

## UNSWEETENED MILK AND VITAMIN C SUPPLEMENTS AMELIORATE LEAD ACETATE INDUCED HEPATIC INJURIES THROUGH IMPROVEMENT IN LIVER FUNCTIONS AND HEMATOLOGY

Onyebuchi F. Orinya<sup>1,4</sup>, \*Kizito A. Agu<sup>1,4</sup>, Benjamin Okechukwu<sup>2</sup>, Benjamin E. Onah<sup>2</sup>, Emmanuel Ike Ugwuja<sup>2,3</sup>, Daniel Orieke<sup>1</sup> Joseph Uche Odo<sup>1</sup>

<sup>1</sup>Department of Medical Biochemistry David Umahi Federal University of Health Sciences Uburu, Ebonyi State, Nigeria

<sup>2</sup>Department of Applied Biological Science, Faculty of Natural and Applied Sciences, State University of Medical and Applied Sciences, Igbo-Eno, Enugu State, Nigeria

<sup>3</sup>Nutrition & Toxicology Unit, Department of Biochemistry, Faculty of Science, Ebonyi State University, Abakaliki, Nigeria

<sup>4</sup>International Institute of Toxicology, Environmental and occupational Health and Safety Research, David Umahi Federal University of Health Sciences Uburu, Ebonyi State, Nigeria

**Corresponding author:** Kizito Akachukwu Agu

Email: [kizitoakachukwu@gmail.com](mailto:kizitoakachukwu@gmail.com), [aguka@dufuhs.edu.ng](mailto:aguka@dufuhs.edu.ng)

Phone: +2347033539455

### Abstract

Lead poisoning poses one of the major health challenges affecting all organ systems but mostly the nervous, renal, haematopoietic, liver and cardiovascular systems. This study investigated the effects of unsweetened milk and vitamin C supplements on markers of hepatic function and hematological parameters of lead acetate exposed albino rats. Twenty male albino rats were randomized into four groups of five rats each. Normal control received feed and water only. Lead group (Pb) received 80mg/kg body weight lead acetate. Standard control (Pb+Vit C) was given 80mg/kg lead acetate daily plus 100mg/kg of vitamin C, while treatment group (Pb+Milk) was given 80mg/kg lead acetate plus 400mg/kg milk. Animals were allowed access to feed and water. All administration was done once daily by oral gavage for 42 days. Biochemical analyses were done using standard procedures. Rats exposed to lead acetate showed a significant ( $p < 0.05$ ) increase in the activities of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase and total bilirubin level, indicating liver dysfunction with a significant ( $p < 0.05$ ) decrease in plasma albumin when compared with the control groups. The results also showed significant ( $p < 0.05$ ) decrease in red blood cell count, packed cell volume, hemoglobin, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration with significant elevations in the mean corpuscular volume and platelet concentrations when compared with the control. Unsweetened milk and vitamin C supplements ameliorated the negative effect of lead on the liver and improved hematological parameters.

**Keywords:** lead acetate, unsweetened milk, liver function and hematological parameters.

### Introduction

Lead exposure is a prevalent public health issue facing the populace as a result of its hazard effects on various physiological systems. Lead toxicity has posed a health threatening situation

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shown by nature of their environmental decadence (Alisha *et al.*, 2017), especially since its manufacturing transformations evolved. Almost all organ systems are associated with toxicity of heavy metals. However, the most susceptible systems include the cardiovascular, renal, haematopoietic, and nervous system (Abhay *et al.*, 2024). Lead (Pb), one of the venomous heavy metals, has been implicated in various aspects of environmental and biological systems, especially in industrialized localities (Srivastava *et al.*, 2024). Lead is one of the oldest deleterious agents known to mankind as its toxicity in both human and experimental animals can be traced back to the ancient times of the Romans, Arabs, Egyptians and Greeks (Jasbir *et al.*, 2023). Lead exists in three isoforms: metallic lead, inorganic lead and organic lead, each with distinct properties and implications for health and its environment (Shafia, 2022). Commonly encountered form of lead can enter the body through multiple routes including; ingestion, inhalation and dermal contact of their presence in food, air and tobacco leaves (Ashkan, 2023). On absorption into systemic circulation, some of its components complexes with erythrocytes, and the remaining stays in plasma to be transported to other tissues (Elayat and Bakheelf, 2010).

