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Evaluation of Toxic Elements in Water Sediments and Commercially Important Shrimp Species Collected From Gorai Creak of Mumbai Suburb of (West Coast) India

KEYWORDS: Contamination, Creak, Sediments,Shrimps,Toxic elements,

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ABSTRACT *The trace elements in various tissues of different shrimp species, and in surface and bottom water sediments were analyzed using ICP-OES techniquethe possible roles of these trace elements in this regard are emphasized. Moreover, patterns of trace elements bioaccumulation and their order of occurrence have been evaluated. This paper also deals with comparison of the related data from different aquatic environments as well as existing guidelines and limits for human consumption. Comparison between the mean concentrations of the trace elements in Carapace, Gills, remaining body tissues and whole body tissues and in water samples are compared with existing guidelines, which indicate that the concentrations of K and Mg are well below the permissible levels for human consumption. However the concentrations of Li, Se,Sr, and Tl were observed somewhat higher than the recommended levels. The amounts of Te present in different tissues of shrimps and in water samples are not comparable with that of the other aquatic animals, drinking water standards or with the human body because tellurium is not regarded as a true trace element, in that there is no recognized biological role for tellurium in human tissues and no clinical deficiency syndrome.*

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. The tendency of heavy metals and some toxic elements to get accumulated in marine animals is of scientific interest in heavy metal chemistry. The bioavailability of trace metals is the key factor determining tissue metal levels in the marine biota. Trace metal uptake occurs directly from surrounding marine water across the permeable body surface and from food along with the seawater to the gut (Depledge and Rainbow, 1990). Fish, crab and prawn form an important link as possible transfer media to human beings. Information on the level of heavy metal pollution in coastal environment is important as they cause serious environmental health hazards (Nitta, 1992; Gupta and Srivastava, 2006; Shukla et al., 2007).

Arabian Sea enriches the Mumbai with a shore line of 100 Km, coastal areas in and around Mumbai are biologically most productive areas supporting a wealth of marine resources. Seafood mainly fish, prawns and shrimps consisting of fats and proteins obtained from seas around Mumbai serves as a vital diet to the large population of Mumbai and satellite areas. It is well known that numerous industries around Mumbai discharge their effluents containing toxic materials in the Ullhas estuaries, Vasai creeks, Thane creek, Mumbai bay and several minor creeks like Manori, Malad, Gorai and Mahim. The untreated domestic effluents containing high nutrients also enter the sea through eight main outfalls and several non point sources. Consequently these areas are reported to be highly polluted Chouksey (2002) and Aniruddha Ram (2003). 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 metal elements such as K, Li, Mg, Se, Sr, Te and Tl are potentially harmful and cause toxic effects to most organisms even in very low concentrations. These toxic effects can be introduced to large populations who are consuming prawns and shrimps as one of the major source of sea food. Toxic heavy metal can cause dermatological diseases, skin cancer and internal cancers (liver, kidney, lung and bladder), cardiovascular disease, diabetes, and anemia, as well as reproductive, developmental, immunological and neurological effects in the human body (Rose et al. 1992 and Lukawski et al. 2005).

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 in their high build up marine organisms particularly fish 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.

Internationally several organizations namely Food and Agriculture Organization (FAO 1983)), American Public Health Association APHA: (1992), Environmental Protection Agency (EPA) US, US Public Health Services (USPHS, 1986), National Academy of Sciences (NAS 1980), USA. etc. have worked on toxicity levels that can influence the human beings on short and long term basis and correlated corresponding symptoms chronic effects and diseases observed. The contaminants contributed to water, sediments and tissues of several marine organisms have also been reported along with toxicity tests.

However in India, the contaminations of sea food studies have not been seriously attended so far. Only a few reports are available on this topic. The concentration of the

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above elements in sea food and contamination of these elements in the diet and other relations with various symptoms have not been studied.

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 effects 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 is completely neglected. In fact the relevant toxic effect may be already prevalent in the society and most probably may become severe in due course of time.

