Heavy metals accumulation in different tissues of some marine fish

By

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Abstract

This study was carried out on some fish *species; Seriola dumerili, Trachurus mediterraneus, Pagellus acarne and Mullus barbatus,* caught from the Mediterranean Sea at Mersa Matrouh region during, January 2000. Heavy metals (Fe, Co, Mn, Zn, Cd, Pb and Cu) were determined in different organs (gills, liver, heart and muscles) of the investigated fish.

It could be concluded that *P. acarne* (the best bioindicator of pollution) was highly contaminated (gills, liver and heart) with Fe, Co, Mn, Zn and Cd. It was shown that the gills, liver and heart tissues of *P. acarne* recorded the highest concentrations of Fe, Co, Mn, Zn and Cd as compared with the gills, liver and heart tissues in the other studied fish.

On the other hand, Fe accumulation was found in the muscle tissues of both *T. mediterraneus and M. barbatus* at levels of 39.03

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and 17.62 ppm, respectively. Whereas, Zn accumulation was recorded in the muscle tissues of both *S. dumerili* and *P. acarne* at concentrations 26.06 and 16.33 ppm, respectively. However, Mn level was not detectable in the heart and liver of both *P. acarne and M. barbatus.* Pb and Cu concentrations were not detectable in the heart tissues of all the studied fish.

However, the muscle tissues of all the studied fish contained the permissible concentrations recommended by the National Health and Medical Research Council (NHMRC) and Food and Agriculture Organization (FAO) for heavy metals concentrations, except, the muscles of *S. dumerili* for Cd and Pb.

Introduction

Heavy metals are considered the most important pollutants which have hazardous effects on the aquatic environment and its organisms and hence human health. Industrial, agricultural and domestic wastes are considered the most important sources of pollution with different heavy metals in water bodies.

Some heavy metals, at specific concentrations, are essential for a series of enzymatic activities. However, when the normal concentrations are exceeded they form an important group of enzyme inhibitors. Metals such as Pb, Ag, Cu, Cd and Hg are particularly toxic and inhibit enzyme activity when they form mercaptides with the sulphhydryl groups responsible for the catalytic activity (Vallee and Wacker, 1970).

Fish is also considered the "filter" that accumulates heavy metals in its tissues, being bound to the fats and proteins inside the cells (Macleod and Pessah, 1973).

Gutenmann *et al.* (1988) found high concentration of Cd (2.58 ppm, on dry wt. basis) in oysters, yet it would not constitute a health hazard to consumers, since appreciable levels of Cd in oysters are associated with metal-binding proteins.

In addition, heavy metals as Fe, Co, Mn, Zn, Cd, Pb, Cu, Cr, Ni, Ag and Hg accumulate in the bodies of the aquatic living organisms (plankton and fish) with concentrations several times higher than that in the surrounding water (Anderson, 1977). Besides, fish viscera contained significantly greater concentrations of heavy metals than the muscle tissues (Chernoff and Dooley, 1979). Khalaf *et al.* (1985) reported high concentrations of Mn, Zn, Cd, Pb and Cu in the kidney, liver, gills and gonads of *Barbus grypus.*

Moreover, Abdel-Baky (2001) recorded high concentrations of metals (Mn, Zn, Pb and Cu) in organs (muscles, liver and gills) of the catfish; *Clarias gariepinus,* from different sites of Lake Manzalah. He found that the concentration of tested metals in different fish organs followed a sequence of: Cu and Zn in liver > gills > muscles and Pb and Mn in gills > liver > muscles. The concentration of the tested metals in fish organs was in the following order: Zn > Cu > Mn > Pb. Bahnasawy (2001) reported that the gills of *Clarias gariepinus* collected from different sites of Lake Manzalah contained the highest concentration of heavy metals (2.4 - 3.9 µ g/g wet wt. Mn, 28.9 - 45.3 µg/g wet wt. Zn, 1.3 - 2.0 µg/g wet wt. Pb and 2.9 - 4.4 µg/g wet wt. Cu).

Similarly, Aboul-Ezz *et al.* (2001) studied the concentrations of Fe, Co, Mn, Zn, Cd, Pb and Cu in different organs (gills, liver, heart and muscles) of *Pagrus pagrus, Saurida undosquamis and Sardinella aurita* collected from the Mediterranean Sea at Mersa Matrouh region, Egypt, during 1996. They found that the concentration of the

metals in the different organs of the fish was in the following order: heart > gills> liver > muscles.