Lead-induced liver toxicity has been associated with oxidative stress, inflammation, and impairment of liver function parameters, which can have profound health implications (Ambreen, 2024). The liver performs a critical role in detoxification, metabolism, and maintaining overall homeostasis in the body (Wu *et al.*, 2023). As researchers seek innovative strategies to mitigate the adverse effects of lead exposure, the potential of unsweetened milk as a dietary intervention in alleviating liver and hematological damage requires thorough investigation.

Milk is an integral part of human and animal diets, recognized for its nutritional constituents. It's rich in essential nutrients, proteins, vitamins, minerals, and bioactive compounds with potential health-promoting properties (Felicito, 2024). These components suggest that milk consumption could influence liver health by modulating oxidative stress, inflammation, and enzymatic activities that impact liver function and hematological parameters (Giovanna *et al.*, 2023). Some studies have explored the potential hepatoprotective effects of milk and the specific impact of milk consumption on liver function parameters in the context of lead exposure remains under-investigated (Yasmin *et al.*, 2023). Elucidating the potential benefits of unsweetened milk in mitigating lead-induced liver and hematological damage could offer a novel and practical dietary approach to reducing the adverse effects of lead toxicity. Therefore, this study investigated the effects of unsweetened milk and vitamin C supplements on markers of hepatic function and hematological parameters of lead acetate exposed albino rats.

## Materials and Methods

**Equipment, Chemicals and Reagents.** All equipment used were optimally functional and chemicals/reagents were of high analytical quality. Lead acetate (Merck, Germany) was procured from Cjay Enterprise Ogoja Road, Abakaliki, Ebonyi State Nigeria while Peak® instant full cream unsweetened milk was purchased from St. Margret Umahi International Market, Lot 1, Abakaliki, Ebonyi State Nigeria.

**Animal Collection.** Adult albino Wistar rats with body weights of >100 g were used for this study. These rats were purchased from Pharmacy Department, University of Nigeria Nsukka, Enugu State, Nigeria. The rats were kept in steel cages in a conventional laboratory setting for a week of acclimatization, with free access to commercial basic diet (Top Feed Growers Mash) and water *ad libitum*. They were kept in the Animal House at the Presco Campus of Ebonyi State University, Nigeria.

**Experimental Design.** Twenty male albino rats were randomized into four groups of five rats each. Normal control (NC) received feed and water only. Lead group (Pb) received 80mg/kg body weight lead acetate (Okediran *et al.*, 2017; Newairy and Abdou, 2009). Standard control

(Pb+Vit C) was given 80mg/kg lead acetate daily plus 100mg/kg of vitamin C (Ait Hamadouche *et al.*, 2012), while treatment group (Pb+Milk) was given 80mg/kg lead acetate plus 400mg/kg milk (Chuang *et al.*, 2004). They were fed with commercial top feed growers mash and water. All administration was done once daily by oral gavage for 42days. Biochemical analyses was done using standard procedures.

**Blood Sample collection.** The experiment was carried out for 42days and blood samples collected via ocular puncture with the animals anesthetized with chloroform after 24hrs fasting. Blood samples were collected using lithium heparin bottles for other tests and EDTA bottles for hematology after which samples were centrifuged at 2000 x g for 5 minutes and the plasma was isolated into plain bottles and stored in refrigerator with temperature of -4°C for analysis.

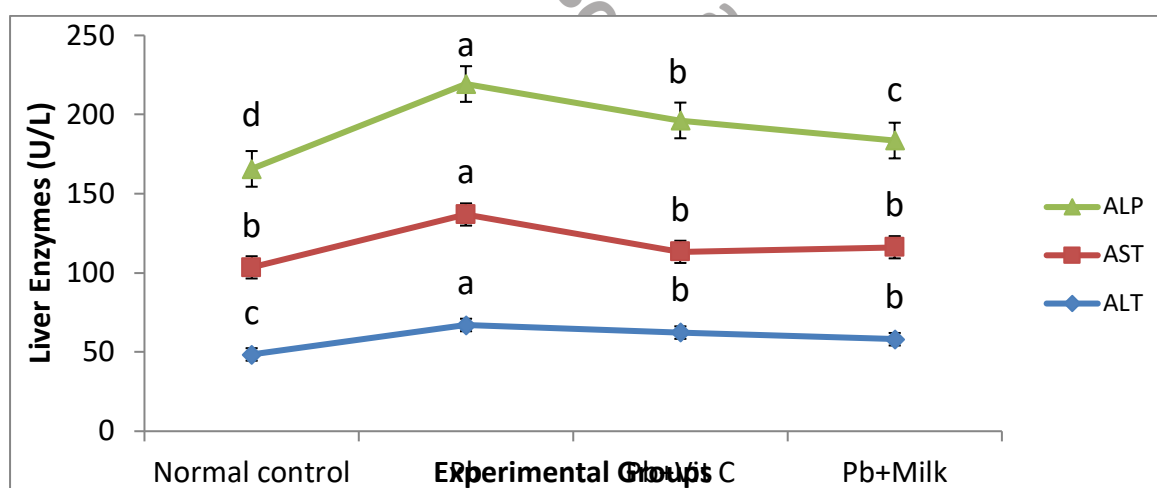
**Liver Function Test.** The following parameters were measured: total bilirubin (TB) (Doumas *et al.*, 1973), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) (Reitman and Frankel 1957), alkaline phosphatase (ALP) (Babson *et al.*, 1966) and plasma albumin (ALB) (Doumas and Peters, 1997).