Materials and methods

a) Sample collection

The Shrimps and water samples were collected from 200 meters away from the Gorai creek of Mumbai from September, 2014 to, December 2014. The Shrimp samples, packed in propylene bags, were stored at – 20 ^{0}C in deep freeze in the Department of Zoology, S.S & L.S. Patkar College, Goregaon (West) Mumbai for further analysis

b) Sample digestion

The samples were identified as per the FAO guidelines manual and were brought to the laboratory in the Department of Zoology S.S & L.S. Patkar College Goeregaon (West) Mumbai, and washed in sea water. Five replicates of the above samples containing shrimps in a petri dish were oven dried at 80°C for 2 days to get the dry weight (DW). The dried samples were crushed into a fine powder by mortar and pestle and pass through a 2 mm sieve and stored in amber colored bottles in vacuum desiccators. For digestion, 1 ml of concentrated nitric acid (70%) was added to the 1 g 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 water samples were well mixed with 2ml concentrated HNO_3 per liter sample and capped tightly until they were ready for analysis as proposed by (Ehi-Eromosele and Okiei 2012).The above procedure was repeated for all the other samples. All above chemicals used were of analytical grade.

c) Preparation of standard metal ion solutions

The instrument was calibrated by using standard solution of metal with different concentration 1, 2, 3, 10, 20 ppm (Merck /-, Sigma Aldrich). The graph was plotted as area Vs concentration and from this graph unknown concentration of metal was determined. The standard metal ion samples were prepared by dissolving 1 g of appropriate standard metal ion in 5 ml Conc. HNO3 diluted to 50 ml solution. The working standards of these metal ion solutions were prepared by appropriate dilutions in deionized distilled water to get the final 10 ppm concentration.

d) Instrumentation

The Elemental concentration was determined by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES, Model Spectro Arcos, FHS-12) at the Catalysis & Inorganic Chemistry Division, CSIR- National Chemical Laboratory, Dr. Homi Bhabha Road, Pune 411008, India

Results and Discussion

Table 1: Range of toxic elements in shrimps and water samples collected from Gorai creak of suburban of Mumbai west coast of India

Sr. No.	Name of the Shrimp Species	K	Li	Mg	Se	Sr	Te	Tl
		N= mg/l	N= mg/l	N= mg/l	N= mg/l	N= mg/l	N= mg/l	N= mg/l
1	*Parapenaeopsissculptillis*							
	Carapace	0.625	0.029	0.101	0.091	0.038	0.476	0.067
	Gills	0.630	0.029	0.093	0.099	0.039	0.482	0.059
	Remaining body	0.323	0.029	0.499	0.101	0.017	0.465	0.083
	Whole body	0.601	0.029	0.045	0.101	0.037	0.475	0.087
2	*Parapenaeopsishardwicki*							
	Carapace	0.578	0.029	0.017	0.101	0.024	0.468	0.062
	Gills	0.587	0.029	0.060	0.106	0.037	0.477	0.083
	Remaining body	0.539	0.029	0.039	0.103	0.038	0.452	0.088
	Whole body	0.479	0.029	0.017	0.100	0.026	0.473	0.082
3	*Metapenaeopsisstridulans*							
	Carapace	0.257	0.029	3.864	0.088	0.357	0.400	0.087
	Gills	0.600	0.029	0.005	0.101	0.033	0.462	0.079
	Remaining body	0.490	0.029	0.136	0.089	0.024	0.466	0.076
	Whole body	0.583	0.029	0.089	0.106	0.024	0.466	0.071
4	*Solenoceracrassicornis*							
	Carapace	0.625	0.029	0.101	0.091	0.038	0.476	0.067
	Gills	0.622	0.029	0.095	0.100	0.039	0.470	0.073
	Remaining body	0.483	0.029	0.058	0.102	0.014	0.484	0.085
	Whole body	0.599	0.030	0.066	0.100	0.037	0.471	0.087
5	*Penaeussemisulcatus*							
	Carapace	0.583	0.029	0.025	0.097	0.029	0.455	0.072
	Gills	0.601	0.029	0.030	0.100	0.036	0.469	0.088
	Remaining body	0.589	0.029	0.086	0.102	0.042	0.469	0.085
	Whole body	0.539	0.029	0.039	0.103	0.038	0.452	0.088
	Water Sample							
6	Surface Water Sample	0.600	0.029	0.015	0.090	0.042	0.470	0.094
7	Bottom water sediments	0.588	0.028	0.048	0.096	0.042	0.473	0.086

