Mesopo. Environ. j., Special Issue E :144-161 , 2018
ISSN 2410-2598
proceeding of 2nd International conference of science and Art University of Babylon and Liverpool John Moores University, UK
Mesopotemia Environmental journal
journal homepage:www.bumej.com

Concentration of Some Heavy Elements in Water, Sediment, Food content and Muscles of *Cyprinus carpio* collected from Main Outfall Drain Near the Center of Al-Nassiriya city.

BasimY.Al-Khafaji[1] Afrah A. Maktoof[1]

Affiliation [1] Department of Biology , Collage of Science , University of Thi-Qar

***Corresponding author:** 16awady2009@gmail.com

basim_y_d@yahoo.com

To cite this article:

Al-Khafaji B.Y. and Maktoof A.A. Concentration of Some Heavy Elements in Water, Sediment, Food content and Muscles of *Cyprinus carpio* collected from Main Outfall Drain Near the Center of Al-Nassiriya city. *Mesop. environ. j.*, 2018, Special Issue E.;144-161.

Abstract:

The present study was conducted during the period from January 2016 to December 2016 in south sector of Main out full drain , Nassiriya. Three stations were fixed to achieve the study. The concentration of eight heavy elements (cadmium, cobalt, copper, iron, manganese, nickel, lead and zinc) were measured in dissolved and particulate phases of water, exchangeable and residual phases of the sediment and tissues (muscle and gut) of important commercial species of fish *Cyprinus carpio* L. The mean concentrations of cadmium, cobalt, copper, iron, manganese, nickel, lead and zinc in dissolved phase of water were 0.04, 0.53, 0.03, 116.63, 2.42, 2.52, 0.35 and 12.12 µg/l respectively, whereas their concentrations in particulate phase were 19.38, 12.23, 35.11, 2078.69, 193.98, 75.37, 27.10 and 77.90 µg/g dry weight respectively. For sediment, the mean concentrations of these elements in the exchangeable and residual phases were as follows: Cd (4.02, 0.05), Co (12.13, 15.48), Cu (6.39, 13.20), Fe (558.16, 1563.11), Mn (102.26, 155.20), Ni (1.44, 72.90), Pb (28.07, 0.92) and Zn (2.15, 18.65) µg/g dry weight respectively.

The order of elements in muscle tissues of fish recorded in *C.carpio* as: Fe> Zn> Mn> Cu> Ni>Co> Pb> Cd.
The results of study showed that concentrations of heavy elements in fish tissues were higher than in water (dissolved phase) and less than their concentrations in sediment, and this was clear through the values of bioconcentration factor (B.C.F) and biosedimentation factor (B.S.F). The results showed higher values of B.C.F than B.S.F for fish species (0.8 – 555.00), (0.001 – 1.68) respectively in *C.carpio*.

Keywords: Heavy elements, Water, Sediment, *Cyprinus carpio*, bioaccumulation, Main outfall drain

Introductions:

Heavy metals are the elements which have a specific gravity greater than 5 g/cm^3 [1]. Environmental pollution by heavy metals began with the use of fire. The process of releasing small amounts of metals into the air, as a result of burning wood, led to a change in the levels of metals in the environment [2 ; 3]. A number of heavy metals and their toxic compounds are known as toxic substances, which can affect human health and living organisms. Some of these heavy metals accumulate in the water, soil and in the tissues of living organisms, and are able to persist in the environment, resulting in a range of harmful future effects [4] There are many global and local studies that have identified the close relationship between agriculture waste and an increase in heavy metals [5 ; 6]. Many local studies have been done about the concentration and distribution of heavy metals in water, sediment and biota in inland water of Iraq among them marshs [7 ; 8 ; 9 ; 10]. Heavy metals can be bioaccumulation and biomagnified via the food chain and finally assimilated by human consumers resulting in health risks [11]. As a consequence, fish are often used as indicators of heavy metals contamination in the aquatic ecosystem because they occupy high trophic levels and are important food source [12]. So, the aim of this study is to estimate the concentration of some heavy metals in water and sediments in the Main outfall Drain river, and to determine the ability of the selected fish *(Cyprinus carpio)* to accumulate this type of pollutants.

Material and Methods

- **The Study area description**

Main outfall drain is a river use to discharge the effluents of agriculture activities from its both side. It is extended from Al-Shaklawiya near Baghdad north until Al-Basrah at the south with length about 565 km (Al-[13]. It is dividing into three sectors (North, Mid and South), the south sector (which the present study area is a part of its) extended from the end of the mid sector until Shatt Al-Basarah in the south, with length about 165 km. The discharge of water is about 220m^3/sec in this sector [14]. New branch was opened in this sector with length 7 km, use to transform the water to the marshes south Al-Nassiriya city.

Three stations were selected in the south sector of this river to implemented, the present study, these are station 1(St.1) was near Al-Holandee bridge and the general caragge in the center of Al-Nassiriya city, St.2 was 20 km far from the first station, while St.3 was in the beginning of the new branch as shown in (Fig.1).

Mesopotamia Environmental Journal
ISSN 2410-2598
Mesop. environ. j. 2018, Special Issue E.;144-161
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

