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THE EFFECT OF CHANGING ENVIROMENTAL PRAMETERS ON RESPIRATION OF BIVLAVE FROM GODVARI RIVER MAJALGOAN, (M.S.), INDIA.

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ABSTRACT
In the present investigation the effect of rise in temperature and atmospheric air was studied on the respiration physiology of *Lamellideans marginalis* from Godavari River. The studies were conducted in three different seasons on 2nd day, 6th day and 12th day of exposure period. The result indicates that the effect of rise in temperature on control group is decreased on 2nd and12th day in every season in rate of respiration was 11.94 on 2ndday 35.29 on 6thday and 13.98 on 12th day. In summer season the rate of respiration followed similar trend in both control and experimental group but in monsoon season the rate reached to steady level. The effect of exposure to atmospheric air in three different seasons the rate reached to steady level. The effect of exposure to atmospheric air in three different seasons on control and experimental groups shows the rate of respiration decreased on the day in all the season .in experimental groups in monsoon season there was very little effects of exposure to atmospheric air on the rate of oxygen consumption and more in summer.

KEY WORDS: Atmospheric air, Godavari river, *Lamellideans marginalis* Temperature,

INTRODUCTION

The effect of environmental parameters is an important aspect for every animal. The physiological studies in relation to ecology of fresh water bivalves are historical based early descriptive work which includes basic taxonomy with notes on habitat, community composition, abundance and distribution. The effect of environmental temperature on animals has been reviewed by many workers (Precht *et.al.,* 1973 and Kuhhemann and precht1979), Since the changes in the Kinetic energy of the environment are usually rapid and quantitatively transferred to the cellular chemistry of the organism, environmental temperature changes cause unique problems. The rate of respiration in aquatic animals is as influenced by activity, body size, stages in life cycle and time of day, as well as previous oxygen experience and genetic background (Prosser1973).

Rate of respiration reflects the metabolic activities of animals and the responses due to change in surrounding environment are an indicator of adjustment capacity of the organism. *Lamellidens marginalis* is an economically important bivalve. It circulates large quantity of water through respiratory surface to obtain food and oxygen .Thus, it suffers a great risk of pesticide poisoning. Therefore, it is considered as a bio-monitoring tool in toxicological studies (Rittschof and McClellan-Green, 2005).Bivalve molluscs reflect immediate responses to toxic substances present in surrounding water by change in physiological responses (Basha *et al.,* 1988) and histological arrangement (EI-Shenawy *et al.,* 2009; Kumar *et al.,* 2011; Kamble *et al.,* 2012). The abundant found of freshwater mussels, *Lamellidens marginals* along the bank of Godavari river near Majalgaon, Dist. Beed Maharashtra the present study has planned to find out the effects of some environmental parameters on respiration physiology in three different seasons.

MATERIALS AND METHODS

The freshwater bivalve molluscs *Lamellidens marginalis* were collected from bank of Godavari River, Majalgoan Dist. Beed. After collection of these bivalves, they were immediately brought to the laboratory. The freshly samples as collected during summer (April-may) monsoon (July-August) and winter (December-January), in the year 2019-20, before conducting the experiments studying the environmental conditions like rise in temperature and exposure to atmospheric air.

After 24 hour laboratory adjustment 50 animals were kept in each of the 2 aquaria during summer, monsoon and winter to study the effect of normal laboratory temperature and others were experimental at different temperatures of the water from control group was 29.5°C in summer, 24.5-25°C in monsoon and 20.5-22 °C in winter. The experimental temperature of water during summer was 32°C, during monsoon it was 30°C were as during winter the experimental temperatures were 28°C. The temperatures of experimental groups were controlled by using thermostats. In each experimental aquarium care was taken to keep the animal away from the thermostat. The water of appropriate temperatures and of controls was renewed every 12-13 h run for 12 days in each season.

The rate of the respiration of the animals from the control and experimental group described above, while studying the effects of rise 6th day and 12th day (except of atmospheric exposure experiment on 12th day). The technique used for the rate of respiration (measurement of oxygen content from freshwater was similar to that described by Golterman et al.(1978), APHA (1985) All the values obtained for the atmospheric air were statistically analysed for confirmation of significance by using student "t"test (Dowdeswell, 1957).

RESULTS AND DISCUSSION

The effect of rise in temperature and effect of exposure to atmospheric air on oxygen consumption of *Lamellidens marginalis* in different season different seasons in table 1 and 2.

Oxygen concentration is also influenced by temperature, firstly oxygen solubility decreases as temperature rises, secondly, organic pollution (for example, domestic waste water), which produces a biological oxygen demand, will have this demand intensified by temperature change on chemical toxicity in part may be mediated through the arability of dissolved oxygen to aquatic organisms. Many substance are more toxic when dissolved oxygen to the aquatic organisms (Caimes *et al,* 1975). The ability of water to retain dissolved gas is greater and oxygen depleting waste, there can be a significant increase in the effective toxicity due to the reduced oxygen content.

Table 1. Effect of rise in temperature on oxygen consumption of *Lamelladens marginalis* in different seasons

Day	Winter		summer		monsoon	
	control	28°C	control	28°C	control	28°C
2nd	02444+_0.018	+_2624+_0.0125 (11.94)	0.1513+_0.05	0.2821+_0.0413 (86.45)	0.2317+_0.0121	+_0.1831+_0.0138(20.98)
6Th	0.1564+_0.0121	0.1012+_0.0221(35.29)	0.1917+_0.0190	0.2112+_0.01212(10.17)	0.1619+_0.0218	0.1843+_0.02141913.83)
12th	0.1423+_0.01712	0.1622+_0.01712	0.1448+_0.0121	0.1612+_0.082(11.32)	0.1422+_0.013	0.1822+_0.062(28.13)

All values are expressed in mg/100gm.

Table 2. Effect of exposure to atmospheric air on oxygen consumption *Lamelladens marginalis* in different seasons.

Day	Winter		summer		monsoon	
	Control	Atmospheric exposure	Control	Atmospheric exposure	Control	Atmospheric exposure
2nd	0.2330+_o.0421	+_0.2413 +_0.01212 (1.125	0.1991+_0.0313	0.2484+_0.0312(29.16)	0.22181+_0.01318	+_21589=-0.204(1.05)
6Th	01920+_0.01358	+_02013+_0.01358(484)	0.1741+_0.02858	0.1814+_0.1318(419)	+_0.2018+_0.01813	0.1921+_0.01213(480)

All values are expressed in mg/100gm, Bracket values represents percentage differential (Compared to control).

In the present investigation the effect of rise in temperature on oxygen consumption *Lamellidens marginalis* in different season on different day's of exposure period in control groups on 2^{nd} day the ate of respiration in winter was 0.2344+_0.018 mg/l/h, where as in summer season on 6th day ate of respiration in winter was 0.1564+_0.0121 mg/i/h. where as in summer it was 0.1917+_0.0190mg/i/h and in monsoon 0.1619+_0.0218mg/l/h on 12th day the rate of respiration in winter was 0.1423+_0.01712mg/l/h where as in summer it was 0.1448+_0.01211 mg/l/h and in monsoon 0.1422+_0.0131 mg/l/h. The study revealed that the rate of respiration decreased through 2^{nd} and 12^{th} day in every season in summer and monsoon after 6^{th} days it show decrease after 12^{th} days compared to 2^{nd} day in winter season the rate of respiration was 0.2624+_0.125 mg/l/h atwas 28 °C .Thus the study revealed that at 28 °C the percentage decrease in rate of respiration was 11.94 on 2nd day35.29 on 6th day and 13.98on 12^{th} day. In summer the rate of respiration at 32°C was 0.2821+_0.041 mg/l/h and on 12^{th} day it was 0.1621+_0.082 mg/l/h. Thus, the percentage decrease in rate of respiration was 86.45 on 2^{nd} day 10.17 on 6^{th} day and 11.32 on 12^{th} day it significantly increased on 2^{nd} and 12^{th} at 32°C compared to control. In monsoon the rate of respiration 30°C was 0.1831+_0.0138 mg/l/h on 2nd day 0.1843+_0.02141mg/i/h on 6th day and 0.1822+ _0.0962 mg/l/h 12th days. This revealed that the rate of respiration increased on non-significantly on 2nd and 6th day significantly increased on 12th day. Comparing the rate of respiration controls in winter and monsoon it is seen that the rate respiration increased on 12th day. Comparing the rate of respiration at 28°C with the respective controls in winter and in winter and it sharply increased from 6th to 12th day. The present investigations the effect of exposure to atmospheric air on oxygen consumption of *L. marginalis* in different season on different days of exposure period in control groups.

