Assessment of Typical Heavy Metals in Bangladeshi Tannery Workers' Hair

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Abstract: **In Bangladesh the safety precaution and working condition of tannery workers are very disappointing. The tannery workers are always coming in contact with different chemical exposure and different heavy metals are inserting into their body organs. The aim of this study was to determine selected heavy metal levels including cadmium (Cd), Chromium (Cr) and lead (Pb) in scalp Hair of tannery workers and find out the Relationship between the chromium concentration in workers hair and their working duration. Human hair sample of different tannery worker were collected from different tanneries in Bangladesh and samples of individual were analyzed for heavy metals (Cd, Cr and Pb) by Flame Atomic Absorption Spectro photometric technique (AAS). The results of replicate analysis shows the following mean concentrations in (mg/kg): $Cd = 0.04\pm 0.085$, $Cr = 5.85 \pm 0.8391$, $Pb = 1.3 \pm 0.0465$. Comparing with others study around the world, the result shows that the presence of chromium is in very large amount in Bangladeshi tannery workers hair, lead in relatively large amount and cadmium is in small amount.**

I. INTRODUCTION

We recognize hair as a decorative part in our body. It can be defined as any of the fine thread like strands growing from the skin of humans, mammals, and some other animals. Here we discuss about human scalp hair. Hair has the advantage of long term memory as it come in direct contact with surroundings and behaves as a permanent recorder. A three-inch strand of human hair will give six month history of what is going on in the body since head hair grows at a rate of about a half an inch a month. Scalp hair is the metabolic end product that has a recognized ability to reflect the body metal burden. The quantification of trace elements in hair has been used for assessment of long-term environmental and occupational exposure to trace metal as well as metabolic status [1]. So by studying heavy metal in human hair, who are working in tannery industry will give us information about pollution level in tannery industry. Industrial pollution can cause widespread environmental problems through its impact on air quality, soil and food chain. According to an estimate 50% of pollution is caused by industry and heavy metal pollution has been associated with large and small scale industry. The pollutants generated in tannery industry contain high concentration of chromium which directly affects human health [2]. The determination of poison in human hair was first published in the 1850s when the presence of Arsenic was reported in the hair of a body exhumed after 11 years. Since then, several literatures have been published on the analysis of

heavy metals and drugs in hair [3]. Heavy metals are a class of non-biodegradable pollutants in the environment that can enter into human bodies through different routes, such as inhalation, ingestion, dermal contact, respiratory tract, food consumption etc, and then can be accumulated in the body [4]. After inserting into body it begins to shows its severe effect. For example, chronic cadmium intoxication may cause damage in respiratory system, reproductive system, kidney, bone and can cause acute intoxication [5]. Long-term exposure to lead may cause kidney and liver damage and has an adverse effect on the central and peripheral nervous systems, haemopoietic system, and cardiovascular system [6]. On the other hand Long-term exposure to chromium can cause respiratory challenge, cancer, skin damage etc [7].Therefore, it is important to monitor heavy metal levels, which are very important for assessing the potential health risks of metals to humans. We do not get the the actual degree of heavy metal contamination by analysis of air, water, and soil as they may vary widely in a given area. So the solution is the biological monitoring of heavy metals pollution for human exposure. To implement this hair is the best option. As an excretory system, human hair can accumulate heavy metals, and as metabolic products, it can incorporate metals into its structure during its growth process. Therefore, concentrations of heavy metals in hair can reflect the mean level of toxicity in the human body. Furthermore, compared to the other bio-indicators such as blood, nail, urine, and saliva, human hair has attractive advantages, such as finer stability, easy collection and transportation, convenient storage, and reflects long-time exposure to heavy metals and higher metal concentrations than in other bio-indicators. Therefore, human hair is considered a good screening tool to extensively assess heavy metals levels. So far, a number of recent studies reported the use of hair analysis to obtain information on heavy metals level. Many type of industries are being established in Bangladesh as process of urbanization and industrialization during the recent decades, and they are causing several heavy metals pollution. And the workers are suffering for this. However, there is shortage of research data reported on the biological monitoring of heavy metal levels in human hair, which can directly reflect the status of heavy metals in the human body. Thus, the main objective of this study is to determine the concerned toxic metal concentrations in Bangladeshi tannery workers hair.

