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Organochlorine Pesticides Residues in Fish

A Thesis Presented by

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Dedication

To MY great ***Father,*** *the most beautiful* ***Mother, My Sisters: (Ayat, Zeinab) & My Lovely Brother: Mohammed*** *Who supports and encourages me.*

Thank you for being with me and not giving up on me and for your constant support.

The simplest thing I offer you is my ***(Master Thesis).***

Your faithful daughter (Esraa)

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Abstract

A total of 100 fish samples were collected from different fish farms in cairo and El Menoufia governerate. The collected samples were represented by *Oreochromis niloticus*, *Mugil cephalus, Claris gariepinus*, *Bagrus bayad* , *Solea solea* fish (20 samples each). 14 organochlorine compounds were analyzed by gas chromatography. *Solea soles* samples revealed the highest mean levels, In contrast to *Bagrus* samples revealed lowest mean levels.

Endrin pesticide found in all examined types followed by DDE.

Most examined fish samples from different species are within the maximum residual limits and should not pose a health risk to consumers. The public health hazards were discussed as well as recommendations were done.

Key words: Organochlorine pesticides, *Oreochromis niloticus, Mugil cephalus, Claris gariepinus, Bagrus, Solea solea*.

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List of Abbreviations

Abb.	Full term
DDD	Dichloro diphenyl dichloroethane
DDE	Dichloro diphenyl dichloroethylene
DDT	Dichloro diphenyl trichloroethane
DHA	Docosahexaenoic acid
EPA	Eicosapentaenoic acid
FAO	Food of agricultural organization
GABA	Gamma aminobutyric acid.
GC	Gas chromatography
HCH	Hexachloro cyclohexane
HPLC	High performance liquid
HS	Highly statistically significant
MRL	Maximum residue limit
ND	Not detected
Ng/µl	Nanogram/ microlitter
OCPs	Organochlorine pesticides
POPS	Persistent organic pollutants
TMDI	Theoretical Maximum Daily Intake
UNEP	United nations environment programme
WHO	World health organization

1. Introduction

Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds). Pesticides are used in public health to kill vectors of disease, such as mosquitoes, and in agriculture, to kill pests that damage crops. By their nature, pesticides are potentially toxic to other organisms, including humans, and need to be used safely and disposed of properly ***(WHO, 2018).***

Fish as human food are considered as a good source of protein, polyunsaturated fatty acids particularly omega-3 fatty acids, calcium, zinc, and iron. Fish considered more important source of food protein than they are today and the safety for human consumption of products from aquaculture is of public health interest ***(WHO, 1999).***

Fish consumption act as a possible source of organochlorine compound accumulation in humans. In fact, dietary intake is considered to be the most important source of organochlorine compound in humans ***(Bjerregard et al., 2001).***

Fish are known to provide many benefits for human health due to their high content of semi-essential fatty acids, which are a kind of polyunsaturated fatty acids that humans must ingest because the body requires them for good health and can synthesize them but the synthesis is rather limited) in fish lipids, particularly eicosapentaenoic acid (EPA) and docosa hexaenoic acid (DHA). A regular consumption of EPA and DHA can reduce

risk of coronary heart disease, cardiovascular diseases, diabetes, neural disorders and hypertension ***(Garg et al., 2006),*** but on the other hand fish are known to biomagnify organochlorine pesticides and other chemicals from the surrounding environment ***(Mackay and Fraser, 2000).***

Fish accumulates some organic chemicals particularly organochlorine pesticides in its fatty tissues due to its inability to metabolize them in the food they eat and from the intake of particulates in water and sediment on which these chemicals have been adsorbed. The bioaccumulation of organochlorines in fish and other animals is the reason why most of the human daily intake of such chemicals comes from our food supply rather than from water ***(Baird, 2005).***

Organochlorine pesticides are chemically produced pesticides which include DDT, dieldrin, heptachlor, chlordane, endosulfan and dicofol. Many types where widely used as insecticides throughout the 1950's and 1960's until their use was banned in western countries since the 1970's. Many organochlorine pesticides are extremely persistent in the environment. They have a low solubility in water and therefore tend to adsorb on to particles. They tend to end up in the lipids of living organisms making them difficult to excrete and causing them to bioaccumulate. They also biomagnify, which causes the top predators of the food chain to contain high concentrations of these compounds. Originally they were used as pesticides in terrestrial ecosystems. However, they are flushed away from

terrestrial ecosystems through rivers and end up in marine ecosystems. Due to their low solubility and high adsorption to particles and lipids, this takes years to decades ***(Daphnis, 2013).***

