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# MERCURY AND SELENIUM CONTENT AND RELATIONSHIP IN (BARBOUNI) *Mullus surmuletus* FROM ALEXANDRIA WATER, EGYPT.

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## ABSTRACT

The levels of mercury forms (total, inorganic and organic) and total selenium were determined in flesh and other body organs of barbouni **Mullus surmuletus.** The results indicated that the mercury forms accumulated mainly in the flesh and the total selenium in the gills. The ratios of mercury forms to total selenium in all fish organs were less than one. A positive correlation was found between mercury forms in flesh, and negative correlations between total mercury and each of fish length and total selenium in gills and backbone of fish. The later relation was negative in viscera of fish.

## INTRODUCTION

Koeman et al (1973) observed a linear relationship between the concentration of mercury and selenium in liver of marine mammals. A molar 1:1 mercury-selenium increament was reported by Ganther and Sunde (1974). Coppon and Smith (1981) determined the concentration of both mercury and selenium in 47 samples of sowrd fish. They found that most of the samples had mercury levels exceeding 0.5 mg/kg (on wet weight) and the correlation between the two elements followed a curve with an equations form (y = ab).

In Egypt, the studies on heavy metal pollutions are limited.

El-Sayed et al (1979) found that sediment of El-Mex contained higher levels of total mercury (8-15 p.p.m.) as compared with the sediments of other beachs of Alexandria. They attributed these levels to the wastes of chlorine alkali plant located in this region. The study of Attia (1981) in the total mercury residues in muscles and organs of small and large size of six marine fish species caught from the three main fishing grounds at Alexandria coast, Abu-Qir, El-Mex and Eastern Harbour indicated that large size of fish had higher residues of total mercury than small one. The highest level of this element was found in muscle of barbouni fish **M. surmuletus** especially that caught from El-Mex area. The same observations were reported by Telab (1981) on the meat of shell fish obtained from this

area compared with that caught from the other fishing ground at Alexandria coast. Therefore, in this study the concentration of mercury and selenium in various organs of the barbouni fish **M. surmuletus** caught from El-Mex area off Alexandria coast were determined to know if the above mentioned relation between the two elements are holding in this type of the fish.

## MATERIALS AND METHODS

**Area of study:**

El-Mex is one the main fishing ground at Alexandria coast. It lies in the begining of west part of this coast. The main sources of water loaded by sediments in this area are the Mahmoudiyah fresh water canal and the drainage water pumped out from El-Umoum drain. According to El-Rayis (1973), El-Wakeel and El-Sayed (1978) and El-Sayed et al (1979) the oceanography and climatic conditions of the El-Mex sea water are; the average of the watre temperature is 16.8°C in winter and 26°C in summer, the sea current runs from south west to the north east with a velocity of 12.15 cm/sec., the surface salinity of the water is 38‰ in winter and 39‰ in summer, and the type of the sediments ranges from clay to sand-slite with an organic matter content of 0.45 to 3.8%.

**Materials:**

Barbouni fish **Mullus surmulatus** samples were collected from El-Mex area in April, 1983 by fihsermen using small wooden boat and gillnets. The number of analyzed fish was 216, the analysis was repeated 6 times in each time 36 fish was taken as a replicate (composite sample), from each of the following lengths range, 155-175, 179-191 and 196-214 mm. The samples were transported to the laboratory in an insulated ice box and kept at -14°C in deep freezer until used for later analysis.

**Methods:**

Samples Preparation For Analysis Of Metals:

Plastic knives and spoons were used for dissecting of the fish to obtain the total flesh tissues, gills, backbone and viscera of each fish. All the operations were made on a clean plastic sheet. Each separated organ was minced four times through a plastic meat chopper to be homogenized before analysis.

These organs were represented the main rout of feed and water uptake (viscera and gills) and the feed accumulation parts (flesh and backbone) in fish.

**Mercury Forms:**

Flameless Atomic Absorption Spectrophotometry (A.A.S) Varian, Model A.A. 175 was used for determination of total and inorganic mercury as described by Bernhard (1976). The estimation of total mercury is based on transformation of all organic mercury in inorganic form by wet combustion, reduction of mercuric ion to metallic form with an excess of $SnCl_2$ or Sn $So_4$ and the volatilisation of metallic mercury at room temperature by aeration and measurement by flameless A.A.S. The

determination of inorganic mercury with flameless A.A.S. was carried out in the presence of organic form and without wet combustion. It was complexed with cysteine in acid medium and release before estimation by adding Sn $cl_2$ and NaOH. In both casses standard curve was established using mercury chloride.

