Available online at www.sciencedirect.com
SCIENCE DIRECT®
Ecotoxicology and Environmental Safety 62 (2005) 436–440
Ecotoxicology and Environmental Safety
www.elsevier.com/locate/ecoenv

Erythropoietic response and hematological parameters in the catfish *Clarias albopunctatus* exposed to sublethal concentrations of actellic

B.O. Mgbenka*, N.S. Oluah, A.A. Arungwa

Fisheries and Hydrobiology Research Unit, Department of Zoology, University of Nigeria, Nsukka, Nigeria

Received 27 May 2003; accepted 18 March 2005
Available online 31 May 2005

Abstract

Clarias albopunctatus fingerlings were subjected to sublethal concentrations (0, 0.3, 0. 5, 0.8, and 1.0 μg/L) of actellic for 18 days in a static bioassay system. The hemoglobin, erythrocyte count, hematocrit, and leucocyte counts were affected by actellic. Compared with the control, the hemoglobin, hematocrit, and erythrocyte count decreased significantly ($P<0.05$) in the actellic-exposed fish. There was significant leucocytosis in the actellic-exposed fish. The fish exposed to actellic suffered macrocytic anemia. The changes in the hematological parameters were concentration dependent except in leucocyte counts.

Keywords: Actellic; *Clarias*; Anemia; Hemoglobin; Erythrocytes; Hematocrit; Leucocytes

1. Introduction

Actellic is an organophosphorous pesticide containing 2% pirimophos-methyl as the active ingredient. As a broad-spectrum pesticide, actellic is not intentionally introduced into water bodies; rather, it enters water bodies as runoff or during aerial spraying to control pests in farmlands within the watershed. Thus, it is necessary to assess the toxic effects of actellic to aquatic organisms, particularly fish, with a view to possibly determining the "no effect" concentrations.

The toxic effects of some pesticides on some biochemical parameters of fish have been reported (Oluah and Njoku, 2001; Omoregie et al., 1990). Liver and blood lactate and tissue glycogen and glucose concentrations are affected by endosulphan (Gimeno et al., 1994), paraquat (Oluah and Njoku, 2001; Simon et al., 1983), and lindane (Omoregie et al., 1990, Ferando and Andrew, 1992).

The hematological parameters provide rapid and sensitive indices of pesticide poisoning and pollution. Changes in the hematologicaal profile of fish exposed to endrin, nuvacron, and lindane have been observed (Srivastava and Narain, 1982; Omoregie et al., 1990; Mgbenka et al., 2003). Similarly, Buckley (1977) and Van Vuren (1986) noted changes in the hematology of fish exposed to agrochemicals and chlorinated water.

In Nigeria, actellic is a popular pesticide and, hence, there is the possibility that it could contaminate water bodies in the areas of application. The purpose of this study was to investigate the hematological perturbations in the freshwater catfish *Clarias albopunctatus* at sublethal concentrations of actellic during chronic exposure.

2. Materials and methods

2.1. Fish collection

The fish were collected from the Anambra River at Otuocha and transported to the Department of Zoology, University of Nigeria, Nsukka Laboratory in a fish container. The fish were acclimated for 3 weeks before the commencement of the study.

*Corresponding author.
E-mail address: bo_mgbenka@yahoo.co.uk (B.O. Mgbenka).

0147-6513/$ - see front matter © 2005 Elsevier Inc. All rights reserved.
doi:10.1016/j.ecoenv.2005.03.031

2.2. Experimental design

A total of 150 fish (mean weight ± standard deviation, 66 ± 3.71 g) were used for the study. The fish were divided randomly into five groups of 30 fish each. Each group was further randomized into three replicate experiments of 10 fish per replicate in 25-L glass aquarium tanks.

Since 1.0 μg/L of actellic was found to be sublethal to the fish (Omoregie et al., 1990), four different concentrations of actellic (0.3, 0.5, 0.8, and 1.0 μg/L) were prepared using the commercial preparation containing 2% pirimophos-methyl powder (ICI, London). Fish in groups 1, 2, 3, and 4 were exposed to 0.3, 0.5, 0.8, and 1.0 μg/L actellic, respectively, while fish in group 5 which served as control was exposed to tap water only.

