ISSN: 2642-9020

Mini Review Article

Journal of Marine Science Research and Oceanography

Toxic Effect of Ladosulfan-Pesticides on Biochemical Indices of *Clarias Gariepinus* (Burchell 1822) Juveniles

Helen Ogochukwu Nwamba[1]*, Christopher Didiugwu Nwani [2], Victor Stephen Njom[1], Emeka Ezenwa Ogamba[1]

[1]*Department of Applied Biology, Enugu State University of science and Technology*

[2]*Department of Zoology and environmental Biology, University of Nigeria Nsukka*

***Corresponding author**
Helen Ogochukwu Nwamba, Department of Applied Biology, Enugu State University of science and Technology

Submitted: 21 Aug 2020; **Accepted:** 24 Aug 2020; **Published:** 28 Sept 2020

Abstract

ladosufan is an insecticide extensively used in agriculture for pest control. The 96h LC50 estimated from probeit analysis was 1.89mg/L. Sub lethal concentrations of 1/10th (0.19 mg/L),1/5th (0.49mg/L) and 1/2th (0.95mg/L) of LC50 were used to determine the effects of the ladosulfan -pesticide on biochemical parameters at day 1, 7, 14 and 21exposure periods. Water quality test was determined on pH, temperature, dissolved oxygen, hardness and alkalinity. The results show that biochemical parameters viz; Total Protein, Alkaline Phosphatase ALP, Alanine Transferase ALTAspartate Amino Transferase (AST) concentrations increased significantly ($P \leq 0.05$) in time and concentration dependent manner. The biochemical parameters concentration had higher values in treated samples than control. The total protein increased from (8.80±0.002b -9.20±0.103b) at 0.19 mg/L, (9.20±0.102a –9.70±0.103c) at 0.48 mg/L and (9.27±0.152a –9.80±0.103c) at 0.95 mg/L of ladosulfan when compared with the control (7.67±0.931c –9.06±0.763c); Alkaline Phosphatase increased from (60.00±0.002a -86.00±1.001b) at 0.19 mg/L, (62.00±1.002b –88.00±1.001c) at 0.48 mg/L and (65.00±1.001a –92.00±1.002d) at 0.95 mg/L of endosulfan when compared with the control (40.00±1.002a –53.67±5.511a) ; Alanine Transferase also increased from (30.00±1.002a -40.00±1.001c) at 0.19 mg/L, (35.00±1.002a –54.00±1.001a) at 0.48 mg/L and (38.00±1.002b –89.00±1.001d) at 0.95 mg/L of ladosulfan when compared with the control (22.33±2.083c –27.33±2.882b) ; Aspartate Amino Transferase increased from (64.00±1.002b -87.00±1.001c) at 0.19 mg/L, (66.00±1.002c –88.00±2.001d) at 0.48 mg/L and (68.33±0.582c –90.00±1.001d) at 0.95 mg/L of ladosulfan when compared with the control (63.00±2.002b –68.00±1.001b) ; respectively. The results indicate that commercial formulation of ladosulfan is toxic to C. gariepinus, the insecticide should be prudently used in both terrestrial and aquatic eco-systems to avoid eco-toxicological hazards.

Keywords: *Clarias gariepinus*, Ladosulfan, Effects, Biochemical Parameters

Introduction

Ladosulfan is abroad-spectrum insecticide which is one of the most frequently applied pesticides in agriculture for the control of a great variety of annual, biennial and perennial terrestrial aquatic weeds and woody shrubs [1]. Ladosulfan is used widely in the rural communities, highly toxic to aquatic animals, miscible with water at pH 4.5 for 1% solution, boils at 113°C, having vapor pressure 1.9. 10-3 Pa at 25°C indicating increased loss to the atmosphere from treated surfaces [2-4]. It is washed from nearby farm lands and accidental discharges into aquatic systems and may contribute to long term eco-toxicological effects to non-target aquatic organisms [5]. Due to affordability, availability and solubility of ladosulfan herbicide, its utilization has increased in recent years in Africa. It then became necessary to study the lethal toxicity and biochemical stress of the herbicide on local species like catfish which will help in formulating the strategies for safeguarding aquatic organisms.

