Concentrations of chemical elements in two species of aquatic birds: Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*)

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Abstract

This study included the determination of six chemical elements (Cadmium, Cobalt, Copper, Lead, Manganese, and Nickel) in the muscles , liver and digestive canal for two male and female species of aquatic birds Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*). Samples were collected from marshes of Kahla district within Maysan Governorate. Chemical elements were detected by flame atomic absorption spectrophotometry. Recorded Copper and lead concentrations were found to be the highest in the range (8.275 - 120.780) and (12.321- 54.085) µg / gm dry weight respectively, being the highest values in liver of the Teal (*Anas crecca*) . Nickel is found in the concentration of (26.24 and 31.49) µg / gm dry weight for males and females respectively in liver of Teal (*Anas crecca*). The concentrations values of Cadmium, Cobalt, and Manganese ranged (ND-2.676), (ND-23.195), (ND-19.480) µg / gm dry weight respectively. The results showed that the liver tissues of both birds recorded high concentrations compared with the muscle tissues and digestive canal, and chemical elements reported higher concentrations during winter compared to their concentrations during spring. The concentrations of all studied chemical elements in muscles were within the tolerance limits with the exception of Lead, which was higher compared to the literature.

Keywords: chemical elements , aquatic birds , Maysan marsh, Atomic absorption spectrophotometry.

Introduction

The marshes of Mesopotamia, one of the largest bodies of water in the Middle East, characterized by heavy vegetation and good biodiversity. This unique environment with qualities picturesque suffered from one of the biggest crimes of the times against the environment and it dries during the nineties of the last century (UNEP, 2001), which led to the destruction of its unique eco-system , because the remaining of these marshes exceed 10% of its size (Khalaf and

Almukhtar, 2005), which called for the need to conduct studies on the new environment to assess the amount of damage they faced , and the current study focused on determining the concentrations of chemical elements in the two species of water birds as they are important species for food.

Birds as aquatic organisms are expected to concentrate chemical elements in their tissue of trace elements (Abaychi & Mustafa, 1988). Waterfowl contains high concentrations of chemical elements on consumption by human being will cause toxic effects (Akinola *et al*., 2008). This is happened due to the bioaccumulation of these chemical elements (GESAMP, 1993). Accordingly the concentration of chemical elements in the environmental media depend upon different factors , (Arkadiusz *et al*., 2007).

Birds are good bioindicator for chemical elements contamination and could be used to effectively and accurately monitor their level for several reasons. Birds are abundant in numbers , have wide geographic distribution range , feed at different trophic levels and many birds are long lived migratory birds can be used to assess exposure in distant regions(komosa and komosa ,2012 ; Rothschild and Duffy 2005).

The aim of this study was to investigate expected accumulation of some chemical elements in the tissues of aquatic birds from marshlands / Southern Iraq.

Materials and methods

Samples of aquatic birds (*Gallinula choropus* & *Anas crecca*) were collected from marshes of Maysan Governorate (Kahla), as shown in (Fig.1), during the winter and spring seasons within the year 2014. Aquatic birds sample were also taken from fishermen in the marshes during the study period.

Bird samples as shown in figure 2, were transferred to the laboratory of Marine Science Centre, and classified according to Allouse , (1961). The

total weight to the nearest 10 gm were measured, the specimens (males & females) were identified accordingly to examining the genital organs (Tab. 1). The muscle tissues , liver and digestive canal for males and females were separated. Chemical elements were analyzed according to the method used by ROPME, (1982) as follows: 1 gm of dry samples were weighted and transferred to a digestion glass tubes 150 ml in size and Pyrex made, then to each tube, 10 ml of a mixture of two concentric acids, nitric acidic HNO_3 and per chloric acid $HClO_4$ in the ratio 4 : 1, respectively were added , mixed well and left for 4-6 hours for primary digestion , and then samples were transferred to aluminum holder and heated to the degree of 70 ^oC for 2-3 hour in a water bath , then the contents of the digestion tube were transferred to Teflon beakers with volume of 150 ml and each sample washed twice with deionized distilled water, and then washing water is added to the Teflon beaker, then each solution is vaporized

to 70-80 ^{o}C using a hot plate to near dryness. To the produced sludge nitric acid in a concentration of 5 % was added and the volume was completed to 50 ml and the solutions were filtered by using filter paper type Whatman No.1 to reject of the small particles. Finally, the resulted solution is transferred to plastic bottles to be ready for analysis. Chemical elements in each sample were measured by Flame Atomic Absorption Spectrophotometer Model SensAA, GBC Scientific Equipment Australian made, provided with Cathode Lamps suitable for each chemical element**.**