In the recent estimation the effect of exposure to atmospheric air on oxygen consumption of *L. marginalis* in different season on different days of exposure period in control groups .on 2nd day was 0.23358+_0.0421mg/l/h and in monsoon 0.2181+_0.01813mg/l/h in monsoon. Thus the study revealed that the rate of respiration deceased on 6th day in all the seasons. In winter the rate of respiration was 0.2413+_0.0212mg/l/h on 2nd day and 0.2013+_ 0.01358mg/l/hon. 2nd day and 0.1814+_0.01318 mg/l/h, on 6th day. In monsoon it was 0.21589+_0.0204 mg/l/h on 2nd day and 0.1921+_0.0213mg/l/h on 6th day. Thus, the study revealed that in all the season the rate of respiration increased non-significantly by 1.025%and 4.847%in winter 29.06% increased non-significantly by 1.025%and 4.847 in winter 29.96% and 4.18% in summer and 1.05 and 4.80 in monsoon after 2 and 6 day respectively. It is seen that in monsoon after 2 and 6 days respectively It is seen that in monsoon there was very little effect of exposure to atmospheric air on the rate of oxygen consumption and more in summer similar observation were made by Muley, 1988, Lioydspeek et al (2002) show that after elevation in temperature in Antarctic bivalve at ernulaelliptica and they stated that maximum circulating haemolymph oxygen content fell. Brace (1926) worked on the respiratory exchange of mussel, *Mytilus edulis* and report that the seasonal pattern of respiration with high values in winter and spring, and low values is summer he concluded that the increasing populations of gonad material in the body through the rate summer and autumn increased oxygen demand of the mussels. Bruce (1926) estimated that in the natural populations temperature would be more important in controlling rate of respiration their innate physiological changes. In the present study the rise in the temperature in summer months as well as at 32°C under experimental conditions resulted in the increase in the rate of respiration which is probably due to the maintain of the body metabolism Bayne (1976).

It is also probable that the increase in the rate of respiration is accounted due to the increases in the day length suggested by Chancel et.al (1979) similar results were observed by Muley 1988. Ansell (1969), Davies (1966 – 1967), Stickle (1973), Akarte (1985), Kulkarni (1987), Rao (1988), worked on freshwater bivalve mollusc and stated that the high temperature and lower nutritional conditions during summer months can significantly bring about alternation in the rate of oxygen consumption in the present study due to exposure also the animals showed increase in the rate of respiration *L. manganilis* shares rise in temperature using different season was kept in such a way that it was of the maximum during the given period of particular season that means in summer the experimental temperature was raise to 32°C, in monsoon to30°C and in the view of irregular flow of water on the animal habitat during different season due to dam construction. The rate of respiration was measured during the rise in temperature and changes on 2nd, 6th and 12th day.while during exposure to atmospheric air; it was measured on 2nd and 6th day. The rate of respiration from control group showed increased the rate during summer monsoon and winter. But the rate was increased more in summer than monsoon and winter. In all season the rate tended to decrease as the exposure period increased .rise in temperature resulted in increase in the respiration in all the seasons, particularly in summer .experiment of exposure to atmospheric air caused increased the rate of respiration.

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REFERENCES
Akarte S.R. (1985). Effect of organophorus insecticides on bivalve mollusks. Ph.D. Thesis, Marathwada University, Aurangabad pp. 1-252.
Ansell A.D. (1969). Thermal releases and shell fish culture, possibilities and Limitations. *Chesapeake Sci.* 10 (3–4): 256 – 257.

APHA (1985). Standard methods, For the examination of water and waste water, 16th edition, APHA Publication, Washington, U.S.A., pp. 1 – 1267

Basha S.M., Swami K.S. and Puspanjali A. (1988). Ciliary and cardiac activity of freshwater mussel Lamellidens marginalis (Lamark) as an index of evaluating organophosphate toxicity. *J. Environ. Biol.* 9(3):313-318.

Bayne B.L. (1979). Marine Mussels, their ecology and physiology, Cambridge University Press, Cambridge, London, New York, Melaborne. 1– 495.

Brace J.R. (1926). The respiratory exchange of mussel, *Mytilus edulis. Biochem. J.* 20:829 - 846.

Chanchel, P.K Pandey, B.N. and Singh, S.B. (1979). Seasonal variations in oxygen consumption of Anabas testudineus. *Bloch. Proc. Nat. Acad. Sci. India.* 49 (B): 159–162.

Davis J.S. (1975). Minimal dissolved oxygen requirements of aquatic life with Emphasis on Canadian species: a review. *J. Fish. Res. N Board. Can,* 32(13): 2295–2332.

Dowdeswell H. (1957). Practical Animal Ecology. Methum and Co. Ltd., London

El-Shenawy N.S., Moawad T.I.S., Mohallal M.E., Abdel-Nabil M. and Taha I.A. (2009). Histopathologic biomarker response of clam, Ruditapes decussates, to organophosphorous pesticides reldan and roundup: a laboratory study. *Oce. Sci. J.* 44(1): 27-34.

Golterman H. L.. Clymo R. S. and Ohnstadt M. A. M. (1978). Methods for Physical and Chemical Analysis of Freshwaters -1BP Handbook No 8, 2nd edition. -Oxford, Edinburgh, London, Melbourne: Blackwell Scientific Publications 1978

Hochachaka T.W and Somero G.N. (1973). Strategies of biochemical adaptation. W.B.Saunders and Co. Philadelphia, p.358

Kamble V.S. and Shinde R.A. (2012). Impact of organochlorine pesticide on oxygen consumption in the freshwater bivalve mollusc *Lamellidens corrianus. Res. J. Pharm. Biol. Chem. Sci.* 3(2): 607-613.

Kamble V.S., Gavhane U.V. and Kamble A.B. (2012). Effect of sub-lethal treatment of organophosphorus pesticide Ekalux (Quinolphos 25% Ec) on histopathology of gonad in freshwater lamellibranch mollusc *Lamellidens corrianus* during monsoon season found near Sangola, dist. Solapur. Res. Link-96, 11(1): 28-30.

Kulkarni D.A. (1987). A study on the reproductive endocrinology of freshwater mollusks. Ph.D. Thesis,Marathwada University, 1 – 192

Kumar S., Pandey R.K., Das S. and Das V.K. (2011). Pathological changes in hepatopancreas of freshwater mussel (*Lamellidens marginalis* Lamarck) exposed to sub-lethal concentration of dimethoate. *GERF Bull. Biosci.* 2(2): 18-23.

Kunnmnann H. and Precht, H. (1979). The influence of environmental temperature and salinity on animals. I Poikilothermic animals and the normal range of temperature. *Zool. Anz.* 202, 145–153.

Lioyds Peck., Hans O., Portner JrisHardewig (2002). Metabolic demand , oxygen supply and critical temperatures in the Antartic bivalve laternulelliptica. *Physiol. Biochem. Zool.* 75(2): 123–133.

Muley S.D. (1988). Reproductive physiology of lamellibranch mollusks from Maharashtra state. Ph.D. Thesis, Marathwada University, 1 – 292.

Precht H., Christophersen J., H. and Larcher W. (1973). Temperature and life pp. 392 – 398, springer – verlag, Berlin and New York.

Prosser C.S. (1973). Temperature in C.L. Prosser (ed.) comparative animal physiology , W.B. Saunders Company . Philadelphia, pp. 1: 362 – 428.

Rao K.R (1988). Neuroendocorine regulation on reproduction in lamellibrach molluscs Ph.D Thesis, Marthwada University Aurangabad 1-278

Rittschof D. and Mc Clellan-Green P. (2005). Molluscs asmultidisciplinary models in environmental toxicology. *Mar. Poll. Bull.* 50: 369-373.

Somero G.N. and Yancey P.H. (1778). Evolutionary adaptation of Km and Kcat Values. Fitting the enzyme to its environment through modification in amino acid and changes in solute of the cytosol.syp. *Biol. Thiry* 21:249-276.

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INFLUENCE OF HEAVY METALS UPON EFFICIENCY OF HYDROLYSIS OF GLYCOGEN IN DIFFERENT SPECIES OF FRESHWATER BIVALVES

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ABSTRACT
The freshwater *Parreysia corrugata* and *Indonaea caeruleus* were exposed to LC_0 and LC_{50} values of 96 hrs with concentrations of 165.01 ppm for zinc chloride, 130.20 ppm for copper sulphate, 95.05 ppm for cadmium chloride and 0.761 ppm for mercuric chloride up to 96 hrs. The *P. corrugata* in monsoon the glycogen in lower concentration showed more amount in mercury, followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In winter the lower concentration showed more amount in mercury followed by zinc, copper and cadmium. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In summer the lower concentration showed more amount in cadmium followed by mercury, copper and zinc. In higher concentration the more amounts in cadmium followed by mercury, copper and zinc. In *I caeruleus* in monsoon the content in lower concentration showed more amount in mercury, followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by copper, cadmium and zinc. In winter the lower concentration showed more amount in mercury followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In summer the lower concentration showed more amount in copper followed by cadmium, zinc and mercury. In higher concentration the more amounts in mercury followed by copper, zinc and cadmium. While, when compared with monsoon and winter of respective metal groups showed in lower concentration more decreased in cadmium, followed by zinc, copper and mercury respectively. In higher concentration the decrease rate was in cadmium followed by zinc, copper and mercury respectively.

