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Haematological changes of fresh water food fish, *Channa striata* on exposure to *Cleistanthus collinus* suicidal plant extract

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ABSTRACT

The freshwater fish *Channa striata* were exposed to lethal concentration of *Cleistanthus collinus* plant extract (10mg/l) 48 hr. At the end of the 48 hr exposure period, blood samples were taken from the control and experimental fish. Blood was assayed for selected haematological parameters (haematocrit, haemoglobin, red blood cell counts, white blood cells counts and erythrocyte sedimentation rate). The derived haematological indices of mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration were calculated. Significant decreases observed RBC ($P<0.05$), Hb content ($P<0.01$) PCV ($P<0.01$) WBC ($P<0.05$) were observed during the exposure period.

Keywords: *Channa striata*; *Cleistanthus collinus*; haematocrit; haemoglobin; MCV; MCH; MCHC

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INTRODUCTION

Human destruction influences the aquatic environment, is in the form of sub-lethal pollution, which results in chronic stress conditions that have negative effect on aquatic life [1]. The main source of freshwater pollution can be attributed to the discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Stress response is characterized by physiological changes and the effect of pollutants on the fish is assessed by acute and chronic toxicity tests [2]. In recent years, haematological variables were used more when clinical diagnosis of fish physiology was applied to determine the effects of external stressors and toxic substances as a result of the close association between the circulatory system and the external environment [3-4]. Some authors [5-8] have reported a decrease in haematocrit, haemoglobin and red blood cells values of some fish after their exposure to insecticides. Plant parts have been shown to cause death of fish and changes in biochemical responses of *Channa punctatus* [9], haematological and histopathological effects on *Clarias gariepinus* [10-11]. The leafy parts of *Lepidagathis alepecuroides* is used to immobilize and kill mudskippers (*Periophthalmus papillio*) and other fish species in river States of Nigeria [12]. Reports on the effect of plant extracts on the blood cells are very limited [13]. Hence, the present investigation on the lethal exposure of suicidal plant, *Cleistanthus collinus* was undertaken and the results are presented.

MATERIAL AND METHODS

Fish (10 g - 15 g) collected from local freshwater sources were maintained in the laboratory at $28\text{ }^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and exposed to a lethal concentration of plant extract ($\text{LC}_{50} 10\text{ mg L}^{-1} 48\text{ h}^{-1}$). LC_{50} value was calculated by Probit [14] method. Haematological parameters such as RBC and WBC counts, haemoglobin content (Hb), Packed cell volume (PCV), erythrocyte sedimentation rate (ESR), mean corpuscular haemoglobin (MCH) and MCH concentration (MCHC) were determined by the standard methods [15]. The statistical significance of difference between control and treated groups of exposure period were tested by using 't' test [16].

RESULTS AND DISCUSSION

Lethal exposure of suicidal plant extract decreased the RBC, PCV, Hb and WBC significantly (Table 1). A reduction in haematological values, indicated anemia in the pesticide exposed fish may be due to erythropoiesis, haemosynthesis and osmoregulatory dysfunction or due to an increase in the rate of erythrocyte destruction in haematopoietic organs [17-18]. In the present study, the decrease in RBC count during the acute treatment might have resulted from severe anemic state or haemolysing power of toxicant (plant extract) particularly on the red cell membrane. The decrease in the haemoglobin content in the present study resulted from rapid oxidation of haemoglobin to methaemoglobin or release of O_2 radical brought about by the toxic stress of plant extract. Lethal exposure of cycas seed extract either increased or decreased the blood values in *Oreochromis* [13]. The decrease in RBC count and haemoglobin

concentration are due to hemolysis. Hemolysis occurs in response to toxicity, that leads to alteration in the selective permeability of membrane [19]. Natarajan [20] found a reduction of RBC and Hb content resulting in hypochronic anaemia which was attributed to deficiency of iron and decreased utilization for Hb synthesis. Goel and Kalpana [21] have reported that RBC count and haemoglobin content values significantly decreased resulting in macrocytic anaemia in *H. fossilis* exposed to zinc, which supports the present findings.

Table 1.
Haemogram of *Channa striata* exposed to lethal (LC₅₀/48 hr) concentration of suicidal plant *Cleistanthus collinus* extract

Blood parameter	Control	Experimental	% changes
RBC ($\times 10^6 \text{ mm}^{-3}$)	3.80 + 0.05	2.21 + 0.02	-41.84*
PCV (%)	45.62 + 0.62	36.18 + 0.51	-20.69**
Hb (g 100 ml ⁻¹)	15.21 + 0.31	12.50 + 0.28	-17.82**
ESR (mm h ⁻¹)	0.57 + 0.01	0.61 + 0.02	+7.02 ^{NS}
WBC ($\times 10^4 \text{ mm}^{-3}$)	14.02 + 0.62	8.17 + 0.80	-41.73*
MCV ($\mu \text{ m}^3$)	120.05 + 4.12	163.71 + 9.50	+36.37*
MCH (pg)	40.03 + 2.90	56.56 + 4.10	+41.29*
MCHC (%)	33.34 + 2.71	34.55 + 4.50	+3.63 ^{NS}

Each value is the mean of 6 individual determinations \pm indicates SD

The signs + or – indicate percent increase or decrease over control

*P < 0.05, **P < 0.01, NS = Not significant

The PCV reading are valuable in determining the effect of stressors on the health of fish and are also used to determine the oxygen carrying capacity of blood [22]. The low PCV would indicate anaemia or oligohaemia [23]. Decrease in PCV shows the extent of the shrinkage of cell size and decrease in the number of cells [24]. Increase observed in other parameter namely ESR and MCHC was not statistically significant. However, the increase recorded in MCV and MCH is significant. An increase ESR may be correlated with the increased MCV of experimental fish since size of the RBC is a critical factor affecting the sedimentation rate. The MCV has been reported to provide information on the size of and status of erythrocytes [25]. The increased values of MCV and MCH may indicate a condition of macrocytic anaemia [26]. MCV and MCHC levels increased in tilapia *Oreochromis mossambicus* when exposed to cadmium [27]. Our results agree with those obtained in previous studies. The white blood cells in fish respond to various stressors including infection and chemical irritants [28]. The decreased number of white blood cells (leucopenia) may also be related to an increase level of corticosteroid hormones, whose secretion is a non-specific response to any environmental stressor [29-30]. A decrease was reported in WBC count in blood of *C. idella* exposed to fenvalerate [31]. The decrease in number of white blood cells (leucopaenia) may be the result of bioconcentration of the test metal (Zink) in the kidney and liver [32]. Environmental changes also cause differences in the physiological and chemical properties of fish blood.

CONCLUSION

The decrease of RBC, PCV and Hb values results in hypochromic microcytic anemia which was attributed to deficiency of iron and its decreased utilization for the Hb synthesis. It is well established that glycolysis is responsible for the reduction of methemoglobin as soon as it is formed, thus maintaining the iron of the Hb in the ferrous form in which state only it acts as an efficient O₂ carrier. The increased activity of LDH and decreased activity of SDH in suicidal plant extract exposed fish indicate the prevailing of anaerobic phase of glycolysis. The disruption of iron synthesizing machinery due to inhibition of aerobic glycolysis could be the reason for the decrease of blood parameters in the stressed fish.

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