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Determination of Mercury in Fish (*Otollithes ruber*) and Canned Tuna Fish Marketed in Khuzestan and Shiraz, Iran

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Abstract: In this study mercury was determined in canned tuna fish produced and distributed in Iran after digestion by the standard methods of AOAC. Mercury contents in fish and canned tuna fish were determined by cold vapor atomic absorption spectrophotometry. The metal contents expressed in mg/kg wet weight for mercury varied from 0.017 to 0.394 (average of 0. 089) and 0.023 to 0.529 (average of 0.146) in fish and canned tuna fish, respectively. The values were comparable and in the range of with the literature valves. The results of this study indicate that fish and tuna fish of produced and marketed in Iran have concentrations well below the standards FAO/WHO levels of these toxic metals and only one tuna samples exceeded the European dietary limit of 0.5 mg Hg/kg.

Keywords: Fish; Canned tuna fish; Mercury; Iran

INTRODUCTION

Fish is widely consumed in many parts of the world by humans because it has high protein content, low saturated fat and also contains omega-3, calcium, phosphorus, iron, trace elements like copper, and a fair proportion of the B-vitamins known to support good health (Tucker, 1997).

At the same time, levels of contaminants in fish are of considerable interest because of potential effects on the fish themselves or the organisms that consume them, including top-level receptors, including people. Contaminant levels, particularly methylmercury (MeHg) and polychlorinated biphenyls (PCBs), are sufficiently high in some fish to cause adverse human health effects in people consuming large quantities (Hightower and Moore, 2003; Hites *et al,* 2004; Andrée *et al,* 2010).

Methylmercury is reported to counteract the cardioprotective effects (Guallar *et al,* 2002) and damage developing fetuses and young children (Houseuova *et al,* 2007; Ikem and Egiebor, 2005). Fish consumption is the only significant source of methylmercury for the public (Rice *et al,* 2000; Burger and Gochfeld, 2005).

Recently the US Food and Drug Administration (Food and Drug Administration, 2004) issued a series of consumption advisories based on methylmercury that suggested that pregnant women and women of childbearing age who may become pregnant should avoid eating four types of marine fish, shark, swordfish, king mackerel, and tilefish, and should limit their consumption of all other fish to just 12 ounces per week (Food and Drug Administration, 2004).

These recent FDA advisories have raised concern about the safety of fish and fish products available in markets, yet there are very few data on contaminant levels in commonly available

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commercial fish, and fish products (Burger and Gochfeld, 2005).

Currently, there is limited information regarding the contaminant levels of mercury in fish, and fish products in Iran. Therefore, the present study was conducted to analysis and determine the content of mercury by precise methods in fish and canned tuna fish marketed in Iran.

MATERIALS AND METHODS

All glassware used were soaked in detergent solution overnight before being rinsed and soaked in 10% (v/v) HNO3 overnight, followed by rinsing with distilled water. All used reagents were of analytical reagent grade Merck, Germany. Standard stock solutions of mercury, cadmium and lead were prepared by diluting concentrated solutions to obtain solutions of 1000 mgl^{-1}. Canned tuna samples were purchased from popular supermarkets in Shiraz and Khuzestan, Iran, during July 2010 to February 2011. Forty five tuna cans and thirty five fish were used in this study.

The working solutions were freshly prepared by diluting an appropriate aliquot of the stock solutions through intermediate solutions using 1 M HCl for diluting mercury solution. Stannous chloride was prepared fresh by dissolving 10 g in 100 ml of 6 M HCl. The solution was boiled for about 5 min, cooled, and nitrogen bubbled through it to expel any mercury impurities. Diluting solution for mercury determination was prepared by diluting 100 ml of conc HNO_3 and 25 ml of conc H_2SO_4 to 1000ml with distilled water (Voegborlo *et al,* 1999).

Mercury was determined in all the digests using cold vapor atomic absorption spectrophotometry flow infection mercury/ hydride analyzer (FIAS 4100, Perkin Elmer, USA), equipped weigh hollow cathode mercury lamp operated at a wave length of 253.7 nm. Quartz absorption cell was used for the mercury determination.

The recoveries of the metals were determined by adding increasing amounts of mercury to samples which were then taken through the digestion procedure. The resulting solutions were analyzed for the metal concentrations. The mean recoveries for mercury were 96.6%.

Statistical analysis of results was performed with SPSS (version 16) software (SPSS Chicago, IL, USA). The mean AFM1 concentration in raw milk, pasteurized milk, UHT milk and the mean of the mercury concentration in samples of fish and canned tuna fish was compared by one way analysis of variance (ANOVA).

RESULTS AND DISCUSSINS

The results indicated that the concentrations varied form from 0.017 to 0.394 mg/kg (average of 0. 089 mg/kg) and 0.023 to 0.529 mg/kg (average of 0.146 mg/kg) in fish and canned tuna fish, respectively (Table 1).

Table 1: Mercury residues (mg/kg) in fish and canned tuna fish samples

Samples	No. of samples	Average	Range
Fish	35	0. 089	0.017 to 0.394
Canned tuna fish	45	0.146	0.023 to 0.529

Many previous literatures have shown that the occurrence of toxic elements contamination is related to length, weight, age and sex of fish (Agusa *et al,* 2005; Emami Khansari *et al,* 2005; De Marco *et al,* 2006; Storelli *et al,* 2002). Season and place are also important in the levels of toxic elements accumulation in fishes (Kagi and Schaffer, 1998). However, good agreements were observed when our results were compared with those reported by other authors (Ikem and Egiebor, 2005; Burger and Gochfeld, 2005; Committee for Inland Fisheries of Africa, 1992; Tuzen and

Soylak, 2007; Soegiantoa and Hamami, 2007; Hamilton *et al,* 2008; Rahimi *et al,* 2010; Ashraf *et al,* 2006; Ashraf, 2006; Hajeb *et al,* 2009; Suppin *et al,* 2005).

Mercury has been recognized as severe environmental pollutant, with high toxicity even at low concentrations it has the ability to enter into biological systems (Porto *et al,* 2005), It has strong tendency to accumulate in aquatic food chain, and about 95% of the methyl mercury in humans is originated from the ingested fish (Houseuova *et al,* 2007). Mercury and methyl mercury are neurological toxicants to humans (Commission of the European Communities, 2001). In addition methyl mercury is also classified as a Group C possible human carcinogen. Based on the wet weight basis, all of the canned tuna fish samples commonly consumed by Iranian analyzed in this study had mercury concentrations below 0.5 mg/kg wet weights and only one tuna samples exceeded the dietary limit of 0.5 mg Hg/kg; the guideline level established by European Communities and Joint FAO/WHO Expert Committee on Food Additives (Codex Committee on Food Additives and Contaminants, 2001; Commission of the European Communities, 2001). Mercury concentrations in fish and canned tuna fish found in this study were in good agreement with those reported by other studies.

This study improves the baseline data and information on mercury concentration in fish and canned tuna fish commonly marketed in Iran. Such data provide valuable information on safety of fishes commonly consumed by public. In added (in addition), analytical data obtained from this study shows that there is no health risks from consumption of canned fishes analyzed when data are compared with the US EPA classified health criteria for mercury in fish and canned fishes. Both low-risk groups (adolescents and adults) and high-risk groups (pregnant mothers and children) should consume fish in moderation since large consumption pattern especially for tunas may result in increased health risks. Globally, further reduction in the levels of environmental contaminants emanating from power plants and other industrial emissions and effluent discharges are highly needed to reduce contaminant inputs into the aquatic environment. More research and assessments of seafood quality is needed in many countries to provide more data and help the health of humans.

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