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Effect of Quarterly Changes on the Concentration of Heavy Metals in Al-Zubaidi (*Pampus argenteus*) collected from Iraqi marine coasts

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A B S T R A C T

In the present study concentrations of some heavy metals calculated in three tissues (Liver, gills, and muscles) of Al-Zubaidi fish (*Pampus argenteus*), which date back to the family Stromateidae, that collected from Iraqi marine coasts, during December 2014 to March 2015.The concentrations of the studied heavy metals (Cobalt, Iron, Nickel, Manganese, Copper, and Cadmium) measured by Flame Atomic Spectrophotometer), and results showed that their highest concentrations were in the liver (16.71, 98.9, 88.13, 10.99, 30.22,and 12.69)µg/g respectively, while the lowest concentrations appear in white muscles (1.16, 5.2, 2.87, 40.68, 3.69, 55.23) µg/g. In the studied period, concentrations of the heavy metals were higher in liver than that in the muscles and gills. The order of seasonal concentration of heavy metals in the muscles were Summer> Spring> Autumn> Winter.

keywords: Al-Zubaidi fish, heavy metals, Iraqi marine coasts, biological accumulation

Introduction

Aquatic ecosystems exposed to many toxic pollutants that affect organisms at different levels, especially nondegradable pollutants, which cause serious problems, such as heavy metals [1]. Organisms require trace amounts of certain heavy metals such as calcium, copper, iron, manganese and zinc: For example concentration of "copper, manganese, zinc, chromium, nickel and cadmium" in fish plays an important role in the function of different body tissues within certain concentrations [2]. Although these metals accumulate in the bodies of these organisms, this depends on the metals, the organism, [3].

Many fish species are among the top spent of trophic pyramids in the aquatic ecosystem [4] and [5]. In consequence, they endangered by diet-borne pollutants e.g. "heavy metals" which transferred through the food chain, and accumulate in different body organs, causes dangerous for the fish and they led to serious problems in both man and animals [6] [7].

Fish are an important source of protein in the world, meaning, “Fish used as the sole source of protein in the diet in addition omega-3 fatty acids present in fish are very important for normal growth. [6] [7] [8]. Therefore, fish maintained from all form of pollution, even in small proportions. As humans consume a large amount from fish, which may concentrate high amount of metals present in aqua environment, so it is important to appoint the heavy metals concentration, which their consume lead to the range of diseases including central nervous system disorders, sclerosis, paralysis, tremor, Alzheimer’s disease, heart disease, and immune disorders [9]. Accordingly, to develop the freshwater fish culture industry, it is important to maintain water standards and quality and monitor the accumulation levels of these metals regularly [10].

Fish used to determine the state of water pollution and are therefore an excellent marker in the identification of contaminants including heavy metals in the water ecosystem [11]. The current study goal to study the seasonal changes in the concentrations of some heavy metals in the Al-Zubaidi fish assembled from the Iraqi marine coasts, and to compare them with previous studied so that set referential study about the status of heavy metals pollution in the marine area through the fish lives there.

Material and Methods

To study heavy metals accumulation by the tissues of Al-Zubaidi fish, 20 samples from this fish used for each season, through the period from December 2014 to March 2015. The method mentioned in ROPME (1982) [12] adopted for digestion the fish samples and as flow: 0.5 g of lyophilized and milled fish tissues samples (gills, liver, white muscle), taken (three replicates), then digested in 3 ml of 1:1 (HCLO

Results

Figure1. shows that the concentration of cobalt during winter and spring is the lowest in the three parts. The concentration in the liver (11.99, 10.13, 5.22 and 16.71) µg/gm dry weight, while concentration in gills (16.12, 15.62, 11.13 and 19.30) µg/gm dry weight, and in the muscles were as follows (4.78, 2.87, ND and 5.54) µg/gm dry weight. Statically no significant differences found at the level of probability ($P < 0.05$) between the three tissues but at the same level of probability significant difference found between cobalt, manganese and cadmium on the one hand and the rest of the metals.