N = 5 (Average of Five determents) ND = Not detected or less than 0.0001 mg/l)

Potassium (K): Water softeners that regenerate using potassium chloride can significantly raise the level of potassium in water. It is recommended that people with kidney disease or other conditions such as heart disease, coronary artery disease, hypertension, diabetes and those who take medication that interferes with how the body handles potassium do not drink water from a water softener that uses potassium chloride. In some countries, potassium chloride is being used in ion exchange for household water softening in place of, or mixed with, sodium chloride, so potassium ions would exchange with calcium and magnesium ions. Adverse health effects due to potassium consumption from drinking-water are unlikely to occur in healthy individuals. Potassium intoxication by ingestion is rare, because potassium is rapidly excreted in the absence of pre-existing kidney damage and because large single doses usually induce vomiting (Gosselin & Hodge, 1984).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of K was observed in remaining body (0.323mg/L) and in gills (0.630 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of K was observed in whole body (0.479 mg/L) and in gills (0.587 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of K was observed in carapace (0.257mg/L) and in gills (0.600 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of K was observed in remaining body (0.483 mg/L) and in carapace (0.625 mg/L). In Penaeus semisulcatus the mean minimum and maximum concentration of K was observed in whole body (0.539 mg/L) and in gills (0.601 mg/L). Amongst all the species of shrimps the mean minimum concentration of K was observed in the carapace of Metapenaeopsis stridulans (0.257 mg/L) whereas the maximum concentration of K was observed in the gills of Parapenaeopsis sculptillis (0.630 mg/L). Amongst the water samples the mean minimum concentration of K was observed in bottom water sediments (0.588 mg/L) whereas the mean amount of K was found maximum in surface water sample (0.600mg/L). There is no guideline or recommended limit for potassium in water. In our study the mean lower and higher concentration of potassium was found lower as cited in the above literature.

lithium (Li): The Australia Inventory of Chemical Substances (AICS, 2007) has classified metallic lithium as a health, physiochemical and ecotoxicological hazard according to the National Occupational Health and Safety Commission (NOHSC) approved criteria for classifying hazardous substances. Lithium, lithium aluminium hydride, and lithium methanolate are found on the Danish list of dangerous substances (Kjolholt et al., 2003). The primary target organ for lithium toxicity is the central nervous system (Kjolholt et al., 2003), therefore, lithium is used therapeutically on membrane transport proteins when treating manic depression. Chemically, lithium resembles sodium but is more toxic. In humans, 5 g of LiCl can result in fatal poisoning. In therapeutic doses, damages on the central nervous system and the kidneys have been reported (Le'onard et al., 1995. Lenntech, 2007). A review of lithium in the aquatic environment in the US (Kszos and Stewart, 2003) found that lithium was detected at low concentrations (-0.002 mg/L) in the major rivers of the US. Further studies (Kszos et al., 2003) identified lithium concentrations in surface waters were typically -0.04 mg/L but could be elevated in contaminated streams.

The result obtained from our present analysis, the mean minimum and maximum concentration of Li in shrimp Parapenaeopsis sculptillis, Parapenaeopsis hardwicki Metapenaeopsis stridulan, Solenocera crassicornisand Penaeus semisulcatus was found to be same (0.029mg/L) in all the parts of the body in all the species, except in the case of Solenocera crassicornisit was found more in whole body (0.030mg/L). Amongst the water samples the mean minimum concentration of Li was observed in bottom water sediments (0.028 mg/L) whereas the mean amount of Li was found maximum in surface water sample (0.029mg/L). In our study the mean lower and higher concentration of Li was found above the lowest concentrations (-0.002 mg/L and -0.04 mg/L concentrations in surface waters) as proposed by (Kszos and Stewart, 2003 Kszos et al., 2003).

