ISSN 1110-0354
Bull. Nat. Inst. of Oceanogr. & Fish., A.R.E., Vol. (27) 2001: 311 - 322

DISTRIBUTION OF TRACE ELEMENTS IN TISSUES OF FIVE FISH SPECIES COLLECTED FROM THE RED SEA COAST OF YEMEN

By

HASSAN, M. A. HEBA;* MAJED, A. AL- EDREESI; HAMID, T. AL-SAAD AND M. A. ABDEL MONEIM**

**Fac. Mar. Sci. & Environ., Univ. Al- Hodeidah, Al- Hodeidah, Yemen.*

Key words: Trace elements, Fish tissues, Red Sea, YEMEN.

ABSTRACT

Distribution of trace elements in different tissues of fish species collected from the Red Sea Coast of Yemen were investigated. The study have been conducted to determine the levels of Cd, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn using Atomic Absorption Spectrophotometer. High concentrations of Cd, Cr, Cu, Fe, Mn, Ni and Pb were observed in Scomberoides commersonianus with mean values of 2.50, 1.30, 2.00, 6.00, 0.60, 2.00 and 1.30 µg/g dry weight respectively, while the high values of V and Zn were measured in Saurida undosquamis with mean values 1.80 and 20.00 µg/g dry wt. Respectively. Generally, the concentrations of trace elements reported in the different fish tissues are within the acceptable worldwide range and lower than those reported in the world.

** Permanent Address: Nat. Inst. Oceanogr. & Fish., P.O.Box Anfoushy, Alexandria, Egypt.

INTRODUCTION

Heavy metals are amongst the pollutants which received attention in various countries. These metals are considered to be the most insidious and dangerous category of pollutants in which enter the marine environment from both natural and anthropogenic sources. In addition to the natural content of metals coming from the geochemical background.

Marine organisms can concentrate trace elements on its by a factor ranging from 1000-10000 time (Kinne, 1984). This means that marine organisms can store pollutants especially trace elements and then transfer them ultimately to human beings (El-Sokkary, 1980; Uysal, 1980). As fishes as considered one of the most groups on the top of aquatic food chain, they also clearly reflect the water quality (Roth & Hornung, 1977; Abdelmoneim, 1994). Many countries have established guidelines regulations and application procedures for trace elements.

Within the Yemen sector of the Red Sea, marine pollution by heavy metals may attributed to a number of anthropogenic activities and industrial wastes which discharged into the coastal area infront of the Hodeidah City. Such effects lead to a local eutrophication, increased of biological oxygen demand (BOD_5) and algal blooms. Sewage treatment plants are helping to alleviate some of these problems. Many workers used fish as bio-indicators to determine the levels of trace elements in the aquatic environments. Trace elements affect the life cycle of fish by causing reduction in the survival growth and reproduction processes (Heba, 1992). Trace elements can be accumulate in different organs of fish and incorporated through the food chain either from water via gills, or from sediments and other organisms via gut (Wiener & Giesy, 1979; Al- Imarah, *et al.*, 1998).

The main objectives of this study are:

To monitor the levels of trace elements in tissues of five fish commercial species collected from the coastal area of Al- Hodeidah City, Red Sea.

The study area:

Location map (Fig. 1) shows the study area where the samples were collected for determination of trace elements. The study area was divided into three sectors. The first sector was selected along the Hodeidah beach

