THE AMAR International Charitable Foundation

*Marsh Bulletin* 7(2)(2012)126-136

MARSH BULLETIN

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# Seasonal variations of some trace elements concentrations in Silver Carp *Hypophthalmichthys molitrix* Consolidated from farms in central Iraq

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## Abstract

Trace elements (cobalt, iron, nickel, manganese, copper and cadmium) were studied at three organs (muscles, liver and gills) of the body of fish, silver carp (*Hypophthalmichthys molitrix*) during the period from autumn 2009 to summer 2010. The concentrations of these elements were measured using Flame Atomic Absorption Spectrophotometry. Results showed that the trace elements (cobalt, iron, nickel, manganese, copper and cadmium) in muscles were ranged from ((ND (spring) to 5.54 (summer) ; 40.68 (winter) to 72.10 (summer) ; 55.23 (autumn) to 69.23 (summer) ; 3.12 (winter) to 5.72 (spring) ; ND (winter) to 14.34 (summer) ; 1.16 (autumn) to 2.89 (spring)) µg/g dry weight, respectively. While in liver were ranged from ((5.22 (spring) to 16.71 (summer) ; 55.80 (winter) to 98.90 (autumn) ; 70.45 (winter) to 89.18 (autumn) ; 6.01 (summer) to 10.99 (spring) ; 20.10 (autumn) to 30.22 (summer) ; 6.50 (autumn) to 12.69 (summer)) µg/g dry weight, respectively. Also, in gills were ranged from ((11.13 (spring) to 19.36 (summer) ; 50.50 (winter) to 83.91 (summer) ; 58.28 (summer) to 78.91 (winter) ; 7.00 (summer) to 13.62 (autumn) ; 11.30 (autumn) to 23.61 (summer) ; 8.51 (summer) to 10.22 (winter)) µg/g dry weight, respectively. Generally, the concentrations of these elements in liver were higher than in muscles and gills. The trace elements concentration had been distributed during the seasons as follow: summer > spring > autumn > winter.

## 1- Introduction

Aquatic ecosystem undergoes to number of toxic pollutants with different levels, in particular the undegradable pollutants which is considered one of the main obstacles in now days (Al-Najare, 2009). Living organisms requires trace amounts of some trace elements such as Cu, Fe, Mn, V, Sr and Zn. These elements tend to accumulate in body of living organisms, and this depending on type of the element, concentration and species type, and here in the reason why these toxic elements are so dangerous (Irwandi and Farida, 2009). Copper, manganese, zinc, chromium, nickel and cadmium play important role in functional fish organs (Metwally and Fouad, 2008).

Fishes are in the highest rank of diets, which make them the most species that more liable to concentrate higher amounts of trace elements from water or food. Some of fishes primary consumers and others are secondary consumers, therefore, they might assimilate as bioindicators for environmental monitoring (Rashed, 2001). Consuming large quantities of fish will accumulate large quantities of some elements which existed in aquatic environment. It is important to determine the concentrations of elements in fishes. The intake consumption of these fishes lead to several diseases, such as disorders of central nervous system, atherosclerosis, paralysis, tremble and Alzheimer. Additionally, heart and immune diseases (Sabine and Wendy, 2009).

Therefore, in order to fish aquaculture in fresh water tanks, water quality and the regular accumulation for elements must be kept at acceptable levels (Birute *et al.*, 2009). The present study deals with the seasonal variations of trace elements in golden fish organs which collected from the aquacultures of middle of Iraq and compared the results with the other studies.

## 2- Materials and Methods

The silver carp *Hypophthalmichthys molitrix* was collected from brooders tank at Hillah city during the period between autumn 2009 and summer 2010. The fresh samples were kept in crushed ice in polystyrene cool box and transferred to the laboratory. Sixty samples for each organ (gills, livers and muscles) were used. Samples were freeze-dried, ground and sieved. The average length and weight of fishes were 495 mm and 858.5 gm, respectively. Trace elements cobalt, iron, nickel, manganese, copper and cadmium have been determined by means of Flame Atomic Absorption Spectrophotometry (model Pye Unicam Sp9) according to ROPME (1982), and this followed by acid digestion of 2 gm of dried samples. Trace elements concentrations were expressed as microgram per gram (µg $g^{-1}$).

