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STUDY ON THE UPTAKE OF DDT BY TILAPIA ZILLII (GERV) LIVING IN FRESH OR SALINE WATER.

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ABSTRACT

This study is a trial to prove that the environmental factors, e.g. salinity, affect the uptake of DDT (organic pollutants) by the fish. This study showed that the uptake of DDT by **Tilapia zillii** living in polluted fresh water to resist to some extent the entrance of DDT through its gills, skin and intestine.

This study showed the accumulation of pollutants on the bottom, as a result of sedimentation of the faeces of the fish which contain very high concentrations of DDT on the bottom specially when the polluted water body is stagnant and snallow.

INTRODUCTION

The extensive use of DDT and other organic pesticides such as toxaphine, lindane....etc during the later years in agriculture and in public health purposes leads to a drastic effect of these pesticides on both terrestrial and aquatic organisms. Risebrough et al (1967) mentioned that DDT and other organic pesticides may stay in the organs and tissues of the living organisms e.g fishes and water birds for a considerable time... months or even years. The bad effect of organic pesticides on the living organisms was discussed by Welcome (1971). He proved that the insecticides and herbicides destroy the metabolic characters and decrease the activity of enzymes. Diechmann et al (1972), Bjerk (1973) showed that there is a direct correlation betwen the fatness of the fish or tissue and its uptake of DDT (organic pollutants). They explained that the fatness of the fish liver varies during the breeding and spawning season and so varies in its DDT content.

This study is a trial to show the effect of one factor of the surrounding environment e.g. salinity on the uptake of DDT by the fish.

MATERIALS AND METHOD

Laboratory experiment was done. DDT with labelled carbon atom ^{14}C was used so that the results obtained would be more accurate. **Tilapia**

zillii Gerv captured from Lake Qarun, where the water salinity is about 30%°, were under the experimental test. Experiments were carried out in two cases

a - High Concentration of ^{14}C DDT

Two aquaria were used. One contained fresh water and the other contained saline water 30%°. Each aquarium contained 20 euryhaline **Tilpaia zillii.** After fish acclimatized, nearly equal and high amount of ^{14}C DDT (dissolved in acetone) was added to each aquarium. This experiment lasted for a short time as all fishes in the two aquaria died after few minutes. The weight and length of each fish was recorded. Its gills, caudal fin (as representative of the skin), kidney,liver,gonads,empty intestine and intestinal content were removed, weighed and their ^{14}C DDT content were measured as impulses/minute. each fish was recorded. Its gills, caudal fin (as representative of the skin), kidney, liver, gonads, empty intestine and intestinal content were removed, weighed and their ^{14}C DDT content were measured as impulses / minute.

b - Low concentration of ^{14}C DDT

Two aquaria were used. One contained fresh water and the other contained saline water 30%o. Each aquarium contained 20 euryhaline **Tilapia zillii.** After fish acclimatized, an equal and small amount of ^{14}C DDT (dissolved in acetone) was added to each aquarium. The experiment continued for 35 days. Every 5-10 days, 3-5 fishes were captured from each aquarium. The length and weight of each fish was recorded. Its liver, kidney, gonads, gills, caudal fin (as representative of the skin), empty intestine and intestinal content were removed off, weighed and their ^{14}C DDT content were measured as impulses / minute. A piece of one gram fish flesh was cut and its ^{14}C DDT content was measured as impulses / minute. The excrements (faeces) were collected periodically by siphoning, dried under hot lamp, weighed and their ^{14}C DDT content was measured as impulses / minute. The water content of ^{14}C DDT was also measured periodically as impulses / minute / ml water. An air pump was used for aeriation of the water aquaria. The water temperature was 30 $\pm$ 3 (artificial heaters were not used). pH of the water was 7.5. Lethal gases and bacteria were completely abscent.