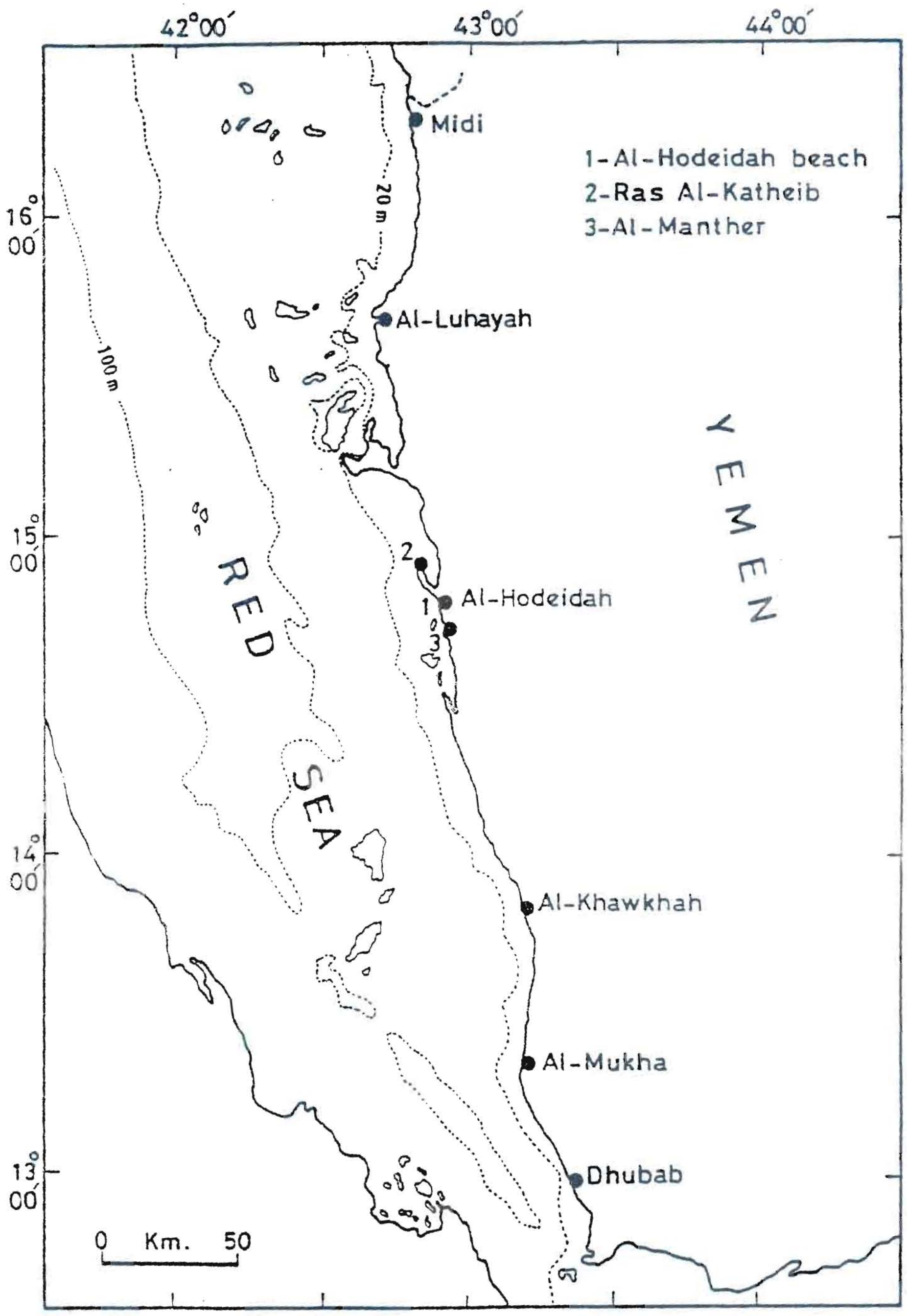

Fig. (1): Map show the coastal area around Al-Hodeidah city

depending on many reasons, among which the sewage effluents. This area receives wastewater from the treatment plant which discharge large quantities of sewage in the sea. The second sector was to the north of Al- Hodeidah harbour in Ras Al- Katheib. The third sector was a remote village (Al-Manther) which lies in the south of Al- Hodeidah City by about to 50 km.

MATERIALS AND METHODS

Fish samples were collected from the coastal area along Al- Hodeidah City Red Sea coast of Yemen during winter 2000. After collection, fish samples were wrapped in a clean plastic bags stored in a cool icebox until returning to the laboratory.