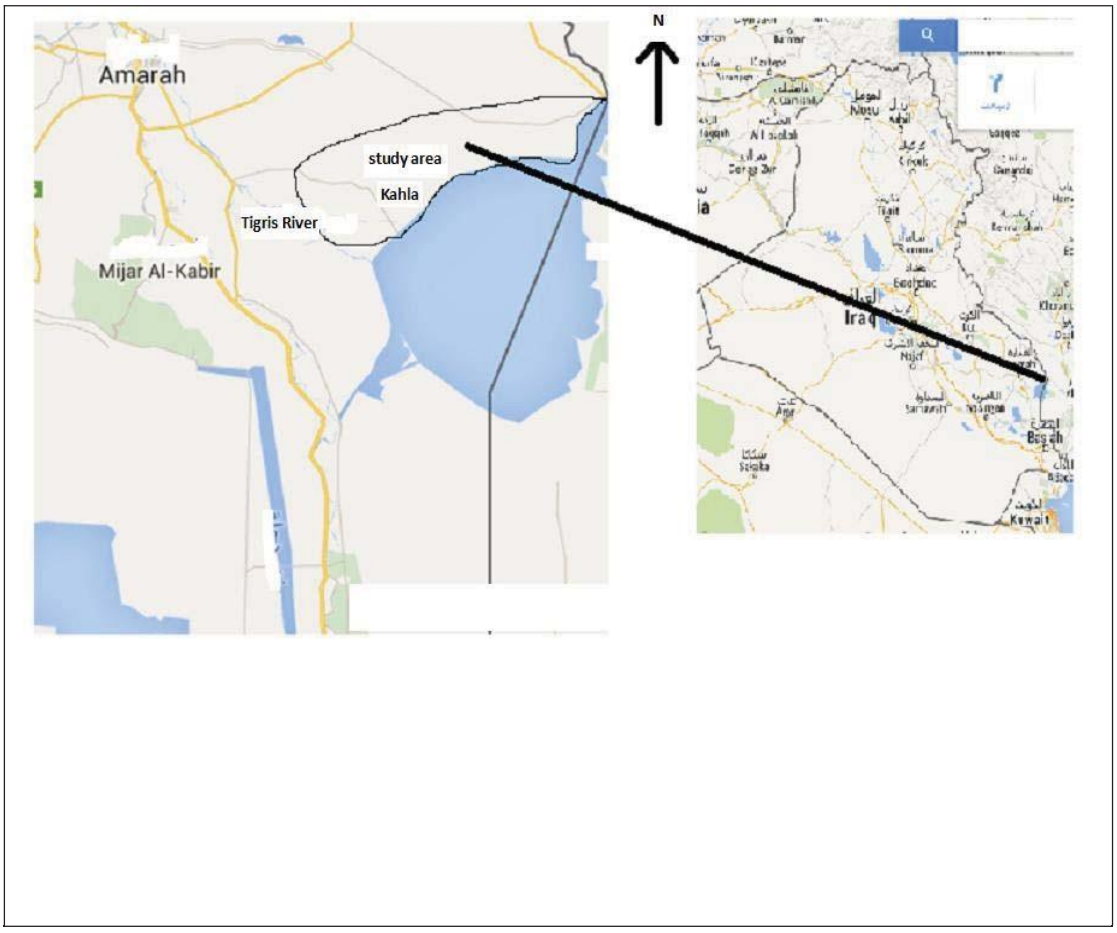


Figure 1. Location map of the study area showing the sampling Station .

Teal, *Anas crecca*

Moorhen, *Gallinula choropus*

Figure 2. Photos of aquatic birds Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*) from marshes of Maysan Governorate (Kahla) .

Result and discussion

Concentrations recorded (µg / gm) dry weight for chemical elements in muscle , liver and digestive canal tissues for males and females , Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*) were in the range of (8.275–120.780) Cu , (12.321–54.085) Pb , (N.D–31.490) Ni , (N.D–2.676) Cd , (N.D–23.195) Co and (N.D–19.480) Mn during winter 2014, (Tab. 2) and (Fig.3). While during spring 2014 range recorded were (1.665–65.756) Cu , (1.769–28.260) Pb, (N.D) Ni , (N.D–2.417) Cd, (N.D–21.410) Co and (N.D–17.709) Mn, (Tab. 3) and (Fig.4).

