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# Presence of Metals in Commercially Important Prawns and Shrimps Species Collected From Mahim and Dadar Market of Mumbai (West Coast) of India

KEYWORDS: Prawn and shrimp, Heavy metals, Spectroscopy

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**ABSTRACT** *The Prawn and shrimp samples of were collected from local markets of Mahim and Dadar areas of Mumbai city from June to December 2013. These prawn samples were dried in the laboratory and, the dried prawns were crushed into a fine powder by mortar and pestle and stored in amber colored bottles in vacuum desiccators. These samples were evaluated by Atomic Absorption spectrophotometer for the determination of the ten heavy metals namely Cu, Zn, Mn, Fe, Co, Cr, Ni, Pb, Cd, and Hg. In the present work, the mean values at minimum and maximum concentrations of copper, zinc, iron and chromium in the prawns and shrimp samples are found below the maximum specified acceptable concentration where as Mn, cobalt, nickel, lead, and cadmium these values were found above the maximum specified acceptable concentration as prescribed by WHO. The mean values of the minimum and maximum concentrations of mercury in the prawns and shrimp samples were not detected as these concentrations were either less than 0.001ppm or absent in all the species of prawns and shrimps.*

## INTRODUCTION

Coastal belts are highly populated and urbanized with industries. Marine food such as fish, prawn, crab and mussel are delicacies and form an important staple part of daily food. Pollution of aquatic environments with heavy metals has seriously increased worldwide attention and under certain environmental conditions, fish, Prawns and shrimps may concentrate large amounts of some metals from the water in their tissues. Heavy metals such as Cu, Zn, Mn, Fe, Co, Cr, Ni, Pb, Cd, and Hg are potentially harmful to most organisms even in very low concentrations and have been reported as hazardous environmental pollutants able to accumulate along the aquatic food chain with severe risk for animal and human health (Desi *et al*. 1998). Toxic heavy metal can cause dermatological diseases, skin cancer and internal cancers (liver, kidney, lung and bladder), cardiovascular disease, diabetes, and anaemia, as well as reproductive, developmental, immunological and neurological effects in the human body(Rose *et al*. 1992) and (Lukawski et al. 2005).

Hence it is necessary to monitor the concentration of these contaminants in prawns and shrimps so that a warning signals can be given to the society in case the concentration levels cross the threshold limits. The available literature reveals that the inshore water of the above creeks around Mumbai possesses elevated levels of contaminants and their consistent inputs have resulted their high build up a marine organism particularly fishes, prawns and shrimps. Hence it is expected that the sea food available around Mumbai may have elevated levels of pollutants. These contaminants if determined can lead to identify causes of disease or toxic effects which would be prevented in the population.

At present the population of Mumbai is severally suffering from lots of disorders particularly respiratory and digestive due to air and drinking waters. Most of these causes have been identified and remedial measures have been taken up. However, toxic effect due to metal contamination of fish, Prawns and shrimps, which is a main diet of majority of the population of Mumbai is not primarily addressed and completely neglected. In fact the relevant toxic effect may be already prevalent in the society and most probably they may become severe in due course of time. Hence, the stage has already reached to address the problem in detailed and to dig the thought under the problem.

It is therefore necessary to determine the extent of contaminants in prawns and shrimps as one of the major source of food so that the warning signals can be given to the society in case the threshold limits have reached. Even otherwise it becomes necessary to educate the society of the social evils of pollution. The study can also provide the information on possible causes of pollution. So that mitigation measures to minimize the pollution can be taken in time.

## MATERIALS AND METHODS

### Sample Collection

The Prawn samples of were collected from local markets (Mahim and Dadar) of Mumbai city from June, 2013 to, December 2013. The Prawn samples packed in propylene bags and were stored at – 20 $^{0}$C in deep freezer in the Department of Zoology, S.S & L.S. Patkar College, Goregaon (West) Mumbai for further analysis.

### Sample Digestion:

Five replicates of samples containing shrimps in a Petri dish were oven dried at 80°C for 2 days to get the dry weight (DW). For digestion, 1 mL of concentrated nitric acid 70% was added to the 1 gm of dry weight samples and wait for 24 h, the samples were digested in Kjeldal flask. This mixture was digested by heating the flask in a heating mantel, at 100°C for 2 h, and 30 % hydrogen peroxide was added to it intermittently till a pale yellow-colored solution was obtained. The digestion flask was further heated gently until frothing subsided and the sample was then heated to dryness. The residue so obtained was left to cool for half an hour and dissolved in 30 ml of deionized water and the solution was filtered using Whatman filter paper No. 42. The digested sample was quantitatively transferred into 50 ml flask, and then diluted with distilled water up to the mark and stored in a polypropylene bottle. The above procedure was repeated for all the other samples. All above chemicals used were of analytical grade.

