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Determination of mercury concentration in canned tuna fish at Libyan market

Entesar Emhamed Aboglida [1], Fouziya Mabrouk Samhoud [2], Ahlam Mohammed Elbeskri [3], Munsif Abubakr Ahmed [4]

[1] Biology, Department of Environmental Sciences and Pollution, Higher Institute of Water Affairs, El Agilat, Libya

[2] Chemistry, General Department, Higher Institute of Water Affairs, El Agilat, Libya

[3] Electrical Engineering, General Department, Higher Institute of Water Affairs, El Agilat, Libya

[4] Environment, Environmental Sciences and Pollution, Higher Institute of Water Affairs, El Agilat, Libya

E-mail: Monsifali68@gmail.com

Abstract:

In this study, Mercury (Hg) concentration of canned fish sold of markets in Libya was determined by cold vapor atomic absorption spectrophotometer using the Direct Mercury Analyzer (DMA). Mercury (Hg) concentration in canned fish brands (n=25) ranged between 0.087-7.542 mg/kg. Some of the samples had Mercury content higher than the acceptable limits. Therefore, comprehensive and intermittent monitoring of heavy metals in canned fish is needed to assess the safety of these products with respect to human health.

Key words: *Canned Tuna Fish, Mercury, Atomic Spectrometry, Direct Mercury Analyzer.*

الملخص:

في هذه الدراسة ، تم تحديد تركيز الزئبق (Hg) للأسماك المعلبة المباعة في الأسواق في ليبيا بواسطة مقياس طيف الامتصاص الذري للبخار البارد باستخدام جهاز تحليل الزئبق المباشر .(DMA) تراوح تركيز الزئبق (Hg) في أنواع الأسماك المعلبة (العدد = 25) بين 0.087−7.542 مجم / كجم. ومن خلال نتائج الدراسة تبين ان هناك بعض العينات بها محتوى من الزئبق أعلى من الحدود المسموح بها. لذلك، هناك حاجة إلى مراقبة شاملة

للمعادن الثقيلة في الأسماك المعلبة المستوردة والمحلية لتقييم سلامة هذه المنتجات فيما يتعلق بصحة الإنسان.

Introduction:

The quality of food had become a major concern in every part of the world, in order to do that many studies had tackled the important aspect of studying the toxic effect of the pollutants in food. The heavy metals represent the most important one of these impurities and that due to their ability to accumulate by marine organisms, which raise a big health concern [6]. According to the American health association, it is important to have fishes in our daily food of 2-3 times a week. Since that fishes can reduce cholesterol, high blood pressure, in addition to that the fishes contain a high quality protein and low calories, as well as fishes have the important Omega-3 fatty acids, which reduce the risk of coronary artery disease [10].

Metal pollution in the marine environment is not that apparent but its impacts on delicate marine ecosystems and humans are drastic. Heavy metals 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 [12]. Over the last few decades, number of chemicals has been increased in the water bodies as a result of industrial, agricultural and domestic waste discharges [11]. Toxicological and environmental studies have prompted interest in the determination of toxic elements in food. While mercury, cadmium and lead can be tolerated only at extremely low levels, at certain concentrations, they are exceptionally toxic to humans; Fish accumulate substantial concentrations of mercury in their tissues and thus can represent a major dietary source of this element to humans. With the exception of occupational exposure, fish are acknowledged the single largest source of mercury for man. Particularly Tuna fish can concentrate a large amount of heavy metals. Most importantly, it is recognized for gathering large amount of mercury [8]. In some instances, fish catches were banned for human consumption because their total mercury content

exceeded the maximum limits recommended by the Food and Agriculture/World Health Organization (0.5µg/g) [4]. Biotransformation of mercury and methyl mercury formation constitute a dangerous problem for human health [6]. The present study aims at determining the concentration of mercury in the local and imported canned fish the found in Libyan market the study included samples collected from western Libya.

