

Effect of phenol on haematological components of Indian major carps *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*

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Abstract: The effect of phenol on haematological components of Indian major carps, *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were observed. After exposure to sublethal concentrations of 5.17 mg l⁻¹, 6.06 mg l⁻¹ and 6.99 mg l⁻¹, the number of red blood cells, haemoglobin content and packed cell volume all decreased but the glucose level increased. The order of decrease in the haematological components of the three fish is in the order of *Catla catla* > *Labeo rohita* > *Cirrhinus mrigala*.

Key words: Phenol, RBC, Haemoglobin, Packed cell volume, Blood glucose

Introduction

Phenolic wastes are common water pollutants generated from a variety of industrial processes used in oil refineries, gas operation, coke ovens, coal gasification and by natural processes such as the decomposition of plant matter (Buikema *et al.*, 1979). Relatively high concentrations of phenol are found in rivers near the outlets of channels where industrial wastewaters have been discharged (Buikema *et al.*, 1979; Loh *et al.*, 2000).

Blood is the most important and abundant body fluid. Its composition often reflects the total physiological condition. The main route of entry for any pesticide is through the gills. From the gills, it is transported to various parts of the body via the blood stream. Blood provides an ideal medium for toxicity studies. The haematological parameters have been considered as diagnostic indices of pathological conditions in animals. Fish blood can serve as a valuable tool in detecting physiological changes taking place in animal. Hence, an attempt has been made to study the effect of phenol on certain blood components of Indian major carps, *Catla catla* (Ham.), *Labeo rohita* (Ham.) and *Cirrhinus mrigala* (Ham.).

Materials and Methods

Catla catla, *Labeo rohita* and *Cirrhinus mrigala* (15-20 g) were acclimated to laboratory conditions for 15 days. Such acclimated fishes were exposed to sublethal concentrations of phenol for 12 days (5.17 mg l⁻¹, 6.06 mg l⁻¹ and 6.99 mg l⁻¹). After the period of exposure, the haematological parameters were determined. The total RBC count was made by using Neubauer crystalline counting chamber as described by Davidson and Henry (1969). The haemoglobin was estimated by acid haematin method (Sahli, 1962). The packed cell volume (PCV) was estimated by using Wintrobe's tube (Mukherjee, 1988). Blood glucose was determined using Folin Malmros microprocedure as modified by Murrell and Nace (1958).

Results and Discussion

In the present study, a decrease in total erythrocyte count, Hb concentration, PCV and an increase in blood sugar concentration was observed in all the exposed fishes (Fig. 1).

Halsband and Halsband (1963), measured a 12% increase in haematocrit values for rainbow trout exposed to 1.5 mg l⁻¹ phenol for 48 hr, this increase may have been caused by factors other than the direct result of the phenol since the erythrocyte numbers were shown to have decreased by 25% although a 26% increase in the mean cell surface area was reported. However, neither Kristofferson *et al.* (1973) using pike, *Esox lucius* L., exposed to 5 mg l⁻¹ phenol for 5 days nor Swift (1978) using rainbow trout exposed to phenol for 24 hr, could detect any significant changes in PCV values.

Swift (1978) reported significant concentrations of phenol in the whole blood plasma and erythrocytes of *Salmo gairdneri*, exposed to phenol for 24 hr.

Damage to blood cells is a recognised symptom of acute phenol poisoning in mammals and such similar results were obtained for fish exposed to near lethal levels of phenol by Waluga (1966b) and Andres and Kurazhovskaia (1969). The number of mature erythrocytes decreased while the number of disrupted and immature erythrocytes and white cells increased.

Significantly increased PCV and whole blood glucose values were observed by Swift (1981), when the fish were exposed to 3.2, 7.4 and 8.5 mg l⁻¹ phenol. However, this significant increase appeared to be limited to the first few hours of exposure, although 24 hr exposure to 7.3 mg l⁻¹ led to a significant decrease in glucose concentration. The other phenol concentrations tested had no significant effect on whole blood glucose values. Similarly increase in the PCV value have been reported for a number of fish species exposed to various experimental conditions (Houston

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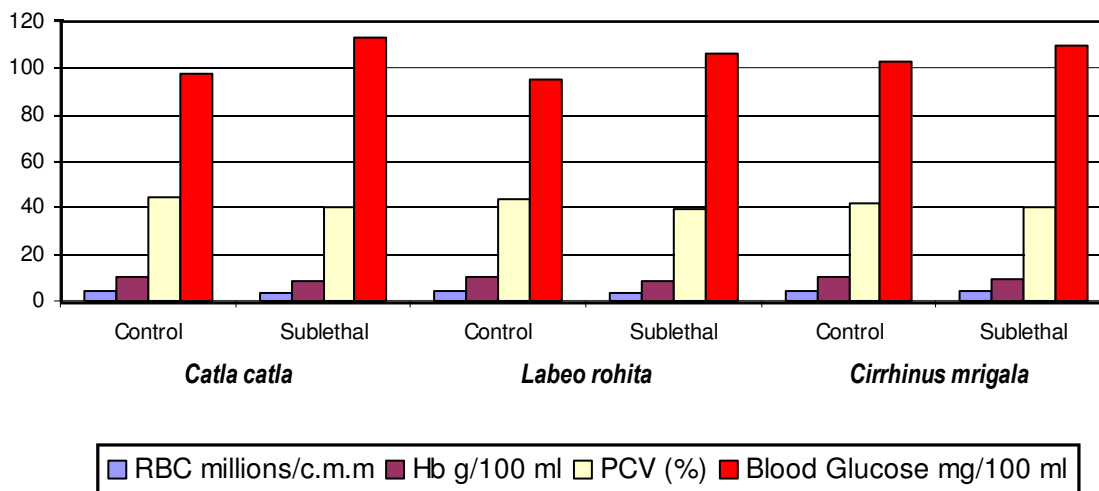