**Hematology Analysis.** Hematological parameters were measured using the CELL-DYN Ruby Auto analyzer (Abbott, Abbott Park, IL, USA). The following hematological parameters were examined: red blood cell count (RBC), packed cell volume (PCV), hemoglobin concentration (HbC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet count (PLT).

**Statistical Analysis.** Data generated were analyzed using the statistical package for social sciences software (Version 25) and thereafter subjected to one way analysis of variance (ANOVA).

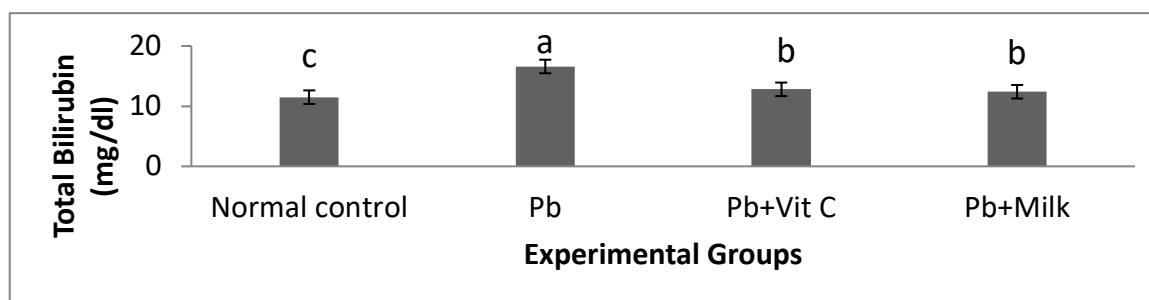
## Results and Discussion

The results of this study showed a significant elevation ( $P < 0.05$ ) in the activities of liver markers ALT, AST and ALP of lead acetate exposed rats relative to the control (Figure 1) with similar observation in Total Bilirubin level (Figure 2). The result in Figure 3 indicated a significant decrease ( $P < 0.05$ ) in plasma albumin when compared with the control groups.



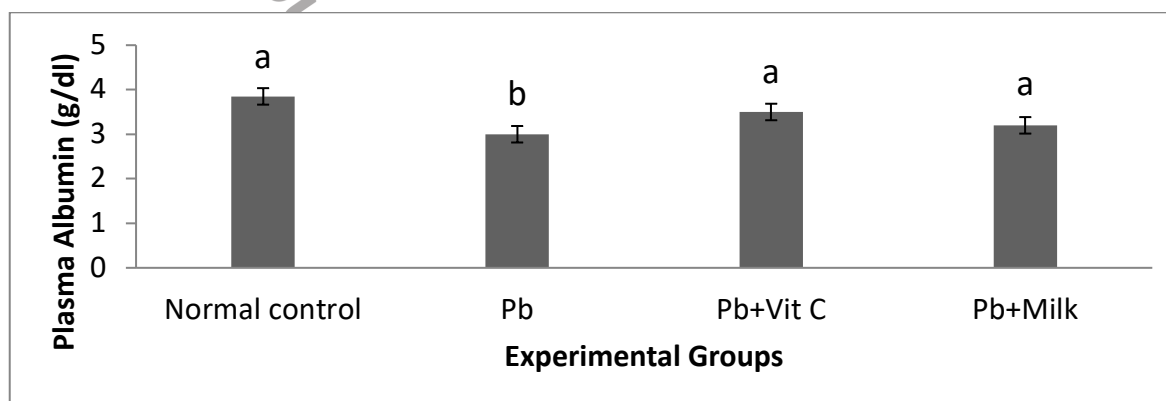
**Figure 1: Effect of unsweetened milk and vitamin c supplements on liver enzymes in lead acetate exposed rats**

Data are shown as mean  $\pm$  SEM (n=5). **SEM:** Standard error of means. Coordinates with different alphabets are significantly different ( $p < 0.05$ ).



