

Determination of chromium in nail samples of hide market workers, Lahore

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Abstract

Chromium is one of the widely used heavy metal used on industrial scale and is root cause of a number of health related problems in humans as well as animals. Chromium not only release into environment from natural sources but also from industries. Tanning of leather include various steps ranging from pretreatment to dying which involves worker's direct contact with chemicals like chromium and which is responsible for causing serious health problems. Present study was conducted for quantitative estimation of chromium in nail samples of workers of hide market situated in Shadbagh Lahore near Railway station. General health condition of workers was also assessed through questionnaire. Nail samples of workers were collected, treated, then analyzed in atomic absorption spectrophotometer (AAS), and results obtained were than analyzed statistically. Results thus gathered were also compared reported values under permissible limit. From results it has been confirmed that concentration of chromium (0.6540 ± 0.039 mg/kg) is significantly high in workers of hide market and they are also suffering from different respiratory problems, skin allergies, and blood pressure. It has also been concluded that this problem is needed to be tackled by adoption of remedial and mitigation measures. Effective and substantial programs are recommended for increasing public awareness about chromium contamination and health effects by social mobilization and community participation.

Keywords: Chromium, Nails, Hide market, Workers and health effects

Introduction

Industrialization revolution has significantly helped to shape the modern world but, unfortunately, it has also put several adverse effects on the natural environment of our living society and ecosystem of the earth. Despite the fact that industries increase the economy of country it has been found that each industry that is developed, adds a significant amount of pollution to the environment. For example Tanning industry involves a sequence of activities ranging from treating raw hides to finishing products which have major impact on the environment resulting from the

generation of waste and waste water and the use of chemicals (Pan et al., 2017).

Leather tanning and processing industrial units are one of the Pakistan's mega exporters of manufactured products, and perhaps one of the top industries causing pollution. In Pakistan, at present there are about 850 tanning units out of which majority is located in vicinity of Karachi and its industrial area (Zubair and Ahmad, 2002). By-products of the livestock division such as hides and skins are principally the raw material for the tanning industry; where they provide guzzler for the manufacture of various leather products. The course of conventional (chrome) tanning processes provides semi-processed materials such as wet blue leathers and soused skins. All of these intermediate



materials, as well as finished leathers, raw materials and (and leather products) may be traded internationally (FAO, 2013).

Basic chromic sulfate liquor is one of the most common tanning processes used in Pakistan. Exposure to chromium during this tanning process may occur due to direct physical contact of worker with the chromium metal solutions having trivalent state. Skins having recent wet tanning process may show 1-2% chromium by weight, while those treated with leather dry powder may contain 2-6% chromium, largely dependent on the process chosen for tanning (WHO, 1990).

Chromium (III) which is most commonly used in tanning industry has capability to bind chemically with proteins present in skin of unit employs working in tanneries that form various antigens which can cause allergic reactions. The significant contact dermatitis is first condition leading to bronchial asthma. Tannery workers have to be in constant exposure to detrimental chemicals revealing them susceptible to serious health issues mainly in class of respiratory disorders and skin diseases (Saif, 2012). According to (EPA, 1998) majority of the epidemiologic researchers have found the relationship between chromium inhalation during tanning process and other health problems such as upper respiratory irritation, lungs obstructions and damage the lower respiratory system.

Materials and Methods

The current study was done for determination of Cr level in nail samples of hide market labors and to assess their general health conditions. The hide market under study was located near Lahore railway station. The labors were selected randomly from market based on their working shifts i.e. morning and evening and they varied from age ranging 18-56 years. 40 nail samples were collected from selected workers. After collection samples were stored in neat and clean plastic poly ethylene bags so as to avoid any further contamination and then were brought in lab for analysis.

Assessment of general health condition of hides market labor

Descriptive analytical approach (Questionnaire) of investigation methodology was employed for the workers personal and physical health assessment. The

survey of the unit was also done to observe and note their physical health problems. Questionnaire was designed focusing the evaluation of health condition of workers selected randomly from hide market.

Sample collection

For the purpose of nail samples collection, selected workers were requested to clean their hands with hand sensitizer or soap in order to avoid any external contamination. Then drying of hands were done with towel or clean tissue paper. After that nail samples of finger were collected from of male workers (age 18-56 years) and conserved in polythene bags.

Procedure of lab analysis

I. Weighing

Nail samples were first weighted on electronic balance.