A dry composite samples of tissues (5-6 each) from the fish having the similar size (Length and Weight) were chosen for each species (UNEP/FAO/IAEA/IOC, 1984). Sub-samples of each of the following species: Talang queenfish (*Scomberoides commersonianus*); Redspot emperor (*Lethrinus lentjan*); Brushtooth lizardfish (*Saurida undosquamis*); Grouper (*Epinephelus* spp) and Narrow barred king mackerel (*Scomberomorus commerson*) were used for the determination of trace elements. Digestion using strong acids mixture ($HClO_4$ & HNO_3) were carried out at low temperature is the most commonly used procedure, (Bernhard, 1976). The digested samples were then diluted with deionized water (DDW) to a known volume before measurements of metals using Atomic Absorption Spectrophotometer (AAS) Perkin-Elmer 2800. To assure precision, parallel experiments using standard samples for all metals (Cd, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn) has been also carried out. Reagent blanks were also included for the deionized water using the same method but without fish samples. The results were expressed in (μg/g) ppm dry weight.

RESULTS AND DISCUSSION

Heavy metals are usually common constituent and represent 50% or more of the beach deposits in some places along the Red Sea Coast of Yemen (El-Anbaawy & Al-Awah, 1993). These beach deposits are mainly derived from mountainous regions, which drain from the Yemen Highlands to the Red

Sea through numerous vallies. The marine environment may also be contaminated with effluent wastes containing trace elements from both anthropogenic and natural processes. Such inputs could results from treated and/or untreated municipal, industrial wastes, agricultural runoff and the deposition from the atmosphere (Abdelmoneim, 1994; Al-Mudaffar, *et al.*, 1994; Heba & Al-Mudaffar, 2000). Such effect may alter the natural biogeochemical cycle. The normal concentration of trace elements in the marine environment was previously reported (Bowen, 1966)

The concentration of trace elements in different fish species are different from one species to another. Our results are presented in Table (1) and Fig. (2). Among of these elements, Zn it seems to be the highest level (20.00 µg/g dry wt.) when compared with the other elements in muscle tissues of *Saurida undosquamis*. Iron is the second order after Zn in the same species. However, *Scomberoides commersonianus* had the highest concentrations of Fe (6.00 µg/g dry wt.) among the other species which tested (Table 1). Generrally, High concentrations of Cd, Cr, Cu, Fe, Mn, V and Pb were observed in *Scomberoides commersonianus* with mean values 2.50, 1.30, 2.00, 6.00, 0.60, 2.00 and 1.30 µg/g dry wt. Respectively, while V and Zn were observed in *Saurida undosquamis* with mean values 1.80 and 20.00 µg/g dry wt., respectively. The high concentrations of V and Zn may attributed to the anthropogenic sources. In our study, no significant difference was recorded in Zn concentration between the remaining fish species except *Epinephelus* spp. (Table 1).

Cadmium and lead concentrations in all fish samples did not show any significant differences (Table 1). The only exception (2.50 µg/g dry wt.) was found in *Scomberoides commersonianus*, due to the different lipid content in animals from different species, age and other physiological factors (Abdelmoneim, *et al.*, 1994a; Heba & Al-Mudaffar, 2000).

The lower concentrations of lead in our samples might be attributed to the lower population and industrial activities in this area (Heba & Al-Mudaffar, 2000).

The high concentrations of Cu in all fish samples may reflect mainly to the site proximity of the Power Station in Ras Al-Katheib area and may also from the antifouling paints.

