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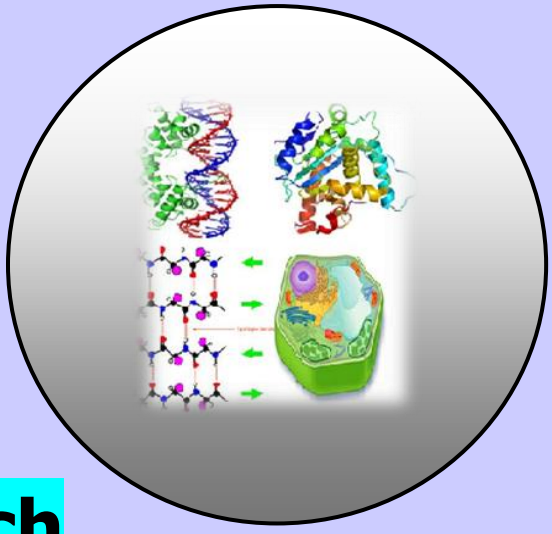

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RESEARCH PAPER

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Toxicity in Blood Parameters of Fish *Clarias batrachus* Due to Fertilizer Calcium Ammonium Nitrate

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ABSTRACT

Fertilizer CAN decreased haemoglobin, red blood cell count and haematocrit 25.15%, 28.58% and 34.61% respectively below control in fish, Clarias batrachus, total leucocyte count (TLC), at higher concentrations and shorter exposures increased gradually and reached the peak when the fishes died.
Keywords: Fertilizer, Calcium Ammonium Nitrate, Haematotoxicity and Fish.

INTRODUCTION

CAN is one of the commonest fertilizers used for increasing crop production in India. Nitrates are naturally present in soil, water, plant material, meat and in small concentration in air (1-40 $\mu g/m^3$). The level of nitrates increases in cultivated soil and in water, due to the use of commercial nitrogenous fertilizers and by the return of water, derived from animal husbandry and other sources to the soil. The plant species also influence the nitrate content of the crops by environmental and genetic factors and by agricultural management practices. In plant products presence of high content of nitrates, due to the use of excessive amounts of nitrogenous fertilizers, may become dangerous to human health. Highly toxic nitrates are produced either by bacteria or by enzymatic conversions during long transports. In fishes, a large number of workers have observed the toxicities of ammonia, nitrates and nitrites (Mukhopadhyay, 1977; Sathyanesan et al, 1978; Swift, 1981; Chatterjee Bhattacharya, 1983; Thurston and Russo, 1983; Begum et al., 1984).

Haematotoxic stress of fertilizer CAN to fishes has not been studied in detail so far. Hence, the experiment was planned to see its haematotoxicity to fish, *Clarias batrachus*. The results are presented in this paper.

MATERIALS AND METHODS

Haemoglobin, total erythrocyte count, haematocrit and total leucocyte count of fresh water commercial fish, *Clarias batrachus* were measured (Trivedi et al., 1989 a, b, 1990). The fertilizer Calcium Ammonium Nitrate was purchased from Government Approved Agricultural Shop, Daliganj, Lucknow).

OBSERVATIONS AND RESULTS

Water Characteristics

Water characteristics analysed before and at the end of each experiment (Table – I) were well comparable. pH, after dissolving different amounts of fertilizer increased slightly, indicating that medium became basic.

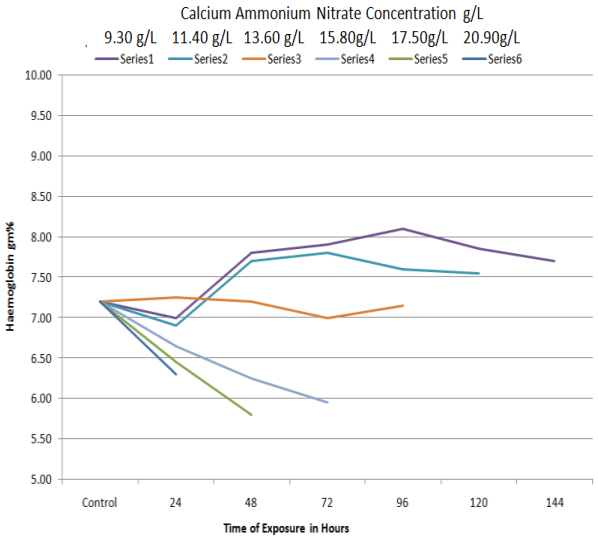
Table 1. Water Characteristics after dissolving Calcium Ammonium Nitrate fertilizer at different time intervals and concentrations with the fish, *Clarias balrachus*.

