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Trace metals distribution in fish tissues (*Cyprinus carpio* and *Barbus luteus*) and sediments from Al-Msab Alamm River near the center of Al-Nassiriya city.

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Abstract:

The present study was conducted to investigate the concentration and distribution of four trace metals cadmium, cobalt, copper and lead, in exchangeable and residual phases of the sediment in Al-Masab Alamm and tissues (gills, liver and muscle) of two important commercial species of fish (*Cyprinus carpio* and *Barbus luteus)* during summer season 2010. Also the present study include some physical and chemical properties of this ecosystem.

The results showed clear coordination between air and water temperature in all study locations. Air and water temperatures ranged between (34.5-39.31) ºC and (26.22-32.01) ºC respectively. PH, salinity, dissolved oxygen and biological oxygen demand ranged between (7.3-8.6), (4.3-9.01) ‰, (6.0-7.70) mg/L and (2.26-3.25) mg/L respectively. Localized variations were noticed in percentages composition of sediment contents of clay, silt and sand. Total organic carbon ranged between (0.28-1.85) in study stations.

The mean concentrations of Cd, Co, Cu and Pb in exchangeable and residual phases as follow Cd (4.22, 0.14), Co (12.40, 19.33), Cu (4.76, 12.71) and Pb (29.21, 1.85) µg/g dry weight respectively.

The present study showed a difference in concentrations of studied metal in different tissues of fish, these concentrations varies from one species to another and the tissues of same species showed differences in concentration of studied metals. This due to the nature and the function of the tissue and ability of fish on regulating the level of the metals in their bodies during the uptake and elimination processes.

Introduction:

The expansion in the production of huge amounts of chemical materials, and the increase in these materials annually are due to the global industrial development, especially of the chemical industries like petrochemicals, paper industry, paints, plastics, and electric instrument industries,but these lead to environmental crease identifying by environmental pollution [1].

Trace metals are generally released in aquatic environments in different ways and accumulation of these metals is dependent on its concentrations, the type of aquatic organisms and the exposure period [2].

Many studies in different regions from the world have represented using the sediment of

rivers and estuaries and fish as an indicators for pollution by trace metals [3,4,5,6,7]