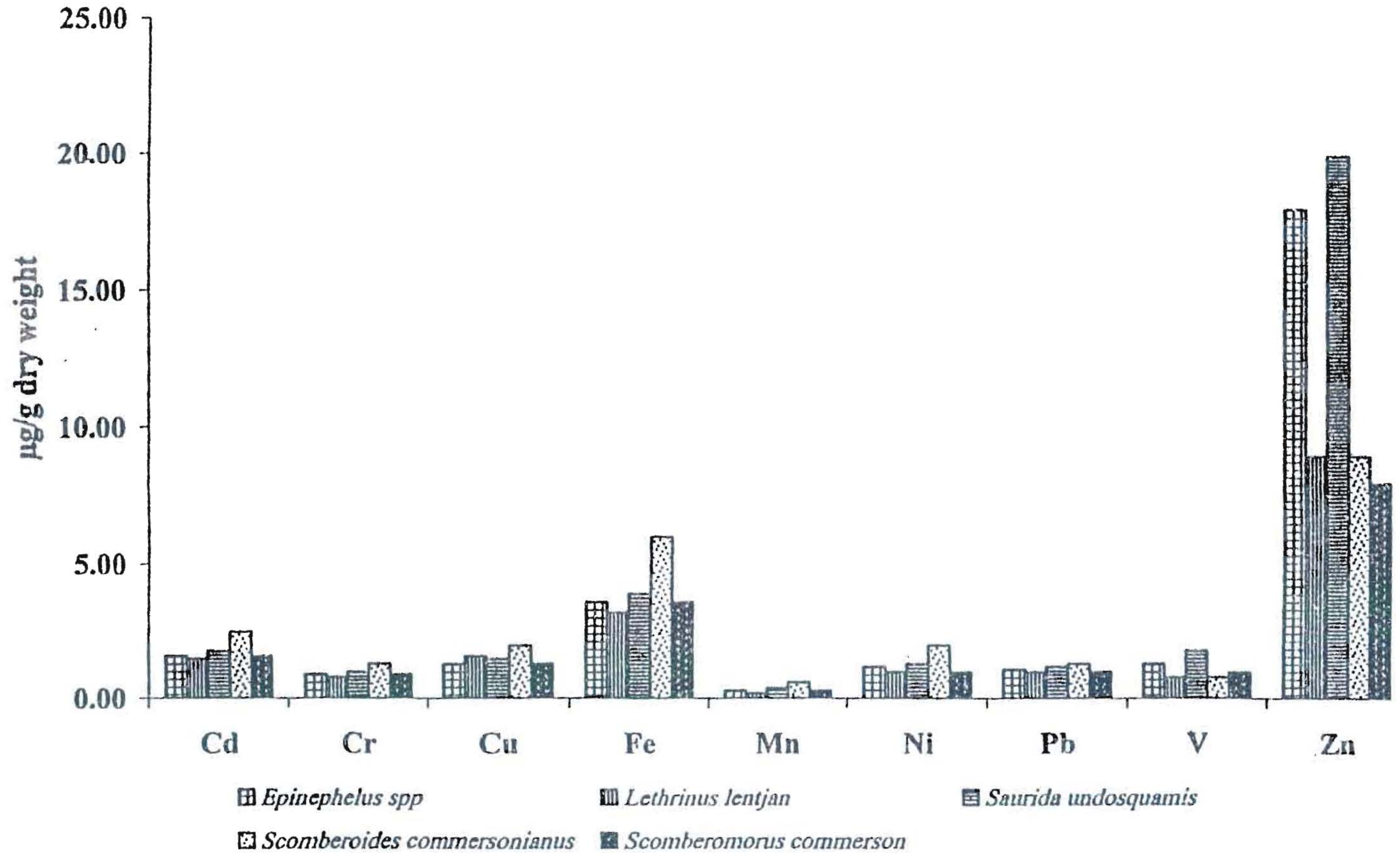

Fig. (2): Mean concentration of trace elements in fish tissues collected from Al-Hodeidah Red Sea coast of Yemen.

Table (1): Mean concentration (µg/g dry weight) of trace elements in fish tissues (muscles) collected from Al-Hodeidah Red Sea coast of Yemen.