Parameters								
Fertilizer concentration (g/L)	Exposure Time (hr)	Room temp (^{0}C)	Aquaria temp (^{0}C)	pH	Hardness (total ppm)	Hardness (permanent ppm)	Alkalinity (methyl orange ppm)	Dissolved oxygen (ppm)
0.00*	00* 144*	29.0* 28.5*	23.5* 23.2*	7.00* 7.02*	182* 162*	182* 162*	255* 285*	7.60* 7.00*
9.30	00 144	29.0 30.0	23.7 24.2	7.05 7.20	179 152	179 152	435 402	7.45 7.20
11.40	00 120	29.0 29.2	24.0 24.6	7.08 7.25	172 858	172 858	445 415	7.60 7.25
13.60	00 96	29.0 21.5	24.3 24.9	7.25 7.45	173 165	173 165	465 455	7.85 7.20
15.80	00 72	29.0 29.5	23.5 24.8	7.35 7.60	168 162	168 162	490 460	7.80 6.95
17.50	00 48	29.5 29.4	23.2 24.2	7.40 7.51	154 146	154 146	520 580	7.85 7.00
20.90	00 24	29.5 29.3	22.9 23.3	7.54 7.68	143 121	143 121	570 595	7.60 6.90

* Control values

Haemogolobin

At lower concentrations (9.30, 11.40 and 13.60 *g/L*), the haemoglobin content in initial exposures were high, but in prolonged time intervals of 144, 120 and 96 hours the fishes died (Fig. 1-A). The fish mortality may be due to haematotoxic stress and failure in adjustment of body mechanism.



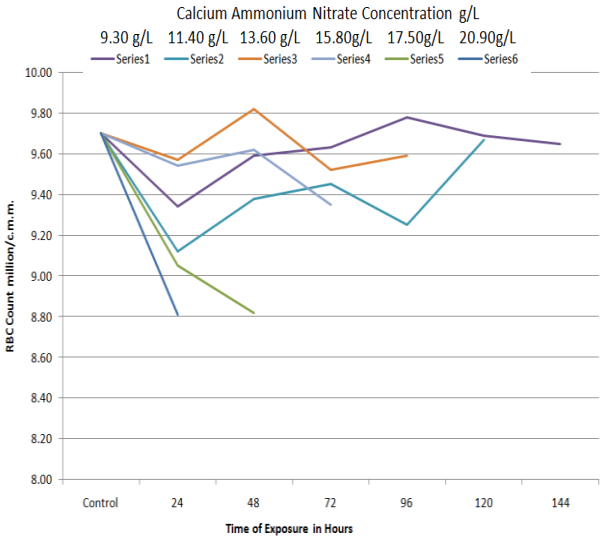
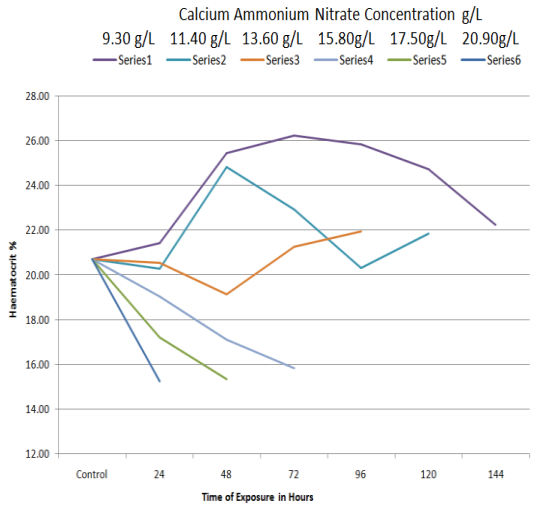


