IRJSE International Research Journal of Science & Engineering
Int. Res. J. of Science & Engineering, 2018; Special Issue A3 : 15-20
ISSN: 2322-0015
SJIF Impact Factor 4.11
UGC Approved Journal No. 63628
RESEARCH ARTICLE **OPEN ACCESS**

Size dependent variation in the rate of oxygen consumption, ammonia excretion and O:N ratio of freshwater bivalve, *Indonaia caeruleus* from Yedgaon Dam during monsoon season (M.S.) India

Gulave Arun

Hon. Balasaheb Jadhav Arts, Commerce & Science College, Ale, Tal - Junnar , District - Pune, (M.S.) , India.
E-mail - arungulave1970@gmail.com |9860388938

Manuscript Details
Available online on http://www.irjse.in
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Gulave Arun. Size dependent variation in the rate of oxygen consumption, ammonia excretion and O:N ratio of freshwater bivalve, *Indonaia caeruleus* from Yedgaon Dam during monsoon season (M.S.) India., *Int. Res. Journal of Science & Engineering*, January 2018; Special Issue A3 : 15-20.

ABSTRACT
Study O: N ratio in freshwater bivalve molluscs, *Indonaia Caeruleus* is reported here by considering the size dependent variation. Freshwater bivalve molluscs were collected from the banks of Kukadi River at Yedgaon dam, near Junnar (Pune). The freshwater bivalves with two different size i.e. small (46-50 mm shell length) and large (56-60mm in shell-length) were collected for determination of changes in the rate of oxygen consumption, rate of ammonia excretion and O:N (oxygen : nitrogen) ratio, during monsoon on July and August . The small size bivalve showed high values of O:N ratio than that of large sized one. The results are discussed in the light of metabolic processes in fresh-water bivalve molluscs.

Key words - Ammonia excretion, *Indonaia Caeruleus*, oxygen consumption.

INTRODUCTION

The O:N ratio is an index of protein utilization in energy metabolism. This ratio is also useful for assessing the relative contribution of protein catabolism [1]. The respiration rates could be used to evaluate mussel stress and over all fitness of animal for survival and reproduction.

The body size of the bivalve mollusc is an important parameter for influencing the pattern of metabolic responses. The relationship between the rate of ammonia excretion and the body size can be variable due to a disproportionate reliance of protein catabolism for energy production in bivalve molluscs. Regulation of chemical composition of the body fluid is an important function of the ionic and somatic regulation and of excretion. This helps in the elimination of waste and conservation of useful metabolites for growth, maintenance and reproduction. Bayne and Scullard [3] reported that amount of nitrogen loss as amino acids relative to ammonia varied with season as well as location site of collection. In bivalve molluscs, several workers have studied nitrogenous excretory products and their reports reveled that, ammonia is the dominant products and large amount of amino- nitrogen are lost in excretion. Segawa [4] observed that, increased oxygen consumption and ammonia excretion is linear with increase in weight and decreases with period of starvation in abalone sulculus diversicular. Ganzalo and Cancino [5] reported that, oxygen conception and ammonia excretion of bivalve Guimordia bahamondei is a function of body weight.

According to Barkai and Griffths [6], 63% of energy content of the food consumed was lost as faces and 32% expended on respiration in abalone. Navarro and Torrijos [7] reported that, energy utilized in oxygen uptake and ammonia excretion was depending on the season and temperature of the water body. A number of investigator have studied oxygen consumption and ammonia excretion according to envirmental factors, turbidity [8], size [9][9], time [10] and growth [11]. Howkins et al. [12] reported O:N ratio on Perna Viridis and Perna indica from Cochin backwaters. Mathew and Menon [13] reported heavy metal stress induced variation in O:N ratio in Perna indica and Donax incarnates.

Review of literature reveled that, very little information was available on fresh water bivalve molluscs from India. By considering the abundant distribution of bivalve molluscs along the banks of kukadi river and paucity of information on O:N in fresh water bivalves, the present study was undertaken on *Indonaia caeruleus*.

METHODOLOGY

During monsoon (July - August) freshwater bivalve molluscs, *Indonaia caeruleus* were collected from banks of Kukadi river at Yedgaon. Animals with two different shell length i.e. small size (46-50mm shell length) and large size (56-60 mm shell length) were selected. After collection, bivalves were brought to the laboratory immediately. In order to remove the algal biomass, mud and other waste materials, the shells of the animals were brushed and washed with freshwater. The cleaned animals were divided into two size group's viz. small size (45-52) and large size (57-64 mm) according to their shell length. Each group comprises 15 animals. Then, they were allowed to defecation and depuration for 12-13 hrs (not acclimatization) in laboratory conditions, under constant aeration.

