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Metal Contents in the Tissues of *Lutjanus fulviflamma* (Smith 1949) and *Epinephelus tauvina* (Forskål 1775) Collected from the Arabian Gulf

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The role heavy metals (the non-degradable and commutative chemicals) play as pollutants is widely recognized (Ballester et al., 1980, Ober et al., 1987). In the sea, accumulation of pollutants may cause the toxicity to the aquatic organism (Buggiani and Vannucchi 1980) and subsequently transferred to man through the food chain. Among the major sources of metal contamination are industrial activities and mining. Natural processes such as volcanic eruptions, erosion and wind are also important. At many places, industrial and agricultural discharges were found primary source of metal poisoning of fish e.g. Poland (Zamojski, et al. 1986), Canada (Cappon, 1987). Highway or motorboat traffic has also been reported as a major contributor of the problem (Van Hassel. et al. 1979; Van Hassel et al. 1980 and Ney and Van Hassel, 1983). Exposure to heavy metals through air, water and/or the food chain is known to induce a wide variety of toxic effects in humans and animals (Dave and Xiu 1991; Goodrich et al. 1991). Some of these heavy metals are considered as essential elements for normal physiological functions of the human as well as for the most of animals micro-nutrients but the higher levels may be toxic or harmful (Sarkka et al. 1978). Extensive studies have been carried out in many parts of the world to determine toxicity and bio-accumulation of these metals in fish and other marine flora and fauna (Nickless et al. 1972; Peden et al. 1973; Hardisty et al. 1974; Badsha and Sainbury 1978). However, there is a gap in our knowledge of the kind and extent of marine pollution by heavy metals around the coast of the United Arab Emirates (UAE) and the resultant contamination of the aquatic habitat. In continuation of our interest in marine environment (Al-Ghais 1995a, b), this study was designed to investigate and to compare the concentrations of cadmium, copper, manganese, nickel, lead and zinc in the skin, muscle and liver, and mercury in the muscle tissues only of *Lutjanus fulviflamma* (Smith 1949) and *Epinephelus tauvina* (Forskål 1775). These species have been selected as these are among the highly commercial fish species found in the trap fishery of United Arab Emirates.

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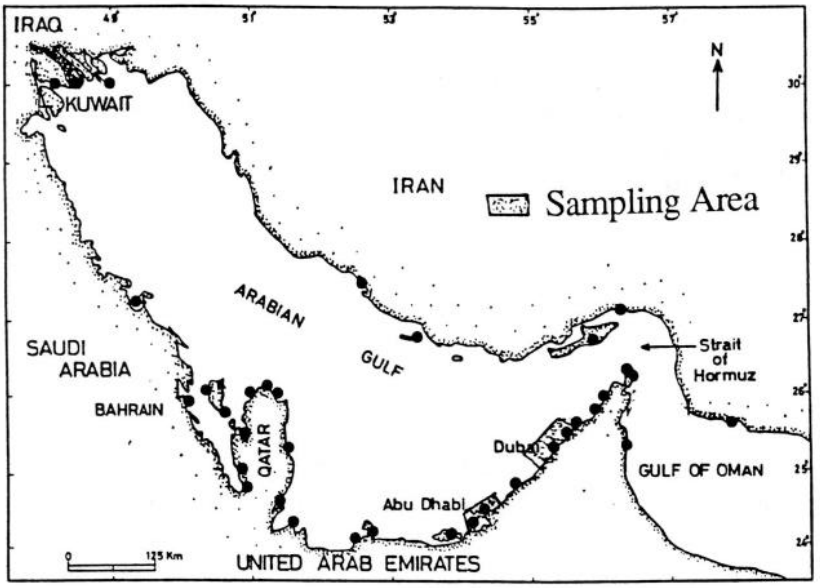

Figure 1. Sampling areas along the United Arab Emirates coast on the Arabian Gulf.

MATERIALS AND METHODS

Samples of *L. fluviflamma* and *E. tauvina* were collected from eastern and western coastal areas of UAE in the months of April to December, 1993. Collected samples were placed in an ice box, transported to the laboratory and kept in a freezer (-15 °C) prior to analysis. At the time of metals analysis the fish were defrosted and their standard length and weight were recorded, and tissues were digested in a mixture of nitrric-perchloric acid, (4:1) mixture (Al- Ghais, 1995b).