Fish species	Elements								
	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
Epinephelus spp	1.60	0.90	1.30	3.60	0.30	1.20	1.10	1.30	18.00
Lethrinus lentjan	1.50	0.80	1.60	3.20	0.20	1.00	1.00	0.80	9.00
Saurida undosquamis	1.80	1.00	1.50	3.90	0.40	1.30	1.20	1.80*	20.00*
Scomberoides commersonianus	2.50*	1.30*	2.00*	6.00*	0.60*	2.00*	1.30*	0.80	9.00
Scomberomorus commerson	1.60	0.90	1.30	3.60	0.30	1.00	1.00	1.00	8.00

* Maximum values

No significant differences noticed in concentration of Cr, Mn & Ni in fish samples except in *Scomberoides commersanianus* (Table 1), probably due to mineralogy of the site.

CONCLUSIONS

The data presented can serve as a baseline study for further depth studies. Furthermore, the levels of the investigated trace elements lay within the range values reported for other regions of the worldwide and with that reported by Bowen (1966). Some of these data (Locally and internationally) are collected in Table (2). However, the concentration of trace elements in fish tissues (muscles) showed a good agreement with most of the other finding except Al-Taee, (1999), who worked on brackish fishes, where the results are quite high especially for Fe, Ni & Pb.

The obtained results indicated that the values of trace elements in fish tissues were nearly under the acceptable limits except Cd in *Scomberoides commersonianus* (2.50 µg/g). The maximum limit for Cd in the edible parts (tissues) should not exceed 2.00 µg/g (WHO, 1973; Bebbington, *et al.*, 1977 and FAO, (1992).

Table (2) : Mean concentration of trace elements in fish tissues compiled from different sources and from the present study (µg/ gdry wt.).

Fish species	Area	Elements								References
		Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	
Epinephelus trauvina	1	0.05	3.30	0.65	19.00	0.27	1.90	0.21	13.60	Burns, et al., 1982
Morone saxatilis	-	0.12	-	1.40	-	-	4.00	2.00	15.20	Bryan, 1984
Lethrinus spp.	2	*0.39-0.51	0.34-0.45	0.43-045	19.25-20.14	0.23-1.13	-	0.64-1.14	4.81-4.87	Abdelmoneim&El-Deek, 1992
Siganus spp.		-	-	0.34	-	-	-	0.62	-	
Cephalopholis spp.		-	-	0.71	-	-	-	0.84	-	
Liza ramada	2.3	-	-	0.68	-	-	-	0.26	-	Emara, et al., 1993
Mugil cephalus		-	-	0.64	-	-	-	0.75	-	
Epinephelus spp.		0.17	-	0.66	-	-	-	0.35	3.37	
Sparus auratus		0.18	-	0.44	-	-	-	0.47	4.58	
Sargus sargus	3	0.10	-	0.49	-	-	-	0.47	4.43	
Mugil spp.		0.07	-	0.52	-	-	-	0.55	4.18	Abdelmoneim, et al., 1994
Siganus rivulatud		0.10	-	0.64	-	-	-	0.81	5.37	
Mugil seheli	2	0013	-	0.5 9	-	-	-	0.54	15.28	Abdelmoneim, et al., 1994a
Acanthopagurus bifaciatus		0.26	0.72	0.51	16.30	0.45	-	3.36	4.34	
Hemiramphus spp.	2	0.55	0.88	0.51	13.[illegible]	0.52	-	3.51	10.22	Abdelmoneim, et al., 1994b
Sphyraena obtusata.		0.27	1.77	1.01	8.11	0.36	-	3.96	6.46	
Sardinella gibbosa.		0.12	-	0.57	-	-	-	0.70	17.45	
Saurida spp.	2	0.15	-	0.50	-	-	-	0.76	7.04	Abdelmoneim, et al., 1996
Apinephelus spp.		0.24	-	0.41	-	-	-	0.93	22.10	
Liza subdviridis		0.03	0.02	1.57	8.55	1.79	2.27	0.06	8.58	
Nematalosa nasus.	4	0.03	0.28	2.94	16.88	1.33	1.49	0.03	7.43	Al – Khafaji , 1996 .
Barbus sharpeyi		1.95	0.06	1.03	44.50	1.93	15.83	12.81	20.58	
Aspius vorax	5	2.01	0.10	1.13	45.47	1.86	15.77	15.15	19.19	Al- Taee, 1999 .
Cuprinus carpio		2.23	0.11	1.91	39.67	1.32	18.96	11.26	40.50	
Gnathanodon speciosus	6	2.57	2.70	1.77	19.40	0.34	1.19	1.60	43.38	Heba, & Al-Mudaffar, 2000
Marine fish	6	*1.50-2.50	0.80-1.30	1.30-2.00	3.20-6.00	0.20-0.60	1.00-2.00	1.00-1.30	8.00-20.00	Present study

