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Toxicity of Chromium on Human Health

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ABSTRACT:

The concentration of Cr in the lungs, aorta, heart and spleen decreases during the first months of life, whereas the liver and kidneys maintain their neonatal level up to the age of 10 years. In the present study the result of concentration of chromium in groundwater and in blood showing that the people, who are drinking groundwater from several years, are infecting by some dangerous disease because the concentration of chromium in blood is also increasing. Analytical data concern may be drawn that the groundwater of Motipur, Sukhinipur, Paewandi and Sheikhpur must not be considered for the drinking purpose before proper treatment.

Keywords: Chromium, groundwater, Motipur, Sukhinipur, Paewandi and Sheikhpur, etc.

[I] NTRODUCTION

Cr (VI) is a strong oxidant – in the form of chromates and dichromate, it penetrates biological membranes and reacts with cell contents, proteins or nucleic acids, while being reduced to Cr (III). Chronic poisoning by chromium compounds has been observed at the work place, by direct contact with skin and mucus membrane, or inhalation of dusts or aerosols [1]. The reaction with genetic material is the basis for the carcinogenicity of some Cr (VI) salts. Several studies were carried out on occupational exposure to chromium in relation to its possible carcinogenic effects. Reports from the chromate production industry have identified Cr (VI) as a potential carcinogen [2].

In contest, Cr (III) is the most stable form in biological systems [3, 4] it does not penetrate biological membranes easily, and it appears that the transport of specific chromium compounds is strictly regulated by the organism. Cr (III) ion has a strong tendency to form co-ordination compounds with a very slow reaction rate [5]. That slow rate suggests that chromium would exert a structural function rather than an active site in an enzyme, which may explain that no chromium-containing enzymes have been, identified [5].

The tannery industry is one of the oldest industries in India. India is the largest market for hide and skin. The leather is tanned by chrome and

vegetable tanning process. The effluent of tannery factory containing chromium is discharged on land surface and it is used for irrigation purposes. Presence of excess amount of chromium beyond the tolerance limit makes it unsuitable for crop growth [6]. The high level of nutrients in the influent has been reported to inhibit seed germination and seedling growth at lower dilution of effluents, which might be due to the presence of excess amount of dissolve solids, chlorides, sulfides, chromium high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in the effluent. Chromium has its effect on certain enzymes such as catalase, peroxidase, and cytochrome oxidase, which have iron as constituent. Similar result was found in catalase activity at excess supply of chromium in barley [7]. Marked toxicity of chromium was found with respect to photosynthetic pigments, photosynthesis, nitrate reductase activity and protein content in algae [8] and higher plants [9, 10]. The direct interaction of metal with cellular components can initiate variety of metabolic responses finally leading to a shift in the development of the plant [11]. Chromium toxicity produces chlorosis and necrosis in plants [12]. Several polluting metals and compounds are discharged into the water streams by tanneries. The main objective of this work is to determine the chromium and heavy metal concentration in groundwater samples.

[II] MATERIALS AND METHODS

2.1. Determination of chromium in water sample

Take 50ml of water sample or on aliquot dilute to 50ml with chromium free distilled water. If necessary clarify by centrifuging add 2.5ml diphenyl carbazide reagent and mix well compare visually against standards containing 3 to 200 µg/l. Prepare a calibration curve in the chromium range of 5 to 400 µg/l if photometric measurement are made at 540 mµ with a 5cm light path. Make comparison or readings at least 5 min, but not later than 15 min, after the reagent is added.

Calculation: Mg/l hexavalent Cr = $\frac{\text{µg Cr (VI)}}{\text{ml sample}}$

2.2. Determination of heavy metals in whole blood

For the determination of heavy metals the sample were diluted. The Samples for the simple dilution procedure were prepared in 15ml disposable centrifuge tubes. To the centrifuge tube 0.6ml of blood either SRM or 0.12ml of the internal standards stock solution was added. In addition to the SRMs 0.6ml of 2% nitric acid and to the sample blood 0.6ml of a stock calibrator solution were added. The samples were diluted to 6ml with sample diluents. QC samples were prepared in an identical fashion to the standards using the QC spike solution. The samples were centrifuged at 4000 rpm for 10 minutes to separate the solids. The sample diluents consisted of 0.5% nitric acid, 0.01% triton x-100 and 0.5% butanol. The internal standards stock, consisted of 250ppb germanium, rhodium and iridium in a 2%nitric solution. The diluents stock was a 0.5% nitric acid, 0.01% triton x-100 and 5% butanol solution on containing 50ppb germanium, rhodium and iridium. Calibrators were prepared from cerilliant stock solution and contained the elements of interest at concentration demonstrated. Quality control (QC) spiking solutions were prepared from apex stock solution and contained the elements of interest at concentration.