Catfish (order siluriformes) are a very diverse group of bony fish. They are named for the barbells (whiskers) around their mouths like cats. They have scale less skin, fleshy ray less posterior fins and sharp defensive spines in the shoulder and dorsal fins. Catfishes are highly esteemed group of fishes, they have high growth rate, commands high market value as they form part of food chain, hardy in nature as they possesses air breathing organs that enables them tolerate difficult aquatic conditions. The present study thus aims at the determination of the biochemical response of ladosulfan on juveniles of *Clarias gariepinus*.

Materials and Methods

450 specimens of *Clarias gariepinus* (Family: Clariidae) juveniles were bought from Sacem fish farm and transported to Applied Biology Special Laboratory Agbani, ESUT, Enugu State, for the investigation. The fish were acclimatized for fourteen days in plastic tanks.

During the acclimation period, juveniles were fed twice daily with Coupons feed (2mm) at 3% body weight. Feeding was terminated 48hrs before the experiment to empty their stomach and avoid pollution of the water with their faeces. The test was conducted using a semi-static bioassay in 40L glass aquaria (60x30x30cm). A range finding test was carried out prior to determine the concentrations of the test solution for the definitive test. This was determined by subjecting juveniles of *Clarias gariepinus* to different concentrations of ladosulfan. Six different ladosulfan concentrations (1.63, 1.73, 1.83, 2.00, 2.20, and 2.40) mg/L were selected for definitive exposure after a series of range findings. A set of 10 specimens of *C. gariepinus* juvenile were randomly exposed to each of the selected concentrations and set in triplicates. Simultaneously, another set of 10 fish specimens was maintained as control in triplicate under the same conditions but contained only tap water. The test solution was renewed on alternate days to maintain the concentration of the chemicals.

The experiment lasted for 4 days and involved 2 phases: Monitoring and recording of water quality parameters and also monitoring and recording the cumulative mortalities of the juveniles under different concentrations of ladosulfan. Mortalities and survival were determined at 24, 48, 72 and 96 hours of exposure period. Dead fishes were removed to avoid pollution. The median lethal concentration (LC_{50}) value was determined following the probiet analysis method described by Finney (1971) [27]. Sub lethal concentrations of $1/10^{th}$ (0.19 mg/L),$1/5^{th}$ (0.49mg/L) and $1/2^{th}$ (0.95mg/L) of LC_{50} were used to determine the effects of the ladosulfan -pesticide on biochemical parameters at day 1, 7, 14 and 21 exposure periods in triplicates.

Biochemical assay serum was used throughout the biochemical assay to determine total Protein by folinphenol reaction method as described by Lowry et al., [25], Alanine Transferase (ALT) was determined following the methods described by Reitman and Frankel (1957), Alkaline Phosphatase (ALP) was determined using Continuous Assay Method as described by Gouri, et al., Aspartate Amino Transferase (AST). The determination of AST was done according to the method of calorimetric assay as described by Reitman and Frank using Randox kit [26].

The data obtained were statistically analyzed by statistical package SPSS (Version 17). The data were subjected to one-way Analysis of Variance (ANOVA) and Duncan's multiple range test to determine the significance difference at 5% probability level.

