ACCUMULATION OF HEAVY METALS IN INTERTIDAL GASTROPOD SHELLS USED AS BIOINDICATOR FROM URAN COAST (WEST COAST OF INDIA)

Mrs. Sandhya Kupekar & *B.G. Kulkarni
Mahatma Phule Arts, Science & Commerce College, Panvel. Dist. Raigad.(Maharashtra).
Mobile No. 09869780048. E-mail: sandhyakupekar@gmail.com
*Institute of Science, Madam Cama Road, Mumbai-32.

Corresponding & Presenting Author : Mrs. Sandhya Kupekar.

Uran, which forms the part of the main land of Konkan is along the eastern shore of Bombay Harbour opposite Colaba. At the beginning of the investigation coast of Uran was surveyed for recording intertidal gastropods. Uran and nearby coastal area surrounded by industries of chemical production. Under such circumstances coastal area of Uran is slowly becoming a ground of chemical pollution. Animals were collected from rocky shores. The accumulation of heavy metals Cu, Zn, Fe, Mn, Cd, Pb has been assessed using Atomic Absorption Spectrophotometer.(GBC 932 AA) in shells of gastropods, tissues and in the sediment. During present investigation the degree of accumulation of heavy metals in shells, tissues and sediment found in the following order. Shell accumulation of heavy metals found in order of Mn>Cu>Zn>Fe>Cd>Pb in *Hemifusus pugilinus* and in *Bursa spinosa* shell in order of Mn>Cd> Cu>Zn>Fe>Pb. In *Hemifusus pugilinus* accumulation of heavy metals in tissue was in following order Fe>Cu>Zn>Mn>Cd.Pb, In *Bursa spinosa* accumulation of heavy metals was in the following order Cu>Zn>Fe>Mn>Cd>Pb. In sediment accumulation of heavy metals found in order of Mn>Fe>Cu>Zn>Cd>Pb, The heavy metals could be accumulated in shells and soft tissues of gastropods. The use of gastropod shells as a bioindicator may be useful for determining the extent of biotransformation in aquatic food webs, as an essential component of risk assessment of heavy metals. Fe and Mn are most abundant metals found in tissues, sediments and shells as compare to other metals. Cu and Zn were accumulated higher in tissues of *hemifusus pugilinus* than tissues of *Bursa spinosa.* While concentration of Mn and Fe was higher in sediment. In shells of both the species concentration of Mn, Cu and Fe were higher. Cd and Pb also found in noticeable amount in shells of gastropods. The high concentration of heavy metals present in sediment is due to anthropogenic inputs and fishing activity. Accumulation varies as per the size and habitat distribution of gastropods. It is well known that tissues of macrobenthos accumulate heavy metals. However presence of heavy metals in shells of gastropods indicates that it is the safer depot for storage of heavy metals. Such storage should be responsible for protection of vital organs. This kind of adaptation may help for survival of the species in polluted areas. The use of gastropod shell as a bioindicator may be useful for determining the environmental change and pollution. Gastropods are among the most promising candidates used in biomonitoring studies focusing on heavy metals. The finding indicates that differences in metal distribution could be attributed to the differences in tissue physiology and detoxification strategies.

Keywords;- Hemifusus pugilinus, Bursa spinosa, Pollution, Atomic Absorption Spectrophotometer.

International Journal of Scientific & Engineering Research, Volume 5, Issue 10, October-2014 1543
ISSN 2229-5518

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Mobile No. 09869780048. E-mail: sandhyakupekar@gmail.com
*Institute of Science, Madam Cama Road, Mumbai-32.

Corresponding & Presenting Author : Mrs. Sandhya Kupekar.

Introduction:

Gastropods are among the most promising candidates used in biomonitoring studies focusing on heavy metals. Heavy metals are among the most common environmental pollutants and their occurrence in waters and biota indicate the presence of natural or anthropogenic sources associated with industrial and domestic effluents (Biney *et al.*,1994; Zarazua *et al.*, 2006). Some studies of the shell material have also been conducted and many author suggest that shells can provide more accurate indication of environmental change and pollution, they exhibit less variability than the living organism's tissue and they provide a historical record of metal content throughout the organism's life time with this record still preserved after death. The mollusc shell is a microlaminate composite of mineral and biopolymers with exceptional regularity and with a strength far exceeding that of the crystals themselves in that the calcium carbonate inorganic phase of the shell contributes 98% of the shell mass. Most metals are generally concentrated many times over within an organism's soft tissue, rather than the shell and so the vast majority of studies concentrate on the soft tissue. However, some studies of the shell material have also been conducted and many authors suggest that shells can provide a more accurate indication of environmental change and pollution. Among the intertidal molluscs, *Nerita lineata* has been evidenced to be one of the most potential biomonitoring species in Sumatera (Indonesia) (Amin et al. 2006, 2008, 2009). *Hemifusus pugilinus and Bursa spinosa* found at rocky shore of Uran coast. Gastropods are one of the most important taxonomic groups which are potential biomonitors of heavy metal pollution and there are several important features or characteristics of the gastropods. Oil spills affect marine life which live hunt or travel in the area covered with oil. Different types of marine life are impacted differently, depending on their physiology and habits. Recently the whole coastal belt of Uran is under heavy process of industrialization. Effluent of industries located in nearby area of Uran coast is released into the coastal water. Therefore, it is worth to assess heavy metals in coastal ecosystem of Uran.

MATERIALS AND METHODS:

Study Area:

At the beginning of the investigation coast of Uran was surveyed for recording intertidal gastropods. The coast of Uran is mixture of rock, sand and muddy shore. Gastropods were recorded at rocky shore. They found to attach to the rocks in the crevices of the rock and below large stones. During present investigation three sites of Uran (Plate No. 1.1, 1.2 and 1.3) were selected for collection of gastropods and sediment samples. The plate Nos. 1.4 and 1.5 represent the gastropods like *Hemifusus pugilinus and Bursa spinosa* collected from the Uran coast.

ISSN 2229-5518

Map of Study Area

The gastropods *Hemifusus pugilinus* and *Bursa spinosa* (Plate 1.4-1.5) were collected during low tide. Gastropods of uniform size were collected from three selected sites between period of January to December. For the shell samples Specimen shell length was ranging between 4.5 to 5.5 cm in *Hemifusus pugilinus* and shell width 1.8-2.5 cm, shell length was ranging between 2.5 to 3.5 in *Bursa spinosa* and shell width 2.5 to 3.5 cm, while the weight ranged between 8.5 to 9.5 in *Hemifusus pugilinus and 4.5* to 5.5 in *Bursa spinosa* throughout the work to reduce possible variations in metal concentrations. All dried shells of gastropods were digested in concentrated HNO_3 (Analar Grade, BDH 69%). The soft tissues were weighed and wet digested in concentrated nitric acid and heavy metals levels have been determined in the tissues, using Atomic Absorption Spectrophotometer. For the sediment samples 1 gm sample of powdered sediment was used for analysis. The sediment samples were repeated until no more brown fumes were liberated indicating completion of digestion of the sample. The dry residue was dissolved in 0.1 N HCl and final volume was made up to 25 ml with glass double distilled water. The samples were analyzed on Atomic Absorption Spectrophotometer (GBC 932 AA). The standard metal solution was used for preparing the standard curve.

ISSN 2229-5518

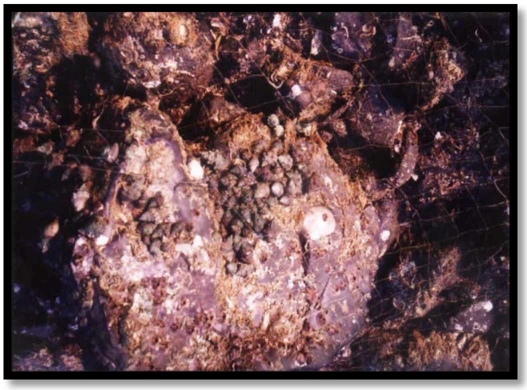
PLATE 1.1

PLATE 1.2

PLATE 1.3

PLATE 1.4

PLATE 1.5



For the tissue samples whole soft tissues of gastropods were carefully removed by shelling the gastropods with plastic knife (Chiu et al., 2000). Samples were dried at 60^0C to constant weight. Atomic Absorption Spectrophotometer (GBC 932 AA) was used to estimate metals in samples. An accurately weighed dried powdered sample was taken in a beaker. To this 20 ml 70% HNO_3 was added and subjected to digestion till brown fumes completely disappear and residue becomes whitish. 1 ml 30% $HClO_4$ was added after the residue was cooled. This was digested for 10-15 minutes to dryness. The dried residue was cooled and the final volume made up to 25 ml with 2M HNO_3. All reagents were of analytical grade. Metals were estimated from this sample using acid as a blank. The metal concentration in the tissues was calculated by using standard calibration curve.

