BIOMONITORING OF HEAVY METAL ACCUMULATION IN MUSCLE TISSUES OF *LOLIGO DUVAUCELII* COLLECTED FROM ENNORE AND ROYAPURAM COAST, CHENNAI

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Abstract

The present study was carried out in the muscle tissues of *Loligoduvaucelii* purchased from local fishermens of Chennai viz, Ennore and Royapuram were used to assess the levels of heavy metal contamination. Ennore coast receives untreated/treated effluents from Manali Industrial belt, which houses many chemical Industries. Royapuram mainly receives domestic sewage. Accumulation of certain essential and non-essential heavy metal such as arsenic, cadmium, chromium, nickel, lithium, lead, and iron were determined using ICP-OES. The results showed that heavy metal contamination in the tissues sampled were in order of Fe> Li > Cr > Ni > Cd > Pb > As in both locations were same. Arsenic was not traced whereas iron was found to be higher in its concentration. The level of contamination in *Loligoduvaucelii* by these heavy metals is compared to those studied in other parts of the world and the legal standards set by international legalizations.

Key Words:

Bioaccumulation, Heavy metals, *Loligoduvaucelii*,*Ennore*, Royapuram

1.Introduction

Cephalopods are increasingly important in global fisheries[1,2,3]They have a significant commercial value and are consumed worldwide, both as food and as a feed supplement[3,4,5,] Cephalopods have grown in popularity in recent years as export demand has soared. It is mostly due to their abundance and high nutritional value. Cephalopods may be significant vectors for metal transfer along aquatic food chains because they not only eat a variety of organisms known for their bioaccumulation capacity for both essential and non-essential metals but also serve as a major food source for a number of fish and cetacean species[6,7]

Squid is a widely consumed type of seafood that is used in cuisines all over the world. It is affordable, adaptable, and delicious. Squid are found abundantly in certain areas, and provide large catches for fisheries. Squid's nutritional value is superior to that of fish due to its high protein and phosphorus content as well as traces of calcium, thiamine, and riboflavin.

Heavy metal concentrations in aquatic creatures may serve as a bioindicator of their impact on organism and ecosystem health [8].Trace metals are accumulated by marine invertebrates from both water and food, and the process varies within the same invertebrate species depending on the metal. In heavy metal chemistry, the propensity of heavy metals to accumulate in marine creatures is of interest. The bioavailability of trace metals is the most important factor influencing tissue metal levels in marine biota. Information on the degree of heavy metal pollution in the coastal environment is critical since it poses a severe environmental health risk.

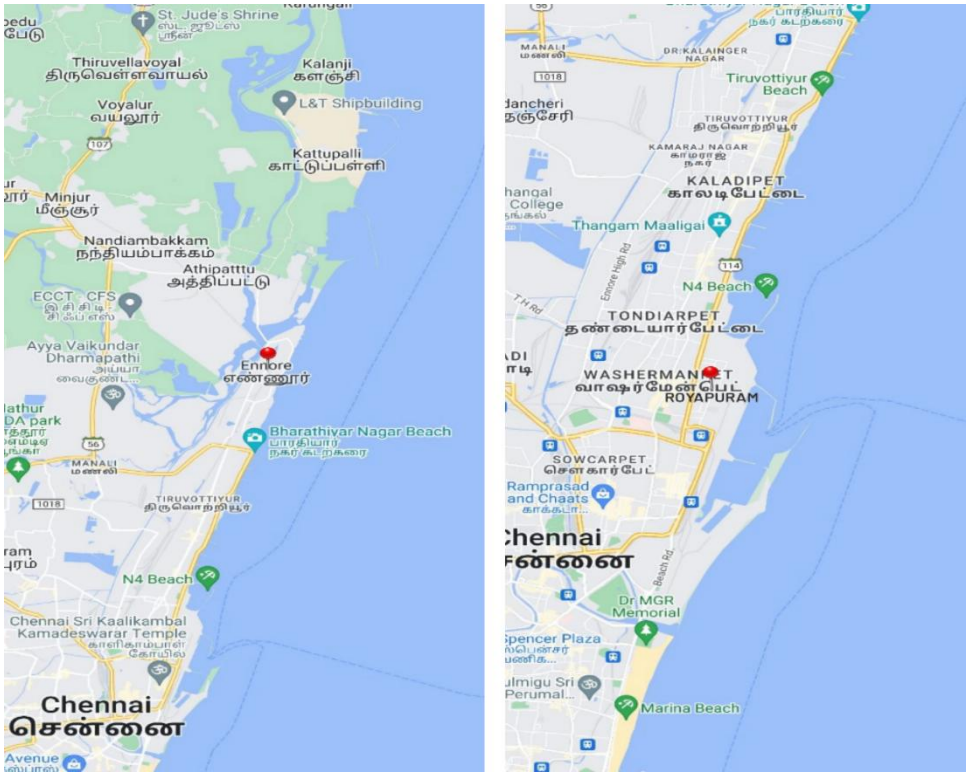
The number of heavy metals consumed by humans through seafood may be revealed by analyzing heavy metals along the food chain. Heavy metals are not degraded like organic pollutants do, thereby rendering remediation more difficult. In this regard, it is necessary to evaluate the presence of heavy metals in seafood in order to guarantee the food's safety for the benefit of human health.The baseline amounts of a few trace elements in the commercially significant Squid *Loligoduvaucelii* from Ennore and Royapuram, Chennai region, are reported in the current research.