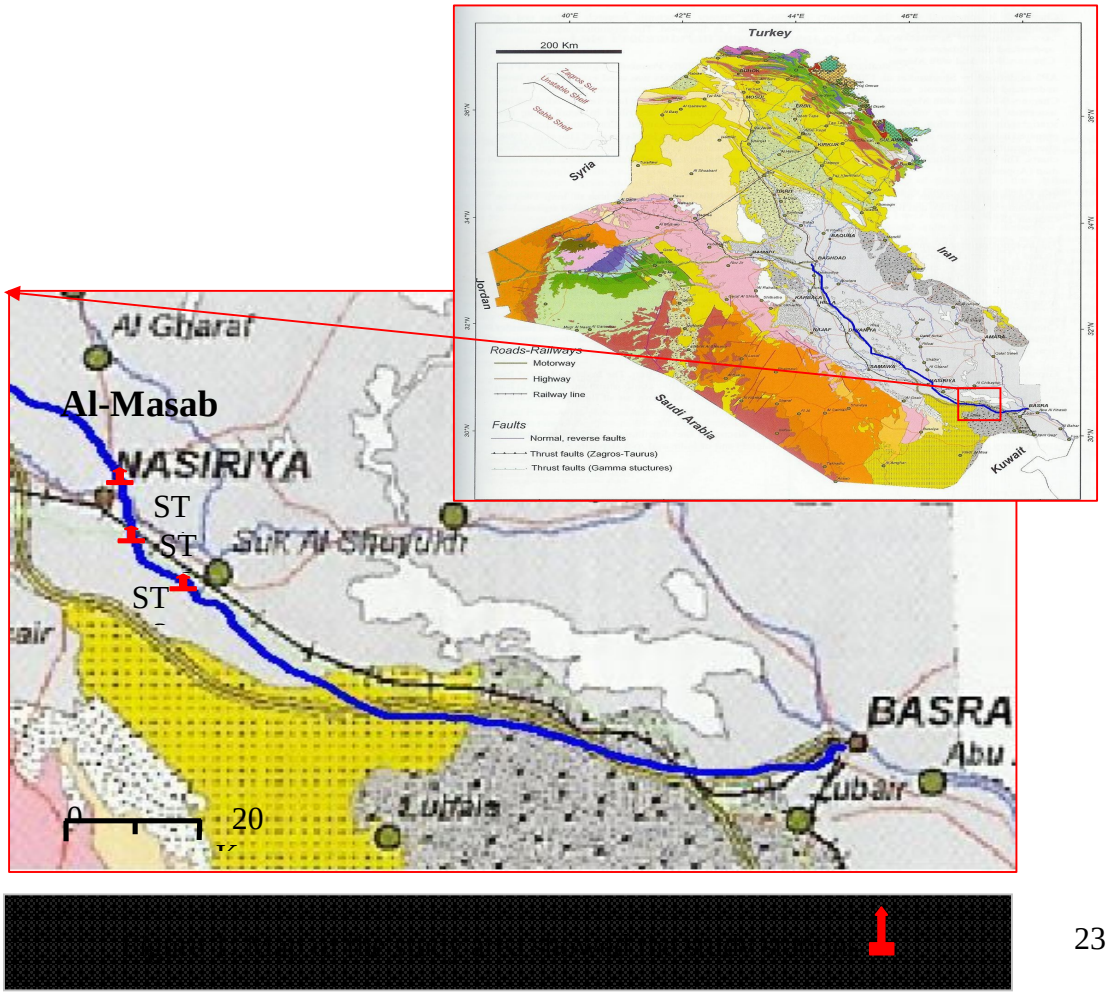
Fishes are known for the ability to concentrate heavy metals in their muscle and since the play important role in human nutrition, they need to be carefully screened to ensure that unnecessary high level of some toxic trace metals are not being transferred to man through fish consumption [8]. This study is geared towards determining the distribution of trace metals in the fish part and sediment Al-Masab Alamm River in Al-Nassiriya city; with the view to establishing abase line data on the current pollution status of the river. The results obtained from this study would also provide information for background levels of metals in the sediments and fish species of the river contributing to the effective monitoring of both environment quality and health of the organisms inhabiting the river.

Materials and Methods :

Study area :

Al-Masab Alamm is a river use to discharge the effluents of agriculture activites from its both sides. It is extended from Al-Shaklawiya near Baghdad north until Al-Basrah at the south with length about 565 km [9]. 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 220m^3/sec in this sector [10]. 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 (Fig.1).



Materials and Methods :

Fish samples and sediments were collected from Al-Masab Alamm river from locations as shown in Fig.(1) during summer/2010.

Fish samples were captured from the study area by using gill nets 25*25 mm mesh size. The captured fish were then placed in polyethylene bags and frozen immediately and transferred to laboratory. In the laboratory, the fish washed with deionized water, standard length and weight were measured to the nearest mm. and mg. respectively, then the abdominal cavity of each specimen was opened and the organs gills and liver were separated, whereas muscle was taken from the left posterior side of each fish, tissues were then dried under 105° for 24 hr. The determination of metals in fish sample was done according to the following procedure described by [3].

Sediments were obtained by van ven grab sampler from representation sites, the surface sediment about 5 cm was used for the present study. Trace metals analysis were preformed on the <63µm fractions of the sediment, which had been separated by sieving after oven drying and grinding. The determination of the trace metals in the exchangeable fraction of the sediment were done following the procedure described by [11] , whereas those in the residual fractions of the sediment was determined following their procedure described by [3].Trace metals were extracted in triplicate from sediments and fish samples. Cd, Co, Cu and Pb were determined in air/acetylene flam atomic absorption spectrophotometer AAS-model SP 9 pye-unicam. Sediment texture was analyzed and the percentage of three size fractions (sand, silt and clay) were calculated according to [12, 13]. Total organic carbon (TOC %) in the sediment were determining according to [14].

Results and Discussion:

The mean water quality data for the studied stations are presented in Table (1). The air temperature during the study period for each location in Al-Masab Alamm ranged between (34.5-39.31)°c, the lowest value was (34.5)°c at station 1 in May , whereas the highest value was (39.31)°c at station 3 in August. The water temperature for the study area ranged between (26.22-32.01)°c, the lowest at station 1 was (26.22)°c in May, while the highest in station 3 was (32.01)°c in August. Temperature is an important factor, which regulates the biogeochemical activities in the aquatic environment [15].