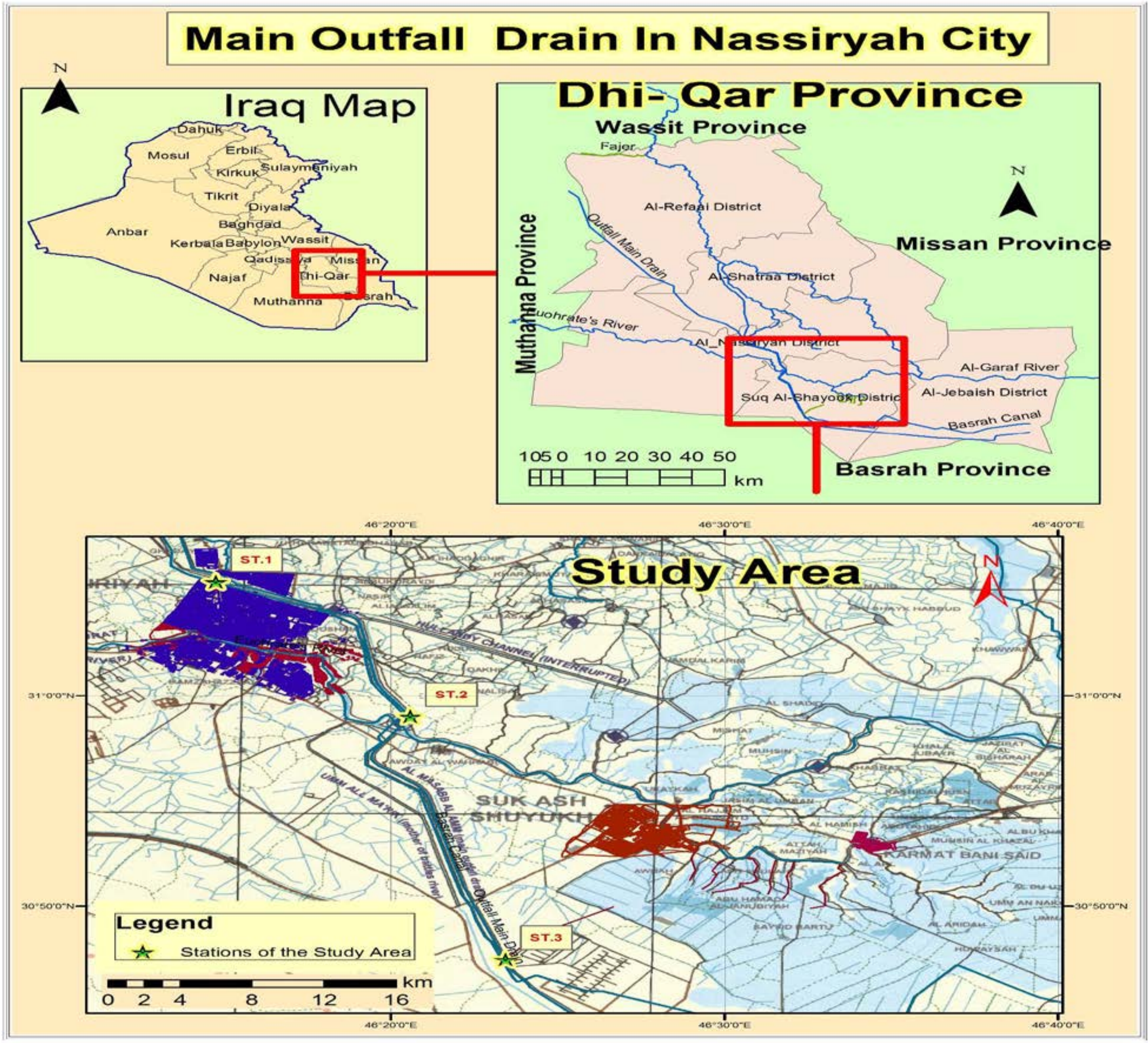


Fig.1 Map of the study area showed the study stations.

Collection of sample:

Samples of water, sediments and *C. carpio* were collected from MOD during winter, spring, summer and Autumn 2016. The water (5 litter) was preserved in plastic bottles by the addition of few drops of nitric acid. Sediments collected by van veen grab sampler then preserved in plastic bags. Fish were collected by use gill nets(25*25) mm mish size and preserved in ice box. In laboratory, the length of the each specimen of fish was measured and the length of fish was ranged from (16-28)cm. Dissected has been performed to separate different organs (muscle and gut) and frozen until ready for acid digestion

Extraction of heavy metals from water

5L of water was collected from each station. Samples were filtered by using a filter glass and vacuum pump through filter papers (0.5 um pore size). The filtered water was considered as dissolved, while the retained matter was particulate. Extraction of heavy metals in the dissolved phase was performed according to the method of [15]. After filtration, the filters were dried in an oven at 60°C for 6 hours until dry, and then weighed to get the values of the total suspended matter. [16] method was used for the extraction of heavy metals from the particulate phase in water

Extraction of trace metals from sediments

Sediments samples were digested after drying according to [17].

Extraction of trace metals from fish

fish organs were digested after drying according to [18] methods.

Measuring of trace metals

Concentrations of some heavy Metals (cadmium, cobalt, copper, Iron, Manganese, nickel, lead, and zinc) were measured by using the flam atomic absorption spectrophotometer, model 210 VGP proved with hollow cathode lamps

Statistical analysis

This study was used to analyze the variance (ANOVA), F test, mean, standard deviation and correlation coefficient to find the significance among the stations by statistical system (SPSS-10).

Result and Discussion:

Trace metals in water

Trace metals (mean and standard deviation) for dissolved and particulate phases in water at three station showed in (Table 1). Trace metals take various chemical forms in the aquatic environment, including soluble free ions, organic or inorganic complexes, or they can be connected with solid suspended matter (clay, silt and sand, zoo and phytoplankton) [19]. These metals are affected by various factors such as temperature, pH and salinity [20 ; 21]. The results of the present study found the mean trace metal concentration in the particulate phase of the study area were Cd (19.38); Co (12.23); Cu (35.11); Fe (2078.69); Mn (193.98); Ni (75.37); Pb (27.10) and Zn (77.90) μg/g dry weight respectively. These values were higher than the mean concentrations in the dissolved phase, which were Cd (0.04); Co (0.53); Cu (0.03); Fe (116.63); Mn (2.42); Ni (2.52); Pb (0.53) and Zn (12.12) μg/L respectively (Table 1). This may be due to the high amount of particulate matter in the study area during the study period. It has been reported that the particulate matter colloids, organic materials and metal hydroxides, which have a large surface area so it can adsorb trace metals. Thus, the increased of concentrations for suspended matter in water due to the transfer of metals from the dissolved phase to the particulate phase [22]. The higher concentration of these metals were found at St.1 compared with their concentration at St.2 and 3 . This is due to the exposure of St.1 to the various type of pollutants such as sewage, oil spilt from fishing boats, animal wastes and chemical used in fishing, because this station was located near to the city center of Al-Nassiriyia city [23]. In addition, there were higher concentrations of these metals in summer, this is related to several physical and chemical factors. So, the rising temperature lead to the increased evaporation of the water and this lead to the increased of the trace metals [25]. The statistical analysis showed significant

ISSN 2410-2598
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

differences between concentration of trace metals in the stations. The results of this study agree with many previous studies [25 ; 26].