II. MATERIALS AND METHODOLOGY

Sample Collection:

Freshly cut human hair samples were collected from the head of 10 individuals. Everyone are the worker of tannery industry in Hemayetpur area. They all have experience of working in tannery industry. They all are between the ages of 20 – 50 years and all of them are male worker. The samples were quickly transferred in to coded polythene bags, sealed tightly and kept for pre- treatment. Prior to sample collection, questionnaires were distributed to respondents which contained highlights of information such as the age, work duration, the name of industry where he works etc.

Sample Preparation

Hair sample may contain different types of dirt molecule in its outer portion, which can interfere in the analysis procedure. So at first every sample was washed. Hair samples were first washed three times with deionized water, then with acetone, and finally, they were again washed with deionized water. The sample was then oven dried and grinded with grinding machine.

Digestion procedure:

0.25g of dried grinded sample was taken in a 50 ml beaker. It was then digested with 10 ml of 6:1 mixture of concentrated HNO_3 and $HClO_4$ and kept overnight at room temperature. Then the sample was heated on a plate at 160°-180° C to obtain white crystalline residue. With 0.1N HNO_3 dilution was done to make up 100ml. except the hair sample The blank was prepared with the same way.

III. ANALYTICAL PROCEDURE

Reagents were used with of ultra high purity (certified & gt; 99.99%). Working solutions were prepared by serial dilution of 1000ppm standard solution. Three standard solutions were made 2 ppm, 4 ppm & 6 ppm to get calibration curve. A flame atomic absorption spectrophotometer varian- 240 was used for quantitative analysis, with automatic background compensation and under optimum analytical conditions. Every sample were analyzed for lead, chromium and cadmium. To get the mean value, three samples of each specimen were treated separately.

Table 1: Heavy metals concentration in tannery workers' hair (mg/kg)

Sample name	Concentration of Chromium (mg/kg)	Concentration of Lead (mg/kg)	Concentration of Cadmium (mg/kg)	Working duration (years)	Tannery name
Sample -1	7.64	1.72	0.03	25	RK tannery
Sample -2	6.06	1.11	0.05	22	Dhaka tannery
Sample -3	5.51	1.50	0.04	20	Dhaka tannery
Sample -4	4.78	1.76	0.06	10	Anwer tannery
Sample -5	5.36	0.97	0.02	20	Samina tannery
Sample -6	8.72	1.21	0.03	30	Samina tannery
Sample -7	7.50	1.06	0.04	25	Reliance tannery
Sample -8	7.49	1.39	0.07	25	Reliance tannery
Sample -9	0.47	1.36	0.04	2	RMM tannery
Sample -10	4.97	1.00	0.02	15	RMM tannery

IV. DISCUSSION

Human hair is reliable and convenient biological indicator of environmental pollution. The analysis of human hair is used to study environmental, occupational and bodily status of several metals - essential and toxic. Although several limitations were encountered in the application of hair analysis, this has got many other advantages too. The present project was undertaken on the tannery workers in Bangladesh (Hemayetpur area) In the present investigation, an attempt has been made on the atomic absorption spectrophometric determination of heavy metals (Lead, Chromium & amp; cadmium) levels in human hair of people working in tannery.

Table 2: Heavy Metal concentration in tannery workers' hair (Mean ± S.D. mg/kg)

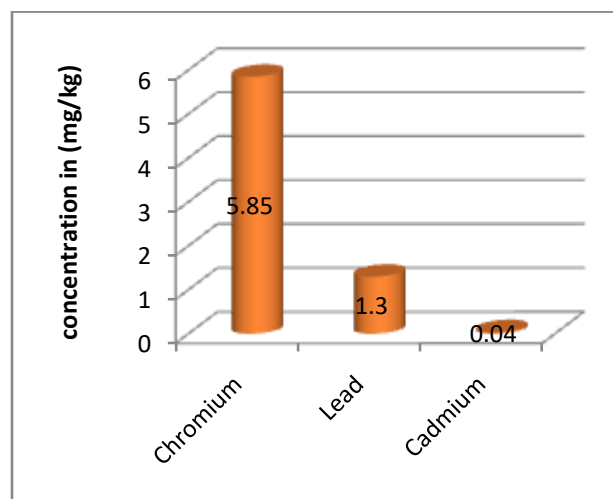| Heavy metal	Concentration Mean values(mg/kg)	Standard Deviation (SD)	Wavelength
Chromium	5.85	± 0.8391	357.87
Lead	1.3	± 0.0465	283.00
Cadmium	0.04	± 0.0085	228.80