**Figure 2: Effect of unsweetened milk and vitamin c supplements on plasma bilirubin level in lead acetate exposed rats**

Data are shown as mean  $\pm$  SEM (n=5). **SEM:** Standard error of means. Bars with different alphabets are significantly different ( $p < 0.05$ )



**Figure 3: Effect of unsweetened milk and vitamin c supplements on plasma albumin level in lead acetate exposed rats.**

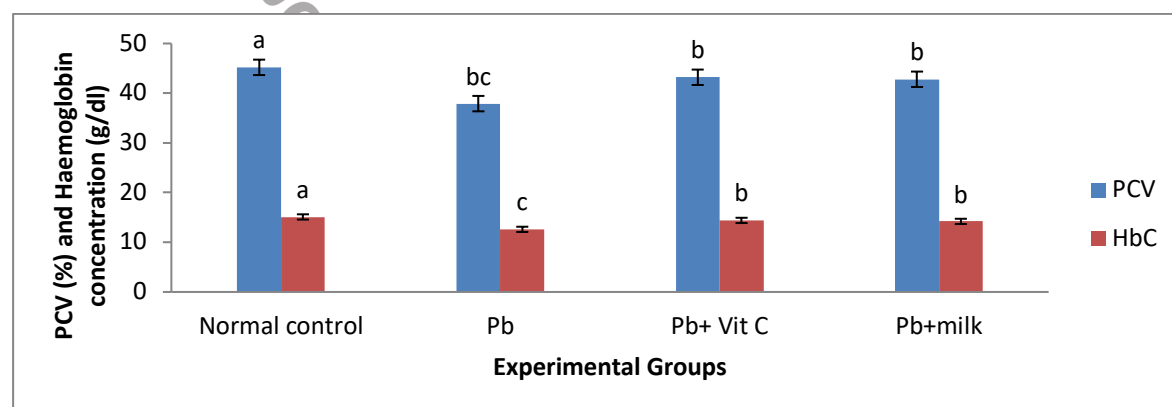
Data are shown as mean  $\pm$  SEM (n=5). **SEM:** Standard error of means. Bars with different alphabets are significantly different ( $p < 0.05$ )

The administration of lead acetate to rats led to a significant ( $P < 0.05$ ) elevation in plasma AST, ALT and ALP activities in the group treated without intervention when compared with the normal control, indicating that exposure to lead acetate may induce a detectable damage to the liver. The elevation in plasma ALT, AST and ALP could be as a result of an increase in cell membrane permeability due to damage exerted on the plasma membrane of hepatocytes associated with lead acetate hepatotoxicity. The result is in accordance with the works of Mehta *et al.* (2002) and Patil *et al.* (2007) who reported a significant increase in AST and ALT concentrations after treatment with lead acetate. The hepatotoxicity induced by lead acetate tends to damage the liver cells with a concomitant increase in serum concentrations of AST and ALT (Abdou *et al.*, 2007). The increased level of total bilirubin observed in the results after induction of lead acetate could be initiation of hemeoxygenases that play an important role in heme catabolism or damage to the hepatocytes as discussed above or both (Alya *et al.*, 2007). The groups that received 400mg/kg of milk and 100mg/kg of vitamin C revealed a significant ( $P < 0.05$ ) decrease in Total bilirubin concentration, ALT, AST and ALP activities when compared to the group that received lead acetate only. This finding is in accordance with the works of Abdel-Mobdy *et al.* (2023), who reported that liver function parameters and bilirubin level in serum significantly decreased in all administered groups with the inclusion of the milk-induced groups relative to normal control. Our findings is also in agreement with the works of Magjeed (2005), Khan and Zohair (2011), and Abdel-Mobdy *et al.* (2021); who reported the hepatoprotective influence of camel milk on poisons; similarly, camel milk ameliorate the liver functions of lead acetate induced rats; they equally reported that camel milk's beneficial

impacts could be due to the incorporation of mineral compositions in it, which plays vital roles in decontamination and as nutraceuticals in the liver.

