

Effectiveness of *Moringa oleifera* Extract in Attenuating the Toxic Effect on Platelet Count: An Experiment on Cadmium Exposed Rats

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History

- Submission Date: 18-01-2019;
- Review completed: 27-03-2019;
- Accepted Date: 25-04-2019.

DOI : 10.5530/pj.2019.11.109

Article Available online

<http://www.phcogj.com/v11/i4>

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ABSTRACT

Aims and Objective: To determine the role of *Moringa oleifera* on total platelet count alterations (T-PC) in rats treated with cadmium. **Materials and Methods:** In the present study female adult Wistar Albino rats, (180-200) gm were divided into, Group I-normal control, Group II-pretreated control, group III-cadmium treated, group IV- pre-treated with *Moringa oleifera* leaf extract (MOE) and then administered oral cadmium for a day, with n=6 each. **RESULTS :** Indicate that the pre-treatment with MOE (100 mg/kg/bw) prior to cadmium infusion augmented the level of total platelet count ($p \leq 0.001$) as compared to the cadmium-exposed group, which might have a role in clotting mechanisms also. **Conclusion:** *Moringa oleifera* extract has a beneficial effect on platelet count in cadmium-induced animal model.

Key words: Cadmium, Platelet count, Clotting mechanisms, Toxicity, *Moringa oleifera*.

INTRODUCTION

Cadmium (Cd) is an environmental element with a broad range of applications in the industry.¹ Cadmium has been identified as a carcinogen by International Agency for Research on Cancer/IARC.² It is mainly found in the environmental air and as a constituent of paint and is known to affect various blood parameters.³ *Moringa oleifera*, from Moringaceae family is a known hypotensive, anticancer, antibacterial agent. It is abundant in vitamins, minerals, phyto-nutrients such as carotenoids like carotene or pro-vitamins.

Cadmium contact can occur through the diet we consume, the water we drink or the fumes we inhale and often leads to changes in the antioxidant immune system in our body.^{4,5} Though the definite mechanisms of its associated toxicity are not yet well covered, there are reports on Cd remarkably enhancing the formation of reactive oxygen species (ROS), boosting lipid- peroxidation and cell-membrane damage and depleting the antioxidant defense elements in different body organs.⁶ It has been proved that after exposure, Cd attaches to red-cell membranes and binding to plasma protein it is transported to liver, where it bound to metallothionein/MT.⁷ Moreover, environmental presence of cadmium and other toxic metals has been directly linked to food contamination.⁸ The bioavailability, retention and toxicity of this environmental dangerous metal are affected by many factors, nutritional status such as low iron levels in the body.⁹ Hematology, the Science of blood, forms a crucial principle of various diagnostic procedures as it includes the examination of formed elements of the circulatory system.¹⁰ Experimental evidences have shown that blood is one of the vital tissues having reproducible

metabolic changes. Undue exposure to cadmium is harmful to human beings as its passage via blood affects the blood parameters, including platelet count.¹¹ *Moringa oleifera* is synonymously termed as the drumstick /horseradish tree, whereas in Nile valley, it is known as Shagara al Rauwaq.¹² Numerous medicinal properties have been attributed to various parts of this scientifically valued tree. In South-Asia, practically entire plant has been used in traditional medicinal preparations for various health issues. It is believed that this particular medicinal preparation is highly effective for inflammation and infections, cardiac related ailments, digestive disorders, as well as liver diseases. It is one of the best natural coagulant discovered so far as it causes an increase in the platelet count.¹³ Although studies have shown that MOE battles cadmium induced metal intoxication, scientific literature is devoid of findings regarding the effect of MOE on the platelet count in cadmium-exposed rats. So, current experiments were designed to investigate the effect of MOE on total platelet-count on adult Wistar Albino rats exposed to cadmium.

MATERIALS AND METHODS

Reagents needed for the study were purchased from Durga Laboratories, Mangalore, Karnataka, India. Institutional Animal Ethics Committee (IAEC) clearance was obtained prior to the research. All the experimental approaches and animal care were according to the recommendations of Institutional Animal Ethics Committee (IAEC).

Plant materials

Moringa oleifera leaves were collected from home grown areas in the shoreline of Karnataka, India and then authenticated by an expert botanist.

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Extract preparation

Plant extract preparation was done according to the previously published paper from the present laboratory.¹⁴

Animals

Twenty-four female Albino rats of albino strain of 4 months old (180-200gms) were used for the present study. Food and water was provided *ad libitum*. Animals were categorized into 4 groups, (n=6).

Hematological parameters

Cardiac catheterization (23G needle) was used to collect the blood sample. About 4 mL of the blood was collected in an anti-coagulated tube.¹⁵ Total platelet count (T-PC) was performed using automated hematological analyzing techniques.¹⁶

Statistical analysis

Data represents mean \pm SEM. Statistical analysis was done by using ANOVA and post-test. Statistical significance was considered $p \leq 0.05$.

RESULTS

In controls, total platelet count was found to be 6.41 ± 0.06 . There was a significant decrease in platelet count (** $p \leq 0.001$) in group III (4.50 ± 0.14) compared to groups I and (** $p \leq 0.0001$) group II (6.73 ± 0.10), whereas, group IV exhibited significant (** $p \leq 0.001$) rise in total platelet count (4.66 ± 0.14) when compared with group III. Groups I and II didn't show any significant difference in platelet count (Tables 1 and 2).