Copper, manganese, and zinc measurements were carried out in triplicate using a double beam atomic absorption spectrophotometer (GBC-906), equipped with background corrector, auto-sampler and recorder. Whereas, cadmium, nickel and lead were measured using Graphite furnace (GF 3000, GBC- 906). Mercury analysis was done using cold vapor (HG 3000, GBC- 906) atomic absorption techniques. Sodium borohydride and hydrochloric acid were used as reducing agents as descibed by the manufacturer for making use of HG3000. The concentrations in the standard solutions, samples and blanks were measured in the same way (Mason, 1987).

All reagents used were of analytical grade (BDH, England and Merck, Germany). Standard stock solutions of 1000 ppm were also procured from BDH, England. Deionized water was used throughout the study. To avoid contamination, all

Table 1. Relationship between length and weight of *E. tauvina* and *L. fulviflamma*

Name of Fish	Sample area	No. of fish	Length (mm) Mean ± S.D.	Weight (g) Mean ± S.D.
E. tauvina	Eastern	30	304 ± 29	790.6 ± 251.1
E. tauvina	Western	25	278 ± 20	571.5 ± 67.2
L. fulviflamma	Eastern	30	164 ± 15	126.4 ± 39.8
L. fulviflamma	Western	35	177 ± 18	169.7 ± 51.7

containers and other materials used in the analysis were glass and polyethylene. Glassware was washed and subsequently treated with HNO_3 for 3-4 hr with a final repeated rinse with deionized water.

RESULTS AND DISCUSSION

Samples of *Epinephelus tauvina* and *Lutjanus fulviflamma* were collected from the east and west coast of the UAE (Fig 1). Muscle tissues, skin and liver were analyzed for cadmium, copper, manganese, nickel, lead and zinc. Muscle tissues were also analyzed for mercury. The average standard length and weight with their range were 304 ± 29 mm (260 - 350 mm), 790.6 ± 251.1 g (453.5 - 1182.5 g) and 278 ± 20 mm (235 - 300 mm), 571.5 ± 67.2 g (453.5 - 654.7 g) for *E. tauvina* collected from at eastern and western coastal areas of UAE respectively.

For *L. fulviflamma* the average standard length and weight with their range was found to be 164 ± 15 mm (145 - 208 mm), 126.4 ± 39.8 g (85.5 - 243.8 g) and 177 ± 18 mm (148 - 226 mm), 169.7 ± 51.7 g (83.9 - 335.5 g) respectively collected from eastern and western coastal areas of UAE (Table 1). Tables 2, 3, 4 & 5 show the average metal concentrations in the muscle tissues, skin and liver.

Metals have became of great concern since the itai-itai (Friebrg 1974) and minimata (Loefroth 1970) diseases. Copper, zinc and manganese are considered as essential elements for normal physiological functions of human body and in animals, including fish, but higher concentrations of these elements could also be harmful (Wallace 1994). In the present study all the analyzed elements were found well within the acceptable limits. For example cadmium in muscle tissues was found 0.030 ± 0.021 and 0.032 ± 0.027 µg/g (wet weight) in *E. tauvina* and 0.033 ± 0.025 and 0.038 ± 0.032 µg/g (wet weight) in *L. fulviflamma*. Mason (1987) suggested the standard limit for tolerable weekly intake of Cd (in fish flesh) as 500 µg per person; comparing this value with one obtained above, quite good amount of fish flesh can be considered safe for consumption.

The WHO recommendation (1972) cited by Dean and Suess (1985), allows a daily intake of 60-70 µg cadmium, to reach this limit also one has to take a good quantity (more than one kilogram) of fish flesh. Further, the mean values of

Table 2. Metal concentrations in muscle tissues, skin and liver of *E. tauvina* collected from eastern coastal areas.

Elements	Muscle tissue	Skin	Liver
Copper	0.247 ± 0.120	0.905 ± 0.077	4.330 ± 0.368
Manganese	0.167 ± 0.087	0.434 ± 0.178	0.527 ± 0.188
Zinc	4.039 ± 0.394	18.47 ± 1.800	32.80 ± 3.77
Cadmium	0.030 ± 0.021	0.049 ± 0.017	0.127 ± 0.058
Nickel	0.055 ± 0.040	0.098 ± 0.083	0.239 ± 0.147
Lead	0.050 ± 0.038	0.077 ± 0.065	0.171 ± 0.110
Mercury	0.107 ± 0.089		

The value are mean ± SD as µg/g, wet weight of tissue.

