

**The relationship between metabolic and
genetic variations in *Tilapia zillii* and levels of
pollutions in Lake Mariut**



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To:

My Father

And

Family

For their cordial support and

understanding,

I'm most grateful

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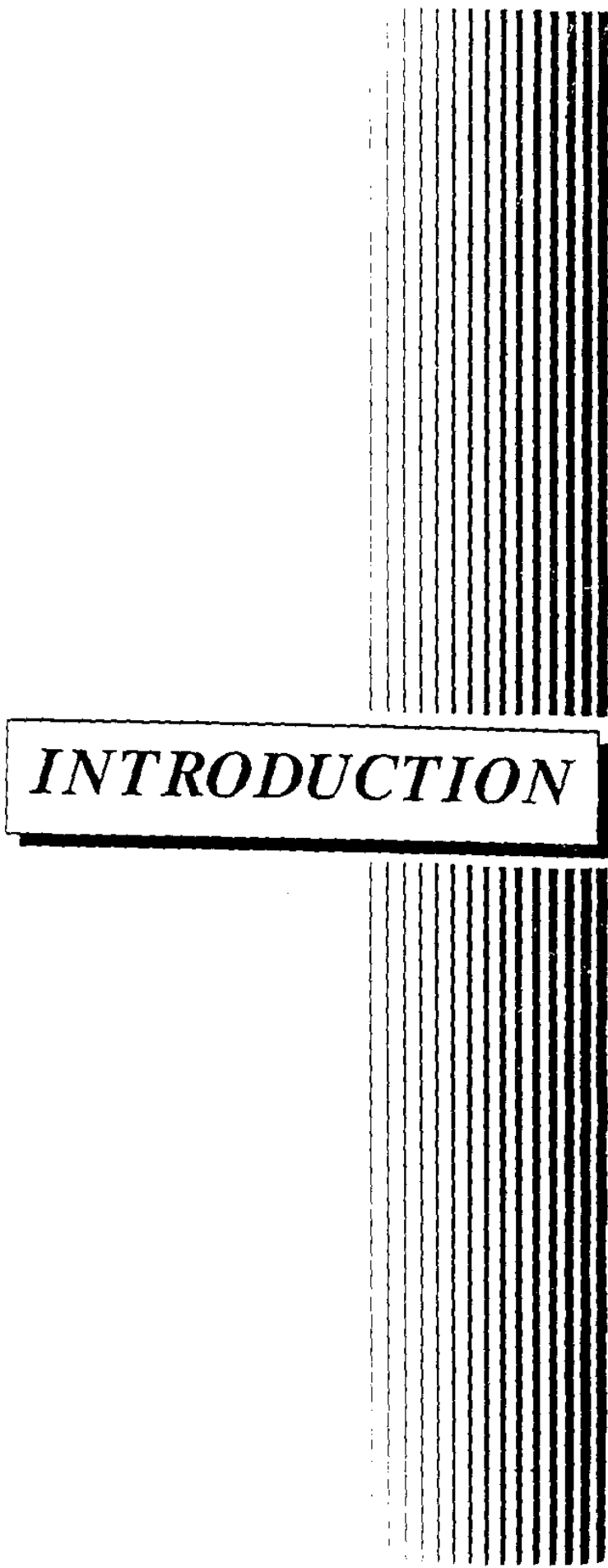
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INTRODUCTION

INTRODUCTION

The effect of environmental contaminations on human health is one of the most challenging problems that faces the world today. The growing world economy and the movement toward global market have driven competition in industrial and technological development at a high speed toward the betterment of mankind. However, in nearly all countries such developments have focused on increased production and economic gains before realizing their impact on the environment, as well as human health.

Although man made chemicals are usually the first environmental contaminants implicated in environmentally related human health problems, potential contribution from natural toxins (e.g. aflatoxins) have been brought to attention by recent research on their identification and toxicology.

Reasons which justify the need for a broad-scale, inter-disciplinary assessment of different types of environmental contamination particularly important in Egypt can be summarized as follows:

- 1-Accumulation of heavy metals in water, fish and vegetation;
- 2-Chronic exposure to low levels of pesticides residues in food and water;
- 3-High level dermal and respiratory exposure to pesticides during on-farm use;
- 4-Contamination of food with natural toxins. The continuously increasing population and the need to increase agricultural productivity have encouraged extensive use of agricultural chemicals in Egypt during the last few decades. Successive large scale aerial and ground applications of insecticides to control insect pests mainly on cotton, maize, and rice

crops during the hot summer in Egypt are repeatedly associated with many acute poisoning cases of humans, livestock, and non-target organisms, and phytotoxicity to host plants.

It is believed that numerous undocumented cases of acute poisoning to humans, farm animals, honey bees, and fish, either due to direct dermal contact or ingestion of contaminated food, water, or feed occur annually in Egypt (El-Sebae, 1990). The concentration of pesticides and heavy metals in the Domietta branch was found to exceed the "Critical Limit", set by Egyptian law (Fathi *et al.*, 1990).