2.Materials and methods

2.1 Study Area:

Ennore Creek (latitude 13°15′N and longitude 80°19′E) is nearly 800 m wide and elongated in a NE–SW direction. Ennore Creek is complex, the average depth rarely exceeding 5 m in the non-monsoon period, being fed by Kosasthalaiyar River and the Buckingham Canal; it is also connected to the Pulicat brackish water lake on the northern side, which once nurtured rich fauna and flora, including mangroves. It is located in the north-eastern part of Chennai, Tamil Nadu, India along the coast of Bay of Bengal. The Ennore Creek is the estuary of the river Kosasthalaiyar which is an outlet for the excess water from the Poondi reservoir. The Ennore Creek flows from the west to east and open into the Bay of Bengal, at Ennore[9].

Fig.1 Ennore and Royapuram - Location on map view



Royapuram fishing harbouralso known as **Chennai fishing harbour** or **Kasimedu fishing harbour** (13º06'16"Nlatitude and 80°17'31"E longitude), in the northern section of Chennai, is one of the city's most well-known angling grounds, under the administrative control of the Chennai Port Trust. For Seafood hunters, this is the place to be, as you can find hefty shellfish and a variety of dazzling fish heaped up in heaps. The breakwater inside the harbour leads up to 300 m into the sea.

2.2 Collection of Sample:

A total of 10 *Loligoduvaucelii samples* were purchased from local fishermen randomly at two main fish landing areas of Chennai viz, Ennore and Royapuram. The average length and whole-body weight of the commercially graded samples taken from Ennore and Royapuram mean values were 14 ± 17 cm and weight 20 ± 26 g respectively.

Collected samples were tagged and put in separate sterile polythene bags, immediately iced and brought to the laboratory in insulated boxes. These were either analyzed fresh or kept frozen (-18℃) until analysis.At the laboratory, Frozen samples were allowed to thaw at room temperature and processed for analysis.

Randomly collected Samples of*Loligoduvaucelii*from two locations were carefully dissected; the muscle tissues were isolated for the current study. The tissue collected were cleaned and sterilized with Saline water (sodium chloride), 2g of muscle tissue was weighed and homogenized manually using mortar and pestle and aliquots were taken for wet digestion. The external standard methods of the Inductively Coupled Plasma Optical Emission Spectrometry method (ICP-OES) were used for the determination of heavy metals[10].

2.3Statistical analysis

Data have been entered in to MS office 2007 excel spread sheet, coded and analysed by SPSS version 24. One way ANOVA was performed to assess whether heavy metal concentrations varied significantly between sites ($P < 0.05$) considered as statistically significant.

3. Results and Discussion

The primary purpose of the squid sample, *Loligoduvaucelii*, used for the study is that it is a significant edible component for human consumption**.** The present study was undertaken to evaluate the accumulation of certain essential and non-essential heavy metal such as arsenic, cadmium, chromium, nickel, lithium, lead, and iron in the muscle tissues of the edible Squid, *Loligoduvaucelii* collected from Ennore and Royapuram.

