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# List of Abbreviations

<b>AAS</b>	<b>Atomic Absorption Spectrophotometer</b>
<b>AOAC</b>	<b>Association of Official Analytical Chemists</b>
<b>BHC</b>	<b>Benzen Hexachloride</b>
<b>BI</b>	<b>Biogenic Amines</b>
<b>BW</b>	<b>Body Weight</b>
<b>Cd</b>	<b>Cadmium</b>
<b>CE</b>	<b>Capillary Electrophoresis</b>
<b>DAO</b>	<b>Diamine Oxidase Enzyme</b>
<b>DDE</b>	<b>1,1,1Dichloro2,2 bis (Pchlorophenyl) ethylene</b>
<b>DDT</b>	<b>Dichloro Diphenyl Tri Chloro Ethane</b>
<b>D.F</b>	<b>Degree of Freedom</b>
<b>E.O.S. C.</b>	<b>Egyptian Organization for Standardization and Control</b>
<b>EPA</b>	<b>Environmental Protection Agency's</b>
<b>FAO</b>	<b>Food and Agriculture Organization</b>
<b>FDA</b>	<b>Food Drug Association</b>
<b>FQPA</b>	<b>Food Quality Protection Act</b>
<b>GC</b>	<b>Gas Chromatography</b>
<b>Gm (g. &amp; gm)</b>	<b>Gram</b>
<b>HACCP</b>	<b>Hazard Analysis and Critical Control Point</b>
<b>HCH</b>	<b>Hexa Chloro Hexane</b>
<b>Hg</b>	<b>Mercury</b>
<b>HMT</b>	<b>Histamine- N-Methyl Transferase Enzyme</b>
<b>HNO<sub>3</sub></b>	<b>Nitric Acid</b>
<b>HPLC</b>	<b>High Performance Liquid Chromatography</b>

<b>KOH</b>	<b>Potassium Hydroxide</b>
<b>MAOI</b>	<b>Mono Amine Oxidase Inhibitors</b>
<b>MPCs</b>	<b>Maximum Permitted Concentration</b>
<b>M.S</b>	<b>Mean Squares</b>
<b>NaCl</b>	<b>Sodium Chloride</b>
<b>No.</b>	<b>Number</b>
<b>OC</b>	<b>Organochlorine</b>
<b>OPs</b>	<b>Organophosphate</b>
<b>PAN</b>	<b>Pesticide Action Network</b>
<b>PCB</b>	<b>polychlorinated biphenyls</b>
<b>PCR</b>	<b>Polymerase Chain Reaction</b>
<b>Pb</b>	<b>Lead</b>
<b>POPS</b>	<b>Persistent organic pollutants</b>
<b>PPb</b>	<b>Part Per Billion</b>
<b>SE*</b>	<b>Standard Error of Mean</b>
<b>S.S</b>	<b>Sum Squares</b>
<b>TCA</b>	<b>Trichloroacetic Acid</b>
<b>TLC</b>	<b>Thin Layer Chromatography</b>
<b>USA</b>	<b>United States of America</b>
<b>USDA</b>	<b>United States Department of Agriculture</b>
<b>USEPA</b>	<b>United States Environmental Protection Agency</b>
<b>USFDA</b>	<b>United States Food and Drug Administration</b>
<b>UV</b>	<b>Ultraviolet</b>
<b>WHO</b>	<b>World Health Organization</b>
<b>++</b>	<b>High significant differences</b>
<b>/g</b>	<b>Per gram</b>
<b>&lt;p</b>	<b>Positive correlation</b>

## ***6- CONCLUSION AND RECOMMENDATIONS***

The obtained results in the current study allow to conclude that most of fish and fish products exposed for consumption were contaminated with various chemical residues such as heavy metals (lead, mercury and cadmium), pesticides (malathion and dieldrin) and biogenic amines residues (histamine, putrescine and tyramine).

Smoked fish contained the highest level of mercury, lead, cadmium, tyramine, histamine and putrescine residues. Furthermore, the highest residual level of cadmium, putrescine, malathion and dieldrin was presented in pickled fish.

To prevent or reduce these toxic residues in fish, the following recommendations should be adapted:

### **6.1. Purchasing:**

- 6.1.1. Purchase seafood from reputable sources – markets and grocers with a history of providing safe food to customers.
- 6.1.2. The market of fish and/or seafood section of the grocery store should look well and smell clean. Employees should wear clean clothes and use disposable gloves when handling raw seafood and should be knowledgeable about the product.
- 6.1.3. Fresh raw seafood should be properly refrigerated or placed in a bed of ice when displayed. Fish should be arranged with the bellies down so that melting ice drains away. Cooked or smoked ready-to-eat seafood should not be displayed in the same display case as raw seafood.

## ***CONCLUSION AND RECOMMENDATION***

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6.1.4. Fish collected from areas contaminated with industrial wastes or agricultural wastes should be avoided.

### **6.2. Fresh Whole Fish:**

6.2.1. When purchasing fresh whole fish, look for eyes that are clear and bulge slightly. The flesh of whole fish and fillets is firm and shiny. The gills of fresh whole fish are bright red or pink and free of slime. The skin is shiny with scales that adhere tightly.