Table 3. Metal concentrations in muscle tissues, skin and liver of *E. tauvina* collected from western coastal areas.

Elements	Muscle tissue	Skin	Liver
Copper	0.394 ± 0.190	1.277 ± 0.627	3.732 ± 1.936
Manganese	0.152 ± 0.099	0.450 ± 0.298	0.723 ± 0.283
Zinc	3.684 ± 1.94	17.240 ± 8.983	30.66 ± 19.13
Cadmium	0.032 ± 0.027	0.073 ± 0.060	0.147 ± 0.086
Nickel	0.058 ± 0.068	0.099 ± 0.076	0.237 ± 0.095
Lead	0.062 ± 0.036	0.092 ± 0.078	0.217 ± 0.132
Mercury	0.107 ± 0.089		

The value are mean ± SD as µg/g, wet weight of tissue.

Table 4. Metal concentrations in muscle tissues, skin and liver of *L. fulviflamma* collected from eastern coastal areas.

Elements	Muscle tissue	Skin	Liver
Copper	0.290 ± 0.150	1.004 ± 0.560	4.616 ± 1.922
Manganese	0.167 ± 0.125	0.533 ± 0.401	0.620 ± 0.121
Zinc	3.059 ± 2.090	18.61 ± 9.969	34.99 ± 20.93
Cadmium	0.033 ± 0.025	0.073 ± 0.075	0.195 ± 0.140
Nickel	0.071 ± 0.071	0.099 ± 0.088	0.277 ± 0.207
Lead	0.064 ± 0.054	0.107 ± 0.099	0.199 ± 0.133
Mercury	0.107 ± 0.089		

The value are mean ± SD as µg/g, wet weight of tissue.

cadmium were much less as compared to the tolerance limit of 1 µg/g (wet weight), set by Spanish Food Directorate as cited by Galindo et al. 1986. Mean lead concentrations in muscle tissues was 0.050 ± 0.038 and 0.062 ± 0.068 µg/g (wet weight) in *E. tauvina* and 0.064 ± .054 and 0.062 ± 0.052 µg/g in *L. fulviflamma* respectively, which are much less than the tolerance limit of 3 µg/g (wet weight), set by Spanish Food Directorate for lead (cited by Galindo et. al.

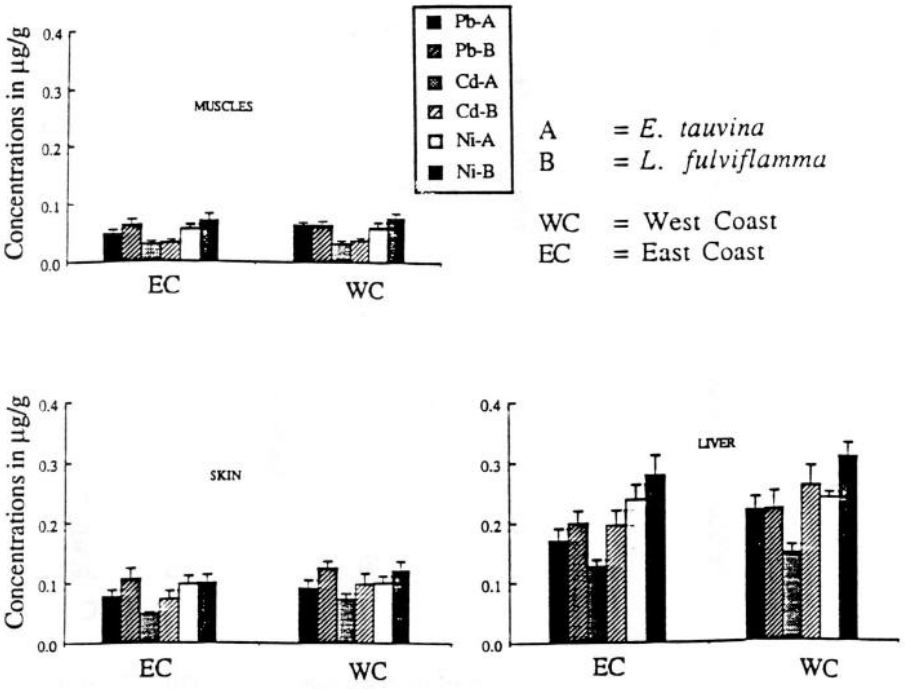

Figure 2. A comparison of concentrations of cadmium, nickel and lead in µg/g.