-NO data available to compare

*Range values

1-Gulf of Oman.
2-Suez Gulf, Red Sea.
3-SE Mediterranean Sea

4 --Shatt Al-Arab, NW Arabian Gulf.
5 –Shatt Al-Hilla River, Iraq.
6 –Red Sea Coast of Yemen.

REFERENCES

Abdelmoneim , M.A. and El - Deek , M.S., 1992 Lethrinus Family: A model of edible Red Sea fishes with low heavy metals accumulation.- pp. 439-448. In 2nd Alexandria Conf.(Food Science & Technology), Fac. Agric . Univ . Alexandria , 2-4 March , 1992 , Alexandria , Egypt .

Abdelmoneim , M.A.,1994:Trace metals distribution in water and sediments of Suez Gulf ,Red Sea ,Egypt. -Bull High. Inst., Public health, 24:963-992.

Abdelmoneim , M.A., Khaled, A.M. and Iskander , M.F., 1994: A study on the Levels of some heavy metals in El-Max Bay ,West of Alexandria, Egypt.- pp. 155-174. In: Proc. 4th Internat. Conf (Environmental protection is a must), sponsored by NIOF & USPD, 10-12 May,1994, Alexandria,Egypt.

Abdelmoneim, M.A., Aly, A.E. and El-Moselhy, K.M., 1994a: Level of Cd, Pb, Cu and Zn in *Mugil seheli* from Suez Bay, (Northern Part of the Gulf of Suez, Egypt.- Bull. Nat. Inst. Oceanogr. & Fish., ARE, 20:69-82.

Abdelmoneim, M.A.,El-Deek, M.S., Beltagy, A.I., Naguib, M.M. and Naguib. Kh., 1994 b: Distribution of heavy metals in some species of edible fish from the Red Sea.- Bull. High. Inst. Public Health, 24: 957-972 .

Abdelmoneim, M.A., El-Moselhy, Kh. And Hassan, S.H., 1996: Trace metals content in three fish species from northern part of the Suez Gulf,Red Sea, Egypt. J. King Abdelaziz. Univ. Mar. Sci., 7: 15-24 (Jeddah) Saudi Arabia.

Al-Imarah, F.J.M., Al-Khafaji, B.Y.D. and Abdul-Razak, M.M., 1998: Distribution of trace metals in organs of Gizzard Shad Nematalosa nasus (Blosh,1795) from Shatt Al-Arab Estuary, Iraq.- Basrah J. Sci., 16 (2): 5 – 10.

Al-Khafaji, B. Y., 1996: Trace metals in waters, sediments and fishes from Shatt Al-Arab Estuary , NW Arabian Gulf. – Ph.D. Thesis, Univ. Basrah, Iraq, 130p.

Al-Mudaffer, N., N., Heba, H.M.A and Fawzi, I., 1944: Trace metals in fish from Red Sea coast of Yemen (Fish Death Phenomenon). Tech Report, Fac. Sci., Sanaa` Univ., Sanaa`, Yemen.