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**Preparation of standard metal ion solutions:**
Stock solutions (1µg / ml) of each of the metal ions were prepared using appropriate metal salt of AR grade quality in dilute hydrochloric acid. The working standards of these solutions were prepared by appropriate dilutions in distilled water.

**Instrumentation:**
The samples were analyzed on Inductively Coupled Plasma Atomic Emissions Spectroscopy (ICP-AES, Model ARCOS *from M/s. Spectro, Germany*) at the Sophisticated Analytical Instrument Facility (RSIC), Indian Institute Of Technology (IIT) Powai, Mumbai-400076, India.

**Chemicals and Reagents:**
All the chemicals and reagents were procured from S.D. Fine Chemicals were of AR grade quality.

**RESULTS AND DISCUSSION**

**Table No. 1. Range of heavy metals in prawn and shrimps species collected from Mahim market of Mumbai**

| S.No. | Name of the prawn/ Shrimp | Metal Ions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cu | Zn | Mn | Fe | Co | Cr | Ni | Pb | Cd | Hg |
| 1 | Microbrachium rosenbergii | 0.712 | 2.118 | 7.316 | 5.161 | 0.016 | 0.099 | 1.124 | 3.121 | 0.217 | ND |
| 2 | Solenocera crassicornis | 1.227 | 1.781 | 6.534 | 5.398 | 0.068 | 0.087 | 1.028 | 3.439 | ND | ND |
| 3 | Metapenaeus Monoceros | 1.199 | 1.393 | 6.716 | 3.234 | ND | 0.058 | 1.022 | 4.548 | ND | ND |
| 4 | Metapenaeus affinis | 1.826 | 1.809 | 7.528 | 4.917 | ND | 0.089 | 1.112 | 2.235 | 0.521 | ND |
| 5 | Parapenaeopsis hardwickii | 1.991 | 3.297 | 7.284 | 8.423 | 0.015 | 0.076 | 1.023 | 2.211 | 0.340 | ND |
| 6 | Parapenaeopsis sculptilis | 1.136 | 2.532 | 6.183 | 4.653 | ND | 0.871 | 1.012 | 1.738 | ND | ND |
| 7 | Penaeus indicus | 1.243 | 2.962 | 6.382 | 4.238 | ND | 0.987 | 2.025 | 1.234 | 0.434 | ND |
| 8 | Penaeus monodon | 1.226 | 3.424 | 7.873 | 4.274 | 0.091 | 0.095 | 1.038 | 4.136 | ND | ND |
| 9 | Penaeus japonicus | 1.978 | 4.397 | 6.667 | 5.987 | 0.017 | 0.018 | 0.034 | 3.765 | 0.126 | ND |
| 10 | Penaeus semisulcatus | 1.306 | 2.121 | 6.288 | 7.652 | 0.019 | 0.079 | 0.033 | 2.876 | ND | ND |

***Each value is the average of 5 determinations.**

**Table No. 2. Range of heavy metals in prawn and shrimps species collected from Dadar markets of Mumbai**

| S.No. | Name of the prawn/ Shrimp | Metal Ions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cu | Zn | Mn | Fe | Co | Cr | Ni | Pb | Cd | Hg |
| 1 | Microbrachium rosenbergii | 1.781 | 4.397 | 5.311 | 5.873 | 0.096 | 0.049 | 1.215 | 2.118 | 0.221 | ND |
| 2 | Solenocera crassicornis | 1.226 | 4.765 | 6.112 | 2.756 | ND | 0.087 | 0.011 | 3.127 | ND | ND |
| 3 | Metapenaeus Monoceros | 1.212 | 2.453 | 6.876 | 3.224 | ND | 0.095 | 1.038 | 4.342 | ND | ND |
| 4 | Metapenaeus affinis | 2.287 | 2.338 | 6.238 | 4.872 | ND | 0.081 | 0.225 | 2.146 | 0.465 | ND |
| 5 | Parapenaeopsis hardwickii | 1.876 | 2.245 | 7.174 | 7.123 | 0.015 | 0.071 | 0.029 | 2.121 | 0.340 | ND |
| 6 | Parapenaeopsis sculptilis | 1.291 | 4.912 | 4.254 | 6.152 | ND | 0.024 | 1.015 | 1.137 | ND | ND |
| 7 | Penaeus indicus | 2.283 | 2.224 | 6.283 | 4.342 | ND | 0.057 | 0.023 | 1.833 | 0.792 | ND |
| 8 | Penaeus monodon | 1.243 | 2.145 | 7.125 | 4.543 | 0.011 | 0.061 | 1.022 | 3.113 | ND | ND |
| 9 | Penaeus japonicus | 0.111 | 1.211 | 6.112 | 5.839 | 0.068 | 0.088 | 0.097 | 2.132 | 0.111 | ND |
| 10 | Penaeus semisulcatus | 1.217 | 2.125 | 6.476 | 7.496 | 0.012 | 0.059 | 0.097 | 1.123 | ND | ND |

***Each value is the average of 5 determinations.**

**Cu**
Copper is an essential trace metal for all living organisms, and also required by crustacean species as an essential part of their oxygen-carrying pigment haemocynin Engel, et al., 1981.