RESULTS AND DISCUSSION

When the concentration of ^{14}C DDT in the water aquaria was high (about 47 impulses/minute/ml water), all fishes, living in fresh or saline water, were very nervous, moved quickly and died after few minutes. Similar results were noticed by Cutkamp et al (1972). They explained that DDt destroys ATP azes which is the basic component of nervous system and brain cells. The maximum content of ^{14}C DDT was noticed in the liver and intestine as they are fatty organs. The gonads contain a considerable amount of ^{14}C DDT (Table 1), that means their destruction and a decrease in fertility of the fish (Saleh, in preparation).

The point of interest in these results is that the content of ^{14}C DDT in the organs and tissues of **Tilapia zillii** living in saline water was more than that living in fresh water except the gills and the caudal fin, i.e. skin (Table 1). This probably means an accumulation of ^{14}C DDT on the gills and skin of **Tilapia zillii** living in fresh water i.e. the gills and skin of **Tilapia zillii** living in fresh water resisted, to some extent, the entrance of ^{14}C DDT .

When the concentration of ^{14}C DDT in the water aquaria was low (about 9 impulses/minute/ml water), the experiment continued for about 35 days. **Tilapia zillii** living in saline water were unhealthy and their mortality was high, and after 27 days there were no living fishes in the saline water aquarium. On the other hand, **Tilapia zillii** living in fresh water were healthy and their mortality was very low.

The time variation of ^{14}C DDT content in the organs and tissues of **Tilapia zillii** living in saline water was high (Fig 1) while the time variation of ^{14}C DDT content in the organs and tissues of **Tilapia zillii** living in fresh water was low and changed very slowly (Fig.2).

Kerzenkin (1962) proved that the principal routes for entrance of elements and compounds present in the surrounding water into the fish are the gills and the skin presumably the caudal fin. The entrance activity of ^{14}C DDT through the gills and skin of **Tilapia zillii** living in saline water was higher than that living in fresh water (Figs. 1 and 2). The high values of ^{14}C DDT content in the gills and the caudal fin of **Tilapia zillii** living in saline water were considered as indication of high entrance of ^{14}C DDT and not an accumulation (resistance). The high content of ^{14}C DDT in the gills and the caudal fin of **Tilapia zillii** living in saline water was accompained by high content of ^{14}C DDT in other organs and tissues (Fig. 1). The low content of ^{14}C DDT in the gills and caudal fin of **Tilapia zillii**, living in fresh water, may be explained as due to their relative resistance to entrance of ^{14}C DDT and also ability of the fish living in fresh water to clean its gills and skin when the conentration of ^{14}C DDT in fresh water was comparatively low (Fig.2). The high similarity between the time variation of ^{14}C DDT content in the gills and the caudal fin of **Tilapia zillii** living in fresh or saline water was expalined by Halim and Saleh (1977). They showed that there is a high correlation between the function of gills and that of skin in osmoregulation and absorption of elements and compounds present in the surrounding water i.e. the rate of entrance or absorption of any element or compound through the gills and the skin is similar.

The adsorption and penetration of ^{14}C DDT through the intestine of **Tilapia zillii** living in saline water was more than that living in fresh water. This may be cleared from the comparatively higher content of ^{14}C DDT

Table 1

Average content of ^{14}C DDT (impulses in minute in 1 gram organ or tissue) in **Tilapia zillii** living in fresh and saline water 30%° aquaria. (Aver. T.W.=21 gm).

Kind of water	Impulses/ minute ml water	Liver	Kidney	Gills	Caudal fin	Impty stomach	Intestinal content	Fish flesh	Gonads
Fresh water	47	3456	1746	1125	1480	2720	3142	104	647
Saline water	46	4050	2700	810	1290	3825	4635	112	840

