Demonstration of Cadmium and Lead residues in Imported Frozen Fish

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A B S T R A C T

A total of ninty random samples of imported frozen fish represented by Mackerel, Herring and Saurus (30 of each) imported from two different countries namely A and B (15 samples of each fish species for each country) were collected from different fish markets in Menoufiya governorate. The obtained results recorded that the occurrence of cadmium in country (A) were53.33, 40.00 and 33.33% in the Mackerel, Herring and Saurus samples, respectively. In country (B) the cadmium occurrence was 40, 26.67 and 20.00% in the Mackerel, Herring and Saurus samples, respectively. In addition, our results recorded that the percentage of occurrence of lead in country (A) were 66.67, 66.67and 53.33% in the Mackerel, Herring and Saurus samples, respectively; while in country (B) were 60, 46.67 and 40 % in the Mackerel, Herring and Saurus samples, respectively. It could be inferred that regarding the products contamination, the highest cadmium and lead contamination was in mackerel followed by herring then saurus. Regarding the locality, country (A) represented the highest contamination of both cadmium and lead followed by country (B).

Keywords: Mackerel, Herring, Saurus, cadmium and lead

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1. INTRODUCTION

The problem of chemical residues in food has been addressed at international level through deferent committees sponsored by some United Nations Organizations (FAO/WHO, 1992). The pollution of imported frozen fish with heavy metals constitutes a public health hazard during recent years. Cadmium is classified as a probable human carcinogen. Chronic exposure to cadmium is also associated with a wide range of other diseases, including heart disease, anemia, skeletal weakness, depressed immune system response as well as kidney and liver disease (Codex Alimentarius Commission Procedural Manual, 2001). Lead is considered as a toxic substance, which accumulates in body due to low rate of elimination (Underwood, 1977). Moreover, lead levels in imported frozen fish over permissible limits are implicated in chronic lead toxicity results in abdominal pain, anemia, encephalopathy and renal damage. Recently, lead is considered as one of immunosuppressive agents in both animal and human (Andreji et al., 2005).

The aim of the present work was to determine cadmium and lead (heavy metals) in imported frozen fish which could be indicative to its healthiness for human consumption.

2. MATERIAL AND METHODS

2.1. Collection of samples:

A total of 90 random samples of imported frozen fish represented by Mackerel, Herring and Saurus (30 of each) imported from two different countries namely A and B (15 samples of each fish species for each country) were collected from different fish markets in Menoufiya governorate. The collected samples were examined for determination of cadmium, lead levels on the basis of wet weight (mg/Kg).

2.2. Determination of heavy metals:

2.2.1. Digestion technique:

Accurately, 2 g of each sample were macerated by sharp scalpel and digested by 10 ml of digestion mixture (60 ml of 65% Nitric acid and 40ml of 70% perchloric acid) in screw capped tube after maceration by Deng et al. (2007). The tubes were tightly closed and the contents were vigorously shaken and allowed to stand over night at room

temperature. Moreover, the tubes were heated for 4 hours in water bath starting from 60°C till reach 110°C ensure complete digestion of the samples. The digestion tubes were vigorously shaken at 30 minutes' intervals during the heating period. The tubes were then left to cool at room temperature and diluted with 1ml deionized water (30%) as well as reheated in water bath at 70oC to ensure complete digestion of the samples. At this point, all organic matrixes have been destroyed. Each tube was diluted with deionized water till reach 25 ml and the digest was filtered with Whattman filter paper No. 42. The filtrates were collected in Pyrex glass test tubes capped with polyethylene film and kept at room temperature until analyzed for their cadmium and lead concentrations.

2.2.2. Preparation of blank and standard solutions:

Instrumental procedures for various analyses were based on those suggested in the operator manual of the Atomic Absorption Spectrophotometer. However, blank and standard solutions were prepared in the same manner as applied for wet digestion and by using the same chemicals (Shibamoto and Bjeldanes, 2000).

2.3. Analysis:

The digest, blanks and standard solutions were aspirated by Flame Atomic Absorption Spectrophotometer (VARIAN, Australia, model AA240 FS) and analyzed for heavy metals concentration. Absorbency of lead and cadmium were directly recorded from the digital scale. These concentration was calculated according to the following equation: C=R x (D/W), where C=Concentration of heavy metal (wet weight), R= Reading of digital scale D= Dilution of the prepared sample. W= Weight of the sample.

3. RESULTS

The obtained results in table (1) revealed that the mean value of cadmium in the country (A) samples were 0.23± 0.02, 0.18± 0.01 and 0.11± 0.01 ppm in the Mackerel, Herring and Saurus, respectively. The average concentration of cadmium in country (B) samples were 0.19± 0.01, 0.13± 0.01 and 0.09± 0.01 ppm in the Mackerel, Herring and Saurus, respectively. Furthermore, in country (A), the percentage of unaccepted samples in table (2) were 26.67, 26.67 and 13.33 % while the percentage of accepted samples were 73.33, 73.33and 86.67% in the Mackerel, Herring and Saurus samples, respectively. In country (B), the percentage of unaccepted samples were 20.00, 13.33 and 13.33 % while the percentage of accepted samples were 80, 86.67and 86.67% in the Mackerel, Herring and Saurus samples, respectively.

