Assessment of Hematological Parameters in Male Wistar Rats Administered with Dichlorvos and Carbofuran

Afolabi, Olusegun Kayode[1]; *Akinyele, Abdulmuiz Akindamola[2]; Sulyman, Rofiat Abidemi[2]; Bello, Habibat Bolanle[2]; Onyemuwa, Chibuike[2]; Akomolafe, Ayomide Peter[2]

[1]Department of Biochemistry, Ladoke Akintola University of Technology, Ogbomoso

[2]Department of Science Laboratory Technology, Federal Polytechnic Ayede, Ayede P.M.B 4001

***- Corresponding author**

DOI: https://doi.org/10.51584/IJRIAS.2025.10020028

Received: 26 January 2025; Revised: 06 February 2025; Accepted: 07 February 2025; Published: 11 March 2025

ABSTRACT

In the agroindustry, pesticides are chemicals that are frequently employed to eradicate pests that might harm crops. Despite its benefits for increasing food production, lowering labour requirements for farms, and enhancing public health, pesticides have a negative impact on the sustainability of the environment, animal health, and human health. Food and water containing pesticides when consumed could be toxic to humans and animals, depending on the levels. This study aimed to assess haematological parameters in male wistar rats administered with dichlorvos and carbofuran after 30 days. Male rats were used for consistency and reliability. The animals were sacrificed, blood was collected through cardiac puncture and the blood samples were used to carry out haematological analysis using an autoanalyzer. Erythrocytes, leucocytes and thrombocytes were assessed. The results obtained revealed a decrease in Erythrocytic and leucocytic indices in the pesticide-administered groups as compared with the control group. These reductions could imply a compromised immune system and an increased risk of developing infections. Overall, the findings from this study indicates that exposure to toxicants in foods and water led to perturbations of haematological indices and would therefore recommend regulated use of these pesticides.

Keywords: Carbofuran, Dichlorvos, Erythrocyte, Haematological, Agricultural

INTRODUCTION

Recently, the use of pesticides has increased, for improvement in the quality and quantity of agricultural products. Pesticides are highly toxic compounds for the environment but still are considered to be the most effective means for protecting crops and livestock from pests, insects, nematodes and weeds. In spite of their usefulness, pesticides pose severe threat to natural resources and poisoning to animals and plants. The apprehension regarding these toxic agents is escalating due to their extensive environmental presence (James *et al.,* 2023). Their impact on human health encompasses encephalopathy, peripheral neuropathy, anemia, harm to the liver, kidneys, and brain, neurobehavioral alterations, as well as disruptions in fertility and pregnancy (Mahurpawar, 2015).

Dichlorvos, an organophosphate, is a predominant pesticide used in domestic insect control in developing countries. Acute and prolonged exposure may lead to death, genotoxic, neurological, reproductive, carcinogenic, immunological, hepatic, renal, respiratory, metabolic, dermal and other systemic effects. Its toxicity is due to the ability of the compound to inhibit acetyl cholinesterase at cholinergic junction of the nervous system (Okoroiwu & Iwara).

Carbofuran [2,3-dihydro-2,2-dimetBhyl-7-benzofuranyl N-methyl carbamate] is one of the most toxic broad spectrum, systemic nematicidal, insecticidal and acaricidal carbamate pesticides. (Sharma et al.,, 2012; Gupta *et al.,* 2019). It is extensively used in agricultural practices due to its broad horizon of controlling soil dwelling and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue II February 2025

leaf feeding insects. There have however been concerns about these eco-toxicological, environmental and hazardous health impacts of carbofuran.(Wang *et al.,* 2019; Wang *et al.,* 2020)

Hematological indices, encompassing parameters such as red blood cell (RBC) count, hemoglobin (HGB) concentration, hematocrit (HCT), and white blood cell (WBC) count, serve as crucial indicators of the overall health and physiological status of an organism. Alterations in these indices may signify disruptions in the normal functioning of the hematopoietic system and immune response. This study was therefore carried out to assess haematological indices in male Wistar rats administered with dichlorvos and carbofuran.

MATERIALS AND METHODS

Experimental Design

Fifteen (15) male Wistar rats weighing between 100 - 120g were purchased from a professional rat breeder which were then acclimatized for 2 weeks in plastic cages. The animals were fed and given water ad libitum. They were randomly assigned to different groups; Control, Carbofuran and Dichlorvos with each group having five (5) animals each. Toxicants were administered to them daily depending on their weights for a period of 30 days at their referenced No Observed Adverse Effect Levels (NOAELs). Dichlorvos and Carbofuran were both administered at 0.03mg/kg body weight.

Body weights of rats were recorded initially and at the end of the experiment. All animals were observed daily for the presence of clinical signs of toxicity during the entire period of study. Rats were sacrificed at the end of exposure period. Blood was collected by cardiac puncture from each rat. The blood was centrifuged and the sera were kept for analysis.