Analysis of heavy metal accumulation:

According to the overall mean value of the average metal accumulation in the squid samples taken from the study sites, the order of the metal accumulation in Ennore and Royapuram was observed to be as follows:

Fe > Li > Cr > Ni > Cd > Pb > As

Moreover, the order of heavy metal concentration in both the location were found to be similar, where the Iron (Fe) has the highest level of concentrations and the arsenic with the very low level of concentrations which is even below the detection level, among the seven metals analysed. Here we can observe that among the seven metals the toxic metals such as Cadmium, Lead, and Arsenic are of low concentration when compared to other essential trace elements. Findings of Sangita Sen and KaruppasamySudalaimuthu[11] suggest that in sediment and water samples taken for heavy metal accumulation, Fe, Mn, and Cr concentrations varied more between sampling locations than other elements, which exhibited a steady trend. Ca > Mn4 > Zn4 > Cr4 > Ni4 > Pb4 >Cu4 > Cd was the average amount of heavy metals that was on the decline.

Table1 - Maximum and Minimumheavy metal concentration(mg/L) in the muscle tissues of*Loligoduvaucelii* samples from Ennore and Royapuram.

ELEMENTS	**Sample size**	**ENNORE**		**ROYAPURAM**	
		Min	**Max**	**Min**	**Max**
Arsenic	5	Nil	Nil	Nil	Nil
Chromium	5	0.000	0.061	0.037	0.084

Cadmium	5	Nil	0.004	Nil	0.005
Lithium	5	0.008	0.112	0.024	0.127
Nickel	5	0.018	0.047	0.043	0.087
Lead	5	Nil	0.001	Nil	0.001
Iron	5	1.341	2.526	2.158	5.367

When compared with two different locations of samples collected, Royapuram region was noted with Maximum and Minimum concentration of heavy metals in the muscle tissues of *Loligoduvauceliiwas* inEnnore region (Table 1). Bioaccumalation of heavy metals in relation to mean and standard deviation is presented in the (Table 2, Fig 2) where Nickel and Iron showed significant differences in Ennore and Royapuram region, whereas other metals showed no significant difference.

Table 2- Heavy metal concentrations (mean± SD) (ppm wet) of squid *Loligoduvauceliicollected* from Ennore and Royapuram

Heavy Metal	**ENNORE Mean ± S.D**	**ROYAPURAM Mean ± S. D**	**F value**	**P value**
ARSENIC	.000± 0.000	.000±0.000	0	0
CHROMIUM	.042±0.246	.061±0.020	1.818	0.214
CADMIUM	.002±0.001	.003±0.002	.118	0.740
LITHIUM	.057±0.033	.065±0.037	.131	0.727
NICKEL	.027±0.013	.056±0.017	9.737	0.014*

LEAD	.000±0.000	.000±0.000	.000	1.000
IRON	1.967±0.497	3.372±1.239	5.535	0.046*

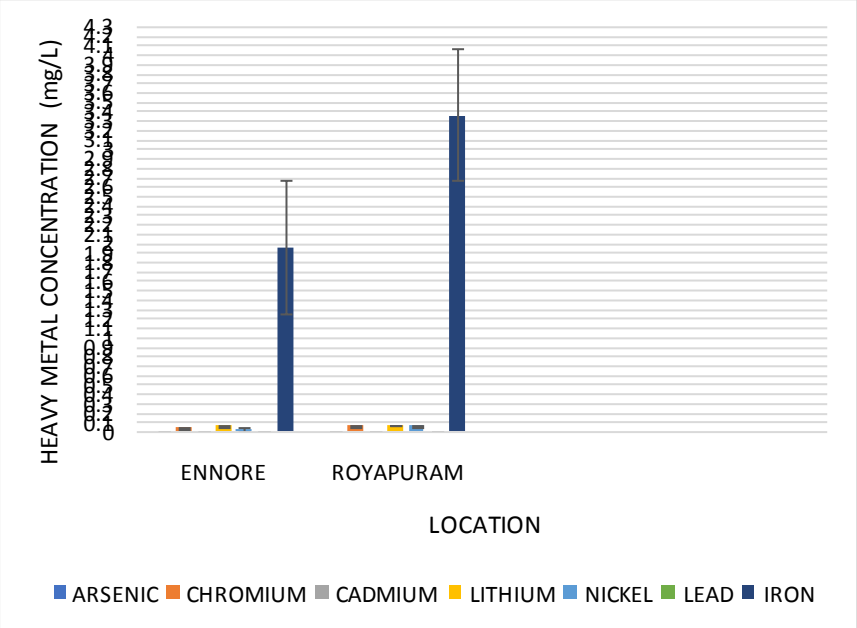
Note: (P< 0.05) statistically significant. (P >0.05) No significance difference.

