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Seasonal changes in biochemical composition of *Indonaia caeruleus* in relation to heavy metal pollution of Yeldari dam (M.S.), India

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Abstract
The aim of the study is to determine the seasonal changes in biochemical composition (protein, ascorbic acid, RNA and DNA) in relation to heavy metal pollution of Yeldari dam in freshwater bivalve, *Indonaia caeruleus*. The freshwater bivalves used as bioindicators of pollution. Heavy metals (Zn, Pb, Cu, Cd and As) were determined seasonally from surface water, soil sediment and soft body tissues of *Indonaia caeruleus*. The biochemical composition (protein, ascorbic acid, RNA and DNA) was estimated from soft body tissues (gills, mantle, digestive glands and whole soft body tissues) of *Indonaia caeruleus*. The heavy metals (Zn, Pb, Cu, Cd and As) was highest during summer season and biochemical composition (protein, ascorbic acid, RNA and DNA) in gills, mantle, digestive glands and whole soft body tissues of freshwater bivalve *Indonaia caeruleus* was highest during monsoon season.

Keywords: Yeldari dam, *Indonaia caeruleus*, heavy metal, biochemical

Introduction
Aquatic ecosystems are most important resources used for drinking, aquaculture, agricultural and industrial purposes. Heavy metal pollution in the aquatic ecosystem has increased due to natural and anthropogenic sources. The heavy metals interact with certain receptors and proteins; they not only affect on cell content but also on cell. Increasing action of synthetic chemicals, industrial output and runoff from multisource discharge causes large amount of stress on aquatic ecosystem (Madhyastha, 1996) [11]. Heavy metals can be accumulated in the body of organism and magnified in the food chain and finally threatening human health (Jin, 1992) [7]. Heavy metals may affect physiological and biochemical mechanism of organism (Radhakrishnan *et al.*, 1991) [16].

Metals are not removed quickly, nor they easily detoxified in the body of animal as a result they accumulate in important organs (Rainbow and Moore, 1986) [18]. Changes in biochemical content acts as indicators of toxic effect on tissues (Thaker and Haritos, 1989) [23]. In several monitoring programs biochemical responses in aquatic animals have been used to decide anthropogenic pollution (Cajaraville *et al.*, 2000) [4].

Alterations in biochemical composition like protein, ascorbic acid, RNA and DNA are helpful to know the effect of pollutant on different soft body tissues and defense mechanism of the body in response to toxic effects of heavy metals (Deshmukh, 2013) [5]. Several researchers have reported seasonal changes in biochemical components, Nagabhushanam and Mane (1975, 1978) [12, 13] on *Mytilus viridis*, Salaskar and Nayak (2011) [22] on *Crassostrea madrasensis* and *Perna viridis*, Deshmukh (2013) [5] on *Lamellidens corrianua*.

Alterations in biochemical composition (protein, ascorbic acid, RNA and DNA) in soft body tissues (gills, mantle, digestive glands and whole soft body tissues) of freshwater bivalve, *Indonaia caeruleus* are helpful to know the effect of heavy metals and defensive mechanism of the body against the pollution. These biochemical components are useful to determine the status of aquatic ecosystem.

Materials and Methods
Surface water, soil sediment and freshwater bivalve, *Indonaia caeruleus* were collected from Yeldari Dam at Yeldari in Jintur taluka of Parbhani district of Maharashtra state, India.

The collected surface water sample is mixed with HNO_3 and preserved at 4 °C until analysis in refrigerator. Soil sediment was collected from 5cm depth and air dried, 5gm oven dried sieved (mesh size 0.5mm) powder of soil sediment was taken in conical flask and about 20 ml of concentrated HCL was added. The sample was digested on hot plate for about 1 hour and evaporated to about dryness, the digested sample was used for heavy metal analysis (Ahmed *et al.*, 2002) [2]. The 20 medium sized bivalves were dissected within 12 hours of collection and their gills, mantle, digestive glands and whole soft body tissues were separated, washed in distilled water and dried in oven at about 70°-80 °C separately. After complete drying the tissues were powdered and stored separately. The analysis of heavy metal concentrations in surface water, soil sediment and soft body tissue (gills, mantle, digestive glands and whole soft body tissues) of *Indonaia caeruleus* was carried out by Atomic Absorption Spectrophotometer (AAS).