KEY WORDS: Glycogen, heavy metals, *P. corrugata, I caeruleus* acute toxicity.

INTRODUCTION
To investigate the physiological changes after heavy metal treatment, to study the changes in the biochemical constituents i. e. carbohydrate as it is important metabolites to provide energy for different vital processes. Carbohydrate plays structural role in every living organism and serves as a reservoir of the chemical energy and many decrease or increase according to needs of the organism. Glycogen is considered to be the major source of energy in animal tissues and maintenance of glycogen reserves is an essential feature of the normal organismal metabolism. The pollutant give the heavy physical irritated stress causing rapid movement and increased respiration rate thus increased the utilization of reserve constituents like lipids and glycogen to meet the high energy demand of body causing decrease in organic constituents content Bhagylakshmi, (1981). The freshwater are an ecologically important fauna because they are used as sensitive biomarkers of aquatic ecosystem pollution. are stationary filter-feeding organisms able to bioaccumulate and concentrate most pollutants even if they are present fairly low concentrations (Niyogi *et al.*, 2001). The mode of action of pollutant may be responsible for cellular disorganization offering the storage and metabolism of the organic constituents. Glycogen quickly reacts to changes in the environment (Fisher and Dimock 2006), and it is connected to the nutritional condition, different types of stress, stages of the life cycle, and sexual maturity (de Zwaan and Zandee 1972; Anacleto *et al.* 2013; Cordeiro *et al.* 2017).

Ramalingam and Indra, (2002) showed decrease in glycogen level when exposed to copper sulphate toxicity on tissue phosphatases and carbohydrate turned over in *Achatina fulcia*. Chaudhari *et al.*,(2002) observed the effect of heavy metal, on the biochemical component like glycogen of various tissues of freshwater bivalve *Parreysia cylindrica*. Monitoring changes in glycogen levels has been used in various studies dealing with for example to monitor stress (Andrade *et al.* 2017) under different conditions such as starvation (Cordeiro *et al.* 2016), transportation (Anacleto *et al.* 2013), in ecotoxicological studies (Hazelton *et al.* 2014). The change in metabolic rate leads towards the change in biochemical composition hence, the change in biochemical composition is an indicator of stress of chemical or physical nature in the surrounding which mainly affects glycogen contents. The higher concentrations of toxicants bring the adverse effects on aquatic organisms, at cellular level or molecular level and ultimately lead to disorder in biochemical composition which is useful in determining different toxicants and protective mechanism of the body to resist the toxic effects of the substances. This study addresses freshwater bivalves which are increasingly being propagated in aquaculture facilities for conservation purposes and there is a need to employ reliable and non invasive methods to assess their energetic status. Many workers evaluated the glycogen content under heavy metal stress conditions (Osada and Mori 2000, Satyaparameshwar *et al.*, 2006, Suryawanshi and Shaikh, 2012). Nevertheless, pelecypod molluscs undergo modifications in their functional response as well as biochemical characteristics of tissue in response to ambient pollutant level. Among freshwater mussels, are most commonly available and distributed all over the country, forming important species for pearl culture operation in India (Surajit Das 2005, Shaikh, 2011, Suryawanshi and Sirsat 2018). Hence, the aim of our study to focus on understanding how *Parreysia corrugata* and *Indonaea caeruleus* from Manjara dam metabolizes and are affected by the wide range of concentration of different heavy metals viz. zinc, copper, cadmium and mercury in aquatic environment.

MATERIALS AND METHODS

The bivalves were collected from Manjara dam near Kallamb city, District Osmanabad, Maharashtra, India during the year 2018-19. The animal habitat was rich in flora and fauna around and in as there was no any industry on both sides as well as in catchment area. The availability of for present study depend upon the topography of the dam weather condition and human activities like pollution, heavy water force, interfering the cattle, washing the cloths along the dam etc. The localities in dam were selected as per the species abundance and water qualities of dam in different geographic area. The *Parreysia corrugata* and *Indonaea caeruleus were* collected for laboratory experiments from study area during monsoon, winter and summer. They were brought to the laboratory and kept in plastic troughs containing five liters of dechlorinated tap water for three days to acclimatize to laboratory conditions. Water from the plastic trough was changed after every 12 hours. The health of approximately same size and weight were selected for the experiments. Since the animals are micro feeders no special food was supplied during the experiment. The acclimatized *P. corrugata* and *I. caeruleus* were exposed to LC_0 and LC_{50} values of 96 hrs with concentrations of 105.01 ppm for zinc chloride, 130.20 ppm for copper sulphate, 95.05 ppm for cadmium chloride and 0.761 ppm for mercuric chloride up to 96 hrs. They were divided into two groups and the first group was maintained as control and each of the remaining group was exposed to different metal concentrations. After 96 hrs exposure the control and experimental were dissected and whole body were weighed and they were then kept in hot air oven at 92 ^{0}C till constant weights were obtained. The dried product was ground to obtain fine powder. From the replicates of three samples the glycogen was analyzed by anthrone reagent method (Dezwaan and Zandee, 1972). The amount of glycogen was calculated by regression equation and expressed in terms mg/100mg dry powder.

RESULTS

In present study the *P. corrugata* and *I. caeruleus* were exposed to different heavy metals for 96 hrs using the values of LC_0 and LC_{50}. The control group was runs simultaneously with exposed bivalves and only the mean values expressed in the **Table-1**. The results were calculated and compared amongst heavy metals and in *P. corrugata* showed more amount of protein in LC_0 bivalves than LC_{50}. In monsoon the glycogen content in LC_0 showed more amount in mercury (8.03) followed by copper (7.55), cadmium (7.39) and zinc (7.01).When these contents compared with zinc it was more in mercury (14.56%), than cadmium (5.43%) and copper (1.71%). In LC_{50} the more amounts in mercury (7.32) followed by cadmium (7.28), copper (6.56) and zinc (6.09). When compared with the zinc it was more in mercury and copper (5.48%) than cadmium (4.90%). In winter the LC_0 showed more amount in mercury (8.30) followed by zinc (8.14), copper (7.85) and cadmium (7.51). When compared with zinc it was more in cadmium (7.74%; $P<0.01$) followed copper (3.57%; $P<0.01$) and mercury (1.97%). In LC_{50} the more amounts in mercury (7.39) followed by cadmium (6.97), copper (6.86) and zinc (6.21). When compared with the zinc species content it was more in mercury (19.01%) than cadmium (12.24%) and copper (10.47%). Furtherwhen compared to monsoon to respective groups the glycogen was increased in all groups and s. In LC_0 more increased in zinc (16.12%) followed by copper (3.98%), mercury (3.67%) and cadmium (1.63%). In LC_{50} it was increased in all metal groups and the increase rate was in zinc (10.52%) followed by copper (4.58%), cadmium (4.20%) and mercury (0.96%). In summer the LC_0 showed more amount in cadmium (7.01) followed by mercury (6.94), copper (6.36) and zinc (5.87). When these contents compared with zinc it was more in cadmium (19.43%) than mercury (18.23%) and copper (8.37%). In LC_{50} the more amounts in cadmium (6.52) followed by mercury (6.25), copper (5.30) and zinc (4.96). When compared with the zinc species content it was more in cadmium (31.46%) than mercury (26.01%) and copper (6.86%). Furtherwhen compared

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with monsoon and winter of respective metal groups showed in LC_0 more decreased in zinc (16.27%; P<0.05), (27.89%; P<0.001) followed by copper (15.77%; P<0.001), (18.98%; P<0.001), mercury (13.58%; P<0.01), (16.39%; P<0.01) and cadmium (5.45%), (6.66%; P<0.05) respectively. In LC_{50} the decrease rate was in zinc (28.54%; P<0.05), (20.13%; P<0.001) followed by copper (19.21%; P<0.001), (22.75%; P<0.001), mercury (14.62%; P<0.001), (15.43%; P<0.001) and cadmium (10.44%), (6.46%; P<0.05) respectively.