*****Denotes significant at 5% level.

The significant differences of heavy metal concentration in two locations were found only in two metals among the seven metals, which is in Nickel (Ni) and Iron (Fe). At every station, Fe had the greatest value while Cd had the lowest which is partially similar to the study carried out. Our present findings are in correlation with researchers done in sediment[12].

These metals can enter an organism's body either directly from the abiotic environment, such as soil, water, or sediments, or indirectly through food. Molluscs, in this scenario, obtain it from the sediments and water. The heavy metals accumulate in these molluscs when they are devoured by the species at the next trophic level (such as fish and mammals) in the food chain, and this process leads to biomagnification [13].

Fig 2: Comparative graphical representation of mean values of heavy metals in squids*Loligoduvaucelii*-Ennore and Royapuram



At every station, Fe had the greatest value while Cd were comparatively lowwhich is partially similar to the study carried out. Our present findings are in correlation with researchers done in sediment by [12].Season had an impact on the concentrations of Fe, Cu, Zn, and Pb in the molluscs under study. The highest quantities of these metals were discovered during the monsoon season, when the habitat water was low in salinity and pHand Metal concentrations in *V.cyprinoides and M.casta. In P.viridis*drop during the summer months, when salinity and pH are high [14].

Squids' high levels of the metal are most likely due to environmental conditions and their dietary habits, as they eat a range of fish, shellfish, and crustaceans [15].Heavy metal deposition in Ennore may occur as a result of Kosasthalaiyar river water mixing with the Ennore estuary. The analysis of total heavy metal levels and distribution revealed that sediment from the Kosasthalaiyar river is contaminated with heavy metals as a result of the area's significant anthropogenic strain[11].

The metals analysed(Li, Cr, Ni, Cd,Pb and As) for current study were under permissible limit for squids which is correletated with the study carried out by Annie supriya etal.[10] but Iron content was higher. According to Satheeshkumar and Senthilkumar[16] the primary source of Fe in coastal waterways is owing to a reduction in grain size, an increase in organic matter and anthrapogenic metals from industrial pollution, as well as direct discharge of sewage and hospital waste into the water bodies.

According to the EPA (1993)[17], iron is the second most common metal in the earth's crust. The element iron is ranked 26th in the periodic table. Iron is a critical element for the growth and survival of nearly all living creatures [18,19].Crossing the rate-limiting absorption phase, an extraordinarily high level of iron enters the body and gets saturated. These free irons enter the heart, liver, and brain cells. Iron toxicity on cells has resulted in iron-mediated tissue damage including cellular oxidising and reducing pathways, as well as toxicity to intracellular organelles such as mitochondria and lysosomes. In addition to causing cellular damage, mutation, and malignant changes, the iron-produced hydrogen free radicals also target DNA, which leads to a variety of disorders[20].

Duysak et al. [21] and Ahmed et al. [22] concluded that the association between metal accumulation and cephalopod parts may be caused by the different metabolic processes, as well as other variables like the season, length, and weight, as well as the physical and chemical conditions of the water.

4.Conclusion

Squids, which are easily available for human consumption, may become contaminated through various sources in coastal regions, so continuous monitoring should be done by the government and other sectors for safe consumption of commercially available edible organisms. In the current investigation, the heavy metals are under permissible limits due to changes in various environmental factors. We may potentially have a better understanding of contamination from further research.

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Conflicts of interest

There are no competing interests in this study, according to the authors.

Ethical approval

No ethical issues

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