6.2.2. There is no discoloration or darkening around the edges of the fish, including the gills. The fish smells fresh, not sour, fishy, or ammonia-like.

### **6.3. Smoked Fish:**

6.3.1. Smoked seafood exhibits a firm, springy texture, glossy surface, and a smoky odor with no signs of dried blood or mold on the product.

6.3.2. Packaged smoked seafood appears fresh and moist. The package should be airtight and not damaged.

### **6.4. Canned fish:**

6.4.1. The cans should be made from high quality tin-plate, with quality control.

6.4.2. All canned fish manufacturing steps, including cutting, treating, curing, packaging and storage should be done under hygienic and sterile conditions, this control is necessary to minimize the potential for any contamination.

## ***CONCLUSION AND RECOMMENDATION***

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6. 4. 3. The cans must be stored in area free from moisture and dates of production and expiration must be recorded on it and appear clearly.

### **6.5. Storage:**

6.5.1. After purchasing, store fish/ seafood immediately in the refrigerator or freezer. If you plan to consume fresh seafood within two days of purchase, cover the seafood and store it on the bottom shelf of the refrigerator separately from cooked and ready-to-eat foods. Be sure to use fish within one to two days after purchase. When freezing fish/ fresh seafood, package in moisture-proof freezer paper or wrap to prevent freezer burn.

6.5.2. Pack dressed fish on ice in the refrigerator. Empty melted ice regularly and replenish ice as needed. Rinse fish that are not prepackaged under cold running water and dry with an absorbent paper towel. Wrap the fish in moisture-proof paper or plastic wrap and place in a plastic bag. Seal fish fillets in plastic bags or containers and cover with ice in pans or trays. Store in refrigerator no longer than two days.

### **6.6. Preparing:**

When preparing fish/ seafood, follow these safe food-handling guidelines:

6.6.1. Preparation, evisceration, cleaning and chilling or freezing must be done as rapidly as possible, and workers should be healthy, well trained and had medical certificates.

6.6.2. Never thaw frozen foods at room temperature. Thaw frozen fish/ seafood on the bottom shelf of the refrigerator. If the fish/ seafood

## ***CONCLUSION AND RECOMMENDATION***

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needs to be thawed quickly, seal in a plastic bag and run cold water over the surface.

6.6.3. When thawing frozen fish that comes in a vacuum-sealed package, remove it from the package, cover or wrap, and thaw it under refrigeration immediately before use. Do not thaw product while it is still inside the vacuum-sealed package.

6.6.4. Wash your hands thoroughly before and after handling raw fish/ seafood.

6.6.5. Keep raw fish/ seafood separate from cooked and ready-to-eat food. Never place cooked seafood on a plate previously used for raw seafood without first washing the plate with soap and water.

6.5.6. Salts used in preparation of brine solution and other spices or additives should be bacteriologically examined

### **6.7. Serving Seafood:**

On serving, do not contaminate the cooked fish/ seafood with unwashed hands. Utensils and food contact surfaces should be clean and sanitary.

6.7.1. Don't leave cooked fish/ seafood outside the refrigerator for more than two hours (or less than one hour if temperatures are above 90°F). Bacteria can grow rapidly in the DANGER ZONE temperatures between 5°C and 60°C. Keep hot foods "hot" and cold foods "cold."

6.7.2. Put leftovers in clean, shallow containers and refrigerate immediately. Do not keep leftovers more than two days. Discard them if they have an unpleasant odor or appearance. When in doubt, throw it out!



## ***CONCLUSION AND RECOMMENDATION***

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6.7.3. Reheat any leftover to an internal temperature of at least 165°F before

### **6.8. General recommendation:**

6.8.1. Monitoring surveys for the Nile River for assessing the pollutants and their concentrations which have adverse effects on water and other aquatic organisms and sediments should be performed periodically.

6.8.2. The use of pesticides in agriculture must be regulated and minimized as the irrigation may pollute the rivers.

6.8.3. Application of pesticides for aquatic weeds and insects must be forbidden and/ or application of phosphate fertilizers should be minimized as it is rich in cadmium and lead.

6.8.4. Detection of pesticide residues must be carried out periodically in local market fish as a routine work.

6.8.5. Using of the biological filters and/or growing grass on the sand dunes to clean up heavy metals from water.

6.8.6. Periodical inspection and control of markets, fish should be practiced to ensure fish safety.

6.8.7. Stationary sale points should be located in a place where the risk of contamination from rubbish, sewage and other toxic chemicals is absent or at minimum state.

6.8.8. Application and implantation of Hazard Analysis and Critical Control Point (HACCP) system in all points of fish manufacturing

## ***CONCLUSION AND RECOMMENDATION***

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as a hazardous control system must be applied to ensure a maximum safety to consumers.