Excess accumulation of copper in hepatic cells causes liver diseases Walshe, (1984). Abnormal accumulation of copper in the tissues and blood is a point of similarity with genetic disease of man called Wilson's disease Jones & Hunt (1983) and Lee and Garvey (1998). Most absorbed copper is stored in liver and bone marrow where it is bound to metallothionein Sarkar et al. (1983), and acute exposure to copper results in nausea, vomiting, bloody diarrhea, hypertension, uremia and cardiovascular collapse Gossel & Bricker (1990).

Abu-Samra et al., (1975) reported that the presence of copper in shell fish was 20.0 ppm which was found below the permissible limit. Ismail 1993; Patimah1993 and Dainal; 1993 and Awaluddin, et al 1992; Malaysia have reported the accumulation of heavy metal copper in *Penaeus mono-*

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*don* was (0.8 ppm to 24.0 ppm); (32. 0 ppm to 99.0 ppm) and (12.8 ppm to 159.0 ppm) which was found above the permissible limit. Krishnamurti et al., (1999) have evaluated the concentration of metals in shrimps and crabs from the Thane – Bassen creek system, Maharashtra and the amount of copper found in *Parapenaeopsis hardwickii* was (22.6 ppm to 30.50 ppm); *Macrobrachium rude* (21.9 ppm); *Metapenaeus brevicarnis* (41.3); *Exapalemon stylifera* (33.0 ppm) and *Penaeus indicus* (25.4 ppm) which was found above the permissible limit. Mitra et al., 2010 analyze the concentration of copper in muscle tissue of five commonly edible shrimp species, namely *Penaeus monodon, Penaeus indicus, Penaeus semisulcatus, Penaeus marguensis* and *Metapenaeus brevicornis* collected from the lower stretch of the River Ganga (in the Sundarbans delta complex) and the concentration of copper in shrimp species ranged from (3.43 ppm to 140.49 ppm) which was found above the permissible limit. Mitra et al., 2012 further evaluated the trace metals in commercially important crustaceans collected from UNESCO Protected World Heritage Site of Indian Sundarbans and they found that the concentration of copper was (2.29 ppm) which was found below the permissible limit. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of copper in *Penaeus indicus* was (0.002 ppm to 0.171 ppm ) and in *Penaeus indicus pencillantus* (0.000ppm to 0.058 ppm ) was found below the permissible limit. Nayem, et al ., 2011 Collected prawn samples from local market showed concentration of Cu was from 0.01 to 0.11 ppm which was found below the permissible limit. The study carried by Levent et al., 2013 have been measured the concentration of copper in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 5.85 ppm to 14. 77 ppm was found below the permissible limits.

In the present work, the values of the mean minimum and maximum concentrations of copper in the prawns and shrimp samples collected from Mahim market are found to be 0.712 ppm in *Microbrachium rosenbergii and* 1.991 ppm in *Parapenaeopsis hardwickii* and from Dadar market are 0.111 ppm in *Penaeus japonicas* and 2.287 ppm in *Metapenaeus affinis* respectively. These values were found below the specified Maximum acceptable concentration as prescribed by (30 ppm) WHO (1989) and (10 ppm) by FAO maximum limits for prawn.

**Zn**

Zinc is called an "essential trace element" because a very small amount of zinc is necessary for human health Casarett & Doull's (1996). It is also used for asthma; diabetes; high blood pressure; acquired immunodeficiency syndrome (AIDS); Alzheimer's disease, Down syndrome, Hansen's disease, ulcerative colitis, peptic ulcers and promoting weight gain in people with eating disorders such as anorexia nervosa Casarett & Doull's (1996).

Both acute and chronic toxicity syndromes occur with large overdoses of zinc and the principal features are epigastric pain, diarrhea, nausea and vomiting. In addition to the gastrointestinal effects, the central nervous system may be affected, showing symptoms such as irritability, headache and lethargy (Hambidge et al., 1986).

