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ACUTE AND CHRONIC EFFECTS OF EAST & WEST TREATMENT PLANTS EFFLUENTS ON TILAPIA ZILLII GERV.

By

MOHAMED HASSAN MOURAD*

***National Institute of Oceanography and Fisheries, Alexandria, Egypt.**

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ABSTRACT

The physico-chemical characteristics of East Treatment Plant Effluent (ETPE) and West Treatment Plant Effluent (WTPE) were studied. Both effluents contains considerable concentrations of pollutants. Primary treatment of these effluents were effective in removing most of these pollutants. The results of acute toxicity tests to (ETPE) and (WTPE) showed that the 48-hr.TL_m for Tilapia zillii Gerv. were 85 % and 40 % (%vol./vol.) before treatment and 100 % and 60 % after treatment, respectively. Fish exposed to sublethal concentration (25 %) of (ETPE) and (WTPE) after primary treatment for 11 days exhibited a depression in feeding rate, changes in the condition of fish flesh, hepatosomatic index, blood glucose levels and hemoglobin content in comparison with the control group. It could be concluded that both plants improved the situation but they did not significantly reduce all of the pollution load.

INTRODUCTION

Lake Mariut has been subjected to various anthropogenic activities particularly over the last two decades. This is due to receiving discharges from agricultural, domestic and industrial wastewater drainage from Alexandria Governorate. This situation destroyed the fish and biological life in the lake (Saleh et al., 1983; Abdalla et al., 1991; Ghazaly, 1992). In March 1993, the East and West Treatment Plants began to treat Alexandria wastewater, where the East Plant is treating the wastewater produced from the east zone of the city while the West Plant is treating those from the middle and west zones. Both are primary treatment plants and they discharge their final effluents into the lake.

The aim of this study is to assess:

1. The effect of primary treatment on the removal efficiency of pollutants from wastewater.
2. The toxic effect of raw and treated effluent on the fish.
3. The influence of sublethal concentration of treated effluents on some physiological parameters of Tilapia zillii Gerv

MATERIALS AND METHODS

Representative large samples from East Treatment Plant (ETP) and West Treatment Plant (WTP) before and after treatment (Screening; Plain sedimentation with retention time 2 hrs.) were brought to the laboratory in a plastic containers. Determination of the physico-chemical characteristics of the wastewater were carried out according to the Standard Methods for the Examination of Water and Wastewater (1975).

Specimens of Tilapia zillii Gerv., obtained from El-Max Farm, weighing 11.0 ± 2.0 g were brought to the laboratory and acclimated under appropriate experimental conditions for two weeks. Acute toxicity tests were carried out according to the Standard Methods for the Examination of Water and Wastewater (1975).

The condition of fish flesh (K_f) was determined according to the following equation:

$$K_f = \frac{\text{gutted weight of the fish in grams} \times 100}{(\text{standard length in centimeters})^3}$$

Hepatosomatic index (HSI) was determined according to this formula :

$$HST = \frac{\text{weight of the liver in grams} \times 100}{\text{gutted weight of the fish in grams}}$$

Blood glucose levels was measured using Diascan-S blood glucose monitoring meter (HDI) and Diascan blood glucose monitoring test strips. Hemoglobin content was measured using Sahli haemometer.

Statistical tests "t-test" were made to evaluate the significance of the changes caused by these effluents.

RESULTS AND DISCUSSION

The physico-chemical characteristics of raw and treated effluents from (ETP) and (WTP) are shown in Table (1). It is evident that the main pollution constituent of (WTP) influent were putrefiable organic matter as measured by chemical oxygen demand (COD : 1564 mg/l) and biochemical oxygen demand (BOD : 598 mg/l). It contains also high concentration of settleable solids (20.3 ml/l). Moreover, dissolved oxygen is not found which is attributed to the high chemical and biochemical oxygen demands. In contrast, the influent of ETP showed moderate concentrations of BOD (120 mg/l); COD (359 mg/l) and settleable solids (2.2 ml/l). The considerable high pollution load found in the influent of WTP in comparison with the influent of ETP is due to the high dilution factor i.e. flow rate in ETP is 300.000-400.000 m^3/day while in WTP is 150.000-250.000 m^3/day. Moreover, industrial wastes were estimated to contribute 18 % by volume to the total effluent going to the ETP while the WTP receive 21 % of the industrial effluents generated at this side of the metropolitan area (Saad et al., 1994).