Fig. 1: Changes in selected haematological components in the blood of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* exposed to sublethal concentrations of phenol for 12 days

et al., 1971; Soivio and Oikari, 1976; Casillas and Smith, 1977). Chatterjee et al. (1983) reported histopathological lesions in the blood of *Heteropneustes fossilis* at 5-10 ppm of phenol.

Although changes in blood haematocrit and water balance did not appear but Kristofferson et al. (1973) stated that the plasma activities of the enzymes, lactate-dehydrogenase (LDH), glutamate-oxalo-acetate-transaminase (GOT) and glutamic-pyruvic transaminase (GPT) were significantly increased in pike fish exposed to phenol. Background information on 'normal' plasma enzyme levels are unavailable, however, the ratio of GOT to GPT and LDH to GOT for treated fish compared to control fish indicates damage to the erythrocytes (Schmidt and Schmidt, 1967). Extension of this type of approach would provide useful data as suggested by Bell (1968).

In *Mugil auratus* after an 8 day exposure to 7.5 mg l⁻¹ phenol, blood haemoglobin concentration, haematocrit value were below controls and blood sugar concentration and the activities of aspartate aminotransferase and glutamic-pyruvic transaminase were above controls (Krajnovic-Ozretic and Ozretic, 1988).

The effects of phenol on haematological properties of catfish (*Clarias leather*) were reported by Chen (2002). After exposure to 5 to 30 mg l⁻¹ phenol for 24 hr a decrease in the number of red blood cells and haemoglobin content and an increase in the erythrocyte sedimentation rate were observed.

The changes in haemoglobin concentration, haematocrit and blood glucose in the present study are similar to those reported by Krajnovic-Ozretic and Ozretic (1988) for phenol. The decrease in RBC and Hb content in the present study are also comparable to those reported by Chen (2002) for catfish *Clarias leather* exposed to phenol.

The decrease in RBC and Hb concentration indicates acute anaemia. The anaemia could be due to the destruction of RBC (Waluga, 1966a, b; Andres and Kurazhovskaia, 1969) triggered by the influx of phenol into the erythrocytes (Swift, 1978). The anaemia may also be of haemolytic type. Haemolysis of RBC was also reported by Krajnovic-Ozretic and Ozretic (1988) in gray mullet exposed to phenol. Haemolysis of erythrocytes were also observed after exposing the erythrocytes, experimentally *in vitro*, to 2 mM dichromate for 24 hr (Roche and Boget, 1993). In the present investigation, haemolysis might have been one of the causes for reduction in Hb, RBC and PCV values. The fall in haematological parameters might be due to decreased rate of production and/or to an increased loss of destruction of RBC (Larsson, 1975). The another reason for RBC suppression could also be damage to the haemopoietic tissue. PCV appears to be positively correlated with RBC counts, hence, a decrease in PCV is observed.

Similar results have been reported for several freshwater fishes exposed to pesticides (Khalaf Allah, 1999; Balathakur and Bais, 2000; Rehulka, 2000). An elevation of blood sugar (hyperglycaemia) is observed in all the exposed fishes. This could be attributable to the physiological stress caused by phenol. Similar increase in whole blood glucose concentrations were reported in fish exposed to 3.2, 7.3 and 8.5 mg l⁻¹ phenol (Swift, 1981). Ravichandran et al. (1995), reported similar hyperglycaemia in the freshwater fish *Oreochromis mossambicus* exposed to sublethal concentrations of phenol.

Blood glucose has been shown to be a sensitive biochemical indicator of environmental stress for any chemical pollutant including pesticides (Silbergeld, 1974; Wedemeyer and Yasutake, 1977). The blood sugar level represents a dynamic balance between the rate at which the sugar is entering the blood

from the liver and the rate at which it is being removed by the body tissue from the blood (Saskin, 1941).

Bakthavathsalam and Reddy (1982) reported that the increase in blood glucose level contributes an active flux of metabolites. Garanina (1984) has also observed that different concentration of toxicants interfere carbohydrate metabolism. The elevated blood glucose levels reflect an increase in the rate of transportation of glucose probably from the liver to muscle where high energy demand was met due to brisk and erratic movements (Ravichandran *et al.*, 1995).

When fish absorb little oxygen from the environment, the respiratory metabolism is depressed and therefore stored intracellular glycogen is utilized. Under such conditions, the hyperglycemic hormone is released for the degradation of glucose. This glucose leaks into the blood causing hyperglycaemia (Bhattacharya *et al.*, 1987).

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