Results

The water temperature ranged from 26.90 to 27.6°C during the experimentation. The pH of the water ranged from 7.00 to 7.29 which was slightly higher than neutral. Dissolved oxygen varied from 6.00 to 6.08mgI-1. The conductivity value ranged from 10-20ppm during the experimental period. The LC50 values (with 95% confidence limits) of 1.891 mgI-1. The results of effects of ladosulfan on biochemical parameters are shown on Table 1. The total protein increased from (8.80±0.002b -9.20±0.103b) at 0.19 mg/L, (9.20±0.102a –9.70±0.103c) at 0.48 mg/L and (9.27±0.152a –9.80±0.103c) at 0.95 mg/L of ladosulfan when compared with the control (7.67±0.931c –9.06±0.763c); Alkaline Phosphatase increased from (60.00±0.002a -86.00±1.001b) at 0.19 mg/L, (62.00±1.002b –88.00±1.001c) at 0.48 mg/L and (65.00±1.001a –92.00±1.002d) at 0.95 mg/L of endosulfan when compared with the control (40.00±1.002a –53.67±5.511a) ; Alanine Transferase also increased from (30.00±1.002a -40.00±1.001c) at 0.19 mg/L, (35.00±1.002a –54.00±1.001a) at 0.48 mg/L and (38.00±1.002b –89.00±1.001d) at 0.95 mg/L of ladosulfan when compared with the control (22.33±2.083c –27.33±2.882b) ; Aspartate Amino Transferase increased from (64.00±1.002b -87.00±1.001c) at 0.19 mg/L, (66.00±1.002c –88.00±2.001d) at 0.48 mg/L and (68.33±0.582c –90.00±1.001d) at 0.95 mg/L of ladosulfan when compared with the control (63.00±2.002b –68.00±1.001b) ; respectively. There were concentration and duration dependent significant ($P \leq 0.05$) increase in total protein, alkaline phosphatase, alanine transferase, aspartate amino transferase at day 1, 7, 14 and 21 at 0.19,0.48 and 0.95mg/L of ladosulfan.

Discussion

Alteration in the concentrations of the biochemical parameters is certain in this research. These alterations have detrimental effects on vital organs where the biochemical parameters perform physiological functions. Alanine transaminase, alkaline phosphatase, are indicators of liver function, creatinine activity portrays kidney health, bilirubin indicates free radical levels in the body of the fish, glucose concentration indicates pancreatic condition of the fish. All these parameters play vital role in metabolic activities of the fish. The results from this research therefore show that ladosulfan can affect many functional organs of fish and possibly affect other organisms that consume fish in the food chain. These reports are in agreement with the following reports; biochemical responses can be applied to determine water quality requirements and safe lethal concentrations for fish life. Physiological changes are the most sensitive indicators of potential toxic effects in fishes [6-9]. The observed physiological changes in the studied formulation of ladosulfan are consistent with previous reports on some herbicides and also pesticides like malathion, chlorpyriphos; profenofos, Nwamba and Ajima [15] *endosulfan* and *endosulfan*, Pragatheeswaram et al., [18], posited that such abnormal and altered physiological characteristics are considered to be the result of excessive elimination of skeletal minerals while Pandy et al., [14], shifted the secretion of mucus over the body and dispigmentation to the function of the endocrine gland under toxic stress resulting to aberrations in the number and area of mucus gland and chromatophores [10-20]. It is however important to note that physico-chemical parameters (temperature, pH, dissolved oxygen), size and age, type of species, water quality, concentration and formulation of test chemicals can affect the toxicity of chemicals to aquatic organisms [21-23].

Conclusion

It was concluded from the present study that the commercial formulation of ladosulfan is toxic to *C. gariepinus.* Most of the physiological abnormalities were recorded mainly at the higher concentrations. The herbicide should be prudently used in both terrestrial and aquatic eco-systems to avoid eco-toxicological hazard. More studies related to toxicity in *C.gariepinus* exposed to ladosulfan and its formulations are necessary to understand the oxidative stress and hematological effects on this fish [24-26].

Acknowledgement

The authors wish to thank the Tertiary Education Trust Fund (TETFund) Nigeria, and the management of Enugu State University of Science and Technology (ESUT) for the grant received and office space provided for the research.