The physico-chemical parameters of water i.e. Temperature, pH, hardness and dissolved oxygen contents were also measured. The rate of oxygen consumption of individual animal was determined according to Wrinkler's modified method [14]. For determination of oxygen consumption of individual bivalve ,four closed respiratory jars 1.0 litre capacity each with an inlet and outlet were used . In order to open their valves, they were kept in continuous circulation of water inside the chamber. After opening their valves, the flow of water was cut off. A sample of water from it was drawn for determination of oxygen consumption and ammonia excretion. After one hour, 50 ml of sample water from the chamber was drawn to find out the oxygen content. At the same time 10 ml of the sample water from the chamber was also drawn and processed for analysis of ammonia according to phenol-hypochloride method suggested by Solorzano, [14]. Data on oxygen consumption, ammonia excretion and 0:N ratios were calculated for each individual bivalve used in this experiments, by dividing its oxygen consumption rate in moles O and by its ammonia excretion rate in moles N [15-16]. The mean values of four individual bivalves from each group were used for statistical analysis. Rate of oxygen consumption of individual bivalve represented mg O_2/l/h/gm body weight and rate of ammonia excreted represented mg NH_3-N/l/h body weight.

RESULTS AND DISCUSSION

The physico-chemical characteristics of the habitat water were temperature 26.5˚C - 29.5˚C on July and 25.5˚C - 28.0˚C on August, pH 8.08 - 9.27 on July and 8.78 - 8.83 on August. Hardness of water is 104 - 115 ppm on July and 97 - 111 ppm on August and dissolved oxygen 6.870 - 7.300 mg /l/h on July and 6.980 - 7.280 mg /l/h on August during monsoon season.

The rate of oxygen consumption during monsoon was found maximum in small sized animal as compared to large sized animal. It was found to be to be (0.7275 ± 0.0866 mg/l/h) on July and on August it was (0.7525± 0.0486 mg/l/h) in small animals. While in large sized animal oxygen consumption was found to be (0.5625 ± 0.0117 mg/l/h) on July and on August it was (0.5628 ± 0.0063 mg/l/h).

The rate of ammonia excretion was found maximum in large sized animal as compared to small sized animal, during monsoon .On July it was found to be (0.0119 ± 0.0006 µg NH_4-N/l/h) and on August it was (0. 0140 ± 0.0003 µg NH_4-N/l/h) in small sized animal. While in large sized animal it was (0.0186 ± 0.0010 µg NH_4-N/l/h) on July and on August it was (0. 0158 ± 0.0007 µg NH_4-N/l/h).

The calculation of O: N ratio revealed high values in small sized animals than large sized one during monsoon on July and on August. On July, the O:N ratio was found to be (53.5740 ± 4.1653) and on August it was (48.3229 ± 2.9219) in small sized animals. And in large sized animals the O: N ratio was (26.5243±1.7791) on July and on August O: N ratio was (31.2318 ± 1.6214).

Table-1 Size dependent variation in the rate of oxygen consumption, rate of ammonia excretion and O:N ratio of freshwater bivalves, *Indonaia caeruleus*, during monsoon season

Month	Size Specific Group	Animal No.	Body Size (mm)	Body weight (gms)	Oxygen consumption ml/lit/hr	Oxygen consumption mg/lit/hr	Ammonia excretion mg- NH_4-N/L	Atomic equivalent of oxygen	Atomic equivalent of ammonia	O: N ratio
July	Small size	I	50	7.821	0.5795	0.8275	0.0125	0.0517	0.00089	58.0898
		II	47	7.228	0.4738	0.6765	0.0113	0.0422	0.00080	52.7500
		III	46	7.204	0.4752	0.6785	0.0120	0.0424	0.00085	49.8823
						0.7275 ± 0.0866	0.0119 ± .0006			53.5740 ±4.1653
	Large size	I	56	8.418	0.4021	0.5741	0.0189	0.0358	0.00135	26.5185
		II	59	9.815	0.3856	0.5506	0.0195	0.0344	0.00139	24.7482
		III	60	10.194	0.3942	0.5629	0.0174	0.0351	0.00124	28.3064
						0.5625 ± 0.0117	0.0186 ± 0.0010			26.5243 ± 1.7791
August	Small size	I	47	7.227	0.5640	0.8053	0.0138	0.0503	0.00098	51.3265
		II	49	7.702	0.5202	0.7428	0.0144	0.0464	0.00102	45.4901
		III	50	7.805	0.4968	0.7094	0.0138	0.0443	0.00092	48.1521
						0.7525 ± 0.0486	0.0140 ± 0.0003			48.3229 ± 2.9219
	Large size	I	58	9.560	0.3951	0.5642	0.0150	0.0352	0.00107	32.8971
		II	59	9.803	0.3894	0.5560	0.0165	0.0347	0.00117	29.6581
		III	57	8.491	0.3981	0.5684	0.0160	0.0355	0.00114	31.1403
						0.5628 ± 0.0063	0.0158 ± 0.0007			31.2318 ± 1.6214

Hardness of water is 104 - 115 ppm on July and 97 - 111 ppm on August and dissolved oxygen 6.870 - 7.300 mg /l/h on July and 6.980 - 7.280 mg /l/h on August during monsoon season.