Table 1:- Changes in glycogen in different species of freshwater bivalves in different seasons during acute toxicity to heavy metals from Manjara dam (M, S.) India

Species			MONSOON				WINTER				SUMMER			
	Control group	metalsvalues	Zinc chloride	Copper chloride	Cadmium chloride	Mercuric chloride	Zinc chloride	Copper chloride	Cadmium chloride	Mercuric chloride	Zinc chloride	Copper chloride	Cadmium chloride	Mercuric chloride
Parreysia corrugata	8.20 ±0.16	LC_0	7.01 ±0.34	7.55 ±0.19 (1.71%)	7.39 ±0.18 (5.43%)	8.03 ±0.24 (14.56%)	8.14 ±0.14 (16.12%) □□	7.85 ±0.14 (3.57%) ** (3.98%)	7.51 ±0.07 (7.74%) ** (1.63%)	8.30 ±0.24 (1.97%) (3.67%)	5.87 ±0.24 (16.27%)□ (27.89%)ΔΔΔ	6.36 ±0.14 (8.37%) (15.77%)□□□ (18.98%)ΔΔΔ	7.01 ±0.37 (19.43%) (5.45%) (6.66%)Δ	6.94 ±0.27 (18.23%) (13.58%)□□ (16.39%)ΔΔ
		LC_{50}	6.09 ±0.66	6.56 ±0.14 (5.48%)	7.28 ±0.07 (4.90%)	7.32 ±0.12 (5.48%)	6.21 ±0.07 (10.52%)	6.86 ±0.20 (10.47%) (4.58%)	6.97 ±0.12 (12.24%) (4.26%) □	7.39 ±0.07 (19.01%) (0.96%)	4.96 ±0.07 (28.54%)□ (20.13%)ΔΔΔ	5.30 ±0.18 (6.86%) (19.21%)□□□ (22.75%)ΔΔΔ	6.52 ±0.70 (31.46%) (10.44%) (6.46%)Δ	6.25 ±0.18 (26.01%) (14.62%)□□□ (15.43%)ΔΔΔ
Indonaea caeruleus	8.12 ±0.13	LC_0	7.05 ±0.02	7.62 ±0.14 (08.09%)	7.39 ±0.07 (4.83%)	7.80 ±0.35 (10.64%)	7.24 ±0.14 (2.69%)	8.08 ±0.14 (11.61%) (5.52%)	7.73 ±0.07 (6.77%) (4.61%) □	8.27 ±0.35 (14.23%) (6.03%)	6.25 ±0.18 (11.35%)□□ (13.68%)ΔΔ	7.16 ±0.24 (14.56%) (6.04%)□ (11.39%)ΔΔ	6.32 ±0.18 (1.12%) (14.48%)□□□ (18.25%)ΔΔΔ	5.85 ±0.25 (17.76%) (5.65%)□□ (11.01%)ΔΔ
		LC_{50}	6.21 ±0.07	6.97 ±0.18 (12.21%)	6.75 ±0.13 (0.65%)	7.16 ±0.07 (15.30%)	6.44 ±0.07 (3.71%)	7.04 ±0.18 (9.32%) (1.01%)	7.19 ±0.12 (11.65%) (6.52%)	7.62 ±0.07 (18.33%) (6.43%)	5.68 ±0.14 (8.54%)□□ (11.81%)ΔΔΔ	6.40 ±0.19 (12.68%) (8.18%)□ (9.09%)Δ	4.98 ±0.27 (12.33%)* (26.23%)□□ (30.74%)ΔΔΔ	6.59 ±0.07 (16.03%) (7.97%)□□□ (13.52%)ΔΔ

(Bracket values represent percentage differences) (*, □, Δ- P < 0.05, **, □□, ΔΔ-P < 0.01,*, □□□, ΔΔΔ- P < 0.001, *- compared to zinc , □- compared to monsoon, Δ- compared to winter of respective metal groups)**

Further the *I caeruleus* in monsoon the glycogen content in LC_0 showed more amount in mercury, (7.80) followed by copper (7.62), cadmium (7.39) and zinc (7.05). When these contents compared with zinc it was more in mercury (10.64%), than copper (8.09%) and cadmium (4.83%). In LC_{50} the more amounts in mercury (7.16) followed by copper (6.97), cadmium (6.75) and zinc (6.21). When compared with the zinc species content it was more in mercury (15.30%) than copper (12.21%) and cadmium (0.65%). In winter the LC_0 showed more amount in mercury (8.27) followed by copper (8.08), cadmium (7.73) and zinc (7.24). When these contents compared with zinc it was more in mercury (14.23%) than copper (11.61%) and cadmium (6.77%). In LC_{50} the more amounts in mercury (7.72) followed by cadmium (7.19), copper (7.04) and zinc (6.44). When compared with the zinc species content it was more in mercury (18.33%) than cadmium (11.65%) and copper (9.32%). Furtherwhen compared to monsoon to respective metal groups the glycogen was increased in all metal groups and s. In LC_0 more increased in mercury (6.03%) followed by copper (5.52%), cadmium (4.61%; P<0.05) and zinc (2.69%). In LC_{50} it was increased in all metal groups and the increase rate was in cadmium (6.52%) followed by mercury (6.43%), zinc (3.71%) and copper (1.01%). In summer the LC_0 showed more amount in copper (7.16) followed by cadmium (6.32), zinc (6.25) and mercury (5.85). When these contents compared with zinc it was more in mercury (17.76%) than copper (14.56%) and cadmium (1.12%). In LC_{50} the more amounts in mercury (6.59) followed by copper (6.40), zinc (5.68) and cadmium (4.98). When compared with the zinc species content it was more in mercury (16.03%) than copper (12.68%) and cadmium

(12.33%). Furtherwhen compared with monsoon and winter of respective metal groups showed in LC_0 more decreased in cadmium (14.48%; P<0.001), (18.25%; P<0.001) followed by zinc (11.35%; P<0.01), (13.68%; P<0.01), copper (6.04%; P<0.05), (11.39%; P<0.01) and mercury (5.65%; P<0.01), (11.01%; P<0.001) respectively. In LC_{50} the decrease rate was in cadmium (26.23%; P<0.01), (30.74%; P<0.001) followed by zinc (8.54%; P<0.01), (11.81%; P<0.001), copper (8.18%; P<0.05), (9.09%; P<0.05) and mercury (7.97%; P<0.001), (13.52%; P<0.001) respectively.

DISCUSSION

A tissue-specific glycogen evaluation can provide more detailed data for the monitoring the health and condition of and can provide new valuable information for future sampling, where more than one type of tissue for the glycogen analysis can be quantified. In the present study results clearly indicate that biochemical constituent. In present study glycogen in the body of experimental bivalves *P. corrugata* and *I caeruleus* decreases significantly as the period of acute concentration of increases. In *P. corrugata* in monsoon the glycogen content in lower concentration showed more amount in mercury, followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In winter the lower concentration showed more amount in mercury followed by zinc, copper and cadmium. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In summer the lower concentration showed more amount in cadmium followed by mercury, copper and zinc. In higher concentration the more amounts in cadmium followed by mercury, copper and zinc. While, when compared with monsoon and winter of respective metal groups showed in lower concentration more decreased in zinc followed by copper, mercury and cadmium respectively. In higher concentration the decrease rate was in zinc followed by copper, mercury and cadmium respectively. Significant depletion in glycogen level suggests possibility of its rapid utilization to provide excess energy for cellular biochemical process through glycolysis. Hypoxic condition might have been prevailed in the bivalve to provide excess energy by its utilization. Depletion in glycogen levels in the present study might be attributed to hypoxic conditions under heavy metals our results are in agreement with Sujatha *et al.*,(1996). Gabbott, and Bayne, (1973), have shownthat al variations in biochemical composition of molluscs depend on environmental parameters such as temperature and available phytoplankton and factors such as timing of the reproductive cycle and the rate of turnover of stored energy.

The greater breakdown of glycogen may suggest the need of high energy to animal in stress conditions caused due to pollutants. The greater decrease in the glycogen level, in the digestive gland might be due to high potential of digestive gland for glycolysis, similar to that of the vertebrate liver as suggested by Kabeer *et al.*, (1977).The mode of action of pollutants may be responsible for cellular dis-organization offering the storage and metabolism of the glycogen. Further, in present study the *I caeruleus* in monsoon the glycogen content in lower concentration showed more amount in mercury, followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by copper, cadmium and zinc. In winter the lower concentration showed more amount in mercury followed by copper, cadmium and zinc. In higher concentration the more amounts in mercury followed by cadmium, copper and zinc. In summer the lower concentration showed more amount in copper followed by cadmium, zinc and mercury. In higher concentration the more amounts in mercury followed by copper, zinc and cadmium. While, when compared with monsoon and winter of respective metal groups showed in lower concentration more decreased in cadmium, followed by zinc, copper and mercury respectively. In higher concentration the decrease rate was in cadmium followed by zinc), copper and mercury respectively. The present results are corobates with Mandal and Ghose (1970) observed glycogen depletion in the body of the snail, *Achatina fulica* (Bawdich) when exposed to calcium arsenate. Decrease in glycogen content indicates disrupted carbohydrate metabolism. The pollutants give the heavy physical irritate stress causing rapid movement and increased respiration rate thus increased utilization of reserved glycogen to meet higher energy demand of body causing decrease in glycogen content (Bhagyalaxmi, 1981). Glycogen is the stored food material in animal tissue which is used as an immediate source of energy when required and is an essential feature of the normal organism metabolism (Thunberg and Manchaster, 1972).

