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Effect of Concentrations of Vestaline®(Pendimethalin) Herbicide on Growth Performance of *Clarias gariepinus* Juveniles

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Abstract: The study was carried out to determine the Effect of Concentrations of Vestaline®(Pendimethalin) herbicide on Growth Performance of *Clarias gariepinus* juveniles. The toxicity test was carried out using 180 healthy fish of mean weight 27.97±0.03g which were divided into six treatments with each treatment having ten fish and the setup was in triplicate. The fish were exposed to 0mg/l (control), 1.89mg/l, 3.79mg/l, 5.68mg/l, 7.57mg/l and 9.46mg/l) concentrations of Vestaline®(Pendimethalin) herbicide for eight weeks during which the fish were fed at 3% of their body weight twice daily and weights measured weekly. Data obtained were subjected to analysis of variance (ANOVA) at P<0.05using Minitab. The results showed retard growth as compared to the control. Growth parameters such as Specific Growth Rate and Food Conversion Efficiency decreased (P<0.05) with increase in concentrations. Poor Food conversion Ratio and poor percentage weight gain were also recorded. Vestaline®(Pendimethalin) herbicide from the study had negative influence on *Clarias gariepinus* weights and ability to utilize feed.

Keywords: *Clarias gariepinus*, Vestaline®(Pendimethalin), Hematology

1. Introduction

About 70% of the earth's surface is covered by water, the only source for fish propagation. Fishes are found in different waters. Some are found in fresh water while some are found in salt water (sea and oceans). On a global scale, fish and fish products are the most important source of protein and it is estimated that more than 30% of fish for human consumption comes from aquaculture [7]. *Clariasgariepinus*, which is widely considered to be one of the most important tropical catfish species for aquaculture, has an almost Pan-African distribution, from the Nile to West Africa and from Algeria to Southern Africa. They also occur in Israel, Syria and South of Turkey. [2]. Fish such as *Clariasgariepinus* are good suitable bio-indicators of environmental pollution monitoring and can play significant roles in assessing potential risk associated with contamination in aquatic environment since they are directly exposed to chemicals resulting from agricultural production or indirectly through food chain of ecosystem [9].

The indiscriminate use of herbicides such as Vestaline®(Pendimethalin) through direct use in aquatic environments or careless handling, accidental spillage, or surface run-off into natural water-ways has harmful effects on the fish population and other forms of aquatic life. Thus, Vestaline®(Pendimethalin) may contribute to long term effects in the environment even in small concentration as they do not degrade easily into the environment [14].

2. Materials and Methods

2.1. Study Area

The study was carried out in the General purpose Laboratory, Department of Fisheries and Aquaculture, University of Agriculture Makurdi, Benue State Nigeria.

2.2. Sample Collection

A total number of 250 (Two hundred and fifty) *Clarias gariepinus* juveniles were used throughout the study. Healthy and active juveniles of African catfish *Clarias gariepinus*

were collected from University of Agriculture Makurdi fish farm for the study. The fish were transported in well aerated plastic containers to the laboratory. The fish were acclimatized in the laboratory for two weeks during which they were fed with commercial floating feed (coppens) at 5% of their body weight. Unconsumed feeds were removed and water replenished twice a week as recommended by [6].

2.3. Experimental Procedure

A preliminary range finding test was carried out based on the concentration of the active ingredient in order to know which concentrations to be used. The concentration was done using a serial dilution formula $C_1V_1 = C_2V_2$. The result obtained from the range finding test provided a guide for the concentrations. The concentrations that were used are; 1.89mg/l, 3.79mg/l, 5.68mg/l, 7.57mg/l and 9.46mg/l.

A total of eighteen (18) glass aquaria were used for the study. Ten juveniles of *Clarias gariepinus*were introduced into each aquarium containing 20 liters of water into which the concentrations of vestaline as mentioned above were introduced. The experiment was carried out for a period of 56 days.

The average weight of the fish in each tank at commencement of the experiment and on a weekly basis were taken with Metler weighing balance model MT 2000. The amount of feed given was adjusted to new weight after weekly weighing.

2.4. Growth Parameters

Growth indices were calculated to evaluate the growth performance and nutrient utilization as described by [3]. The calculated growth parameters are as follows:

2.5. Mean Weight Gain (MWG)

This was calculated by the weight difference between the mean final weight and mean initial weight.

