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**RESEARCH ARTICLE**

# The effects of Heavy metal (Nickel) on Hematological parameters of laboratory male mice

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## *Abstract*

The present study is aimed to investigate the hematological parameters such as hemoglobin(Hb), red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC) in the blood of laboratory male mice exposed to sub-lethal concentration of nickel chloride ($NiCl_2$, $6H_2O$). The present study shows that the level of hemoglobin, red blood cells and packed cell volume were significantly decreased and simultaneously the white blood cells, mean cell volume, mean cell hemoglobin and mean cell hemoglobin concentration were significantly decreased due to nickel exposure. The present study concluded that the nickel compound affects the hematological parameters of mice by received contaminated water.



## INTRODUCTION

Metals are commonly found in the environment, they are present as a natural elements or as a result of anthropogenic activities in different environmental media such as air, water and soil, which constitute an important factor of exposure to animals and human (Louis, 1993). Heavy metals are considered as one of the most important factors which affect varies population, reducing their growth, reproduction and/or survival rate (Wong and Wong, 1990). It leads the devastation of valuable species either indirectly through breaking the biological food chain or directly by affecting the aquatic life .Heavy metal constitute a serious type of pollution in the environment and being stable compounds, they are not readily removed by oxidation, precipitation or other processes and affects the activity in recipient animal (Nammalwar, 1985). Heavy metals such as chromium, mercury, lead and arsenic are non-essential elements and are toxic to the organisms even at low levels. The cumulative concentration of pollutants along the food chain poses a threat to both human and animal health. Nickel (Ni) is the 24th most abundant element in the Earth's crust (Parthipan and Muniyan, 2013).

Nickel is one of the microelements which occur in trace amounts in living organisms. It constitutes a potential hazard to the enviornment media (air, water and soil). This is due to its extensive and wide spread utilization in various industries, it is a common by-product of electroplating industries, steel production, metal mining, smelting, refining,ceramic and processing along with fuel combusation, and waste incineration activities(WHO,1991). Although it can exist in several different oxidation states, the prevalent oxidation state under environmental conditions is Ni (II), nickel in the +2 valence state. Other valences (-1, +1, +3, and+4) are also encountered, though less frequently (Parthipan and Muniyan, 2013). Although trace metals like Ni are essential for normal physiological process, ecotoxicity testing has shown that NiSO4. 6H2O and NiCl2.6H2O fall into the "harmful" classification where their abnormally high concentrations can become toxic and disturb the homeostasis of an animal (Javed, 2003). Stress reaction involves various physiological changes including alteration in blood composition and immune mechanisms. It has also been linked as one major factor of disease outbreaks; low productivity and mortality in animals. Other toxic endpoints include decreased growth, mobility and reproductive effects (Allen, 1995).

Nickel is a known hematotoxic, immunotoxic, hepatotoxic, pulmotoxic and nephrotoxic agent. Allergic skin reactions are common in individuals who are sensitive to nickel (De Medeiros *et al.*, 2008). Nickel compounds are carcinogenic to human and are potent inducers of kidney and lung tumours in experimental animals and induce genotoxicity and oxidative stress through the generation of reactive oxygen species(Lee *et al*., 2001). Blood plays a decisive role in the regulation of life processes to make them function properly, Blood acts as an internal transporter and important tool to assess organism's toxicant and it is one of the major routes for absorption of environmental pollutant, also it is the most important parameters for evaluation of physiological status and response of the whole organisms (Parthipan and Muniyan, 2013).

## Materials and Methods

Prior to the start of the experiment, the male mice were acclimatized to the laboratory condition for one week, under control temperature, 22±2 Cº, at (12) hours light and (12) hours dark cycles. The mice were housed in plastic cages measuring 30×12×11 cm. Mice were divided into four equal groups each comprising of 10 animals. Each group was kept in separate plastic cages. The first group was kept as negative control; the mice were received tap water without any treatment. The animals of test group were exposed to different sub-lethal concentration of nickel chloride (20,40 and 60 mg/kg) via drinking water.

The experiment was lasted for six weeks after end experiment the animals were sacrificed and the blood was collected and used for hematological parameters, the blood were collected in commercial tubes containing about 40 µl of potassium salt of EDTA as anticoagulant and analyzed within 24 h by fully automated hematological cell counter (Sysmax K-4500 of Transasia Ltd.) (Garcia-Mazano *et al.*, 2001). The parameters measured were red blood cell (RBC) count, white blood cell (WBC) count, hemoglobin (Hb) concentration, packed cell volume (PCV%), mean cell volume (MCV), platelet count. The values of the mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated.

### Statistical Analysis

The data obtained from the control and experimental groups were subjected to determine the level of significance at exposure periods and metal concentrations by least significant differences (LSD).