The biochemical composition (Protein, ascorbic acid RNA and DNA) content was estimated from dry powder of different tissues. Protein was measured by Lowry's method (Lowry *et al.*, 1951) [10]. Ascorbic acid was estimated by the method of Roe (1967) [21]. RNA was measured by following Orcinol method of Volkin and Cohn (1954) [24]. DNA content estimated by using Diphenylamine method of Burton (1956) [3]. The protein, ascorbic acid, RNA and DNA content was calculated by referring standard graph value.

Results and Discussion

The heavy metals Zn, Cu, Pb, Cd and as were determined seasonally from surface water, soil sediment and different tissues (gills, mantle, digestive glands and whole soft body tissues) of *Indonaia caeruleus* (Table 1). The results indicate that heavy metals Zn, Cu, Pb, Cd and As in surface water, soil sediment and different tissues of freshwater bivalve, *Indonaia caeruleus* were highest during summer season. This might be due to decrease in water level during summer season (Deshmukh, 2013) [5]. High concentration of Zn was observed by Ravera *et al.*, (2007) [5] in all tissues of *Pictorum mancus* in summer.

The heavy metals Zn, Pb, Cu, Cd and as were lowest during monsoon season in surface water, soil sediment and different tissues of freshwater bivalve, *Indonaia caeruleus*. This could be due to increased water level during monsoon season due to precipitation (Jain and Salman 1995; Patil *et al.*, 2004, Deshmukh, 2013) [6, 15, 5].

Table 1: Heavy metal concentrations in surface water (mg/l), soil sediment (µg/g) and different tissues of freshwater bivalve, *Indonaia caeruleus* (µg/g) collected from Yeldari dam

Heavy metals		Zn	Pb	Cu	Cd	As
Surface water	Summer	0.1217±0.0003	0.0271±0.0002	0.0188±0.0003	0.0064±0.0002	0.0063±0.0002
	Monsoon	0.0703±0.0004	0.0237±0.0004	0.0135±0.0002	0.0051±0.0002	0.0044±0.0001
	Winter	0.1092±0.0006	0.0251±0.0003	0.0150±0.0003	0.0057±0.0002	0.0052±0.0002
Highest permitted value for drinking water IS (1991)		15	0.05	1.5	0.01	0.01
Soil Sediment	Summer	205.15±2.80	19.16±1.02	55.81±2.10	3.81±0.20	3.37±0.53
	Monsoon	125.70±2.16	13.45±0.91	39.82±1.53	2.21±0.42	2.00±0.24
	Winter	188.62±2.78	18.02±1.09	42.18±1.23	3.35±0.47	2.22±0.34
Gills	Summer	655.53±7.08	105.15±2.00	132.42±3.05	24.95±0.48	4.82±0.28
	Monsoon	511.65±5.75	88.73±2.16	114.50±1.72	20.62±0.62	3.96±0.35
	Winter	593.61±6.13	110.04±2.48	124.23±1.49	21.46±0.35	4.47±38
Mantle	Summer	485.74±4.19	103.62±2.32	123.61±2.42	19.51±0.42	3.09±0.30
	Monsoon	373.21±5.18	75.46±1.97	104.39±2.03	14.63±0.70	2.41±0.35
	Winter	419.95±5.29	92.41±1.74	110.18±1.80	17.15±0.38	3.01±0.48
Digestive glands	Summer	847.71±7.15	121.82±1.25	163.57±2.66	27.60±0.68	5.08±0.37
	Monsoon	685.40±4.58	102.34±1.72	136.30±1.80	22.94±0.75	3.85±0.48
	Winter	750.38±6.82	118.82±2.41	144.62±1.35	24.43±0.45	4.77±0.69
Whole soft body tissue	Summer	591.81±5.18	109.65±2.50	143.15±2.20	21.04±0.27	3.90±0.32
	Monsoon	408.28±5.10	82.44±1.68	113.42±1.87	18.13±0.54	2.84±0.22
	Winter	451.46±6.27	104.31±2.00	117.35±1.39	20.35±0.92	3.82±0.71

