THE EFFECT OF WEIGHT COMPOSITION OF SARDINA PILCHARDUS FISHED FROM BENGHAZI COAST ON ITS CONTENT OF MERCURY AND LEAD

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Abstract

This study was conducted in order to evaluate the contents of mercury, and cadmium common fish in Benghazi coast nominated *Sardina Pilchardus*. The effects of the fishing area and weight composition on the accumulation of these minerals were also studied.

Data showed the concentration of mercury and lead in the tissues (muscles, gills, gut, and spinal column) of *Sardina Pilchardus* from Benghazi coast was 0.2331 ppm and 8.403 ppm, respectively. The weight composition of *Sardina Pilchardus* no significant differences were found for concentration of lead; the less concentration was observed in mussels and less concentration of mercury was found in the gut.

There was a fishing area effect on the content of these minerals; whereas the effect was clear for the concentration of lead in muscles, gills and spinal columns. The same effect was found for cadmium in the gill, gut and spinal column, while was an effect on mercury concentration was only in the spinal column.

Keywords: *Sardina Pilchardus*; Mercury; Lead; and Weight composition.

Introduction

Because of human activities and industrialization around the world, heavy metal levels in the ocean are becoming an issue (Javed & Usmani, 2016).

Three heavy metals lead (Pb), cadmium (Cd), and mercury (Hg)are the only ones among a variety of harmful compounds that contaminate fish and seafood that are included under the European Union's hazardous metals laws (Canli et al., 2018).

The World Health Organization (WHO) and the United States Environmental Protection Agency have designated metallic Elements, including lead (Pb), mercury (Hg), and cadmium (Cd) as harmful to humans. (USEPA, 2002).

In the recent era of modern society, environmental contamination is a significant problem. Heavy metals are well-known environmental contaminants that are more dangerous for marine life and living things in general because of their toxicity. A distinct class of naturally occurring elements known as heavy metals persists in the environment for a very long period of time and is not biodegradable (Kanamarlapudi et al., 2018).

Heavy metals can interact improperly with various intracellular structures and interfere with biological systems. Due to bioaccumulation, they are extremely harmful to humans and marine life even at very low doses. Therefore, even a trace amount of their presence in fish could pose a major risk to consumers' health. Chronic exposure to mercury and its constituents is dangerous to human health, particularly for fetuses and young children (Chahid et al., 2014).

Sardina Pilchardus is a rapidly growing and short-lived small pelagic fish species. It is one of the most important fish resources throughout its range in the northeastern Atlantic, from the North Sea to the Senegalese coast, including the Mediterranean and the Black Seas. Few previous studies have investigated the feeding behavior of sardine in the Mediterranean Sea (Borme et al., 2013), despite the ecological and commercial importance sardine in the Mediterranean (Palomera et al., 2007).

Pollution of marine ecosystems is a global problem, due to the ability of these ecosystems to concentrate and accumulate certain minerals within food chains (Jinadasa et al., 2010). This study focused on estimating the levels of mercury and lead in one of the common fish species on the coast of Benghazi, *Sardina Pilchardus* as well as studying the effect of the weight composition of fish on the accumulation of mercury and lead.

Materials and Methods

1. Study Area

This study focuses on three areas along the coast of the city of Benghazi, which are Dariana, Al-Sabri, and Qaminis, as shown on the following map.

Figure (1): The Three Study Areas are Shown on the Map of the Benghazi Coast.

2. Sampling and Sample Preparation

Fish samples were collected from the three study areas, where they were placed in diapers with a quantity of crushed ice in a ratio of 1:2 ice to fish and transferred to the laboratory in University of Benghazi. Once the fish samples arrived at the laboratory, the following tests were performed.

3. Estimation of the Weight Composition

The weight composition of the fish was estimated for each of the fishing areas, where the weight of all fish was estimated as total, scales, gut, fins, bones, head and meat for all samples. After that, the weighty composition of the thicker samples was estimated as the weight of each part of the fish's body, expressed as a percentage of the total weight (Mazen, 1983).