All metabolic and physiological activities and life processes are greatly influenced by water temperature [16].Water temperature is related with solar radiation and air temperature in the present study, water temperature follows changes in air temperature because of increase the surface area in comparison with volume. There are differences in the temperature among the stations over the day and that come from the different time of samples taking. These are agreed with the [17, 18]. The water salinity values for all stations varied between (4.3- 9.01)‰, the lowest value (4.3) ‰ was recorded in June at station 3, the highest value (9.01) ‰ was recorded in August at station 1. The higher value of salinity was observed in the study for the Al-Masab Alamm because this river used as a drainage water supply and this due to the high level of dissolved salts. As, the highest salinity values were registered during the summer months, that was caused by decreasing of the water levels and increasing of the evaporation ratio [19]. Furthermore, the dissolved ions are concentrated by evaporation and diluted by freshwater input, these results were in agreement with the previous studies of [20, 21]. Water pH values during the study period for all stations in Al-Masab Alamm ranged between (7.3-8.6). The pH was in alkaline level, it has being known that Iraq water mainly tend to be alkaline, this agree with results which obtained by [22,21]. The daily differences in pH values were because of removing carbon dioxide from bicarbonate due to photosynthesis activity during day hours [23] or in water, with high algal

concentration. pH varied, reaching values as high during the day when algae are using carbon dioxide in photosynthesis and pH drops during the night when the algae respire and produce carbon dioxide [24].The maximum value of dissolved oxygen was (7.70)mg/l in May at St3., while the minimum value was(6.00) mg/l in August at St.1. The lower value of DO at St 1. may be due to higher the degradation of organic substances, the latter process reduce the DO content in water, [25]showed the amount of DO in water is decreasing with the increasing of organic substances, which use the energy of organic substances by chains of microorganisms which use DO as oxidize factor in degradation process. Maximum biological oxygen demand has been recorded at station 1 in August, while the minimum value has been at station 3 in May. The results of the present study showed that the BOD5 in station 1 were higher than other stations and that caused by adding different amounts of domestic and sewage waste, agriculture runoff, urban runoff and near the station from the center city. Hot months were recorded high (BOD5) value because of microorganisms' activity [26], these results agreement with [27].

Concentrations of trace metals in sediment (exchangeable and residual phases) at different stations under study are presented in Table (2), Sediments acts as archive for many pollutants one of them is trace metals. Acknowledge of the concentration and distribution of trace metals in the sediment can therefore play a key role in defecting sources of pollution in aquatic ecosystem [28].

In the present study, the concentrations of all studied trace metals recorded higher concentrations at station 1 more than the other stations; this may be due to the high organic carbon content and the high percentage of fine grain size (silt and clay) of sediment texture. [29] has indicated that the concentration of trace metals in the sediment are affected by many factors such as grain size of the sediment texture, Total Organic Carbon percentage (TOC%) content and carbonate content of the sediment as well as physical and chemical parameters. Lower concentrations of trace metals were recorded at station 3 because this station represent new branch and had less exposure to this type of pollutants. TOC content and amount of fine grain size(silt and clay) in the mentioned station was recorded lower value comparing with other stations (Fig. 2) respectively, while station 2 recorded relatively higher value of trace metals more than those in st.3 because of , in this station high traffic density of fishing boats. Trace metal pollution 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]. The present study showed that the different tissues of C.carpio and B. luteus fish were varied from one to another in their accumulation of trace metals (Table 3). The results of the present study showed that, liver accumulate and concentrate highest concentrations of Cu in comparison with other metals in both species. [31] Reported that the liver was the major site for Cu accumulation because liver is the responsible organ in controlling the toxicity of heavy metals. [32] found the same results in Tiliapia fish collected from Nassar lakes as well as obtained by [33, 34 and 35]. Co accumulated in liver of C. carpio, whereas it accumulated in the gills of B. luteus. Generally, the different distributions of trace metals in the body tissues may be due to the physiological nature of the tissues in the species, and this indicates that the different species have different patterns of accumulation. [36] Have indicated that the accumulation and distribution of metals in the fish tissues depend on the duration of exposure, physiological condition of the metal and the environmental factors around the fish.