(MWG) = Mean Final Weight (MFW) - Mean Initial Weight (MIW)

2.6. Specific Growth Rate (SGR)

This was calculated by taking the natural Log of the mean weight difference between the mean final weight and mean initial weight, divided by the number of days.

$$\frac{lnlnMFW - lnlnMIW}{T} \times 100.$$

Where; l_n = natural logarithm
MFW = Mean Final Weight
MIW = Mean initial weight
T = period of experiment (in days).

2.7. Food Conversion Ratio (FCR)

This was calculated by dividing the weight of feed fed by Weight gain of fish in (g).

$$\text{FCR} = \frac{\text{weight of feed consumed}}{\text{Weight gain of fish}}$$

2.8. Food Conversion Efficiency (FCE)

This was calculated by dividing gain in weight of fish by quantity of feed fed multiplied by hundred.

$$\text{FCE} = \frac{Weightgainoffish}{Feedfeed} \times 100,$$

$$\text{Percentage Survival Rate (\%)} = \frac{Numberoffishthatsurvived}{Numberoffishstocked} \times 100.$$

2.9. Physicochemical Parameters of the Test Solution

The following parameters were determined during the study using Hanna multi parameter water tester Model HI 98129; Temperature, Hydrogen ion concentration (pH), Total dissolved solids (TDS), Electrical conductivity (EC) by inserting the probe into the water sample and setting the mode to read in °C, PPM and µS/cm respectively by use of the MODE keypad.

Dissolved oxygen (DO) was determined using Hanna dissolved oxygen meter Model HI 94124 by inserting the probe into the sample and recording the displaced value on the LCD after one minute.

2.10. Data Analysis

Data collected from the study was analyzed using Minitab 17. The data was further subjected to analysis of variance (ANOVA) at 0.05% level.

3. Result

The effect of the sub-lethal concentration of Vestaline®(Pendimethalin) herbicide on mean weight of *Clarias gariepinus* juveniles showed that there was a sharp decrease in weight of fish in week one with increase in concentration (Figure 1). Week two experienced a slight increase in weights of fish in concentrations 1.89mg/l, 3.79mg/l, and 5.68 with the control (0.00mg/l) recording the highest increase while the last two concentrations maintained a stationary growth. This trend of growth continued until the 7th week before the highest concentration (9.46mg/l) recorded a meaningful increase.

There was no significant difference ($P>0.05$) in the initial mean body weight of all fish used in the research (Table 1). There was a significant difference ($P<0.05$) in Mean final weight (MFW) which showed decrease in weight with increase in concentration with control having the highest weight. The same trend was also observed in Mean Weight Gain (MWG), Percentage Weight Gain (% WG), Specific Growth Rate (SGR), Feed Conversion Efficiency (FCE) all decreased significantly ($P<0.05$) with increase in concentration. While feed conversion Ratio (FCR) increased significantly ($P<0.05$) with increase in concentration. All the treatments recorded 100% survival except the last two

treatments which recorded 83.33% and 66.67% respectively.

The result of the physico-chemical parameters of the water used (Table 2) Showed that all the parameters determined increased significantly (P<0.05) with increase in concentration except Dissolved oxygen which decreased with increase in concentration. On the other hand, there was no significant difference (P>0.05) between temperatures.

Table 1. *Nutrient utilization of Clarias gariepinus juveniles exposed to concentrations of Vestaline®(Pendimethalin) herbicide for eight weeks.*