The temperature of water (27 ± 0.5 °C) was taken three times daily with a maximum and minimum mercury-in-glass thermometer. The pH (6.80 ± 0.10) was recorded with a pH meter (Model PH J – 201 L) and the dissolved oxygen (5.55 ± 1.00 mg/L) was determined by the Winkler titration method.

The static bioassay renewal technique was adopted throughout the study period of 18 days. By this, the water and actellic were changed daily to maintain toxicant concentrations at each level throughout the duration of study. Two fish from each replicate were killed and the blood was collected for hematological studies every 6 days. The feeding regime and the method of collecting the blood samples were as earlier described (Oluah, 2001).

2.3. Tissue preparation

One fish from one of the tanks containing each level of actellic and the control was removed at the beginning and the end of the experiment. Each removed fish were killed; the gills were excised, washed in distilled water, fixed in Bouin's fluid, and dehydrated in different grades of alcohol. The dehydrated tissue was embedded in paraffin wax and 10 μm sections of the gill tissue were cut using a rotatory microtome. The sections were stained in hematoxylin–eosin, examined in a photomicrographic microscope, and photographed.

2.4. Hematological assay and statistical analysis

The hematocrit was determined by the microhematocrit method (Allen, 1994). The cyanmethanemoglobin method (Blaxhall and Daisley, 1973) was adopted in the determination of hemoglobin concentration. The erythrocyte count was made using an improved microscope Neubauer counter after diluting the blood with Toisson's solution. Also, the leucocyte count was done using the Neubauer microscopic counter after diluting the blood with Turk's solution. One-way analysis of variance (ANOVA) was used to analyze the data followed by the FLSD post hoc test (Steel and Torrie, 1980).

3. Results

The results of the study, shown in Tables 1–4, showed that actellic had adverse effects on the hematological parameters of *C. albopunctatus* during the exposure period. The hematological parameters of the control fish were not significantly affected during the study period.

The hemoglobin concentrations in the fish exposed to sublethal concentrations of actellic were significantly lower ($P<0.05$) than those in the control fish. The hemoglobin concentrations did not vary with duration of exposure in the fish exposed to 0.3 and 0.5 μg/L actellic ($P>0.05$) but varied significantly ($P<0.05$) in the fish treated with 0.8 and 1.0 μg/L actellic (Tables 3 and 4). Generally, the results showed that the higher was the actellic concentration the greater was the degree of reduction in hemoglobin concentration.

The erythrocyte counts in the treatment groups were significantly reduced compared with those in control

Table 1
Changes in hematological parameters in *Clarias albopunctatus* during exposure to 0.30 μg/L actellic

Variables	Duration of exposure (days)			
	Control	6	12	18
Hemoglobin (g/dl)	16.0 ± 0.86	15.0 ± 0.17	15.0 ± 0.17	17.0 ± 0.92
Erythrocyte (10^6/mm^3)	3.55 ± 0.11	3.25 ± 0.08	2.63 ± 0.42	2.24 ± 0.51
Hematocrit (%)	36.0 ± 1.26	44.55 ± 1.8	15.0 ± 1.08	31.0 ± 1.40
MCV (μm^3)	130 ± 2.81	137.08 ± 1.76	57.03 ± 1.6	138.39 ± 1.56
MCH (pg)	44.74 ± 0.28	46.15 ± 0.91	60.84 ± 0.48	75.89 ± 0.65
MCHC (%)	34.41 ± 1.60	33.67 ± 1.04	106.67 ± 1.84	54.89 ± 0.65
WBC (10^4/mm^3)	4.70 ± 1.50	11.70 ± 1.75	20.50 ± 1.32	54.84 ± 1.46

MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; WBC, white blood cell; MCHC, mean corpuscular hemoglobin concentration.