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Impacts of Some Environmental Pollutants on Biochemical Functions of *Tilapia sp.* at Different Hot Spot Areas of Alexandria, Egypt

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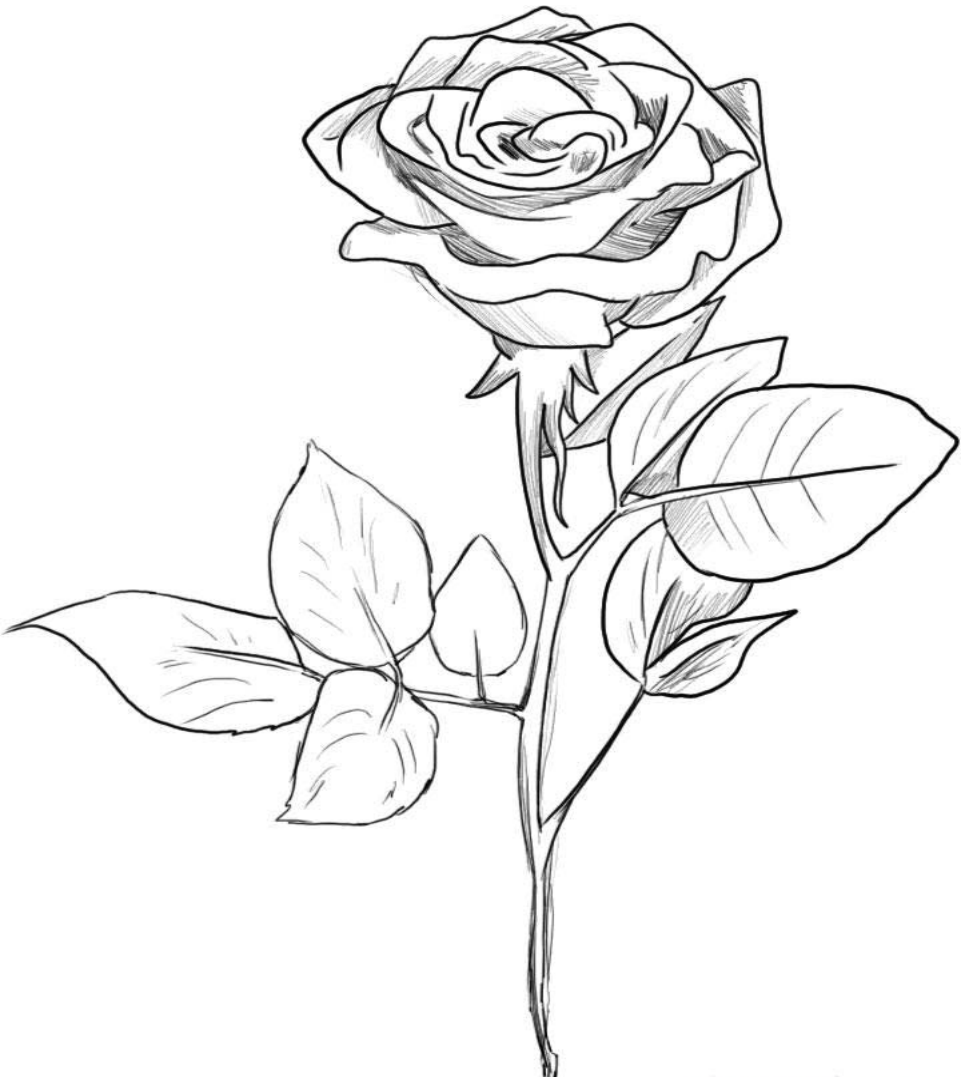
بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

"وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُمْ بِمَا كُنْتُمْ تَعْمَلُونَ"

صدَقَ الله العَظِيم

(التوبة:١٠٥)

GOD bless my Parents



Declaration

I declare that this thesis has been composed and the work recorded here has been done by me.

It has not been submitted for any other degree at this or any other university.

Mohamed Gamal M. Amer

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ABSTRACT

Biochemical markers are a popular measure of toxic effects on organisms due to their assumed fast response and are usually assessed after acute exposure of the organism to the stressor xenobiotics.

This study aimed to measure heavy metals (Fe, Cu, Zn, Pb, Cd and Hg), total hydrocarbons (THCs), polyaromatic hydrocarbons (PAHs), pesticides (OCPs) and polychlorinated biphenyls (PCBs) toxicity incidence on *Tilapia niloticus*. Biomarkers such as total antioxidant activity (TAA), aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphotase (ALP) activities in blood plasma, in addition to the total proteins and lipids in *T. niloticus* tissues (muscles and liver) have been investigated. The resulting data was subjected to statistical analyses in order to assess water quality index (WQI) and its impacts on biochemical functions of Tilapia collected from three different hot spot sites (Nubaria, Umoum and Kilo 21).

Principle component analysis (PCA) used to evaluate both the hot spot sites and the highly affected groups, in addition to the origin of pollution in each site and group. This study highlights the importance of using a set of integrated biomarkers to assess the some environmental pollutants toxicity in *Tilapia niloticus*. The results showed that pollutants induced a significant increase in the total proteins and total lipids content in the muscle and liver tissues. Total Cyclodienes (TC), Pb, Cd, hexachlorocyclohexanes (HCHs), Hg and organochlorine pesticides (OCPs) were shown to be accumulated higher than other environmental pollutants in both muscle and liver. Origin of pollution in liver tissues of group I during summer was related to Zn, Pb, Hg and PCBs. ALT, AST, ALP activities and TAA increased significantly ($p \leq 0.01$) indicating tissues damage in groups appeared to be highly affected by pollutants as indicated by PCA.