Trace metals in sediments:

The concentration of trace metals in sediments is affected by several factors, including human activities and some environmental factors such as temperature, salinity, the proportion of organic matter in sediments, and sediment grain size [27] , as well as plant density. Concentration of trace metals in sediment (exchangeable and residual phases) at differed station under study were presented in table (2), sediments acts as archive for many pollutants one of them is trace metals. knowledge of the concentration and distribution and distribution of trace metals in the sediment can therefore play a key role in defecting sources of pollution in aquatic ecosystem [28]. Sediment for MOD contained very high significant amount of trace metals when compared with their concentration in water (dissolved and particulate phases). Sediments act as the most important reservoir or sink of metals and other pollutants in the aquatic environment [29]. Trace metals contamination in sediment can affected the water quality and bioaccumulation of metals in aquatic organisms, resulting in potential long-term implication on human health and ecosystem [30]. Trace metals concentration in exchangeable phase were less than in residual phase. The exception was in Cd and Pb, this could be due to the anthropogenic sources [10]. In the present study sediment showed higher concentrations of trace metals at Station 1 compared to station 2 and 3 (Table 2). This was due to the location of Station 1 near to residential areas, which discharged their waste directly into the MOD river. Lower concentrations of trace metals were recorded at st.3 because this station represent new branch and had less exposure to this type of pollutants.

The statistical analysis showed that the metals correlation differences in MOD sediment for one to other. Significant differences appeared between exchangeable phase and residual phase for the same metals as well as correlation of this between differences element, not found between others. This showed the individual characteristics of metals and recognized behavior for all studied metals and under this location effect differences factors such as amount and quality of pollutant and physical and chemical properties of water.

The present study showed clear differences in mean concentration of (TMs) in study stations and that agreed with the results obtained by [31 ; 32 ; 33, while disagree with [34 ; 35] this may due to the same Geological nature of river sediment or similarity bottom structure or by the same agriculture and human additional quality input river. In this study, it was found a clear seasonal differences for all metals.

High Lead in the sediment from the study area associated with the highest traffic density in the center of Al-Nassiriya city.

Metals concentration in the gut with food content and muscle of fish:

Gut with Food content:

The results revealed a clear variation monthly in the gut of *C.carpio* during of the food study year (Fig. 2). The seasonal variations in the concentration of trace metals in the gut with food content of *C.carpio* is presented in (Fig. 2). The highest mean concentrations of Co, Cu and Mn in the gut with the food of *C.carpio* were recorded during summer and autumn, but Pb and Zn were observed in autumn and spring. (Fig. 2). The gut has a key role in basic accumulation, biotransformation and excretion of contaminants in fish [36]. It is well known that a large amount of metallothionein induction, caused by contamination, occurs in gut tissue of fish [37].

Food is one of the important factors which influence the metals uptake into tissues [38]. High levels of trace metals in the food content were obtained during spring, autumn and summer for species, this is due to the intensity of feeding for both species that take place in this period .Throughout this study, debris and mud were found in gut contents at all months of the study for *C.carpio* which pointed out clearly to the browsing habit of the fish on the bottom deposits. The debris ingested could be helpful in the grinding of food particles in the thick walled pyloric gut which act as a gizzard cited by [39]. The high level of trace metals in the gut of studied species could be due to the food structure of these species, which accumulated at high level of trace metals from surrounding water. [38] have indicated that the food pathway seems to have a significant impact on the uptake of Cd and Zn by fish from the west basin of Palestine lake.

Muscle

The trend of metal accumulation in the muscle of *C.carpio* was Fe >Zn >Mn >Cu > Ni > Co > Pb > Cd (Fig. 3). Seasonal variations of Cd, Pb, Ni, Mn, Cu and Co revealed that the highest concentrations during autumn, whereas Fe and Zn in muscle have recorded the maximum values in winter (Fig. 3). The annual mean concentrations of metals in the muscles of *C.carpio* were (12.42 µg/g) Co, (16.65 µg/g) Cu, (180.13 µg/g) Fe, (34.79 µg/g) Mn, (12.93 µg/g) Ni, (6.01 µg/g) Pb, (35.03 µg/g) Zn and (0.04 µg/g) Cd dry weight. The results of statistical analysis showed a positive correlation among some trace metals in the muscle of *C.carpio* , while negative correlation was observed in *C.carpio* between Cd with Fe, Pb with Fe, Ni with Fe and Mn with Fe.

Fish has the ability to accumulate trace metals from water and sediment. This ability depends upon various factors such as bioavailability, amount of uptake, kind of food and physically efficiency of organism to excrete excess of [40] . Earlier studies also indicated that different contents of trace metals in different fish species might be a result of different ecological needs, metabolism and feeding patterns [41 ; 42].

In this study, we measured the accumulation of Cd, Co, Cu, Ni, Pb and Zn in gut and muscle of the species namely *C.carpio* caught from MOD.

The muscle tissues are not considered as active sites for metal accumulation [43] . The levels of trace metals were determined in the muscles in each species because of its importance for human consumption [44] . Low concentrations of some trace metals were recorded in the muscles of species. The present results agree with those reported by [45 ; 46 ; 47] . The elevated level of the Fe in the muscles of *C. carpio* is probably due to the geochemical structure of the river bed [48]. Zn was high in the muscles of species. This agreed with the findings of [49] for omnivorous fish and [7]. The high concentrations of Fe and Zn in the muscles of species indicate that these metals are required metabolically by living organisms, whereas the Cd and Pb were lower in the muscles of species. This may be due to that the active regulation of essential and non essential metals by fish in their muscle tissues. Muscle are the main edible part of fish and can directly influence human health. Therefore, most governorates have established toxicological limits for trace metals in sea food [11]. According to [50], the allowable concentration for Cd, Cu, Ni, Pb, and Zn were 50,200, 5.5, 200 and 1000 ppm, respectively. The assessment of trace metals in these organisms has became necessary to draw a certain base- line for later monitoring because fish is important in human diet which can comprise a significant pathway for transport of toxic substance to humans [49].