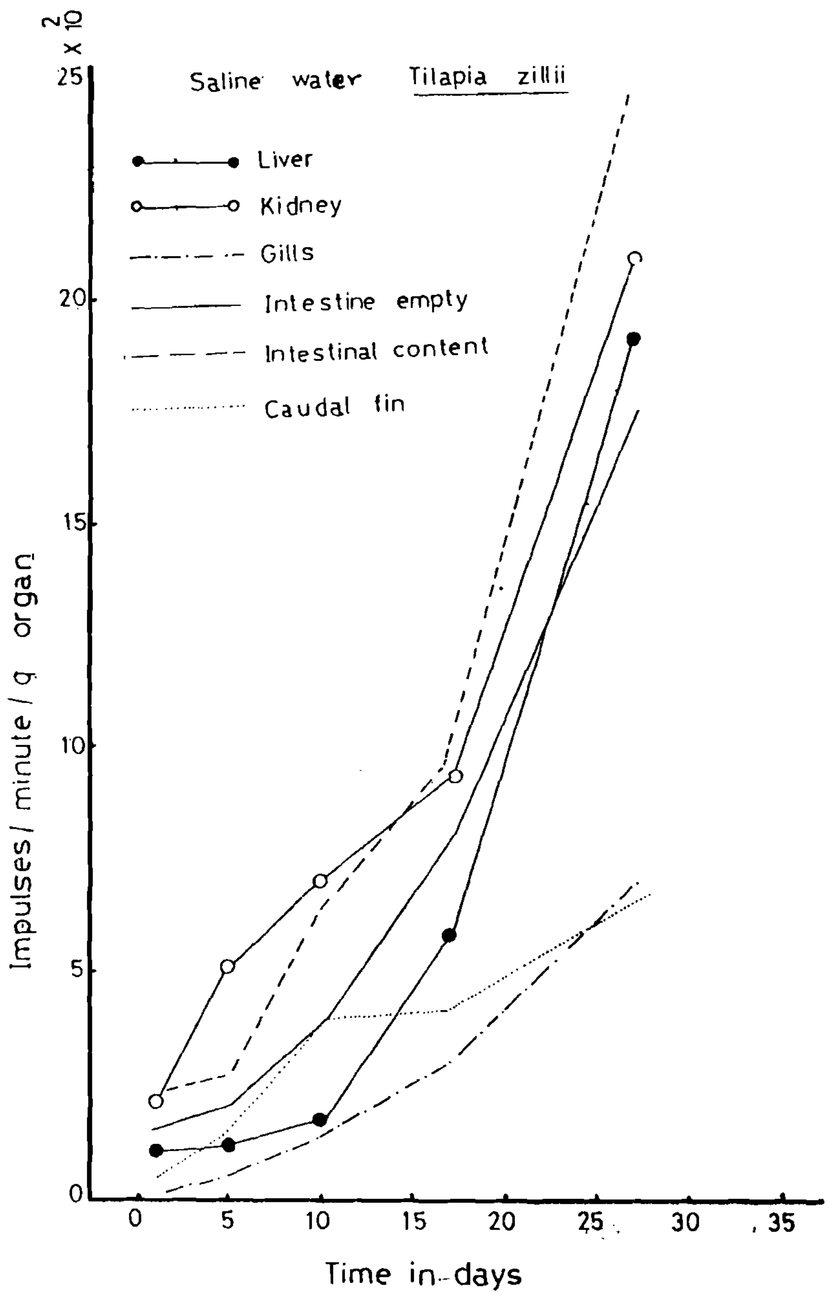

Fig. 1. Time variation of ^{14}C DDT content in liver, kidney, gills, caudal fin, empty intestine and intestinal content of **Tilapia zillii** living in saline water.

