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روش تحقیق کمی

Heavy metals content of canned tuna fish marketed in Tabriz, Iran

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Abstract:

BACKGROUND: Some heavy metals are dangerous to health and there is rising concern about the quality of foodstuffs in some parts of the world. Fish, particularly Tuna fish, can concentrate huge quantities of several metals from water and they even play a significant role in human nourishment. **OBJECTIVES:** In this study, the concentrations of mercury and four trace metals in five brands of canned tuna samples purchased within the Tabriz city (Iran) were determined after digestion via the Association of Official Analytical Chemists techniques. **METHODS:** A total of 40 samples were collected. Lead and cadmium levels were determined via graphite tube atomic absorption spectrophotometry, whereas nickel and tin levels were determined via flame atomic absorption spectrophotometry, and mercury levels were determined via hydride generation atomic absorption spectrophotometry. **RESULTS:** The ranges obtained for the elements were Pb (0.01-0.242), Ca (0.0-1.05), Ni (0.113-0.589), Sn (0.05-0.5) and Hg (0.1-0.205) mg/kg wet weight. **CONCLUSIONS:** The results showed that tuna fabricated and marketed in Tabriz (Iran) had safe level of heavy metals that were lower than the averages of EC/FAO/WHO levels for these toxic metals.

Introduction

The topic of heavy metals is receiving growing popularity in food manufacturing because of elevated occurrence of contamination in agricultural and seafood products. Some heavy metals are very dangerous to health and there is rising concern about the quality of foodstuffs in some parts of the world. Small quantities of these elements are ordinary in our environment and diet and are really essential for physical wellbeing; however, large quantities of any of them will result in acute or chronic poisoning (Ikem and Egiebor, 2005; Inskip and Piotrowsiki, 1985; Rauf et al., 2009; FDA, 2001). The poisonous effects of heavy metals, mostly mercury, lead, cadmium, nickel, and tin have been largely investigated (Inskip and Piotrowsiki, 1985; Mergler et al., 2007; Yi et al., 2011). Heavy metals can enter the human being body throughout foodstuff, atmosphere, water, and absorption through the skin; nevertheless, ingestion is the most probable method of exposure (Ikem and Egiebor, 2005; Rauf et al., 2009). The aquatic environment is one of the major places contaminated by heavy metals. Moreover, several factors including season, physical and chemical quality of water are able to play an important role in metal gathering in different fish tissues (Ashraf et al., 2006; Ikem and Egiebor, 2005; Olowu et al., 2010; Rauf et al., 2009; Vinodhini and Narayanan, 2008). Aside from the hazard from contaminated environment, canned

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foodstuff is exposed to heavy metal contamination for the duration of the canning procedure (Ashraf et al., 2006; Malakootian et al., 2011; Mol, 2011; Voegborlo et al., 1999).

Accumulation of heavy metals in aquatic creatures can cause a long-term effect on biogeochemical cycling in the ecosphere (Rauf et al., 2009). Fish is frequently at the top of aquatic foodstuff succession and possibly will concentrate huge quantities of several metals from the water and they even play a significant role in human being nourishment (FDA, 2001; Mansour and Sidky, 2002; Rauf et al., 2009). They should be carefully monitored to make sure that unnecessary high level of several toxic trace metals are not being transmitted to human being by fish consumption (Emami Khansari et al., 2005; Ikem and Egiebor, 2005; Malakootian et al., 2011; Schmitt and Brumbaugh, 1990).

Canned fish in particular are well consumed in developed and developing countries, and metal contamination particularly in canned fish and other marine products have been largely investigated (Burgera and Gochfeld, 2005; Castro-Gonzalez and Mendez-Armenta, 2008; Dural et al., 2007; Emami Khansari et al., 2005; Hutcheson et al., 2008; Qiao-qiao et al., 2007; Sivaperumal et al., 2007; Türkmen et al., 2005; Tüzen, 2003; Yilmaz et al., 2007).