2.3. Microwave digestion

The microwave digestion samples were prepared for analysis by adding 0.75ml aliquots of blood sample and 1.5ml of concentrated “optima” grade nitric to quartz insert. Next, Teflon digestion vessels are filled with 2ml of concentrated hydrogen peroxide and 8 ml of 18 mΩ or deionized water. The peroxide permitted higher digestion temperatures by reducing the nitric vapors. The quartz inserts were then lowered into

the Teflon vessels, capped and digested in on Ethos advanced microwave.

Table 1: Conditions for microwave digestion

Step	Time	Power	Temp
1.	2 min	1000 W	85° C
2.	3.30 min	1000 W	135° C
3.	4.30 min	1000 W	230° C
4.	15 min	1000 W	230° C

[III] RESULTS AND DISCUSSION

3.1. Estimation of chromium concentration in different groundwater samples

3.1.1 Estimation of chromium concentration of Sukhinipur groundwater

The chromium concentration was studied in the groundwater of different regions of Sukhinipur. It was observed that the maximum chromium concentration was found in S3 region as shown in Graph 1.

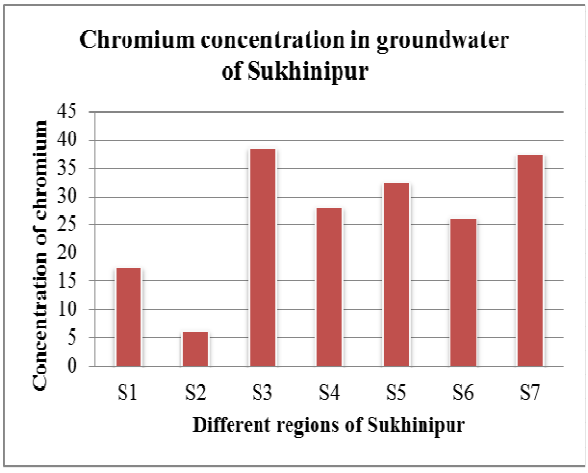

Figure 1: Concentration of chromium in groundwater of Sukhinipur. The maximum concentration was found in S3 region.

3.1.2 Estimation of chromium concentration of Sheikhpur groundwater

The chromium concentration was studied in the groundwater of different regions of Sheikhpur. It was observed that the maximum chromium concentration was found in S2 region as shown in Graph 2.

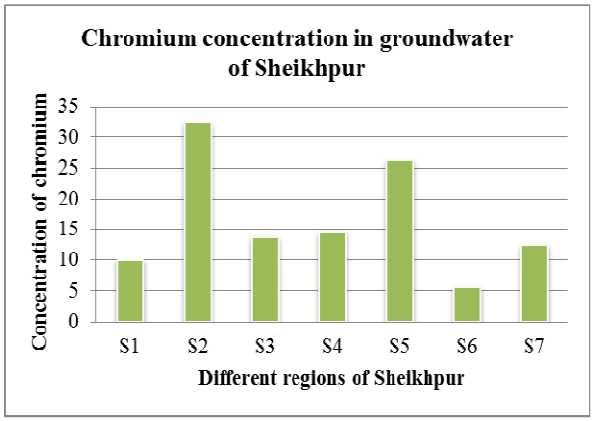

Figure 2: Concentration of chromium in groundwater of Sheikhpur. The maximum concentration was found in S2 region.

3.1.3 Estimation of chromium concentration of Paewandi groundwater

The chromium concentration was studied in the groundwater of different regions of Paewandi. It was observed that the maximum chromium concentration was found in S1 region as shown in Graph 3.

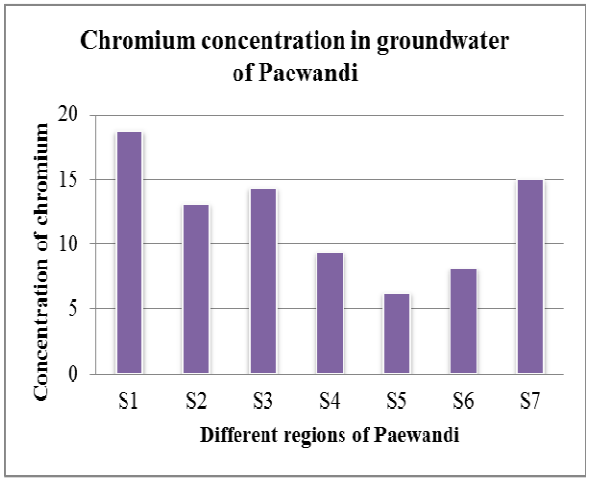

Figure 3: Concentration of chromium in groundwater of Paewandi. The maximum concentration was found in S1 region.

