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Short communication

Acute effects of Ultraviolet-A radiation on African Catfish *Clarias gariepinus* (Burchell, 1822)

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Abstract

In the present work, the destructive effects of Ultraviolet-A radiation on the African Catfish, *Clarias gariepinus* was revealed in terms of total protein, cholesterol, glucose, hemoglobin and erythrocytic indices, differential blood cell counting, heamatocrite, creatinine level, Aspartic Amino Transferase, Alanine Amino Transferase and Alkaline Phosphatase. These destructive effects were also confirmed by histopathological changes in liver, blood corpuscles and skin.

Keywords: Ultraviolet radiation; Biochemical and histopathological parameters; African Catfish; *Clarias gariepinus*

1. Introduction

The reduction of ozone in the stratosphere as a consequence of human activity led to an increase in the level of ultraviolet radiation (UVR) at the ground. UVR has both positive and negative effects. Among the negative effects of UVR are generalized damage to DNA which causes disturbance of cell functions, blockage of genetic transcription, alteration in cell division and so on. Many organisms possess protective and effective cellular repair mechanisms against UV exposure; however, excessive exposure to UV-radiation may overload their capabilities [1].

Ultraviolet-A radiation (320–400 nm) is scattered rapidly in water with biologically useful amounts to at least 100 m deep in clear aquatic environments [2]. Also, UV-B radiation (280–315 nm) reaching the earth's surface has increased due to stratospheric ozone depletion caused anthropogenically [3–5]. In lakes, attenuation depths for UV may range from a few centimeters in waters having high concentration of dissolved organic carbon (DOC) to over 10 m or more in some of those with the lowest DOC [4,6,7]. Many studies have demonstrated that enhanced UV-B radiation may be a threat to many organisms, also in aquatic ecosystems [8].

Solar radiation may have negative effects on the aquatic ecosystems resulting in decreased biomass productivity including fish yields [1]. In addition to these general negative impacts, the UVR destroys the fish immune system including blood cells [9,10]. The biochemical, hematological and histopathological characteristics of fishes are also damaged by UVR [11]. Accordingly, the present study aimed to elucidating such negative impacts on some biochemical, hematological and histopathological characteristics of an economically important Nile fish, *Clarias gariepinus.*

2. Materials and methods

2.1. Specimen collection

Thirty specimens of adult *C. gariepinus* were collected from the River Nile at Assiut, and then were transported to Fish Biology Laboratory of Zoology Department, Faculty of Science, Assiut University. The fish (220–250 g) were kept in 100 l indoor tanks and fed daily adlibitum with commercial pellets. During the experiments the

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fish were kept on a 12:12 h light/dark regime. After two-week acclimatization, fishes were classified into three groups: control and two UVR-treated groups (one exposed for 1 h/day and 3 h/day, each for three days) [12]. The dechlorinated water used was characterized by pH of 7.56, 20.5 °C and 2.5 mg/l dissolved oxygen.

2.2. UV-A source

The fishes were exposed to UV-A using a UV- Lamp of 366 nm (ULTRA-VIOLET Products, Inc., San Cabriel, California U.S.A. model UVL_56). Experimental aquaria were fitted from above with UV-A source at 20 cm above the aquarium bottom (water level was 15 cm) [12].

2.3. Hematological and biochemical analyses

Blood samples were taken from the caudal vein into heparinzed tubes. The concentration of Hb and blood cells count were immediately estimated. Other samples of blood were centrifuged at 5000 rpm for 10 min and serum samples were stored in polyethylene Eppendorf test tubes at −20 °C until serum analysis. The RBC's, WBC's, blood Platelets, Haematocrite (HCT), mean corpuscular volum (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and Hemoglobin (Hb) were determined by using automated technical analyser (Mindray Bc-2800). Creatinine (Cr), Aspartic Amino Transferase (AST), Alanine Amino Transferase (ALT), Alkaline Phosphatase (ALP), glucose, cholesterol and total protein were determined by kits of SGMitalia Company U.S.A.

2.4. Histopathological studies

Vertical sections of skin on the dorsal and ventral sides, sections of liver and blood film were prepared and stained with heamatoxylin and eosin (H&E) and then examined by light microscope. 100×-magnification oil immersion objective was used.

