ANALYSIS OF NICKEL CONTENT IN CANNED FISH CONSUMED IN IRAN

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Abstract- The presence of toxic metals in the environment could constitute a hazard to food safety and public health. These can be accumulated in aquatic animals such as fish. Samples of four brands of canned fish in the Iranian market (yellowfin tuna, common Kilka, Kawakawa and longtail tuna) were analyzed for levels of Ni after wet digestion with acids using GFAAS. The mean concentrations of Ni in the different brands were 0.37, 0.19, 0.14 and 0.18 µg g^{-1} for brands A, B, C and D respectively; Significant differences were observed in the Ni levels between all of the different brands of canned fish evaluated in this study. The mean concentration of Ni for the varieties of canned fishes was generally within the FAO/WHO, U.S. FDA and U.S. EPA recommended limits for fish.

Keywords- Nickel, Canned Fish, Food Safety, Iran.

I. INTRODUCTION

Trace metals are generally released into aquatic environments in different ways and accumulation of these metals is dependent on the concentration of the metal and the exposure period (1).

Metal pollution in the marine environment is not very visible but its impacts on delicate marine ecosystems and humans are drastic. Heavy metal burdens in fish follow a multivariate dependence pattern. Fish can accumulate substantial amounts of metals in their tissues especially muscles and this, can represent a major dietary source of these metals for humans (2, 3). Levels of heavy metals in fish, sea foods and fish products have been widely reported (1, 4-22).

Trace metals are significant either from the viewpoint of their essentiality or their toxicity (23, 24). Low or high trace element unbalances can be considered as risk factors for several diseases. Metals, such as Fe, Cu, Zn and Mn, are essential metals since they play important roles in biological systems (13). Nickel at trace levels acts as an activator of some enzyme systems but its toxicity at higher levels is of concern. It accumulates in the lungs and frequently causes bronchial failure. In addition to environmental contamination of Ni in foods, it can also get into foods through processing activities such as canning and cooking in Ni containing vessels. Based on the U.S. EPA's oral reference dose of 20 µg kg^{-1} day, a provisional maximum tolerable daily intake of Ni of 1.2 mg/person/day can be estimated (12).

Canned fish are eaten regularly in many countries, including Libya, USA, Portugal, the Kingdom of Saudi Arabia, Turkey and Iran (4, 7, 8, 9, 12). Therefore, in this study, the level of Ni was evaluated in commercial canned fish products that are commonly consumed in Iran.

II. DETAILS EXPERIMENTAL

2.1. Sample Collection

During the year 2012, 120 samples of four different Iranian brands (30 samples for each brand were obtained: "Famila Co." (Tehran), yellowfin tuna (Thunnus albacares) [Brand A]; "Shilaneh Co." (Qazvin), common Kilka (Clupeonella cultriventris caspia) [Brand B]; "Pars Tuna Co." (Bushehr), Kawakawa (Euthynnus affinis) [Brand C], and "Hiltune Co." (Tehran), longtail tuna (Thunnus tonggol) [Brand D]) of canned fish (185 g cans) were analyzed for their content of Ni. These 120 canned fish samples were procured from groceries, markets, supermarkets, hypermarkets and main food distribution networks in Tehran.

2.2. Chemical Analysis

All glassware was cleaned by soaking overnight in 10% nitric acid, followed by rinsing with distilled water. The acids used for wet digestion were of high purity Ultrex (Merck, Germany) grade, while the distilled water was further deionized (SKU: D4521). The blank values were below the detection limits of the instrument. Working standards were made from the stock by dilution of the measured aliquots with 1.0M nitric acid. Spectrophotometric analysis was done at the most sensitive setting for Ni. Each sample was analyzed in triplicate and the results, which mostly agreed within ±1.0%, were averaged. A reagent blank determination was carried out with every batch of 10 samples.

After opening each can oil/broth was drained off and the meat was homogenized thoroughly in a food blender (Hongdun HWT). Samples were then digested without delay in quartz Erlenmeyer flask with 15 ml of a Suprapure nitric:perchloric:sulphuric acid (25 + 25 + 1 v:v:v) mixture. About 5 g of sample were digested, using a hot plate at 150 °C. Further aliquots of nitric acid were added until a completely colorless solution was obtained. After evaporation

using Perkin Elmer Multiwave 3000, the residue was dissolved in 10 ml of water with 1ml of conc. Suprapure HCl at 100 °C. Finally, the volume was made up to 25 ml with deionized water. Determination of Ni was done by direct aspiration of the sample solution into the air-acetylene flame of the atomic absorption spectroscopy (4110 ZL, Perkin Elmer) (12).

2.3. Statistical Analysis

One-way analyses of variance (ANOVA) and Tukey test were used to determine whether Ni concentrations varied significantly between species, with values less than 0.05 ($p<0.05$) considered statistically significant. The statistical calculations were done using SPSS 15.0 version (SPSS Inc., Chicago, IL, USA) statistical package.

III. RESULTS AND DISCUSSION

The concentration of Ni in canned fish is presented in Table 1 along with the statistical parameters. Thirty samples for each canned fish were analyzed to assess the amounts of these metals. Statistical analyses of the data for yellowfin tuna showed no significant differences among all of the samples. The mean Ni content in Kawakawa was much lower than in yellowfin tuna. For comparing the mean concentrations of Ni in the different brands of canned fish by ANOVA and the Tukey test are shown in table 1. The results indicated that there were significant differences within and between all of the evaluated brands ($p<0.05$).

Table1: Nickel content (μg g^{-1}) in various varieties of canned fish

Brand / Metal	A	B	C	D
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Ni	0.37 ± 0.12^{d}	0.19 ± 0.12^{c}	0.14 ± 0.11^{a}	0.18 ± 0.12^{b}

Vertically, letters a, b and c show statistically significant differences ($p<0.05$).

The levels of heavy metals in fish depend upon many factors like the duration of exposure of fish to contaminants in the water, the feeding habits of each fish species, the, concentrations of contaminants in the water column, water chemistry, any contamination of fish during handling and processing, and fish sex, weight, season (15). According to Taha´n et al. (1995), the pH of the canned product, the quality of the lacquer coatings of canned products, oxygen concentration in the headspace, quality of coating and place of storage may control the metal levels in canned fishes for those metals found in the canning material (23).

Levels of Ni in canned fish from Denmark and Nigeria were 0.20 μg g^{-1} and 3.11 μg g^{-1} respectively. Our values compared well with those from Denmark but were significantly lower than those reported from Nigeria (Table 1). In the literature Ni levels ranged from <0.01 to 2.04 μg g^{-1} for muscles of fish from the Black Sea coast (24), 0.66 to 1.59 μg g^{-1} for muscles of fish from Iskenderun Bay (Turkmen et al., 2006), 0.02-4.22 μg g^{-1} for muscles of fish from the coastal waters of the Turkish seas (25), 0.02-3.97 μg g^{-1} for muscles of fish from the Marmara, Aegean and Mediterranean seas (23).

CONCLUSIONS

The results from this study suggested that significant differences existed in the Ni concentration across four different canned fish species. Also, analytical data obtained from this study shows that the Ni concentrations for the varieties of canned fishes were generally within the FAO/WHO, U.S. FDA and U.S. EPA recommended limits for fish. There is therefore no serious health risk associated with the consumption of the canned fishes studied.

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