Thus, fish harvested from waters that are exposed to varying amounts of industrial chemicals and pesticides accumulate in their tissues varying levels of heavy metals that might cause illness. The hazard is most commonly associated with long-term exposure to these contaminants (FDA, 1998).

The progressive increase in the quantities of pollutants derived from several sources (industrial, agricultural and sewage) in the Mediterranean Sea has drastic effect on the environment. Furthermore, pollution by heavy metals has hazardous effects on human health through the consumption of polluted fish. Therefore, the main goal of this study was to determine the levels of some heavy metals (Fe, Co, Mn, Cd, Zn, Pb and Cu) accumulation in different tissues (gills, liver, heart and muscles) of some fish species; *Seriola dumerili, Trachurus mediterraneus, Pagellus acarne* and *Mullus barbatus* caught from the Mediterranean Sea at Mersa Matrouh.

Material and Methods

Samples of the four fish species were obtained from the Mediterranean Sea at Mersa Matrouh by fishermen during, January 2000 . The following species were obtained: *Seriola dumerili, Trachurus mediterraneus, Pagellus acarne and Mullus barbatus.* Mean weight and length of these fish were (500.0 g and 36.0 cm), (104.4g and 21.0 cm), (60.6g and 15.8cm) and (39.3g and 14.3 cm), respectively. Extreme care was applied to separate the investigated organs [gills, liver, heart and muscles (edible part)] from each sample. The homogenised sample of each organ was dried at 105 °C to constant weight to evaporate its water content. According to Salisbury and Chan (1985), 10 ml of the digestion mixture (containing nitric

acid 69-71%, perchloric acid 70-72% and sulphuric acid 95-98% in the ratio 5:1:1, respectively) were added to 2 g of ground dried sample to digest it. Samples were left for 6hrs at room temperature, then heated using a heating mantel at 80 °C to dissolve all tissues and at 200 °C to evaporate the gasses produced. Five ml of the digestion mixture were added to the digested samples and they were left to cool under room temperature, filtered using Whatman No.42 to separate the lipid content. The remaining solution was transferred to a 25 ml volumetric flask and diluted to volume with deionised-distilled water. A blank was prepared using 2 ml distilled water and the pre-mentioned steps were applied. Concentrations of Fe, Co, Mn, Zn, Cd, Pb and Cu were determined using a Perkin-Elmer Atomic Absorption Spectrophotometer (Model No. 2380). The data obtained were expressed as mean + standard deviation mg/kg dry wt. basis.

Results

Accumulations of heavy metals (Fe, Co, Mn, Zn, Cd, Pb and Cu) in different tissues (gills, liver, heart and muscles) of *Seriola dumerili, Trachurus mediterraneus, Pagellus acarne and Mullus barbatus* obtained from the Mediterranean Sea during, January 1997 are shown in Tables 1, 2, 3, 4, 5, 6 & 7 and Fig. 1.

Iron (Fe):

As shown in Table 1 and Fig.1, there are large differences in the metal concentrations in the different organs of the four fish species. The gills of *P. acarne* contained the highest concentration of Fe (205.66 ppm), followed by *M. barbatus* (178.42 ppm), *T. mediterraneus* (34 . 35 ppm) and the lowest level was found in *S. dumerili* (16.75 ppm). Concerning the level of Fe in the liver of fish, the highest concentration was in the liver tissues of *P. acarne* followed by *T. mediterraneus,*

M. barbatus and S. dumerili, reaching 1233.37, 364.83, 194.76 and 15.06 ppm (on dry wt. basis), respectively. Its concentration in the heart tissues was 1157.34, 696.63, 279.89 and 30.63 ppm for *P. acarne, T. mediterrameus, M. barbatus and S. dumerili,* respectively.

On the other hand, it was noticed that the investigated muscles had the lowest level of Fe especially in both *P. acarne* (10.07 ppm) and *S. dumerili* (10.16 ppm), followed by *M. barbatus* (17.62 ppm) and *T. mediterraneus* (39.03 ppm).Generally, from the data obtained, Fe accumulation in the studied organs was in the following order: liver > heart > gills > muscles for *P. acarne*. For, *T. mediterraneus, M. barbatus* and *S. dumerili,* this order varied depending mainly upon the species of fish and the organ examined.