RESULT AND DISCUSSION:

The accumulation of heavy metals Cu, Zn, Fe, Mn, Cd, Pb has been assessed using Atomic Absorption Spectrophotometer (GBC 932 AA) in shells of gastropods, tissues and in the sediment. During present investigation the degree of accumulation of heavy metals in shells, tissues and sediment found in the following order. Shell accumulation of heavy metals found in order of Mn>Cu>Zn>Fe>Cd>Pb in *Hemifusus pugilinus* and in *Bursa spinosa* shell in order of Mn>Cd> Cu>Zn>Fe>Pb. In *Hemifusus pugilinus* accumulation of heavy metals in tissue was in following order Fe>Cu>Zn>Mn>Cd.Pb, In *Bursa spinosa* accumulation of heavy metals was in the following order Cu>Zn>Fe>Mn>Cd>Pb. In sediment accumulation of heavy metals found in order of Mn>Fe>Cu>Zn>Cd>Pb, (Table 1.1).The heavy metals could be accumulated in shells and soft tissues of gastropods. The use of gastropod shells as a bioindicator may be useful for determining the extent of biotransformation in aquatic food webs as an essential component of risk assessment of heavy metals. Fe and Mn are most abundant metals found in tissues, sediments and shells as compare to other metals. Cu and Zn were accumulated higher in tissues of *Hemifusus pugilinus* than tissues of *Bursa spinosa.* While concentration of Mn and Fe was higher in sediment. In shells of both the species concentration of Mn, Cu and Fe were higher. Cd and Pb also found in noticeable amount in shells of gastropods. Marine gastropods normally accumulate and store Cu and use it in the synthesis of hemocyanin a blood pigment. The similar Cu concentrations in the different soft tissues of *N. lineata* may in part be attributed to Cu in hemocyanin (Dallinger & Wieser 1984). According to Pyatt et al. (2003), although the total concentration of metals in the soft tissues of molluscs can be a measure of metal bioavailability originating from both natural and anthropogenic sources (Rainbow 1995). The presence of high levels of Fe, Cu and Zn than Pb, Ni and Cd in the soft tissues of *N. lineata* could be due to their roles as components of metabolically important biomolecules including enzymes, metalloenzymes and respiratory pigments (Catsiki et al. 1994; Depledge et al. 1994; Langston et al. 1998; Rainbow 1997). Cd and Pb levels reported in the *P. viridis* shell by Yap et al. (2003b). It is generally recognized that the molluscs soft tissues accumulate higher concentrations of Cu, Zn and Fe than those in the shells (de Wolf et al. 2001; Szefer et al. 2002; Yap et al. 2009b). Shells are particularly sensitive to environmental levels of exposure and could be valuable for monitoring heavy metal contamination in the marine environment. Conversely, the apparent variability in shell composition can often be traced to non-uniform cleaning and treatment procedures before shell digestion and analysis. The accumulation of metals has been mainly studied from the content of the soft tissues. However, metals can accumulate in the shell, which can act as a receptor for these metals

In the present work essential metals were accumulated higher than nonessential metals. In all the gastropods high levels of Cu, Zn Mn, & Fe were detected, than that of Cd & Pb.

