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INFLUENCE OF TREATED DAIRY EFFLUENT ON HAEMATOLOGICAL CHANGES IN FRESHWATER CATFISH *CLARIAS BATRACHUS*

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ABSTRACT

The effect of treated dairy effluent was assessed by performing chronic exposure test on the fish *Clarias batrachus*. The fish was exposed to four concentrations of treated dairy effluent, 25%, 50%, 75% and 100% for a period of 30 days. Haematological observations were made after this period with respect to the indices *viz.,* total erythrocytes (RBC), haematocrit or packet cell volume (PCV), mean corpuscular volume (MCV), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet (Plt) and mean platelet volume (MPV).

INTRODUCTION

It is emphasized that increased industrialization leads to deterioration of environmental quality and subsequently the health man and animals. The rapid industrial progress has added to the problems of pollution. Industrial pollutants are known to bring changes in the abiotic and biotic components of the ecosystem.

Dairy industry is noted as one of the significant contributors to water pollution. Dairy wastes include wash water from milk cans, equipment, bottles, floors, portions of spilled milk, sour milk and buttermilk etc. These wastes contain considerable amount of biodegradable organic matters, undergo anaerobic decomposition and create obnoxious odour. They affect fauna and flora and in turn, may result in the alteration in the fundamental biochemical and physiological mechanism of animals (Sin et al. 1990, Maheswari Devi et al. 1991).

The haematological parameters are considered as diagnostic indices of pathological conditions in animals. Such studies have been made in lower vertebrates taking into consideration the various environmental factors (Kristofferson et al. 1974). Numerous haematological studies have been made, especially on the species which are used extensively in pisciculture. Comparatively, less data are available on fish species which are largely living under natural conditions. The importance and possible use of haematological data in Icthyological investigation and fishery management have been substantiate by a number of authors (Blaxhall 1973, Hickey 1976). Bouck (1951) stated that environmental stress causes a variety of detectable and recognizable changes in the blood of fish. Blood chemistry offers the potential for several biomakers of toxicant stress (Mayer et al. 1992) and it may be possible in some cases to use biochemistry to extrapolate back from the fish to some features of habitat quality (Lockhart & Metner 1984). Changes in blood parameters are often quick in response to environmental or physiological alterations; further more, they are easily measurable and provide an integrated measure of the physiological status of the organism. Number of investigators have carried out numerous investigations in different fish species by exposing them to different industrial effluents to study their haematological effects. Mcleay (1973) exposed kraft and pulp mill effluent to *Oncorhynchus kisitch,* likewise Murugesan & Haniffa (1985) and Haniffa & Arul Selvan (1991) exposed the fish *Anabas testudineus* and *Oreochromis mossambicus* in textile mill effluent.

Moreover, Udayakumar (2005) and Ramesh (2006) experimented the catfish *Clarias batrachus* by introducing them in dairy and sago effluents respectively.

Several investigations and their reports are available about other industrial effluents, but work on dairy effluent is meagre. Hence, the present investigation has been designed to examine the impact of treated dairy effluent with blood of freshwater fish *Clarias batrachus.*

MATERIALS AND METHODS

Treated dairy effluent was collected from a local dairy plant. 100 catfish having a weight of 5 ± 1 g were procured. The stockfish were maintained in a clean cement tank under normal room temperature (23 ± 1°C). The fish were fed with finely chopped semiboiled beef liver and chick intestine mixture. Test animals were acclimatized to the laboratory conditions for 20 days before experiment. 25%, 50%, 75% and 100% concentrations of treated dairy effluent were chosen with one control for experiment. Exposure period was 30 days. After completion of exposure period, randomly two fish were selected from each concentration and subjected to haematological tests. The blood was collected from the caudal vein by using a hypodermic syringe rinsed with sodium citrate solution. The collected blood was transferred immediately to EDTA tubes for further analysis. The haematological parameters such as total erythrocytes (RBC), haematocrit or packet cell volume (PCV), mean corpuscular volume (MCV), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet (Plt) and mean platelet volume (MPV) were determined by the standard human haematological procedures modified for fish as described by Blaxhall & Daisly (1973).

RESULTS

The values of different blood parameters of experimental fish are shown in Table 1 and are presented through Figs. 1 to 8.

Red Blood Corpuscels: The control fish shows $1.66 \times 10^6/mm^3$ of RBC counts, but it was high in 25%, 75% and 100% and low in 50% concentrations of treated dairy effluent with the values 1.85, 1.83 and 1.83 and $1.15 \times 10^6/mm^3$ units RBC respectively (Table 1, Fig.1).