Cobalt (Co) :

In the gills of fish (Table 2), the highest concentration of Co was found in the gills of *M. barbatus* (20.83 ppm) and its lowest concentration was observed in the gills of *S. dumerili* (3.73 ppm). While, the liver tissues in *P. acarne, M. barbatus, T. mediterraneus* and *S. dumerili* contained 115.51, 57.15, 19.05 and 4.86 ppm of Co, respectively. Concerning the heart of fish, it was found that Co level recorded the highest value in the heart tissues of *P. acarne* (324.35 ppm), followed by *T. mediterraneus* (139.24 ppm), *M. barbatus* (80.03 ppm) and *S. dumerili* (31.05 ppm).

On the other hand, there were small concentrations of Co in the muscle tissues of fish (5.25, 4.73, 4.33 and 2.42 ppm for *S. dumerili, M. barbatus, P. acarne and T. mediterraneus,* respectively). Generally, the heart and liver tissues of *P. acarne* were polluted with more Co than other fish spp. The same trend was found in the gills of *M. barbatus* and the muscles of *S. dumerili.*

Manganese (Mn) :

From Table 3, it was found that Mn concentration in the gills of *P. acarne* was 16.85 ppm, followed by *M. barbatus* (15.40 ppm), *S. dumerili* (7.46 ppm) and its level decreased in the gills of *T. mediterraneus*, reaching 4.56 ppm. The liver tissues of both *T. mediterraneus* and *S. dumerili* contained 8.16 and 3.10 ppm of Mn, respectively. However, Mn level was not detectable in the liver tissues of both *P. acarne* and *M. barbatus.*

The heart tissues of *S. dumerili* contained 6.23 ppm of Mn but it was not detectable in the heart of other fish spp.

The concentration of Mn in the muscle tissues of fish was in the following order: *T. mediterraneus* (0.93 ppm) < *M. barbatus* (1.32 ppm) < *P. acarne* (1.57 ppm) < S. *dumerili* (3.32 ppm).

Zinc (Zn):

Zn levels in the gills of *P. acarne, S. dumerili, M. barbatus and T. mediterraneus* (Table 4) were 106.83, 37.01, 26.70 and 2.87 ppm, respectively. Its concentration was high in the liver tissues especially in *P. acarne* (226.69 ppm), followed by *S. dumerili* (192.90 ppm), *T. mediterraneus* (68.80 ppm) and *M. barbatus* (61.07 ppm). The heart tissues of *P. acarne* contained the highest level of Zn reaching 263.71 ppm and the lowest concentration was found in *M. barbatus* (23.24 ppm).

On the other hand, the muscles contained lesser Zn concentration than the other organs (Table 4). The highest level of Zn was found in the muscles of *S. dumerili* (26.06 ppm), while, the lowest level was observed in *T. mediterraneus* (3.07 ppm).

Cadmium (Cd):

Concerning the gills polluted with Cd (Table 5 and Fig. 1), the highest accumulation was found in *P. acarne* (18.85 ppm), while, the

lowest concentration was observed in *S. dumerili* (2.41 ppm). The liver tissues of *P. acarne* contained 195.45 ppm of Cd as highest level, whereas the same organ in *S. dumerili* had only 2.48 ppm of Cd. The heart tissues of *P. acarne* contained the highest concentration of Cd (189.99 ppm), followed by *T. mediterraneus* (76.16 ppm), *M. barbatus* (33.29 ppm) and the lowest level was in the heart of *S. dumerili* (18.99 ppm).

Moreover, the levels of Cd in the studied muscles were low when compared with other organs. The highest level of Cd was found in the muscles of *S. dumerili* (3.98 ppm), while, the muscles of *P. acarne* contained the lowest level (1.90 ppm).

Lead (Pb):

The gills of *S. dumerili* (Table 6) contained 9.76 ppm of Pb, while, it was not detectable in the same organ in other fish species. The same trend was found in the liver and muscles of fish reaching 5.42 and 7.81 ppm, respectively. Pb concentrations in the heart tissues were not detectable in all the studied fish species.

Copper (Cu):

The gills of *T. mediterraneus* and *S. dumerili* (Table 7) contained 3.01 and 2.42 ppm of Cu, respectively. A similar trend was found in their muscle tissues to be 4.44 and 2.91 ppm of Cu in *T.mediterraneus* and *S. dumerili,* respectively. Both *S. dumerili* and *T. mediterraneus* contained in their liver 40.85 and 24.82 ppm of Cu, respectively. On the other hand, the concentration of Cu was not detectable in the heart tissues of all the studied fish.

Discussion

Fish is considered as the "filter" that accumulates heavy metals in their different tissues, being bound to fats and proteins inside the cells.