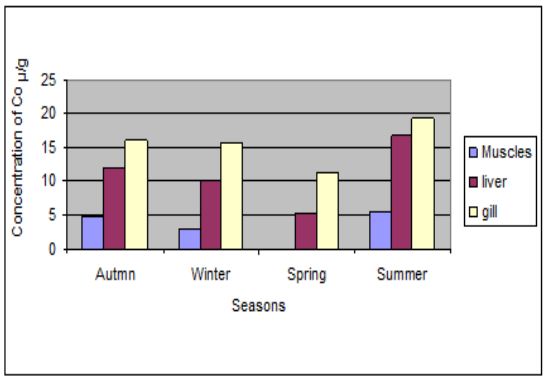

Figure 1. Concentration of Cobalt (µg/gm) dry weight in the muscles, liver, and gills during four seasons

Figure (2) shows that the concentration of the Iron was high during the study seasons, the concentration in the liver were (98.9, 55.8, 71.75 and 94.65) µg/gm of dry weight. Also, and the concentrations of the metal in the gills were high (63.4, 50.5, 60.18 and 83.91) µg/gm dry weight. In the muscles, the concentrations were (41.35, 40.68, 45.07 and 72.1) µg/gm dry weight, respectively. The results also showed a meaning difference in the level of probability (P <0.05) between iron and the other metals.

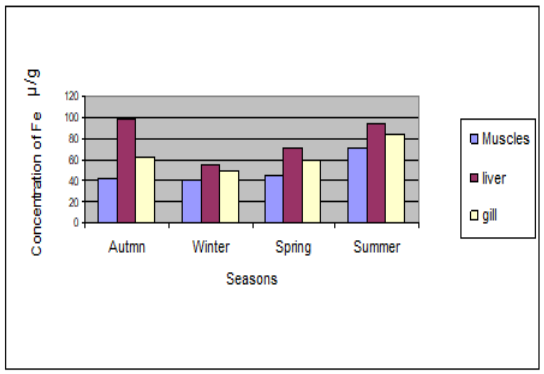

Figure 2. Concentration of Iron (µg/gm) dry weight in the muscles, liver, and gills, during four seasons.

The concentration of nickel also high in the three studied parts of the fish body as in Figure (3), as it was in the liver (88.13, 70.45, 88.13 and 70.45) µg/gm dry weight, and in the gills (72.34, 78.91, 77.34 and 78.91) µg/gm dry weight, either in the muscles (55.23, 59.23, 65.23 and 69.23) µg/gm dry weight. A significant difference found at the level of probability (P <0.05) between the nickel, iron and the other metals at the same level of probability. There was also a significant difference between winter and summer in muscles on the one hand and in liver and gill on the other.

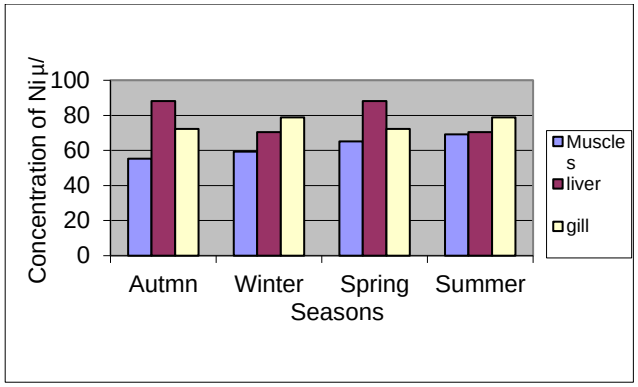

Figure 3. Concentration of Nickel (µg/gm) dry weight in the muscles, liver, and gills tissues during four seasons.

Figure (4) shows the lowest values of Manganese in liver, gills and muscle (9.23, 8.00, 10.99 and 6.01), (13.62, 7.21, 8.97 and 7.00), (3.69, 3.69, 5.72 and 3.82) µg/gm dry weight respectively. There were no significant differences at the level of probability (P <0.05) between the three tissues.

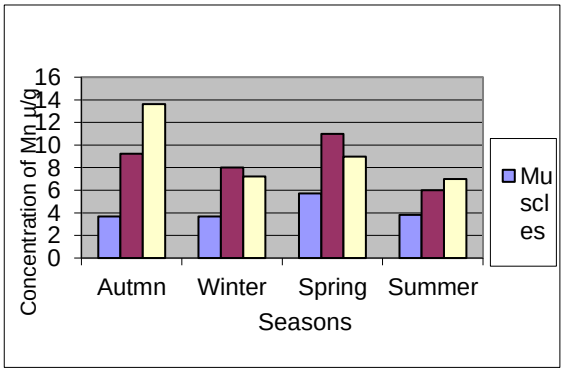

Figure 4. Concentration of Manganese (µg/gm) dry weight muscles, liver, and gills, during four seasons.