The study showed that concentrations of most elements were higher during winter than spring, it explained upon nutrition activity in birds which has been recorded in higher activity during winter than during spring, it is played a great role in increasing of concentrations during winter in addition to the effect of surrounding environment (high or low concentrations in the water). Recorded concentrations of the studied elements in the Teal *A. crecca* were higher than the Moorhen *G. choropus* which could be explain on the basis of the different

feeding habitat the type of food, as well as the influence of environmental factors that vary from one type to another. Birds are particularly useful as bioindicator of pollution because they are often high in the food chain (Burger *et al*., 1994). Several physiological and biological processes, such as feeding habits, growth, age, reproduction, molting, and migration may influenced metal concentration and distribution in birds (Kim *et al*., 2007).

The average of the chemical elements concentration's in different tissues of the common teals and moorhens ranked from highest to lowest , were as follows: liver > digestive canal > muscles . In this study the highest levels of trace metals in common Teal tissue were detected in

liver which explained as : once elements are taken up and ingested they can be stored in internal tissues such as the kidneys and liver (Ahmad mahmoodi *et al*., 2009). Recorded Copper and lead values were the highest in the range of muscle tissues , liver and digestive canal (Tab. 4).Chemical elements reach in aquatic environments from different sources, mainly human activities, e.g. industry, urban and agricultural discharge, mine runoff, solid waste disposal and atmospheric deposition (Merciai *et al*., 2014). The results showed that concentration of Pb in aquatic birds were highest than the permissible limits of ANZFA (2001) and WHO/FAO (2000) , representing a potential risk for human consumption as food.

Conclusions

As a conclusion, the concentrations of all detected elements in the liver were found to be the highest in both Moorhen (*G. choropus*) and Teal (*A. crecca*). Moreover, the study revealed that concentrations of chemical elements were higher during winter compared to spring. And recorded concentrations of the studied elements in Teal (*A. crecca)* were higher than in Moorhen (*G. choropus).* The concentrations of all studied chemical elements were within the tolerance limits with the exception of Pb, which was the highest than reported by ANZFA (2001) and WHO/FAO (2000) tolerance limits.

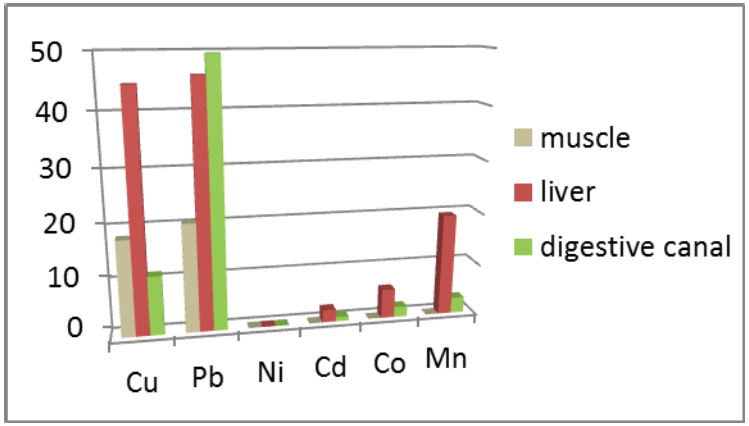
Table 1. Number of birds and the average weight for studied samples caught in Maysan marshes (Kahla) Southern Iraq.

Aquatic birds	Sex	winter 2014		spring 2014	
		number of species	Weight average (gm)	number of species	Weight average (gm)
Gallinula choropus	Males	8	750	10	690
Gallinula choropus	Females	10	580	10	598
Anas crecca	Males	8	225	7	239
Anas crecca	Females	6	242	7	251

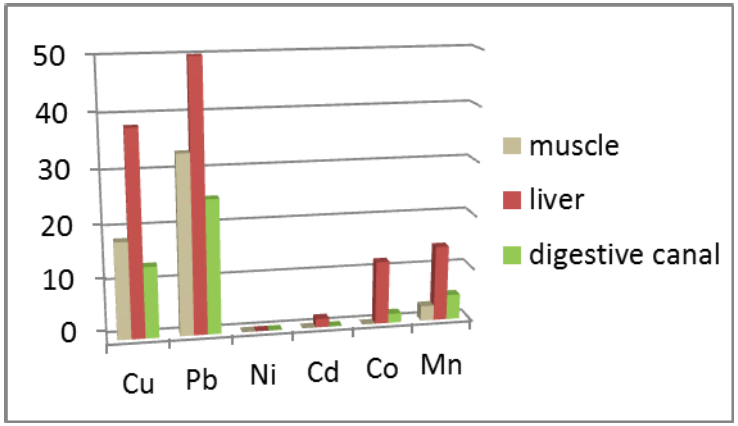
Table 2. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during winter 2014.