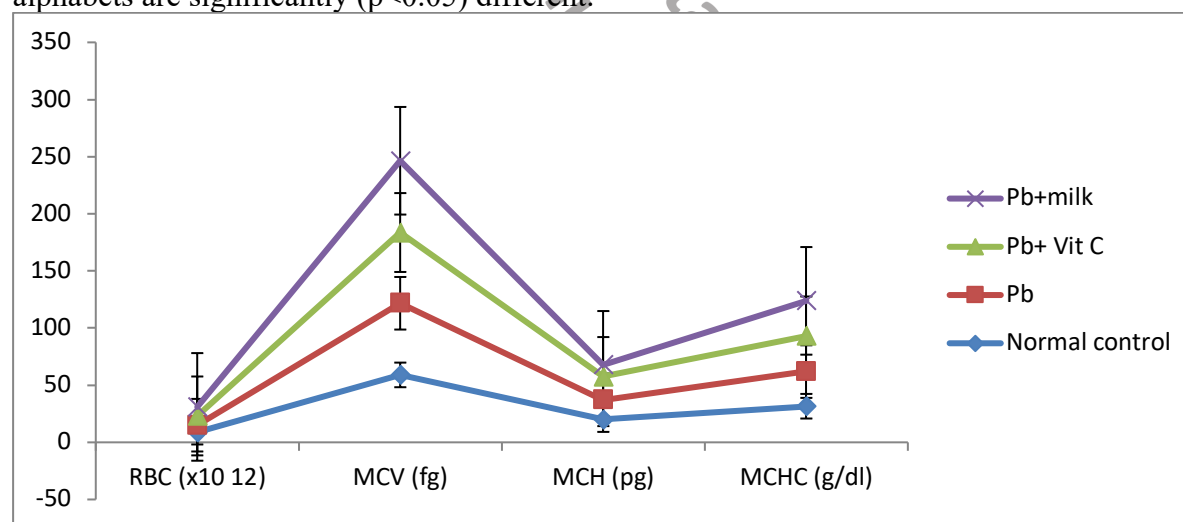
There was a significant ( $P < 0.05$ ) reduction in the plasma albumin level of the rats exposed to lead acetate when compared with the normal control. The observed variations in plasma albumin is an indication of liver malfunction since it's responsible for proteins synthesis, mostly albumin (Mariam *et al.*, 2023).

The results in Figure 4 and 5 indicated significant reduction ( $P < 0.05$ ) in packed cell volume (PCV), hemoglobin (HB), red blood cell count (RBC), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) with a significant ( $P < 0.05$ ) elevation in the mean corpuscular volume (MCV) and platelets count (Figure 6) when compared with normal control groups of lead acetate exposed rats.



**Figure 4: Effect of unsweetened milk and vitamin c supplements on packed cell volume (PCV) and haemoglobin concentration (HbC) of lead acetate exposed rats**

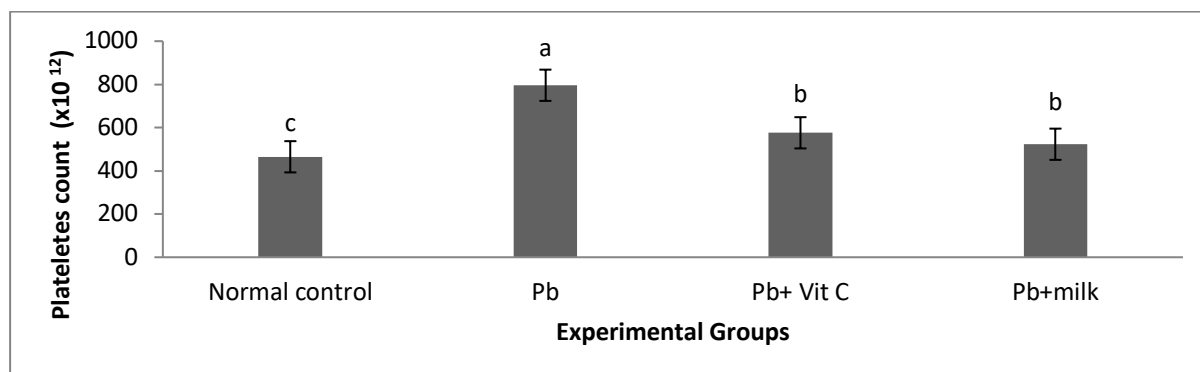
Data are shown as mean  $\pm$  SEM ( $n=5$ ). SEM: Standard error of means. Bars with different alphabets are significantly ( $p < 0.05$ ) different.



**Figure 5: Effect of unsweetened milk and vitamin c supplements on red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and indices of lead acetate exposed rats**

Data are shown as mean  $\pm$  SEM ( $n=5$ ). SEM: Standard error of means.