The depletion of glycogen content was greater in the digestive gland as compared to the foot and mantle of the bivalve, when exposed to pollutants. This indicates that the digestive gland is the principal metabolic center for various metabolic functions. The gradual increased content of glycogen from March onwards could be due to the development of the gonads Shettigar *et al.*, (2013), an intimate association of glycogen with the period of sexual activity was also observed in *Corbicula sp.* Greseth *et al.*, (2003) and Baby *et al.*, (2010) observed that the glycogen content in *Lamellidens margianalis* was increased during winter. The amountof glycogen present in different tissues is closely linked with food availability and gonadal development. Glycogen is found maximum in gonad during winter season, which shows utilized as reserve material during unavailability of food. to increase inflow and turbidityof water and to cope up with new environmental change. Similar results are observed by Pandit (2005) in *L. marginalis* of Godavari River. Significant reductions in bivalves glycogen greatly reduce their ability to cope with natural stressors present in the new environment. Glycogen storage fluctuates ally during ebb periods of gametogenisis and decrease rapidly in response to reduced food availability and environmental stress Patterson *et al.*, (1997, 1999). Further, in present study the results showed during winter caused some how different trend was observed, revealing different type of substrate utilization to meet the energy demand. The study showed maximal reduction of glycogen in body of the both bivalves mollusc may be the result of heavy metal stress induced hypoxia reflecting the elevation of glutamate dehydrogenase activity in body parts for mobilization of glucose from tissue glycogen to meet the high-energy demand. Similar observations were made by Das and Jana (2003) on cadmium induced stress in *Lamellidens marginalis*. Kulkarni et al. (2005) reported significant decrease in total sugar and glycogen content in *Lamellidens corianus* under sublethal impact of hildan and concluded it to be due to energy demand by the animal in stress conditions.

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REFERENCES
Anacleto P., Maulvault A. L., Barrento S., Mendes R., Nunes M. L., Rosa R. and Marques. A. (2013). Physiological responses to depurationand transport of native and exotic clams at different temperatures. *Aquaculture*. 136–146.

Andrade J. T. *et al.* (2010). Nutrient analysis of some commercially important molluscs of Bangladesh. *J. Scientific Res.* 2(2): 390-396.

Bhagyalakshmi A. (1981). Physiological studies on the fresh water field crab, *Oziotelphusa senex senex* (Fab) in relation to pesticide impact. *Ph.D. Thesis, Sri Venkateswara University Tirupati, India.*

Cordeiro N. I. S., Andrade J. T. M., Montresor L. C., Luz D. M. R., Araujo J.M., Martinez C. B., Pinheiro J., and Vidiggal T. H. D. A.. (2017). Physiological response of invasive mussel *Limnoperna fortunei* (Dunker, 1857) (Bivalvia: Mytilidae) submitted to transport and experimental conditions. *Brazilian J. Biol.* 77:191–198.

Cordeiro, N. I. S., J. T. M. Andrade, L. C. Montresor, D. M. R. Luz, C.B. Martinez, G. Darrigran, J. Pinheir, and T. H. D. A. Vidigal. (2016). Effect of starvation and subsequent feeding on glycogen concentration,behavior and mortality in the golden mussel *Limnoperna fortunei* (Dun-ker, 1857) (Bivalvia: Mytilidae). *J. Limnol.* 75:618–625.

Das Shamik and Jana B.B. (2003). Oxygen uptake and filtration rate as animal health biomarker in *Lamellidens marginalis* (Lamarck). *Indian J.Exptal. Biol.* 42: 1306-1310.

De Zwaan A. and D. I. Zandee. (1972). Body distribution and alchanges in the glycogen content of the common sea mussel *Mytilus edulis*. *Comparative Biochemistry and Physiology A: Physiology* 43:53–58.

Fisher G. R. and Dimock R. V. (2006). Indicators of physiological conditionin juveniles of *Utterbackia imbecillis* (Bivalvia: Unionidae): a comparison of rearing techniques. *American Malacol. Bull.* 21:23–29.

Fritts A. K., J. T. Peterson P. D. Hazelton and Bringolf R. B. (2015). Evaluation of methods for assessing physiological biomarkers of stressin freshwater. *Canadian J. Fisheries Aquatic Sci.* 72:1450–1459.

Gabbott P.A., and Bayne B. L. (1973). Biochemical effects of temperature an nutritive stress on *Mytilus edulis* L. *J. Mar. Bio. Ass. U. K.*53: 269-286.

Gopalkrishna A., Bhaskar V. S. and Kapoor D. (2003). Pearl forming freshwater mollusks of India. *First Indian Pearl Congress and Exposition* (Abstract), CMFRI, Kochi, 17.

Greseth S.L., Cope W.G., Rada R.G., Waller D.L. and Bartsch M.R. (2003). Biochemical composition of three species of Unioid after emersion. *J. Molluscan Studies*. 69: 101-106.

Kabeer Ahmed I., Sivalah S. and Ramana Rao K.V. (1977). On the possible significance of changes in organic constituents in selected tissues of Malathion exposed snail, *Pila globosa* (Swainson). *Comp. Physiol. Ecol.*, 4(2) : 81-82.

Kulkarni A.N., Kamble S.M. and Keshavan R. (2005). Studies on impact of hildan on biochemical constituents in the freshwater mussel, *Lamellidens corianus*. *J. Aqua. Biol.*, 20(1): 101-104.

Mandal T.K. and K.C.Ghose 1970. Application of calcium arsenate : Histopathological changes and glycogen mobilization in *Achitina fulica* (Bawdich). *Indian J. Exp. Biol.* 8: 332-333.

Niyogi S, Biswas S., Sarkers., and Datta A.G. (2001). Antioxidant enzymes in brackiswater oyster, *Saccostrea cucullata* as potential biomarkers of polyaromatic hydrocarbon pollution in Hooghly Estuary (India): Seasonality and its consequences. *Sci Total Environ.* 281: 237-246.
Osada Qi L., M. and Mori K. (2000). Biochemical variations in Pacific oyster gonadal tissue during sexual maturation. *Fisheries Sci.* 66 (3): 502-508.
Pandit S. V. (2005). Seasonal variations in the biochemicals of thefresh water bivalve molluscs, *Lamellidens marginalis* (L.) from Godavari River at Kaigaon, near Aurangabad. *Ph. D. Thesis, Dr. BabasahebAmbedkar Marathwada University, Aurangabad,* India. pp. 1 – 213.
Patterson M.A., Parker B.C. and Neves, R.J. (1999). Glycogen concentration in the mantle tissue of freshwater (Bivalvia: Unionidae) during starvation and controlled feeding. *American Malacological Bulletin,* 15(1), pp. 47-50. 3
Patterson M.A., Parker B. C. and Neves R.J. (1997). Effects of quarantine times of glycogen levels of native freshwater (Bivalvia: Unionidae) previously infested with zebra . *American Malacological Bulletin*, 14(1-2), pp. 75-79.
Ramalingam K. and Indra (2002). Copper sulphate (CuSo4) toxicity on tissue, phosphatases and carbohydrate turnover in *Achatina fulcia. J. Environ. Biol.*, 23(2), 181-188.
Satyaparameshwar, K., T. Ravinder Reddy and N. Vijaya Kumar, 2006. Study of carbohydrate metabolism in selected tissues of freshwater mussel, *Lamellidens marginalis* under copper sulphate toxicity. *J. Enviro. Biol.* 27(1): 39-41.
Shaikh M. J. (2011). Seasonal variation in biochemical constituents in different body tissues of freshwater bivalve molluscs *Lamellidens marginalis* from Pravara River in Maharashtra. *Int. J. Bioscan* 6(2): 297-299.
Shettigar Malathi and Seetharamaiah Thippeswamy (2013). Fatty acid composition in Freshwater mussel *Parreysia corrugata* (Muller, 1774) from Tunga River in the Western Ghats, India. *Advanced Biotech*, 11.
Sujatha C.H., Nair S.M. and Chacko J. 1996. Tributyltin oxide induced physiological and biochemical changes in a tropical estuarine clam. *Bull. Environ. Contam.Toxicol.* 56: 303-310.
Surajit Das (2005). Operational techniques for cultured pearl production in *Lamellidens marginalis* (Lamarck): A hands on experience. *J. Aqua. Biol.* 20(1): 163-165.
Suryawanshi G D and Sirsat P. B. (2018). Heavy metals Toxicity To freshwater bivalve *Lamellidens corrianus* and effect on biochemical contents. *J. Res. Development* Special Issue pp. 1-5
Suryawanshi G. D. and Shaikh A. M. (2012). Changes in glycogen during mercury accumulation and depuration of rock oyster *Crassostrea cattuckensis*, *National Journal of Life Sciences*, 09(1), 87-90.
Thurberg L.V. and Manchester K.L. (1972). Effect of dinervation on the glycogen content and on the activities of enzymes glucose and glycogen metabolism in rat diaphragm muscle. *Biochem. J.* 128 : 789.

