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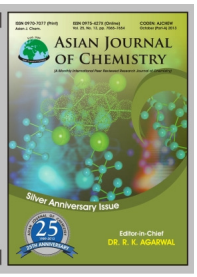

Impacts of Textile Waste Water on Fingerlings of Fresh Water Reservoir

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Dye wastewater as an organic persistent pollutant chosen to investigate the impact on fingerlings of *Tilapia mossambica* collected from Kanjheer Lake of Sindh (average length, 15-18 cm) and weight, 42-45 g) at laboratory scale. The non-treated dye waste water collected from the regular dye centers from local market. Experiments were conducted into the three replicates *viz.*; non-treated and treated by dye waste water till mortality of all the fingerlings. The treatment was designed into two sets (I) 1 % and (II) 10 % dye waste in fish aquarium. It was observed that the fingerlings exposed to 10 % of the dye waste experienced rapid death within 12 h. While those which exposed to 1 % the dye waste showed delay in the mortality rate. It was the reduction in the length and the weight with reddish injury symptoms in the skin of the fingerlings. The dissection of the fish showed that the liver, kidney, heart and intestine were dissolving and appeared as bubbles. Investigations suggested that the decrease in muscles or dissolve of other important organism can be related with decrease in the concentration of the total protein. An increase in the concentration of total lipids and glucose may be due to the abnormal metabolism under stress. Analysis of essential mineral ions showed that the sodium ions contents were decreases and the concentration of potassium, calcium and magnesium ions increases after the exposure period. From the present research, it is assumed that the textile dye waste water induced adverse effects on fingerlings nurseries of economically important fish.

Key Words: Mortality, Injury symptoms, Carcinogenic, Waste stress.

INTRODUCTION

Pollution of natural water by industrial waste has increased tremendously with the quick growth of the industries in the country[1]. Water pollution caused by the textile industry is mostly by the discharge of dissipate flows coming out from damp processing operation like desizing, scouring bleaching, mercerizing, dyeing and printing *etc*. Owing to this chemical effluence, the typical running of the cell is distressed and this sequentially may cause adaptation in the physiology and the biochemical mechanisms of animals resulting in the destruction of significant functions like respiration, osmoregulation, reproduction and yet mortality[2]. Textile effluents are known toxicants, which inflict acute disorders in aquatic organisms. Uptake of textile effluents through food chain in aquatic organisms may cause various physiological disorders like hypertension, sporadic fever and renal damage; cramps *etc*. The bio-accumulation of organic and inorganic toxicants depends on availability and persistence of the contaminants in water, food and physiological properties of the toxicants[3]. The noxious wastes build up in the food chain are responsible for the adverse effects and finally death of marine organisms[4,5] and they can impart severe damage to marine life[6].

Further it is also critical to estimate toxic effects of dye waste water on fishes, as they form very chief members of food chain of the ecology. Fishes are the susceptible to contaminations of water and pollutants could extensively damage definite hematological and biochemical processes when they come into organs of these animals[7], the discharge and accumulation of dyes in suspension solution form in inland waters from tanneries, textile, paper and other industries generate remarkable chemico-azo strain on marine organism counting fishes and a number of time results in their mass mortality[8,9].

Consideration of toxicity of sewage from examination of being physico-chemical parameters is frequently erroneous as mainly dye industrial effluents are complex mixtures of diverse components. They apply synergistic and antagonistic effect on organism. For examining water quality organisms was used[10].

Keeping all the above mentioned facts this study was launched to check the impact of dye waste on nurseries of the fresh water fingerlings. The fingerlings were collected from the fresh water lake. The biophysical and biochemical parameters were monitored in the two sets of the experiments.

EXPERIMENTAL

The dye waste water was collected from the dye center from Karachi city, commonly disposed without treatment. The experimental fishes *(Tilapia mossambica*) were collected through fisherman from water reservoirs of Kanjheer Lake located in *Thatta* Sindh during month of March 2011 and instantaneously brought to the laboratory for exploring the nutritional profile for the survival of fish species under stress condition[11]. A group of healthy fishes were used for experiments. The fishes were fed with standard fish meal and kept in laboratory conditions for 15 days in glass aquaria. The fishes of average length 15-18 cm and weight 42-45 g were used for experiment. The investigations were carried out weekly till the mortality of the fish. After exposure period the fishes were dissected to check the impact of dye waste on the important organs like liver, kidney and muscles[12]. The concentration of total protein and glucose were estimated according to the Randox Standardized Kit (Randox Laboratory Ltd, UK) and of total lipids according to the Standardized Kit (Bio Science)[11]. The estimation of the amount of Na^+, K^+, Ca^{2+} and Mg^{2+} ions, were estimated by atomic absorption spectrophotometer. The data was subjected to statistical analysis.