Materials and methods:

Sampling:

During the year of 2017, we are collection about Twenty Five (25) types of canned tuna from imported and local brands were used for this study (with 3 replicates for each type) were collected from different supermarkets found, to determine the concentration of mercury (Hg) as shown in Table 1.

Sample collected preparation:

All glass ware was cleaned by soaking overnight in 10 % nitric acid, followed by rinsing with distilled water. The acids used for wet digestion were of analytical reagent (Merck, Darmstadt, Germany) grade, while the distilled water was further deionized. 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 performed at the most sensitive setting for (Hg) metal. Each sample was analyzed in triplicates.

After opening, each cans oil was drained off and the meat was homogenized thoroughly in a food blender with stainless steel cutters. Each sample was then taken and digested promptly as follows: For the determination of selected mercury metal, about 2 ± 0.001 g of homogenized sample were weighed into a 250 ml beaker and 10 ml of concentrated HNO_3 were added. The beaker was covered with a watch glass, and after most of the sample was dissolved by standing overnight, it was then heated on a hot plate

with boiling until any vigorous reaction had subsided. The solution was allowed to cool, transferred into a 50 ml volumetric flask and diluted to the mark with distilled water [13].

Chemical analysis:

Mercury was determined by Cold Vapor Atomic Absorption Spectrophotometer using the Direct Mercury Analyzer (DMA).

Results and Discussion:

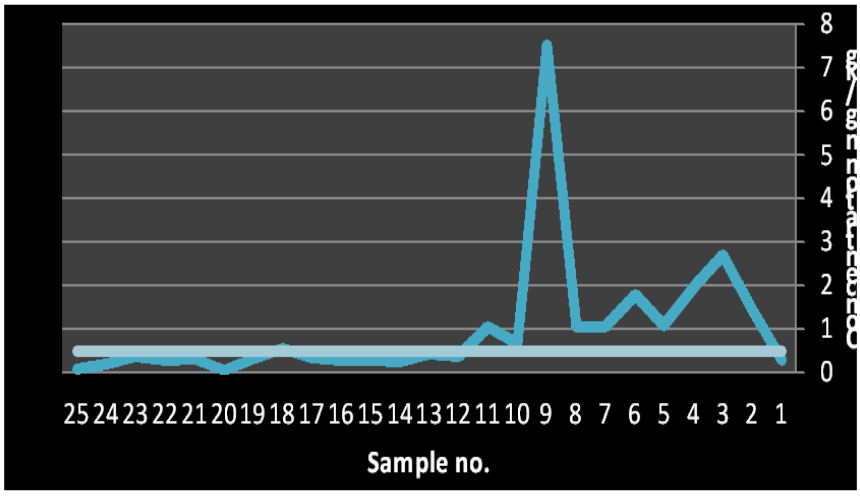
Table 1. Shows the levels of Hg in Twenty Five (25) canned fish brands collected from markets in Libya

Sample No.	Manufacturer	Production date	Expire date	Type of Medium	Concentration (±0.303 mg/kg)
1	Thailand	7/2015	7/2019	Oil with brine	0.087
2	Thailand	6/2016	6/2018	Oil with brine	0.261
3	Portugal	2/2016	2/2018	Oil with brine	0.378
4	Turkey	4/2017	4/2022	Oil with brine	0.287
5	India	4/2015	4/2020	Oil with brine	0.337
6	Vietnam	2/2015	2/2019	Oil with brine	0.052
7	Libya	1/2017	1/2019	Olive oil	0.340
8	United Arab Emirates	2/2016	2/2019	Oil with brine	0.552
9	Libya	9/2016	9/2019	Olive oil	0.356
10	Oman	11/2016	11/2018	Oil with brine	0.294
11	Spain	11/2016	11/2019	Oil with brine	0.282