Fish, particularly Tuna fish can concentrate a large amount of heavy metals. Most importantly, it is recognized for gathering large amount of mercury (Castro-Gonzalez and Mendez-Armenta, 2008; Emami Khansari et al., 2005; Ikem and Egiebor, 2005; Malakootian et al., 2011; Mansour and Sidky, 2002; Voegborlo et al., 1999). Once heavy metals are consumed, several health-related problems will occur; especially pregnant women and children are exposed to them (Ikem and Egiebor, 2005). Eating a lot of tuna would result in serious health problems because of inorganic mercury and methyl mercury and other heavy metals effects (Ashraf et al., 2006; Ikem and Egiebor, 2005; Mol, 2011; Mergler et al., 2007). The aim of this study was to evaluate heavy metals content of canned tuna fish in Tabriz city (Iran), spectrometrically.

Materials and Methods

Instruments: All the glassware employed in the procedures were soaked in 10% (v/v) nitric acid for 20 min, followed by washing with 10% (v/v) hydrochloric acid, and washed with deionized water before utilization. A Varian Model 240 atomic absorption spectrophotometer prepared with a deuterium setting corrector was employed for the determination of heavy metals.

Reagents and materials: All reagents employed in this study were analytical reagent grade, Merck, Germany. Twice distilled water was employed for the preparation of solutions. Standard stock solutions of mercury, lead, cadmium, nickel, and tin were prepared from Titrasol (1000 mg/L) and were diluted to the related metal solution. The operational solution was prepared by diluting a suitable aliquot of the stock solutions via 1 M HCl and 5% H_2SO_4 for diluting mercury solution, 10% HNO_3 for diluting lead and cadmium solutions, and 5% HCl for diluting nickel and tin solution (Emami Khansari et al., 2005).

Sample collection and digestion: Canned tuna samples were collected from random popular supermarkets in Tabriz (Iran) between January 2011 and October 2011. Forty canned tuna were employed. In this study, digestion procedure was performed as described earlier by Emami Khansari, Ghazi-Khansari and Abdollahi (2005). After unbolting of each can (180 ± 3g), its content was homogenized via food blender. Then, the homogenized sample (2±0.001g) was weighed into a 0.51 glass digestion tube, and for mercury 10 ml of concentrated HNO_3 and 5 ml of concentrated H_2SO_4 were little by little added. Next, the tube was put on top of a steam bath item to be completely dissolved. After the tube had cooled, the solution was cautiously moved into a 50 mL volumetric flagon. For the reduction of mercury, 5mL $SnCl_2$ was employed. For the determination of lead and cadmium, 2±0.001g of homogenized sample was weighed into a 200 mL beaker and 10 mL of concentrated HNO_3 were added. A glass coated the beaker and the majority of the sample had dissolved via resting during the night then warmed on a hot plate with boiling until any dynamic reaction settled. The solution was left to cold, and then moved into a 50 mL volumetric flagon and diluted to the mark by means of distilled water. For the determination of nickel and tin, 10±0.001g of homogenized sample were weighed into a beaker and 10mL of concentrated HNO_3 were added. After boiling the quantity was

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decreased to 5mL, concentrated HCl was added and warmed smoothly until the sample bumping finished. Afterward solution was left to cold, and then moved in a 25mL volumetric flagon and diluted to the mark by means of distilled water.

Chemical examination: Mercury was determined via the hydride generation method. The produce process method involves regular adding up of reductant, consisting of 0.3%NaBH4 and 0.5% NaOH. The level of Nickel and Tin was determined via straight aspiration of the sample solution into the NO2/acetylene flame. The blanks and calibration standard solutions were as well examined using a similar technique to the sample solutions. Lead and Cadmium were determined via graphite heating system atomic absorption spectro-photometry, using pyrolytic podium graphite tubes, ascorbic acid, and palladium for medium adjustment and using the process of adding up for quantification (Emami Khansari et al., 2005; Malakootian et al., 2011).