Total Selenium Content:

It wsa determined spectrophotometrically at 377 mu after wet digestion using Beckman spectrophotometer as described by El-Sokkary and Gien (1977). This method based on the reduction of selenium by 1N HCL in the presence of 2,3 diamino naphthalene to from celoured piazelend. A standard curve was established using pure selenium.

Statistical Anaylsis:

Mean, standard deviation, standard error, coefficient of variation, and correlation coeficient for the obtained results were calculated according to Snedecor and Cochrau (1967).

## RESULTS AND DISCUSSION

**Mercury Forms:**

The results in Table (1) indicate that:

1. Total mercury content in the flesh (on wet weight basis) ranged from 0.47 to 0.8 mg/kg with an average of 0.6 mg/kg. It was less than the maximum permissiable limit of 1 mg/kg (on wet weight basis) recommended by Food and Drug Admenstration, U.S.A. Generally this average was less than that reported by Caracciolo et al (1974) and Bernhard and Renzoni (1977) for the same type of fish obtained from coast of Israel, Gulf of Cadiz, Ebro-Blanes, Strait of Gibraltar and Off North Sardinia in Mediterranean Sea.

2. The body organs of fish can be arranged according to their content of total organic and inorganic mercury in the following decreasing order, viscera, flesh, gills, and backbone. Kikucki et al (1976) found that the distribution of total mercury in sea bream (Chryscphrys major) organs increased in this order: spleen, brains liver then muscle. Westoo (1973) showed that the viscera of salmon **Salmo salar** and sea trout **Salmo trutta** contained higher methyl mercury than flesh.

3. The inorganic mercury represented about 58, 81, 70 and 65% of total mercury in flesh, gills, backbone and viscera respectively. These values reveal that most of organic mercury accumulated mainly in flesh and viscera. Cappon and smith (1981) found that about 60 to 95% of total mercury were concentrated in fish muscle tissues as methyl mercury.

**Total-Selenium Content:**

Table (1) illustrates the total selenium in various organs of barbouni fish **M. Surmletus.** The data in this Table reveals the following:

1. The total selenium in flesh tissues ranged from 0.862 to 0.919 mg/kg

TABLE 1

Mercury compounds and total selenium content (mg/Kg) in the fish barbouni (M. surmuletus) from El-Mex of Alexandria coast.

| Average of fish length (mm) | Flesh tissues | | Organs | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Gills | | Backbone | | Viscera | |
| | dry weight | dry weight | dry weight | dry weight | dry weight | dry weight | dry weight | dry weight |
| **A. Mercury :** | | | | | | | | |
| **Total - Hg** | | | | | | | | |
| 165 ± 10 | 0.466 | 1.836 | 0.412 | 1.570 | 0.676 | 1.591 | 0.650 | 2.737 |
| 185 ± 6 | 0.543 | 2.201 | 0.507 | 1.765 | 0.486 | 1.112 | 0.689 | 3.444 |
| 205 ± 9 | 0.796 | 3.229 | 0.416 | 1.487 | 0.561 | 1.402 | 1.065 | 5.227 |
| **Inorganic - Hg** | | | | | | | | |
| 165 ± 10 | 0.288 | 1.134 | 0.314 | 1.134 | 0.483 | 1.136 | 0.414 | 1.742 |
| 185 ± 6 | 0.313 | 1.268 | 0.415 | 1.444 | 0.356 | 0.814 | 0.446 | 2.229 |
| 205 ± 9 | 0.438 | 1.777 | 0.359 | 1.284 | 0.370 | 0.925 | 0.731 | 3.587 |
| **Organic - Hg** | | | | | | | | |
| 165 ± 10 | 0.178 | 0.702 | 0.098 | 0.367 | 0.193 | 0.455 | 0.336 | 0.995 |
| 185 ± 6 | 0.230 | 0.933 | 0.092 | 0.321 | 0.130 | 0.298 | 0.213 | 1.216 |
| 205 ± 9 | 0.358 | 1.452 | 0.057 | 0.204 | 0.191 | 0.477 | 0.334 | 1.640 |
| **B. Selenium :** | | | | | | | | |
| 165 ± 10 | 0.862 | 3.390 | 2.550 | 9.536 | 0.983 | 2.313 | 1.457 | 6.134 |
| 185 ± 6 | 0.966 | 3.899 | 2.476 | 8.612 | 1.716 | 3.922 | 1.482 | 7.410 |
| 205 ± 9 | 0.919 | 3.710 | 2.763 | 9.869 | 1.893 | 4.732 | 1.206 | 5.912 |

(on wet weight basis). According to Chau et al (1976) the level of 0.25 mg/kg in the diet or 0.01 p.p.m in the water showed physiological and histological changes in some experimental animals.

