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Research Article

Effect of Lara Force® on the Haematological Parameters of *Clarias gariepinus*

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ABSTRACT
This study investigated the effects of Lara Force® a commercially available pesticide composed of Lambda-Cyhalothrin and Imidacloprid on the haematological parameters of *Clarias gariepinus*. The *Clarias gariepinus* were exposed to varying concentrations of the pesticide in controlled bioassays, with both acute (24-hour) and extended (21-day) exposure periods. Detailed haematological assessments, including measurements of haemoglobin concentration, packed cell volume, mean corpuscular volume, red and white blood cell counts, and differential leukocyte percentages, were performed to determine physiological alterations. The results indicate significant disruptions in blood parameters, suggesting that the fish initiate compensatory mechanisms to counteract pesticide-induced stress, while deteriorating water quality evidenced by increased acidity and reduced dissolved oxygen, compounds these effects. The study highlights the threats posed by pesticide contamination, which are direct physiological stress on aquatic organisms. These findings underscore the urgent need for stricter pesticide regulations, integrated pest management strategies, and continuous environmental monitoring to protect aquatic ecosystems and sustain fish health.

Keywords: *Clarias gariepinus*; Effect; Fish; Haematological parameters; Health; Lambda-Cyhalothrin

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INTRODUCTION

Pesticides are any substance, or mixture of chemicals or biological ingredients intended for repelling, destroying or controlling any pest, or regulating plant growth (The world health organization WHO 2020; WHO 2021). Pesticides pose significant environmental risks to both humans and animals as they accumulate and concentrate within the food chain (Khan *et al.,* 2023). They can enter the environment through agricultural runoff, industrial pollution, and improper disposal of pesticide containers (Tudi *et al.,* 2021; Ray and Shaju, 2023). Changes in water quality due to pesticide exposure can stress fish and make them more susceptible to diseases, potentially leading to physiological changes, including variations in haematological and biochemical markers (Inyang *et al.,* 2018). Generally, pesticides are intended to manage and eradicate pests. Their widespread application for this purpose is recognized worldwide, with some studies emphasizing their advantages, particularly in vector control (WHO 2021). Blood, a vital fluid, consists of water, electrolytes, nutrients, proteins, and other substances, and plays a crucial role in transporting nutrients and oxygen throughout the body while eliminating metabolic waste and contributing to the body's defense systems (Ochei and Kolharker, 2003). Pesticides can linger in the environment for a long period and accumulate in living system is one of the key issues with their usage (Khan *et al.,* 2023; Mohammed *et al.,* 2020). Many chlorinated pesticides do not break down readily even under natural processes or sunlight. This slow degradation means that these substances continue to exist in both freshwater and marine settings, gradually accumulating in the tissues of animals (Ibrahim *et al.,* 2022; Adamu *et al.,* 2022). For example, fish absorb these chemicals directly from polluted water or by consuming contaminated food, making them clear indicators of environmental pollution (Mohammed and Adamu 2019; Mohammed *et al.,* 2020).

Fish serve as effective model organisms for ecotoxicological assessments because of their close relationship with their aquatic surroundings, meaning any environmental changes are likely to be reflected in their haematological profiles (Ayanwale *et al.,* 2020: Ajang *et al.,* 2024). Aquatic species, especially fish, are particularly vulnerable to pesticide contamination (Adamu *et al.,* 2021). The high lipophilicity of pyrethroids leads to significant absorption through the gills, which increases fish sensitivity to exposure from aqueous pyrethroids. Research has shown that fish display various stress indicators when exposed to pesticides (Ajang *et al.,* 2024). Haematological evaluations can offer important insights into the health and condition of both wild and farmed fish. Other studies have indicated that the haematological effects of contaminant exposure can vary based on factors such as species, age, reproductive cycle, and overall health (Vaiyanan *et al.,* 2015). Given the extensive application of Lara Force in agricultural and public health contexts, this research aims to explore alterations in the haematological parameters of *Clarias gariepinus* subjected to varying concentrations of Lara Force.

MATERIALS AND METHODS

Sample collection

Fish samples were sourced from a hatchery farm located in Abuja and were transported biological mini garden of Ibrahim Badamasi Babangida university, Lapai Niger State Nigeria where they were kept and allowed to acclimate for fourteen (14) days, prior to commencement of the experiment

The exposure experiment

The exposure experiment was conducted in a glass tank following a 5 × 2 Complete Randomized Block Design. A total of two hundred (200) juvenile *Clarias gariepinus* were utilized throughout the study. Before the experiment commenced, twenty-five (25) juvenile of the test fish were placed in each tank, which held 50 liters of water, and the setup included two replicates. The tanks were configured to have a control group (0) and three (3) exposure concentrations of Lara Force® (0.02 mg/L, 0.04 mg/L, and 0.06 mg/L). The water and test solutions in the tanks were refreshed every 72 hours, and the fish were fed at the same interval to ensure sufficient blood samples could be collected for haematological analysis. The fish were exposed to the varying concentrations of Lara Force® for a total of 21 days, and they were not fed prior to blood collection (Kanu *et al.,* 2023). Blood samples for haematological analysis were obtained via the caudal vein from each fish using a 23G needle and syringe. These samples were stored in EDTA bottles before being sent to the laboratory for analysis. Blood samples for haematological evaluation were taken every 7 days, measuring parameters such as erythrocyte count, haematocrit, haemoglobin content, total protein content in blood plasma, red blood cells, white blood cells, and packed cell volume.