Elements	*Gallinula choropus*						*Anas crecca*					
	Muscles		Liver		digestive canal		Muscles		Liver		digestive canal	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Cu	18.012 ± 1.35	18.200 ± 1.44	38.055 ± 2.98	44.670 ± 2.11	13.232 ± 1.01	11.233 ± 0.66	19.855 ± 1.40	31.435 ± 0.70	62.870 ± 3.01	120.78 ± 4.11	8.275 ± 0.99	11.233 ± 0.87
Pb	33.285 ± 1.04	20.594 ± 1.69	49.925 ± 2.78	46.012 ± 3.21	24.965 ± 1.23	49.510 ± 1.78	20.805 ± 1.52	20.711 ± 0.45	29.250 ± 1.47	54.085 ± 2.08	12.480 ± 0.50	12.321 ± 0.99
Ni	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	26.240 ± 1.28	31.490 ± 0.88	N.D	N.D
Cd	N.D	N.D	1.611 ± 0.12	2.417 ± 0.65	N.D	0.806 ± 0.09	N.D	N.D	2.676 ± 0.11	2.215 ±0.32	0.806 ± 0.04	1.611 ± 0.04
Co	N.D	N.D	11.748 ± 0.44	5.617 ± 0.31	1.721 ± 0.01	1.958 ± 0.04	N.D	N.D	15.664 ± 0.33	23.195 ± 1.20	N.D	3.916 ± 0.29
Mn	2.808 ± 0.19	N.D	14.042 ± 1.20	19.480 ± 0.97	4.680 ± 0.13	3.010 ± 0.42	0.936 ± 0.01	1.655 ± 0.22	2.808 ± 0.03	3.916 ± 0.32	2.808 ± 0.19	3.744 ± 0.33

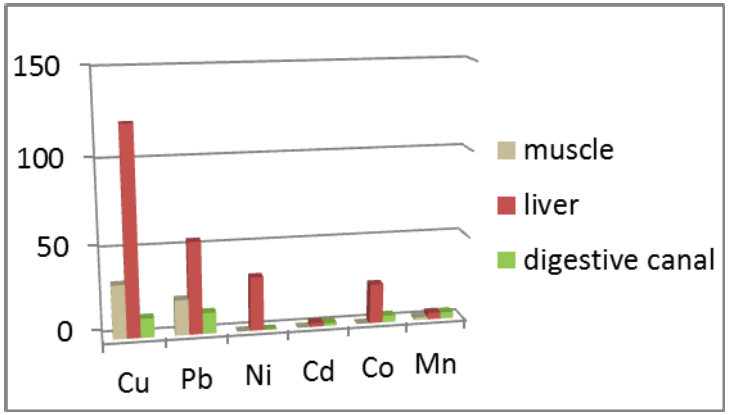
N.D. : not detected



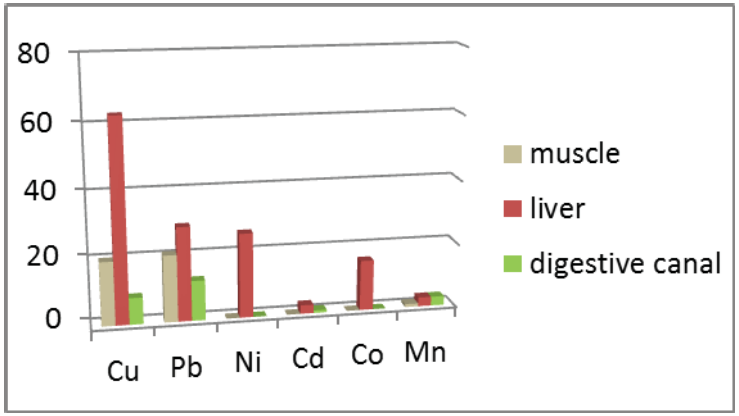
Gallinula choropus (Females)



Gallinula choropus (Males)



Anas crecca (Females)