Fish are substances containing chemically combined chlorine and carbon. They may be grouped into three general classes: the dichlorodiphenylethanes (e.g DDT, DDD, dicofol, etc.), the chlorinated cyclodienes (aldrin, dieldrin, heptachlor, etc.), and the hexachlorocyclohexanes (e.g lindane). These compounds differ substantially between and within groups with respect to toxic doses, skin absorption, fat storage, metabolism, and elimination. The signs and symptoms of toxicity in humans, however, are remarkably similar except for DDT ***(Hayes, 1991).***

Also known as persistent organic pollutants (POPS), organochlorines have extremely strong bonds between their chlorine and carbon components and are attracted to fats. They are also highly insoluble in water, meaning they don't dissolve, and when it rains, they can spread widely through runoff. The problem with this strength is that once organochlorine pesticides are used, they stay around for a long time, not only in the water supply and in the soil but also in human and animal bodies ***(Jennifer, 2017).***

The wide spread usage of pesticides in Egypt led to many problems and constituted hazard in animals. In recent years pesticides in food arise as an important problem of serious public health hazards which may lead to acute or chronic hepatic toxicity for human being ***(Hassouba et al., 2007).***

In Egypt, organochlorine pesticides were used from the 1950s until 1981 as in the other parts of the world, although, their use was officially banned in 1980s. This class of chemicals is characterized by persistence in the environment and the tendency to accumulate in aquatic organisms ***(Yamashita et al., 2000).***

Many organochlorine compounds have been isolated from natural sources ranging from bacteria to humans. Chlorinated organic compounds are found in nearly every class of biomolecules including alkaloids, terpenes, amino acids, flavonoids, steroids, and fatty acids. Organochlorides, including dioxins, are produced in the high temperature environment of forest fires, and dioxins have been found in the preserved ashes of lightning-ignited fires that predate synthetic dioxins. In addition, a variety of simple chlorinated hydrocarbons including dichloromethane, chloroform, and carbon tetrachloride have been isolated from marine algae. A majority of the chloromethane in the environment is produced naturally by biological decomposition, forest fires, and volcanoes ***(Gribble, 1996).***

As far as health problems caused by the presence of pesticide residues in food stuffs are concerned, several countries have for many years carried out food contamination monitoring programmes and evaluated data of pesticide residues according to criteria and guidelines recommended by the Codex Committee on Pesticide Residues as well as by the European Union ***(Camoni et al., 2001).***

DDT cogeners and metabolites might act as tumor promoters in hormonally sensitive cancers due to their oestrogenic and anti-androgenic properties. Cellular researchers have also suggested that free-radical mediated oxidative stress may be associated with some organochlorine residues in human breast tumors ***(Iscan et al., 2002).***

Therefore, the present study was planned out to know organochlorine pesticides residues most prevalent in market fish and to discuss public health hazards of organochlorine pesticides residues in fish as well as recommendations to minimize them in fish.

2. Review of literature

2.1. Sources of pesticides:

Saker and Gaber (1992) mentioned that most of pesticides ultimately find their way into rivers, lakes, ponds, and other water bodies but also to the organisms which contribute to the food of fish.

Domagalski and Kuivila (1993) reported that there is growing concern about possible environmental contamination from agrochemicals, industries and household and rain water runoff from agricultural systems, disposal of outdated stocks, containers and packets and discharge of waste from industries.

Froese et al., (1998) said that pesticides can enter water system directly through area treatments aimed at destroying the vegetation, algae and insects, or indirectly through the inflow of sewage and industry wastewater, through rainfall washing and leaching the surrounding contaminated soil, as well as through accidental or deliberate contamination industries.

Roche et al., (2000) recorded that the distinct land uses (rural, urban and industrial) lead to the contamination of aquatic environments by persistent organic pollutants mainly through runoff, direct discharges and wet or dry deposition.

Arnot and Gobas (2003) reported that there are high tendencies of organochlorine pesticides being circulated by air