Patimah 1993 and Dainal 1993; Ismail 1993 have reported the accumulation of heavy metal zinc in Penaeus monodon in Malaysia was (68.8 ppm to 186.0 ppm) and (5.0 ppm to 16.0 ppm) higher value was found above the WHO limits. Krishnamurti et al., (1999) have evaluated the concentration of metals in shrimps and crabs from the Thane – Bassen creek system, Maharashtra and the amount of Zn found in *Parapenaeopsis hardwickii* was (64.7 ppm to 130.2 ppm); *Macrobrachium rude* (62.0 ppm); *Metapenaeus brevicarnis* (50.7 ppm); *Exapalemon stylifera* (67.5 ppm) and *Penaeus indicus* (67.5 ppm) which was found below the WHO limits. Hanan et al., 2009 has found that the residues osf some heavy metals and hormones in fresh water prawn *Macrobrachium rosenbergii* and marine shrimp *Penaeus semisulcatus* with reference to the nutritive value and the amount of zinc was found to be (75.614 ppm ) in fresh water prawn and in marine shrimp it was (51. 834 ppm) which was found below the WHO limits. Mitra et al., 2010 analyze the concentration of cadmium in muscle tissue of five commonly edible shrimp species, namely *Penaeus monodon, Penaeus indicus, Penaeus semisulcatus, Penaeus marguensis* and *Metapenaeus brevicornis* collected from the lower stretch of the River Ganga (in the Sundarbans delta complex) and the concentration of zinc in shrimp species ranged from (4.11ppm to 353.45 ppm). Mitra et al., 2012 further evaluated the trace metals in commercially important crustaceans collected from UNESCO Protected World Heritage Site of Indian Sundarbans and they found that the concentration of zinc was (23.9 ppm) which was found below the WHO limits. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of zinc in *Penaeus indicus was* (1.032ppm to 1.542 ppm ) and in *Penaeus indicus pencillantus* (0.191ppm to 0.282 ppm ) which was found below the WHO limits . Mustafa et al., 2012 have evaluated the concentration of zinc in *Acetes indicus* collected from Malacca and Kedah and the concentration was (45.79 ppm and 45. 08 ppm) which was found below the WHO limits . Levent et al., 2013 have been measured the concentration of cadmium in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 0.219 ppm to 0.491 ppm which was found below the WHO limits.

In the present work, the values of the mean minimum and maximum concentrations of zinc in the prawns and shrimp samples collected from Mahim market are found to be 1.393 ppm in *Metapenaeus Monoceros* and 4.397 ppm in *Penaeus japonicas* and from Dadar market are 1.211 ppm in *Penaeus japonicas* and 4.912 ppm in *Parapenaeopsis sculptilis* respectively. These values were found below the specified Maximum acceptable concentration WHO (1992) limits (1000 ppm).

**Mn**

Manganese is a mineral that is required in small amounts in the human body, in normal conditions, contains about 10 mg to 20 mg of manganese, and it is present in enzymes like oxidoreductases, transferases, hydrolases, lyases, isomerases, and ligases (Oga, 2008; Goldhaber 2003) which are necessary for several biological functions.

High levels of manganese in human body can cause dermatitis, problems in the glucose metabolism and of proteins, mitochondria abnormalities, infertilities, bad formation of the bones, decrease of the serum cholesterol, and other diseases (ATSDR, 2000). Excess of manganese can be a toxicant and the nervous system seems to be the

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most vulnerable to it (Erikson et al., 2007).

Hossaina, (2001) have found the trace metal Mn in Penaeid shrimp and Spiny lobster from the Bay of Bengal and the concentration of Mn was found to be in Penaeid shrimp (*Penaeus monodon*) and Spiny lobster (*Panulirus polyphagus*) 3.10 ppm to 15.2 ppm Which was found above the permissible limit. Adedeji and Okocha 2011 evaluated the bioaccumulation of Mn in prawns from Epe Lagoon and Asejire River in Southwest Nigeria was found to be 94.61 ppm which was found above the permissible limit. Mustafa et al., 2012 have evaluated the concentration of Mn in *Acetes indicus* collected from Malacca and Kedah and the concentration was (6.10 ppm and 6.95 ppm) which was found above the permissible limit. Levent et al., 2013 have been measured the concentration of nickel in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal Mn concentration in *C. crangon* was 6.0 ppm to 15.0 ppm which was found above the permissible limit as prescribed by WHO.

In the present work, the values of the mean minimum and maximum concentrations of Mn in the prawns and shrimp samples collected from Mahim market are found to be 6.183ppm in *Parapenaeopsis sculptilis* and 7.873ppm in *Penaeus monodon* and from Dadar market are 4.254ppm in *Parapenaeopsis sculptilis* and 7.125ppm in *Penaeus monodon* respectively. These values were found above the specified Maximum acceptable concentration (1 ppm) as prescribed by limits WHO (1989).

