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Haematological alteration in air breathing fishes on exposure to paper mill effluent

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ABSTRACT

Air breathing fishes like *Channa punctatus, Clarias batrachus* and *Anabas testudineus* were exposed to paper mill effluent (20%) for a period of 30 days. Changes in haematological parameters like Haemoglobin (Hb), Total Erythrocyte Count (TEC), Total Leucocyte Count (TLC) and Packed Cell Volume (PCV) was observed at end of exposure period. Among the three fishes *Clarias batrachus* was found to be more tolerant than other two fishes.

Key words: Air breathing, Paper mill effluent, Haematology

INTRODUCTION

Paper mill industry is one of the major polluting industries across the world. Due to the direct release of the effluent into the water bodies as an organic load, it threatens the aquatic ecosystem there by affecting the flora and fauna in general and fishes in particular. Toxicological studies of pulp & paper mill effluent have very often been reported (Walden, 1976, Hontela et al 1997, Pathan et al 2009, Mishra et al 2011). Paper mill effluent does have an effect on fish physiology (Munkittrick et al., 1992, Ukagwu et al, 2012).

Respiratory metabolism of fish *Oreochromis mossambicus* was effected due to paper mill pollution (Nanda et al., 2002). Effect in respiratory metabolism was due to changes in the haematology of fish *Rasbora daniconius* (Vijayram et al.,1988).When exposed to paper mill effluent ,the air breathing fishes showed a toxicity response like *Anabas testuduineus* > *Clarias batrachus* > *Channa punctatus* (Nanda et al.,2000). In view of the above findings the present piece of research work was designed to study the haematological changes in air breathing fishes due to paper mill effluent.

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MATERIALS AND METHODS

Live specimen of *Anabas testuduineus*, *Clarias batrachus* & *Channa punctatus* were collected from local fish farm and acclimated to the laboratory condition for period of one week. Fishes were fed with commercially available balanced diet daily. During acclimation period water was replenished daily to avoid accumulation of unutilized food and metabolic waste of the fish. The fishes were ranging a length of 15-20 cm and weighing 25-35 gm. The effluent sample was collected and physic-chemical characteristics were done following the standard methods of APHA (1985). After determining the 96hr. LC_{50} value (Nanda et al., 1999) ,the effluent was diluted to 20% and three aquaria was set for all three different species. Three aquaria were used as control with tap water. Each species was kept in separate aquaria. To all the aquaria ten numbers of fish was released and exposed for a period of 30 days. The effluent concentration was renewed after every alternate day to maintain the desired concentration and to avoid excess deposition of excretory materials.

At the end of the exposure period, blood was drawn from gill region with the help of heparinized needles &

stocked in heparin coated glass vials. Haematological parameters like Haemoglobin (Hb) ,Total Erythrocyte Count (TEC) ,Total Leucocyte Count (TLC) and Packed Cell Volume (PCV) were done by the standard methods described by Dacie & Lewis (1975).The absolute value like Mean Cell Haemoglobin (MCH), Mean Cell Haemoglobin Concentration (MCHC) and Mean Cell Volume (MCV) were calculated from the above findings.

RESULTS AND DISCUSSION

On exposure to 20% concentration of paper mill effluent for 30 days, there has been a marked changes observed in haematolgy of fishes. This is presented in the table-1. Before the start of the experiment the 96 hr LC_{50} value for the fishes was worked out (Nanda et al., 2000). The level of toxicity was found to be, *Anbas testudineus* was more sensitive to effluent (%) whereas *Clarias batrachus* was more resistant. The physico-chemical characteristics of effluent indicated highly alkaline with BOD & COD at the higher site and heavy metals were below permissible level (Nanda et al.,1999).

The haematological variables altered significantly ($p < 0.001$) in fishes exposed to effluent. The variation in the haemoglobin concentration among *Anabas testuduineus*, *Clarias batrachus* & *Channa punctatus* was insignificant ($p>0.05$).After the exposure period there was depletion in the erythrocyte indices like haemoglobin concentration ,total erythrocyte count and packed cell volume in all the three species. However the changes are less in *Clarias batrachus* than other two species. This may be due different accessory respiratory structure.

Depletion in erythrocyte indices may be attributed to deficit in iron and its utilization in haemoglobin synthesis (Nanda and Behera, 1996).Decrease in iron uptake may be related to our earlier work which is evident with the damage of intestinal villi (Nanda et al 2004).It was also observed that respiratory metabolism was also effected when *Oreochromis mossambicus* was exposed to paper mill effluent (Nanda et al., 2002).

The absolute values like MCH, MCV &MCHC are always in response to the above erythrocyte parameters. There has been an increase in MCH in all the three species which signifies macrocytic anaemia. However the increase in *Clarias batrachus* is not significant ($p>0.05$). The MCHC also shows significant ($p<0.001$) decrease in both *Clarias batrachus* and *Anabas testudineus* from the control value. However there has been no change in the MCHC level of *Channa punctatus* between control and treated species. There has been a significant ($p<0.001$) level of increase in MCV level in all the three species from their control species. The increase in MCV level may be attributed to liver damage which is evident from our previous work (Nanda et al 2004).So the overall alteration in absolute values of haematological parameters indicates of macrocytic hypochromic anaemia.

Increase in total leucocyte content indicates leucopoesis. There was increase in lymphocyte count of *Lithognathus mormyrus* when exposed to paper mill effluent (Wahbi et al ., 2004)This is also in agreement with my earlier work when air breathing fish *Heteropneustes fossilis* exposed to heavy metal (Nanda and Behera, 1996).

CONCLUSION

From the above findings it is evident that *Anabas testudineus* is more sensitive whereas *Clarias batrachus* is more resistant to paper mill pollution .Hence, exposure of air breathing fishes to paper mill effluent alters the haematological parameters with a different response in species which relate to their air breathing structure.

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Table-1-Haematological changes in air breathing fishes on exposure to paper mill effluent

Haematological Parameters	*Channa punctatus*		*Clarias batrachus*		*Anabas testudineus*	
	0%	20%	0%	20%	0%	20%
Hb (g %)	12.66 ± 2.09	5.74 ±1.08	12.86 ±2.15	8.69 ±1.07	12.59 ±2.4	4.7 ±2.4
TEC ($x10^6.mm^{-3}$)	2.6 ±2.03	1.03 ±2.03	2.83 ±0.06	1.74 ±0.03	2.6 ±0.23	0.78 ±0.7
PCV (%)	32.9 ±3.42	15.21 ±1.91	32.51 ±0.49	21.56 ±1.94	45.43 ±0.6	24.82 ±0.13
MCH (pg)	48.22 ±3.65	55.18 ±2.33	46.43 ±3.46	49.9 ±1.3	48.52 ±3.02	60.14 ±3.68
MCHC (%)	38.45 ±2.66	37.83 ±2.73	40.49 ±3.38	27.53 ±2.86	27.74 ±2.28	19.0 ±1.71
MCV (μ^3)	124.98 ±6.2	147.44 ±8.79	114.99 ±3.43	181.2 ±5.65	176.74 ±21.9	316.87 ±28.2
TLC ($x10^3.mm^{-3}$)	16.49 ±1.86	39.54 ±1.16	17.1 ±1.5	68.1 ±2.8	15.71 ±2.43	44.06 ±1.77

Data are means 10 observation, ± indicates standard deviation

facility for this work

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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