The high concentration of Co in these tissues in both species may be related to its concentrations in sediment. It can be pointed from the concentrations of Pb and Cd that it has been accumulated with lower levels in muscles of the fish in comparison with its concentrations in either the gills and liver. Lead and cadmium have been found in the kidney of C.carpio and in the

liver of B. luteus except Cd could be found in gills of the same species as compared to other tissues.This indicates that the difference in the accumulation patterns of Pb and Cd in fish tissues depend on uptake and elimination rates of metals [37]. The results of the present study agree with those found by other researchers [38].

Low concentrations of trace metals were recorded in the muscles of both species. The present results agree with those reported by [7]. The concentrations of most metals in most tissues of C. carpio were higher than in B. luteus, which promote the mentioned phenomenon. [39] Have indicated that differences in metal accumulation in fish bodies may be due to the differences in their diet during the growth of the species.

Table (1): Mean values of selected environmental factors in the study area during the study period.

Months	Stations	Air temp.°c	Water temp.°c	Salinity (‰)	pH	Do (mg/l)	BOD (mg/l)
May	1	34.5	26.22	6.01	8.4	7.60	2.3
	2	35.2	27.10	5.16	7.6	7.66	2.28
	3	36.4	27.80	5.06	7.4	7.70	2.26
June	1	34.9	26.66	7.56	8.3	6.7	3.1
	2	35.5	27.54	5.19	7.5	6.75	3.09
	3	37.2	28.20	4.30	7.3	6.80	3.07
July	1	37.12	30.00	7.65	8.45	6.2	3.15
	2	38.22	31.12	5.35	7.79	6.3	3.12
	3	39.0	31.03	4.90	7.6	6.4	3.10
August	1	37.86	30.24	9.01	8.6	6.00	3.25
	2	38.13	31.96	8.26	7.87	6.1	3.14
	3	39.31	32.01	8.00	7.75	6.1	3.13

Table (2): Mean concentration ±SD of trace metals in sediment (exchangeable and residual phases) µg/g dry weight in the study area during the study period.

Station	phases	Cd	Co	Cu	Pb
1	Exch.	6.03±0.04	14.56±0.51	7.61±0.50	32.32±2.80
	Resid.	0.08±0.02	21.7±1.40	12.77±1.05	2.46±0.48
2	Exch.	4.02±0.09	12.25±0.98	4.44±1.11	29.32±12.04
	Resid.	0.06±0.02	20.1±0.06	9.79±1.21	1.78±0.13
3	Exch.	2.26±0.42	10.4±0.80	2.25±1.24	26.00±11.76
	Resid.	0.04±0.02	16.1±0.06	5.8±2.33	1.31±0.30
Mean exch.		4.22±0.27	12.40±0.64	4.76±0.95	29.21±8.86
Mean resid.		0.14±0.02	19.33±0.51	12.71±1.53	1.85±0.30

Exch.= Exchangeable phase Resid.= Residual phase

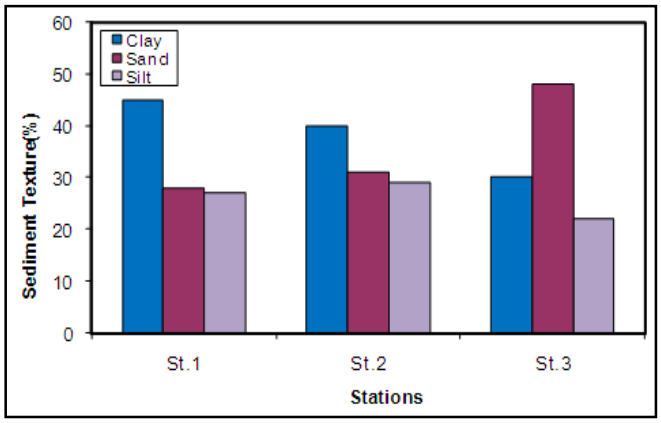


Figure (2): Percentage of clay, silt and sand in sediments for all locations of the study.