Haematological analysis

The fishes were anaesthetized in five (5) litres of well-water containing 0.2 g of benzocaine, which had been dissolved in 5 ml acetone. Blood was drawn from the posterior caudal vein according to Schmitt et al. (1999) and 2 ml was decanted in heparinized bottles for red blood cell count (RBCC), haematocrit (PCV), haemoglobin (Hb) and white blood cell count (WBCC). The haemoglobin (Hb), haematocrit (PCV), Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), Red blood cell count (RBCC), Platelet count (PLC), Total white blood count (TWBC), Neutrophil N(%) and Lymphocyte L(%) were analyzed using standard methods as described by Jain (1986). MCV was calculated in femtoliters = PCV/RBC x 10, MCH was calculated in picograms = Hb/RBC x 10 and MCHC = (Hb in 100mg blood / Hct) x 100.

Data Analysis

Descriptive statistics (Mean± standard deviation) were carried out on the haematological data obtained. ANOVA was used to test for the significance difference in the changes in haematological parameters between the duration of exposure and also between the different treatments at 0.05 level of significance. All analysis were carried out using paleontological statistical software (PAST version 4.0).

RESULTS

The result of the haematological parameters of *Clarias gariepinus* exposed to different concentration of Lara force® at 24hours is shown in Table 1. The result shows significant different in haemoglobin (Hb), haematocrit (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), Red blood cell count (RBCC), platelet count (PLC), total white blood count (TWBC) and Neutrophil N(%)in the control treatment and fish treatment exposed to different concentration of Lara force® at 24hours while the Lymphocyte L(%)of the fishes shows no significant different between the control and different concentration of Lara force® at 24hours. The result of the haematological parameters of *Clarias gariepinus* exposed to Lara force® at 21 days is shown in Table 2. The result shows significant different in haemoglobin (Hb), haematocrit (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet count (PLC), total white blood count (TWBC), Neutrophil N(%) and Lymphocyte L(%) in the control treatment and fish treatment exposed to different concentration of Lara force® at 21days while Red blood cell count (RBCC) of the fishes shows no significant different between the control and different concentration of Lara force® at 96hours.

DISCUSSION

The haematological analysis of *Clarias gariepinus* exposed to Lara force® reveals pronounced changes in blood parameters that indicate direct toxic effects and the initiation of compensatory physiological mechanisms. The haemoglobin (HB) values ranged from 17.61 ± 0.53 g/dL to 29.52 ± 0.89 g/dL, with the highest value recorded in T3-1 and the lowest in T1-2. This wide range strongly suggests that pesticide exposure disrupts the normal oxygen-carrying capacity of the blood. Such disruption could lead to conditions like anemia or, alternatively, provoke a compensatory increase in HB to ensure sufficient oxygen delivery to tissues (Gajula *et al.,* 2025). It also indicates that the fish may be mounting a compensatory response to counteract pesticide-induced hypoxia (Burtscher *et al.,* 2022), which could adversely affect overall metabolism and energy production in these organisms (Chen & Luo, 2023).

Packed Cell Volume (PCV) and Mean Corpuscular Volume (MCV) further elucidate the impact of pesticide exposure on the blood cell profile. PCV values, which represent the percentage of blood volume occupied by red blood cells, varied from 29.00 ± 0.87% in T1-1 to 39.00 ± 1.17% in T3-2. An increase in PCV may point to an elevated red blood cell production or changes in blood viscosity, potentially affecting circulation and tissue perfusion (Sinha *et al.,* 2022). In the same vien, MCV values ranged from 80.00 ± 2.40fi to 103.00 ± 3.09fi, with the largest cells observed in T3-2. This increase in MCV may signal stress-induced alterations or impaired erythropoiesis, the process of forming new red blood cells (Sudnitsyna *et al.,* 2020). Furthermore, changes in overall blood cell counts, including an increase in Red Blood Cell Count (RBC) from 7.22 ± 0.22 x 10^{12}/L in the control to 9.34 ± 0.28 x 10^{12}/L in T2-1, and a dramatic rise in Total White Blood Cell Count (TWBC) from 15.21 ± 0.46 x 10^{12}/L in the control to 49.21 ± 1.48 x 10^{12}/L in T3-2, reflect an active immune response. Differential counts showing variations in neutrophil (46.00 ± 1.38% to 59.00 ± 1.77%) and lymphocyte (35.00 ± 1.05% to 43.00 ± 1.29%) percentages further suggest that the immune system is being activated as a defense mechanism against the xenobiotic-induced damage (Little *et al.,* 2020; Gwozdzinski *et al.,* 2021; Chu *et al.,* 2023; Subaramaniyam *et al.,* 2023).