Mesopotamia Environmental Journal
ISSN 2410-2598
Mesop. environ. j. 2018, Special Issue E.;144-161
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

Bio- Concentration Factors (B.C.F) and Bio-Sedimentation Factors (B.S.F)

The values of (B.C.F) in the muscle of *C.carpio* were higher than the values of (B.S.F) for all metals (Table 3). The order of trace metals levels in muscle of *C.carpio* according to the (B.C.F) were Cu> Mn> Zn> Co> Pb> Ni> Fe> Cd. The results showed that the Bio-Concentration and Bio-Sedimentation factors of all elements in fish from water were greater than sediments, this agree with obtained by [7 ; 51 ; 52]. This result might be due to the feeding behavior of fish which is filter feeder and the result was concordant with the findings of [53].

Table1. Seasonal average values, ± standard deviation of eight trace metals in the dissolved phase (µg/l) and particulate phase (µg/g) of water from MOD.

Season	station	Cd		Co		Cu		Fe	
		Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD
Winter	1	0.08± 0.05	17.48±1.5 4	0.53± 0.03	12.51± 0.46	0.015± 0.001	33.3± 0.16	200.49± 48.79	2609.45± 66.06
	2	0.05± 0.03	15.07±0.9 2	0.35± 0.02	11.92± 0.39	0.012± 0.001	31.11± 0.49	153.93± 29.86	2225.75± 209.15
	3	0.03± 0.02	11. 68± 1.51	0.28± 0.02	10.77± 0.40	0.006± 0.001	25.56± 0.64	143.97± 30.17	2115.24± 110.11
Spring	1	0.09± 0.04	23.64±2.2 1	0.49± 0.08	13.71± 2.15	0.017± 0.0007	29.68± 0.82	178.9± 48.78	3103.15± 241.19
	2	0.05± 0.03	21.64± 2.03	0.36± 0.03	11.54± 0.014	0.014± 0.0007	22.16± 0.66	156.25± 16.90	2922.05± 269.48
	3	0.03± 0.02	19.08± 0.11	0.27± 0.03	10.71± 0.61	0.007± 0.005	17.78± 0.92	146.4± 16.83	2655.7± 488.61
Summer	1	0.06± 0.01	14.87± 1.91	0.58± 0.08	14.39± 0.98	0.11± 0.01	25. 06± 7.92	180.61± 17.96	3061.12± 772.47
	2	0.04± 0.01	12.58± 1.76	0.50± 0.1	12.33± 0.86	0.08± 0.009	22.01± 7.80	119.37± 45.34	2194.62± 767.95
	3	0.02± 0.01	9.83± 1.26	0.37± 0.1	10.50± 0.07	0.06± 0.009	17.01± 7.96	109.42± 42.25	1977.20± 778.86
Autumn	1	0.08± 0.03	16.37± 3.16	0.63± 0.13	15.42± 0.34	0.05± 0.04	34.25± 8.41	173.37± 44.28	2462.7± 923.29

Mesopotamia Environmental Journal
ISSN 2410-2598
Mesop. environ. j. 2018, Special Issue E.;144-161
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

	2	0.04± 0.03	14.20± 3.32	0.54± 0.09	12.85± 0.78	0.03± 0.024	31.73± 8.14	148.66± 62.28	2046.57± 1063.60
	3	0.02± 0.01	11.02± 3.58	0.45± 0.09	10.16± 0.25	0.02± 0.01	26.48± 7.86	138.23± 62.26	2000.83± 1000.80
Mean		0.04± 0.02	19.38± 1.94	0.53± 0.06	12.23± 0.60	0.03± 0.008	35.11± 4.33	116.63± 38.80	2078.69± 549.46

Season	station	Mn		Ni		Pb		Zn	
		Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD	Dis. ±SD	Part. ±SD
Winter	1	2.69± 0.06	164.33± 19.37	2.63± 0.28	100.02± 0.01	0.5± 0.06	29.42± 3.40	15.35± 3.08	90.13± 17.27
	2	2.63± 0.07	142.67± 10.94	2.06± 0.12	99.27± 0.21	0.3± 0.06	27.10± 2.90	12.68± 2.55	76.43± 26.89
	3	1.99± 0.006	123.5± 10.45	1.57± 0.50	74.37± 0.59	0.06± 0.05	24.34± 4.05	9.03± 2.63	50.95± 21.16
Spring	1	2.93± 0.08	279.95± 160.16	2± 0.014	82.05± 24.03	0.35± 0.07	26.1± 4.10	10.84± 1.10	81.02± 12.71
	2	2.8± 0.07	152± 30.40	1.62± 0.17	80.4± 24.89	0.15± 0.07	24.02± 4.24	8.52± 0.68	61.89± 15.42
	3	1.87± 0.03	120.25± 0.34	0.05± 0.013	56.52± 23.32	0.05± 0.03	21.52± 4.93	5.51± 0.68	46.66± 18.87
Summer	1	2.83± 0.25	256.65± 26.88	2.12± 0.80	65.83± 0.50	0.65± 0.36	40.61± 9.18	16.34± 3.95	97.19± 4.00
	2	2.65± 0.18	199.97± 21.40	1.66± 0.53	62.83± 0.49	0.57± 0.17	37.27± 9.16	13.81± 3.90	87.53± 11.14
	3	1.84± 0.10	178.9± 26.84	0.77± 0.46	42.05± 0.80	0.45± 0.13	33.27± 6.12	10.49± 3.68	61.88± 21.07
Autumn	1	2.71± 0.25	256.36± 75.58	2.70± 0.13	88.39± 20.19	0.40± 0.26	34.31± 18.41	17.11± 2.75	100.45± 0.29

	2	2.59± 0.14	234.23± 69.18	2.03± 0.05	86.38± 21.04	0.46± 0.21	31.29± 16.80	14.41± 3.28	97.00± 5.23
	3	1.54± 0.07	219.04± 71.80	1.61± 0.51	66.36± 21.9416	0.3± 0.26	26.02± 13.00	11.39± 3.23	83.66± 11.83
Mean		2.42±0.0	193.98±43.61	2.52±0.31	75.37±11.49	0.35±0.14	27.10±9.02	12.12±2.62	77.90±13.82

Diss.= Dissolved phase

Part.= Particulate phase

SD= Standard deviation

Table 2. Seasonal average values, ± standard deviation of eight trace metals in the exchangeable and residual phase (μg/g) of sediment from MOD.