Hematological Analysis

5 rats of each group were anaesthetized and blood samples were drawn from the heart of each animal at the end of the experiment. The blood samples were used for haematological analysis. Blood samples were analysed for blood parameters such as red blood cell (RBC) count, hemoglobin (HGB) levels, hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW-CV); Leukocyte count: white blood cell count (WBC), Lymphocytes (LYMPH), monocytes (Mid) and granulocytes (Gran); Thrombocytic indices such as platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW) and platelet crit (PCT) using CELL-DYN 1700 counter (Abbott Hematology Analyser Cell-Dyn 1700, Abbott Laboratories, Abbott Park, Illinois, U.S.A.) in Bolab laboratories.

Statistical Analysis

The results of haematological analysis were presented as the mean ± SD. Comparisons were made between control and toxicant groups using one-way analysis of variance (ANOVA) and Tukey's post-hoc test. Data were analysed using GraphPad Prism version 5. Values of $p \leq 0.05$ were regarded as statistically significant

RESULTS

Table 1 presents hematological parameters including red blood cell (RBC) count, hemoglobin (HGB) levels, hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW-CV) in response to exposure to carbofuran and dichlorvos on red blood cell indices. There was no significant change ($p>0.05$) in RBC, HCT, MCV, MCH, MCHC and RDW-CV. A significant decrease ($p<0.05$) was seen in HGB of the carbofuran exposed group.

Groups	RBC (10^{12}/L)	HGB (g/dL)	HCT (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)	RDW-CV (%)
Control	6.12±0.60[a]	13.37±1.36[a]	35.13±3.11[a]	59.78±1.28[a]	21.98±1.05[a]	38.80±1.08[a]	16.13±0.33[a]

Carbofuran	5.11±0.46[b]	10.77±1.19[b]	30.40±2.12[a]	59.20±0.80[a]	20.93±0.80[a]	33.97±0.75[b]	14.93±0.59[b]
Dichlorvos	5.92±0.80[a]	13.20±0.82[a]	34.53±3.93[a]	57.40±1.14[b]	21.98±1.05[a]	34.83±1.60[b]	16.10±0.32[a]

Table 1 Effect of dichlorvos and carbofuran on red blood cell indices after 30 days of exposure. Values are expressed as mean ± standard deviation for 5 rats and considered significant at $p<0.05$. Values with different alphabets in the column are significantly different at $p<0.05$

Table 2 below show the results for the effects of dichlorvos and carbofuran exposures on white blood cell count (WBC), Lymphocytes (LYMPH), monocytes (Mid) and granulocytes (Gran). No significant difference ($p>0.05$) was observed in all the white blood cell parameters across the groups

Toxicants	**WBC (10^9/L)**	**LYMPH (10^9/L)**	**Mid (10^9/L)**	**Gran (10^9/L)**
Control	10.38±1.30[a]	8.36±1.16[a]	0.78±0.26[a]	1.24±0.55[a]
Carbofuran	6.26±0.95[b]	5.38±1.17[b]	0.4±0.35[a]	0.48±0.47[a]
Dichlorvos	6.46±1.04[b]	4.94±0.35[b]	0.56±0.45[a]	0.96±0.68[a]

Table 2 Effect of dichlorvos and carbofuran on white blood cell indices after 30 days of exposure. Values are expressed as mean ± standard deviation for 5 rats and considered significant at $p<0.05$. Values with different alphabets in the column are significantly different at $p<0.05$

Table 3 below shows the results for the effects of carbofuran, and dichlorvos on platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW) and platelet crit (PCT) after 30 days of exposure. No significant changes ($p>0.05$) was observed in MPV and PDW across the groups. However, there was a significant decrease in PLT in the dichlorvos group and a significant increase in the combined group ($p<0.05$).

Toxicants	**PLT (10^9/L)**	**MPV (fL)**	**PDW**	**PCT (mL/L)**
Control	285.6±10.63[a]	6.46±1.19[a]	16.6±0.82[a]	1.90±0.85[a]
Carbofuran	346.2±25.28[b]	7.26±1.31[a]	15.8±0.54[a]	2.46±0.93[a]
Dichlorvos	223.8±16.78[b]	7.16±0.87[a]	16.24±0.68[a]	1.662±0.27[a]

Table 3 Effect of dichlorvos and carbofuran on thrombocytic indices after 30 days of exposure. Values are expressed as mean ± standard deviation for 5 rats and considered significant at $p<0.05$. Values with different alphabets in the column are significantly different at $p<0.05$

DISCUSSION

Hematological parameters are often evaluated to assess the functional health status and the internal environment of an organism (Salihu *et al*., 2016). Previous studies have shown that exposure to chemicals like pesticides can alter hematological parameters in animals (Singh *et al*., 2010). Our study evaluated the effects of carbofuran and dichlorvos administration on haematological parameters in wistar rats. Erythrocytic results obtained indicated that administration of carbofuran led to a significant decrease in RBC, HGB, MCHC and RDW-CV compared with the control group. Administration of dichlorvos however led to a significant decrease in MCV and MCHC, when compared with the control group. These findings are in agreement with earlier findings of Holy *et al*. in 2015 on administration of dichlorvos and another by Afolabi *et al*. in (2019) on administration of Carbofuran. Leucocytic results obtained revealed that administration of the pesticides significantly lowered the WBC and

Lymphocyte count as well. Previous studies have documented the ability of pesticides to lower leucocyte count. (Gaikwad *et al*., 2015; Uchefuna *et al*., 2024). Thrombocytic evaluation revealed that administration of carbofuran significantly increased the platelets while dichlorvos led to a significant reduction in platelet, compared with the control group. This is in agreement with a study by Edem *et al*., (2012).