**Fe**

The ingestion of large quantities of iron results in haemochromatosis a condition in which normal regulatory mechanisms do not operate effectively, leading to tissue damage as a result of the accumulation of iron. This condition rarely develops from simple dietary overloading Watt, and Merrill, (1963). Tissue damage has occurred, however, in association with excessive intake of iron from alcoholic beverages in some cases of alcoholism. Tissue damage has also resulted from prolonged consumption of acidic foodstuffs cooked in iron kitchenware Hopps (1972).

Hossaina, (2001) have found the trace metal iron in Penaeid shrimp and Spiny lobster from the Bay of Bengal and the concentration of iron was found to be in Penaeid shrimp (*Penaeus monodon*) and Spiny lobster (*Panulirus polyphagus*) 9.0 ppm and 110.0ppm which was found above the permissible limit. Hanan et al., 2009 has found that the residues of some heavy metals and hormones in fresh water prawn *Macrobrachium rosenbergii* and marine shrimp *Penaeus semisulcatus* with reference to the nutritive value and the amount of iron was found to be (39.276 ppm ) in fresh water prawn and in marine shrimp it was (30.382 ppm) which was found below the permissible limit. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of iron in *Penaeus indicus was* (0.009 ppm to 0.542ppm) and in *Penaeus indicus pencillantus* (0.061ppm to 0.396 ppm) which was found below the permissible limit. Levent et al., 2013 have been measured the concentration of cadmium in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The concentration heavy metal iron in *C. crangon* was 30.0 ppm to 58.0 ppm which was found below the permissible limit.

In the present work, the values of the mean minimum and maximum concentrations of iron in the prawns and shrimp samples collected from Mahim market are found to be 3.234 ppm in *Metapenaeus Monoceros* and 8.423 ppm in *Penaeus monodon* and from Dadar market are 4.254ppm in *Parapenaeopsis hardwickii* and 7.496 ppm in *Penaeus semisulcatus* respectively. These values were found below the specified Maximum acceptable concentration (100 ppm) limits by WHO 1989 for prawn.

**Co**

Cobalt is not often freely available in the environment, but when cobalt particles are not bound to soil or sediment particles the uptake by plants and animals is higher and accumulation in plants and animals may occur. Cobalt is used in many alloys (super alloys for parts in gas turbine aircraft engines, corrosion resistant alloys, high-speed steels, cemented carbides), in magnets and magnetic recording media, as catalysts for the petroleum and chemical industries, as drying agents for paints and inks. The radioactive isotopes, cobalt-60, is used in medical treatment and also to irradiate food, in order to preserve the food and protect the consumer. Cobalt is beneficial for humans because it is a part of vitamin B12, which is essential for human health. Cobalt is used to treat anaemia with pregnant women, because it stimulates the production of red blood cells. However, too high concentrations of cobalt may damage human health, mainly with people that work with cobalt. Health effects may also be caused by radiation of radioactive cobalt isotopes. This can cause sterility, hair loss, vomiting, bleeding, diarrhea, coma and even death.

Arun Kumar and Hema Achyuthan 2007 have evaluated the concentration of heavy metal chromium accumulation in certain marine animals along the East Coast of Chennai, Tamil Nadu, India and they found the concentration of cobalt was (0.0001 ppm). The study carried by Levent et al., 2013 have been measured the concentration of cobalt in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 0.24 ppm to 0.61 ppm.

In the present work, the values of the mean minimum and maximum concentrations of cobalt in the prawns and shrimp samples collected from Mahim market are found to be 0.015 ppm in *Parapenaeopsis hardwickii* and 0.091ppm in *Penaeus monodon* and from Dadar market are 0.011ppm in *Penaeus monodon* and 0.096 ppm in *Macrobrachium rosenbergii* respectively. These values were found above as compared with Arun Kumar K and Hema Achyuthan 2007 and found below with Levent et al., 2013.

**Cr**

The particulates of chromium enter the aquatic medium through effluents discharged from tanneries, textiles, electroplating, mining, dyeing and printing industries (Mertz, 1992, 1993; Burton et. al 1993; Burton, 1995). Chromium compounds have been found to be mutagenic and carcinogenic in a variety of test systems. Chromium is also a compound of biological interest, probably having a role in glucose and lipid metabolism as an essential nutrient (Lingard et. al 1979). Death in acute chromium poisoning is usually due to uraemia. Chronic intoxication by inhalation or skin contact leads to incapacitating eczematous dermatitis, with oedema and ulceration.