Concerning marine fish it seems to accumulate more heavy metals than freshwater fish. Heavy metals are known to accumulate in the bodies of the aquatic living organisms in concentrations several times higher than that in the surrounding waters (Johnels et al., 1967; Cumont, 1971 and Macleod and Pessah, 1973).

Some heavy metals such as Fe, Mn, Zn and Cu are essential for a series of enzymatic activities and growth of the living organisms. However, they are likely to show toxic effects when organisms are exposed to levels higher than their normal requirements. Other heavy metals like Co, Cd and Pb are not essential for metabolic activities and exhibit toxic properties (Bahnasawy, 2001).

It is evident that the occurrence of heavy metals (Fe, Co, Mn, Zn, Cd, Pb and Cu) is known to concentrate in various degrees in fish organs as suggested by Deb and Santra (1997) who commented that metal bio-accumulation in a specific tissue provides a better basis for the regular monitoring of the exposure than the whole body.

The present study revealed that, there were marked differences between the concentrations of heavy metals in the different organs of the different studied species.

From the presented data, it could be found that *P. acarne* was highly polluted with Fe, followed by *T. mediterraneus, M. barbatus* and finally *S. dumerili.* The highest levels of Fe were found in the liver, heart and gills of *P. acarne* which recorded 1233.37, 1157.34 and 205.66 ppm (on dry wt. basis). While, the lowest levels of Fe were observed in the heart, gills and liver tissues of S. dumerili which decreased by 97.35%, 91.86% and 98.78%, respectively, from the highest values of Fe. On the other hand, the results indicated that Fe concentration in the muscle tissues of *T. mediterraneus* was 39.03 ppm and 10.07 ppm in the muscle tissues of *P. acarne.*

Thus, it could be observed that *P. acarne* is the best bioindicator of pollution with Fe, especially in its liver, heart and gills.

Anthony *et al.* (1983) found that Fe levels in the edible part of Blue fish, Croaker, Flounder, Sea Bass and Sea Trout (Gray) were 451.60, 372.45, 102.85, 136.25 and 225.65 (g/100g, respectively (on wet wt. basis). While, Gall *et al.* (1983) observed that Fe concentrations in the fillets of Grouper, Red Snapper, Pompano and Spanish Mackerel were 0.3, 0.2, 0.7 and 0.6 mg/100g, respectively (on wet wt. basis). Furthermore, it was found that the muscles of *Tilapia* collected from Wadi Al-Raiyan recorded the highest Fe level ranging from 8.05 to 11.06 ppm (on dry wt. basis), followed by those from Lake Qarun (4.23-6.20 ppm), those from Lake Nasser (5.20 ppm) and those from River Nile (3.91-5.82 ppm) (Hussien, 1993).

Aboul-Ezz *et al.* (2001) recorded high concentrations of Fe in the gills, liver, heart and muscles of Pagrus pagrus, *Saurida undosquamis* and *Sardinella aurita* collected from the Mediterranean Sea at Mersa Matrouh region during 1996. They found that the highest concentrations of Fe were in the heart of *P. pagrus* (3559 .92 ppm), *S. undosquamis* (1097.97 ppm) and *S. aurita* (709.83 ppm).

Concerning Co accumulation, the highest level was found in the heart for *P. acarne* (324.35 ppm, on dry wt basis), it decreased by 57.07%, 75.33% and 90.43% for the heart tissues of *T. mediterraneus*, *M. barbatus* and *S. dumerili*, respectively. While, in case of the liver, Co accumulation took the following trend: *P. acarne* > *M. barbatus* > *T. mediterraneus* > *S. dumerili* as seen from the data obtained. Similarly, the gills of *M. barbatus* contained Co levels reaching 20.83ppm, which decreased by 44.26%, 64.38% and 82.09% in *P.acarne*, *T. mediterraneus* and *S. dumerili*, respectively. On the other hand, it was found that the muscle tissues of the studied fish contained

Co levels lesser than those recorded in the previous organs especially in *T. mediterraneus* (2.42 ppm).

Especially the heart and liver of *P. acarne* which might be considered as bioindicator for pollution with Co.

The concentrations of Co in the different organs of *T.mediterraneus, P. acarne* and *M. barbatus* followed the order: heart > liver > gills > muscles. The same trend was also observed in *Pagrus pagrus* and *Sardinella aurita* collected from the Mediterranean Sea during 1996 (Aboul-Ezz *et al.*, 2001).