Table 5. Metal concentrations in muscle tissues, skin and liver of *L. fulviflamma* collected from western coastal areas.

Elements	Muscle tissue	Skin	Liver
Copper	0.254 ± 0.153	0.818 ± 0.496	4.198 ± 1.612
Manganese	0.150 ± 0.110	0.502 ± 0.366	0.524 ± 0.171
Zinc	3.305 ± 1.990	15.82 ± 9.562	29.26 ± 21.99
Cadmium	0.038 ± 0.032	0.098 ± 0.100	0.257 ± 0.207
Nickel	0.076 ± 0.048	0.121 ± 0.097	0.307 ± 0.137
Lead	0.062 ± 0.052	0.124 ± 0.074	0.221 ± 0.158
Mercury	0.107 ± 0.089		

The value are mean ± SD as µg/g, wet weight of tissue.

1986). The average of other elements (copper, manganese and nickel) were also found comparable to those noted for biota in other areas of the world (Eisler, 1981) and also from the Arabian Gulf (Flower et. al. 1993).

A comparison of cadmium, nickel and lead (Fig. 2) and of copper, manganese and zinc (Fig 3) in muscle tissue, liver and skin of *E. tauvina* and *L. fulviflamma* indicated that, in general, muscle tissue had markedly lower concentrations of metals as compared to liver. Where as metal concentration in skin was also lower as compared to liver but higher as compared to muscle.

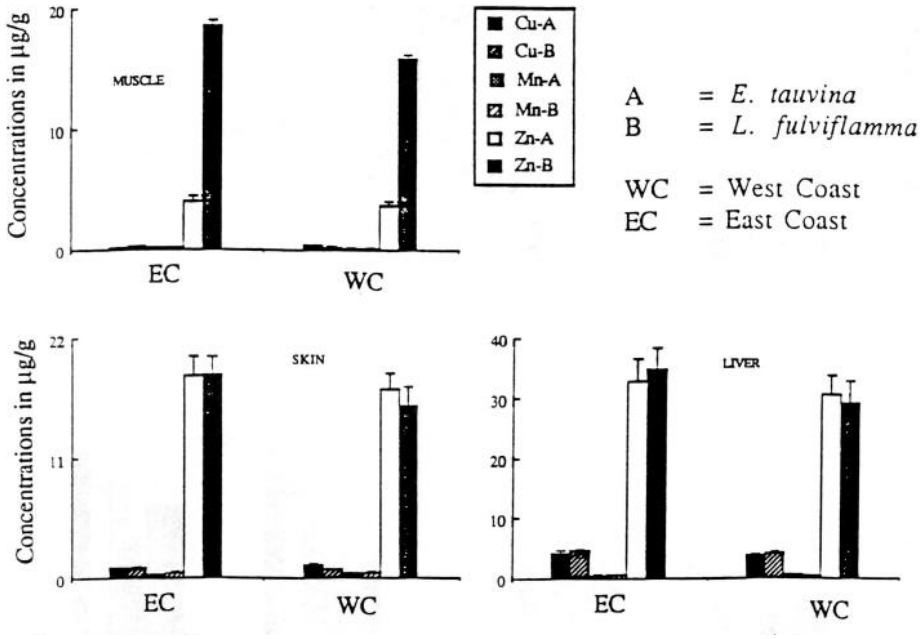

Figure 3. A comparison of concentrations of copper, manganese and zinc in µg/g.

The current study suggests that the concentrations of heavy metals present in the fish *E. tauvina* and *L. fulviflamma* of the UAE region are well below the documented toxic levels for human consumption and, hence, the fish are safe to eat. Moreover, it also reflects that metal pollution of the marine environment in this region is still relatively limited.

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