Season	station	Cd		Ca		Cu		Fe	
		Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD
Winter	1	5.36± 0.55	0.07± 0.02	12.45± 6.49	21.04± 1.39	12.03± 0.76	20.87± 3.23	640.7± 84.44	1886.73± 98.0
	2	3.36± 0.57	0.04± 0.02	11.89± 0.34	20.09± 0.08	8.67± 0.56	17.4± 2.92	590.3± 86.52	1490.07± 169.63
	3	2.44± 0.38	0.02± 0.01	10.50± 1.16	16.09± 0.08	6.36± 0.60	12.54± 2.75	406.97± 90.03	1261.60± 151.41
Spring	1	5.54± 0.71	0.06± 0.02	13.65± 2.21	22.17± 1.84	11.47± 0.73	17.93± 0.08	776.3± 155.28	1811.25± 253.92
	2	3.55± 0.73	0.04± 001	11.62± 0.34	21.12± 1.41	8.48± 0.78	14.07± 0.014	769.55± 149.55	1694.3 ± 237.59
	3	2.35± 0.44	0.02± 0.001	10.12± 0.89	16.62± 0.70	5.02± 1.41	9.63± 1.84	647.1± 174.51	1377.8 ± 230.94

Mesopotamia Environmental Journal
Mesop. environ. j. 2018, Special Issue E.;144-161
ISSN 2410-2598
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

Summer	1	6.04± 0.04	0.08± 0.02	14.56± 0.51	21.7± 1.40	7.61± 0.50	12.77± 1.05	533.52± 190.94	1606.33± 297.51
	2	4.02± 0.10	0.06± 0.03	12.25± 0.98	20.19± 0.06	4.44± 1.11	9.79± 1.21	484.43± 190.58	1333.4 ± 271.99
	3	2.26± 0.42	0.04± 0.02	10.4± 0.15	16.1± 0.06	2.25± 1.25	5.8± 2.33	374.84± 197.15	1112.4 ± 188.65
Autumn	1	6.68± 1.16	0.08± 0.006	15.36± 0.25	22.48± 1.57	9.62± 1.93	16.22± 5.74	561.83± 228.38	1943.1 ± 37.38
	2	4.38± 0.59	0.06± 0.006	12.78± 0.82	20.76± 1.16	6.65± 2.00	13.22± 5.57	510.4± 214.71	1770.97± 189.47
	3	2.34± 0.58	0.03± 0.006	10.04± 0.86	16.43± 0.59	4.02± 1.75	8.19± 5.26	402± 213.26	1461.4 ± 134.55
Mean		4.02±0.52	00.05±0.01	12.23±0.74	15.48±0.85	66.39±1.11	13.20±2.66	5558.16± 164.61	1563±181.16

Season	station	Mn		Ni		Pb		Zn	
		Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD	Ex. ±SD	Res. ±SD
Winter	1	91.22 ± 3.79	151.23 ± 73.91	1.61± 1.10	77.5± 1.60	40.43± 1.09	0.09± 0.01	3.93± 0.13	22.15± 0.70
	2	79.91 ± 6.75	130.47 ± 76.49	1.42± 0.57	69.16 ± 1.19	19.00± 1.68	0.06± 0.01	1.97± 0.077	20.13± 0.74
	3	64.63 ± 7.08	113.21 ± 75.24	0.6± 0.05	59.03 ± 0.98	14.59± 1.22	0.04± 0.01	0.39± 0.35	16.03± 1.75
Spring	1	107.63± 6.26	190.3.65± 3.46	0.7± 0.28	59.03 ± 0.98	21.83± 3.10	0.11± 0.014	2.52± 0.71	18.39± 2.54

	2	101.15± 7.85	171.7± 12.02	0.55± 0.21	61.75 ± 15.77	19.11± 2.73	0.08± 0.014	1.03± 0.12	16,33± 3.21
	3	93.61 ± 9.31	155.2± 6.93	0.35± 0.21	56.82 ± 13.33	15.85± 3.12	0.05± 0.007	0.03± 0.014	12.58± 2.07
Summer	1	127.18± 20.37	161.32 ± 20.38	2.13± 1.09	83.41 ± 18.58	32.32± 12.80	2.46± 0.49	3.94± 1.21	21.17± 3.36
	2	107.58± 15.72	142.57 ± 20.24	1.62± 1.20	79.61 ± 18.86	29.32± 12.04	1.78± 0.13	2.68± 1.01	19.02± 3.56
	3	99.64 ± 15.97	128.45 ± 10.91	1.36± 1.15	65.03 ± 21.99	26.00± 11.76	1.31± 0.30	1.02± 1.00	15.93± 4.20
Autumn	1	149.67± 30.90	200.03 ± 67.99	2.69± 0.43	96.24 ± 3.53	37.39± 17.63	2.32± 0.57	4.55± 0.35	22.99± 0.98
	2	111.04± 33.04	165.36 ± 34.01	2.31± 0.55	89.6± 6.47	34.38± 17.65	1.56± 0.18	2.40± 0.52	20.96± 0.98
	3	97.90 ± 31.08	152.23 ± 26.09	1.98± 0.50	77.98 ± 6.93	30.87± 16.21	1.25± 0.43	1.38± 0.54	18.2± 2.30
Mean		102.26±15.59	155.20 ±35.63	1.44± 0.59	72.90 ±6.93	28.07± 8.42	0.92±0.18	2.15±0.5	18.65±2.19

Ex.=Exchangeable phase

Res.= Residual phase

Mesopotamia Environmental Journal
Mesop. environ. j. 2018, Special Issue E.;144-161
ISSN 2410-2598
(proceeding of 2nd International conference of science and Art –University of Babylon and Liverpool John Moores University, UK).