Depledge *et al.* (1993) reported that Co concentrations were high in the gills of crab (Dorippe granulata) (123.9 (g/g dry wt.). Moreover, Faris *et al.* (1998) found that Co accumulated in the gills of *Liza subviridus* and in the liver of *Nematolosa nasus* collected from the North West Arabian Gulf.

As regards Mn, the gills of *P. acarne* contained the highest level (16.85 ppm), but the lowest level was found in *T. mediterraneus* (4.56 ppm), which contained 8.16 ppm Mn in their liver tissues. However, Mn levels in the liver tissues of both *P. acarne* and *M. barbatus* were not detectable. Manganese levels were also not detectable in the hearts of the investigated fish except in *S. dumerili*. In addition, the results showed that there were low concentrations of Mn in the muscle tissues of all the studied fish.

Anthony *et al.* (1983) found that Mn levels were 22.05, 33.75, 14.95, 10.70 and 18.55 (g/100g (on wet wt. basis) in the muscle tissues of Blue fish, Croaker, Flounder, Sea Bass and Sea Trout (Gray), respectively. Gall *et al.* (1983) reported that Mn levels were 13.5, 14.5, 13.8 and 12.2 (g/100g (on wet wt. basis) for Grouper, Red Snapper, Pompano and Spanish Mackerel fillets, respectively.

As regards Zn pollution. the data showed that the heart and liver tissues of *P. acarne* were highly polluted with Zn (263.71 and 226.69 ppm, respectively).

Anthony *et al.* (1983) reported that Zn levels in the muscles were 763.2, 371.5, 393.8, 341.2 and 471.0 (g/100g (on wet wt. basis) for Blue fish, Croaker, Flounder, Sea Bass and Sea Trout (Gray), respectively. Gall *et al.* (1983) found that Zn concentrations in the fillets were 0.4, 0.3, 0.8 and 0.5 mg/100g (on wet wt. basis) for Grouper, Red Snapper, Pompano and Spanish Mackerel, respectively. Moreover, Hussien (1993) recorded high concentrations of Zn in *Tilapia* fish collected from different locations.

Aboul-Ezz *et al.* (2001) found high concentrations of Zn in the heart of *Pagrus pagrus* (438.96 ppm) and *Saurida undosquamis* (216.72 ppm) collected from the Mediterranean Sea.

Concerning Cd pollution, the highest concentration was found in the liver of *P. acarne* (195.45 ppm) which decreased by 82.37%, 92.46% and 98.73% in the liver tissues of *M.barbatus, T.mediterraneus* and *S. dumerili,* respectively. The levels of Cd in the heart tissues were 189.99 and 18.99 ppm for *P. acarne* and *S.dumerili,* respectively. A similar trend was observed in the gills of both previous fish species. On the other hand, Cd concentration in the muscle tissues of the studied fish was very low.

El-Moselhy (1999) found that the gills and liver of *Tilapia* sp., collected from the Lakes Manzala, Timsah and Nasser and the River Nile at Cairo City, showed higher Cd concentrations than those

found in the muscles. Similarly, Aboul-Ezz *et al.* (2001) reported that the highest concentrations of Cd were found in the heart and liver of *Pagrus pagrus* and *Sardinella aurita* collected from the Mediterranean Sea at Mersa Matrouh region and the lowest concentrations were observed in their muscles.

Pollution with Pb, the highest level was observed in the gills (9.76 ppm), liver (5.42 ppm) and muscles (7.81 ppm) of *S. dumerili,* while, the Pb level in its heart was not detectable. The Pb level was also not detectable in any organ of the other fish species. Therefore, *S.dumerili* was the best bioindicator of Pb pollution.

However, Badsha and Goldspink (1982) reported that Cd and Pb appeared to accumulate in the heart, liver, kidney and brain as well as in the bone of fish.

Paster *et al.* (1994) found that Pb and Cd concentrations varied with proximity to sources of pollution. Cd concentrations were greatest (up to 3500 ng/g) in molluscs and Pb concentrations were greatest (up to 980 ng/g) in molluscs and some pelagic fish species.

On the other hand, Aboul-Ezz *et al.* (2001) reported that Pb concentrations were not detectable in any organs (gills, liver, heart and muscles) of *Pagrus pagrus, Saurida undosquamis* and *Sardinella aurita* collected from the Mediterranean Sea.

