ce	0.0158	0.0761	0.0163	0.0566	0.0196
Ge	0.0996	0.1226	0.0808	0.1197	0.0896
Ir	0.0004	0.0027	0.0007	0.0029	0.0032
La	0.008	0.0378	0.0082	0.0702	0.0118
Mo	0.002	0.0438	0.0059	0.3466	0.26
Nd	0.006	0.0363	0.0097	0.039	0.009
Os	0.0001	0.0016	0.0006	0.0041	0.0023
Ru^{109}	0.0071	0.0196	0.0091	0.0215	0.0087
Sb	0.0172	0.2601	0.0172	0.3861	0.2066
Se	0.5369	0.6501	0.4028	12.593	0.8088
Sn	00644	0.3443	0.0296	0.4386	0.2118
Sr	7.3637	66.8651	5.0294	77.7908	4.5124
Te^{125}	0.0002	0.0101	0.0015	0.0097	0.004
Th^{232}	0.001	0.0034	0.0011	0.0039	0.003
Ti^{49}	2.17	3.4689	1.5539	3.933	0.9071
Ti^{47}	1.5597	4.8005	1.9301	6.5831	0.3137
Tl^{205}	0.0003	0.0021	0.0004	0.0023	0.0077
W^{184}	0.002	0.0222	0.0016	0.0088	0.025
Zr^{90}	0.0762	0.2875	0.0829	0.562	0.4176

Discussion

Chemical elements have the ability to incorporate with the keratin structure of hair which taking place by binding through the sulfhydryl groups of protein (Abdulraheem et al., 2012). All types of detergents have the ability to cause leaching of those elements and reduce their concentrations in the hair compare to other tissues such as nails (Buchancova et al., 1993).

Accumulation of chemical elements in hair might be attributed to two different major sources of exposure: occupational, and food and drinks (WHO, 1995).

Certain trace elements which exist in human body in very low concentrations are known to be important in biochemical processes (Srogi,2004) and they may play a major role in the central nervous system (Assaf and Chung, 1984), increase or decrease in their concentrations might involve in a verity of neuropsychiatric conditions including Parkinson and Al-Zehimer diseases and Down's syndrome (Abdoulahi and Al-Saad, 2008).

Table 3 reveals that comparable levels of min. and max. concentrations were recorded for male and female for all studied elements except that for Mo, Os, Ru, Se, and Zr which showed higher values for female compared to male, and the only one exception which showed high min. and max. values for male compared to female was for W. Differences in concentrations of heavy metals between male and female due to slow oxidation rates for female compared to male, this will lead to higher levels of heavy metals with highly oxidation state in female, while those with lower oxidation states will be lower in female than male, (Wilson, 2016).

Compared with standard levels, very law values of chemical elements concentrations in the range of 100 ng/g were recorded for Ir, La, Mo, Nd, Os, Ru, Sb, Sn, Te, Th, Tl, and W as shown in tables 1 and 2 in human hair for both gender male and female, while the only element which recorded very high concentrations in human hair of both male and female compared to standard levels was Sr, in which it recorded maximum values of 66.865 and 77.790 µg/g for male and female respectively compared to standard value of 4.512 µg/g. And for a certain level, Se recorded high level with range of 20 times for female compared with standard level while for male it is comparable to standard level.

Conclusion

Since the present study reveals high levels of some heavy metals in hair of Iraqi volunteers, there should be highly need for awareness about hazards of occurrences to avoid health effects of the toxic metals.

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