Arun Kumar and Hema Achyuthan 2007 have evaluated the concentration of heavy metal chromium accumulation

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in certain marine animals along the East Coast of Chennai, Tamil Nadu, India and they found the concentration of chromium was (0 .0 ppm to 0.002 ppm) which was found below the permissible limit. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of chromium in *Penaeus indicus* was (1.626 ppm to 1.983 ppm ) and in *Penaeus indicus pencillantus* (1.212ppm to 1.824 ppm ) which was found below the permissible limit WHO (1989) but was found above as compared with FAO (1 ppm) maximum limits for prawn.

In the present work, the values of the mean minimum and maximum concentrations of chromium in the prawns and shrimp samples collected from Mahim market are found to be 0.018 ppm in *Penaeus japonicus* and 0.987 ppm in *Penaeus indicus* and from Dadar market are 0.024 ppm in *Parapenaeopsis sculptilis* and 0.095 ppm in *Metapenaeus Monoceros* respectively. These values were found above as compared with Arun Kumar K and Hema Achyuthan 2007 and found below with Levent et al., 2013 which was found below the permissible limit as prescribed by WHO (1989) (50 ppm) and by FAO(1 ppm) maximum limits for prawn.

**Ni**

Nickel is called the depression and suicide metal as it is associated with these feelings and symptoms. It is a particularly deadly toxic metal Sunderan and Oskarsson, (1991).

Cocoa is one of the foodstuffs with higher than average natural nickel content. Small amount of nickel is needed by the body to produce red blood cells. However, excess amount can become toxic (Sunderan and Oskarsson, 1991).

Krishnamurti et al., (1999) have evaluated the concentration of metals in shrimps and crabs from the Thane – Bassen creek system, Maharashtra and the amount of nickel found in *Parapenaeopsis hardwickii* was (0.008 ppm to 0.009 ppm); *Macrobrachium rude* (0.004 ppm); *Metapenaeus brevicarnis* (0.010 ppm); *Exapalemon stylifera* (0.006 ppm) and *Penaeus indicus* (0.04 ppm) which was found below the permissible limit as prescribed by WHO. Hossaina, (2001) have found the trace metals in Penaeid shrimp and Spiny lobster from the Bay of Bengal and the concentration of nickel was found to be in Penaeid shrimp (*Penaeus monodon*) and Spiny lobster (*Panulirus polyphagus*) 0.2 ppm and 0.6ppm which was found below the permissible limit as prescribed by WHO. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of nickel in *Penaeus indicus* was (0.142 ppm to 0.240 ppm) and in *Penaeus indicus pencillantus* (0.116 ppm to 0.207 ppm) which was found below the permissible limit as prescribed by WHO. Levent et al., 2013 have been measured the concentration of nickel in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 2.0 ppm to 6.0 ppm which was found above the acceptable concentration 0.5ppm to 1.0 ppm by WHO (1989).

In the present work, the values of the mean minimum and maximum concentrations of nickel in the prawns and shrimp samples collected from Mahim market are found to be 0.033 ppm in *Penaeus semisulcatus* and 2.025 ppm in *Penaeus indicus* and from Dadar market are 0.011 ppm in *Solenocera crassicornis and* 1.215ppm in *Macrobrachium rosenbergii* respectively. The upper maximum limits were found above the acceptable concentration 0.5ppm to 1.0 ppm by WHO (1989).

**Pb**

It is known as deadely and accumulative poison even when consumed in small quantaties and is capable of deadling nerve receptor in man Bodansky, and Latener, 1987. The main sources of lead pollution in the environment include effluents & emissions from industries, emissions from vehicles running on leaded petrol, the smoke and dust emissions of coal and gas-fired power stations, use of lead sheets by roofers as well as the use of paints and anti-rust agents. Contamination by lead of foodstuffs is caused by the soldered seams of cans and the soldered closures of condensed milk cans, the metal caps of wine bottles and, also by lead pipes used in drinking water systems Bodansky, and Latener, 1987.

From the public health point of view, lead toxicity reportedly causes renal tubular dysfunction indicated by proteinuria, aminoaciduria, glucosuria, hyperphosphaturia and impairment of sodium transport Goyer (1986) and Manahan (1992).