II. Washing of nail samples

The nail samples were then scrapped and dirt particles were cleaned off with (TritonX-100) a nonionic detergent opting a standardized cleaning protocol. (Gammelgaard et al., 1991).

III. Sample treatment by wet acid digestion method

For acid digestion, collected nail samples were mixed and heated with 5 ml of two concentrated acids comprising nitric and perchloric acid in ratio of 6:1. Solution which was then kept for whole night under ambient conditions in order to avoid fumes being produced, later it was heated at 160–180°C pending the solution became clear and heating was continued till only 1 ml of the solution left behind. Dilution of sample was then carried out by using 0.1 N nitric acid (HNO₃).

IV. Storage of digested samples

After above treatment, samples were then placed in glass test tubes and finally kept in refrigerator of laboratory having temperature: 4-6°C.

Analytical procedure for chromium analysis

Chemical analysis involved following steps:

- A. **Preparation of standards:** A known 1000mg/l concentration of the chromium standard solution was prepared which was



then further diluted with distilled water into sequence of standard solution in suitable volume.

B. Construction of calibration curve: Standard solutions of different concentration of chromium were aspirated in AAS, then absorbance and concentration values of these solution were recorded and the data was automatically processed and assessed in computer to draw the calibration graph.

C. Determination of chromium concentration of samples on atomic absorption spectrophotometer (AAS): All samples were aspirated into flame with the help of capillary attached to AAS for 5 seconds and the cycle of each sample was ended by aspirating distilled water. The reference, absorbance and concentration values of standard solution and each sample were then noted.

Data analysis

Results were examined and tabulated after completion of Cr concentration analysis in nail samples. Averages, standard deviation, and standard error mean, ratios. Ranges and t-test were calculated. Then results were presented in the form of tables, line graphs, pie charts and bar graphs. All calculations were performed using statistical packages, Minitab software and Microsoft Excel 2010.

Results

The analysis of chromium (Cr) concentration in nail samples confirmed considerable amount of chromium in them. The chromium concentration in nail samples was above allowable limit of chromium that is 0.52 mg/kg and ranging from 0.11 to 0.79 mg/kg.

Further data was arranges in different groups as explained below:

Chromium concentration vs. working duration of workers

First the chromium concentration was compared with working duration of workers. And it was founded that chromium (Cr) concentration in workers who works for 9 hours a day was in range of 0.18 to 0.72 mg/kg with average value of 0.375 ± 0.0137 mg/kg, the chromium (Cr) level in workers who works for ten

hours a day ranged from 0.19 mg/kg to 0.76 mg/kg with average concentration 0.340 ± 0.049 mg/kg and the chromium (Cr) level workers who works for twelve hours a day ranged from 0.30 to 0.78 mg/kg with average Cr 0.430 ± 0.121 mg/kg (Fig.1). For comparison purpose t-test was applied and p-value was found to be significant ($p < 0.05$)

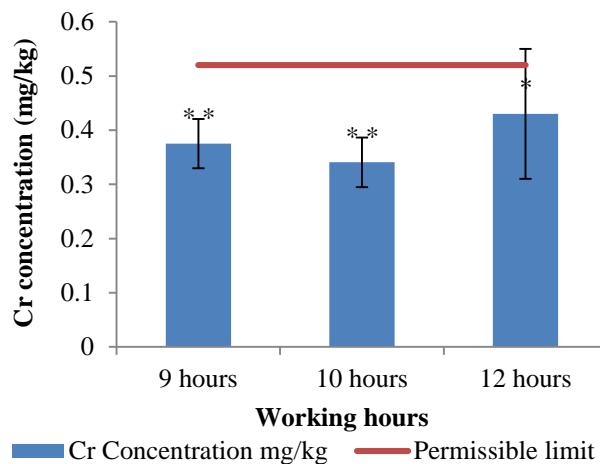


Figure - 1: Comparison of mean chromium (Cr) concentration in nail samples of workers with respect to their working hours ($p < 0.05$).

Quantitative amount of chromium vs. age of workers

Correspondingly chromium (Cr) concentration, a comparison was drawn between ages of workers. Chromium (Cr) amount in workers with age range of 18-28 years was found to be between 0.19 to 0.79 mg/kg with average amount of Cr 0.354 ± 0.1113 mg/kg, while another group of workers whose age was from 29-39 year showed amount of chromium to be in range of 0.12 to 0.31 mg/kg with average Cr level 0.255 ± 0.0283 mg/kg, from 40-50 showed a range of from 0.15 to 0.70 mg/kg with average value 0.418 ± 0.048 mg/kg in an age group of 51-61year Cr level ranged from 0.30 to 0.76 mg/kg with average Cr 0.591 ± 0.151 mg/k (Fig.2).