**Figure 6: Effect of unsweetened milk and vitamin c supplements on platelets count of lead acetate exposed rats**

Data are shown as mean  $\pm$  SEM (n=5). **SEM:** Standard error of means. Bars with different alphabets are significantly ( $p < 0.05$ ) different.

The findings from this study suggest that unsweetened milk and vitamin c supplements may have a positive influence on haematological parameters in lead acetate exposed rats as shown in figure 4. There was a significant ( $P < 0.05$ ) reduction in PCV level in lead acetate group when compared to the normal control. Groups that received unsweetened milk and vitamin c supplements showed significant ( $P < 0.05$ ) elevation in PCV level in relation to lead acetate group. This indicates that milk consumption may help maintain healthy red blood cell volume in the presence of lead exposure. The decrease in PCV and HbC in the lead acetate exposed group aligns with the known hematotoxin effects of lead, which can impair erythropoiesis and haemoglobin synthesis (Katarina *et al.*, 2024; Wahab *et al.*, 2010). The improvement observed in the lead acetate + vitamin C group implies a potential ameliorative outcomes of vitamin C on lead-induced haematological changes. Notably, the lead acetate + milk group displayed results approaching those of the normal control, indicating that milk consumption might have a positive influence on blood parameters of animals exposed to lead acetate (Doris and Jorge, 2020). The protective effect of milk could be attributed to its nutritional composition, including proteins, vitamins, and minerals. Calcium and other components in milk might counteract the hematotoxin effects of lead, contributing to the observed improvements (Christian *et al.*, 2021). These findings suggest that incorporating milk into the diet may have haematological benefits for individuals exposed to lead. However, it is pertinent to conduct further studies, including human trials, to validate these results and understand the underlying mechanisms.

The results in figure 5, indicates a significant reduction in the red blood cell (RBC) count in the group that received lead acetate. This aligns with the general understanding of adverse effects of lead on haematopoiesis. The increase in MCV as shown in the present study indicates changes in the size of red blood cells, potentially suggestive of alterations in their maturation. The decrease in MCH and MCHC in the same group further supports the notion of lead-induced anaemia, an indication of a decrease in haemoglobin content per red blood cell and its concentration.

Conversely, the incorporation of 100mg/kg body weight of vitamin C and 400mg/kg body weight of milk seemed to have a positive effect on red blood cell count and related indices, suggesting a potential protective role. The effects of vitamin C were more pronounced in comparison to milk, whereas milk appeared to play a role in enhancing red blood cell count, the sharp decrease in MCH and MCHC suggests that it might have a unique influence on the

haemoglobin content and concentration within each red blood cell (Scholz-Ahrens *et al.*, 2003; Torres *et al.*, 1995).

Understanding the mechanisms behind these observed effects, especially the unexpected changes in MCH and MCHC in the milk-supplemented group, calls for further investigation. It's essential to explore how milk components interact with lead and influence erythropoiesis, haemoglobin synthesis, and red blood cell characteristics

In figure 6, the platelet count of animals given lead acetate increased significantly when compared to the normal control. This elevation in platelet count with lead acetate exposure aligns with the known association between lead exposure and inflammatory processes. Meanwhile, vitamin C and milk intervention tends to mitigate this effect. This suggests potential protective effects of these substances against lead acetate induced platelet alterations. An elevated platelet count (thrombocytosis) can have clinical implications, including an increased risk of thrombosis. On the other hand, excessively low platelet counts (thrombocytopenia) can lead to bleeding disorders. Therefore, understanding the factors that influence platelet count, including dietary components like milk, is essential for assessing their potential impact on overall health and homeostasis, especially in the context of lead exposure (Wati *et al.*, 2023).

## Conclusion

Our findings suggest protective effects of unsweetened milk and vitamin C supplements on hepatotoxicity and hematological damages associated with exposure to lead acetate in rats. Hence, unsweetened milk and vitamin C possess hepatoprotective potentials that deserve to be further evaluated towards understanding the underlying mechanisms of their hepatoprotective potentials in lead toxicity.