Abu-Samra et al., (1975) reported that the presence of lead in shell fish was 2.0 ppm which was found above the permissible limit. Awaluddin, et al 1992; Ismail, 1993; Patimah, 1993 and Dainal; 1993 Malaysia have reported the accumulation of heavy metal lead in *Penaeus monodon* was (4.6 ppm to32.0 ppm); (1. 68 ppm to 54.0 ppm) and (0.1 ppm to 5.9 ppm) which was found above the permissible limit. Krishnamurti et al., (1999) have evaluated the concentration of metals in shrimps and crabs from the Thane – Bassen creek system, Maharashtra and the amount of lead found in *Parapenaeopsis hardwickii* was (0.003 ppm); *Macrobrachium rude* (0.009 ppm); *Metapenaeus brevicarnis* (0.00 ppm); *Exapalemon stylifera* (0.002 ppm) and *Penaeus indicus* (0.06 ppm) which was found below the permissible limit. Hossaina, (2001) have found the trace metals in Penaeid shrimp and Spiny lobster from the Bay of Bengal and the concentration of lead was found to be in Penaeid shrimp (*Penaeus monodon*) and Spiny lobster (*Panulirus polyphagus*) 17.5 ppm and 105.1 ppm which was found above the permissible limit. Hanan et al., 2009 has found that the residues osf some heavy metals and hormones in fresh water prawn *Macrobrachium rosenbergii* and marine shrimp *Penaeus semisulcatus* with reference to the nutritive value and the amount of zinc was found to be (0.46 ppm) in fresh water prawn and in marine shrimp it was (0.43 ppm) which was found below the permissible limit. Mitra et al., 2010 analyze the concentration of lead in muscle tissue of five commonly edible shrimp species, namely *Penaeus monodon* (4.29 ppm); *Penaeus indicus*(7.48 ppm); *Penaeus semisulcatus*(8.21 ppm); *Penaeus marguensis* (7.11 ppm); and *Metapenaeus brevicornis* (2.07 ppm); collected from the lower stretch of the River Ganga (in the Sundarbans delta complex) and the concentration of lead in shrimp species ranged from (3.43 ppm to 140.49 ppm) which was found above the permissible limit. Tabinda et al 2010 evaluated the toxic and essential trace element, contents in the muscle of prawns of two prawn species from Keti Bunder and they found that the mean concentrations of lead in *Penaeus indicus* was (0.098 ppm to 0.114 ppm ) and in *Penaeus indicus pencillantus* (0.052 ppm to 0.282 ppm ) which was found below the permissible limit. Okocha and Adedeji 2011 have found that the concentration lead in Prawn (*Macrobrachium Vollenhovenii*) (5.22 ppm) in Asejire river and (9.18 ppm) in Epe Lagoon which was found above the permissible limit. The study carried by Levent et al., 2013 have been measured the concentration of lead in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 0.291 ppm to 0.491 ppm which was found below the permissible limit.

In the present work, the values of the mean minimum and maximum concentrations of lead in the prawns and shrimp samples collected from Mahim market are found to be 1.234ppm in *Penaeus indicus* and 4.548 ppm in *Metapenaeus Monoceros* and from Dadar market are 1.123ppm in *Penaeus semisulcatus and* 4.342 ppm in *Metapenaeus Monoceros* respectively. These values were found above the specified Maximum acceptable concentration as prescribed by WHO 1992 (0.5ppm).

**Cd**

Cadmium a highly toxic metal, is present throughout the environment and accumulates in liver and kidney of mammals through the food chain Barber, 1998. Cadmium may enter into the aquatic bodies through sewage sludge and with the run off from agricultural lands as it is one of the major components of phosphate fertilizers. Also, the major sources of contamination include electroplating, paper, PVC plastic, pigments and ceramic industries, battery, mining and smoldering units and many other modern industries Gupta et al., 2003.