RESULTS AND DISCUSSION

Textile run-offs are considered by their ability to decrease biological oxygen demand (BOD), unusual turbidity, colour, chemical oxygen demand (COD), total suspended solids (TSS) and total hardness. Dye wastewater as an organic persistent pollutant chosen to investigate the impact on fingerlings of *Tilapia mossambica* collected from Kanjheer Lake of Sindh (average length,15-18 cm) and weight, 42-45 g) at laboratory scale. The non-treated dye waste water collected from the regular dye centers from local market. Experiments were conducted into the three replicates *viz.*; non-treated and treated by dye waste water till mortality of all the fingerlings. The treatment was designed into two sets (I) 1 % and (II) 10 % of dye waste in fish aquarium. It was observed that the fingerlings exposed to 10 % of the dye waste experienced rapid death within 1 h. While those which exposed to 1 % the dye waste showed delay in the mortality rate. It was the reduction in the length and the weight with reddish injury symptoms in the skin of the fingerlings (Figs. 1-10). The dissection of the fish showed that the liver, kidney, heart and intestine were dissolving and appeared as bubbles. Following aspects related to the biophysical and biochemical alterations were investigated.

Biophysical investigation: It was observed that 10 % of dye waste water was lethal for the fingerlings and fishes experienced rapid death within 12 h of experiment. The fishes which were exposed to 1 % of dye waste showed slow rate of mortality for one month. The reddish injury symptom on skin of 10 and 1 % of textile dye waste treated fish showed that, it is carcinogenic in nature and showed direct impact on the skin of fish as skin of fish directly in contact of the toxic dye waste. The rapid death of the fingerlings attributed to the increase in chemical oxygen demand of the dye waste which decreases the biological oxygen demand due to which fish experience with in 12 h of observation with loss of weight (Fig. 2). The fingerlings which were kept in 1 % of dye waste showed that

Fig. 1. Untreated fingerlings of *Tilapia mossambica*

Fig. 2. Fingerlings of *Tilapia mossambica* treated with 1 % of dye waste water for 1 week

Fig. 3. Fingerlings of *Tilapia mossambica* treated with 1 % of dye waste water for 2 weeks

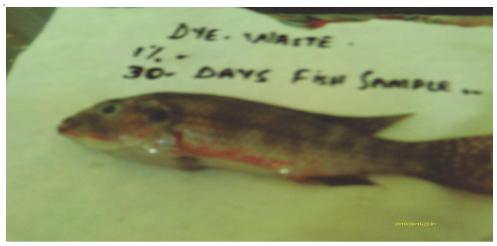

Fig. 4. Fingerlings of *Tilapia mossambica* treated with 1 % of dye waste water for 4 weeks

Fig. 5. Fingerlings of *Tilapia mossambica* treated with 10 % of dye waste water for 12 h

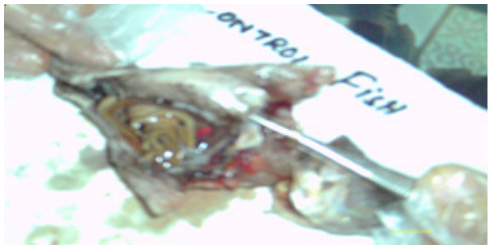

Fig. 6. Dissection of Untreated fingerlings of *Tilapia mossambica*

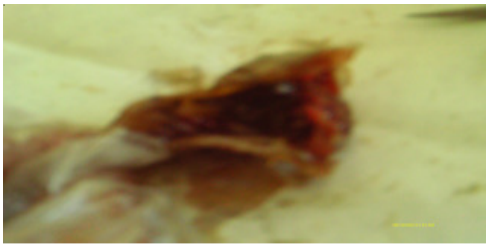

Fig. 7. Dissection of fingerlings of *Tilapia mossambica* treated with 1 % dye waste water for 1 week

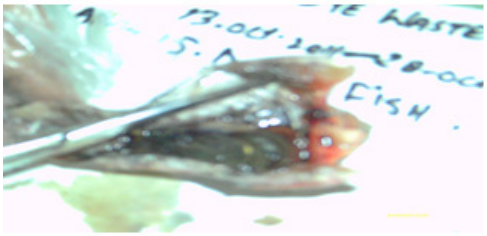

Fig. 8. Dissection of fingerlings of *Tilapia mossambica* treated with 1 % dye waste water for 2 weeks

Fig. 9. Dissection of fingerlings of *Tilapia mossambica* treated with 1 % dye waste water for 4 weeks

Fig. 10. Dissection of fingerlings of *Tilapia mossambica* treated with 10 % dye waste water for 12 h

there were a loss of weight and length of fish and shrinkage in the whole body was observed (Fig. 3). The dissection of the fish showed that the liver, kidney, heart and intestine dissolve and appeared as bubbles. The same results were observed in the fish treated with low percent of dye waste water for long time, like that of 4 weeks. This indicated that low concentration or high concentrations of dye waste both are lethal for fisheries and responsible of lowering in fisheries product. Results proved that the textile effluents are toxic, which inflict acute disorders in aquatic organisms and curiosity of textile effluents through food chain in aquatic organisms may cause various physiological disorders like hypertension, sporadic fever, renal damage, cramps *etc*.[11]. It was also proved that the bio-accumulation of organic and inorganic toxicants depends on availability and persistence of the contaminants in water, food and physiological properties of the toxicants[3].