Al-Taee, M.M.S., 1999: Some metals in waters, sediments, fishes and plants of the Shatt Al-Hilla River- Ph.D.Thesis, Univ. Babylon, Iraq,130p.

Bebbington, G.N., Mackay, N.J., Chvolka, R., Williams, R.J. and Dunn, A., 1977: Heavy metals selenium and arsenic in nine of Australian commercial fish. – Aust. J.Mar. Freshwat. Res., 28: 277-286.

Bernhard, M., 1976: Manual of methods in aquatic environment research Part 3. Sampling and analyses of biological material. FAO Fish. Tech. Paper No. 158: 124p., FAO, Rome, Italy.

Bowen, H.J.M., 1966: Trace Elements Biochemistry–Academic Press, Inc., New York, 241 p.

Bryan, G.W., 1984 : Chapter 3. In: kinne O., ed (Pollution due to heavy metals and their compounds), Vol. 5, Marine Ecology (A compr-ehensive integrated treatise on life in oceans and coastal waters), A Wiley-Inter Science Publiation, New York, USA.

Burns, K,A., Villenneuve, J.P., Anderlini, V.C. and Fowler, S.W., 1982: Survey of tar, hydrocarbons and metal pollution in the coastal waters of Oman- Mar. Pollut., 13: 240-247.

El-Anbaawy, M.I.H. and Al-Awah, M.A.H., 1993: Opaque mineralogy of some beach sand, Yemen Red Sea coastal areas. Egypt J. Geol., 37 (2): 39-52.

El-Sokkary, I.H., 1980: Mercury accumulation in fish from the Mediterr-anean coastal area of Alexandria,-Egypt. – J Etud. Pollut., Caglian. (CIESM) 5: 493 –496 .

Emara, H.I., EL- Deek, M.S.and Ahmed, N.S., 1993: A comparative study on the levels of trace metals in some Mediterranean and Red Sea fish–Chem. & Ecol., 8 : 119 – 127.

FAO, 1992: Cmmittee for Inland Fisheries of Africa. – Report of the 3rd session of the working party on Pollution & fisheries, Accra, Ghana, 25-29 Nov. 1991, FAO Fish. Rep. No 47,43 p., FAO,Rome, Italy.

Heba, H.M.A., 1992: Protein turnover in the temperate zone and tropical fish – Ph.D Thesis, Aberdeen Univ., Scotland, UK. (Unpublished Manuscript)

Heba, H. M. A. and Al-Mudaffar, N., 2000: Trace metals in fish, mussels, shrimp and sediments from Red Sea coast of Yemen–Bull. Nat. Inst. Oceanogr. & Fish., ARE, 26:151-165.

Kinne, O.(ed), 1984: - pp. 1091-1110 In: (Pollution due to heavy metals and their compounds), Vol. 5, Marine Ecology (A comprehensive integrated treatise on life in oceans and coastal waters), A Wiley-Inter Science Publication , New York , USA.

Roth, I. and Hornung, H., 1977: Heavy metal concentrations in water, sdiments and fish from Mediterranean coastal area, Israel.-Environ. Sci. Technol., 11:265-269.

UNEP / FAO / IAEA / IOC,(1984): Sampling of selected marine organisms and sample preparation for trace metal analysis. Reference for Marine Pollution Studies, No. 7 Rev .2 : 19 p

Uysal, H.,1980: Levels of trace element in food chain orrgnisms from the Aegean coast.- J. Etud. Pollut., Cagliari,(CIESM)., 5:503-512.

WHO,1973: Health Hazards of the Human Environment.- WHO,Geneva, Switzerland.

Wiener, J.G. and Giesy, J.P., 1979: Concentration of Cd, Cu, Mn, Pb and Zn in fishes in a highly organic software pond – J. Fish. Res Bd. Canada, 36 : 270 – 279.