Table 1: Biochemical parameters of clarias gariepinus exposed to different concentraions of ladosulfan-pesticides

Parameter	Concentration (ug/l)	Exposure Duration (Days)			
		DAY 1	DAY7	DAY14	DAY21
AST	Control	63.00±2.002b	65.00±2.002b	67.67±3.051a	68.00±1.001b
	0.19	64.00±1.002b	80.00±1.002b	84.38±2.082b	87.00±1.001c
	0.48	66.00±1.002c	86.00±1.002d	87.00±2.643c	88.00±2.001d
	0.95	68.33±0.582c	88.33±0.582d	89.33±1.533c	90.00±1.001d
ALT	Control	22.33±2.083c	25.33±2.083a	26.33±3.051a	27.33±2.882b
	0.19	30.00±1.002a	38.00±1.002b	39.00±2.642b	40.00±1.001c
	0.48	35.00±1.002a	43.00±1.002b	45.33±3.213c	54.00±1.001a
	0.95	38.00±1.002b	68.00±1.002c	81.33±1.523d	89.00±1.001d
ALP	Control	40.00±1.002a	59.00±1.002a	60.00±2.002a	53.67±5.511a
	0.19	60.00±0.002a	60.00±0.002a	81.33±1.533b	86.00±1.001b
	0.48	62.00±1.002b	62.00±1.002b	83.00±3.003c	88.00±1.001c
	0.95	65.00±1.001a	68.00±1.001a	90.67±0.583d	92.00±1.002d
TOTAL PROTEIN	Control	7.67±0.931c	7.68±0.931c	7.70±1.132d	9.06±0.763c
	0.19	8.80±0.002b	8.88±0.002b	9.13±0.151c	9.20±0.103b
	0.48	9.20±0.102a	9.30±0.102a	9.63±0.251b	9.70±0.103c
	0.95	9.27±0.152a	9.47±0.152b	9.66±0.151b	9.80±0.103c

Note: Values with different alphabetic superscripts differ significantly ($p < 0.05$) between exposure durations. Values with different numeric superscripts differ significantly ($p < 0.05$) between concentrations within exposure duration.

References

1. Tsui MT, LM Chu (2008) Environmental fate and non- target impact of herbicide in as tropical wet land. Chemosphere 71: 439-446.
2. WHO, World Health Organization (1994) SHARP SHOOTER. Environ health Criteria 159.
3. USEPA, US Environmental protection eligibility Decision (RED): SHARP SHOOTER. US Environmental protection Agency, office of Prevention, Pesticides and Toxic Substances.
4. Battaglin WA, CK Rice, MJ Foazio, S Salmos, RX Barry, et al. (2009) The occurrence of herbicide, insecticide and other pesticides in vernal pools and adjacent streams in Washington DC, Mary land, lowa and Wyoming 2005-2006. Environ. Monit Assess 155: 281-307.
5. Pesce S, C Fajon, C Bardot, F Bannemoy, C Portelli, et al. (2008) Longitudinal changes in microbial plank tonic communities of a French river in relation to pesticide and nutrient in puts. Aquat Toxicol 86: 352-360.
6. Christopher DidigwuNwani, waziranghlakra, Naresh Sahebrao Nagpure, Ravinda Kumar, Basedeo Kushwaha, et al. (2010) Toxicity of Herbicide Atrazine: effect on lipid peroxidation and activities of antioxidant enzymes in the fresh water fish Channapunctus (Bloch). International journal of Environmental research public health 7: 3298-33122.
7. Christopher DidigwuNwani, waziranghlakra, Naresh Sahebrao Nagpure, Ravinda Kumar, BasedeoKushwaha, et al (2010) Lethal concentration and toxicity stress of carbosulphan, Glyphosphate and Atrazine to fresh water air breathing fish Channapunctus (Bloch). International aquatic research 2: 105-111.
8. Christopher DidigwuNwani, UduIbiamAma, Florence Okoh, UcheObasi Oji, Rebecca ChimaOgbonyealu, et al. (2013) Acute toxicity of the chloroacetanilide herbicide butaclor and its effects on the behavior of the fresh water fish Tilapia Zilli. African journal of Biotechnology 12: 499-503.
9. Banaee M, A Sureda, AR Mirvaghefi, K Ahmadi (2011) Effects of diazinonon biochemical parameters of blood in rainbow trout (Oncorhynchusmykiss). Pest Biochem Physiol 99: 1-6.

10. Lushchak O, O Kubrak, JM Storey, KB Storey, Lushchak, et al. (2009) Low toxic herbicide Round up in ducesmildoxidattive stressing old fish tissue. Chemosphere 76: 932-937.