The copper component recorded the following concentrations, as shown in Figure (5). Concentrate in the liver (20.1, 22.4, 28.43 and 30.22) µg/gm dry weight, while in gills (11.3, 16.3, 20.41 and 23.61) µg/gm of dry weight, and the muscles recorded (5.20, ND, 9.56 and 14.34) µg/gm dry weight,

respectively. The results showed significant differences at the level of probability (P <0.05) between the spring and the rest of the seasons.

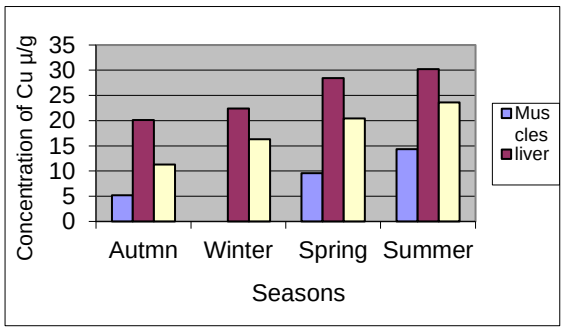

Figure 5. Concentration of Copper (µg/gm) dry weight in the muscles, liver, and gills, during four seasons

Concentrations of cadmium were volatile as shown in Figure (6). In the liver were (6.5, 7.2, 7.39 and 12.69) µg/gm dry weight, and in gills (9.34, 10.22, 8.82 and 8.51) µg/gm dry weight, and in the muscles (1.16, 2.32, 2.89 and 1.52) µg/gm dry weight, respectively, and a significant difference found at the level of probability (P <0.05) between autumn, winter, spring and summer and at the same level of probability significant difference found between the muscles on one hand, and liver on the other.

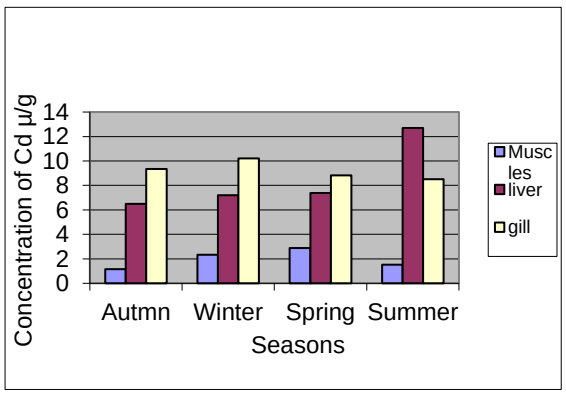

Figure 6. Concentration of Cadmium (µg/gm) dry weight in the Muscles, Liver, and gill tissues, during four seasons.

Discussion

Measuring the concentrations of metals in the fish play an important role in the life system, because it is necessary for humans who feed on these fish, some of which may be toxic and may cause a serious problem to the human health [1]. Results of the present study show that there is variance in the concentration of heavy metals in the liver, gills and muscles. The levels of accumulation in different fish organ/tissue vary according to their "physiological role". There are other factors that can affect the level of accumulation, such as regulator ability, behaviour and feeding habits differences [7], what is important here is their concentration in the muscles because this part is good to eat. When the present results compared with previous works, the measured concentrations found to be much less than these recorded by [3], where they recorded the concentration of cadmium, cobalt and copper in the muscles (4.57, 18.22 and 13.05) µg/gm, respectively. Mohamed accordingly the results of the present study are within internationally permissible limits compared to the limits recommended by FAO/WHO (2004) [15]. This attributed to the high levels of salinity in the marine area, which helps to adsorb heavy metals on the suspended minutes in the water and thus deposition to the bottom, In addition, the fish under study fed on jellyfish, which lives in the water's surface where low concentrations of heavy metals occur.

In relation to the distribution of metals in the studied tissues, results showed that the accumulation of metals was