Mean ± Standard deviation

Table 2: Biochemical content in different tissues of freshwater bivalve, *Indonaia caeruleus* from Yeldari dam (Values are in mg/100mg of dry weight)

Season	Tissues	Protein	Ascorbic acid	RNA	DNA
Summer	Gills	53.57±1.70	0.902±0.020	6.16±0.34	1.81±0.045
	Mantle	46.80±0.65	0.695±0.015	5.27±0.28	1.32±0.027
	Digestive glands	52.41±1.44	1.055±0.024	6.52±0.41	1.75±0.062
	Whole soft body tissue	49.15±1.05	0.878±0.019	5.77±0.50	1.58±0.040
Monsoon	Gills	61.15±2.00	1.080±0.032	7.73±0.59	2.18±0.055
	Mantle	53.02±1.33	0.894±0.023	6.11±0.32	1.72±0.052
	Digestive glands	61.98±1.80	1.299±0.017	8.07±0.45	2.10±0.080
	Whole soft body tissue	57.72±1.25	1.055±0.038	7.42±0.22	2.02±0.034
Winter	Gills	58.26±1.31	0.935±0.026	7.46±0.33	2.05±0.058
	Mantle	52.45±1.28	0.713±0.019	5.20±0.51	1.59±0.042
	Digestive glands	57.40±1.50	1.058±0.015	7.58±0.68	2.06±0.067
	Whole soft body tissue	55.64±1.49	0.905±0.031	7.29±0.25	1.93±0.054

Mean ± Standard deviation

Seasonal alterations in protein, ascorbic acid, RNA and DNA contents in gills, mantle, digestive glands and whole soft body tissue were determined in freshwater bivalve, *Indonaia caeruleus* collected from Yeldari dam (Table 2). Any type of toxic stress leads to changes in physiological and biochemical mechanism in the body of an organism (Abel 1974; Langstone 1986; Lomte *et al.*, 2000, Deshmukh, 2013) [1, 8, 9, 5]. The obtained results indicate that lowest protein, ascorbic acid, RNA and DNA in different tissues of *Indonaia caeruleus* during summer season this could be due to pollution stress of heavy metals. During summer season lowest protein, DNA, RNA and ascorbic acid in different tissues of freshwater bivalve, *Lamellidens marginalis* were reported by Deshmukh (2013) [5].

Conclusion

The protein, ascorbic acid, RNA and DNA content was highest during monsoon season this is due to lower metal concentration in surface water, soil sediment and soft body tissues of bivalve. The protein, ascorbic acid, RNA and DNA content was lowest during summer season this is due to increase in metal concentration in surface water, soil sediment and soft body tissues of bivalve. After increase in heavy metal concentration the biochemical composition decreases this might be due to increased pollution stress.

