Determination of Heavy Metals in Fish Species of the Mediterranean Sea (Libyan coastline) Using Atomic Absorption Spectrometry

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Abstract: The presence of heavy metals in our environment has been of great concern because of their toxicity when their concentration is more than the permissible level. These metals enter in the environment by different ways e.g. industrial activities.

We have used flame atomic absorption spectrometry technique for determination of the concentration of Co, Cd, Pb, Fe and Cu in different tissues of six samples of fishes.

The concentrations of Co, Cd and Pb in all examined tissues were more than the reported literature values (WHO). On the other hand, the concentrations of Cu in all examined tissues were less than the reported literature values (WHO). The concentrations of Fe in all examined tissues were less than the reported values (Table 2) except in Sardinella aurita (skin and tail) and Synodus saurus (tail) where the levels of Fe in them are higher than the accepted levels in reported literatures (Table 2).

Keywords: Heavy metals, Fish, Marine, Atomic absorption spectrometry, Libyan coastline.

Introduction

Pollution of different environments is due to human activities in recent years. One of such pollution is marine pollution by heavy metals. The heavy metals are accumulated in the marine environment then transfer to the marine organisms e.g. fishes by different ways. When their concentrations exceed the required levels, they become toxic and cause several health problems [1-4]. The fishes became sick then die when too much contamination is happened [5].

Several techniques have been used for determination of metal concentrations in fish species such as flame atomic absorption spectrometry [6-11], graphite furnace atomic absorption spectrometry [12-14], electro-thermal atomic absorption spectrometry [15, 16], inductive coupled plasma [17-19] and mass spectrometry [18, 19]

Different digestion methods were used as sample preparation methods for determination of heavy metals in fish samples.

Olaifa et al. presented the digestion of fish samples as following: 2 g of the sample were added to the mixture of HNO_3-H_2O_2 (1:1) and digested for 2 hours at 160 ^{o}C. The digests allowed to cool then transferred to 25 ml volumetric flask and fill up to the level with de-ionized water [20].

Huijuan et al. showed another digestion technique called microwave digestive technique for digestion of fish samples. The sample was weighted in the Teflon vessel, followed by addition of one or more oxidizer and kept for 8 hours at room temperature. After digestion, the sample was cooled at room temperature then diluted to 20 ml with de-ionized water [21].

The aim of the present study is to determine the concentrations of Co, Cd, Pb, Fe and Cu in different tissues (bone, skin, flesh and tail) of fish species of the Mediterranean Sea (Libyan coastline) using flame atomic absorption spectrometry. The fish Species used in this study were *Sardinella aurita, Pagellus erythrinus, Balistes capriscus, Trachurus trachurus, Synodus saurus* and *Dactylopterus* volitans.

Materials and Methods

The nitric acid was purchased from Fluka, Germany. The flame atomic absorption spectrometry from NovAA-400, Analytikjena AG, Germany.

The fish samples were collected from local market in Tripoli, Libya (**Table 1**) and cleaned then washed with distilled water. Different dried tissues (bone, skin, flesh and tail) were dried at room temperature for two weeks. The dried tissues were digested as following: 1.0 g of each was dissolved in 1 M nitric acid (10 ml), boiled to complete the dissolution and filtrated. The obtained precipitate was washed with nitric acid (1 M) and transferred to 25 ml volumetric flask and fill up to the level with de-ionized water.

Results and Discussion

The accepted values of the concentrations of Co, Cd, Pb, Fe and Cu in fishes as reported in the World Health Organization (WHO) are presented in **Table 2.**

The concentrations of Co in different tissues are presented in **Table 3.** It was found that the concentration of this metal was ranged from 0.570 mg/kg to 44.693 mg/kg, which means that, the concentrations of Co in all examined tissues were more than the reported level shown in Table 2.

Table 1: The fish species used in the present study.

Specie name	Date of collection
Sardinella aurita	22/2/2005
Pagellus erythrinus	22/2/2005
Balistes capriscus	24/2/2005
Trachurus trachurus	24/2/2005
Synodus saurus	25/2/2005
Dactylopterus volitans	25/2/2005

Table 2: levels of some heavy metals in fishes as reported in WHO.

Concentration, mg/kg	Heavy metal
0.015	Co
0.030	Cd
0.050	Pb
0.300	Fe
1.000	Cu

Table 3: The concentration of Co in different tissues of fish samples.