Magnesium (Mg): Magnesium is constituent causing "hardness" in water. Higher levels of magnesium may produce a bitter taste but are not normally a health hazard. Magnesium plays an important role as a cofactor and activator of more than 300 enzymatic reactions including glycolysis, ATP metabolism, transport of elements such as Na, K and Ca through membranes, synthesis of proteins and nucleic acids, neuromuscular excitability and muscle contraction etc. Magnesium deficiency increases risk to humans of developing various pathological conditions such as vasoconstrictions, hypertension, cardiac arrhythmia, atherosclerotic vascular disease, and acute myocardial infarction, eclampsia in pregnant women, possibly diabetes mellitus of type II and osteoporosis (Rude, 1998; Innerarity, 2000; Saris et al, 2000). These relationships reported in multiple clinical and epidemiological studies have recently been more and more supported by the results of many experimental studies on animals (Sherer et al, 2001). The recommended magnesium daily intake for an adult is about 300-400 mg (Scientific Committee for Food, 1993; Committee on Dietary Reference Intake, 1997).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of Mg was observed in whole body was (0.045mg/L) and in remaining body (0.499 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of Mg was observed in carapace and in whole body (0.017 mg/L) and in gills (0.060 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of Mg was observed in gills (0.005mg/L) and in carapace (3.864 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of Mg was observed in remaining body (0.058 mg/L) and in carapace (0.101 mg/L). In Penaeus semisulcatus the mean minimum and maximum concentration of Mg was observed in carapace (0.025 mg/L) and in remaining body (0.086 mg/L). Amongst all the species of shrimps the mean minimum concentration of Mg was observed in the gills of Metapenaeopsis stridulans (0.005 mg/L) whereas the maximum concentration of Mg was observed in the carapace of Metapenaeopsis stridulans (3.864 mg/L). Amongst the water samples the mean minimum concentration of Mg was observed in surface water (0.015 mg/L) whereas the mean amount of Mg was found maximum in bottom water sediments (0.048 mg/L). In our study the mean lower and higher concentration of Mg was found below the tolerable limits as to that of the recommended guideline value 150 mg/L of Mg in drinking water. None of the shrimp samples or water samples was analyzed for manganese exceeded the limit permitted by WHO.

Selenium (Se): Selenium (Se) is present in the earth's crust, often in association with sulfur containing minerals. Selenium undergoes bioconcentration, bioaccumulation, and biomagnifications as trophic levels increase (Taylor et al., 1992). In aquatic organisms, the following adverse effects have been observed: loss of equilibrium and other neurological disorders, liver damage, reproductive failure, reduced growth, reduced movement rate, chromosomal aberrations, reduced hemoglobin and increased white blood cell count, and necrosis of the ovaries. Most drinking-water contains concentrations of selenium that are much lower than 10 µg/L except in certain seleniferous area. Very low selenium status in humans has been associated with a juvenile, multifocal myocarditis called Keshan disease and a chondrodystrophy called Kaschin-Beck disease (Hogberg & Alexander, 1986; IPCS,1987 FAO/WHO, 2004).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of Se was observed in carapace was (0.091mg/L) and in remaining body and whole body (0.101 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of Se was observed in whole body (0.100 mg/L) and in gills (0.106 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of Se was observed in carapace (0.088mg/L) and in whole body (0.106 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of Se was observed in carapace (0.091 mg/L) and in remaining body (0.102 mg/L). In Penaeus semisulcatus the mean minimum and maximum Se of potassium was observed in carapace (0.097 mg/L) and in whole body (0.103 mg/L). Amongst all the species of shrimps the mean minimum concentration of Se was observed in the carapace of Metapenaeopsis stridulans (0.088 mg/L) whereas the maximum concentration of Se was observed in the gills of Parapenaeopsis hardwicki and in the whole body of Metapenaeopsis stridulans (0.106 mg/L). Amongst the water samples the mean minimum

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concentration of Se was observed in surface water (0.090 mg/L) whereas the mean amount of Se was found maximum in bottom water sediments (0.096mg/L). In our study the mean lower and higher concentration of Se was found above the tolerable limits as prescribed by (Högberg & Alexander, 1986; IPCS, 1987; FAO/WHO, 2004) as very low selenium (10 µg/l in drinking water) status in humans has been associated with a juvenile, multifocal myocarditis called Keshan disease and a chondrodystrophy called Kaschin-Beck disease.