References

1. Lowry OH, Rosenbrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. J Biol Chem. 1951;193(1):265-75.
2. Volkin E, Cohn WE. Estimation of nucleic acid. In: Glick D, editor. Methods of biochemical analysis. Vol. 1. New York: Interscience; 1954, p. 287-305.
3. Burton K. Study of the conditions and mechanism of the diphenylamine reaction for the colorimetric estimation of deoxyribonucleic acid. Biochem J. 1956;62:315-23.
4. Abel PD. Toxicity of synthetic detergents to fish and aquatic vertebrates. J Fish Biol. 1974;6:279-98.
5. Nagabhushanam R, Mane UH. Reproduction in the mussel, *Mytilus viridis* at Ratnagiri. Bull Dept Mar Sci Univ Cochin. 1975;7:377-87.
6. Robbins SL, Angell M. Basic pathology. 3rd ed. Philadelphia: WB Saunders; 1976.
7. Nagabhushanam R, Mane UH. Seasonal variations in the biochemical composition of Mytilus viridis at Ratnagiri on the West Coast of India. Hydrobiologia. 1978;57:69-72.
8. Thaker AA, Haritos AA. Cadmium bioaccumulation and effects on soluble peptides, proteins and enzymes in the hepatopancreas of the shrimp, Callianassa tyrrhena. Comp Biochem Physiol. 1989;94(1):63-70.
9. Radhakrishnan K, Suresh A, Urmila, Shivarama B, Krishnan B. Effect of mercury on lipid metabolism profiles in the organs of *Cyprinus carpio* (Linn.). J Mendel. 1991;8:125-35.
10. Jin L. Environmental bionomy. 1st Ed. Beijing: Higher Education Press; 1992.
11. Rainbow PS. The significance of trace metal concentrations in marine invertebrates. In: Dallinger R, Rainbow PS, editors. Ecotoxicology of metals in invertebrates. Boca Raton: Lewis Publishers; 1993, p. 119-131.
12. Langston WJ. Metals in sediments and organisms in the Mersey estuary. Estuar Coast Shelf Sci. 1986;23:239-61.
13. Rainbow PS, Moore PG. Comparative metal analysis in amphipod crustaceans. Hydrobiologia. 1986;141:273-89.
14. Jain S, Salman S. Heavy metal concentration in a highly eutrophic lake sediments and overlying water. Pollut Res. 1995;14:471-6.
15. Madhyastha MN. Recent approaches in aquatic toxicology. Indian J Comp Anim Physiol. 1996;14(2):99-101.
16. Paka NS, Rao AN. Ecological studies of two lentic water bodies with reference to cyanobacteria. J Environ Biol. 1997;18:2333-44.
17. Cajaraville MP, Bebianno MJ, Blasco J, Porte C, Sarasquete C, Viarengo A. The use of biomarkers to assess the impact of pollution in coastal environments of the Iberian Peninsula: a practical approach. Sci Total Environ. 2000;247:295-311.
18. Lomte VS, Chaudhari RT, Massarrat S. Changes in protein content of freshwater bivalve, Parreysia cylindrica on exposure to nickel chloride and lead chloride. Ind J Environ Ecoplan. 2000;3:63-5.
19. Ahmed K, Mehedi MY, Haq R, Ahmed F. Heavy metal concentration in water and sediment of the Sundarbans reserved forest, Bangladesh. Asian J Microbiol Biotechnol Environ Sci. 2002;4(2):171-9.
20. Patil PR, Chaudhari DN, Kinage MS. Water quality status of Padmalaya lakes, Erandol at Jalgaon District, Maharashtra State. Environ Ecol. 2004;22:65-8.
21. Ravera O, Beone GM, Trincherini PR, Riccardi N. Seasonal variations in metal content of two Unio pictorum mancus (*Mollusca*, *Unionidae*) populations from two lakes of different trophic state. J Limnol. 2007;66(1):28-39.
22. Salaskar GM, Nayak VN. Nutritional quality of bivalves, Crassostrea madrasensis and Perna viridis in the Kali estuary, Karnataka, India. Recent Res Sci Technol. 2011;3(4):6-11.
23. Deshmukh GM. Biomonitoring of heavy metal pollution of Jayakwadi reservoir at Paithan using bivalves as bioindicators [Ph.D. Thesis]. Aurangabad: Dr. BAM University; 2013.
24. Roe JH. Method of biochemical analysis. In: Blick F, editor. Methods of biochemical analysis. Vol. 5. New York: Interscience; 1967, p. 44-45.