Biochemical investigation: The analysis of biochemical parameters (total protein, total lipid and glucose) in tissues of muscles of the normal fish bear with textile dye solution (1 %) for 1 week, 2 weeks and 4 weeks and with textile dye solution (10 %) for 12 h are showed in the Table-1. In non-treated fish lipids content were less as compared to the treated one. It was revealed that the lipids content was decreased initially in the first week of observation while increased in rest of the observations (Table-1). The decrease in lipid contents in first week of observation related to the adverse impact of dye waste on fish metabolism which may be due to survival strategies which the fish adopt to overcome the stress. As the lipid content is major source of energy in stress. The increase in lipid contents may also be related with increase in glucose concentration through degradation of lipids into glucose. An increase in the concentration of glucose may also be related to the inhibition of oxidation of carbohydrate to produce energy due to the increase of COD of dye waste that may results in non-utilization of glucose into the energy. The decrease in muscles or dissolve of other important organism can be related with decrease in concentration of total protein and an increase in the concentration of total lipids and glucose (Table-1). Similar results were observed that the considerable amount of the lipid extracted from the tissue during extreme starvation, or in stress conditions. It was also described that lipid forms an important fuel reserve which stored in large quantities and it is an essential component of protoplasm and used in starvation[13].

Results showed the significant decrease in protein ($p < 0.005$) content of muscle under the textile waste effluent. The decline in protein contents in muscles, liver and intestine was observed after the revelation of textile mill sewage on *Cyprinus carpio*[14]. The same results were observed in the muscle of tissue *C. punctatus* after the exposure of heavy metals[15]. Literature search revealed that the reduction of the protein level might be due to the defective protein production and variations between the ribosome and the membranes of endoplasmic reticulum[2,16]. The increase in the glucose level of the tissue in exposed fish clearly indicated that the glycogen reserves are being used to meet the strain caused or it may be the results of degradation of protein under stress. It is described in literature search that increase in serum glucose levels in fish under stress[11]. In the protection of blood glucose protein has a vital role as one of the main sources of energy[17]. Protein is the most essential and abundant biochemical component present in the animal body and the evaluation of protein is considered to be important[18]. Glucose is a carbohydrate that has a significant role in the bioenergetics of animals, being distorted to chemical energy (ATP), which in turn can be expressed as mechanical energy.

Electrolytes investigation: The concentration of Na^+, K^+, Ca^{2+} and Mg^{2+} ions in the tissues of liver, muscles and kidney normal fish bare with textile dye solution (1 %) for 1 week, 2 weeks and 4 weeks and with textile dye solution (10 %) for 12 h are showed in the Table-2. The change in electrolytic concentration may be due to the change in permeability properties of different biological membrane system (Figs. 1-10) which may be attributed to the decrease in the concentration of Na^+. The iso-osmatic condition of the intra cellular milians in fish bare by dye waste maintained by pumping out the Na^+ ions and tries to compensate this loss by ornamental the amino acids pool, without disturbing the water content of the body

TABLE-1
CONCENTRATION OF BIOCHEMICAL PARAMETERS (TOTAL PROTEIN, TOTAL LIPID AND GLUCOSE) IN MUSCLES OF THE FISH *Tilapia mossambica* EXPOSED TO 1 AND 10 % CONCENTRATION OF TEXTILE DYE SOLUTION

Parameters studied	Control	1 week treatment in 1 % textile dye waste	2 weeks treatment in 1% textile dye waste	4 weeks treatment in 1 % textile dye waste	12 h treatment in 10 % textile dye waste
Total protein (g/dl)	97.67 ± 0.2	96.67 ± 0.5	37.87 ± 1	32.89 ± 1	71.76 ± 0.3
Total lipid (mg/dl)	18.04 ± 1	4.01 ± 1	28.07 ± 0.5	40.106 ± 1	46.02 ± 0.5
Glucose (mg/dl)	22.89 ± 1	28.31 ± 1	34.39 ± 2	40.36 ± 1	42.77 ± 0.2