Strontium (Sr): Strontium occurs naturally in Earth's crust (at approximately 0.02–0.03%) in the form of minerals such as celestite (strontium sulfate) and strontianite (strontium carbonate). Minor amounts occur in other mineral deposits and in, or near, sedimentary rocks associated with gypsum, anhydrite, rock salt, limestone anddolomite. Strontium can also occur in shales, marls and sandstones (ATSDR, 2004). It is released into the air by natural processes, such as weathering of rocks by wind, entrainment of dust particles, resuspension of soil by wind and sea spray. Oceanic strontium can leave the oceans by sea spray and by deposition in marine carbonate sediment (Capo et al., 1998). Air in coastal regions has higher concentrations of strontium as a result of sea spray (Capo et al., 1998). The only studies located regarding death in humans following inhalation exposure to stable strontium are related to strontium chromate. Strontium chromate has been implicated as a cause of increased deaths from lung cancer in occupational studies (Davies 1979, 1984). The only report of adverse respiratory effects in humans resulting from the inhalation of stable strontium is a case report of an anaphylactic reaction to smoke from an ignited roadside flare (Federman and Sachter 1997). A single study documented adverse cardiovascular effects in humans resulting from the inhalation of stable strontium in smoke from an ignited roadside flare (Federman and Sachter 1997). Osteoporosis is characterised by reduced bone mass and disruption of bone architecture, resulting in increased bone fracture and fragility, and thereby imposing a significant burden on both the individual and society (Federman and Sachter 1997).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of Sr was observed in remaining body was (0.017mg/L) and in gills (0.039 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of Sr was observed in carapace (0.024 mg/L) and in remaining body (0.038 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of Sr was observed in remaining body and whole body (0.024 mg/L) and in carapace (0.357 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of Sr was observed in remaining body (0.014 mg/L) and in gills (0.039 mg/L). In Penaeus semisulcatus the mean minimum and maximum concentration of Sr was observed in carapace (0.029 mg/L) and in remaining body (0.042 mg/L). Amongst all the species of shrimps the mean minimum concentration of Sr was observed in the carapace of Solenocera crassicornis(0.014 mg/L) whereas the maximum concentration of Sr was observed in the gills of Metapenaeopsis stridulans (0.357 mg/L). Amongst the water samples the mean minimum and maximum concentration of Sr was observed same in bottom water sediments (0.042 mg/L) and surface water sample (0.042mg/L). In our study the mean higher concentration of Sr was found above the value estimated by USEPA, 2002 and USEPA, 1981 (The surface waters, dissolved strontium was detected with an average concentration of 0.36 mg/l (range 0.0005–30 mg/l) and the concentration of dissolved strontium in influents from publicly owned treatment works was between 0.025 and 0.45 mg/l)

Tellurium (Te): Tellurium as an alloying additive in steel; as a (minor) additive in copper alloys, in lead alloys, in cast and malleable iron; in the chemical industry as a vulcanizing agent and accelerator in the processing of rubber, and as a component of catalysts for synthetic fiber production; in the production of cadmium-tellurium-based solar cells; in photoreceptor and thermoelectric electronic devices, other thermal cooling devices, as an ingredient in blasting caps, and as a pigment to produce various colours in glass and ceramics (George 2012) in the past, therapeutically, in the (intramuscular) treatment of syphilis, leprosy, trypanosomiasis (through intramuscular injections), and against excessive sweating (Larner 1995).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of Te was observed in remaining body was (0.463mg/L) and in gills (0.482 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of Te was observed in remaining body (0.452 mg/L) and in gills (0.477 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of Te was observed in carapace (0.400mg/L) and in remaining body and whole body (0.466 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of Te was observed in gills (0.470 mg/L) and in remaining body (0.484 mg/L). In Penaeus semisulcatus the mean minimum and maximum concentration of Te was observed in whole body (0.452 mg/L) and in gillsand remaining body (0.469 mg/L). Amongst all the species of shrimps the mean minimum concentration of Te was observed in the remaining body of Parapenaeopsis hardwicki (0.400 mg/L) whereas the maximum concentration of Te was observed in the remaining body of Solenocera crassicornis(0.484 mg/L). Amongst the water samples the mean minimum concentration of Te was observed in surface water (0.470 mg/L) whereas the mean amount of Te was found maximum in bottom water sediments (0.473mg/L). Although tellurium is not regarded as a true trace element, in that there is no recognized biological role for tellurium in human tissues and no clinical deficiency syndrome, nonetheless the amounts of tellurium in the human body are reported to be higher than several of the recognized trace elements.