4. Heavy Metal Determination

Heavy metals were estimated for fish samples in muscles, gills, bones and guts as follows:

1. Digestion of Fish Samples

To avoid contamination of samples from external sources, all used tools and glassware were immersed in 20% nitric acid solution for 24 hours and then washed with distilled

water, then deionized water. After cutting and mixing the samples thoroughly, 1 g in a 100-ml beaker was digested with 20 ml of concentrated nitric acid (96%) and 3 ml of per chloric acid (60%); the beaker was covered, and the mixture was left to boil quietly over an electric preheater without apparent acid loss. During the first stage of digestion, the cover was lifted and the temperature was gradually raised until the white vapours rose and the digested sample turned into a clear, colourless liquid. Then the contents of the flask were cooled and 10 ml of a 1:1 hydrochloric acid solution was added. Finally, deionized water was added to the volume up to the mark (AOAC, 1980).

2. Estimation of Mercury

Determination of mercury by atomic absorption method using atomic absorption spectrophotometry of type Q A A 989 Furnce Unicam was conducted under the following operating conditions.

Cuvette Type	**Electrographite**
Ash temperature	200º C
Atomies temperature	750º C
20 ml of 66 mg/l gives about	0.1 A
Wave length	175 nm

3. Estimation of Lead

Lead was determined by the atomic absorption method using a Philips PU 9100X atomic absorption spectrophotometer (A. A. S) with a unit called a Slotted Tube Atom Trap (STA T) under the following operating conditions.

Cuvette Type	**Electrographite**
Wavelength nm	217
Lamp current M A	10
Slit width nm	0.5
Flow Rate Fuel/Air Acetylene/L	0.9- 1.2

5 Statistical Analysis

SPSS was used to analyses the difference to see if there was an effect because of the fishing areas, as well as if there were significant differences in heavy metal concentrations between the different tissues. The standard deviation SD of the averages was calculated too.

Results and Discussion

1. Effect of weight composition on heavy metal content

Table (1): Weight Composition of *Sardina Pilchardus* Fished from the Coast of Benghazi City.

Fishing Area	Fish Weight g	Weight Composition (% of Total Fish Weight)					
		Muscles and Skin	Head	Gut	Bone	Fins	Fish Scales
Dariana	44.25± 1.03	40.00±1.03	12.56±1.00	11.90±1.23	9.08±1.01	5.40±0.99	8.33±0.85
Al-Sabri	40.05±1.10	45.36±1.90	12.9±0.58	14.38±0.74	7.59±0.88	5.71±0.95	4.60±0.25
Qaminis	41.59±1.86	47.10±1.96	13.22±0.67	9.87±0.69	11.33±0.75	10.09±0.59	2.59±0.47

It is clear from the results in Table (1) that the weight of *Sardina Pilchardus* fish caught off the coast of Benghazi ranges between 40.05 g and 44.25 g, with an average of 41.96 g. The largest weight of sardine fish was from Dariana, and the lowest weight of sardine fish was in Al-Sabri.

From the results, it became clear that the percentage of parts suitable for human consumption (muscles and skin) of *Sardina Pilchardus* fish from the area of Durian represents 40% of the total weight, while the percentage of parts unfit for human consumption, which include the head, gut, bones, fins, and scales, represents 47.27 % of the total weight.

As for *Sardina Pilchardus* fished from Al-Sabri and Qaminis, the percentage of parts fit for human consumption was 45.36% and 47.10%, respectively. The percentage of parts unfit for human consumption was 45.18% and 47.077% of the total weight, respectively.

It is clear from the previous results that the net ratio percentage of sardine fish samples caught from the shores of Benghazi ranged from 40.00 to 40.10%, and these results were consistent with the net ratio percentage for several types of fish mentioned in the previous studies (Mazen, 1983 and Sheikh, 1999).

2. Mercury Content in Different Tissues of *Sardina Pilchardus* Fish

Table (2): Concentration of Elemental Mercury in Different Tissues of *Sardina Pilchardus* Caught off the Coast of the City of Benghazi.