Haematocrit: The haematocrit was lower in 50% group (19.6%) and increased in 25% and 75% and 100% at 28 and 28.1 and 27.1% respectively. The control fish shows 27.9% haematocrit value (Table 1, Fig. 2).

Mean Corpuscular Volume: The 50% effluent exposed fish shows maximum (170.6 μm^3) MCV value. The control fish had 168 μm^3 whereas the 25%, 75% and 100% exposed fish show lower MCV values of 151.3, 153.4 and 148.2 μm^3 respectively (Table 1, Fig. 3).

Haemoglobin: The haemoglobin of control fish recorded was 12.1 g/dL. However, it was gradually decreased with increase in concentration of the effluent from 25%, 75% to 100% with the values 10.1, 9.5 and 9.0 g/dL respectively. However, the 50% group shows a lower Hb of 6.9 g/dL (Table 1, Fig. 4).

Mean Corpuscular Haemoglobin and Concentration: Both the MCH and MCHC declined in all the exposed concentrations (25%, 50%, 75% and 100%) of the dairy effluent and found to be 54.8, 60.6, 51.9 and 49.1 pg, and 36.2 g/dL, 35.5 g/dL, 33.8 g/dL and 33.1 g/dL respectively. The MCH and MCHC of control group show 72.8 and 43.3 g/dL respectively (Table 1, Figs. 5 and.6).

Platelets: The platelets in control fish were $30 \times 10^3/mm^3$. A total increase in platelets levels was

Table 1: Alterations of haematological parameters in *Clarias batrachus* after 30-day exposure in control, and 25%, 50%, 75% and 100% concentrations of the treated dairy effluent.

S.N.	Parameters	Control	Concentrations of Treated Dairy Effluent			
			25%	50%	75%	100%
1	RBC (10^6/mm^3)	1.66	1.85 (+11.44%)	1.15 (-30.72%)	1.83 (+10.24%)	1.83 (+10.24%)
2	HCT or PCV (%)	27.9	28 (+0.36%)	19.6 (-29.75%)	28.1 (+0.72%)	27.1 (-2.87%)
3	MCV (µm^3)	168	151.3 (–9.94%)	170.6 (+1.55%)	153.4 (-8.70%)	148.2 (-11.78%)
4	Hb (g/dL)	12.1	10.1 (–16.53%)	6.9 (-42.97%)	9.5 (-21.49%)	9 (-25.62%)
5	MCH (pg)	72.8	54.8 (–24.72%)	60.6 (-16.76%)	51.9 (-28.71%)	49.1 (-32.55%)
6	MCHC (g/dL)	43.3	36.2 (–16.40%)	35.5 (-18.01%)	33.8 (-21.94%)	33.1 (-23.56%)
7	Plt (m/mm^3)	30	40 (+33.33%)	50 (+66.67%)	70 (+133.33%)	46 (+53.33%)
8	MPV (µm^3)	9.5	12.6 (+32.63%)	8.2 (-13.68%)	9.1 (-4.21%)	11.9 (+25.26%)

Values in parentheses denotes percent change '+' increase and '-' depletion over control values

observed in all the exposed concentrations of the dairy effluent with the values 40, 50, 70 and 46 × 10^3/mm^3 in 25%, 50%, 75% and 100% respectively (Table 1, Fig. 7).

Mean Platelet Volume: The MPV in control group was observed to be 9.5 µm^3. It was elevated in 25% and 100% (12.6) and (11.9 µm^3) respectively, and decreased in 50% and 75% (8.2) and (9.1 µm^3) respectively (Table 1, Fig. 8).

DISCUSSION

The use of clinical haematology in fish research has a long tradition in many countries of the world. The knowledge of haematological indices makes it possible to learn more objectively the condition and function of the fishes and their responses to external influences. Fish haematology makes it possible to characterize the fishes in a more complex manner within the framework of Ichthyology. Blood often exhibits pathological changes before the appearance of any external symptoms of toxicity. Therefore, the haematological studies in animals form a promising tool for the investigation of physiological alteration caused by the environmental pollutants. Blood being the medium of intercellular and intracellular transport, comes in direct contact with various organs and tissues of the body; the physiological state of an animal at a particular time is reflected in its blood.