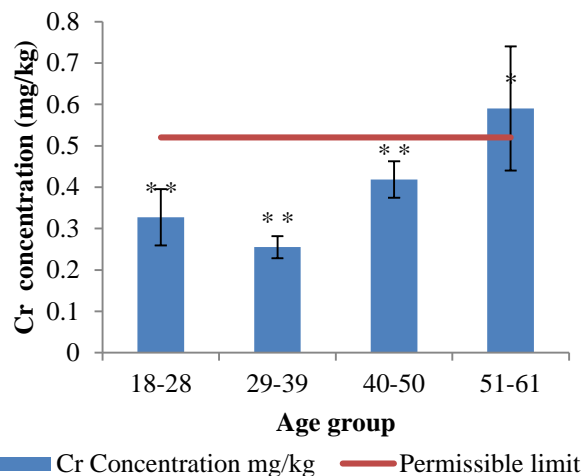


Figure - 2: Age group wise comparison of mean chromium level in nail samples of workers (p<0.05)

Chromium concentration vs. working years of workers

Then average chromium concentration was compared with service of employees. Chromium (Cr) level in workers who were working from 1-17 years was in range of 0.17 to 0.80 mg/kg with average value 0.384 ± 0.0547 mg/kg, while in age group 18-35 years, Cr level ranged from 0.12 to 0.60 mg/kg with average Cr concentration 0.326 ± 0.0471 mg/kg and in last age group 36-54 years was range from 0.30 to 0.74 mg/kg with average Cr 0.502 ± 0.1337 mg/kg (Fig3).

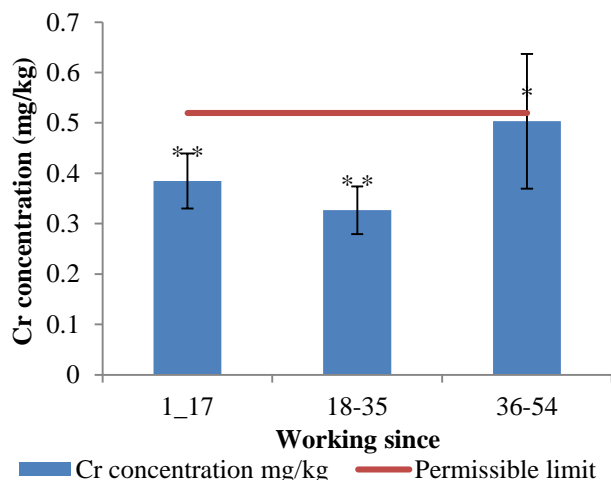


Figure - 3: Comparison between average chromium concentration in nail samples with respect to working years of employees (p<0.05)

Chromium concentration vs. working shifts of workers

Then at last chromium concentration was compared with the different working shifts of labors. Chromium level in labors who works in first half of the day ranged between 0.12 to 0.80 mg/kg with average value 0.453 ± 0.0527 mg/kg and in labors who works in evening time ranged between 0.12 to 0.32 mg/kg with average value 0.272 ± 0.0195 mg/kg $p < 0.05$ (Fig 4)

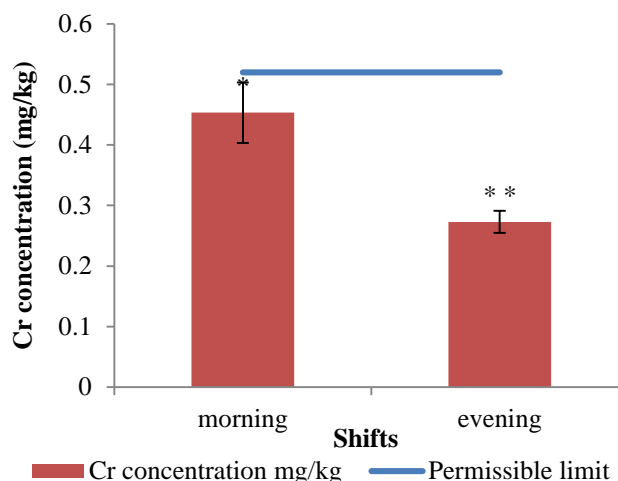


Figure - 4: Comparison between average chromium level with respect to working shifts of employees (p<0.05)

Discussion

The current study revealed concerning results with respect to chromium in nail samples of hide market workers. Chromium existence with variable range in nails of worker due to direct contact with it poses serious threat to their health. The study revealed that environmental status of workers was improper, not up to mark. This existing condition of workplace of hide market require efficient curative and alleviation measures in order to improve health status of workers as well as the working place.