11. Nwani CD, WS Lakra, NS Nagpure, R Kumar, B Kushwaha, et al. (2010) Mutagenic and genotoxic effects of Carbosulfan in fresh water air-breathing fish Channapunctatus (Bloch) using micro nucleus assay and alkaline single-cell gel electrophoresis. Food and Chem Toxicol 48: 202-208.

12. Shiogiri NS, MG Paulino, SP Carraschi, FGB Araldi, CCruz, et al. (2012) Acute exposure to herbicide affects the gills and liver of the Neotropical fish, piaractusmesopotamicus. Environ Toxicol. Pharmcol 34: 388-396.

13. Ali D, NS Nagpure, S Kumar, R Kumar, B Kushwaha, et al. (2009) Assessment of geno toxic and mutagenice effects of Chlorpyriphos in fresh water fish (Channapunctatus (Bloch) using micro nucleus assay and alkaline single-cellgel electrophoresis. Food Chem Toxicol 47: 650-656.

14. Pandey AK, NS Nagpure, SP Trivedi, R Kumar, B Kushwaha, et al. (2011) Investigation on acute toxicity and behavourial changes in Channapunctatus (Bloch) due to organophoshate pesticide profenofos. Drug Chem. Toxicol 34: 424-428.

15. Nwani CDNS, Nagpure R, Kumar B, Kushwaha P, WS Lakra (2011) Mutagenic and geno-toxic assessment of herbicide to fresh water fish Channapunctatus (Bloch) micronucleus test and single cell gel electrophoresis. Environ ToxicolPharmacol 31: 314-322.

16. Chang J, S Liu, S Zhou, Wang, G Zhu, et al. (2011) Effects of Sharp shooter on reproduction and hormone levels in adult zebra fish (Daniorerio). Exp Toxicol Pathol.

17. Pandey A, GK Kunwara, JSD Munshi (1990) Integumentary chromatophores and mucus glands of fish as indicator of heavy metal pollution. J Fresh water Biol 2: 117-121.

18. Kumar R, NS Nagpure, B Kushwaha, SK Srivastava, WS Lakra, et al. (2009) Investigation of the genotoxicity of malathion to fresh water teleost fish Channapunctatus (Bloch) using the micro nucleus test and come tassay. Arch Environ Contam Toxicol 58: 123-130.

19. Gupta PK, BS Khangarot, VS Durve (1981) The temperature dependence of the acute toxicity of copper to a fresh water ponds nail, Viviparous bengalnsis L. Hydrobio logia 83: 461-464.

20. Young RA (2000) Health and Safety Research Division, Oak Ridge National laboratory, oak Ridge, Tennessee.

21. Pavan K, R Kumar, NS Nagpure, P Nautyal, A Dabas, et al. (2012) Genotoxic and mutagenic assessment of herxavalent chromium in fish following in vivo exposure. Human Ecol Risk Ass 18: 858-870.

22. Lmegaard N, GAJM Jagers, OP Akkerhuis (2000) Ministry of environment and Energy, National Research institute, safety Factors in Pesticide Risk Assessment. Differences in species Sensitivity and Acute- Chronic Relations NERI Technical Report 325.

23. Giesy JP, S Dobson, KR Solomon (2000) Eco-toxicological risk assessment for Round up herbicide. Rev Environ Contam Toxicol 167: 35-120.

24. Sprague JB (1971) Measurement of pollutant toxicity to fish I. Bio assay methods for acute toxicity. Water Test 3: 793-821.

25. Lowry OH, Rosebrough NJ, Farr AL, Radall Rl (1951) Protein measurement with folin phenol reagent. J Biol chem 193: 263-275.

26. Reitmann S, Frankel S (1957) A colorimetric method for determination of scrum glutamate oxaloacetate and glutamic pyruvate transaminase. American Journal of Clinical pathology. 28: 56-63.

27. Finney DK (1971) Probit analysis. Third edition, Cambridge: Cambridge University Press 333.