Figure 1: Concentration of heavy metals (mean value0 in tannery workers' hair

Table 3: Comparison of hair metal levels in different countries (mean± S.D. mg/kg)

Country	Chromium(Cr)	Lead(Pb)	Cadmium(Cd)	Reference
Poland	0.568 ± 1.04	1.046 ± 1.39	0.114 ± 0.14	[8]
Japan	0.31 ± 0.45	4.80 ± 4.64	-	[9]
France	0.20	0.41	0.011	[10]
Turkey	-	14.11 ± 4.64	-	[11]
Sweden	0.167 ± 0.118	0.960 ± 0.850	0.058 ± 0.056	[12]
Italy	0.99 ± 2.17	7.11 ± 5.92	0.23 ± 0.55	[13]
Brazil	0.3	12.50 ± 0.70	0.059 ± 0.05	[14]
Spanish	0.535 ± 0.130	1.46 ± 0.208	0.022 ± 0.054	[15]
India	-	4.65	0.13	[16]
Bangladesh (Hemayetpur)	5.85 ± 0.8391	1.3 ± 0.0465	0.04 ± 0.0085	This Study

From this study I have found that the concentration of chromium is extremely high in the hair of Bangladeshi tannery workers comparing with other countries people. The chromium (Cr) level in Bangladeshi tannery workers hair is 10.299 times greater than Poland, 18.87 times greater than Japan, 29.25 times greater than France, 35.02 times greater than Sweden, 5.91 times greater than Italy, 19.5 times greater than Brazil and 10.93 times greater than Spanish. On the other hand the concentration of Lead (Pb) and Cadmium (Cd) are in the suitable range comparing with other countries people.

This study gives us a concept that there is a relationship between the chromium concentration in workers hair and their working duration. From this study the highest concentration of chromium is found in sample-6 (8.72mg/kg), who has been associating with chrome tanning process in Samina tannery for 40 years. The second highest range is found in sample-1 (7.64), who has been associating in chrome tanning process in RK tannery for 35 years. The relationship between the chromium concentration in workers hair and their working duration is given bellow in figure-2.
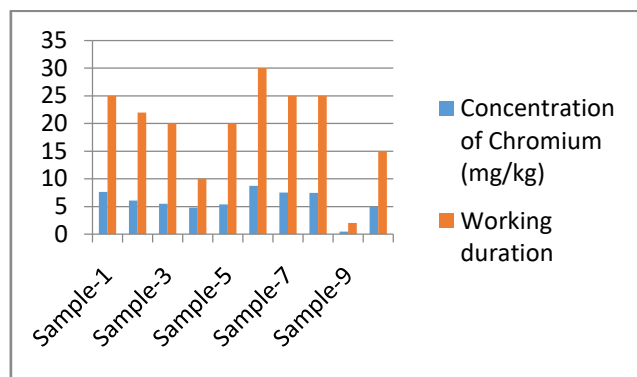

Figure 2: Relationship between the chromium concentration in workers' hair and their working duration

This study gives us a clear concept that the Bangladeshi tannery workers are in danger zone. Everyday Huge amount of chemical including chromium are being used in tannery industry for tanning purpose. Workers are coming in direct contact with this chemical. And that's why they are being affected by this chemical.

From this study I have found that the chromium level is extremely high in Bangladeshi tannery workers hair. Chromium is carcinogenic in nature and it can cause several fatal diseases in human body. To protect the tannery workers from this threat every industry should take necessary safety precaution.

V. CONCLUSION

Hair analysis might soon become a powerful diagnostic tool in monitoring of environmental pollution with its many convenience comparing with blood and other physical sample. By recognizing this we can easily evaluate the pollution level. In the present study it was found that the concentration of heavy metals specially chromium (Cr) in tannery workers hair are in large amount, And the concentration of lead and cadmium are in suitable range comparing with others study around the world. The obtained results were compared with findings of other authors and some tendencies were confirmed. To make hair analyzing reliable it is necessary to study the effect of age, sex, hair color and exposure on large group from various populations living in different regions.

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