Majority of the labor community in Pakistan is unqualified not practiced in occupational health and safety. Moreover, occupational health and safety is not integrated in any industrial business in Pakistan. As compared to the total workers, the number of occupational health practitioners and nurses in Pakistan is extremely low which that occupational health organization is not fully understood in the country. The only governmental organization, semi-governmental and private institute that



trains staff about occupational health and safety in Pakistan is “Centre for the Enhancement of Working Conditions and Environment” (LEF, 2013). Analysis of the data revealed that contract times of a worker works in a day has huge impact on the health of labors. The chromium concentration in workers who works for twelve hours a day was more as compared to those who work for 9-10 hours. In present research work a huge association was found between working hours both qualitatively and quantitatively and worker’s health, by using meta-analysis in order to recognize any linkage between the health symptoms and extent of the working week. Results revealed a small, but substantial positive correlation between health status at physiological and psychological stages and working hours (Berniell, 2012).

Studies revealed that workers mostly drink water from working site which is not clean enough. A suitable availability of free, pure and clean drinking water is always necessary for every workplace. Precautionary measures are essential in order to confirm that drinking water sources are not polluted by any course or activity of the workplace (OSH, 1995). The higher chromium level in nail samples of workers also could have relation to the truth that the employee were not provided with any type of personal protective equipment when they were dealing with hazardous chemicals like chromium and don’t wash their hands after every processing. According to Environmental protection agency the tannery management is always responsible for their workers’ safety. They have the responsibility to communicate and pass potential exposure awareness to the employee in such a way that they are skilled enough and aware to avoid the hazards in work place. They also have the responsibility to ensure availability of safety equipment to works so that they can be protected from the expected contact with chromium in the tanning practice. It is essential that labor of tanning business have sufficient awareness and knowledge about the various types of chemicals and their hazardous impact that present in the work place (EPA, 2005).

It was also noted during the hide market survey that workers use their own clothes for removal of their exudates as a result of which they breathe in and swallow chromium suspended particles matter and dust directly that has toxic effects and this habitat of workers was found to be a major source of respiratory disorders among them. A study was conducted in Sweden, where ninety seven employees were chosen

from a chrome plant and examination of data showed that almost all of workers breathed the chromium particles by mouth at their work place and absorbed the chrome dust particles which lead to respiratory problems among workers (Mancuso, 1951). In present study it was observed that high blood pressure and skin problems were the common diseases among the labor of hide market. It was also noted that high blood pressure and skin diseases among selected employees of market was directly associated with the contact time and temperature range at workplace as most of the chemical and physical process of skins are carried in open areas with direct sun exposure. A study conducted by Kamran et al., 2014 depicted that most of the tannery workers were suffering from blood pressure, headache, skin allergy, respiratory problems and liver disorder and the major cause of these diseases among tannery workers evaluated was the direct exposure of chromium over a long period of time during working.

According to (Rastogi et al., 2008) the incidence of respiratory problem was observed to be more among the leather tanners as compare to non-leather tanners. It was also found that lung restriction and bronchial obstruction were the major problem present in the exposed group. Some studies showed that the chromium exposure in the leather tanning industries is the main cause of variety of distinctive cancers including kidney, lung, nasal, oral cavity, bladder and skin along with dermatitis, ulcers, respiratory problems and damage of nasal septum (Rastogi et al., 2007).

Conclusion

It was concluded from the present study that chromium level in all nail samples were considerably more as compared to permissible limit of chromium which is 0.52 mg/kg and from questionnaire data it was also observed that respiratory problems and skin allergies were the common diseases among workers due to direct contact with high concentration of chromium and its salts. It was also noted that management of hide market were not focusing attentively on considering health condition of workers, for the application of standards for use of toxic metals like chromium and also no precautionary measure had been opted so as to minimize exposure to hazardous chemicals at workplace. So they should be special focus by hide



market management on the health status of workers including the use of PPE. Mentoring of hair, nails and blood samples of workers is also recommended on regular bases for detection of toxic metals.

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