TABLE-2
CONCENTRATION OF Na^+, K^+, Ca^{2+} AND Mg^{2+} IONS IN THE TISSUES OF LIVER, MUSCLES AND KIDNEY OF THE FISH *Tilapia mossambica* EXPOSED TO 1 AND 10 % CONCENTRATION OF TEXTILE DYE SOLUTION

Parameters studied	Control	1 week treatment in 1 % textile dye waste	2 weeks treatment in 1 % textile dye waste	4 weeks treatment in 1 % textile dye waste	12 h treatment in 10 % textile dye waste
Sodium (ppm)	Liver 129.2 ± 0.5 Muscle 105 ± 0.25 Kidney 80.66 ± 0.5	Liver 120.70 ± 0.5 Muscle 101.19 ± 0.1 Kidney 73.03 ± 0.5	Liver 109.32 ± 0.9 Muscle 93.10 ± 0.2 Kidney 67.78 ± 0.25	Liver 96 ± 1 Muscle 87.32 ± 0.1 Kidney 61.34 ± 0.5	Liver 92.64 ± 0.2 Muscle 79.27 ± 0.2 Kidney 53.09 ± 0.1
Potassium (ppm)	Liver 20.75 ± 1 Muscle 18.34 ± 0.2 Kidney 14.63 ± 1	Liver 22.00 ± 2 Muscle 19.21 ± 1 Kidney 15.92 ± 1	Liver 24.12 ± 0.1 Muscle 20.51 ± 0.1 Kidney 17.11 ±0.1	Liver 25.80 ± 1 Muscle 21.92 ± 0.1 Kidney 18.85 ± 1	Liver 27.91 ± 1 Muscle 23.46 ± 0.25 Kidney 19.14 ± 0.5
Calcium (ppm)	Liver 16.18 ± 1 Muscle 14.21 ± 2 Kidney 19.53 ± 1	Liver 17.96 ± 0.5 Muscle 15.46 ± 1 Kidney 21.31± 0.2	Liver 20.70 ± 1 Muscle 18.8 ± 0.2 Kidney 24.71 ± 1	Liver 22.04 ± 1 Muscle 20.00 ± 2 Kidney 27.14 ± 0.6	Liver 26.09 ± 0.1 Muscle 22 ± 1 Kidney 35.28 ± 1
Magnesium (ppm)	Liver 12.21 ± 0.9 Muscle 15.85 ± 0.5 Kidney 19.47 ± 0.3	Liver 12.92 ± 0.1 Muscle 17.05 ± 0.5 Kidney 20.23 ± 1	Liver 13.46 ± 1 Muscle 18.23 ± 1 Kidney 21.56 ± 2	Liver 14.26 ± 0.1 Muscle 19.95 ± 0.5 Kidney 22.69 ± 0.1	Liver 13.78 ± 0.2 Muscle 19.25 ± 0.5 Kidney 24.17 ± 1

during runoff stress[19]. K^+ contents in the three muscles were higher as compared to the non-treated one. The elevation in K^+ ion concentration of the sample is attributed to the decline in the extra cellular space[20]. It may be attributed to maintain the balance of the fish. K^+ is the most important cation of inter cellular fluid and a chief component of the extra cellular fluid. It is important for the activity of nerves and it is present in nerve fibers which are associated to carbohydrate metabolism[21]. The elevation in the concentration of Ca^{2+} ion may be due to an impaired ability of fish to dynamically emit excess of Ca^{2+} ions through kidney[22]. The increment in the divalent cations like calcium and magnesium may be the result in the damage of the skin injury membrane permeability (Figs. 2-4).

Further an increase in the divalent cations like calcium and magnesium will also impair the membrane permeability[12]. Renal dose and dysfunction may result in a major increase in Mg^{2+} level. This significant valuation in Mg^{2+} and Ca^{2+} level is due to hyperactivity of parathromone due to pesticide strain which in turn release more amounts of Ca^{2+} ions in body fluid[23].

The electrolytes like Na^+, K^+, Ca^{2+} and Mg^{2+} plays a major role in fish body and are dispersed in solution throughout all the body fluids. The chief anions are the chloride and bicarbonate ions. Survival of constant internal ion concentrations (*e.g.*, Na^+, K^+, Cl^-, Ca^{2+} and Mg^{2+}) are vital for the active regulation of water influx and ion efflux in marine life[4].

Conclusion

The investigation concluded that non-stop discharge of untreated textile waste into main streams cause severe impact on nurseries of economically important fish species. Acute toxicity studies of textile dye waste on the *Tilapia mossambica* point out the important changes in the ion concentrations (*e.g.* Na^+, K^+, Ca^{2+} and Mg^{2+}). It was supposed that, textile dye waste could induce toxic effects and disturb fish reproduction. It may be recommended that untreated textile waste should be treated or it should be tempered before dumping.

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