Analysis of variance (ANOVA) was performed to assess whether trace element concentrations varied significantly between seasons and organs. Revised least significant differences test (RLSD) and probabilities ($p<0.05$) were considered statistically significant. All statistical calculations were performed with SPSS program.

## 3- Results

Cobalt levels (µg/g dry weight) in muscles, liver and gills ranged from ((ND (spring) to 5.54 (summer) ; 5.22 (spring) to 16.71 (summer) and 11.13 (spring) to 19.36 (summer)), respectively (Fig. 1). Cobalt concentrations were shown no significant differences ($P>0.05$) between organs during the seasons. The concentrations of iron (µg/g dry weight) in the muscles, liver and gills of fish examined were ranged from ((40.68 (winter) to 72.10 (summer) ; 55.80 (winter) to 98.90 (autumn) ; 50.50 (winter) to 83.91 (summer)), respectively (Fig. 2). The analysis of variance showed that the concentrations of iron among the organs were significantly different ($P<0.05$) and no significant differences ($P>0.05$) between the seasons. Nickel concentrations (µg/g dry weight) in muscles, liver and gills ranged from ((55.23 (autumn) to 69.23 (summer) ; 70.45 (winter) to 89.18 (autumn) ; 58.28 (summer) to 78.91 (winter)), respectively (Fig. 3). There were significant differences ($P< 0.05$) recorded in nickel among the organs during the seasons. For manganese, the levels in muscles, liver and gills ranged from ((3.12 (winter) to 5.72 (spring) ; 6.01 (summer) to 10.99 (spring) ; 7.00 (summer) to 13.62 (autumn)) µg/g dry weight, respectively (Fig. 4). Manganese concentrations were shown no significant differences ($P>0.05$) between organs during the seasons. The concentration (µg/g dry weight) of copper in fish muscles, liver and gills varies from ((ND (winter) to 14.34 (summer) ; 20.10 (autumn) to 30.22 (summer) ; 11.30 (autumn) to 23.61 (summer)), respectively (Fig. 5). Copper levels were significantly different ($p<0.05$) among fish organs during the seasons. The amount of cadmium in fish muscles, liver and gills ranged from ((1.16 (autumn) to 2.89 (spring) ; 6.50 (autumn) to 12.69 (summer) ; 8.51 (summer) to 10.22 (winter)) µg/g dry weight, respectively (Fig. 6). The analysis of variance showed that the concentrations of cadmium among the organs were significantly different ($P<0.05$). Figure (7) shows that a negative relationship between the total length and total concentration of trace elements was observed.

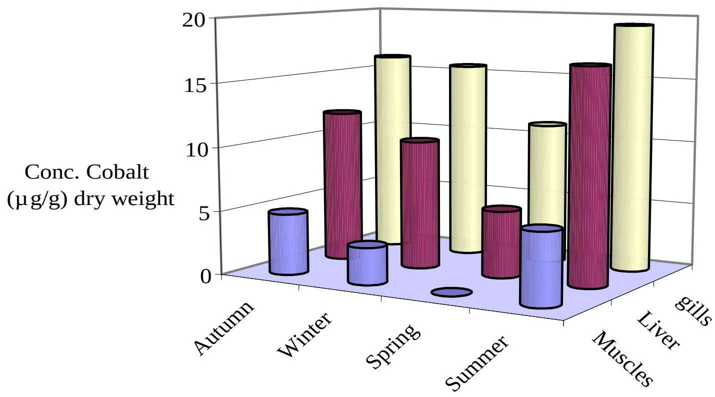


Fig. 1. Concentrations of Cobalt (µg/g dry weight) in fish organs during different seasons.

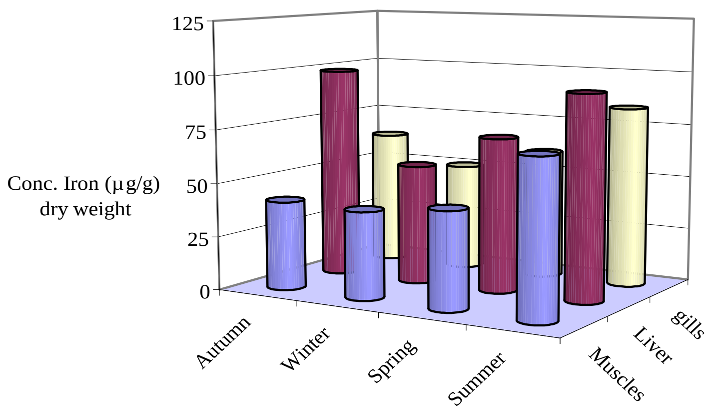


Fig. 2. Concentrations of Iron (µg/g dry weight) in fish organs during different seasons.