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HEAVY METAL INDUCED PROTEIN ALTERATIONS IN THE FRESHWATER BIVALVES FROM NAGAPUR DAM DIST BEED, (M. S.) INDIA

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ABSTRACT
The freshwater *Lamellidens marginalis* and *lamellidens corrianus* were exposed to LC_0 and LC_{50} values of 96 hrs with concentrations of 165.01 ppm for zinc chloride, 130.20 ppm for copper sulphate, 95.05 ppm for cadmium chloride and 0.761 ppm for mercuric chloride up to 96 hrs. The *L. marginalis* in monsoon the protein content in LC_0 bivalves showed more amount in copper, followed by cadmium, zinc and mercury. In LC_{50} mussels the more amounts in copper followed by cadmium, zinc and mercury. In winter the LC_0 bivalves showed more amount in copper followed by cadmium, zinc and mercury. In LC_{50} mussels the more amount in copper followed by zinc, cadmium and mercury. In summer the LC_0 bivalves showed more amount in copper followed by cadmium, zinc and mercury. When these contents compared with zinc it was more in mercury than copper and cadmium. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. When compared with the zinc species content it was more in mercury than cadmium and copper. In *L. corrianus* in monsoon the protein content in LC_0 bivalves showed more amount in zinc followed by copper, cadmium and mercury. In LC_{50} mussels the more amounts in copper followed by cadmium, zinc and mercury. In winter the LC_0 bivalves showed more amount in copper followed by zinc, mercury and cadmium. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. In summer the LC_0 bivalves showed more amount in zinc followed by mercury, copper and cadmium. When these contents compared with zinc it was more in cadmium than copper and mercury. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. When compared with the zinc species content it was more in mercury than copper and cadmium.

KEY WORDS: acute toxicity, heavy metals, *L. marginalis*, *L. corrianus*, Protein.

INTRODUCTION

Protein is the most efficient organic reserves of most of the bivalve and other animals and it is responsible for variety of function in organisms. The proteins represent an energetic reserve because of their high caloric value and are mainly used in chronic stress conditions. The trace metals are known to be non-biodegradable and highly toxic to most organisms (Kaoud and Dahshan, 2010). Some metals are ubiquitous and important biochemical constituent of the earth's crust and trace amounts can be released into aquatic environments through the processes of weathering and erosion (Batty *et al.*, 2010). Small doses of metals are essential for almost all living organisms as it has a major role in numerous biochemical and physiological processes acting as a co-factor of proteins; metabolism of proteins, nucleic acids, carbohydrates and lipids (Rosabal *et al.*, 2012). The studies on biochemical response of a bivalve to stressors have led to the better understanding as to how bivalve cope with the stressor at the biochemical level (Suryawanshi and Deshpande, 2016). The inorganic constituents of water have effect on the diversity of the bivalves, the texture of the sediment and the quantity of organic matter seemed to have played a role in their distribution and bivalves are able to survive even in the presence of sandy soil and lesser organic matter Shafakatullah Nannu *et al.*, (2014). The effects of chronic exposure of color pigments which is using in paintings on changes in the biochemical constituents like protein, glycogen and lactic acid, in different body parts of fresh water mussels *L. marginalis* (Phadnis *et al.*, 2013). Exposure to environmental stressors can induce oxidative stress in cells and result in a decrease in reducing potential and metabolic transformation to reactive intermediates (Simmons *et al.*, 2011). Benthic biota can acquire metals through ingestion of sediment particles, food and directly from pore water and overlaying water (Griscom and Fisher, 2004).

The biochemical assay provides both qualitative and quantitative changes of tissue level in the bivalve. The aspect of energy metabolism and reproduction has been reported for a number of species of bivalves due to their commercial importance and edibility values In this regards many researchers devoted to study on the biochemical composition of bivalve molluscs (Kapil Manoj and Ragothaman, 1999, Shaikh, 2011, Kamble *et al.*, 2019, Suryawanshi and Kamble 2020). Hence, the aim of study to focus on understanding how bivalves *Parreysia corrugata* and ***Lamellidens***

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corrianus from Nagapur dam metabolizes and are affected by the wide range of concentration of different heavy metals like zinc, copper, cadmium and mercury in aquatic environment.

MATERIALS AND METHODS

The bivalve species habitats are rich in flora and fauna around Nagapur dam; it is large sized dam constructed on Nagapur River near village Nagapur, Dist. Beed hence selected for study and in as there is no any industry on both sides as well as in catchment area. The locality in dam is selected as per the species abundance and water qualities of dam in different geographic area. The bivalves *L. marginalis* and *L. corrianus* were collected for laboratory experiments from study area during monsoon, winter and summer seasons of year 2018-19. They were brought to the laboratory and kept in plastic troughs containing five liters of dechlorinated tap water for three days to acclimatize to laboratory conditions. Water from the plastic trough was changed after every 12 hours. The healthy bivalves of approximately same size and weight were selected for the experiments. Since the animals are micro feeders no special food was supplied during the experiment. The acclimatized bivalves were exposed to LC_0 and LC_{50} values of 96 hrs with concentrations of 165.01 ppm for zinc chloride, 130.20 ppm for copper sulphate, 95.05 ppm for cadmium chloride and 0.761 ppm for mercuric chloride up to 96 hrs. The bivalves were divided into two groups and the first group was maintained as control and each of the remaining group was exposed to different metal concentrations. After 96 hrs exposure the control and experimental bivalves were dissected and whole body were weighed and they were then kept in hot air oven at 92 ^{0}C till constant weights were obtained. The dried product was ground to obtain fine powder. From the replicates of three samples the protein was estimated using Lowry method (Lowry *et al.*, 1952). The amount of protein were calculated by regression equation and expressed in terms mg/100mg dry powder.

RESULTS

In *L. marginalis* in monsoon the protein content (Table-1) in LC_0 bivalves showed more amount in copper , (4.98) followed by cadmium (4.89), zinc (4.83) and mercury (4.73).

Table 1:- Changes in protein levels in different species of freshwater bivalves in different seasons during acute toxicity to heavy metals from Nagapur dam Dist Beed (M. S.) India.

Species			MONSOON				WINTER				SUMMER			
	Control group	metalsvalues	Zinc chloride	Copper sulphate	Cadmium chloride	Mercuric chloride	Zinc chloride	Copper sulphate	Cadmium chloride	Mercuric chloride	Zinc chloride	Copper sulphate	Cadmium chloride	Mercuric chloride
Lamellidens marginalis	3.93 ±0.22	LC_0	4.83 ±0.11	4.98 ±0.10 (3.11%)	4.89 ±0.18 (1.25%)	4.73 ±0.04 (16.57%)	5.03 ±0.16 (0.42%)	5.11 ±0.13 (1.60%) (2.62%)	5.09 ±0.09 (1.19%) (4.09%)	4.97 ±0.14 (1.19%) (5.08%)	4.52 ±0.07 (6.42%)□ (10.14%)ΔΔ	4.60 ±0.14 (1.77%) (7.64%)□ (9.99%)ΔΔ	4.58 ±0..16 (1.33%) (6.34%) (10.02%)ΔΔ	4.06 ±0.13 (10.18%)** (14.17%)□□ (18.31%)ΔΔ
		LC_{50}	4.73 ±0.07	4.93 ±0.07 (4.23%)*	4.78 ±0.11 (1.06%)	4.53 ±0.07 (4.23%)*	4.85 ±0.35 (2.54%)	4.99 ±0.09 (2.89%)* (1.22%)	4.82 ±0.17 (0.62%) (0.09%)	4.75 ±0.04 (2.07%) (4.86%)□	4.33 ±0.23 (8.46%)□ (10.73%)	4.35 ±0.07 (0.47%) (11.77%)□□□ (12.83%)ΔΔΔ	4.14 ±0.13 (4.39%) (13.39%)□□ (14.11%)ΔΔ	3.99 ±0.10 (7.86%) (11.93%)□□ (16.0%)ΔΔΔ
Lamellidens corrianus	4.09 ±0.05	LC_0	4.98 ±0.13	4.95 ±0.16 (0.61%)	4.91 ±0.10 (1.61%)	4.89 ±0.03 (1.81%)*	5.20 ±0.10 (4.42%)	5.22 ±0.13 (0.39%) (5.46%)	4.45 ±0.11 (1.93%)** (7.95%)□□	5.09 ±0.14 (2.12%) (4.09%)	4.67 ±0.07 (6.23%)□ (10.20%)ΔΔ	4.65 ±0.16 (0.43%) (6.07%) (10.92%)ΔΔΔ	2.80 ±0.07 (2.15%)*** (6.93%)□□□ (11.89%)ΔΔΔ	4.65 ±0.16 (0.43%) (4.91%)□ (8.65%)ΔΔ
		LC_{50}	4..73 ±0.04	4.93 ±0.10 (4.23%)	4.77 ±0.07 (0.85%)	4.57 ±0.10 (3.39%)	4.97 ±0.04 (5.08%)	5.11 ±0.09 (2.82%) (3.66%)	4.91 ±0.09 (1.21%) (2.94%)	4.87 ±0.04 (2.02%) (6.57%)	4.53 ±0.07 (4.23%)□ (8.26%)ΔΔ	4.65 ±0.11 (2.65%) (5.68%)□ (9.01%)ΔΔ	4.49 ±0.04 (0.89%) (5.88%)□□ (8.56%)ΔΔ	4.41 ±0.11 (2.65%) (3.51%) (9.45%)ΔΔ