## 7. SUMMARY

The present study was carried out to analyze fish samples and fish products for determination of their contents to heavy metals (mercury, lead and cadmium), pesticides (dieldrin and malathione) and biogenic amines (tyramine, histamine and putrescine). This study was applied on 80 random samples of fresh fish, canned fish, pickled fish and smoked fish (20 of each) which collected from different fish markets in Menoufia Governorate and examined for :-

The obtained results revealed that the mean values of mercury in the examined fresh water fish, canned fish, pickled fish and smoked fish were  $0.43 \pm 0.02$ ,  $0.69 \pm 0.04$ ,  $0.74 \pm 0.05$  and  $0.85 \pm 0.04$  mg/kg respectively.

The differences associated with mercury were highly significant among fish and fish products ( $P < 0.01$ ).

According to **Egyptian Organization for Standardization EOS (2005)** which recommended that the maximal permissible limit for mercury is 0.5 (mg/kg) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish were 16, 13, 11 and 10 represented as 80%, 65%, 55% and 50%, respectively.

Regarding to lead, the average concentrations in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $0.06 \pm 0.01$ ,  $0.15 \pm 0.01$ ,  $0.18 \pm 0.02$ , and  $0.32 \pm 0.02$  mg/kg, respectively.

It is revealed that there are high significant differences among fish and fish products ( $P < 0.01$ ).

## ***SUMMARY***

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According to **Egyptian Organization for Standardization EOS (2005)** which recommended that the maximal permissible limit for lead is 0.1 (mg/kg) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish are 19, 15, 12 and 11 represented as 95%, 75%, 60% and 55%, respectively.

The average concentrations in the examined fresh water fish, canned fish, pickled fish and smoked fish samples for cadmium residue were  $0.09 \pm 0.01$ ,  $0.11 \pm 0.01$ ,  $0.14 \pm 0.01$ , and  $0.18 \pm 0.02$  mg/kg, respectively, and it was revealed that there are high significant differences among them ( $P < 0.05$ ).

**Egyptian Organization for Standardization EOS (2005)** recommended that the maximal permissible limit for cadmium is 0.1 (mg/kg) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish samples are 17, 16, 14 and 14 represented as 85%, 80%, 70% and 70%, respectively.

The obtained results also revealed that the mean values of dieldrin, in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $147.63 \pm 6.25$ ,  $140.88 \pm 4.79$ ,  $235.37 \pm 9.01$  and  $187.95 \pm 7.31$  (ppb), respectively.

The differences associated with dieldrin were highly significant among fish and fish products ( $P < 0.01$ ).

According to **Egyptian Organization for Standardization EOS (1992)** which recommended that the maximal permissible limit for dieldrin is 200 (ppb) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were 18, 18, 15 and 17 represented as 90%, 90%, 75% and 85%, respectively.

## ***SUMMARY***

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The average concentrations of malathione, in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $193.3 \pm 7.041$ ,  $165.90 \pm 5.86$ ,  $301.62 \pm 12.05$ , and  $258.27 \pm 9.49$  (ppb), respectively.

The differences associated with malathione were highly significant among fish and fish products ( $P < 0.01$ ).

According to **Egyptian Organization for Standardization EOS (1991)** which recommended that the maximal permissible limits for malathione is 300 (ppb) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish are 19, 20, 16 and 18 represented as 95%, 100%, 80% and 90%, respectively.

Concerning the average concentrations of histamine as biogenic amine residue, in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $8.35 \pm 0.51$ ,  $7.24 \pm 0.39$ ,  $6.91 \pm 0.46$ , and  $10.62 \pm 0.70$  (mg /100g), respectively.

The differences associated with histamine were highly significant among fish and fish products ( $P < 0.05$ ).

According to **Egyptian Organization for Standardization EOS (1996)** which recommended that the maximal permissible limit for histamine is 20 (mg/100g) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish are 19, 18, 19 and 17 represented as 95%, 90%, 95% and 85%, respectively.

Regarding to tyramine residue, found that the average concentrations of the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $7.34 \pm 0.52$ ,  $11.45 \pm 0.85$ ,  $10.67 \pm 0.63$ , and  $14.52 \pm 0.91$  (mg /100g), respectively.

## ***SUMMARY***

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The differences associated with tyramine were highly significant among fish and fish products ( $P < 0.01$ ).

According to **Egyptian Organization for Standardization EOS (1996)** which recommended that the maximal permissible limit for tyramine is 20 (mg/100g) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish are 19, 17, 18 and 15 represented as 95%, 85%, 90% and 75%, respectively.

The average concentrations of putrescine, in the examined fresh water fish, canned fish, pickled fish and smoked fish samples were  $3.68 \pm 0.19$ ,  $5.16 \pm 0.31$ ,  $4.09 \pm 0.25$ , and  $8.17 \pm 0.46$  (mg /100g), respectively.

The differences associated with putrescine were highly significant among fish and fish products ( $P < 0.01$ ).

According to **Egyptian Organization for Standardization EOS (1996)** which recommended that the maximal permissible limit for putrescine is 20 (mg/100g) in fish, the number of accepted samples in the examined fresh water fish, canned fish, pickled fish and smoked fish are 20, 20, 19 and 18 represented as 100%, 100%, 95% and 90%, respectively.

Public health significance of these chemical residues and possible sources of fish contamination as well as some recommendations to control or minimize such toxic pollutants were discussed.