Statistical analyses: The conduct tests were triplicate (n=3). Data were analyzed via one-way analysis of variance (ANOVA). All statistical analyses of data were performed by SPSS 16.0 (SPSS Inc., Chicago, IL, USA) software.

Results

Recoveries of mercury, lead, cadmium, nickel, and tin from canned tuna samples in five brands (A, B, C, D and E) are presented in Table 1.

The accumulation of mercury, lead, cadmium, nickel, and tin in five brands in canned tuna marketed in Tabriz city of Iran were analyzed at the end of the investigational era, which were exposed to the chosen heavy metals (Table 2). In this study; the highest average of Hg was found in the A brand (0.203±0.136 mg/kg µg/g) and the lowest average was in the D one (0.187±0.125 mg/kg), the highest average of Pb was found in the B brand (0.125±0.087 mg/kg) and the lowest average was in the C one (0.055±0.041 mg/kg), the highest average of Cd was found in the B brand (0.391±0.389 mg/kg) and the lowest average was in the E one (0.076±0.061 mg/kg), the highest average of Ni was found in the B brand (0.348±0.198 mg/kg) and the lowest average was in the C one (0.262±0.152 mg/kg) and the highest average of Sn was found in the A brand (0.47±0.487 mg/kg) and the lowest average was in the D one (0.086±0.353 mg/kg). Statistical analysis of results via ANOVA demonstrated no major variations among all samples.

Table 1. Recoveries of mercury, lead, cadmium, nickel and tin from canned tuna samples in five brands (A, B, C, D and E).

Tuna fish	%Recovery				
	Hg	Pb	Cd	Ni	Sn
A	95	100	95	99	100
B	95	103	96	100	102
C	95	100	95	99.5	99.6
D	93	98	90	97	100
E	95	101	95	100	99.8

Discussion

Data of heavy metal concentrations in fish is significant with regard to the nature of managing and human being consumption of fish. Fish is regularly at the top of the foodstuff chain and has the affinity to concentrate heavy metals from water (Mansour and Sidky, 2002; Rauf et al., 2009). Consequently, bio-accumulation of metals in fish can be considered as an index of metal contamination in the aquatic bodies that possibly will be a practical implement to study the natural function of metals present at upper concentrations in fish (Ikem and Egiebor, 2005; Rauf et al., 2009).

Mercury (Hg): Mercury in fish fleshy tissue can signify an ecological and human health risk to those ingesting the fish (Hutcheson et al., 2008). Mercury possibly will make changes in the regular growth of the brain of children and at higher levels might make neurological changes in adults (Commission of the European Communities, 2001; Ikem and Egiebor, 2005). Furthermore, Mercury has toxicity result on the kidney, and it is probably a carcinogen (Occupational Safety and Health Administration, 2004; Inskip and Piotrowsiki, 1985; Mergler et al., 2007). Tuna can accumulate a large amount of mercury and methyl mercury (Castro-Gonzalez and Mendez-Armenta, 2008; Emami Khansari et al., 2005; Ikem and Egiebor, 2005; Malakootian et al., 2011; Mansour and Sidky, 2002; Voegborlo et al., 1999). In this study, the average Hg concentration was investigated in five brands; A, B, C, D, and E which were 0.203±0.136, 0.195±0.13, 0.154±0.101, 0.102±0.136 and 0.187±0.125 mg/kg, respectively. All the samples were below the acceptable limits

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Table 2. Range and mean values (±SD) of mercury, lead, cadmium, nickel and tin (mg/kg)in five brands (A, B, C, D and E) in canned tuna fish (n=3).