## Result

The table (1) showed no any significant differences in the total of WBC counts between the intermediate or high dose, and no any significant differences between the intermediate or low dose, but only the highest dose was significantly different ($P \leq 0.01$) from the lowest dose .Moreover all these doses are significantly different ($P \leq 0.01$) as compared to the control group. (RBC, PCV and MCV) showed no any significant differences among these doses, but there were a high significant difference ($P \leq 0.01$) found between these doses as compared to the control group. Whereas (Hbg) did not show any significant differences between the lowest or intermediate doses, but these doses are significantly different ($P \leq 0.01$) as compared to the highest dose. As well as all these doses are significantly different ($P \leq 0.01$) in Hbg values as compared to the control group. Moreover (MCH) showed no any significant differences between the lowest or intermediated doses, but these doses are significantly different ($P \leq 0.01$) as compared to the highest dose. On other hand only the highest dose showed a significant difference ($P \leq 0.01$) when compared with the control group. A high significantly different ($P \leq 0.01$) in (MCHC) values showed between the intermediate and high dose, as well as a high significant difference ($P \leq 0.01$) in (MCHC) values showed between these doses as compared to the control group in one side and as compared to the lowest dose on another, while no any significant difference in (MCHC) values between the lowest dose as compared to the control group.

**Table (1): The changes in the hematological parameters of mice exposed to different sub-lethal doses of nickel chloride.**

| Concentration Mg/kg / Metal | | WBC (cell×$10^3$/ $mm^3$) | RBC (cell×$10^6$/ $mm^3$) | Hbg ( g/dl) | PCV ( %) | MCH (pg/cell) | MCV (fl) | MCHC (g/dl) |
|---|---|---|---|---|---|---|---|---|
| Ni | 20 | 3.34 ± 0.62* | 6.84 ± 0.71 | 12.08 ± 0.55 | 34.25± 1.90 | 15.1 ± 0.35 | 43.50 ± 1.21 | 34.51± 0.37 |
| | 40 | 2.66 ± 0.50 | 5.02 ± 0.65 | 9.34 ± 1.26 | 34.44 ± 2.58 | 13.5 ± 0.59 | 41.80 ± 0.46 | 31.30± 0.46 |
| | 60 | 1.84 ± 0.50 | 4.92 ± 0.96 | 6.22 ± 1.25 | 32.61 ± 4.99 | 10.06± 1.28 | 42.00 ± 0.53 | 28.30± 0.44 |
| | CO | 4.78± 0.31 | 9.49 ± 0.61 | 15.15 ± 0.85 | 49.52 ± 2.43 | 15.53 ± 0.09 | 56.02 ± 0.87 | 34.57± 0.30 |
| **LSD** | | **1.42** | **2.14** | **2.94** | **9.19** | **2.10** | **2.30** | **2.89** |

## Discussion

The results obtained from the present study showed that when male mice exposed to different doses of $NiCl_2$ causes significant differences in the most of hematological parameters .Similar results have been reported by De Luca *et al*., (2007) and Joshi *et al*, (2002) demonstrated that impaired intestinal absorption of iron. Other causes may be due to inhibition of erythropoiesis, sever damage occur at stem cell within bone marrow or by destruction of red blood cells. Arjun *et al*. (2002) found decrease in WBC, RBC, Hbg and PCV for male rats treated with Cr and Ni elements this decrease may be result from nickel- chrome induced anemia arising by injury of hematopoietic stem cells. These findings are in agreement with findings by Tikare (2012) refers to decrease WBC and lymphocyte counts either by decrease production or increase consumption ,while decline in Hb possible return to the reduce of its formation by decrease the pool of succinyl as well as the pool of glycine.

However, unlike results obtained by Al-Hamdany (2010) who found that significant increase in WBC counts in rats exposed to lead acetate due to inflammation and increase stimulate production, but found significant decrease in Hb resulted by accumulation metal inside the red cell and prevented it from formation of Hb or may be inhibition ferrochelatase enzyme which responsible for linked iron to the globin protein and form hemoglobin. Ololade and Oginni ,(2010) demonstrated that the decrease in red blood cell indices MCV, MCH and MCHC can attributed to the decrease iron within erythrocytes or its content of hemoglobin and this causes decrease carrying capacity of oxygen by blood, ultimately stimulate formation of red blood cells. Moreover than that when rats exposed to different level of mercury chloride causes decrease in RBC, PCV and Hb may be due to fragile and disrupters red blood cell membrane then hemolysis and finally decrease Hb, while found no any significant differences in WBC as compared to the control (Al-Alwany ,2011).

The present study is in agreement with others found that decrease in RBC, Hb, PCV and WBC may attributed to formation erythrocyte oxidative stress, this led to sever anemia, leucopenia (a reduction in the number of WBC), and thrombocytopenia (deficiency of platelets in the blood) together with elevated level of MDA in erythrocyte and decrease in glutathione peroxidase (Adjroud and Mouffok ,2009). The present data unlike to other researcher such as obtained by Spears *et al*., (1984) demonstrated that no any significant differences in hematological parameters (WBC, RBC, Hb and PCV) in pigs that given 25 ppm of nickel chloride at 21 days in basal diet as compared to the control.

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