3.1.4 Estimation of chromium concentration of Motipur groundwater

The chromium concentration was studied in the groundwater of different regions of Motipur. It was observed that the maximum chromium concentration was found in S6 region as shown in Graph 4.

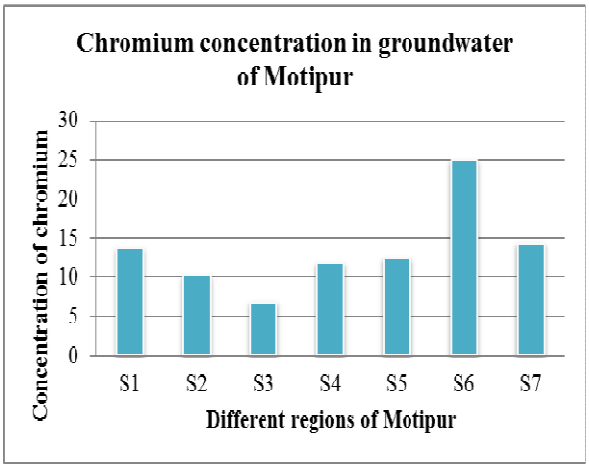

Figure 4: Concentration of chromium in groundwater of Motipur. The maximum concentration was found in S6 region.

3.1.5 Estimation of chromium concentration in Normal tap water

The chromium concentration was studied in normal tap water. It was observed that the maximum chromium concentration was found in S3 & S6 samples as shown in Graph 5.

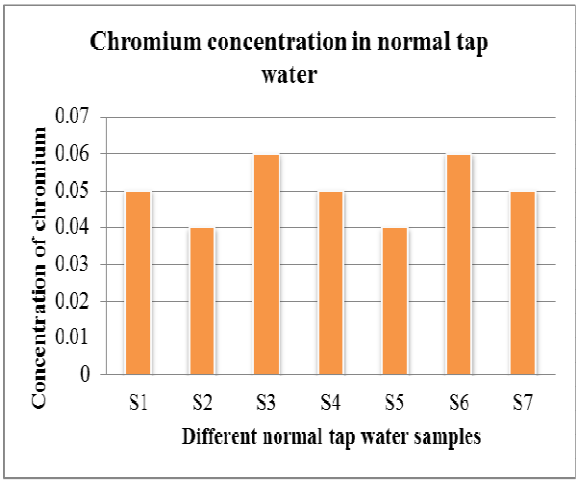

Figure 5: Concentration of chromium in normal tap water. The maximum concentration was found in S3 & S6 region.

3.2 Estimation of chromium concentration in blood

The chromium concentration was studied in blood samples. It was observed that the maximum chromium concentration was found in S8 samples as shown in Graph 6.

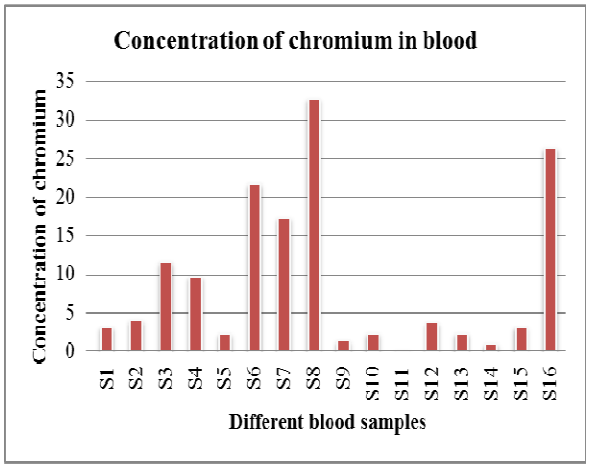

Figure 6: Concentration of chromium in blood samples. The maximum concentration was found in S8 sample.

[IV] CONCLUSION

Chromium interacts with the thyroid metabolism in humans. Binding of Cr (III) with nucleic acids has been found to stimulate the DNA-dependent RNA synthesis. The third interaction of Cr (III) acts with insulin and its receptors. This suggests that Cr (III) acts with insulin on the first step in the metabolism of sugar entry into the cell and facilitates the interaction of insulin with its receptor on the cell surface. The results of concentration of chromium in groundwater and in blood showing that the people, who are drinking that groundwater from several years, are infecting by some dangerous disease because the concentration of chromium in blood is also increasing. Analytical data concern may be drawn that the groundwater of Motipur, Sukhinipur, Paewandi and Sheikhpur must not be considered for the drinking purpose before proper treatment.

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