In the present investigation an increase and decrease in level of erythrocytes, haematocrit and mean corpuscular volumes were found. On the other hand declined haemoglobin, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations were observed. But the mean platelet volume and platelets were found to be enhanced. These findings have been well established with different pollutants by several studies. Generally, RBC and PCV were found to be increased while Hb, MCH, MCHC and MCV were decreased when the fish *Notopterus notopterus* was exposed to phenolic compounds (Verma et al. 1981). Gill & Pant (1985) found that when the freshwater fish, *Punctius conchonius* was exposed to cadmium it showed decreased RBC, HB and HCT values, but increased MCH and MCV after 30 days exposure. The decreased values of haematocrit, haemoglobin and red blood cell count indicate disturbances in the red blood status (Hardig et al. 1988). Srivastava et al. (1996) reported declined levels of RBC, Hb and HCT percentage in the fish treated with malachite green and fuchsine dyes at different time intervals. Navaraj & Kumaraguru (2003) observed that the fish *Oriochromis mossambicus*, exposed to electroplating effluent, induced haematological changes with the increase in time of exposure and concentration of the effluent. Subramanian et al. (2003) revealed that the RBC and haematocrit showed an increase in the fishes

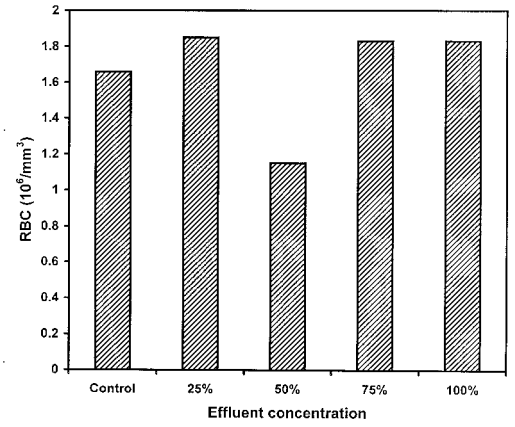

Fig. 1: Red Blood corpuscels.

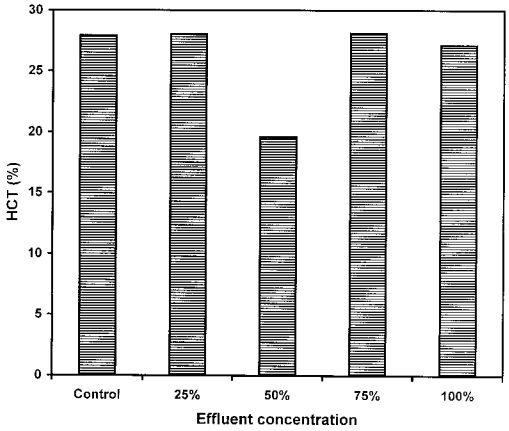

Fig. 2: Haematocrit.

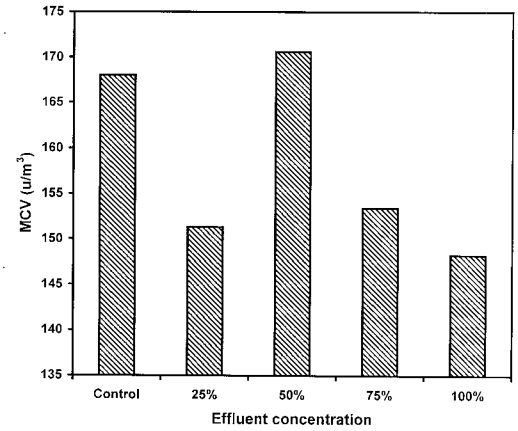

Fig. 3: Mean corpuscular volume.

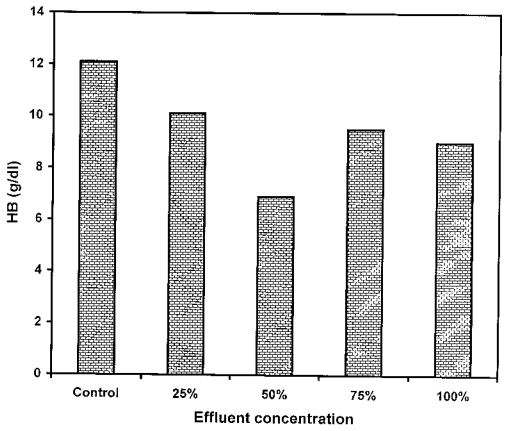

Fig. 4: Haemoglobin.

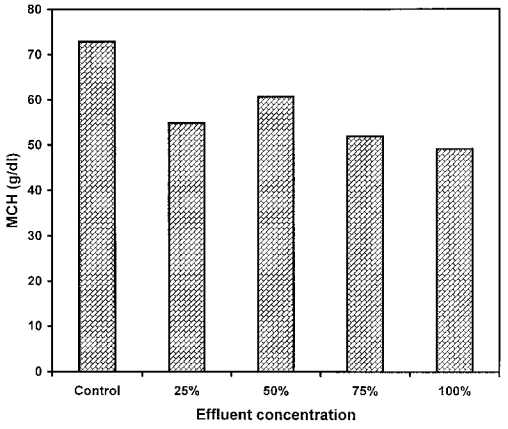

Fig. 5: Mean corpuscular haemoglobin.