Fishing Area	The Parts Anatomical			
	Muscle(ppm)	Gills(ppm)	Gut(ppm)	Spinal Column(ppm)
Dariana	0.0011±0.0010	0.0011±0.0010	0.0023±0.0017	0.0112±0.0011
Al-Sabri	0.0016±0.0012	0.0063±0.0015	0.0017±0.0013	0.012±0.002
Qaminis	0.0738±0.014	0.094±0.018	0.063±0.009	0.254±0.020
Average	0.0255±0.047	0.0338±0.0647	0.0223±0.032	0.0922±0.080

The average mercury concentration in different tissues of *Sardina Pilchardus* fish caught off the coast of Benghazi (Dariana, Al-Sabri, and Qaminis) is shown in Table (2). The average concentration of mercury in the muscles, gills, gut, and spinal column for all fishing areas is 0.0225 ppm, 0.0338 ppm, 0.0223 ppm, and 0.0922 ppm, respectively.

From the results of the statistical analysis, there are no significant differences between the three fishing areas in terms of mercury concentration in the muscles, gills, and gut of *Sardina Pilchardus* fish at a probability level of 0.05.

Table 2shows that the highest concentration of mercury in the spinal column of *Sardina Pilchardus* caught from the Qaminis area is 0.254 ppm, while the lowest concentration of mercury in the muscles and gills of *Sardina Pilchardus* is in the area of Darianaat 0.0011ppm.

In a previous study on mullet caught off the coast of Alexandria, Egypt, the concentration of mercury in the muscles ranged from 2.625 ppm to 5.088 ppm, in the gills from 0.618 ppm to 1.361 ppm, in the gut from 1.972 ppm to 4.796 ppm, and in the spinal column from 0.631 ppm to 1.854 ppm (EL-Sharnouby, 1983).

Aissiouie et al. (2022) reported that the highest average concentration of mercury in sardine muscles was 0.5 ppm.

The concentration of mercury, according to FAO/WHO, was 0.5 ppm. Comparing the concentrations of mercury in the muscles of *Sardina pilchardus* for this study was lower than the permissible concentration of FAO/WHO.

The results of previous studies confirm that the concentration of mercury in different tissues of fish is higher than the results obtained in this study.

3. Lead Content in Different Tissues of *Sardina Pilchardus* Fish

Table 3: Concentration of Elemental lead in Different Tissues of *Sardina Pilchardus* Caught off the Coast of the City of Benghazi.

Fishing Area	The Parts Anatomical			
	Muscle(ppm)	Gills (ppm)	Gut (ppm)	Spinal Column (ppm)
Dariana	0.660±0.021	2.330±0.092	11.55±1.070	3.772±0.629
Al-Sabri	0.2255±0.016	0.522±0.026	2.035±0.361	1.390±0.141
Qaminis	0.175±0.050	0.360±0.029	1.400±0.067	0.765±0.012
Average	0.363±0.112	1.070±0.380	4.995±0.611	1.975±0.254

From the results shown in Table (3), it is clear that the average concentration of lead in the different tissues of *Sardina Pilchardus* in the three study areas ranged from 0.363 ppm to 4.995 ppm, with an average of 2.11ppm for all tissues. The highest concentration of lead was in the gut, the spinal column, and then the gills, while the lowest concentration of lead was in the muscles.

The results obtained from this study do not agree with the results of previous studies.

In a previous study on mullet fish in Turkey, the concentration of lead in the muscles was 6.24 and in the gills, it was 20.84, which is higher than the concentrations of lead in this study (Kalay, 1999). In another study conducted on mullet fish from Lake Platon in Hungary, the concentration of lead in muscles was 1.53 ppm, gills 4.39 ppm, and gut 3.72 ppm (Farkas, 2002). The concentration of lead in the muscles of *Sardina Pilchardus* was 0.25 in an Algerian study (Aissioui et al., 2022).

FAO/WHO stated that the concentration of Lead in fish was 0.31. The lead concentration in muscle was within the permissible limits according to the international cadmium legislation.

Conclusion

To sum up, the results of examining the effect of the weight structure of *Sardina Pilchardus* fish on its content of heavy metals revealed that there are no significant differences at the probability level P 0.05 between the different tissues (muscles, gills, gut, and spinal column) of *Sardina Pilchardus* fish in terms of mercury concentration in all fishing areas. This low concentration of mercury in fish may be due to the low rate of pollution of the marine environment with mercury in the city of Benghazi. The results showed that there were significant differences at the probability level of $p<0.05$ between the different *Sardina Pilchardus* tissues in terms of lead concentration in all fishing areas. The lowest concentration of lead is in the muscles, while the mercury concentration is the lowest in the gut.

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