Furthermore, the average concentration of lead in the country (A) samples in table (3) were 0.40±0.03, 0.31±0.02 and 0.19±0.01 ppm in the Mackerel, Herring and Saurus, respectively. The average concentration of lead in country (B) samples were 0.27± 0.02, 0.20± 0.01 and 0.14 ± 0.01 ppm in the Mackerel, Herring and Saurus, respectively. In addition, in country (A), the percentage of unaccepted samples in table (4) were 46.67, 33.33 and 26.67 % while the percentage of accepted samples were 53.33, 66.67 and 73.33 % in the Mackerel, Herring and Saurus, respectively. In country (B), the percentage of unaccepted samples in table (4) were 40.00, 26.67 and 20 % while the percentage of accepted samples were 60, 73.33 and 80 % in the Mackerel, Herring and Saurus, respectively.

Table (1): Statistical analytical results of cadmium levels (ppm) in the examined samples of in Imported Frozen Fish. (n=15)

country / fish	Max permissible limit (mg %)*	Min.	Max.	Mean ± SEM*
country *(A):*				
Mackerel	0.05	0.03	0.44	0.23 ± 0.02
Herring	0.05	0.03	0.35	0.18 ± 0.01
saurus	0.05	0.01	0.23	0.11 ± 0.01
country *(B):*				
Mackerel	0.05	0.02	0.34	0.19 ± 0.01
Herring	0.05	0.01	0.26	0.13 ± 0.01
saurus	0.05	0.01	0.17	0.09 ± 0.01

SEM*= Standard error of mean. * Egyptian Organization of Standardization "EOS" (2010)

Table (2): Acceptability of the examined samples of fish based on their levels of cadmium (n=15).

country / fish	Positive samples		accepted Samples		Unaccepted Samples	
	No.	%	No.	%	No.	%
Country A:						
Mackerel	8	53.33	11	73.33	4	26.67
Herring	6	40	11	73.33	4	26.67
Saurus	5	33.33	13	86.67	2	13.33
Country B:						
Mackerel	6	40	12	80	3	20
Herring	4	26.67	13	86.67	2	13.33
Saurus	3	20	13	86.67	2	13.33

Table (3): Statistical analytical results of lead levels (ppm) in Imported Frozen Fish. (n=15)

country / fish	Max. permissible limit (mg %)*	Min.	Max.	Mean ± S.E*
country *(A)*:				
Mackerel	0.10	0.06	0.83	0.40± 0.03
Herring	0.10	0.05	0.68	0.31 ± 0.02
saurus	0.10	0.02	0.37	0.19 ± 0.01
country *(B)*:	0.10			
Mackerel		0.05	0.61	0.27 ± 0.02
Herring	0.10	0.03	0.49	0.20 ± 0.01
saurus	0.10	0.01	0.28	0.14 ± 0.01

Table (4): Acceptability of the examined samples of Imported Frozen Fish. Based on their levels of lead. (n=15)

country / fish	Positive samples		accepted Samples		Unaccepted Samples	
	No.	%	No.	%	No.	%
Country A: Mackerel	10	66.67	8	53.33	7	46.67
Herring	10	66.67	10	66.67	5	33.33
Saurus	8	53.33	11	73.33	4	26.67
Country B:	9	60	9	60	6	40
Mackerel						
Herring	7	46.67	11	73.33	4	26.67
Saurus	6	40	12	80	3	20

4. DISCUSSION

From the obtained results, the collected imported frozen fish samples (Mackerel, Herring and Saurus) were highly contaminated with toxic heavy metals residues (cadmium and lead). Regarding the products contamination, the highest cadmium contamination was in Mackerel followed by Herring then Saurus. The current results in cadmium relatively agree with those recorded by Reham (2011) surveyed that the cadmium concentration in examined samples of frozen pangasius hypophthalmus fish and frozen sardine ranged from 0.03 to 0.24 and 0.04 to 0.42 with a mean value of 0.11 ± 0.01 and 0.14 ± 0.02 mg/kg wet weight, respectively. El-Sayed (2010) cited that the average concentration of cadmium in fresh water fish, canned fish, pickled fish, smoked fish samples were 0.09 ± 0.01,0.11± 0.01, 0.14 ± 0.01,0.18 ± 0.02mg/kg, respectively. Şireli et al. (2006) recorded that the cadmium concentration ranged from 0.003to 0.036 with a mean value of 0.01367 mg/kg wet weight, in the examined samples of smoked fish. In human, Cd is highly cumulative poison with a biological half-life about 20-30 years in human body (Manahan, 1992). Our findings revealed that, Mackerel showed the highest lead contamination followed by Herring then Saurus. The obtained results agree with those recorded by Reham (2011) observed that the lead concentration in examined samples of frozen pangasiushy pophthalmus fish and frozen sardine ranged from 0.05 to 0.31 and 0.02 to 0.18 with a mean value of 0.15 ± 0.01 and 0.09 ± 0.01 mg/kg wet weight, respectively. El-Sayed (2010) cited that the average concentration of lead in fresh water fish, canned fish, pickled fish and smoked fish samples were 0.06 ± 0.01,0.15 ± 0.01, 0.18 ± 0.02,0.32 ± 0.02mg/kg, respectively. Also the obtained results agree with El-Dahbi-Dina (2006); Mohamed (2009) and El-Mowafi (1995). In contrast, these results disagree with those observed by Noha and Ghada (2007), Şireli et al. (2006) Virbickas and Sakalausklene (2006), Celik et al. (2004) and Abd El-Nasser et al. (1996). Lead poisoning may cause leg cramps, muscular weakness, central nervous system depression and coma (Mason, 1991). Also, lead considered as one of toxic substance which accumulates in the body due to its low rate of elimination. The classic symptoms of lead poisoning are colic, anemia and encephalopathy (Chisolm, 1973).

It could be inferred that regarding the product contamination, the highest cadmium and lead contamination was in Mackerel followed by Herring then Saurus.

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