Parameters	Concentration (mg/L)						P-Value
	0.00	1.89	3.79	5.68	7.57	9.46	
MIW (g)	28.57±0.02	28.55±0.05	28.56±0.02	28.60±0.02	28.62±0.05	28.57±0.05	0.10
MFW (g)	51.78±0.48^{a}	44.41±0.86^{b}	41.92±0.54^{c}	39.52±0.62^{d}	35.71±0.21^{e}	33.37±0.67^{f}	<0.01
MWG (g)	23.21±0.50^{a}	15.68±0.87^{b}	13.33±0.55^{c}	10.85±0.68^{d}	7.08±0.25^{e}	4.69±0.65^{f}	<0.01
% WG	81.25±1.81^{a}	54.60±3.09^{b}	46.64±1.96^{c}	37.85±2.44^{d}	24.74±0.91^{e}	16.36±2.27^{f}	<0.01
SGR	1.06±0.01^{a}	0.77±0.03^{b}	0.68±0.02^{c}	0.57±0.03^{d}	0.39±0.01^{e}	0.26±0.03^{f}	<0.01
FCR	0.11±0.00^{d}	0.14±0.00^{cd}	0.15±0.00^{cd}	0.18±0.00^{c}	0.25±0.00^{b}	0.36±0.05^{a}	<0.01
FCE	8.96±0.11^{a}	7.05±0.25^{b}	6.35±0.18^{b}	5.48±0.26^{c}	3.96±0.11^{d}	2.79±0.34^{e}	<0.01
% Survival	100.00±0.00^{a}	100.00±0.00^{a}	100.00±0.00^{a}	100.00±0.00^{a}	83.33±3.33^{b}	66.67±3.33^{c}	<0.01

Means on the same row with different superscripts are statistically significant (P<0.05).
MIW = Mean Initial Weight.
MFW = Mean Final Weight.
WG = Weight Gain.
FCR = Feed Conversion Ratio.
MWG = Mean Weight Gain.
FCE = Food Conversion Efficiency.
SGR = Specific Growth Rate.

Table 2. *Mean Physico-chemical parameters of the water during exposure of Clarias gariepinus Juveniles to Concentrations Of Vestaline®(Pendimethalin) herbicide.*

Parameters	Concentration (mg/L)						P-Value
	0.00	1.89	3.79	5.68	7.57	9.46	
Temp. (°C)	25.55±0.25	26.25±0.05	26.40±0.10	25.80±0.10	26.20±0.10	25.85±0.05	0.08
pH	8.60±0.10^{c}	8.65±0.05^{c}	8.70±0.20^{c}	9.15±0.05^{b}	9.20±0.10^{b}	9.85±0.05^{a}	0.01
TDS (mg/L)	104.05±0.55^{f}	115.45±0.25^{e}	118.30±0.10^{d}	120.50±0.80^{c}	127.70±0.60^{b}	132.95±0.55^{a}	0.01
EC (µS/cm)	201.15±0.05^{f}	229.05±0.75^{e}	232.65±0.45^{d}	235.40±0.30^{c}	257.15±0.85^{b}	263.05±0.35^{a}	0.01
DO	5.80±0.00^{a}	5.65±0.15^{a}	5.35±0.05^{b}	4.25±0.05^{c}	3.55±0.05^{d}	3.40±0.00^{d}	0.02

Means on the same row with different superscripts are statistically significant (P<0.05).
TDS = Total Dissolved Solids.
Temp. = Temperature.
EC = Electrical Conductivity.
DO = Dissolved Oxygen.

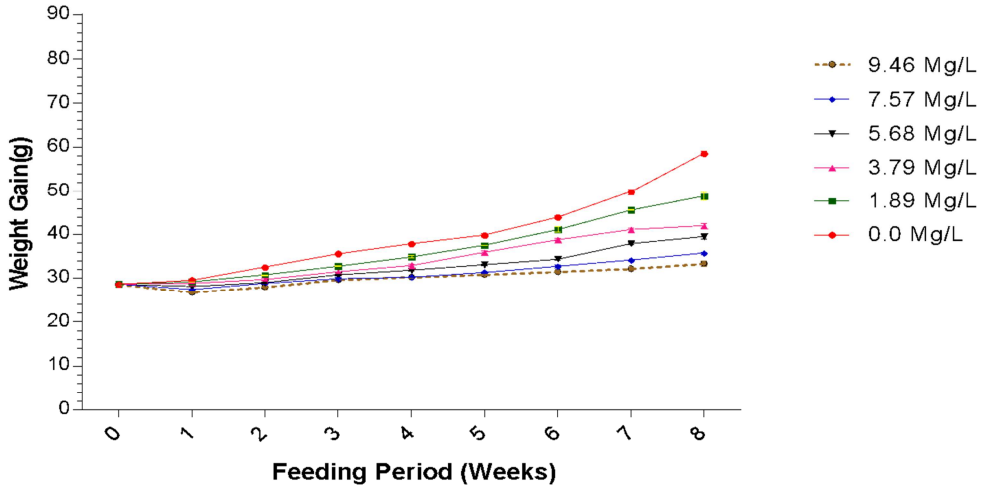

Figure 1. *Mean weight gain of ClariasgariepinusJuveniles exposed to sub-lethal concentrations of Vestaline®(Pendimethalin) herbicides.*

4. Discussion

The results of this study indicates that Vestaline®(Pendimethalin) herbicide is toxic on the physico-chemical parameters of water and growth rate of *Clariasgariepinus*juveniles.