With regard to Cu pollution, the liver tissues contained 40.85 and 24.81 ppm in *S. dumerili* and *T. mediterraneus,* respectively. However, Cu concentrations decreased in the gills and muscle tissues of *S. dumerili* and *T. mediteraneus,* whereas, the Cu level in the heart

tissues was not detectable. The Cu level was not detectable in the gills, liver, heart and muscles of *P. acarne* and *M. barbatus*. Consequently, *S. dumerili* followed by *T. mediterumens* were the best bioindicators of pollution with Cu.

El-Nabawi *et al.* (1987) found that the concentration of Cd, Cu, Pb and Zn were 0.023, 6.9, 0.47 and 16.5 ppm dry wt., respectively, in the muscle tissues of *Pagellus erythrinus*; 0.023, 8.0, 0.60 and 25.5 ppm, respectively, in the muscles of *Siganus rivulatus*; 0.018, 7.8, 0.19 and 16.5 ppm, respectively, in the muscles of *Sphyraena sphyraena* and 0.012, 10.2, 0.18 and 27.0 ppm, respectively, in the muscles of *Trigla hirundo* collected from Abu Qir Bay.

Scott and Latshaw (1993) reported that the concentrations of Cu, Fe, Mn and Zn were 12, 286, 4 and 28 (g/g in the muscles of menhaden (*Brevoortia tyrannus*).

Moreover, Aboul-Ezz *et al.* (2001) recorded very low concentrations of Cu in the muscles of *P. pagrus, S. undosquamis* and *S. aurita* collected from the Mediterranean Sea. However, Cu concentrations were not detectable in the gills, liver and heart of fish.

The data showed that Fe, Co, Zn and Cd concentrations exhibited their highest levels in the gills, liver and heart of the studied fish and lowest levels in the muscles. This agrees with the results reported by El - Moselhy (1999), Shenouda *et al.* (1992), Faris *et al.* (1998) and Aboul -Ezz *et al.* (2001).

Generally, it could be concluded that the highest accumulation of Fe was recorded in the liver, heart and gills, Co and Cd in the heart and liver,

Mn in the gills, Zn in the heart, liver and gills of *P. acarne*. Whereas, Pb accumulation was cleared in the gills, muscles and liver and Cu in the liver of *S. dumerili*. Therefore, both *P. acarne and S. dumerili* are considered the best bioindicators of pollution with heavy metals.

The present study showed that the level of metals in the tissues of the fish depended mainly on the organ, species and metal. This is in agreement with the results reported by Fujise *et al.* (1988), Shenouda *et al.* (1992), Faris et al. (1998) and Aboul - Ezz *et al.* (2001).

The standard concentrations of Cu and Pb for human consumption are 30.0 and 2.0 mg/kg, respectively, as recommended by the National Health and Medical Research Council (NHMRC) (Marks *et al.*, 1980). WHO limits reported by FAO (1992) recommended that the standard concentrations of Cd for human consumption is 2.0 mg/kg. Western Australian Food and Drink Regulations recommended a level of 40 mg/kg Zn for human consumption (Marks *et al.*, 1980). Accordingly, the concentrations of Cu, Pb, Cd and Zn in the muscles of fish are still below the permissible levels, except, the muscles of *S. dumerili* for Pb and Cd.

Finally, it might be concluded that, the muscles of the investigated fish collected from the Mediterranean Sea at Mersa Matrouh region showed very low concentrations of heavy metals (Fe, Co, Mn, Zn, Cd, Pb and Cu), however, the gills, liver and heart contained higher concentrations of the metals. In order to protect the investigated fish, the rate of waste discharge in the Mediterranean Sea should be decreased to overcome the problem of heavy metals' pollution which affects the fishery resources and which extends to the human beings.

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Table (1): Iron concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus M ± SD**	**P. ACARNE M ± SD**	**M. barbatus M ± SD**
Gill	16.75±1.02	34.35+3.43	205.66±17.94	178.42+59.57
Liver	15.06±1.99	364.83+32.64	1233.37±64.13	194.76+17.66
Heart	30.63±1.04	696.63+72.97	1157.34±818.74	279.89+76.22
Muscle	10.16±1.42	39.03+1.66	10.07±1.25	17.62+ 5.59

Table (2): Cobalt concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus M ± SD**	**P. ACARNE M ± SD**	**M. barbatus M ± SD**
Gill	3.73±0.45	7.42±1.37	11.61±2.16	20.83±7.16
Liver	4.86±1.92	19.05±2.25	115.51±17.38	57.15±3.09
Heart	31.05±1.38	139.24± 3.14	324.35±55.90	80.03±5.72
Muscle	5.25±0.99	2.42±0.41	4.33±1.17	4.73±0.47

Table (3): Manganese concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus M ± SD**	**P. ACARNE M ± SD**	**M. barbatus M ± SD**
Gill	7.46±1.67	4.56±0.40	16.85±2.14	15.40±0.80
Liver	3.10±1.37	8.16±1.68	ND	ND
Heart	6.23±0.90	ND	ND	ND
Muscle	3.32±1.49	0.93±0.18	1.57±0.57	1.32±0.03

M (SD = Mean (Standard Deviation.
Number of fish used (n) = 6
ND = Not detectable, below the detection level of the used atomic absorption spectrophotometer.