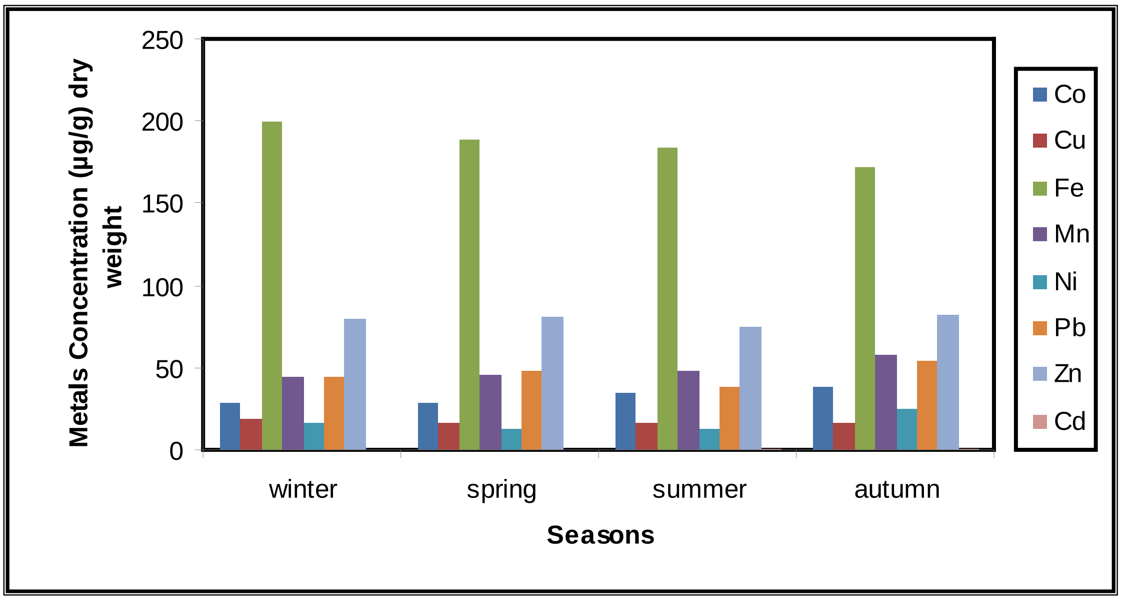
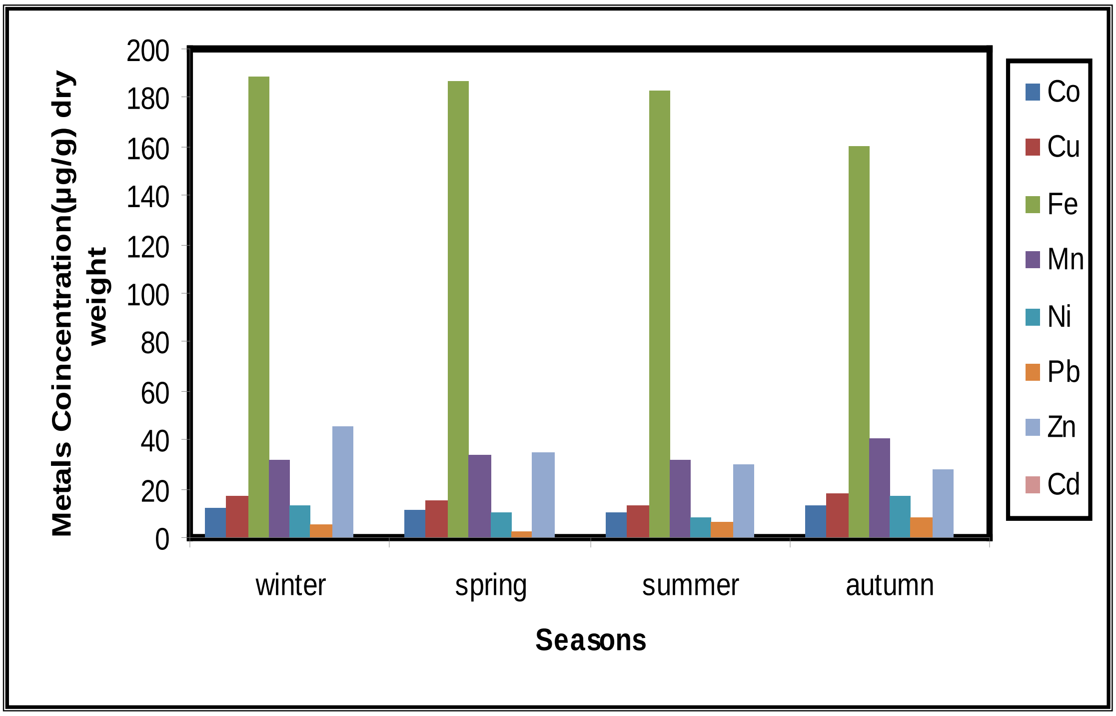


Fig. 2Seasonal variations in the mean concentrations of trace metals(µg/g) dry weight in the food content from the gut of *C.carpio*.



. **Fig.3 Seasonal variations in the metals concentrations of trace metals (µg/g) dry weight in the muscle of *C.carpio***

Table 3. Bioconcentration factor (B.C.F) and Biosedimentation factor (B.S.F) in the muscle of *C. carpio*.

Metal	Metal concentration		*C. carpio*		
	water µg/l	sediment µg/g	Muscle	B.C.F	B.S.F
Cd	0.05	4.07	0.04	0.8	0.001
Co	0.44	31.69	12.42	28.23	0.39
Cu	0.03	18.53	16.65	555.00	0.90
Fe	154.05	1818.23	180.13	1.169	0.01
Mn	2.42	243.21	34.79	37.21	0.14
Ni	1.73	73.28	6.01	7.47	0.17
Pb	0.26	26.01	2.93	17.17	0.23
Zn	12.12	20.8	35.03	35.02	1.68

Conclusions

From the present study, it can be concluded the following:

1. The bottom sediments are considered to be important ecologically since the substances that accumulate there tend to become incorporated in the food chain and thus become a hazard to the environment and human.
2. The heavy elements concentration in the particles phase are much more than the dissolved phase.
3. The heavy elements concentration in the residual phase are much more than the exchangeable phase expect Cd, Pb metals can be attributed to anthropogenic sources.

4. The B.C.F values for all metals were more than B.S.F values.

5. Muscle tissues contain less concentration of these metals.

6- Therefore, according to the results of this study, the consumption of MOD fish can be safe for human health in spite of possible contamination with trace metals.