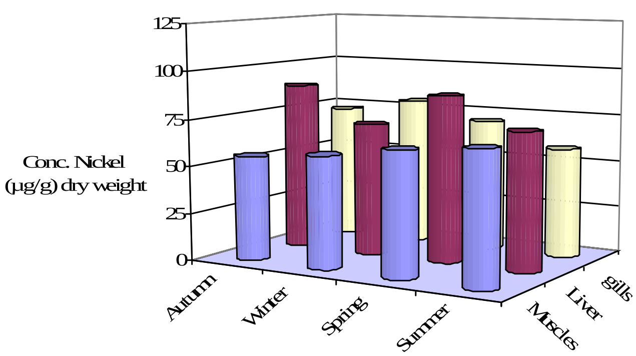


Fig. 3. Concentrations of Nickel (µg/g dry weight) in fish organs during different seasons.

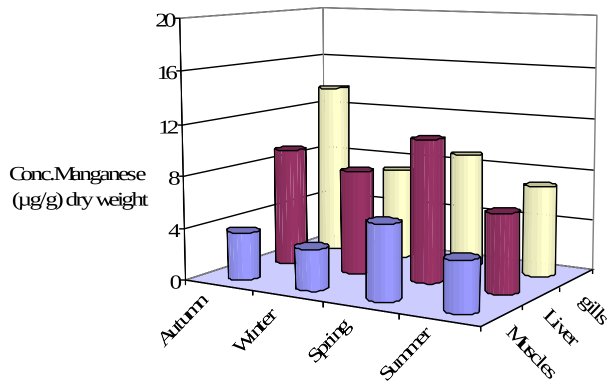


Fig. 4.Concentrations of Manganese (µg/g dry weight) in fish organs during different seasons.

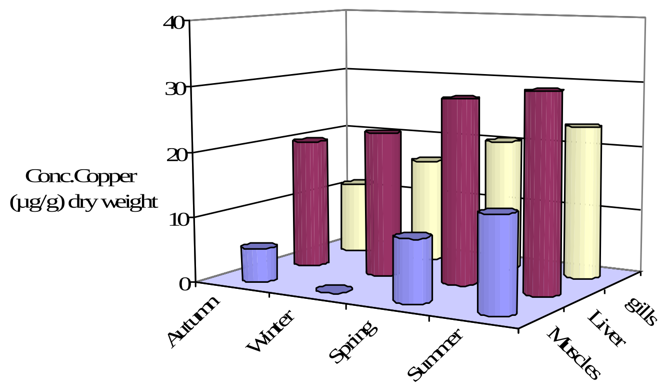


Fig. 5. Concentrations of Copper (µg/g dry weight) in fish organs during different seasons.

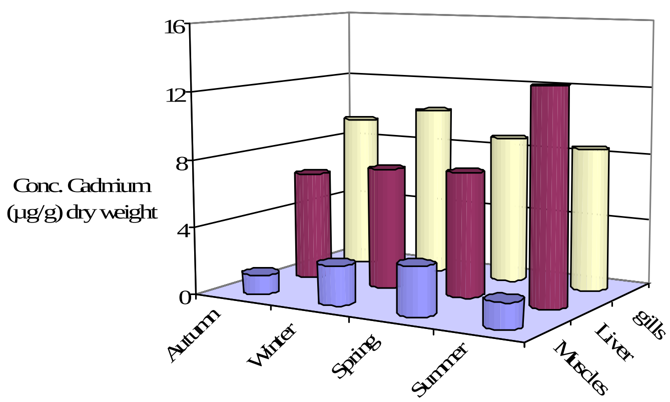


Fig. 6. Concentrations of Cadmium (µg/g dry weight) in fish organs during different seasons.