Table (4): Zinc concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus** M ± SD	**P. ACARNE** M ± SD	**M. barbatus** M ± SD
Gill	37.01±1.22	2.87±0.82	106.83±8.38	26.70±3.41
Liver	192.90±2.97	68.80±11.33	226.69±27.98	61.07±6.21
Heart	42.68±2.47	84.20±60.01	263.71±21.05	23.24±4.67
Muscle	26.06±2.05	3.07±1.04	16.33±4.00	10.44±0.62

Table (5): Cadmium concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus** M ± SD	**P. ACARNE** M ± SD	**M. barbatus** M ± SD
Gill	2.41+0.80	3.80+0.90	18.85+1.12	9.10+1.43
Liver	2.48+0.76	14.74+4.24	195.45+13.52	34.46+1.02
Heart	18.99+1.44	76.16+13.03	189.99+4.31	33.29+5.18
Muscle	3.98+1.01	2.07+1.05	1.90+0.43	2.26+0.58

M (SD = Mean (Standard Deviation.

Number of fish used (n) = 6

Table (6): Lead concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus** M ± SD	**P. ACARNE** M ± SD	**M. barbatus** M ± SD
Gill	9.76+0.53	ND	ND	ND
Liver	5.42+1.22	ND	ND	ND
Heart	ND	ND	ND	ND
Muscle	7.81+5.85	ND	ND	ND

Table (7): Copper concentrations (ppm dry weight) in the different organs of S. dumerili, T. mediterraneus, P. acarne and M. barbatus collected from the Mediterranean Sea.

Organs	Fish			
	S. dumerili M ± SD	**T. mediterraneus** M ± SD	**P. ACARNE** M ± SD	**M. barbatus** M ± SD
Gill	2.42+1.07	3.01+0.77	ND	ND
Liver	40.85+3.07	24.82+1.83	ND	ND
Heart	ND	ND	ND	ND
Muscle	2.91+0.98	4.44+0.55	ND	ND

M (SD = Mean (Standard Deviation.

Number of fish used (n) = 6

ND = Not detectable, below the detection level of the used atomic absorption spectrophotometer.