12	Vietnam	2/2016	2/2019	Oil with brine	0.269
13	Thailand	3/2017	3/2020	Olive oil with brine	0.438
14	Thailand	11/2016	11/2019	Oil with brine	0.388
15	Italy	6/2016	6/2019	Olive oil with brine	1.068
16	Thailand	11/2016	11/2019	Oil with brine	0.684
17	Thailand	8/2017	8/2020	Oil with brine	7.543
18	Thailand	8/2017	8/2020	Oil with brine	1.068
19	Thailand	5/2017	5/2020	Oil with brine	1.072
20	Thailand	5/2017	5/2020	Oil with brine	1.800
21	Thailand	7/2017	7/2020	Oil with brine	1.080
22	Thailand	3/2017	3/2020	Oil with brine	1.966
23	Spain	5/2016	5/2018	Oil with brine	2.700
24	Thailand	2/2016	2/2019	Oil with brine	1.452
25	Thailand	5/2017	5/2020	Olive oil with brine	0.295

Table 2. Mean contents of mercury (µg g^{-1}) in canned tuna samples

Metal	Standard Specification	Range	Mean	Standard Deviation
Mercury	0.5	0.052 - 7.543	1.002	1.514



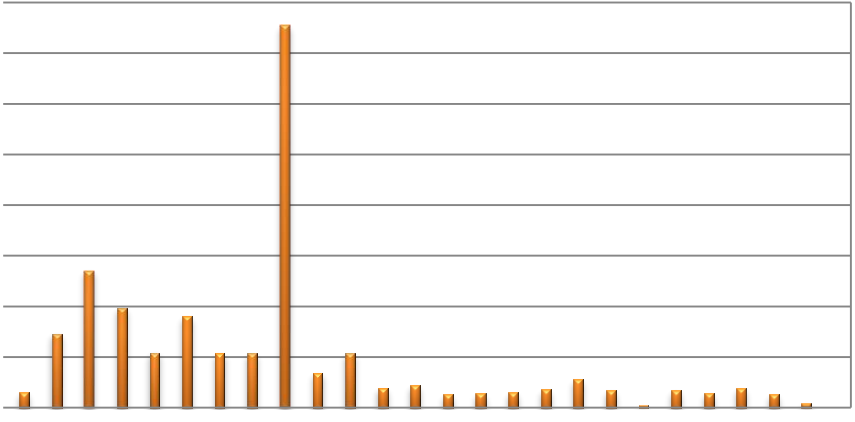


Figure 1. Mercury concentrations in canned tuna fish
Figure 2. Compare Mercury concentrations in canned tuna fish with WHO

From Table 1. the mercury was present in all canned tuna samples in this study, its varied concentrations from 0.052-7.543µg/g as

shown in Figure 1. The highest concentration was observed in sample number Seventeen 7.543µg/g. We also noted that the mercury content was high in most of the studied samples compared with those reported by other authors [13] [3] [9] as shown Table 3. Therefore, most of the canned tuna fish samples commonly consumed by Libyans analyzed in this study had mercury concentrations higher than 0.50 µg g-1 limit recommended by the [4] as shown in Figure 2.

Many studies have also shown that mercury is bio amplified in the food chain. As such, high-trophic level predatory species, such as tuna sharks and swordfish, generally have high mercury concentrations. Mercury can cause adverse effects on the renal and nervous systems and can cross the placenta with potential toxic effects on the fetus [2] [13].

Table 3. Mercury level (µg g-1) in canned tuna fish reported internationally

Country	Mercury	Reference
Libya	0.200 - 0.660	Voegborlo et al. 1999
Ghana	0.088 - 0.410	Boadi et al. 2011
Iran	0.100 - 0.205	Pourjafar et al. 2014
India	0.600 - 0.600	Mahalakshmi et al. 2014
USA	0.020 - 0.740	Ikem and Egiebor. 2005
Libya	0.052 - 7.543	Present study

Conclusion:

This study improves the baseline data and information on mercury concentration in canned tuna fish commonly marketed in Libya. Such data provide valuable information on safety of canned tuna fish commonly consumed by public. In addition, analytical data obtained from this study shows that there is health risks from some consumption of canned fishes analyzed when data are

compared with the US EPA classified health criteria for mercury in canned tuna fish.

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