Tuna fish	Heavy metals									
	Hg		Pb		Cd		Ni		Sn	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
A	0.109-0.298	0.203±0.136	0.002-0.109	0.090±0.048	0.151-0.359	0.236±0.134	0.005-0.988	0.312±0.211	0.102-1.099	0.470±0.487
B	0.100-1.335	0.195±0.130	0.055-0.653	0.125±0.087	0.099-0.854	0.391±0.389	0.001-0.775	0.348±0.198	0.004-0.652	0.303±0.340
C	0.010-0.333	0.154±0.101	0.000-0.259	0.055±0.041	0.012-0.895	0.266±0.143	0.008-0.951	0.262±0.152	0.040-0.299	0.144±0.412
D	0.000-0.319	0.102±0.136	0.006-0.851	0.076±0.057	0.001-0.557	0.106±0.063	0.018-1.000	0.327±0.243	0.000-0.991	0.086±0.353
E	0.095-0.326	0.187±0.125	0.017-0.451	0.098±0.064	0.031-0.099	0.076±0.061	0.000-0.394	0.297±0.234	0.008-1.014	0.403±0.430

recommended as 0.5 mg/kg (EU, 2005; FAO, 1983; FAO/WHO, 1972; Mergler et al., 2007). In a similar study, Emami Khansari, Ghazi-Khansari and Abdollahi (2005) determined the average concentration of Hg in canned tuna in Iran. They reported the average Hg contents as 0.117 mg/kg.

Lead (Pb): Lead is broadly distributed in environment and solder employed in the produce of cans is an important resource of contamination of food via Pb (Mol, 2011). Lead can reduce cognitive growth and intellectual performance in kids and cause high blood pressure and cardiovascular syndrome in adults (Commission of the European Communities, 2001; Ikem and Egiebor, 2005; Malakootian et al., 2011). Consequently, monitoring lead concentration becomes very important. In accordance with European commission (EC) 2001 instruction and FAO/WHO (1972), the highest lead level acceptable for canned fish are 0.4 and 0.5 mg/kg, respectively. In this study, all the samples were lower than the acceptable limits recommended as 0.2 mg/kg (EC) and 0.5 mg/kg (FAO/WHO). In a similar study, Malakootian et al. (2011) determined Pb concentration in sixteen brands of canned tuna in southern Iran. They reported the greatest average concentration of lead in four brands (Sahel, Jonob, Bartar and Darya) was 0.3 mg/kg and the lowest average of lead concentration in one brand (Bist) was 0.11 mg/kg. In another study, Emami Khansari, Ghazi-Khansari and Abdollahi (2005) reported the average Pb concentration as 0.0366 mg/kg in canned tuna in Iran. Ashraf (2006) studied the concentration of lead in some samples of tuna in Saudi Arabia. He reported the quantity of lead in tuna 0.002, 0.21, 0.23, and 0.84 mg/kg in every sample.

Cadmium (Cd): Large amounts of cadmium can cause chronic toxicity, including impaired renal function, poor reproductive ability, skeletal damage, hepatic dysfunction, hypertension, and cancers (Commission of the European Communities, 2001; Ikem and Egiebor, 2005; Mol, 2011). FAO (1983) recommended the highest limit for this metal in fish is 0.5 mg/kg. Moreover, in accordance with EC 2001 highest limit of cadmium in fish is 0.05 mg/kg (Malakootian et al., 2011; Sivaperumal et al., 2007). In this study, all the samples were lower than the acceptable limits recommended as 0.5 mg/kg (FAO). Malakootian et al., (2011), and Emami Khansari, Ghazi-Khansari and Abdollahi (2005), reported the average concentration of Cd, 0.019 and 0.022 mg/kg in canned tuna in Iran.

Nickel (Ni): Nickel is also one of the important heavy metals that tuna can accumulate in its tissue. Ni can cause respiratory difficulties, nervous and digestive disorders, psychological problems, and also it is carcinogenic (Ashraf et al., 2006; Ikem and Egiebor, 2005). In the studied tuna, the quantity of Ni was below the US-EPA standards (Joyeux et al., 2004; Malakootian et al., 2011). In a similar study, Malakootian et al., (2011) reported the average concentration of Ni, 0.24 mg/kg in canned tuna fish in southern Iran.