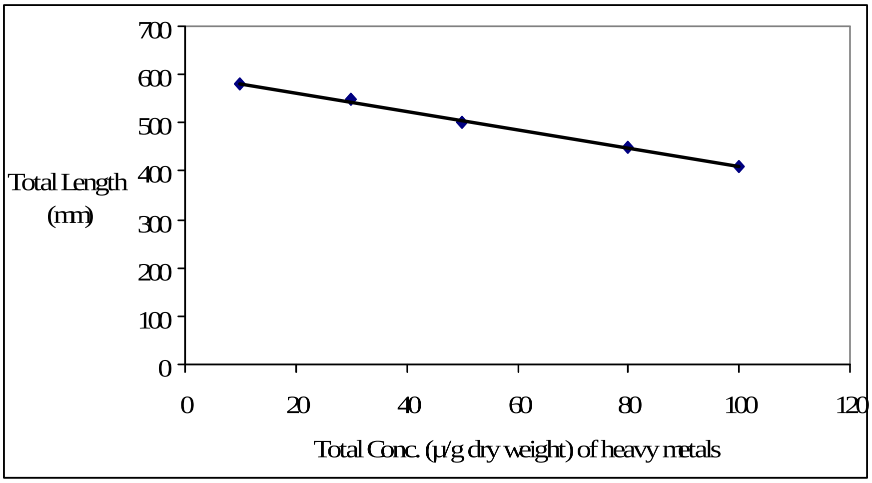


Fig. 7. Relationship between the total length (mm) and total concentration (µg/g dry weight) of trace elements.

**4- Discussion**

Fish is a good source for protein. The protein in fish is considered of high biological value. This means that fish can be used as main source of protein, which contains omega-3 fatty acids. This help to prevent heart disease, because it makes the blood less dense, and then decrease the clots which cause myocardial infractica (Khalil and Faragallah, 2008 ; Mormede and Davies, 2001 ; Kilgour, 1991). It's useful to use fish to state the water pollution, therefore, it's an excellent sign of pollutants and in particular trace elements in environmental ecosystem (Blasco *et al.,* 1998).

The accumulated elements in fish play an important role in the life system because they are necessary to humans, since most people use these fishes in their diet. Some of these fish may be toxic and may cause serious effects on human health (Irwandi and Farida, 2009). From the results, there is considerable fluctuation in trace elements between liver, gills and muscles, and especially the muscles which is the most important part suitable for consumption (edible). When comparing the present results with other studies (Table 1), we find that the concentrations in this study were less than in other environments results, and within the allowed limits such as stated by (FAO/WHO, 1984). Fish farms are in confined environment and the amount of entering pollutants are limited so pollution's source that enters the ponds with water could be controlled. The location of liver in the circulatory system that his job summarized with absorbs the trace elements from the blood and then reject of them in several mechanisms, caused cosmetic changes in liver (Rashed, 2001). Iron, copper and nickel showed highest concentrations in the liver and less concentration in the muscles and this is agree with the study of Mediha *et al.* (2007). Fish has the ability to concentrate the trace elements in their bodies. Due to the composition of their gills and its location, the concentrations of trace elements vary according to the concentration of elements in water (Evans, 1987). Cadmium and cobalt showed highest concentration in the gills, because of fish feeding habits (Romeoa *et al.*, 1999), environmental needs and metabolism (Canli and Furness, 1993), the age, size and length of fish (Linde *et al.*, 1988), and the concentration of element in environment during the seasons (Al-Najare, 2009). In this study, highest values were recorded during the spring and this is agreement with Mohamed *et al.* (2009). The concentration of accumulated elements in organism organs may be increased than that in water with 102 times for iron, 103 times for cadmium and 105 times for zinc and manganese, also, there is relationship between the accumulation of trace elements and their locations in parts of the fish body (Rauf *et al.*, 2001). Concentration of trace elements depends on the biological factors such as species, sex, life cycle, fat deposited in the body of fish as well as environmental factors such as water temperature and salinity, season and the availability of nutrients (Forstner and Wittmann, 1981).