References:

[1] Järup, L. Hazards of heavy metal contamination', *British medical bulletin*, Vol. 68. No. 1. P, 167. 2003.

[2]Nriagu, J.O.Global metal pollution: poisoning the biosphere?', *Environment: Science and Policy for Sustainable Development*,.Vol. 32, No. 7. PP, 7-33. 1990.

[3] Nriagu, J.O .A history of global metal pollution', *Science*. Vol. 272. No. 5259. pp, 223.1996.

[4] Ilyin, I.; Rozovskaya, O.; Travnikov, O. and Aas, W. Heavy metals: transboundary pollution of the environment', *EMEP Status Report*.2009.

[5] Abaychi, J.K and DouAbul, .A. 'Trace metals in Shatt Al-Arab river, Iraq', *Water Research*, Vol. 19, No. 4, pp. 457-62 .1985.

[6] Stringer, R.; Labunska, I. and Bridgen, K. Organ chlorine and heavy metals contaminants in the environment around premix, Altamira, Mexico. Univ. of Exeter. U.K. PP. 1-39.2001.

[7] AL-Khafaji, B.Y .Trace metals in water, sediments, and fishes from Shatt Al-Arab estuary north-west Arabian Gulf', Ph. D. Thesis submitted to Basrah University. pp, 110.1996 .

[8] Qzar, E.A.A .Concentration of trace metals in environment and some Gastrophoa (Mollusca) in East Hammar marsh', M. Sc. Thesis submitted to Basrah University.pp.122.2009.

[9] Al-Haidary, M.J.S. Distribution of heavy metals in Mesopotamia marsh Ecosystem, Iraq. Ph.D. Thesis submitted to Baghdad University.130pp. 2009.

[10] AL-Khafaji, B.Y. Distribution pattern of selected heaby metals in waterm sediment and two species of fish from AL-Hammar marsh south of Iraq. ', paper presented to The fifth scientific conference 2010, College of Science-University of Babylon. pp,115-124.2010 .

[11] Agah, H.; Leermakers, M.; Elskens, M.; Fatemi, S.M.R. and Baeyens, W. Accumulation of trace metals in the muscles and liver tissues of five fish species from the Persian Gulf.Environ.Monit.Assess.Vol.157.pp,499-514. 2009.

[12] Blasco, J.; Rubio, J.A.; Forja, J.; Gomez-Parra, A. and Establier, R. Heavy metals in some fishes of the muglidae family from salt-pounds of Codiz Bay SW Spain. Ecotox. Environ. Res. Vol.1.pp, 71-77. 1998.

[13] Al-Kubaysi, A.Al.R. The ecological study of suddam river .Ph.D. Thesis submitted to Baghdad University.pp,142.1996.

[14] Mohammed, S. S. Evaluation the quality of water in Al-Masab Alamm river in Thi-Qar Governorate. M.Sc. Thesis submitted to Thi-Qar University .pp, 106. 2010.

[15] Riley, J and Taylor, D. Chelating resins for the concentration of trace elements from sea water and their analytical use in conjunction with atomic absorption spectrophotometry', *Analytica chimica acta*. Vol. 40. pp, 479-85.1968.

[16] Sturgeon, R.; Desaulniers, J.; Berman, S and Russell, D. Determination of trace metals in estuarine sediments by graphite-furnace atomic absorption spectrometry', *Analytica chimica acta*. Vol. 134. pp, 283-91.1982.

[17] Yi, L.; Hong, Y.; Wang, D. and Zhu, Y . Determination of free heavy metal ion concentrations in soils around a cadmium rich zinc deposit', *Geochemical Journal*, Vol. 41, No. 4. Pp, 235-40.2007.

[18] R.O.P.M.E. Manual of oceanographic observation and pollutant analysis Methods .ROPME/P.O.Box 26388,13124 Safa, Kuwait.1982.

[19] Hem, J.D . Study and interpretation of the chemical characteristics of natural water, Vol. 2254, Dept. of the Interior, US Geological Survey. 1985.

[20] Mustafa, B.Z .Clams *Corbicula fluminea* as an indicator for heavy elements polluted in Shatt al-Arab River. M. Sc.Thesis submitted to Basra University.1985.

[21] Al-Hjaj, M.M.K. Distribution of heavy metals in water and sediment in channels of Al-Ashar and Al-Kandaq and associated with Shatt Al-Arab and its Influence on the algae ', M. Sc thesis submitted to Basrah University. 1997.

[22] Warren, L.A. and Zimmerman, A.P. Suspended particulate oxides and organic matter interactions in trace metal sorption reactions in a small urban river', *Biogeochemistry*, Vol. 24. No. 1. pp, 21-34.1994.

[23] Al-Khafaji, B.Y.; Awas, B.M. and Afrah. A.M. Distribution of some heavy metals in water, sediment and fish in Euphrates river near Al-Nassiriyia city center south of Iraq. J. Baghdad for women,.Vol.8. No.1.pp, 552-560. 2012.

[24] Fang, T.H. and Lin, C.L. Dissolved and particulate trace metals and their partitioning in a hypoxic estuary: the Tanshui estuary in northern Taiwan', *Estuaries and Coasts*, Vol.25. No.4.pp, 598-607.2002.

[25] Al-Abadi, H.J.S. Investigation of Microbial and Metal Contamination of Waters and Sediments in Abu-Zariq Marsh Southern of Iraq. M. Sc. Thesis. Collage of science-University of Thi-Qar.pp112. 2011 .

[26] Maktoof, A.A. ; Al-Khafaji, B.Y. and Zaniab. A. Level and Distribution of selected trace Elements in fis tissues (*Cyprinus carpio* and *Barbus luteus*) and sediments from Main outfall drain river near the center of Al-Nassiriya city. Iraqi Journal of Biotechnology.Vol. 14. No. 2.pp, 92-104.2015.

[27] Bentivegna, C.S.; Alfano, J.E.; Bugel, S.M. and Czechowicz, K . Influence of sediment characteristics on heavy metal toxicity in an urban marsh', *Urban Habitats*, Vol. 2. No. 1. pp, 92-4. 2004.