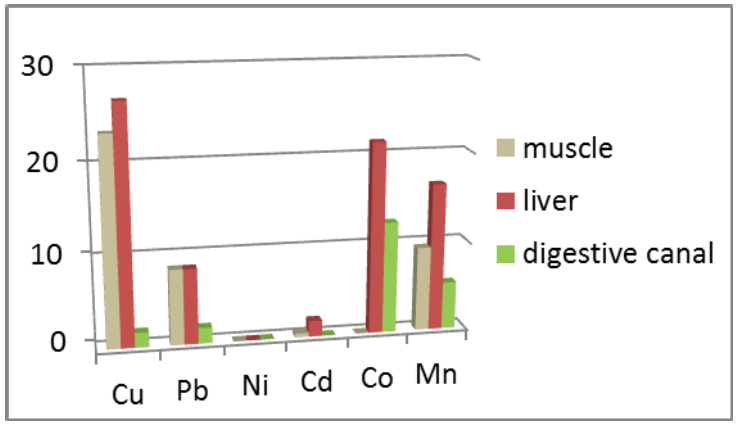


Anas crecca (Males)

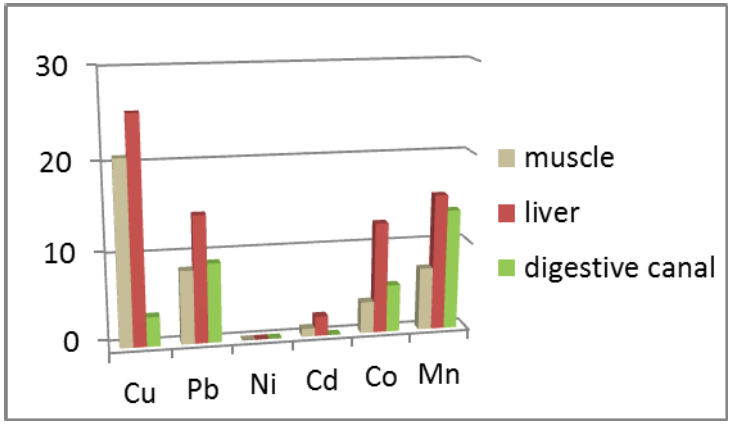
N.D. : not detected

Table 3. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during spring 2014.

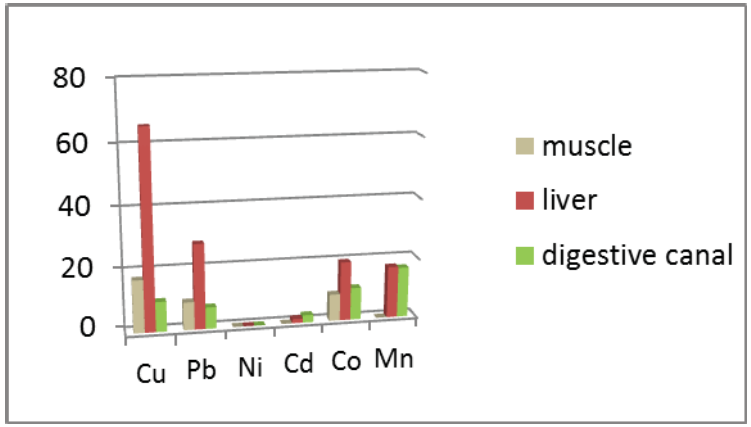
Elements	*Gallinula choropus*						*Anas crecca*					
	Muscles		Liver		digestive canal		muscles		liver		digestive canal	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Cu	20.809 ± 1.28	23.306 ± 0.70	25.434± 1.33	26.635 ± 1.23	3.329 ± 0.28	1.665 ± 0.11	12.485 ± 1.09	17.479 ± 1.32	32.462 ± 1.77	65.756 ± 2.01	9.156 ± 0.33	9.988 ± 0.57
Pb	8.325 ± 0.63	8.478 ± 0.23	14.370 ± 1.04	8.478 ± 0.60	8.981 ± 0.54	1.769 ± 0.09	8.478 ± 0.23	9.260 ± 0.63	14.130 ± 1.32	28.260 ± 2.01	8.478 ± 0.98	7.156 ± 0.88
Ni	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Cd	0.500± 0.009	0.445 ± 0.008	2.230 ± 0.32	1.784 ± 0.76	N.D	N.D	N.D	N.D	0.446 ± 0.005	1.338 ± 0.12	0.445± 0.005	2.417 ± 0.035
Co	3.568 ± 0.25	N.D	12.489 ± 0.63	21.410 ± 1.98	5.353 ± 0.50	12.489 ± 0.72	N.D	8.905 ±0.63	8.905 ± 0.45	19.580 ± 1.35	N.D	10.706 ± 0.55
Mn	7.084 ± 1.18	9.445 ± 0.98	15.348 ± 1.90	16.528 ± 2.09	13.577 ± 0.97	5.313 ± 0.54	14.167 ± 1.02	N.D	17.709 ± 1.91	17.117 ± 1.52	8.264 ± 0.87	16.640 ± 2.01