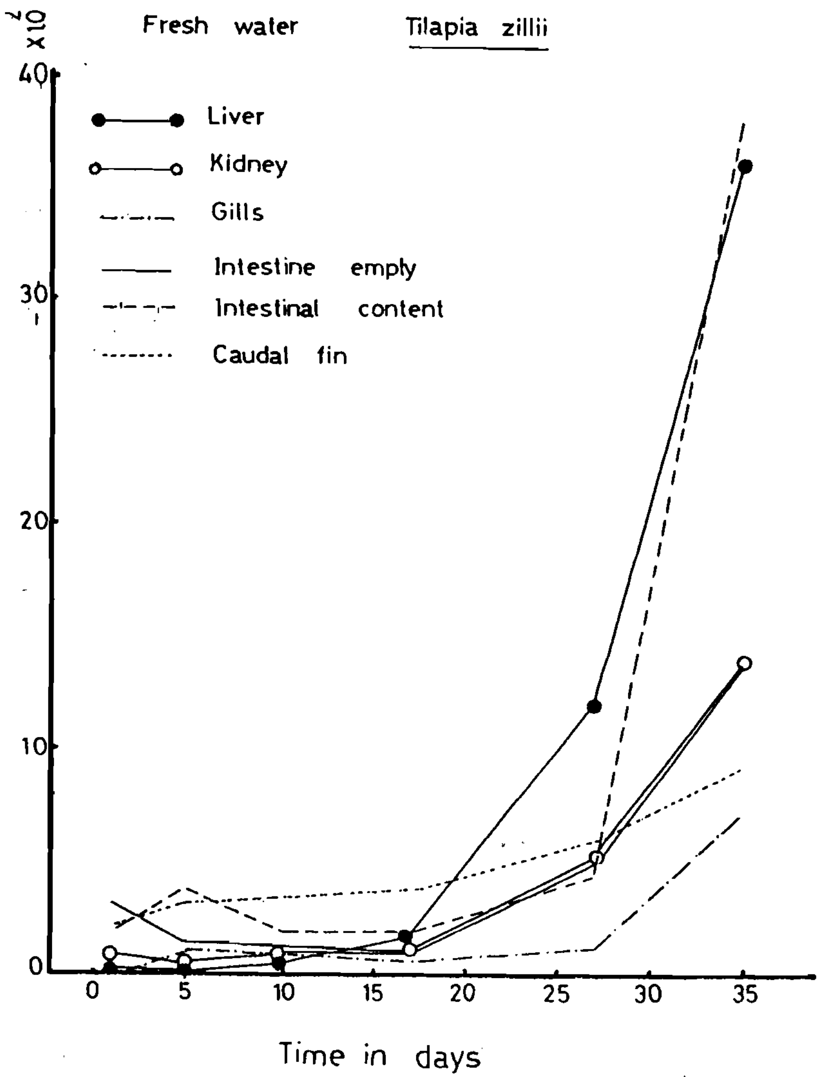

Fig. 2. Time variation of ^{14}C DDT content in liver, kidney, gills, caudal fin, empty intestine and intestinal content of Tilapia zillii living in fresh water.

in the excrements of **Tilapia zillii** living in fresh water (Table 2). Janicki and Kinter (1971) mentioned that DDT destroys the osmoregulation of the intestine of the eel **Anguilla rostrata** acclimatized to sea water.

At the end of the experiment, ^{14}C DDT content in the flesh of **Tilapia zillii** living in saline water was three times more than that living in fresh water (Fig.3).

Table 2.
Periodical content of ^{14}C DDT in the excrements of **Tilapia zillii**
(impulses in minute in 1 gram excrement) living in fresh or saline water.

Time in days	Fresh water aquarium	Saline water aquarium
After 2 days	3352	3041
After 5 days	2165	2133
After 10 days	1884	1463
After 11 days	1429	1166
After 20 days	1235	1012
After 25 days	1143	1092
After 27 days	534	487
After 35 days	33	There were no fishes remained alife.

The progressive increase of ^{14}C DDT content in the liver, kidney and intestine of **Tilapia zillii,** living in fresh or saline water, (Figs.1 and 2) may be explained by the fact that the liver takes pollutants or poisons from the blood comming from the intestine. The liver eliminates these poisons by the kidney or through the intestine again.

In general, the more uptake of ^{14}C DDT by **Tilapia zillii** living in polluted saline water may be explained by the fact that the fish living in saline water swallows much water to avoid hypertonism (Black, 1957).