Effects on water

Water quality parameters plays a great role in causing the toxicity by different pesticides that ultimately have harmful effect on diversity, abundance and dynamics of aquatic flora and fauna. The presence of pesticides in water has offensive taste, odour and colour to fish and aquatic plants even when they are present in low concentrations [5].

Reports demonstrated that in carp aquaculture ponds, mortalities of carp might be triggered by unsuitable environmental factors, such as poor water quality leading to low oxygen supply, resulting from pesticides dissolved in water or included in feeds [1].

The results of physico-chemical parameters of the test water used for thetoxicity decreased significantly in dissolved oxygen and increased in pH, Total Dissolved Solids (TDS) and Electrical conductivity (EC) whileTemperature showed no significant difference.

The variation or differences in the physico chemical parameter might be due to the effects of vestaline herbicide on the water quality. This is similar to work done by [3] on *Daturainnoxia* root extracts. Although the concentration of Total Dissolved Solids (TDS) and Electrical Conductivity (EC) differed significantly, they are still within acceptable limits according to [6] who reported the mean water quality standard for survival of aquatic organism.

The reduction on oxygen concentrations can be attributed to heighten activities of the fish due to the herbicide which can deplete oxygen from the water and also in the presence of adverse environment, organisms intends to adjust itself for survival this could cause increase uptake of oxygen. This agrees with the statement of [15] which states that "the reduced oxygen in water could be caused by increased uptake by fish. Also [16] had earlier reported that the introduction of a toxicant into an aquatic system might decrease the dissolve oxygen concentration, which will impair respiration leading to asphyxiation. The increase in pH with increase in concentrations might have resulted from the pH of the herbicide. Skin damage, that is, body lesions noticed especially after 72h on fish might be indicative of pH stress. It shows further that fish like *C. gariepinus* has limited tolerance to abnormal pH changes.

In this present study temperature did not differ significantly possibly because the reaction of vestaline may not have been exothermic or endothermic and also temperature is influenced by environmental temperature.

Effects on growth

This study revealed that there was generally slight increase in the trend of weight gain of fish during the study period. There was decrease in weight of fish with increase in concentration of the toxicant at the first week, with exception of the control group, after which there was increase in weight gain but the increase was at marginal rate compared to the control group.

This finding is similar with the reports of [13] on *Clarias gariepinus*and [11] on *Oreochromis niloticus*. It also agrees with the reports of [8] on *Clarias gariepinus* fingerlings when exposed to sublethal concentrations of formalin. The fish from the control group gave the best weight gain, specific growth rate (SGR), feed conversion ratio (FCR) and feed conversion efficiency (FCE). All these growth indices reduced with increase in concentration. The decrease in growth rate with increase in concentration in this study agrees to reports of [10] who reported decrease in growth parameters of Oreochromis *niloticus* with increase in concentration of Stomp® (Pendimethalin) herbicide. The result of this study showed a dose-dependent reduction in feed conversion efficiency (FCE).

These results also agree with those previously recorded by [4] who found 50% growth inhibition of aquatic microorganisms (*S. capricornutum*) green microalgae exposed to 52 µg/l pendimethalin. This observation is also similar to earlier report of [12] who reported that sub-lethal concentrations of toxicants often result in several physiological dysfunctions instead of an outright mortality of fish.

The reduction in growth could be due to low feeding rate resulting from the presence of the herbicide in the water which can modify the taste of food, leading to reduced attractiveness to fish or more energy was used up on chemical detoxification and tissue repair.

5. Conclusion

In conclusion, the results revealed that concentrations of Vestaline®(Pendimethalin) herbicide are harmful directly or indirectly to *Clarias gariepinus* juveniles because the physio-chemical parameters of water such as pH, Total Dissolved Solids, and Electrical Conductivity increased with increase in concentration except Dissolved Oxygen that decreased. This showed that Vestaline®herbicide can negatively affect water quality and water quality in turn can have negative effects on fish.