(Bracket values represent percentage differences) (*, □, Δ- P < 0.05, **, □□, ΔΔ-P < 0.01, *, □□□, ΔΔΔ- P < 0.001, *- compared to zinc , □- compared to monsoon, Δ- compared to winter of respective metal groups)**

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When these contents compared with zinc it was more in mercury (16.57%) than copper (3.11%) and cadmium (1.25%). In LC_{50} mussels the more amounts in copper (4.93) followed by cadmium (4.78), zinc (4.73) and mercury (4.53). When compared with the zinc species content it was more in mercury and cadmium showed equal amount of content i e. (4.23%; P<0.05) and cadmium (1.06%). In winter the LC_0 bivalves showed more amount in copper (5.11) followed by cadmium (5.09), zinc (5.03) and mercury (4.97). When these contents compared with zinc it was more in copper (1.60%) than cadmium (1.19%) and mercury (1.19%). In LC_{50} mussels the more amount in copper(4.99) followed by zinc (4.85), cadmium (4.82) and mercury (4.75). When compared with the zinc species content it was more in copper (2.89%; P<0.05) than mercury (2.07%) and cadmium (0.62%). On the other hand the content when compared to monsoon to respective groups the protein was increased in all groups. In LC_0 mussels the content more increased in mercury (5.08%) followed by cadmium (4.09%), copper (2.62%) and zinc (0.42%). In LC_{50} it was increased in all groups and the increase rate was in mercury (4.86%; P<0.05) followed by zinc (2.54%), copper (1.22%) and cadmium (0.09%). In summer the LC_0 bivalves showed more amount in copper (4.60) followed by cadmium (4.58), zinc (4.52) and mercury (4.06). When these contents compared with zinc it was more in mercury (10.78%; P<0.05) than copper (1.77%) and cadmium (1.33%). In LC_{50} mussels the more amounts in copper (4.35) followed by zinc (4.33), cadmium (4.14) and mercury (3.99). When compared with the zinc species content it was more in mercury (7.86%) than cadmium (4.39%) and copper (0.47%). On the other hand when the content compared with monsoon and winter of respective groups the content showed in LC_0 bivalves more decreased in mercury (14.17%; P<0.01), (18.31%; P<0.01) followed by copper (7.64%; P<0.05), (9.99%; P<0.01), zinc (6.42%; P<0.05), (10.14%; P<0.01) and cadmium (6.34%), (10.02%; P<0.01) respectively. In LC_{50} the decrease rate was in cadmium (13.39%; P<0.01), (14.11%; P<0.01) followed by mercury (11.93%; P<0.01), (16.0%; P<0.001), copper(11.77%; P<0.001), (12.83%; P<0.001) and zinc (8.46%; P<0.05), (10.73%) respectively.

On the other hand the *L. corrianus* in monsoon the protein content in LC_0 bivalves showed more amount in zinc (4.98) followed by copper (4.95), cadmium (4.91) and mercury (4.89). When these contents compared with zinc it was more in mercury (1.81%; P<0.05) than cadmium (1.61%) and copper (0.61%). In LC_{50} mussels the more amounts in copper (4.93) followed by cadmium (4.77), zinc (4.93) and mercury (4.57). When compared with the zinc species content it was more in copper (4.23%) than mercury (3.39%) and cadmium (0.85%). In winter the LC_0 bivalves showed more amount in copper (5.22) followed by zinc(5.20), mercury (5.09) and cadmium (4.45). When these contents compared with zinc it was more in mercury (2.12%) than cadmium (1.93%; P<0.001) and copper (0.39%). In LC_{50} mussels the more amounts in copper (5.11) followed by zinc (4.97), cadmium (4.91) and mercury (4.87). When compared with the zinc species content it was more in copper (2.32%) than mercury (2.02%) and cadmium (1.21%). On the other hand the content when compared to monsoon to respective groups the protein was increased in all groups.

In LC_0 mussels the content more increased in cadmium (7.95%; P<0.01) followed by copper (5.46%), zinc (4.42%) and mercury (4.09%). In LC_{50} it was increased in all groups and the increase rate was in mercury (6.57%) followed by zinc (5.08%), copper (3.66%) and cadmium (2.94%). In summer the LC_0 bivalves showed more amount in zinc (4.67) followed by mercury (4.65), copper (4.65) and cadmium (2.80). When these contents compared with zinc it was more in cadmium (2.15%; P<0.001) than copper (0.43%) and mercury (0.43%). In LC_{50} mussels the more amounts in copper (4.65) followed by zinc (4.53), cadmium (4.49) and mercury (4.41). When compared with the zinc species content it was more in mercury (2.65%) than copper (2.65%) and cadmium (0.89%). On the other hand when the content compared with monsoon and winter of respective groups the content showed in LC_0 bivalves more decreased in cadmium (6.93%; P<0.001), (11.89%; P<0.001) followed by zinc (6.23%; P<0.05), (10.20%; P<0.01), copper (6.07%), (10.92%; P<0.001) and mercury (4.91%; P<0.05), (8.65%; P<0.01) respectively. In LC_{50} the decrease rate was in cadmium (5.88%; P<0.01), (8.56%; P<0.01) followed by copper (5.68%; P<0.05), (9.01%; P<0.01), zinc (4.23%; P<0.05), (8.26%; P<0.01) and mercury (3.51%), (9.45%; P<0.01) respectively.

DISCUSSION

Freshwater bivalves are performing efficient role in transformation and reserved of energy in food chains coupled with their sessile made of life. Proteins play a nutritionally and physiologically important role in bivalves by providing an efficient source of high energy content and essential fatty acids. Seasonal changes in protein content may be of great importance in relation to energy metabolism necessary for growth and reproduction (Lodeiros *et al.*, 2001). Thus, food availability may be the important source of nutrients required for the gonadal repining process. Seasonal variation in temperature and availability of food appear to be closely related to energy available for growth and reproduction in other bivalve species (Smaal *et.al.*, 1997). The protein seems to be its only alternative resource of energy under conditions of food scarcity. However, it cannot be certain without further studies and proper investigation about the possible advantage of using protein as an energy reserve and the mechanisms of regulation. In present study the *L. marginalis* showed more amount of protein in monsoon the protein content in bivalves showed more amounts in zinc, followed by cadmium, mercury and copper. When compared with the zinc species content it was more in cadmium than copper and mercury showed equal amount of content.

According to our study it was observed that the protein concentration altered due to metals and it was increased during exposure. In present study *L. marginalis* in monsoon the protein content in LC_0 bivalves showed more amount in copper, followed by cadmium, zinc and mercury. When these contents compared with zinc it was more in mercury than copper and cadmium. In LC_{50} mussels the more amounts in copper followed by cadmium, zinc and mercury. When compared with the zinc species content it was more in mercury and cadmium showed equal amount of content and cadmium. In winter the LC_0 bivalves showed more amount in copper followed by cadmium, zinc and mercury. When these contents compared with zinc it was more in copper than cadmium and mercury. In LC_{50} mussels the more amount in copper followed by zinc, cadmium and mercury. When compared with the zinc species content it was more in copper than mercury and cadmium. On the other hand the content when compared to monsoon to respective groups the protein was increased in all groups. In LC_0 mussels the content more increased in mercury followed by cadmium, copper and zinc. In LC_{50} it was increased in all groups and the increase rate was in mercury followed by zinc, copper and cadmium. In summer the LC_0 bivalves showed more amount in copper followed by cadmium, zinc and mercury. When these contents compared with zinc it was more in mercury than copper and cadmium. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. When compared with the zinc species content it was more in mercury than cadmium and copper. When comparison between heavy metals the mercury was more affected the body parts and zinc was less affected.

The fall in the protein content during pollutant exposure may be due to increase protein catabolism and decrease anabolism of protein. Mahajan and Zambare (2001) showed that after acute and chronic exposure to mercuty, protein contents in different tissues of freshwater bivalve *Corbicula striatella* were found that highly depleted and maximum protein depletion was found in foot. The results obtained in the present study are supported by several investigators who reported decrease in protein of various organisms under influence of different metals. However, total protein content decreased on exposure to chromium in all the three tissues like gill followed by adductor muscle and mantle of freshwater bivalve *L. marginalis* (Satyaparameshwar *et al.*, 2006). Our present data is compatible with many studies such as (Suryawanshi *et al.*, 2014) the fall in the protein content during pollutant exposure may be due to increase protein catabolism and decrease anabolism of bivalves *L. marginalis*. Whereas, the protein decreases in organism due to largest need of energy for the metabolic process which leads to increases utilization of protein to meet energy and increase the proteolysis to reach the high energy demands under heavy metal stress in fresh water bivalves (Suryawanshi, 2017). On the other hand, upon 96 hrs exposure to metals the protein decreased in all heavy metals but the more decrease was in mercury, cadmium and copper and zinc of mussels this showed greater demand of energy over the utilization of body reserves in this organs, where in protein metabolites decreased. The increase in MT levels and concomitant decrease in the accumulation of various heavy metals (Gagnon *et al.*, 2006) and labile zinc in gonad and gill tissues might be explained by the inflammation hypothesis.