mainly in both liver and gill, and this may be because of the fabric nature of liver and its physiological composition, besides its location in the circulatory system, and enzymes that can combine with heavy metals and remove them outside the body [16]. This is consistent with the Mediha et al. (2007) [17], where they found that the highest concentration of iron, copper and nickel in the liver and the lowest concentration found in the muscles of Cyprinidae species. With gills, the high concentration of heavy metals recorded in them because of the association of metals with the mucus layer forming "complexities difficult to remove from the gill lamellae when preparing the samples for analysis [6].The adsorption of metals onto the gills surface, as the first target for pollutants in water, could also be an important influence in the total metal levels of the gill [18] The nature of the tissue cells, and the site of ion exchange in the tissues of the gill and existing enzymes, which can hold the metals. The concentration of metals in gill also differs by varying the concentration of metals in the water. Most fish can concentrate heavy metals in their bodies through their diet or through gills [19]. Target organs, such as liver and gills, are metabolically active tissues and accumulate heavy metals in higher levels, as shown in many species of fish in different areas: like in M. cephalus in the Mediterranean Sea [20], Cyprinus carpio and Tinca tinca from Lake Beysehir Turkey [21],and this is also consistent with the study of [22] and [23], where they showed that the concentration of the metals recorded heavily in the liver and gills and lower in the muscle for different fish. From the result of the present study we can observe that it is very difficult to compare the concentrations of heavy metals even between two tissues of the same fish, and this is because of differences in the tissue and [5] [6].

Present result also shows that the highest concentrations of the metals was in the liver and the lowest concentration found in the muscle tissue except the metals Cadmium, and Cobalt have the highest concentration in gills and this because of feeding habits [25], environmental needs and metabolism [26], age, size and length of fish [27].

As far as the relation between the seasons and heavy metals accumulation in fish tissues, results show that the highest values of metals recorded during spring and egg laying season, this is consistent with the findings of [14]. In this period, the proportion of fats in the bodies to proteins and carbohydrates increase, and heavy metals usually concentrated in fat [28]. Ansari

Conclusions

This survey permitted assessing the degree of temporal and spatial contamination by heavy metals (Co, Fe, Ni, Mn, Cu, Cd) in Al-Zubaidi fish (Pampus argenteus) that collected from the Iraqi Marian water, and from the results we can conclude the following.

1. Al-Zbede fish accumulate trace metals specifically in liver and gills;while muscle contains the lowest concentration of trace metals compared

to that recorded in the liver and gills.

2. The fish tissues are not contaminated that the accumulated metals were in the tissues within international limits and it shows none danger for human consumption. Although the concentration of the metals in both gills and liver is within the permissible limits, it may be harmful to health.

3. The tendency of the metals to accumulate significantly in both the gills and the liver shows that the source of those metals is artificial, and it has entered the water and diluted by water but concentrated in the tissues of the fish being inclined to accumulate inside it.

4. The accumulation of the metals in the fish tissues can reflect the amount of pollution in the aquatic environment and the diversity of its sources and therefore its use as vital evidence of pollution in environmental monitoring programs.

5. The observation of the accumulation of metals in different parts of the fish shows those metals in a free and ready image in the water that the fish take directly.

Recommendation

1.It recommended intensifying research on aquatic organisms, especially fish of all kinds and genotypes, to determine the extent of their contamination with various heavy metals to prevent their access to the food chain.

2. Conduct further studies on the different age stages of this species of fish.

3. Follow-up of environmental studies in the region and on the coasts area with the study of pollutants at the highest tide to determine the amount of pollutants that water brings with them.

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تأثير التغيرات الفصلية على تركيز المعادن الثقيلة في أسماك الزبيدي (*Pampus argenteus*) التي تم جمعها من السواحل البحرية العراقية

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الملخص

درست تراكيز بعض العناصر الثقيلة (Cd, Cu, CO, Fe, Mn, Ni) في ثلاثة انسجة (كبد, غلاصم, عضلات) من جسم اسماك الزبيدي للفترة من كانون الاول 2014 الى اذار 2015, قيست تركيز العناصر بواسطة جهاز مطياف الامتصاص الذري Flame Atomic Absorption Spectrophotometer , اظهرت النتائج ان اعلى القيم لتراكيز العناصر المدروسة في الكبد اذ بلغت (88.13, 10.99, 98.9, 11.99, 30.22, 12.69) مايكروغم/غم على بنفس الترتيب في الكبد في حين كانت اقل القيم للعناصر في العضلات البيضاء هي (55.32, 6.01, 55.8, 2.87, 0, 1.16) مايكروغم/غم في الاسماك .وبصورة عامة كان تركيز العناصر في الكبد خلال فترة الدراسة اعلى منة في العضلات والغلاصم وان ترتيب الفصول في تركيز العناصر الثقيلة في العضلات كان كالتالي صيف> ربيع> خريف> شتاء.

الكلمات المفتاحية: اسماك الزبيدي , المعادن الثقيلة, السواحل البحرية العراقية