Ismail, 1993; Awaluddin, et al 1992 and Patimah, 1993 have evaluated the concentration of cadmium in tiger prawn *(Penaeus monodon)* in Malaysi and concentration of cadmium was found to be 1.6-6.1 ppm; 0.2-49.0 ppm and 0.1-0.8 ppm which were above the maximum permissible limits. Hossaina, (2001) analyze the concentration of cadmium concentrations in abdominal tissue and cephalothorax of Penaeid shrimp (*Penaeus monodon*) and Spiny lobster (*Panulirus polyphagus*) from the offshore fishing grounds of the Bay of Bengal, Bangladesh coast from January to December 1996 which ranged from Cd, ( 3.1 ppm to 15.2 ppm ) this was the first report of this element in Penaeid shrimp and Spiny lobster from the Bay of Bengal which was far above the maximum permissible limits. Kaoud and Eldahshan 2010 have found the cadmium accumulation in muscles of *M. rosenbrgii* was ranged from (0.005ppm to 0.065 ppm) which was above the maximum limits. Tabinda et al 2010 evaluated the toxic and essential trace element, contents of two prawn species *Penaeus indicus* ; *Penaeus indicus pencillantus* from Keti Bunder and they found that the mean concentrations of Cd ( 0.025ppm to 0.026 ppm ) in the muscle of prawn and it was found above the permissible limits. Mitra et al., 2010 analyze the concentration of cadmium in muscle tissue of five commonly edible shrimp species, namely *Penaeus monodon, Penaeus indicus, Penaeus semisulcatus, Penaeus marguensis* and *Metapenaeus brevicornis* collected from the lower stretch of the River Ganga (in the Sundarbans delta complex) and the concentration of cadmium in shrimp species ranged as (3.66 ppm ). Mitra et al., 2012 further evaluated the trace metals in commercially important crustaceans collected from UNESCO Protected World Heritage Site of Indian Sundarbans and they found that the concentration of cadmium in *Penaeus indicus* (0.021 ppm to 0.032 ppm) and in *Penaeus indicus pencillantus* (0.007 ppm to 0.058 ppm) which was found above the maximum permissible limits. Okocha and Adedeji 2011 have found that the concentration Cd in Prawns (*Macrobrachium Vollenhovenii*) (0.91ppm) which was above the maximum permissible limits. Nayem et al., 2011 have collected prawn samples from local market showed the range of Cd was 0.01 ppm to 0.06 ppm, which was above the maximum permissible limits. Adedeji and Okocha 2011, evaluated the bioaccumulation of cadmium in prawns from Epe Lagoon and Asejire River in Southwest Nigeria was found (Cd; 0.91 ppm ) above the maximum limits. Levent et al., 2013 have been measured the concentration of cadmium in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) collected from Samsun coasts in the Black Sea coast of Turkey in 2010. The heavy metal concentration in *C. crangon* was 0.228 ppm to 0.481ppm which was found above the maximum permissible limits.

In the present work, the values of the mean minimum and maximum concentrations of cadmium in the prawns and shrimp samples collected from Mahim market are found to be 0.126 ppm in *Penaeus japonicus* and 0.521 ppm in *Metapenaeus affinis* and from Dadar market are 0.111ppm in *Penaeus japonicus and* 0.792 ppm in *Penaeus indicus* respectively. These values were found above the specified Maximum acceptable concentration as prescribed by WHO (1984) 0.005 ppm.

**Hg**

Mercury is extremely harmful, even a concentration of 0.03 ppm in drinking water is not permissible. Mercury enters natural water through industrial discharge where by bacterial action it is converted into very stable and water soluble methyl mercury ion. Mercury which is taken up by fish and through food chain enters higher animals and man. Most of the fish today have a mercury concentration of 0.02-0.2ppm which is now considered 'normal'. In polluted water its concentration may be even 1ppm. Consumption of such fish is hazardous, which was indeed the cause of death of over one thousand persons in the Minamata Island of Japan, due to what goes by name ' Minamata disease'. Mercury deactivates sulphur containing enzymes with active –SH groups, affects brain cells and central nervous system. Symptoms of mercury poisoning are physical and emotional disturbances, self-consciousness, timidity, embarrassment with insufficient reasoning, anxiety, indecision, lack of concentration, depression or despondency, resentment of criticism, irritability or excitability, a complete change of personality as of the Mad Hatter, a character depicted in the well-known " Alice in Wonderland" story (Banerjea -1995).

Abu-Samra et al., (1975) reported that the presence of mercury in shell fish was 1.0 ppm which was found above the permissible limit as prescribed by WHO (1989) 0.02-0.2ppm for prawn.

In the present work, the values of the mean minimum and maximum concentrations of mercury in the prawns and shrimp samples were not detected as these concentrations were either less than 0.001ppm or absent in all the species of prawns and shrimps.

**CONCLUSION**

From the above results, in the case of metal contamination, Mn, cobalt, nickel, lead, and cadmium was found to be high in Prawn and shrimp samples collected from Mahim and Dadar markets. It can be assumed that the sea from where the Prawn and shrimp were collected might be receiving outfalls from industrial waste and sewage

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from the city as it faces the open Arabian Sea. The levels of heavy metals such as copper, zinc, iron and chromium in Prawn and shrimp samples collected from Mahim and Dadar markets were within permissible limits. These elemental toxicants may be transferred to man on consumption of Prawn and shrimp obtained from the market. These heavy metals transferred to man through the consumption of Prawn and shrimp, pose health hazards because of their cumulative effect in the body. Therefore, it was concluded that the Prawn and shrimp are not heavily burdened with metals, but a danger must be considered depending on the agricultural and industrial developments in this region. The Prawn and shrimp from Arabian sea should be monitored periodically to avoid excessive intake of trace metals by human, and to monitor the pollution of aquatic environment. In view of these findings strict method of waste disposal control should be adopted to ensure the safety of the environment and safeguard our aquatic life.

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