The excrements of **Tilapia zillii,** living in fresh or saline water, contained a very high amount of ^{14}C DDT (Table 2). These excrements precipitated on the bottom of the aquaria. Such precipitation probably occur in nature mainly when the water environment is shallow and stagnant. This means that the bottom of the polluted hydrosphere becomes very dirty and polluted although the water content of pollutants decreased by time i.e. at the final days of the experiment the water content of ^{14}C DDT became small, on the other hand the fish mainly inhabiting saline water becomes highly polluted with ^{14}C DDT and the bottom is covered with excrements which contain a high amount of ^{14}C DDT. The major metabolite of DDT excreted from marine organisms is DDT (Patil et al, 1972). Transformation of DDT took place in biologically active samples such as surface films, plankton, algae and sediments. However, Goldberg (1976) showed that the insecticides are not readily metabolized in plain sea water.

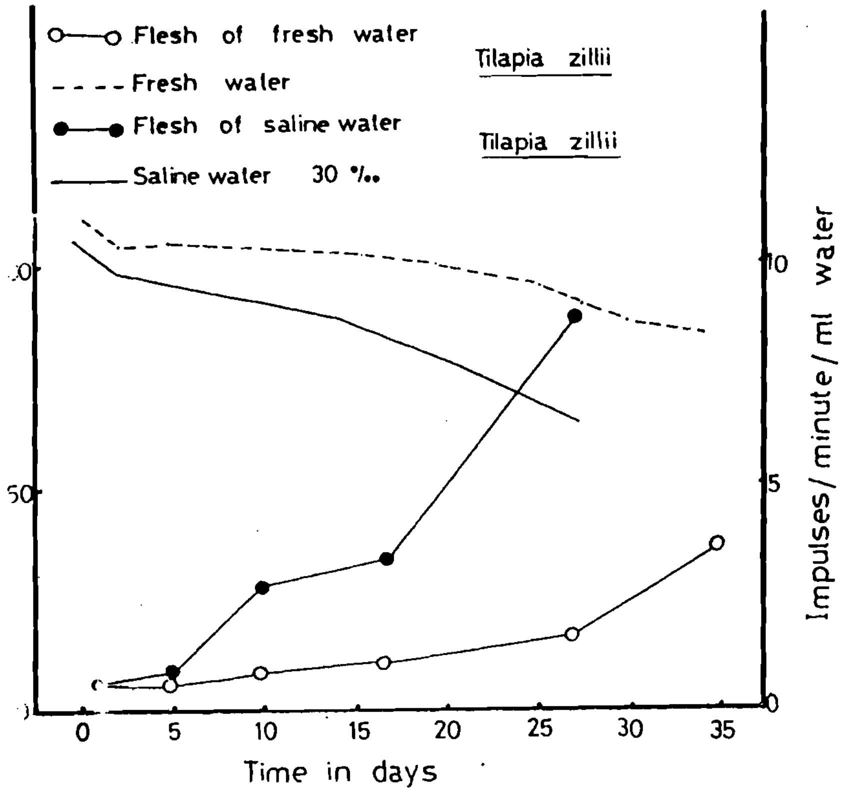

Fig. 3. Time variation of ^{14}C DDT content in flesh of **Tilapia zillii** living in fresh and saline water(30%°), and also ^{14}C DDT content in water aquaria.

SUMMARY AND CONCLUSIONS

The previous results could be summarized in the following conclusions

1 - The fish living in saline water polluted with DDT (organic pollutants) is more affected than that living in polluted fresh water.

2 - DDT (organic pollutants) is highly accumulated in the intestine and liver (fatty organs).

3 - Excrements of fish, living in fresh or saline water, contain very high amount of pollutants. These excrements precipitate on the bottom mainly when the water is stagnant and shallow.

4 - The DDT content in the gonads is considerable. This means the damage of gonads and a decrease of fish fertility.

5 - DDT (orgnic pollutants) kill the fish when it is at lethal concentration. On the other side, when the concentration of DDT is sublethal, the fish may remain alife but polluted and then eaten by man i.e. pollutants badly affect both fishery resources and human health.

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