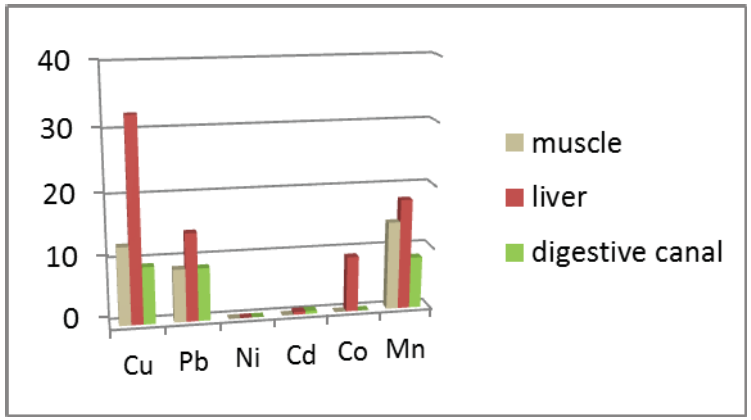
Gallinula choropus (Females)



Gallinula choropus (Males)



Anas crecca (Females)



Anas crecca (Males)

Figure 4. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during spring 2014.

Table 4. Ranges of concentrations of chemical elements (µg / gm) in different tissues of aquatic birds Maysan (Kahla) marshes.

Elements	muscles	Liver	digestive canal
Cu	12.485–31.453	25.434–120.780	1.665–13.232
Pb	8.325–33.285	8.478–54.085	1.769–49.510
Ni	N.D	N.D- 31.490	N.D
Cd	N.D–0.500	0.446–2.676	N.D-2.417
Co	N.D-8.905	5.617–23.195	N.D-12.489
Mn	N.D-14.445	2.808–19.480	2.808–16.640

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دراسة تراكيز العناصر الكيمياوية في نوعين من الطيور المائية : دجاج الماء (*Gallinula choropus*) و الحذاف الشتوي (*Anas crecca*)

علي مهدي ناصر و سلمي طالب لفته الياسري و فارس جاسم محمد الامارة

قسم الكيمياء و تلوث البيئية البحرية- مركز علوم البحار ، جامعة البصرة

المستخلص

تضمنت هذه الدراسة تقدير ستة عناصر كيمياوية : النحاس و الرصاص و النيكل و الكادميوم والكوبلت والمنغنيز في العضلات والكبد والقناة الهضمية لنوعين من الطيور المائية لذكور واناث دجاج الماء *Gallinula choropus* والحذاف الشتوي *Anas crecca* المستجمعة من منطقة الكحلاء ضمن اهوار ميسان \ جنوب العراق. تم تقدير العناصر الكيمياوية بواسطة جهاز الامتصاص الذري اللهبي . كان لعنصري النحاس والرصاص اعلى القيم المسجلة اذ تراوحت تراكيزهما بين (8.275 – 120.780) ، (12.321-54.085) مايكغم / غم وزن جاف على التوالي ، اذ سجلت اعلى القيم في كبد اناث الحذاف الشتوي . سجل النيكل قيمتين فقط لفصل الشتاء هما 26.240 و 31.49 مايكغم / غم وزن جاف للذكور والاناث على التوالي في كبد الحذاف الشتوي ايضا ، اما تراكيز الكادميوم والكوبلت والمنغنيز تراوحت تراكيزهما (N.D-2.676) ، (N.D-23.195) ، (N.D-19.480) مايكغم / غم وزن جاف على التوالي . اظهرت نتائج الدراسة بأن انسجة الكبد سجلت تراكيز عالية مقارنة بأنسجة العضلات والقناة الهضمية وكانت التراكيز في الشتاء اعلى من الربيع . كما اظهرت النتائج ان التراكيز في جميع العناصر المدروسة في العضلات كانت ضمن الحدود المسموح بها مقارنة مع كل من ANZFA (2001) و WHO/FAO (2000) ماعدا عنصر الرصاص .

كلمات مفتاحية : العناصر الكيمياوية ، الطيور المائية، اهوار ميسان، الامتصاص الذري اللهبي.