The physico-chemical characteristics of treated effluents of both ETP and WTP indicated that primary treatment was effective in removing most of the pollutants as shown in Table (1). This means that, the situation in Lake Mariut will partially improve but not to the extent of reducing significantly the pollution load.

The results of acute toxicity tests showed that the median tolerance limit (48-hr.TL_m) values for Tilapia zillii Gerv. exposed to raw effluents of ETP and WTP were 85 % and 40 % (%vol./vol.), respectively. The mortality of fish could be attributed mainly to the presence of high concentrations of residual solids, organic matter and low dissolved oxygen. It is well known that high concentrations of solids may cause gills fouling (Saleh, 1982). Lloyd (1960), reported that fouling of gill lamellae may contribute to asphyxia and fish mortality. On the other hand, the 48-hr.TL_m values for Tilapia zillii Gerv. exposed to treated effluents of ETP and WTP were 100 % and 60 % (%vol./vol.), respectively which means that primary treatment was effective in removing most of the pollutants from the wastewater of ETPE while WTPE still have appreciable concentrations of pollutants and the combined effect of the pollutants was still effective.

Table (1): The physico-chemical characteristics of influent and effluent from East and West Treatment Plants.

Parameter	East Treatment Plant INF	EFF	% Rm	West Treatment Plant INF	EFF	% Rm
pH	7.5	7.3	2.7	7.4	7.3	1.4
Settl.S.(ml/l)	2.2	0.3	86.4	20.3	0.9	95.6
T.S. (mg/l)	1456	1291	11.3	3011	2030	32.6
D.S. (mg/l)	1140	1128	1.1	2050	1918	6.4
S.S. (mg/l)	316	163	48.4	961	112	88.3
F.S. (mg/l)	1030	1009	2.0	2011	1655	17.7
V.S. (mg/l)	426	282	33.8	1000	375	62.5
DO (mg/l)	0	0.8	-	0	1.5	-
BOD (mg/l)	120	82	31.7	598	73	87.8
COD (mg/l)	359	210	41.5	1564	77	95.1
FOG (mg/l)	96	73	24	108	57	47.2

Table (2): Changes in the condition of fish flesh (K_f), hepatosomatic index (HSI), blood glucose levels (BGL) and hemoglobin content (Hb%) of Tilapia zillii Gerv. exposed to 25 % treated effluent from East & West Treatment Plants.

Parameter	Control	ETPE	WTPE
Kf	1.579 ± 0.113	1.498 ± 0.092*	1.486 ± 0.157*
H.S.I.	2.396 ± 0.685	1.500 ± 0.36**0**	1.610 ± 0.378*
B.G.L.	35.5 ± 12.60	45.5 ± 18.94	21.1 ± 10.43*
Hb (%)	46.1 ± 8.732	54.8 ± 9.215	48.0 ± 1.632

Changes in some parameters of Tilapia zillii Gerv after exposure to 25 % ETPE and WTPE for 11 days are shown in Table (2) Basically, fish exposed to these effluents exhibited significant depression in feeding rate in comparison with the control aquarium This observation is in agreement with Butler et al (1990) As shown in Table (2), the mean values of the condition of fish flesh (K_1) decreased significantly ($P < 0.05$) after exposure to ETPE and WTPE from 1 579 to 1 498 and 1 486, respectively Saleh (1982)[b], reported that water pollution deteriorate the condition of fish flesh due to a disturbance in the components of this flesh A significant ($P< 0.05$) decrease in the mean values of hepatosomatic index (HSI) was also observed after exposure of the fish to both effluents which indicate a disturbance in the function of the liver The obtained results is in accordance with Saleh (1982)[a] Blood glucose levels decreased significantly ($P< 0.05$) after exposure of the fish to WTPE while hyperglycemia was developed after exposure of the fish to ETPE On the other hand, hemoglobin content increased insignificantly ($P> 0.05$) which may be attributed to gill damage or increased demand for oxygen by certain tissues (Andersson et al , 1988)

From the above we can concluded that both treatment plants reduced the pollution load which was disposed in Lake Mariut. Thus the situation will partially improve but residual concentrations of pollutants are still appreciable and should not be neglected

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