2. Among the fish organs, gills contained the highest amount of total selenium (on dry weight basis) whereas the backbone had the lowest value. The flesh had less selenium than viscera. Kaiser et al (1979) found that selenium was accumulated mainly in liver tissues followed by skin and flesh of brown trout **Salmo trutta.**

3. The accumulation of total selenium was 16% in flesh, 40% in gills, 15% in backbone, and 28% in viscera. These results indicate that the main routes selenium enternace are feed and water uptake.

**Mercury-Selenium Interaction:**

From the above results it can be concluded that:

1. Total-selenium had an affinity to accumulate mainly in gills, while mercury had a tendancy to concentrate in viscera.

This conclusion agrees with that reported by Sato et al (1980) for the distribution of selenium in sea bream (Chrysophrys major) and Kikueki et al (1976) for the accumulation of mercury in horse mackerel (**Trachurus japonicus**).

2. Increasing the levels of total selenium in fish accompanied with a decraese in the level of mercury. Therefore the ratio of mercury, total, organic and inorganic, to total selenium was less than one in all fish organs. Koeman et al (1973) observed a ratio of 1:1 mercury: selenium in liver of marine mammals.

Nakagawasai et al (1976) reported a ratio of 2:5 mercury: selenium in muscle tissue of sea bass **Lateolabora japonicus.**

**Statistical Anaylsis:**

Table (2) illustrates the correlation coefficient between the variables under study in each organs of fish. The data in this table reveals that:

1. There is a positive relationship in flesh tissue of fish between:

a) length of fish and its weight.

b) mercury forms and length of fish or it's weight.

2. In the gills, negative significant correlation was observed between length of fish and total mercury, total mercury and total selenium and inorganic mercury and organic mercury whereas this relations was insignificant between total selenium and each of inorganic and organic mercury.

3. In backbone, a negative insignificant correlation was found between lenght of fish and each of total and inorganic mercury, total selenium and mercury forms.

TABLE 2
Correlation coefficient between the factors affecting mercury and selenium content in barbouni (M. surmuletus).

| Variables | Flesh tissues | | | | | Gills | | | | Backbone | | | | Viscera | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Hg | Inorganic Hg | Organic Hg | Total Selenium | Total Weight | Total Mercury | Inorganic Mercury | Organic Mercury | Total Selenium | Total Mercury | Inorganic Mercury | Organic | Total Selenium | Total Hg | Inorganic Hg | Organic Hg | Total Selenium |
| Total length | 0.964 | 0.947 | 0.976 | 0.617 | 0.999 | 0.289 | 0.405 | 0.9919 | 0.2556 | -0.392 | -0.645 | 0.11099 | 0.9822 | 0.970 | 0.964 | 0.983 | -0.1374 |
| Total mercury | | 0.998* | 0.998* | 0.387 | 0.959 | | 0.757 | 0.408 | -0.999 | | 0.955 | 0.88712 | -0.557 | | 0.999* | 0.997* | -0.372 |
| Inorganic Mercury | | | 0.994 | 0.333 | 0.942 | | | -0.287 | -0.779 | | | 0.6688 | -0.776 | | | 0.996 | -0.393 |
| Organic mercury | | | | 0.432 | 0.972 | | | | | | | | -0.0781 | | | | -0.312 |
| Total selenium | | | | | 0.632 | | | | 0.375 | | | | | | | | |

4. In viscera of fish, a negative insignificant correlation was found between total selenium and each of length of fish, total, inorganic and organic mercury. On the other side, a strong positive significant correlation was found between total mercury and each of organic and inorganic mercury.

The above findings agree well with that reported in the literature. The studies of Scott and Armstrong (1972) and Berhard and Renzoni (1977) on Swedish pike (**Esox lucius**) showed a positive correlation between mercery content in axial muscle and total weight or length of fish. Mackay et al (1975) reported that a highly significant correlation was observed between mercury and selenium in the muscle tissues of blue marli fish (**Makaira nigricans**).

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