## References

- Abdel-Mobdy, A. E., Elhusseiny, M.S. and Abdel-Mobdy, Y. E. (2021). Evaluation of therapeutic and protective influences of camel milk against gamma radiation-induced hematotoxicity, hepatotoxicity and nephrotoxicity in albino rats. *Annals Romanian Society Cell Biology*, **34**: 7958–7976.
- Abdel-Mobdy, Y. E., Abdel-Mobdy, A. E. and AL-Farga, A. (2023). Evaluation of therapeutic effects of camel milk against the hepatotoxicity and nephrotoxicity induced by fpronil and lead acetate and their mixture. *Environmental Science and Pollution Research*, **30**: 44746–44755.
- Abdou, Z. A., Attia, M. H. and Raafat, M. A. (2007). Protective effect of citric acid and thiol compounds against cadmium and lead toxicity in experimental animals. *Journal of Biological Chemistry and Environmental Science*, **2**: 481–497.
- Abhay, B. F., Siddant, R. and Swati, S. (2024). Understanding heavy metal toxicity: Implications on human health, marine ecosystems and bioremediation strategies. *Marine Pollution Bulletin*, **206**: 116707-116709. doi: 10.1016/j.marpolbul.2024.116707.
- Alisha, V., Paul, M., Pravita, G. (2017). A comprehensive review of environmental exposure of toxicity of lead. *Journal of Pharmacognosy and Phytochemistry*, **7**(4): 1991-1995.
- Alya, A. B., Afef, N., Naoufel, H., Najoua, G. and Saloua, E. (2007). Antioxidant enzymes activities and bilirubin level in adult rat treated with lead. *Comptes Rendus Biologies*, **5**: 7-10.
- Ambreen, S. (2024). Comparative study on hepatotoxic effect of paracetamol, Lead and Arsenic: Analysis, Evaluation and Treatment solution. *SCIREA Journal of Health*, **8**(1): 1-11. Doi: 10.54647/pmh330318.

- Ashkan, M. F. (2023). Lead: Natural Occurrence, Toxicity to Organisms and Bioremediation by Lead-degrading Bacteria: A Comprehensive Review. *Journal of Pure and Applied Microbiology*, **17**(3): 1298-1319. <https://doi.org/10.22207/JPAM.17.3.26>.
- Babson, A. L., Greeley, S. J., Coleman, C. M. and Philips, G. E. (1966). Phenolphthalein monophosphate as a substrate for serum alkaline phosphatase. *Clinical Chemistry Acta*, **12**: 336-343.
- Christian, L., Sarah, E., Markus, B. and Sascha, V. (2021). Potential Protective Protein Components of Cow's Milk against Certain Tumor Entities. *Nutrients*, **13**(6): 1974-1978. doi: 10.3390/nu13061974.
- Doris, M. C. P. and Jorge, I. C. B. (2020). Lead and cadmium blood levels and transfer to milk in cattle reared in a mining area, *Heliyon*, **6**(3): 202-208. doi.org/10.1016/j.heliyon.2020.e03579.
- Doumas, B. T. and Peters, T. J. (1997). Serum and urine albumin: a progress report on their measurement and clinical significance. *Clinical Chemistry Acta*, **258**: 3-20.
- Doumas, B. T., Perry, B. W., Sasse, E. A. and Straumfjord, J. V. (1973). Standardization in bilirubin assays: evaluation of selected methods and stability of bilirubin solutions. *Clinical Chemistry*, **19**: 984-993.
- Elayat, W. and Bakheelf, M. S. (2010). Effects of chronic lead toxicity on liver and kidney functions. *Journal of Medical Laboratory Science*, **1**: 29-36.
- Felicitto, J. (2024). Healthy Effects of Milk and Dairy Product Consumption in the Mediterranean Area and Japan. *Endocrine, Metabolic & Immune Disorders-Drug Targets*, **24**(15): 1813-1822.
- Giovanna, T., Patrizia, G., Fabiano, C., Gina, C., Chiara, F., Sabino, G., Angela, C., Petrella, L., Silvia, D.C., Bice, A., Giuseppe, C. and Mariapina, M. (2023). Hepatocyte Aquaporins AQP8 and AQP9 Are Engaged in the Hepatic Lipid and Glucose Metabolism Modulating the Inflammatory and Redox State in Milk-Supplemented Rats. *Nutrients*, **15**(16): 3651-3655.
- Jasbir, S., Arora, A., Anjali, S., Justin, J., Shweta, G. and Richa, A. (2024). A Systematic Review of Lead Exposure on Mental Health. *Environmental contamination remediation and management, Journal*, 51-71. doi: 10.1007/978-3-031-46146-0\_4.
- Katarina, Ž., Jovana, Ž., Katarina, B., Dragica, B., Đurđica, M., Dragana, V., Evica, A. M., Aleksandra, B. D., Marijana, Č., Zorica, B., Biljana, A. and Danijela, Đ.C. (2024). Integrative investigation of hematotoxic effects induced by low doses of lead, cadmium, mercury and arsenic mixture: In vivo and in silico approach. *Science of The Total Environment*, volume 930. 10.1016/j.scitotenv.2024.172608.
- Khan, A. A. and Al-Zohair, M. A. (2011). Hepatoprotective effects of camel milk against CCl<sub>4</sub>-induced hepatotoxicity in rats. *Asian Journal of Biochemistry*, **6**(2): 171-180.
- Magjeed, N. A. (2005). Corrective effect of milk camel on some cancer biomarkers in blood of rats intoxicated with aflatoxin. *Journal of Saudi Chemistry Society*, **9**(2): 253-263.
- Mariam, A., Anna, S., Staffan, W., Jan, W., Olav, R. and Åke, N. (2023). Albumin and fibrinogen synthesis rates in advanced chronic liver disease. *American Journal of Physiology Gastrointestinal Liver Physiology*, **325**(5): 391-397. doi: 10.1152/ajpgi.00072.
- Mehta, A., Kannan, G. M., Dube, S. N., Pant, B. P., Pant, S. C. and Flora, S. J. (2002). Hematological, hepatic and renal alterations after repeated oral or intraperitoneal administration of monoisoamyl DMSA. I. Changes in male mice. *Journal of Applied Toxicology*, **22**: 359-369.
- Patil, A. J., Bhagwat, V. R., Patil, J. A., Dongre, N. N., Ambekar, J. G. and Das, K. K. (2007). Occupational lead exposure in battery manufacturing workers, silver jewelry workers, and spray painters in western Maharashtra (India): effect on liver and kidney function. *Journal of Basic Clinical Physiology and Pharmacology*, **18**: 87-100.