DISCUSSION

Cadmium, a major contaminant of an environmental and industrial origin, carry a potential threat and affects multiple system in human and animals.¹⁷ Previous data suggest that blood is most important tissue in the body with reproducible metabolic alterations. Alterations in blood parameters are one of the most reliable toxicity markers of drugs and heavy metals.¹⁸ Earlier reports of blood clotting tests demonstrated that exposure to cadmium had resulted in hemostatic dys-regulation due to significant decrease in platelet-count.¹⁹ The present study which is in accordance with previous data, also showed a considerable reduction in TPC on cadmium exposure, which justifies the deadly effects of cadmium on blood components. A decline in T-PC could lead to extreme hematological disorders like purpura and leukemia. In severe conditions it may lead to death.²⁰ Studies have shown that, liver is the major organ for synthesis of pro-coagulation factors and substances.²¹ The toxic effects of cadmium is generally due to its binding property to reactive agents. It results in the down regulation

Table 1: Study animals.

Sl. No.	Groups	Characteristic features
1.	I	Control (normal saline)
2.	II	Treated with the MOE aqueous leaf extract, (100 mg/kg/bw) orally, for 10 days
3.	III	Administered cadmium chloride (10 mg/kg/bw) orally [Single dose]
4.	IV	Pre-treated with the MOE extract (100mg/kg/bw) for 10 days after which Cd (10 mg/kg/bw) oral infusion for 1 day

Table 2: Effect of MOE on total platelet count in cadmium exposed rats.

Groups	Total platelet count
I	6.41 ± 0.06
II	6.73 ± 0.10
III	4.50 ± 0.14
IV	4.66 ± 0.14

of enzymatic reactions, gene growth and reproduction. Cadmium stimulates lipid-peroxidation and the formation of reactive oxygen species (ROS), thus results in oxidative cellular and tissue-damage.²² It has been reported that, Cadmium augments adenylate-cyclase and hence hinders phospho-diesterase (PDE) activity. This in turn reduces the platelet-aggregation rate.²³ *Moringa oleifera* is a multipurpose tree.²⁴ It has various pharmacological properties that had been used in the treatment of innumerable disorders.²⁵⁻²⁷ Present findings reveal a clear rise in T-PC in rats pre-treated with MOE, prior to administration of Cd, which may indicate the protective effect MOE against cadmium induced hem-toxicity. Nevertheless our findings are in agreement with the reports from previous studies.²⁸ Thrombopoietin like substance may be present in the extract which in-turn has a vital role.²⁹ Several studies reported that *Moringa oleifera* is one of the natural coagulant.¹³ It is also observed that that specific byproducts of these leaves has been found to have therapeutic potential. Hence used across the world claiming no side-effects.³⁰ Present study confirms the potential of MOE in positively influencing the hemopoietic-system.

CONCLUSION

Current findings project that MOE has a remedial effect on cadmium-induced toxicity to platelets in animal model. Further studies are needed to discover the detailed mechanisms triggering the present effects.

ACKNOWLEDGEMENT

We are thankful to the Department of Physiology, Kasturba Medical College (KMC), Mangalore, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India, for providing the laboratory and necessary instruments for conducting the experiments.

CONFLICTS OF INTEREST

No conflicts of interest are declared

ABBREVIATIONS

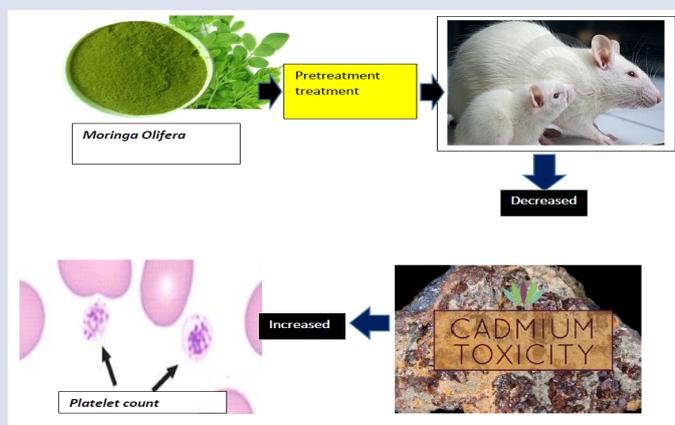
MOE: *Moringa olifera* extract; Cd: Cadmium; T-PC: Total platelet count.

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GRAPHICAL ABSTRACT



SUMMARY

Cadmium (Cd) exposure produces alterations in the platelet count. MOE has a remedial effect on this toxicity. Hence, this study showed potential of MOE in positively influencing the hemopoietic-system.

ABOUT AUTHORS



Dr. Vinodini NA: I had obtained my Ph. D. degree from Manipal Academy of Higher Education Manipal, and currently working as Associate professor in the department of physiology Kasturba Medical college Mangalore Karnataka. My field of research interest is toxicology, reperfusion injury and cancer and to find out preventive as well as therapeutic solutions from different plant sources. I have received best paper award in an international conference organized by IISRO held at Pattaya and having more than 40 papers to my credit.



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