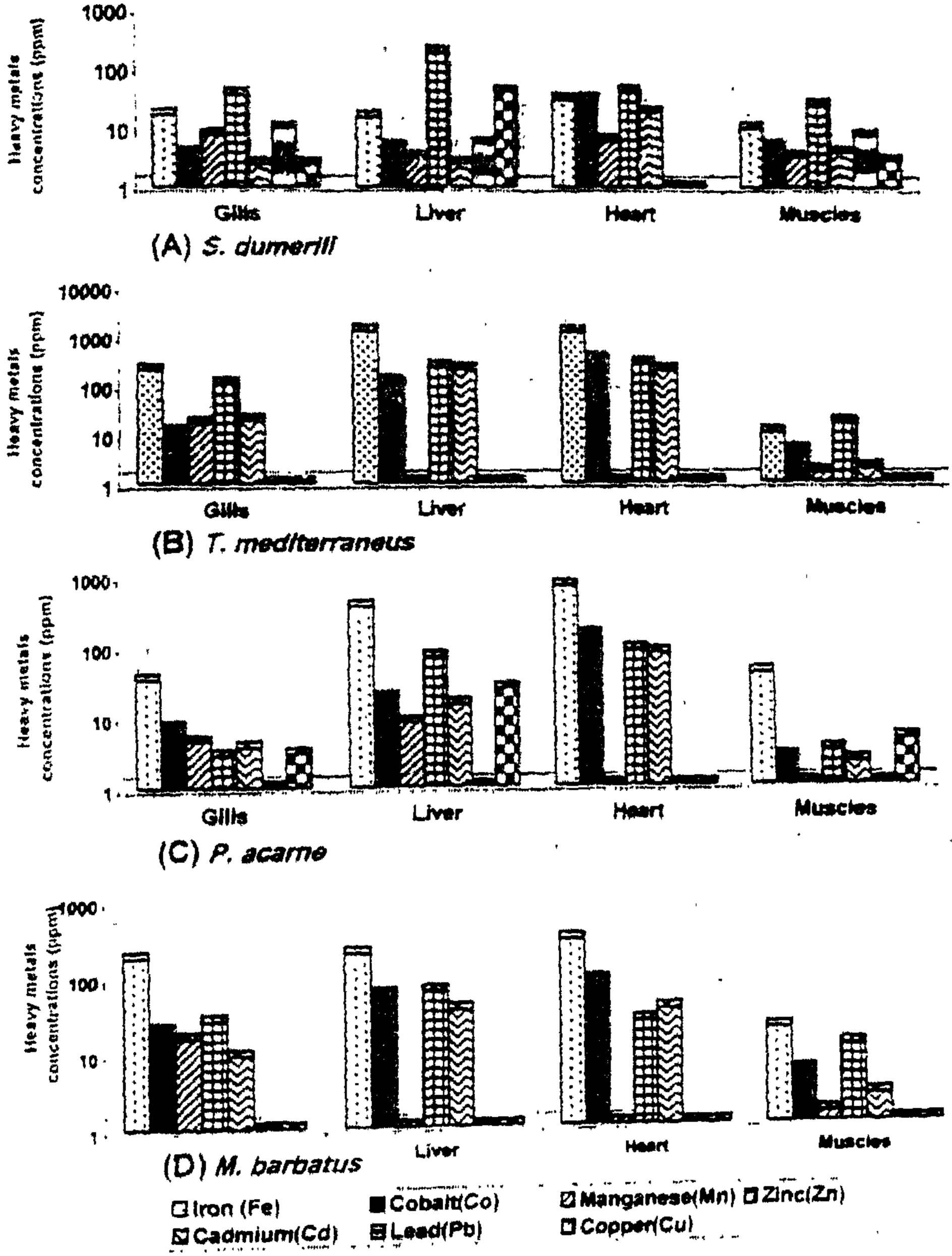

Fig. (1): Heavy metals concentrations (ppm dry weight) in the different organs of the different fish collected from the Mediterranean Sea.

تراكم العناصر الثقيلة في أنسجة مختلفة لبعض الأسماك البحرية

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محطة بحوث الأسماك بالقناطر الخيرية ـ القاهرة ـ مصر

أجريت هذه الدراسة علي بعض الأسماك (الشولة ـ الصاورو ـ الباجليوس ـ الحمامة) المصادة من البحر المتوسط خلال يناير ٢٠٠٠ م . ولقد تم تقدير بعض العناصر (الحديد ـ الكوبلت ـ المنجنيز ـ الزنك ـ الكادميوم ـ الرصاص ـ النحاس) في الأنسجة المختلفة (الخياشيم ـ الكبد ـ القلب ـ العضلات) لهذه الأسماك .

وقد أمكن استنتاج أن أسماك الباجليوس كانت أنسجتها ملوثة بعناصر الحديد ـ الكوبلت ـ المنجنيز ـ الزنك ـ الكادميوم خاصة في أنسجة الخياشيم والكبد والقلب . سجلت خياشيم وكبد وقلب أسماك الباجليوس أعلي التركيزات من عناصر الحديد والكوبلت والمنجنيز والزنك والكادميوم مقارنة بالأنواع الأخري .

وعلي الجانب الآخر فإن أنسجة عضلات أسماك الصاورو والحمامة احتوت علي عنصر الحديد بتركيز ٣٩,٠٣ ، ١٧,٦٢ مجم / كجم علي التوالي ، بينما أحتوت عضلات الشولة والباجليوس علي عنصر الزنك بتركيزات ٢٦,٠٦ ، ١٦,٣٣ مجم / كجم علي التوالي ، علاوة علي ذلك فإن عنصر المنجنيز لم يكتشف في أنسجة القلب والكبد لكل من أسماك الباجليوس والحمامة ، بينما لم يكتشف عنصري الرصاص والنحاس في أنسجة القلب في جميع الأسماك موضع الدراسة .

وأخيراً فإن عضلات الأسماك موضع الدراسة أحتوت علي تركيزات من العناصر أقل من المستويات المسموح بها من خلال منظمات الأغذية والزراعة وكذلك اللجنة الدولية للطب والصحة ماعدا عضلات أسماك الشولة بالنسبة لعنصري الكادميوم والرصاص .