When organism expose to stress tends to shift all the metabolic processes to face the toxic effects of stress and this lead to changes in biochemical and physiological mechanism in the body of organism, both duration of exposure and heavy metal concentrations important in determination of the level of biomarker response (Lehtonen *et al.*, 2003). It is therefore essential to study the effect of environmental variables on the the protein contents. However, it appears that the some group of bivalves showed protein decreases and protein synthesizes might be due to high concentration of metal and irrespective time of exposure period such as 96 hrs. While, the detected as shown in the results, enable us to make conclusions about the idea of variation in protein and protein was observed and we think that differences might be due to type of heavy metals, tolerance capacity, physiological status and metabolic rate of animals. However, increase in the protein content in some mussels groups was also seen which suggest the inhibition of lipase activity and protein synthesis likely due to impairment in metabolism and to the inhibition of enzyme activity in protein metabolism. Similar finding also do support to above results. (Rashmi *et al.*,2005). Further in present study the protein in lower concentration *L. corrianus* in monsoon the protein in LC_0 bivalves showed more amount in zinc followed by copper, cadmium and mercury. When these contents compared with zinc it was more in mercury than cadmium and copper.

In LC_{50} mussels the more amounts in copper followed by cadmium, zinc and mercury. When compared with the zinc species content it was more in copper than mercury and cadmium. In winter the LC_0 bivalves showed more amount in copper followed by zinc, mercury and cadmium. When these contents compared with zinc it was more in mercury than cadmium and copper. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. When compared with the zinc species content it was more in copper than mercury and cadmium. On the other hand the content when compared to monsoon to respective groups the protein was increased in all groups. In LC_0 mussels the content more increased in cadmium followed by copper, zinc and mercury. In LC_{50} it was increased in all groups and the increase rate was in mercury followed by zinc, copper and cadmium. In summer the LC_0 bivalves showed more amount in zinc followed by mercury, copper and cadmium. When these contents compared with zinc it was more in cadmium than copper and mercury. In LC_{50} mussels the more amounts in copper followed by zinc, cadmium and mercury. The results obtained in the present study indicate severe disturbance in the protein metabolism of the fresh water bivalves exposed to different heavy metals.

The results obtained in present study are in agreement of most of the above observations and showed decrease in the protein in the body parts of bivalves shows its prime utilization in gearing of the metabolism. Another possible explanation for the decrease in the protein might be due to diapedesis and mucoprotein which is eliminated in the form of mucous. During the experiments in laboratory it was noticed that the excessive secretion of mucous and diapedesis on the water surface might be scrubbing the body by bivalves due to metals and avoiding the water into the body hence supports this possibility. Pardeshi and Gapat, (2012) were noticed that protein contents were significantly reduced after nickel exposure in all tissues of the bivalve *L. corrianus* as compared to control group of animals. However, total protein content decreased on exposure to various metals in different body parts of freshwater bivalve *L. marginalis* were observed (Suryawanshi *et al.*, 2016). The results obtained in present study are in agreement of most of the above observations and showed decrease in the protein in the body parts of bivalves shows its prime utilization in gearing of the metabolism. Our present study showed when comparison between the metals the zinc was not affected much hence the protein was not depleted more in the body of bivalves but mercury metal concentration showed more pronounced to the bivalves hence more protein was depleted and this indicates that the Zn is essential and Hg is not essential metal to the body of mussels so the variation in protein concentration was observed.

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REFERENCES

Batty L. C., Auladell M., Sadler J. and Hallberg, K. (2010). The impacts of metalliferous drainage on aquatic communities in streams and rivers. *Ecol. Indust. Pollut.* (2): 70-100.

Gagnon C., Gagne F., Turcotte P., Saulnier I., Blaise C., Salazar M.H. and Salazar S. (2006). Exposure of caged mussels to metals in a primary—treated municipal wastewater plume. Chemosphere. (62) 998–1010.

Griscom S.B., Fisher N.S. (2004). Bioavailability of sediment-bound metals to marine bivalve molluscs: an overview. *Estuaries.* (27): 826–838.

Kamble, S. G., R. D. Sonwane and G. D. Suryawanshi (2019). Biochemical variation in freshwater bivalve *Lamellidens marginalis*. *Think India J.* (22): Special Issue-31

Kaoud H. A. and El-Dahshan A. R. (2010). Bioaccumulation and histopathological alterations of the heavy metals in *Oreochromis niloticus* fish. *Nature Sci.* (8): 4-8

Kapil Manoj and Ragothaman, G (1999). Mercury, copper and cadmium induced changes in the proteins levels in muscle tissue of an edible esturine fish, *Bolephthalmus dussumeri* (Cuv). *J. Environ. Biol.* 20(3): 231-234

Lehtonen K.K. and Leiniö S. (2003). Effects of Exposure to Copper and Malathion on Metallothionein Levels and Acetylcholinesterase Activity of the Mussel *Mytilus edulis* and the Clam *Macoma balthicafrom* the Northern Baltic Sea. *Bull. Environ. Contam. Toxicol.* (71): 489–496.

Lodeiros, C. J., Rengel, J. J., Guderley, H. E., Nuseni, O. and Himmelman, J. H. (2001). Biochemical composition and energy allocation in the tropical scallop *Lyropecten (Nodipecten) nodosus* during the months leading up to and following the development gonads. *Aquaculture* (199): 63-72.
Lowry O.H.,Rosenbrough N.J., Farr A.L., and Randall R.J. (1951). Protein measurement with Folin phenolreagent. *J. Biol. Chem.* (193), 265-27.
Mahajan A. Y. and Zambare S. P. (2001). Ascorbate effect on copper sulphate and mercuric chloride induced alterations of protein levels in freshwater bivalve, *Corbicula striatella. Asian. J. Microbiol. Biotech. and Env. Sci.* (3): 95-100.
Pardeshi Anilkumar and Gapat Meenakshi (2012). Ascorbate effect on protein content during nickel intoxication the freshwater bivalve, *Lamellidens corrianus*, Bioscience Discovery 3 (2):270 -274.
Phadnis, S. D.; Chandagade, C. A.; Jadhav, V. V. (2013). Impact of colour pigments on biochemical parameters of bivalve, *Lamellidens corrianus*, J. of Env. Biol. 34. (2): 267-271.
Rashmi CA, Sivakumar AA, Mohandas S and Aruchami M. (2005). Effect of cadmium and zinc on antioxidant enzyme activity in the gastropod, *Achatina fulica*. Comparative biochemistry and physiology part C: *Toxicol. Pharmacol.* 140: 422-426.
Rosabal M., Hare L., Campbell P. G. (2012). Subcellular metal partitioning in larvae of the insect Chaoborus collected along an environmental metal exposure gradient (Cd, Cu, Ni and Zn). *Aquatic Toxicol.* (120): 67–78.
Satyaparameshwar K., T. Ravinder Reddy and N. Vijaya Kumar, (2006). Effect of chromium on protein metabolism of fresh water mussel, *Lamellidens marginalis J. Env. Biol.* (2): 401-403.
Shafakatullah Nannu and M. Krishnamoorthy (2014). Nutritional Quality in Freshwater Mussels, *Parreysi*a spp. of Periyar River, Kerala, India. *Res. J. Recent Sci.* (3): 267-270.
Shaikh, M.J. (2011). Seasonal variation in biochemical constituents in different body tissues of freshwater bivalve mollusk, *Lamellidens corrianus* (Lamark) from Pravara river in Maharashtra. *The Bioscan.* 6(2): 287-288.
Simmons, S. O., Fan, C. Y., Yeoman, K., Wakefield, J., and Ramabhadran, R. (2011). NRF2 oxidative stress induced by heavy metals is cell type dependent. *Curr. Chem. Genomics.* (5): 1–12.
Smaal, A. C., Vonck, A. P. M. A. and Bakker, M. (1997). Seasonal variation in physiological energetics of *Mytilus edulis* and *Cerastoderma edule* of different size classes. *J. Mar. Biol. Assoc. U. K.* (77), 817-838.
Suryawanshi G. D. and Kamble S. G. (2020). Changes in Protein Metabolism of Freshwater Bivalves (*L. Marginalis* and *L. Corrianus*) Due To Short Term Exposed To Heavy Metals." *J. Environ. Sci. Toxicol. Food Technol.* 14 (9): 28-32.
Suryawanshi G. D., Kurhe A. R. and Miguel A. Rodriguez (2014). Mercury Exposure Produce Changes in Protein Content in Different Body Parts of Oyster *Crassostrea cattuckensis* (Newton and Smith). *J. Environ. Sci. Comp. Sci. Eng. Tech.* (1): 0065-0071.
Suryawanshi, G. D. and Deshpande P. A. (2016). Changes in protein in different body parts of bivalve *L. marginalis* due to heavy metals. *Int. J. of Trends Fisheries Res.* 5 (3): 25-29.