The rate of oxygen consumption during monsoon was found maximum in small sized animal as compared to large sized animal. It was found to be to be (0.7275 ± 0.0866 mg/l/h) on July and on August it was (0.7525± 0.0486 mg/l/h) in small animals. While in large sized animal oxygen consumption was found to be (0.5625 ± 0.0117 mg/l/h) on July and on August it was (0.5628 ± 0.0063 mg/l/h).

The rate of ammonia excretion was found maximum in large sized animal as compared to small sized animal , during monsoon .On July it was found to be (0.0119 ± 0.0006 µg NH_4-N/l/h) and on August it was (0. 0140 ± 0.0003 µg NH_4-N/l/h) in small sized animal .While in large sized animal it was (0.0186 ± 0.0010 µg NH_4-N/l/h) on July and on August it was (0. 0158 ± 0.0007 µg NH_4-N/l/h). The calculation of O: N ratio revealed high values in small sized animals than large sized one during monsoon on July and on August. On July, the O:N ratio was found to be (53.5740 ± 4.1653) and on August it was (48.3229 ± 2.9219) in small sized animals. And in large sized animals the O: N ratio was (26.5243±1.7791) on July and on August O: N ratio was (31.2318 ± 1.6214).
The results of the experiments were shown in Table-1.

DISCUSSION

The rate of oxygen uptake was increased in small sized bivalves, as compared to large sized ones during monsoon season. While the ammonia excretion rate was found more increased in large sized bivalves as compared to small sized ones on July and August during monsoon seasons. Increased in the rate of oxygen uptake in small sized animals is due to small size relatively with small glycogen reserves. This increases considerably their protein catabolism, whereas larger ones with large size having large glycogen storage [17]. The metabolic rate is strongly dependent on body size. It is known that weight specific rate of oxygen consumption is lower in larger organisms than in smaller ones. This generalization applies in both intra- species as well as inter-species bivalve molluscs of different sizes. In the present study on *Indonaia caeruleus*, the size specific oxygen consumption followed a general trend of acceptance i.e. smaller sized bivalve shows higher values of oxygen consumption than larger one. Mane [19] and Bayne [20] revealed that, body size in bivalves is important factor. Hence older and large bivalves have a lowest value than those of small individuals. It is known the oxygen uptake was mainly dependent on reproductive condition of bivalves during monsoon season, hence, the rate of oxygen consumption showed significant increase in smaller sized bivalve particularly during monsoon.

The energy utilization in oxygen consumption and ammonia excretion was significantly different which depending on size, season and temperature, but season being important factor which affect the overall fitness of the animal [6]. Many authors have shown that, in bivalve major nitrogenous excretory product is ammonia. A profound difference occurs in loss of nitrogen between different sizes and seasons [20,21]. In the present study on *Indonaia caeruleus*, the rate of ammonia excretion is more in large sized bivalves on July and August during monsoon seasons, because small size bivalves catabolise different biochemical substrates to varying degrees, according to season [22] The O:N ratios can provide indices of balance in animal tissues between the rate of catabolism of protein, carbohydrate, and lipid substrates. This ratio may be used to indicate the proportion of protein catabolised to carbohydrates and lipids. Higher value of O:N ratio indicates increased catabolism of carbohydrates or lipids. The increase or decrease of O:N ratio in bivalves of different sizes, could be due to the state of a gonadal development and level of metabolic activity of the bivalve molluscs. .

CONCLUSION

From this study it was concluded that, the rate of ammonia excretion in *Indonaia caeruleus* was found to be depleted in small sized bivalves as compared to large sized bivalves particularly on July and August of monsoon seasons. It was found to be weight specific and also dependent upon physiological state of the

organism. The rate of oxygen consumption of *Indonaia caeruleus* showed seasonal patterns as well as the reproductive activity of the animal. Low rate of oxygen consumption was observed during monsoon in small and large sized bivalves. The rate of ammonia excretion in *Indonaia caeruleus* was found to be depleted in small sized bivalves as compared to large sized bivalves particularly on July and August of monsoon seasons. It was found to be weight specific and also dependent upon physiological state of the organism. The O:N ratio shows higher value in small sized bivalve than that of larger ones.