Thallium (Tl): Thallium is readily absorbed through the GI tract and distributed throughout the organs and tissues of the body (Sabbioni et al., 1980 b). Once thallium is distributed, elimination occurs mainly in the urine and feces with the amounts in each varying by species. The lowest known dose to cause symptoms is a single dose of 0.31 g; the patient recovered after treatment (Cavanagh et al., 1974). Studies of thallium toxicity in humans are comprised of clinical reports, case studies, and medical surveys. As indicated by case reports, the acute toxicity of thallium is characterized by alopecia (hair loss), severe pain in the extremities, lethargy, ataxia, abdominal pain or vomiting, back pain, abnormal reflexes, neuropathy, muscle weakness, coma, convulsion, other neurological symptoms (i.e., mental abnormalities, tremors, abnormal movements, abnormal vision, and headache), and death (Lu et al., 2007; Tsai et al., 2006; Saha et al., 2004). Low rates of bioconcentration may occur in aquatic systems and thallium may be as toxic as copper on a weight basis (Zitko et al., 1975). Thallium can cause reductions in larval fish growth and percent embryo hatchability and mortality (Le Blanc and Dean 1984).

The result obtained from our present analysis, in shrimp Parapenaeopsis sculptillis the mean minimum and maximum concentration of Tl was observed in gills was (0.059mg/L) and in whole body (0.087 mg/L). In shrimp Parapenaeopsis hardwicki the mean minimum and maximum concentration of Tl was observed in carapace (0.062 mg/L) and in remaining body (0.088 mg/L). In shrimp Metapenaeopsis stridulans the mean minimum and maximum concentration of Tl was observed in whole body (0.071mg/L) and in carapace (0.087 mg/L). In shrimp Solenocera crassicornisthe mean minimum and maximum concentration of Tl was observed in carapace (0.067 mg/L) and in whole body (0.087 mg/L). In Penaeus semisulcatus the mean minimum and maximum concentration of Tl was observed carapace (0.072 mg/L) and in gills and whole body (0.088 mg/L). Amongst all the species of shrimps the mean minimum concentration of Tl was observed in gills of Parapenaeopsis sculptillis (0.059 mg/L) whereas the maximum concentration of Tl was observed in gills, remaining body and whole body of Parapenaeopsis hardwicki and Penaeus semisulcatus (0.088 mg/L). Amongst the water samples the mean minimum concentration of Tl was observed in bottom water sediments (0.086 mg/L) whereas the mean amount of Tl was found maximum in surface water sample (0.094mg/L). Thallium compounds are highly toxic to humans. McMurtrey and Robinson (1938) wrote, "Thallium compounds have been used as depilatories with disastrous effects. In our study the mean lower and higher concentration of Tl in shrimp species and in water samples were found above as proposed by Carson and Smith (1977) reported, " 'Non-effect levels' for mammals have not been established experimentally, but levels of near 3 ppb thallium in an animal's diet are likely to produce toxic effects detrimental to the individual's survival."

Conclusion:
The toxic elements such as K, Li, Mg, Se, Sr, Te and Tl are potentially harmful and caused toxic effects to most organisms even in very low concentrations. From the above results it is expected that the sea food available in and around Mumbai may have elevated levels of pollutants. These toxic elements may cause dermatological diseases, skin cancer and internal cancers (liver, kidney, lung and bladder), cardiovascular disease, diabetes, and anemia, as well as reproductive, developmental, immunological and neurological effects in the human body. These toxic elements 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 shrimps are not heavily burdened with toxic elements, 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 and toxic elements 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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