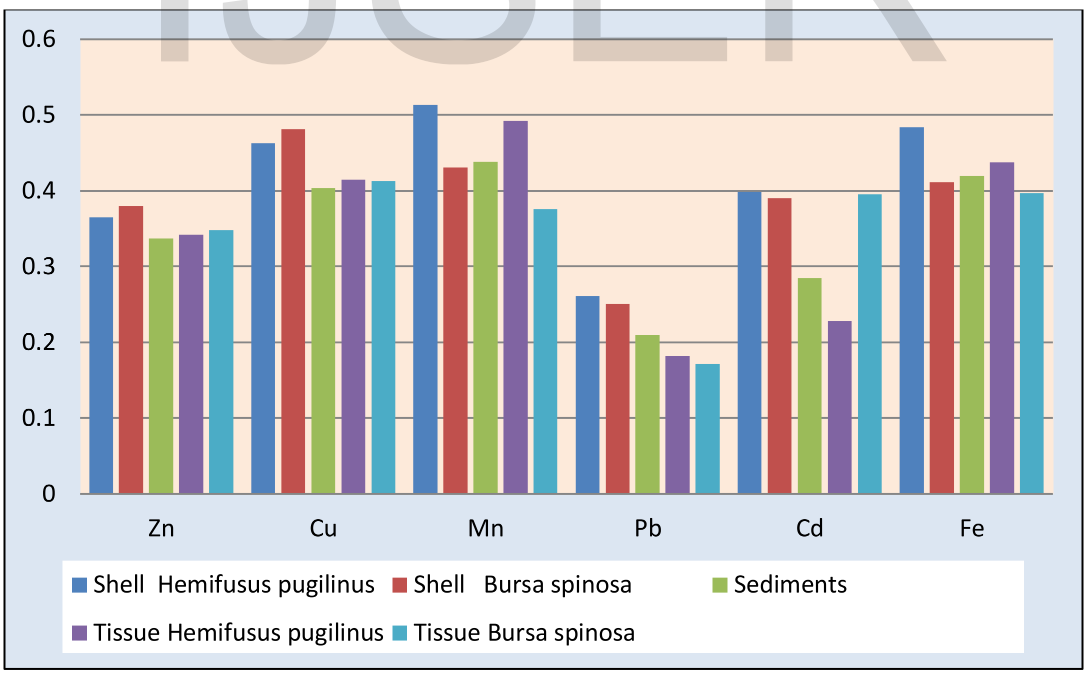
ISSN 2229-5518

Accumulation of high level of Cu, Zn & Fe in soft bodied gastropods can be attributed to their metabolic requirement where these metals act as a co-factor in metabolic process. Similar correlations in between trace element accumulations and metabolic activities have been reported in bivalves, (Frias-Espericueta et al., 1999, Wang, 2002). Further seasonal variation in amount of heavy metals accumulated by these gastropods can be associated with food supply, changes in runoff particulate material to the sea precipitation and variations related to the reproductive cycle (Fowler and Oregioni 1976, Lotouche and Mix 1981, Turkmen and Turkmen, 2004). It is well known that these three metals are biologically essential and plays an cofactor in enzymatic processes. (Singh and Steinnes, 1994). However, their accumulations in higher side affect biological process in marine vertebrates.

Table No.1.1: Level of Heavy metals in Shell, Sediment and Tissues of gastropods mg/g (Site I, Site II, Site III)

	Zn	Cu	Mn	Pb	Cd	Fe
Shell *Hemifusus pugilinus*	0.365 ±0.025	0.463 ±0.009	0.513 ±0.012	0.2 61 ±0.016	0.399 ±0.017	0.484 ±0.010
Shell *Bursa spinosa*	0.380 ±0.025	0.481 ±0.025	0.431 ±0.005	0.251 ±0.009	0.390 ±0.025	0.411 ±0.007
Sediments	0.337 ±0.003	0.404 ±0.005	0.438 ±0.005	0.210 ±0.009	0.285 ±0.005	0.420 ±0.007
Tissue *Hemifusus pugilinus*	0.342 ±0.040	0.415 ±0.017	0.492 ±0.007	0.182 0.009	0.228 ±0.009	0.437 ±0.004
Tissue *Bursa spinosa*	0.348 ±0.024	0.413 ±0.015	0.376 0.014	0.172 ±0.023	0.395 0.017	0.397 0.009

Table No.1.2: Level of Heavy metals in Shell, Sediment and Tissues of gastropods mg/g (Site I, Site II, Site III)



ISSN 2229-5518

Conclusion:

The present findings indicated that the differences in metal distribution could be attributed to the differences in tissue physiology and metal handling, storage and detoxification strategies. In particular, the concentration of Cu and Mn was higher in the soft tissues. In shells of both the species concentration of Mn, Cu and Fe were higher. Cd and Pb also found in noticeable amount in shells of gastropods were to be significantly higher than those in the sediment. The present findings indicated that the differences in metal distribution could be attributed to the differences in tissue physiology and metal handling, storage and detoxification strategies Accumulation of cadmium and lead in noticeable amount in all the gastropods shell clearly shows that effluent containing these heavy metals enter into the coastal waters of Uran from adjacent industries Accumulation of cadmium and lead in noticeable amount in all the gastropods clearly shows that effluent containing these heavy metals enter into the coastal waters of Uran from adjacent industries. The data clearly indicates anthropogenic input of heavy metals into coast of Uran. In conclusion higher level of heavy metal detected in Uran coast can affect the life processes of organisms.

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