The haematological findings provide a comprehensive picture of how Lara force® disrupts both the internal physiology of *Clarias gariepinus* and the integrity of its aquatic environment. The observed alterations in blood parameters, including increased haemoglobin levels, variations in PCV and MCV, and shifts in red and white blood cell counts, demonstrates the fish's attempts to compensate for reduced oxygen transport and heightened immune challenges. Deteriorating water quality such as acidification, increased ionic concentrations, and lower dissolved oxygen further compounds the stress on these organisms, impairing their homeostatic functions and overall fitness. These results underscore the dual threat posed by pesticide exposure, not only through direct toxic effects but also by triggering compensatory mechanisms that may eventually fail under prolonged stress. The findings correlate with previous research, as highlighted by Amaeze *et al.,* (2020) who reported alterations in haematological parameters and induction of genotoxic effects in *C. gariepinus* for all pesticides assessed, and by Kanu *et al.*, (2023) who observed that the toxic effects of pulse exposure were largely reversible by day 14. This study, using *C. gariepinus* and *O. niloticus*, demonstrates that even brief exposure to high pesticide levels can be as hazardous as continuous exposure, emphasizing the urgent need for improved monitoring and management strategies.

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Table 1: Haematological Parameters of *Clarias gariepinus* Exposed to Lara force® at 24hours

Sample	HB (g/dL)	PCV (%)	MCV (fi)	MCH (pg)	MCHC (g/dL)	RBCC (10^{12}/L)	PLC (10^6/L)	TWBC (10^{12}/L)	N (%)	L (%)
Control 1	23.02±0.69a	36.00±1.08^b	86.00±2.58^a	45.00±1.35^a	43.00±1.29^a	7.22±0.22^a	139.00±4.17^a	15.21±0.46^a	49.00±1.47^a	35.00±1.05^a
T1-1	25.32±0.76^b	29.00±0.87^b	89.00±2.67^a	43.00±1.29^a	47.00±1.41^b	7.89±0.24^a	144.00±4.32^b	19.32±0.58^b	56.00±1.68^b	39.00±1.17^a
T2-1	28.40±0.85^c	31.00±0.93^a	87.00±2.61^a	41.00±1.23^a	49.00±1.47^b	9.34±0.28^b	148.00±4.44^b	23.71±0.71^c	52.00±1.56^b	37.00±1.11^a
T3-1	29.52±0.89^c	37.00±1.11^b	92.00±2.76^b	53.00±1.59^b	57.00±1.71^c	9.12±0.27^b	155.00±4.65^c	31.46±0.94^d	59.00±1.77^b	40.00±1.20^a

Concentrations of Lara Force® (T1-1=0.02mg/L, T2-1=0.04 mg/L, and T3-1=0.06 mg/L) Values are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences ($p < 0.05$) based on three-way ANOVA and Tukey's post-hoc test.

Table 2: Haematological Parameters of *Clarias gariepinus* Exposed to Lara force® at 96hours

Sample	HB (g/dL)	PCV (%)	MCV (fi)	MCH (pg)	MCHC (g/dL)	RBCC (10^{12}/L)	PLC (10^6/L)	TWBC (10^{12}/L)	N (%)	L (%)
Control	24.75±0.74^b	38.00±1.14^b	82.00 ± 2.46^a	48.00±1.44^a	45.00±1.35^a	7.98±0.24^a	134.00±4.02^a	17.94±0.54^a	46.00±1.38^a	38.00±1.14^b
T1 2	17.61±0.53^a	34.00±1.02^a	80.00 ± 2.40^a	46.00±1.38^a	43.00±1.29^a	8.19±0.25^a	138.00±4.14^a	33.18±1.00^b	53.00±1.59^b	40.00±1.20^c
T2 2	20.82±0.62 ^{b}	35.00±1.05^b	84.00 ± 2.52^a	47.00±1.41^a	46.00±1.38^a	8.93 ± 0.27^a	133.00±3.99^a	42.47±1.27^c	50.00±1.50^b	35.00±1.05^a
T3 2	26.43±0.79 ^{b}	39.00±1.17^b	103.00±3.09^b	54.00±1.62^b	59.00±1.77^b	8.46 ± 0.25^a	146.00±4.38^b	49.21±1.48 ^{c}	55.00±1.65^b	43.00±1.29^c

Concentrations of Lara Force® (T1-2=0.02mg/L, T2-2=0.04 mg/L, and T3-2=0.06 mg/L) Values are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences ($p < 0.05$) based on three-way ANOVA and Tukey's post-hoc test.

CONCLUSION

This study revealed that exposure of *Clarias gariepinus* to pesticide Lara force® significantly alters the fishes haematological profiles. Simultaneously, blood parameters such as haemoglobin, packed cell volume, and white blood cell counts exhibit marked fluctuations, reflecting stress, compensatory mechanisms, and immune activation. These changes threaten fish health and ecosystem stability, emphasizing the urgent need for stricter pesticide regulations, integrated pest management, and continuous monitoring. Adopting sustainable practices is absolutely essential to safeguard aquatic environments and mitigate the adverse effects of chemical pollutants

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