From the present study results, trace elements showed highest concentration during spring (spawning season), because of the increase in fat and proteins in the body, which are concentrated high proportions of trace elements (Páez-Osuna *et al.*, 1995). Also, the concentration of trace elements in fish with the larger lengths is less than in the other, and this is due to the proportion of body size and organs evolution, and perhaps may be the amount of pollutants in large fish is highest than in small fish, but its concentration is lower per unit area (Al-Najare *et al.*, 2012).

Table 1. Concentrations of trace elements (µg/g) in fish's muscle at Iraqi waters and Arabian Gulf.

| Location | Cd | Co | Fe | Mn | Ni | Source |
|---|---|---|---|---|---|---|
| Shatt Al-Arab estuary | ND | 14.30 | 43.9 | 1.40 | 14.16 | Al-Saad *et al.* (1997) |
| Khor Al –Zubair | 11.90 | - | 51.5 | 10.70 | 26.00 | Al-Edanee *et al.* (1991) |
| Shatt Al-Arab | 9.10 | 19.60 | 60.5 | 7.30 | - | Abaychi and Al-Saad (1988) |
| Shatt Al-Arab | ND | 9.11 | - | 5.09 | 0.36 | Al-Khafaji (2005) |
| Kuwait | 1.80 | 2.40 | 148 | 4.00 | 20.60 | Anderlini *et al.* (1982) |
| Kuwait | 13.35 | 20.04 | 12.5 | 7.52 | - | Fowler *et al.*(1993) |
| World wide | 0.10 | 0.20 | 50.0 | 10.0 | 1.00 | Bryan (1986) |
| Polluted | 17.92 | - | 50.0 | 3.90 | 17.80 | Dallinger & Kautzky (1985) |

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# التغيرات الفصلية في تركيز العناصر الثقيلة لاسماك الكارب الفضي *Hypophthalmichthys molitrix* المجمعة من مزارع وسط العراق

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**الخلاصة**

درست تراكيز بعض العناصر الثقيلة (الكوبلت، الحديد، النيكل، المنغنيز، النحاس والكادميوم) في ثلاثة أعضاء هي (الكبد والغلاصم والعضلات) من أسماك الكارب الفضي *Hypophthalmichthys molitrix* المجمعة من مزارع وسط العراق للفترة من خريف 2009 الى صيف 2010, قيست تركيز العناصر بواسطة جهاز مطياف الامتصاص الذري اللهبيFlame Atomic Absorption Spectrophotometer. تراوحت تراكيز العناصر الثقيلة (الكوبلت والحديد والنيكل والمنغنيز ووالنحاس والكادميوم) في العضلات بين ((غير محسوس (الربيع) – 5.54 (الصيف) ؛ 40.68 (الشتاء) – 72.10 (الصيف) ؛ 55.23 (الخريف) – 69.23 (الصيف) ؛ 3.12 (الشتاء) – 5.72 (الربيع) ؛ غير محسوس (الشتاء) – 14.34 (الصيف) ؛ 1.16 (الخريف) – 2.89 (الربيع)) مايكروغرام/غرام وزن جاف على التوالي. بينما تراوحت تراكيزها في الكبد بين ((5.22 (الربيع) – 16.71 (الصيف) ؛ 55.80 (الشتاء) – 98.90 (الخريف) ؛ 70.45 (الشتاء) – 89.18 (الخريف) ؛ 6.01 (الصيف) – 10.99 (الصيف) ؛ 20.10 (الربيع) ؛ 30.22 – (الخريف) (الصيف) ؛ 6.50 (الخريف) – 12.69 (الصيف)) مايكروغرام/غرام وزن جاف على التوالي. في حين تراوحت تراكيزها في الغلاصم ((11.13 (الربيع) – 19.36 (الصيف) ؛ 50.50 (الشتاء) – 83.91 (الصيف) ؛ 58.28 (الصيف) – 78.91 (الشتاء) ؛ 7.00 (الصيف) – 13.62 (الخريف) ؛ 11.30 (الخريف) – 23.61 (الصيف) ؛ 8.51 (الصيف) – 10.22 (الشتاء)) مايكروغرام/غرام وزن جاف على التوالي. بلغ تراكيز العناصر الثقيلة في الكبد خلال فترة الدراسة أعلى مما في الغلاصم والعضلات، وإن ترتيب الفصول في تركيز العناصر الثقيلة في العضلات كان كالتالي: الصيف > الربيع > الخريف > الشتاء.