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Comparative Study of Mercury in Canned and Fresh Indian Oil Sardine *Sardinella longiceps*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Essential and non-essential heavy metals are two categories for heavy metals. Small amounts of essential heavy metals are required by the human body to ensure its proper operation. High concentrations can become hazardous and change how the biochemical mechanisms that keep the human body functioning normally. The human body does not require non-essential heavy metals like mercury (Hg), which can be harmful to human health. Mercury can come from both natural and anthropogenic sources. When polluted soil and organisms are consumed by aquatic species, mercury bioaccumulates in their tissues, and its concentration rises up the food chain. Within the marine ecology, fish are at the top of the food chain. The aquatic food chain often starts with fish, and fish organs and tissues are at the top of the hierarchy and accumulate large amounts of heavy metals. In particular, the liver, kidney, and gill organs store metals (loids) at the highest level, and

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this varies depending on the type of metal; nonetheless, muscle is extensively examined as it is the main part of fish consumed by people. The muscular tissue of canned and fresh Indian oil sardines (*Sardinella longiceps*) was examined in the current investigation to determine the buildup of mercury there. Utilising a spectrophotometric analytical approach, stannous chloride was used for the analysis. Mercury levels in canned and fresh sardines were found to be 0.09 and 0.10 ppm, respectively. Sardines have a known Hg concentration of 0.04-0.18 ppm at the non-predator trophic level worldwide, which is also the level at which sardines may be consumed. Thus, the present sardines under study from Mumbai region are found to be suitable for consumption.

Keywords: Mercury; canned; Sardinella longiceps; spectrophotometer; bioaccumulation; marine ecosystem; toxicity.

1. INTRODUCTION

Heavy metals are classified into essential and non-essential heavy metals. Essential heavy metals are needed in small quantities by the human body to ensure their normal functioning. High quantities can become toxic and alter the normal biochemical processes of the human body's functions. Non-essential heavy metals like mercury (Hg) are not needed by the human body and can have adverse effects on the human health [1].

Sources of mercury can be both natural as well as anthropogenic. Natural sources that attribute to the accumulation of mercury in nature are soil and earth's crust. Hg can escape wastewater discharge from oil refineries in soil and water, leading to contamination of soil and water [2-4].

Mercury bioaccumulates in the tissues of aquatic species through the ingestion of contaminated soil and its concentration increases through the trophic chain [5]. Fish are at the top of the trophic levels in the marine ecosystem. The trophic chain starting from the bottom of the food chain to the top is as follows: heterotrophic (zooplankton and benthic invertebrates), herbivorous, and carnivorous (predatory fish). Therefore, predatory fish contain higher levels of Hg since they are placed at the top level of the trophic chain [6-9].

Fish are generally at the top of the aquatic food chain; fish organs and tissues accumulate the heavy metals in the environment. Especially the liver, kidney, and gill organs accumulate metal(loid)s at the highest level, and this varies according to the metal type, however, muscle is widely analysed as it is the main portion of fish consumed by humans. *Sardinella longiceps*, also known as the Indian oil sardine, is a species of fish that belongs to the family Clupeidae. It is found in the Indian Ocean and is an important food fish for people living in the coastal regions of India, Sri Lanka, and Maldives. *Sardinella longiceps* is a small pelagic fish that grows up to 25 centimetres in length. It has a silver-coloured body with a bluish-green back and a deeply forked tail. This species feeds on plankton and small fish and is an important prey for larger predatory fish, such as tuna and sharks. Sardines are canned in oil in large scales food industries where the safety, quality might be compromised [10].

Fig. 1. *Sardinella longiceps*

The carnivorous fish sharp nose shark (*Rhizoprionodon oligolinx*) had the highest Hg concentration 1.287 ppm compared to 0.0068 ppm for the Badah (Gerres oyena), which is considered an omnivorous fish [11]. When low or mid-trophic level species have high Hg, the Hg levels increase in the upper trophic level species (e.g., tuna fish). In addition, it was reported that deeper the water column of the ocean, the higher the Hg level in the fish species. For example, benthic species have higher Mercury levels than pelagic species (e.g., sardines and mackerels) [12,13].

A study showed that mesopelagic organism like Zooplanktons, shrimps, jelly fish and snipe had lower Hg levels compared to epipelagic organism [14]. The literature review clearly indicates that none of the research have focused on the Hg level of fresh and canned sardine fish along or near the Mumbai coast. Thus this research is relevant in this aspect.