- Reitman, S. and Frankel, S. (1957). A colorimetric method for determination of serum glutamic oxaloacetic and glutamic pyruvic transaminases. *American Journal of Clinical Pathology*, **28**: 56-62.
- Scholz-Ahrens, G., Kartharina, E., Schaafsma, P., Kip, F., Elbers, H., Boeing, P. and Juergen, S. (2003). Iron- fortified milk can improve iron status in young women with low iron stores. *Milchwissenschaft- milk Science International*, **59**: 253-257.
- Shafia, A. and Amina, A. (2022). Lead (Pb): Health Effects and Assailable Populations. *American Journal of Biomedical Science & Research*, **15**(2): 253-255.
- Srivastava, H., Saini, P., Singh, A., and Yadav, S. (2024). Heavy Metal Pollution and Biosorption. In *Biosorption Processes for Heavy Metal Removal*, 1-38.
- Thrall, M. A. and Weiser, M. G. (2002). Hematology. In: Hendrix, C. M. (Editor), *Laboratory Procedures for Veterinary Technicians*, 4th Edition. Mosby Maryland Heights, 29-74.
- Torres, A., Marco, A., Kazue, S, N., Ferreira, L., Suzana, D. and Souza, Q. (1995). Effect of Vitamin C and Iron-fortified Milk use on Hemoglobin levels and Nutritional condition of Children cared for in day. *Revista De Publica*, **29**(4): 301-307.
- Wahab, A. A., Joro, J. M., Mabrouk, M. A., Oluwatobi, S. E. and Bauch, Z. M. (2010). Ethanolic extract of phoenix dactylifera prevent lead induced hematotoxicity in rats. *Continental Journal of Biomedical Sciences*, **4**: 10-15.
- Wati, L. R., Djanggan, S., Tatit, N. and Lilik, Z. (2023). The Role of Protein Intake on the Total Milk Protein in Lead-Exposed Lactating Mothers. *Nutrients*, **15**(11): 2584-2589. doi: 10.3390/nu15112584.
- Wu, J., Duan, C., Yang, Y., Wang, Z., Tan, C., Han, C., and Hou, X. (2023). Insights into the liver-eyes connections, from epidemiological, mechanical studies to clinical translation. *Journal of Translational Medicine*, **21**(1): 712-716.
- Yasmin, A. M. E., Abdel- Mobdy, A. E. and AL-Farga, A. (2023). Evaluation of therapeutic effects of camel milk against the Hepatotoxicity and Nephrotoxicity induced by fipronil and lead acetate and their mixture. *Environmental Science Pollution Research*, **30**: 44746–44755. <https://doi.org/10.1007/s11356-022-25092-0>.