The difference in Mean Weight Gain with increase in concentration could be either due to lower feeding rate or an increased activity associated with attempts to avoid the polluted medium.

Growth parameters such as Specific Growth Rate (SGR) and Feed Conversion Efficiency (FCE) decrease while feed conversion Ratio (FCR) increased with increase in concentration which can be attributed to increased expenditure of energy on chemical detoxification and tissue repair.

References

[1] Anyusheva, M., Lamers, M., La, N., Nguyen, V. V., Streck, T., (2012). Fate of pesticidesin combined paddy rice–fish pond farming systems in Northern Vietnam. *J. Environ. Qual*. 41 (2), 515–525.

[2] Awachie J. B. E, Ezenwaji H. M. G (1998). The importance of *Clarias* species in the fishery development of Anambra river basin, Nigeria. CIFA.

[3] Ayuba, V. 0., Ofojekwu, P. C. and Musa, S. 0 (2012). Haematological Response and Weight changes of the African Catfish Clariasgariepinus Exposed To Sub Lethal Concentrations of Daturainnoxia Root Extract. PAT December, 2012; 8 (2): 134-143 ISSN: 0794-5213. www.patnsukjournal.net/currentissue.

[4] Brazenait J. and Sakaliene O. (2006): Availability and toxicity of pendimethalin to aquatic microorganisms. Biologija, 3: 59–62.

[5] De, A. K., (2003). Environmental Chemistry, 5th ed. New Age International Limited, New Delhi, pp. 19-23.

[6] Faioye 0.0., Adebisi A. A. and Fagade S.0 (2004). Toxicity of *Parkiabiglobosa* and *Raphiavinfera* extracts on Clarias gariepinus juveniles, *African Journal of Biotechnology*. 3 (11): 627-630.

[7] FAO. (2003). The role of aquaculture in improving food security and nutrition Paper presented at the Committee on World Food Security. Twenty-ninth Session, Rome, 12–16 May 2003.

[8] Jimmy, U, U. Tsukwa K. And Ayuba V. O (2013), effects of sublethal concentra1tion of formalin on the growth of fingerlings. in the proceeding of the 28th annual conference of fisheries society of Nigeria (FISON:) Abuja 25th-29th Nov, 2013. Pp 176.

[9] Lyons G, Watterson A. (2010). A Review of the Role Pesticides Play in some Cancers: Children, Farmers and Pesticide users at Risk? CHEMTrust, UK.

[10] Nabela I. El-Sharkawy, Rasha M. Reda and Iman E. El-Araby (2011). Assessment of Stomp® (Pendimethalin) toxicity on *OreochromisniloticusJournal of American Science, 2011*; 7 (10) http://www.americanscience.org.

[11] Omoregie, E. (1998). Changes in haematology of the Nile Tilapia, *Oreochromisniloticus* (Trewavas) under the effect of crude oil. *Acta Hydrobiologica*, 40: 284-292.

[12] Omoregie, E. and Ufodike, E. B. C. and Onwuliyi, C. O. E. (1995). Effects of Petroleum effluent on carbohydrate reserves of the Nile Tilapia *Oreochromisniloticus* (L), *Journal of Aquatic Science*. 12: 1.

[13] Onusiriuka, B. C. and Ufodike, E. B. C. (1998). Acute toxicity of water extracts of Akeeapple, *Blighiasapida* and sausage plant, *Kigeliaafricana*on African catfish, *Clariasgariepinus* (Teugals). *Journal of Aquatic Sciences*, 9: 35-41.

[14] Shallangwa, S. M. and Auta, J. (2008). Sub-lethal effect of 2,4- Dichlorophenoxy-acetic acid on Growth and Food Utilization of the African Catfish *Clarias gariepinus* (Teugels). *Journal of Fisheries International*, 3 (3): 65-67.

[15] Vijayan, M. M., Takemura, A. And Mommsen, T. P. L (2001) Estradiol impairs hypo-osmoreulatory capacity in the euryhaline tilapia, *Oreochromisniloticus*. *American journal of physiology*. 281 (4): 1161-1168.

[16] Warren, C. E., (1999). Biology and Water Pollution. Org., 21: 35-52. W. B. Sanders and Company Philadelphia, USA.