Tin (Sn): Too much consumption of Sn possibly will cause gastrointestinal irritation, nausea, vomiting, diarrhea, anemia, kidney and liver difficulties, and skin and eye irritation (Ikem and Egiebor, 2005). Estimation of tin in canned foodstuff is significant for the quality evaluation. For the reason that, Sn content shows the level of corrosion of the container,

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consequently influences the acceptability of foodstuff (Mol, 2011). As a matter of fact, a chief resource of Sn contamination in canned foodstuffs is poor lacquering of canned containers. Other reasons that can speed up the leaching of Sn from metal containers into seafood comprise the pH of the food in the can, temperature of the canned foods, storage time, and exposure to atmosphere of opened canned fish (Ikem and Egiebor, 2005; Mol, 2011). In this study, Sn concentrations were under the acceptable limit of 250 mg/kg (Mol, 2011) in every one of the samples. Emami Khansari, Ghazi-Khansari and Abdollahi (2005) reported the average concentration of Sn as non-detectable. In another study, the middling of 0.140 mg/kg and 0.023 mg/kg were attained for canned anchovies and for canned rainbow trout, respectively (Mol, 2011).

The results of this study showed that tuna fish (in five brands; A, B, C, D and E fore examples) fabricated and marketed in Tabriz (Iran) had safe level of heavy metals that were lower than the averages of EC/FAO/WHO levels for these toxic metals.

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مجله طب دامی ایران، ۱۳۹۳، دوره ۸، شماره ۱، ۱۴-۹

مقادیر فلزات کمیاب در کنسرو تن ماهی عرضه شده در بازار تبریز

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چکیده

زمینهٔ مطالعه: برخی فلزات سنگین برای سلامتی انسان خطرناک اند و نگرانی فزاینده‌ای از وجود این فلزات در مواد غذایی در مناطقی از دنیا وجود دارد. ما[illegible] به ویژه ماهی تن، مقادیر زیادی از چندین فلزسنگین را ازآب جذب بدن خود می‌کند و نقش مهمی در تغذیهٔ انسان دارد. **هدف:** در این مطالعه مقادیر جیوه و چهار عنصر کمیاب دیگر در پنج نمونه برند تجاری عرضه شده در بازار تبریز بعد از هضم به روش AOAC تعیین شد. **روش کار:** [illegible] ۴۰ نمونه جمع‌آوری شد. مقادیر سرب و کادمیوم به روش اسپکتروفتومتری جذب اتمی با لولهٔ گرافیتی، مقادیر نیکل و قلع به روش اسپکتروفتومتری جذب [illegible] باسیستم شعله‌ای و مقدار جیوه به روش اسپکتروفتومتری باسیستم تولید هیدرید تعیین شد. **نتایج:** مقادیر عناصر اندازه‌گیری شده [illegible] گرم در کیلوگرم وزن مرطوب عبارت بود از سرب (۰/۲۴۲-۰/۰۱)، کادمیوم (۱/۰۵-۰/۰)، نیکل (۰/۵۸۹-۰/۱۱۳)، قلع (۰/۹-۰/۰۵) و جیوه (۰/۲۰۵-۰/۱). **نتیجه‌گیری نهایی:** نتایج نشان دادند که کنسرو ماهی تن عرضه شده در بازار تبریز حاوی مقادیر بی خطر از فلزات سنگین برای سلامتی انسان [illegible] پایین‌تر از متوسط مقادیر توصیه شدهٔ EC/FAO/WHO است.

واژه‌های کلیدی: اسپکتروفتومتری جذب اتمی، کنسرو ت[illegible]، فلزات [illegible]

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*)نویسنده مسؤول: تلفن: ۲۸۰۴۸۲۸(۴۱۱)۹۸+ نمابر: [illegible]۸۰۴۸۲۸(۴۱۱)۹۸+ *Email: pourjafarhadi59@ut.ac.ir*

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