Fig: 1-A Effect of Fertilizer Calcium Ammonium Nitrate on Haemoglobin of Fish *Clarias batrachus*

Fig: 1-B Effect of Fertilizer Calcium Ammonium Nitrate on RBC Count of Fish *Clarias batrachus*



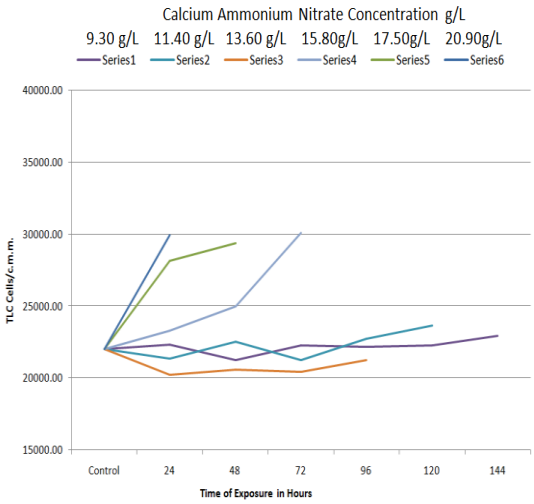


Fig: 1-C Effect of Fertilizer Calcium Ammonium Nitrate on Haematocrit of Fish *Clarias batrachus*

Fig: 1-D Effect of Fertilizer Calcium Ammonium Nitrate on TLC of Fish *Clarias batrachus*

Red Blood Cells (RBC) Count

The fishes tolerated well the concentrations of 9.30, 11.40 and 13.60 *g/l*, for 144, 120 and 96 hours; the RBC count was similar to controls (Fig. 1-B). However, the fishes died after that. Concentrations of 15.80, 17.50 and 20.90 *g/l* proved lethal in 72, 48 and 24 hours and decrease in count was observed.

Haemtocrit

Haematocrit at the concentrations of 9.30, 13.60 11.40 *g/l* remained almost unaffected (Fig. 1-C) and very little changes were seen at 15.80, 17.50 and 20.90 *g/l* concentrations in 72, 48 and 24 hours.

Total Leucocyte Count (TLC)

At lower concentrations, the TLC was not significantly changed indicating that the fertilizer did not possibly cause any infection (Fig. I-D). At higher concentrations, the number of leucycyte cells increased gradually and were maximum at the end.

DISCUSSION

Calcium ammonium nitrate leaches out of the fields, pollutes the surrounding water areas and affects the fishes and other aquatic animals. Acute and chronic toxicity studies on nitrate intoxication in animals and humans have shown that nitrate ingestion results in disturbances of energy conversion processes, such as glycolysis and the pentose cycle; interferes with the activity of glutathione—ascorbic acid system in blood, hepatic and cerebral tissues and raises the levels of methemoglobin and of NADH-methemoglobin reductase activity with a concomitant reduction of haemoglobin levels (WHO, 1978). Clinical symptoms of nitrate toxicity, mainly due to hypoxia, appear when methemoglobin values exceed about 20 to 40% (WHO, 1978) and death usually occurs at 80 to 90% levels (Buck et al., 1976).

Nitrates and nitrites are rapidly absorbed in gastrointestinal tract and react with haemoglobin to form methemoglobin which, in adults, is rapidly converted to oxyhemoglobin by reductase enzyme systems, such as, NADH—methemoglobin reductase. In infants, this enzyme system is not completely developed. Under these conditions therefore, its increase in the body results in, characteristic symptoms of methemoglobinemia, as had been observed in a large number of studies on nitrate intoxication (WHO, 1978).

In our studies, the haematotoxic stress of fertilizer CAN lowered haemoglobin, RBC count, and haematocrit 25.15%, 28.58% and 34.61% % respectively. TLC increased 67.37% at the highest concentration of 20.90 *g/L* within 24 hours. The blood cell counts can be used to monitor the detrimental toxicity of fertilizer CAN in relation to time intervals and concentrations. The haematotoxic stress was the outcome of CAN intoxication to fish *Clarias batrachus*, which similarly may be applicable to other fresh water fishes of the surrounding water areas.

