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NOTE

Determination of Mercury, Cadmium, Tin and Nickel in Three Canned Tuna in Iran

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Considering the importance of fish and its related products to meet the needs of the people to protein and other minerals as well as the impact of infected aquatic ecosystems on the fish infestation are the subject of interest. The presence of heavy metals as the result of industrial pumping and environmental contamination in sea food products such as tuna, measuring the existing heavy metals levels in the aquatic environment can serve as a suitable indicator of water pollution and the quality of these food and the risks of their being poisoned with heavy metals can be considered accordingly. This research was conducted on 21 samples of canned tuna selected randomly from the three factories producing canned tuna namely Shilton, Teihou and Telaji in 2011. After transferring the samples to the laboratory and digesting them, they were analyzed for heavy metals including mercury, tin, cadmium and nickel through atomic absorption technique. The highest and lowest amount of mercury and nickel were observed in the manufacturing factories of Telaji and Shilton, respectively and the highest and lowest amounts of cadmium and tin were related to the manufacturing factories of Teihou and Shilton, respectively. The results showed that the amount of the given heavy metals in the products of these factories were lower than the standards set by FDA, EPA, FAO/WHO and are not detrimental to human's health.

Key Words: Heavy metals, Mercury, Cadmium, Tin, Nickel, Canned tuna, Iran.

Considering the growing population and increasing demand for protein intake, the need for more resources to supply protein is a subject of interest[1]. The proteins with marine origin have a significant degree of importance due to their higher protein and omega 3 fatty acid contents[2]. With population growth, we witnessed the industrial development and as a result the increasing problem of environmental pollution and food contamination to heavy metals were brought about which require major focus[3]. Meanwhile, fish due to aquatic pollution are exposed to different levels of these elements depending on fish size and age and these heavy metals can accumulate in fish tissue at different significant levels. Some large species of fish such as thunnus SPP due to having a special diet that is known as biomagnifications have high concentrations of mercury in their body tissue. Since mercury, arsenic, cadmium and lead, are toxic for humans even at a very small amounts, their exact measurement and identification is important. Biotransformation of mercury changes it into a toxic known as methyl mercury; also, an increase in the nickel intake increases the risk of lung, larynx and prostate cancer[4-7].

The cadmium causes poisoning and iron deficiency and the tin, which is not a toxic element can, cause corrosion of cans due to its high application in the manufacture of cans for painting the cans. Since the south waters of Iran, providing the main source of canned tuna are exposed to various contaminants due to passing tanker and sewage disposal, therefore, the fish caught from these areas can be exposed to such contamination. As a result, measurement and evaluation of heavy metals to determine the health quality of the canned products for human consumption and compare them with some standards to assess of risk factors appear to be crucial.

Twenty one samples of canned tuna produced by Telaji, Teihou and Shilton factories were randomly selected (7 samples from each factory) and were transferred to the Amol central laboratory of food quality control. All the samples for each factory (7 samples from each factory) were separately combined and homogenized. In order to chemically digest and prepare the samples, AOAC (Association of official Analytic chemist) reference technique was used. For mercury measurement, approximately 2 g of the sample (with measurement accuracy of 0.001 g) were weighed and combined with 10 mL concentrated nitric acid and 5 mL sulfuric acid and was increased to a volume of 50 mL with tin chloride (method 9.2.24). 2 g of sample were weighed for measuring cadmium and nickel (with measurement accuracy of 0.001 g) and was preserved with 10 mL of concentrated nitric acid for over night and in order to purify and complete digestion, the mixture was boiled to reach the volume of 50 mL.

In order to measure the tin, 10 g of the sample (with measurement accuracy of 0.001 g) were weighed and at first was combined with 20 mL of concentrated nitric acid to reduce its volume to half and then in order to complete the digestion process and stabilize the mixture, it was boiled with 10 mL of concentrated hydrochloric acid to reach the volume of 50 mL.

All the raw materials used in this study were of analytical grade type and the standard solutions were prepared daily from the original solutions and all equipment and glass wares were kept in nitric acid 10 % v/v for 24 h and then were washed and dried. The chemical analysis was performed by atomic absorption spectrometry technique using Perkin Elmer 4100 system[5] equipped with a flame graphite furnace and hydride generation.

Tin was measured by the flame of acetylene-nitroxcide and corrected by deuterium lamp and nickel and cadmium were measured by using pyrolytic platform tube and ascorbic and palladium as modifier and optimized conditions and finally the mercury was measured by using hydride generation using $NaBH_4$ combination and directing obtained steam to the specified cell according to instructions given when working with the machine. ANOVA statistical analysis was also used in this study and the mean of the data were compared using the t-test and the significant differences were determined at p = 0.05.

The highest amount of mercury, cadmium, nickel and tin were 49.63 ± 7.51, 328.13 ± 10.18, 180.06 ± 30.22 and 81.20 ± 10.74 micrograms to kilograms, respectively and their lowest values were 34.51 ± 1.28, 137.41 ± 4.98, 52.98 ± 4.02 and 26.81 ± 1.71 micrograms to kilograms, respectively (Table-1). In this study, the rate of heavy metals in Telaji and Shilton samples were significantly different ($p \leq 0/05$) but there was not any significant difference in Telaji and Teihou samples. The highest and lowest amount of mercury and nickel was observed in the manufacturing factories of Telaji and Shilton, respectively and the highest and lowest amounts of cadmium and tin was related to the manufacturing factories of Teihou and Shilton, respectively (Table-1).

TABLE-1
AMOUNTS OF MERCURY, CADMIUM, NICKEL AND TIN IN THREE CANNED TUNA PRODUCED IN IRAN

Heavy metal	Tuna type		
	Telaji	Teihou	Shilton
Mercury	34.51 ± 1.28	45.13 ± 8.04	49.63 ± 7.51
Cadmium	137.41 ± 4.98	328.13 ± 10.18	296.98 ± 53.02
Nickel	52.98 ± 4.02	134.17 ± 14.82	180.06 ± 30.22
Tin	26.81 ± 1.71	81.20 ± 10.74	63.19 ± 11.02

The results showed that the amount of the given heavy metals in the products of these factories were lower than the standards set by FDA, EPA and WHO. Given that the process of producing canned tuna and its packaging are not involved in the contamination to these heavy metals, the highest and largest effect can be attributed to different factors such as age, sex, place of growth, the fishing season[5,6], ecological and biological conditions and metabolic activity, also it is shown that the cooking and frying reduces the amount of heavy metals like cadmium and lead and we should consider the fact that the presence of these metals in canned tuna may be different in different parts of the world.

In this study, the average amount of mercury was lower than the limits set by international standards of WHO, EPA and FDA (500, 1000 and 1000 micrograms to kilograms). Similar studies have been done in this field. In a similar study conducted in 2010 by Velayatzadeh *et al.*[7] also showed that the amount of heavy metals was less than the given standard. In another study done in 2008 by Salaramoli and Aliesfahani[8], the total mercury levels in samples was 146.65 ± 63.35 ppb compared with the standards (1 microgram per gram) showed a lesser value which are consistent with the results of this study[8].

In a study conducted by Lashkarimoghadam *et al.*[9] on the concentration of the heavy metals in the tuna oil and meat, it was clear that the nickel content in the tuna fish was very low but its oil has the highest amount than the standard and the cadmium level in this study was higher than the NHMRC 2007 standard (0.05 mg/kg). Regarding the fact that in this study the concentrations of mercury, cadmium, tin and nickel was below the limit of international standards it can be concluded that the canned tuna produced by three factories of Telaji, Shilton and Teihou are not harmful to human's health.

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