RECCOMMENDATION

The results from this study calls for cautious use of pesticides and a possible review of exposure limits by regulatory agencies.

REFERENCES

1. Afolabi, O.K., Oyewo, E.B., Adeleke G.E., Badmus, J.A., Wusu, A.D.(2019). Mitigation of Aluminium Phosphide-induced Hematotoxicity and Ovarian Oxidative Damage in Damage in Wistar Rats by Hesperidin. American Journal of Biochemistry. 9(1): 7-16
2. Edem, V.F., Akinyoola, S.B., Olaniyi, J.A., Rahamon, S.K., Owoeye, O., Arinola, O.G., (2012).Haematological Parameters of Wistar Rats Exposed to 2, 2 Dichlorovinyl Dimethyl Phosphate Chemical. *Asian J. Exp. Biol. Sci 3*(4): 838 – 841
3. Gaikwad Avinash Shivaji, Panjakumar Karunamoorthy, Shridhar Jagannath Kondhalkar, Mala Ambikapathy, Ravichandran Beerappa (2015) Assessment Of Hematological, Biochemical Effects And Genotoxicity Among Pesticide Sprayers In Grape Garden, Journal Of Occupational Medicine And Toxicology.
4. Gupta, R.C., Sachana, M., Mukherjee, I.M., Doss, R.B., Malik, J.K., Milatovic, D., (2018). Organophosphates and carbamates, in: Gupta, R.C. (Ed.). Elsevier, Amsterdam, Netherlands, pp. 495-508.
5. Holy B., Kenanagha B., Onwuli D.O. (2015) Haemato-pathological effects of dichlorovos on blood picture and liver cells of albino rats. J. Toxicol. Environ. Health Sci.;7:18–23
6. James J.G., Dylan G.S., Monique J.W., David G.Z., Robert R. & Yaritza T. (2023). Toxic agents and health disparities in the socially marginalized. *Encyclopedia of Toxicology*, 9, 169-176.
7. Mahurpawar, M. (2015). Effects of heavy metals on human health. *International Journal of Research - granthaalayah*, 530(516), 1-7.
8. Okoroiwu H. U. & Iwara A. I., (2018). Dichlorvos toxicity: A public health perspective Interdiscip Toxicol.; 11(2): 129–137. Published online 2019 Mar 2. doi: 10.2478/intox-2018-0009
9. Owoeye, O., I.A Adedara, O. S. Bakare, O.A Adeyemo, C. Egun & E.O Farombi (2014) Kolaviron and vitamin E ameliorate hematotoxicity and oxidative stress in brains of prepubertal rats treated with an anticonvulsant phenytoin. *Toxicology mechanisms and methods.* 24(5): 353-361.
10. Salihu, M., M.A Salleh, S.I, Abdelwahab, A.M., S.A Majid, S.M. Wahab & S.N.A Halim (, 2016) 6-Gingerol-rich fraction from Zingiber officinale prevents hematotoxicity and oxidative damage in kidney and liver of rats exposed to carbendazim. *Journal of dietary supplements*. 13(4): . 433-448.
11. Sharma, R.K., Jaiswal, S.K., Siddiqi, N.J., Sharma, B., 2012a. Effect of carbofuran on some biochemical indices of human erythrocytes in vitro. Cell Mol Biol (Noisy-le-grand) 58, 103-109.
12. Singh, N.N. & A.K. Srivastava,(2010) Haematological parameters as bioindicators of insecticide exposure. *Journal of Environmental biology,*. 19(5): 838-854.
13. Uchefuna Roy Chinwuba, Nnakife Jessica Chi-amaka, Ezeokafor Emmanuel Nonso, Ebisintei Precious, Nwaefulu Kester E., Ike Chibueze Jeremiah, Onwuka Kelechi Collins, Nsofor Cordelia Uche, Augustine Wisdom Ehimen, Aralu Obed Chiwendu. Biochemical And Hematological Changes In Male Wistar Rats Following Subacute Exposure To Pesticide
14. Wang, J., Zhang, X., Ma, H., & Zhu, Y. (2019). Oxidative stress induced by cypermethrin in rat liver. Pesticide Biochemistry and Physiology, 154, 66-72.
15. Wang, Q., Zhai, Y., & Li, Y. (2020). Phytoremediation of carbofuran-contaminated soil using plant species with detoxification abilities. Environmental Science and Pollution Research, 27(20), 25482-25491.