Specie name	Concentration of metal, mg/kg			
	bone	skin	flesh	tail
Sardinella aurita	0.715	5.853	0.570	6.480
Pagellus erythrinus	0.703	6.500	0.570	6.796
Balistes capriscus	0.712	7.080	4.875	14.007
Trachurus trachurus	0.655	7.007	4.871	44.693
Synodus saurus	nm[*]	13.129	5.187	7.160
Dactylopterus volitans	nm[*]	NM[*]	5.173	NM[*]

nm[*]: not measured

The results of analysis indicated that the concentrations of the Cd in all examined tissues varied from 0.328 mg/kg to 2.929 mg/kg as shown in **Table 4**. These values were greater than the reported level indicated in literature (Table 2).

Table 5 present the concentration level of Pb in all examined tissues of Fish samples. The obtained results from this table indicated that the concentrations ranged

from 0.246 mg/kg to 2.386 mg/kg. These values were higher than the accepted values reported in Table 2

Table 6 explained the concentration level of Fe in all examined tissues. The concentrations of Fe in all tissues were less than the reported values (Table 2) except Specie number 1 (skin and tail) and Specie number 5 (tail) where the levels of Fe in them were a little higher than the accepted levels in reported literatures (Table 2).

Table 4: The concentration of Cd in different tissues of fish samples.

Specie name	Concentration of metal, mg/kg			
	bone	**skin**	**flesh**	**tail**
Sardinella aurita	0.439	2.738	0.329	2.902
Pagellus erythrinus	0.347	0.347	0.328	2.929
Balistes capriscus	0.351	0.354	2.615	0.706
Trachurus trachurus	0.351	0.368	2.682	0.745
Synodus saurus	0.346	0.345	2.651	2.088
Dactylopterus volitans	nm[*]	nm[*]	2.615	NM[*]

nm[*]: not measured

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Table 5: The concentration of Pb in different tissues of fish samples.

Specie name	Concentration of metal, mg/kg			
	bone	**skin**	**flesh**	**tail**
Sardinella aurita	1.392	1.065	1.177	1.476
Pagellus erythrinus	1.310	0.475	0.065	1.385
Balistes capriscus	1.380	0.537	0.995	0.246
Trachurus trachurus	1.076	0.709	0.997	0.592
Synodus saurus	nm[*]	0.330	1.210	2.386
Dactylopterus volitans	nm[*]	nm[*]	0.9895	nm[*]

nm[*]: not measured

Table 6: The concentration of Fe in different tissues of fish samples.

Specie name	Concentration of metal, mg/kg			
	bone	**skin**	**flesh**	**tail**
Sardinella aurita	0.300	0.756	0.148	0.492
Pagellus erythrinus	0.160	0.088	0.099	0.302
Balistes capriscus	0.095	0.175	0.253	0.166
Trachurus trachurus	0.078	0.181	0.181	0.300
Synodus saurus	nm[*]	0.289	0.366	0.527
Dactylopterus volitans	nm[*]	nm[*]	0.136	nm[*]

nm[*]: not measured

The concentration of Cu in all examined tissues are presented in **Table 7.** The concentrations were ranged from 0.007 mg/kg to 0.16 mg/kg. It is very clear that these values are less than the reported values which indicated in Table 2.

Conclusion

High accumulation of Co, Cd and Pb was observed in Fish species (*Sardinella aurita, Pagellus erythrinus, Balistes capriscus, Trachurus trachurus, Synodus saurus* and *Dactylopterus* volitans) of the Mediterranean Sea at Libyan Coastline. While the accumulation of Cu in the same species were too low. On the other hand, the accumulation of Fe in the same species were low except in *Sardinella aurita* (skin and tail) and *Synodus saurus* (tail).

Table 7: The concentration of Cu in different tissues of fish samples.

Specie name	Concentration of metal, mg/kg			
	bone	**skin**	**flesh**	**tail**
Sardinella aurita	0.010	0.026	0.008	0.033
Pagellus erythrinus	0.010	0.011	0.007	0.016
Balistes capriscus	0.008	0.012	0.013	0.038
Trachurus trachurus	0.007	0.011	0.116	0.022
Synodus saurus	nm[*]	0.018	0.013	0.042
Dactylopterus volitans	nm[*]	nm[*]	0.015	nm[*]

nm[*]: not measured

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