[28] Forstner, U. and Wittmann, G.T.W. Metal pollution in the aquatic environment. Springer-Verlag, New York.1981.

[29] Gupta A.; Rai, D.K.; Pandey; R.S. and Sharma, B. Analysis of some heavy metals in the riverine water, sediment and fish from river Ganges at Allahabad. Environ. Monit. Assess. Vol.157.pp, 449-458.2009.

[30] Fernandes, C.; Fontainhas-Fernandes, A.; Peixoto, F. and Salgado, M.R. Bioaccumulation of heavy metals in *Liza saliens* from the Esomriz-Paramos coastal lagoon, Portugal.Ecotox.Environ.Saf.Vol.66.pp,426-431.2007.

[31] Madkour, H.A. Distribution and relationship of heavy metal in the gian clam (*Tridacana maxima*) and associated sediments from different sites in the Egyptian Red sea coast. Egypt. J. Aqua. Res., Vol.31.No.2.pp, 45-59.2005.

[32] Kazaar, A.A. Determination of some trace metals in environment and three types of Mollusca in Al-Hammar west. M.Sc. Thesis submitted to Basrah University. pp,118 p.2009

[33] Muhsin, A.H. Pollution by heavy metals and bioaccumulation in Aquatic invertebrates in water surface in Basrah. Ph.D. Thesis submitted to Basrah University. pp,214.2011.

[34] Salman, J.M. Environmental study of possible pollutants in Euphrates river from Al-Hindiya Barrage to Al-Kufa –Iraq. Ph.D. Thesis submitted to Babylon University.PP 197.2006.

[35] Al-Ghanemi, H.A.H. Use of Aquatic Plants as Bioindicators of Heavy metals in Euphrates river- Iraq. M.Sc. Thesis submitted to Babylon University.pp 196 . 2010.

[36] Zauke, G. P.; Savino, V.M.; Ritterhoff, J. and Savinova, T. Heavy metals in fish from the Barents Sea (summer 1994). Sci., Total Environ., Vol. 227.pp, 161-173.1999.

[37] Olsvik, P.A.; Gundersen, P.; Nadersen R.A. and Karl, E.Z. Metal accumulation and metallothionein in brown trout, *Salmo trutta*, from two Norwegian rivers differently contaminated with Cd, Cu and Zn. Comparative biochemistry and physiology part C. Toxicol. Pharmacol.. Vol.128.pp, 189-201. DOI: 10. 1016/S1532 – 0456 (00) 00191 – 5.2000.

[38] Murrphy, B.R.; Atchison, G.J.; Alan, W. and Kolar, D.J. (1978): Cadmium and Zinc content of fish from an industrial contaminated lake. J. Fish. Biol. Vol.13. pp,327-335. 1978.

[39]Al-Shawardi, A.O. Ecology and Biology of Crucian carp *Carassius carassius* (L. 1758) and Khishini *Liza abu* (Heckel, 1843) in Tharthar Arm and Tigris. Ph.D. Thesis submitted to Al-Mustansiriya University. pp,142 .2006.

[40] Bowen, H.J.M. Trace elements in biochemistry˝ Academic Press, Inc., New York, pp,241.1966. [41] Al-Saleh, I. and Shinwari, N. Preliminary report on the levels of elements in four fish species from the Arabian Gulf of Saudia Arabia. Chemspere. Vol.48. pp, 749- 755.2002.

[42] Yilmaz, A. B. Levels of heavy metals (Fe, Cu, Ni, Cr, Pb and Zn) in tissue of *Mugil cephalus* and *Trachurus mediteraneus* from Iskenderun Bay, Turkey. Environmental Research.Vol. 92.pp,277-281. 2003.

[43] Romeo, M.Y.; Siau, Y. Z.; Sidoumou, Z. and Gnassia-Barelli, M. Heavy metal distribution in different fish species from the Mauritania coast. The Science of the Total Environment. Vol.232.pp, 169-175.1999.

[44] Marcovecchio, J.E. The use of *Micropogonias furnieri* and *Mugil liza* as bioindicators of heavy metals pollution in La Plata river Estuary, Argentina. Sc. Total Environ., Vol. 323.pp, 219-226. DOI: 10. 1016/j. Scitotenv, 2003.09.029.2003.

[45] Al-Maliky, R.N.A. Biogeochemical assessment of trace metals in Al-Hammar marshes, Iraq. Ph.D. Thesis submitted to Baghdad University. pp, 253.2009.

[46] Raphael, E.C.; Augustina, O.C. and Frank, E.O. Trace metals distribution in fish tissues, Bottom sediments and water from Okumeshi river in Delta State, Nigeria. Environ. Res. J.Vol. 5.No. 1.pp, 6-10.2011.

[47] Abdel-Baki, A.S.; Dkhill, M.A. and Al-Quraishy, S. Bioaccumulation of some heavy metals in tilapia fish relevant to their concentration in water and sediment of Wadi Hanifah, Saudia Arab. African. J. Biotechnology., Vol.10, No.13.pp, 2541-2547. 2011.

[48] Al-Hashimi, A. H. and Salman, H. H. Trace metals in the sediment of the North-Western coastal of the Arabian Gulf. Mar. Poll. Bull., Vol.16.pp, 118-120. 1985.

[49] Mathis, B.J. and Cumming, T.F. Selected metals in sediments, water and biota in the Illinois river. J. Water Pollut. Control Federat.,Vol. 45.pp,1573-1583. 1973.

[50] WHO (World Health Organization. Guidelines for drinking water. WHO, Geneva. pp,231-246.2005.

[51] Al-Taee, M.M. Some metals in water, sediments, fishes and plants of Shatt Al-Hilla river, Ph.D. Thesis submitted to Babylon University. pp,128 pp. 1999.

[52] Rashed, M.N. Monitoring of environmental heavy metals in fish from Nasser lake. Environ. Int., Vol. 27.pp, 27-33.2001.

[53] Ali, M.H. and Fisher, M.R. Accumulation of trace metals in some invertebrate and fish species relevant to their concentration in water and sediment of lake Qarun, Egypt, Egyp Aquatic Res.Vol. 31. No.1. pp, 289-301.2005.