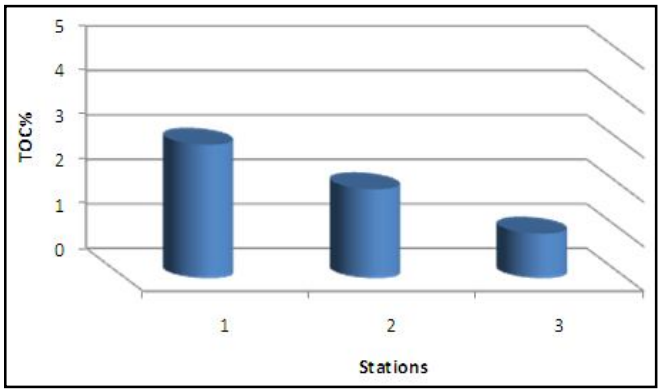


Figure (3): Mean values of total organic carbon (TOC %) variations for all locations of the study.

Table (3): Concentration of trace metals (Mean±SD) µg/g dry weight in different organs from fish A-Cyprinus carpio B- Barbus luteus.

A-*C. carpio*

organs / Metals	N.	Gill	Liver	Muscle
Cd	30	0.11±0.005	0.08±0.01	0.05±0.005
Co	30	10.13±0.56	23.76±1.45	10.45±0.98
Cu	30	13.45±1.57	20.77±0.31	14.14±0.64
Pb	30	14.62±0.0.18	13.46±0	6.42±0.69

B- *B. luteus*

organs / Metals	N.	Gill	Liver	Muscle
Cd	30	$0.11\pm2.314E^{-18}$	0.04±0.01	0.02±0.005
Co	30	22.18±0.19	2.26±0.04	1.80±0.005
Cu	30	3.94±0.53	92.82±5.83	12.84±0.18
Pb	30	2.08±0.02	8.16±1.23	2.39±0.23

N: Number of samples

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توزيع العناصر النزره في انسجة الاسماك (الكارب الاعتيادي والحمري) ورواسب المصب العام قرب مركز مدينة الناصرية.

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الخلاصة:

أجريت هذه الدراسة لقياس تراكيز وتوزيع أربع من العناصر النزره (الكادميوم ,الكوبلت ,النحاس والرصاص) في نهر المصب العام للرواسب بجزيئيها المتبادل والمتبقي وأنسجة (الغلاصم ,الكبد والعضلات) لنوعين من الأسماك التجارية المهمة جمعت من المصب العام خلال موسم الصيف 2010. وكذلك شملت الدراسه الحالية دراسة بعض الخصائص الفيزيائيه والكيميائية لذالك النظام البيئي.أظهرت نتائج الدراسة توافق واضح بين درجة حرارة الهواء ودرجة حرارة الماء في جميع المواقع اذ تراوحت بين (34.5-39.31)°م و(26.22-32.01) °م ,وكانت قيم الاس الهيدروجيني ذات مدى ضيق في جميع المواقع وتراوحت بين (7.3-8.6). سجلت قيم الملوحة والأوكسجين المذاب والمتطلب الحيوي للأوكسجين بين(4.3-9.01)جزء بالألف,(6.00-7.70)ملغم/لتر و(2.26-3.25) ملغم/لتر.سجلت اختلافات موقعيه في النسب المئوية لمكونات الرواسب من الطين والغرين والرمل تراوحت معدلات محتوى الكاربون العضوي الكلي في الرواسب بين (0.28-1.85)%.

بلغت معدلات تراكيز العناصر النزرة في الرواسب بجزيئيه المتبادل والمتبقي كالأتي الكادميوم (4.22,0.14), الكوبلت (12.40,19.33), النحاس(4.76,12.71) والرصاص(29.21,1.85) (مايكروغرام/غرام) وزن جاف على التوالي.

تبين من الدراسة وجود تراكيز متباينة من العناصر النزرة في أنسجة كلا النوعين من الأسماك. إن تراكيز العناصر المدروسة تختلف في تراكمها من نوع لأخر, وتختلف في أنسجة النوع الواحد. وهذا يعود إلى طبيعة ووظيفة الأنسجة وقابلية الأسماك على تنظيم مستويات هذه العناصر في أجسامها خلال عمليات الأخذ والأزاله.