REFERENCES

1. Bayne BL and Widdows J. The physiological ecology of two populations of Mytilus edulis J. Oecolosia.1978; 37: 137-162.
2. Bayne BL. In Marine mussels: Their ecology and physiology. *International Biological programme to Cambridge University Press. Cambridge, London, New York, Melbourne*, 1976:159.
3. Bayne BL and Scullard CS. An apparent specific dynamic action in Mytilus edulis, in the Laboratory, Helgol. Wiss. Meersunter. 1977;20: 526-552.
4. Segawa S. Oxygen consumption and ammonia excretion by the balone Sulcus diversicolor in starved condition. *Bull. Jap. Soc.Sci. Fish*. 1991;57: 2001-2006
5. Ganzalo BA and Cancino JM. Physiological characteristics of the brooding bivalve, Galmardia. bahamondei, Madio Ambiente. 1988;9: 13-20.
6. Barkai R. Gnffiths CL. An energy budget for the South African abalone Haliotis midae Linnaeus. *J mollusc Stud* 1988; 54:43-51
7. Navarro JM and Torrijos R. Seasonal variation in oxygen uptake and ammonia excretion in the predatory gastropod Concholepas concholepas. Comp. *Biochem. Physiol*. 1994;108A: 39-49.
8. Grants J. and Thorpe B. Effects of suspended sediments on growth, respiration and excretion of soft- shell clam, Mya arenaria *Can J. fish. Agnat. Sci*. 1991;48: 1285-1292.
9. Bhagde RV and Mane UH. A study on the metabolism in Green mussel, Perna viridis *J. mar. Biol. Ass. India*. 2005;47 (1): 106-110.
10. Vitale MA and Friedl FE. Ammonia production by freshwater bivalve, Ellipto buckley (Lea). Intact and Monovalve preparations Comp. *Biochem. Physiol*. 1984;77(A):113-116.
11. Bacon CS and Mac Donald BA. Food quality, feeding activity and energy balance in the sea scallop, Placopecten megelanicus *J. Shell-fish. Res*. 1991; 10: 1-37.
12. Hawkins AJS, Bayne BL, Menon NR and Damodaran R. The mussels Perna viridis and P. indica as transplantable indicators of pollution: comparison of their metabolic responses to reductions of both oxygen tension and salinity. National Seminar on mussel watch, Cochin Univ. Sci. Technol., Cochin, 1986:51-64.
13. Mathew P and Menon NR. Heavy metal stress induced variation in O.N. ratio of two tropical bivalves Perna indica and Donax incarnatus. *Indain J. Expt. Biol*. 1993;31: 275-292.
14. Golterman HL, Clymo RS and Ohnstad MAM. Physical and chemical analysis of freshwaters, IBP, Handbook, No- 08. Blackwell Scientific Publication, Oxford, London, Edinburgh, Melbourne, 1978;2nd Edn. 172-178
15. Solorzano L. Determination of ammonia in natural waters by phenol-hypochlorite method. *Limnology and oceanography* 1969;14: 799-801.
16. Widdows J. Physiological indices of stress in Mytilus edulis. *J. Mar. Biol. Ass*. U.K. 1978; 58:125-142
17. Bayne BL and Newell RC. Physiological energetics of Marine Molluscs. In: The Mollusca Physiology, (Wilbur. K. M.) Part-I Vo1. 4, Academic press, New York, 1983:405-515.
18. Bayne BL. Aspects of metabolism of Mytilus edulis during starvation, *Neth. J. Sea. Rev*. 1973; 7:399 - 410
19. Mane UH. Oxygen consumption of clam, Katelysia opima in relation to environmental conditions. *Broteria*. 1975;64(1-2): 33-58.
20. Nagwanshi M. Reproductive physiology & freshwater bivalve molluscs from Aurangabad, Maharashtra State, Ph.D. Thesis, Dr.B.A.

Marathwada University, Aurangabad, India, 1996:364.

21. Salve SK. Changes in biochemical constituents of *Indonaia caeruleus* (Prashad, 1918) Mollusca: Bivalvia, from Godavari river at Paithan. Ph. D. Thesis Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.(M.S.). 2007:1 – 245.
22. Gabbott PA. Developmental and seasonal metabolic activities in marine molluscs, In: Hochachka P. W (ed). The Mollusca. Vol. 2. Academic Press, New York, 1983: 165-217.
23. Jadhav Mangesh, Bhavane Vasant & Gulave Arun. Size dependent variation in the rate of oxygen consumption, ammonia and O:N ratio of freshwater bivalve, Lamellidens marginalis from Godavari river during monsoon (m.s) india, *J. Trends in Fishery research*,2012;1(2):22-26
24. Gulave AR. Size specific physiological fitness of fresh water bivalve, indonaia caeruleus (prashad 1918) from Gajanan sagar Yedgaon, Tal – Junnar , Dist – Pune ., Ph. D. Thesis Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. (M.S.). 2012:1 – 237.