Rural farming populations in Egypt are at an increased health risk from exposure to agricultural chemicals which are known or suspected to be carcinogenic. Acute neurological and dermal diseases from occupational exposures are well described among farmers in both the United States and among developing countries. In addition, mortality studies among rural residents and/or farmers in the United States and some other countries (Pependorf *et al.*, 1979; Cantor, 1982; Hoar *et al.*, 1986; Blair *et al.*, 1983; Blair *et al.*, 1985; Muller, 1989) have revealed statistically significant and/or recurring association between farming and leukemia, lymphoma, and lip, prostate, and skin cancers (Pependorf and Donham, 1990). Suspect cancer causing agent(s) include exposures to pesticides (especially herbicides) and heavy metals, and ultraviolet radiation (sun), but no clear etiology has been established (Blair *et al.*, 1985; and Schenker & McCurdy, 1986).

Exposure assessment for environmental pollutants is complicated because of the multiple routes of exposure and often to a wide variety of unrelated chemicals. Dermal absorption, inhalation, and ingestion are all

possible routes to varying degrees during application (Morgan *et al.*, 1977; Carman *et al.*, 1982; and Popendorf, 1988), harvest (Popendorf and Leffingwell, 1982; and Nigg *et al.*, 1984), in residences via direct application, spray drift, or volatilization (Spencer *et al.*, 1973; Maybank *et al.*, 1978; and Taylor, 1978), and in food and water (Armstrong *et al.*, 1973; Draper *et al.*, 1981; D'Itri & Wolfson, 1987; Fairchild, 1987 and NRC, 1987).

Nowadays, our human population is exposed to a great number of substances, to which the population has not been specifically adapted. Most, if not all, of these substances represent the main source of pollution.

Pollution is, at the present time, a highly emotive word, conjuring up visions of imminent disaster to the environment and the human race with chemicals synthesized by man himself being the main cause for concern.

Human population is threatened physically as a species with the depletion of resources and poisoning of our environment because of unplanned technological developments.

Chemical and radiation hazards; contaminating air, earth, rivers and sea, comprise the bulk of the universal pollution problem. In industry, disposal of wastes is also an important source of chemical pollution.

Pollution by sewage or industrial effluents and/or agrochemicals produces various effects depending upon the nature of the chemicals.

Several instances of fish poisoning have been traced to industrial wastes, and the early detection of unexpectedly high levels of mercury, for example, Tait (1972) suggested that pollutants may be spreading to the deep ocean and become concentrated to a remarkable extent in the

tissues of marine organisms. The concentration becomes greater at each stage of a food chain with the effect that even substances present in the water at very great dilution may in time have disastrous effects on some populations.

A population may be able to tolerate a certain level of pollution as long as other conditions are favourable. However, if circumstances become adverse, for example through food shortage or climatic extreme, constitutions may be so weakened that mortality then becomes very high.

Alexandria is the second largest city in the middle east, with more than one-third of the Egyptian industries concentrated there (El-Bestawy, 1993). Textiles, steel, chemicals, paper, dyes, petroleum refineries and food industries are examples of the industrial activities present in the city. The method of disposal of industrial wastewater is to discharge it directly into the sea, or into Lake Mariut which borders the southern edge of the city. In addition, discharge into the lake also includes agricultural and sewage wastewater. Ten factories in the Moharrem Bey region, south of the Mahmoudia Canal, combine their wastes in one collector and pump them out into the northeast corner of the lake proper. These wastes are different in the quantity and nature of the dissolved and suspended solids, heavy metals and organic load. Agricultural wastewater from Beheira Province carries a huge amount of dissolved nutrients, fertilizers, organic matter and pesticides.

The lake environment, as a result of such heavy pollution, is severely affected.

AIM OF THE WORK

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The present investigation aims at investigating the relationship between metabolic and genetic variations in *Tilapia zillii* and levels of pollutions in Lake Mariut.

In order to achieve such a purpose, fish were chosen, caught from six selected locations and the programme of the study was planned to cover the following points:

- 1- Monitoring of the pollution in different locations of the lake;
- 2- Estimating fish population density in different locations of the lake;
- 3- Determination of pollutant levels in various tissues of the fish caught from different locations (especially Cd, Pb and Cu);
- 4- Studying the variations induced in certain enzymes (cholinesterase; glutamic oxaloacetic transaminase; and glutamic pyruvic transaminase);
- 5- Determination of the enzymatic damages especially those involved in metabolism (acetyl cholinesterase and acid phosphatase);
- 6- Estimation of hepatosomatic index and coefficient of condition;
- 7- Studying the DNA and RNA in the flesh in addition to total protein in the flesh as well as in the liver.
- 8- Analysis of *in vivo* chromosome complement in gills as well as kidneys;
- 9- Estimation of cell-cycle duration in somatic cells of gills and kidneys;
- 10- Analysis of *in vivo* induction of sister chromatid exchange after incorporation of 5-bromodeoxyuridine for two rounds of DNA-replication;

- 11- Investigation the physio-chemical properties of fish chromatin isolated from liver;
- 12- Correlating variation and/or alteration in the above mentioned parameters with levels and types of pollution; and
- 13- Assessment of the employed organism (*Tilapia zillii*), from a molecular cytogenetic point of view, as a sensitive biomonitor for the pollution of aquatic environment.