In conclusion, the studied groups could be arranged in the following order according to pollutants loading: Group I (Nubaria) > Group II (Umoum) > Control group (Kilo 21) and that was confirmed by WQI values. It is recommended to take care when using Nile Tilapia from those sites for human consumption as it accumulates pollutants in liver and muscles.

LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectrophotometer.
Ace	Acenaphthene.
Acthy	Acenaphthylene.
Ag	Silver.
ALA	Aminolevulinate dehydratase.
ALKP	Alkaline phosphatase.
ALP	Alkaline phosphatase.
ALT	Alanine aminotransferase.
Ant	Anthracene.
ANZECC	Australian and New Zealand Environment Conservation Council.
AOAC	Association of Official Agricultural Chemists.
APDC	Ammonium pyrrolydine dithiocarbamate.
APHA	American Public Health Association.
As	Arsenic.
AST	Aspartate aminotransferase.
BaA	Benzo(a)anthracene.
BAF	Bioaccumulation factor.
BAM	Bioaccumulation monitoring.
BaP	Benzo(a)pyrene.
BbF	Benzo(b)fluoranthene.
BCM	Billion Cubic Metres.
Be	Beryllium.
BEM	Biological effect monitoring.

BghiP	Benzo(ghi)perylene.
Bi	Bismuth.
BkF	Benzo(k)fluoranthene.
BOD	Biochemical Oxygen Demand.
CARC	Carcinogenic polyaromatic hydrocarbons.
Cd	Cadmmium.
Chr	Chrysene.
CM	Chemical monitoring.
COD	Chemical Oxygen Demand.
COMB	Combustion polyaromatic hydrocarbons.
Cu	Copper.
CV	Cumulative variance.
DBA	Dibenz(a,h)anthracene.
DDTs	Dichlorodiphenyltrichloroethanes.
DIDW	Deionized double distilled water.
DL	Detection limit.
DNA	Deoxyribonucleic acid.
DO	Dissolved Oxygen.
EC	Electric Conductivity.
EDTA	Ethylenediaminetetraacetic acid.
EEAA	The Egyptian Environmental Affairs Agency.
EIMP	Environmental Information and Monitoring Program.
EM	Ecosystem monitoring.
EPA	Environmental Protection Agency.
EOS	Egyptian organization of standardization and quality.
ERA	Environmental Risk Assessment.

FAA	Flame atomic absorption.
FAAS	Flame Atomic Absorption Spectrophotometer.
FAO	Food and Agriculture Organization.
FAS	Ferrous ammonium sulfate.
Fe	Iron.
Flu	Fluoranthene.
FDA	Food and Drug Administration.
FRAP	Ferric Reducing Antioxidant Power.
GC-MS	Gas Chromatograph-Mass Spectrometer.
GPS	Global Positioning System.
HCHs	Hexachlorocyclohexanes.
Hg	Mercury.
HM	Health monitoring.
IAEA	International Atomic Energy Agency.
InP	Indeno(1,2,3-cd)pyrene.
IOC	Intergovernmental Oceanographic Commission.
IU	International unit.
K	Length-weight relationship.
LDH	Lactate dehydrogenase.
LOD	Limit of detection.
LOL	Limit of linearity.
LPO	Lipid peroxidation.
LSI	Liver Somatic Index.
m/z ratio	Mass-to-charge ratio.
MDH	Malate dehydrogenase.
MIBK	Methyle isobutyle ketone.

MPL	Maximum permissible limit.
mRNA	Messenger ribonucleic acid.
MVU	Mercury Vaporization Unit.
MWRI	Ministry of water and Irrigation.
N.S.	Non significant.
NADH	Nicotinamide adenine dinucleotide.
Naph	Naphthalene.
NAS-NAE	National Academy of Science.
NFE	Nitrogen free extract.
ng	Nanogram.
NIST	National Institute of Standards and Technology.
nm	Nanometer.
NRCC	National Research Council of Canada.
NTU	Nephelometer Turbidity Unit.
o,p´-DDD	o,p´-1,1-dichloro-2, 2-bis (4-chlorophenyl) ethane.
o,p´-DDE	o,p´-1,1-dichloro-2,2-bis(4-chlorophenyl) ethylene.
o,p´-DDT	o,p´-1,1,1-trichloro-2, 2-bis (4-chlorophenyl) ethane.
OCPs	Organochlorine pesticides.
OD	Optical density.
OOM	Oxidizable Organic Matter.
p,p´-DDD	p,p´-1,1-dichloro-2, 2-bis (4-chlorophenyl) ethane.
p,p´-DDE	p,p´-1,1-dichloro-2,2-bis(4-chlorophenyl) ethylene.
p,p´-DDT	p,p´-1,1,1-trichloro-2, 2-bis (4-chlorophenyl) ethane.
PAHs	Polycyclic Aromatic Hydrocarbons.
Pb	Lead.
PC	Principle component factor.