Chronic ammonia toxicity to duckweed fed Tilapia *(Oreochromis niloticus)* was observed (El-Shefai et al, 2004). Haematological response of African catfish *(Clarias gariepinus)* & rat to crude oil exposure was also reported (Taofik et al, 2008) Ammonia toxicity in fishes (Randall et al, 2002) and Acute toxicity of inorganic fertilizers to African catfish, *Clarias gariepinus* (Teugals) was also seen (Ufodike et al, 2008). Ethological responses of *Channa striatus* to fertilizer industrial wastewater were also reported (Yadav et al, 2007).

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REFERENCES

APHA, AWWA and WPCF (1985). American Public Health Association, American Water Works Association and Water Pollution Control Federation. *Standard Methods for the Examination of Water and Waster Water*, 16th Ed. American Public Health Association,

Washington, D. C. Begum, S. J. Mohanchari, V. and Indira, K. (1984). Changes in energy fuels of fish during ammonia stress. Environ. Ecol, 2 : 286-289.

Buck, B. W., Osweiler, G. D. and Van Gelder, G. A. (1976). In: *Common Plants Known to Accumulate Nitrate,* 2nd Ed., Kendall, Hunt Publ. Co., Dubugue, Iowa.

Chatterjee, S. and Bhattacharya, S. (1983). Ammonia induced change in the hepatic glutathione level of an air-breathing fresh water teleost. *Channa punctatus* (Bloch) Toxicol. Lett., 17: 329-333.

Mukhopadhyay, S. (1977). Potential contribution of fertilizer nitrogen to the pollution of natural water. In : *Environmental Pollution and Toxicology* (S. P. Ray Chaudhuri and D. S. Gupta, Eds) pp 223-226 Today and Tomorrow's Printers and Publishers New Delhi.

Naqvi, M. S. (1983). In: *Effect of Environmental Pollution on Fresh Water Fishes*, Ph. D. Thesis, University of Lucknow, Lucknow.

Sathyanesan, A. G , Joy, K. P. and Kulkarni, R. S. (1978). Endocrine changes in fishes in response to pollutants (Q.J. Surg. Sci. 14: 67-77.

Singh, R. K. (1982). In *Ecophysiological Studies on some Fresh Water Fishes*, Ph.D. Thesis, University of Lucknow, Lucknow.

Swift, D. J. (1981). Changes in selected blood component concentrations of rainbow trout, *Salmon gardneri* (Richardson) exposed to hypoxia or sublethal concentrations of phenol or ammonia. J. Fish Biol., 19; 45-61.

Trivedi, S. P. Singh, P., Sethi, N. and Singh, R. K. (1990). Evaluation of haematotoxic effects of two commonly used fertilizers. Diammoniurn Phosphate and Urea, on fish *Clarias batrachus*. *Ecotox. Environ. Saf.* 19 (2) : 135-142.

Thurston, R. V. and Rosso, R. C. (1983). Acute toxicity of ammonia to rainbow trout Trans. Amer. Fish. Soc. 112 696-704.

W. H. 0. (1978). *Environmental Health Criteria*, No. 5, World Health Organisation, Geneva.

El-Shefai, S.A., El-Gohary, F.A., Nasr, F.A., Vander Steen, N.P., and Gijzen, H.J. (2004). Chronic ammonia toxicity to duckweed fed Tilapia *(Oreochromis niloticus)*. Aquaculture, 233:117-127.

Taofik, O., Sunmonu, Oyelola, B., Oloyede, (2008). Haematological response of African catfish *(Clarias gariepinus)* & rat to crude oil exposure. The internent Jr. of Haematology. 4(i).

Randall, D.J. and Tsui, T.K.N. (2002). Ammonia toxicity in fish. Marine pollution Bull. 45,17-23.

Ufodike, E.B.C. and Onusiriuka, B.C. (2008). Acute toxicity of inorganic fertilizers to African catfish, *Clarias gariepinus* (Teugals). Aquacul. Res. 21, 181-186.

Yadav A, Neraliya, S. and Gopesh, A. (2007). Acute toxicity levels and ethological responses of *Channa striatus* to fertilizer industrial wastewater. J. Environ. Biol. 28 (2), 159-162.

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