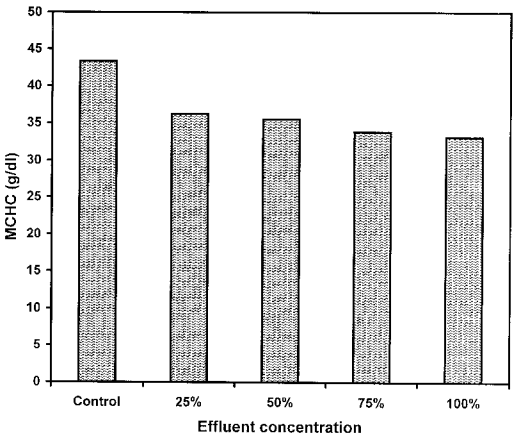

Fig. 6: Mean corpuscular haemoglobin concentration.

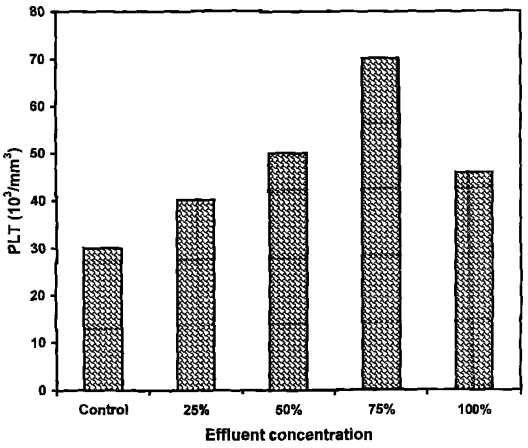

Fig. 7: Platelets.

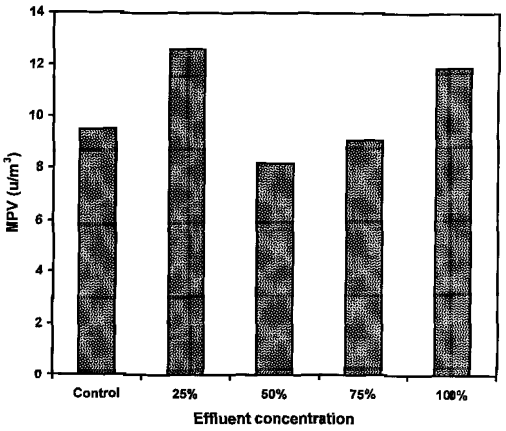

Fig. 8: Mean platelet volume.

exposed to DDT and mercury. The higher value of RBCs in DDT and mercury exposed groups suggest erythropoiesis. Satyanarayan et al. (2004) stated that after chlorinated pesticide exposure to the fishes *Cyprinus carpio* and *Puntius ticto,* they showed decrease in RBC count with respect to increase in exposure period. The fish *Clarias batrachus* exposed to 25%, 50%, 75% and 100% concentrations of the treated dairy effluent shows an increase or decrease in RBC, Hb, HCT, MCV, MCH and MCHC values, but blood platelet was found to be low (Udayakumar 2005). Wells et al. (2005) found high haematocrit value in the fish *Arius leptaspis.* Yougeshkumar et al. (2006) reported the haematological parameters in different sizes of fish *Clarias batrachus.* The findings proved that smaller size fish show decreased HB and HCT, but medium size fish show lower Hb and RBC counts. The MCH and MCHC were found to be decreased with the size of fish and show an increase in large fish. However, PCV and MCV showed gradual increase in all sizes of the fish. Recently Ramesh (2006) studied some haematological parameters in the fish *Clarias batrachus* exposed to treated sago effluent. His results revealed the elevation and declined trend in RBC, HCT and MCH and MCV.

The increase in HCT, Hb and RBC counts due to the nonspecific stress triggers release of catecholamines, which in turn cause contraction of spleen and release of red blood cells out in the circulation. The decline in RBC number and Hb content could be due to either destruction of erythrocytes or inhibition of erythropoiesis. The declined MCHC values in the blood indicate the destruction of erythrocytes. The increase in blood platelet value is due to damage of vascular epithelium cells. Finally, to conclude, the alterations in the haematological parameters in the fish *Clarias batrachus* exposed to different concentrations of treated dairy effluent, may be due to physiological stress caused by the presence of high TDS, alkalinity, chloride and sodium in the effluent.

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