2. MATERIALS AND METHODS

Procurement and preparation of the sample: The fresh and canned sardines were procured from the local fish market in Virar. They were brought to the Wilson College Zoology Laboratory in a small ice bucket so as to maintain the chilled condition. In the laboratory, the fish and the can were kept on ice to avoid any kind of deterioration due to temperature. The canned sardine fish meat was obtained after opening the can, while the fresh sardine was subjected to dressing by removing the scales, gut, head, fins, etc. The tissues were obtained by filleting, and that was used for the analysis purposes.

Chemical analysis: The fish tissues were subjected to pretreatment before being used for the analysis. 10 grammes of fresh sardine tissue and canned sardine tissue were weighed. They were kept separately in different beakers and mixed with a 1:1 dichloromethane: methanol solution, which was later homogenised using a mortar and pestle. Accurately 3 grammes of the homogenised test samples of fresh sardine tissue and canned sardine tissue were taken, and then 75 ml of oxalic acid solution, 75 ml of stannous chloride solution, and 15 ml of HCl solution were added to them. The entire mixture was refluxed for 2.5 hours and kept undisturbed for around 15 minutes until the flesh completely dissolved and a froth was observed.

The mixtures were then filtered through Whatman filter No. 1, and the filtered solution was diluted using 250 ml of distilled water. From this mixture, 5 ml of the final diluted solution was taken and was used for spectrophotometric estimation. The concentration was determined by comparing the O.D. of the test with that of the standard [15].

3. RESULTS

The level of mercury in the tissue of the fresh and canned sardine after the Stannous Chloride Spectrophotometric analysis is mentioned in the table.

Table 1. Level of mercury in the tissue of the fresh and canned sardine

Sr. No.	Sardine type	Mercury level (ppm)
1	Canned Sardine	0.09 ± 0.008
2	Fresh Sardine	0.10 ± 0.007

4. DISCUSSION

The fresh sardines are consumed more as the result of their accessibility and relative reasonable price by the local population. The mercury in sardines comes from the environment, where it is released into the water by industrial pollution and runoff from farms. Mercury can then be absorbed by plankton, which are eaten by small fish, which are then eaten by larger fish, such as sardines.

As the mercury moves up the food chain, it becomes more concentrated. Hence the concentration of mercury in the environment needs to be controlled and at the same time serving of sardine per week also needs to be restricted. Mercury exposure is also associated with increased risk of hypertension, myocardial infarction, coronary dysfunction, and atherosclerosis mercury exposure was linked with the progression of atherosclerosis and an increased risk of developing cardiovascular disease. Mercury levels are predictors of the levels of oxidized low-density lipoprotein (LDL) Oxidized LDL particles are frequently found in atherosclerotic lesions and are associated with the development of atherosclerotic diseases and acute coronary insufficiency [16].

Similar studies were carried out on Tunisian sardine and the maximum Hg content was 0.17 µg wet weight (1.7 times the mean), corresponding to 0.15 µg wet weight. For a person eating 100-150 g of sardines daily, the maximum amount of MeHg ingested is of 15-22 µg daily (105-153 µg weekly), a value of the same order of magnitude as the 200 µg permissible tolerable weekly intake (PTWI) for methylmercury proposed by World Health Organisation [17]. The concentration of mercury obtained Indonesia and Bali is 0.58 ± 0.65 mg/kg, and 0.938 ± 0.45 mg/kg, respectively. If a comparison is made with the concentration of mercury in fish in other locations in the world, the mercury concentration obtained in this study is quite high [18]. Hence it's the need of the hour that the release of mercury in the aquatic ecosystem needs to be controlled.

5. CONCLUSION

The results of the present study exhibit 0.10 ± 0.007 ppm and 0.09 ± 0.008 ppm mercury in Fresh and Canned sardine respectively. Globally the non-predator trophic level sardines are known to have Hg concentration of 0.04 – 0.18

ppm [19]. A concentration of 0.05 ppm mercury in sardines is considered to be low and poses no immediate health risk to adults. However, it is important to note that mercury is a cumulative toxin, meaning that it can build up in the body over time. As a result, it is important to limit your consumption of fish that are high in mercury, such as sardines, to two or three servings per week.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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