2.5. Statistical analysis

Basic statistics of the biochemical and hematological parameters of the control and exposed groups were reported as mean ± standard error and range. The data were analyzed by one-way ANOVA followed by a post hac Tukey-test and Dunnet's *t*-test at 0.05 level of significance. Homogeneity of variances was evident for all parameters. SPSS–package was used [13].

3. Results and discussion

3.1. Biochemical and hematological studies

The basic statistics of the biochemical and hematological parameters are shown in Table 1. The UVR had great significant ($p < 0.05$) impacts on the treated fish in comparison with the control ones. The total protein, ALT, AST, Cr and MCV increased in comparison with the control whereas, MCH, MCHC, HCT, ALP, glucose, cholesterol, RBC's, WBC's, Hb, and blood platelets decreased. Differential leucocytic count was represented by 57% lymphocytes, 29% neutrophils, 3% esinophils, 6% monocytes and 5% special granulocytes in the control and by 33% lymphocytes, 47% neutrophils, 5% esinophils, 9% monocytes and 6% special granulocytes in the treated groups. These changes in the hematological parameter were reflected in erythrocyte haemolysis (Fig. 1b–d). RBC's also became enlarged with irregular shape and very faint cytoplasmic staining indicating the loss of essential content especially hemoglobin in comparison with the control (Fig. 1a). Similar results were recorded by [11] for some of UVR-induced hematological and biochemical parameters of tambaqui, Colossoma macropomum. This author refered to the decreased lymphocytes under the influence

Table 1
Hematological changes and biochemical results (mean value ± SE) of *Clarias gariepinus* from Assiut-Egypt, exposed to different doses of UVR ($N = 10$ for each group)

Groups parameters	Control group	1 h-Post-exposure group	3 h-Post-exposure group
Glucose (mg/dl)	$47.47 \pm 0.50^{*}$	$39.90 \pm 0.39^{**}$	$35.50 \pm 0.63^{***}$
Cholesterol (mg/dl)	$344.60 \pm 1.00^{*}$	$224.50 \pm 3.02^{**}$	$172.50 \pm 1.04^{***}$
Creatinine (mg/dl)	$0.36 \pm 0.00^{*}$	$0.51 \pm 0.01^{**}$	$0.56 \pm 0.01^{***}$
ALP (μ/l)	$179.89 \pm 0.93^{*}$	$89.80 \pm 1.17^{**}$	$40.48 \pm 1.76^{***}$
ALT (μ/l)	$107.40 \pm 2.13^{*}$	$141.30 \pm 1.19^{**}$	$324.60 \pm 1.78^{***}$
AST (μ/l)	$310.70 \pm 2.13^{*}$	$750.30 \pm 2.44^{**}$	$846.70 \pm 1.97^{***}$
Total protein (mg/dl)	$3.36 \pm 0.04^{*}$	$4.02 \pm 0.05^{**}$	$4.40 \pm 0.07^{***}$
RBC's (million/μl)	$3.27 \pm 0.04^{*}$	$3.00 \pm 0.06^{**}$	$2.70 \pm 0.03^{***}$
WBC's (thousands/μl)	$13.64 \pm 0.13^{*}$	$8.90 \pm 0.6^{**}$	$7.00 \pm 0.4^{***}$
Hb (mg/dl)	$8.96 \pm 0.08^{*}$	$7.64 \pm 0.05^{**}$	$7.23 \pm 0.11^{***}$
Platelets (thousands/μl)	$267.60 \pm 2.01^{*}$	$219.60 \pm 9.0^{**}$	$189.21 \pm 3.3^{***}$
MCV (μm^3)	$123.56 \pm 1.20^{*}$	$143.47 \pm 0.54^{**}$	$151.88 \pm 1.13^{***}$
MCH (pg)	$62.03 \pm 0.51^{*}$	$57.63 \pm 0.46^{**}$	$53.66 \pm 0.44^{***}$
HCT (%)	$39.52 \pm 0.77^{*}$	$35.75 \pm 0.27^{**}$	$31.68 \pm 0.79^{***}$
MCHC (g/dl)	$44.23 \pm 0.1732^{*}$	$41.2 \pm 0.1564^{**}$	$40.07 \pm 0.2914^{***}$

*, **, and *** means that there is a significant difference at $p < 0.05$.