EFFECT OF BROAD SPECTRUM ANTIBIOTICS ON OXYGEN CONSUMPTION RATE OF FRESHWATER BIVALVE, *PARREYSIA CYLINDRICA* (ANNANDALE AND PRASHAD)

Nandurkar H.P. and S.P. Zambare*
Department of Zoology, Sant Gadge Baba Amravati University, Amravati. (M.S.) 444 602. INDIA
E-mail: hema_nagpure19@rediffmail.com
* Department of Zoology, Dr. B. A. Marathwada University, Aurangabad (M.S.) 431 004.INDIA
E-mail: sureshchandraz@yahoo.co.in

The freshwater bivalves, *Parreysia cylindrica* were exposed to tetracycline and Chloramphenicol, broad spectrum antibiotics. Acute treatment of tetracycline (166.54PPM) and chloramphenicol (369.09PPM) to *P. cylindrica* was given for 96 hrs and for chronic treatment they were exposed to the concentration of tetracycline (33.30 PPM), chloramphenicol (73.81 PPM) for 21 days respectively. The rate of oxygen consumption in *Parreysia cylindrica* after acute and chronic exposure to tetracycline and chloramphenicol showed significant decrease. The acute and chronic exposure of chloramphenicol reduced the oxygen consumption very strongly than that of tetracycline. The reduction in oxygen consumption may be due to metabolic stress or pathogen-free condition.

From time immemorial people get fascinated by the gem Pearl. Day by day the demand of the pearl is rising. The original pearls are coming from the marine bivalves. The production and demand of the pearls are not coinciding with each other due to the different reasons; main of them are overexploitation and pollution, attributed to divert the attention towards freshwater bivalves for artificial pearl culture. In artificial pearl culture in freshwater bivalves beads are implanted. During this process little surgery is required. It is always followed by keeping the animals in certain antibiotic treated water to reduce the mortality during post-operative care. Study of antibiotics on the physiology of the invertebrates is still not studied. It is a short attempt to know the metabolic disturbances through oxygen consumption of a model animal *Parreysia cylindrica*.

Respiration is vital process for life sustenance. Almost all metabolic activities take place at the expense of oxygen to yield energy. A metabolic response of an organism to a changing or stressful environment is an overall indicator of its adaptive ability. Metabolic processes are the most sensitive parameters of stress as all enzymatic reactions on the substances and physiological responses are incorporated in a unique manner\(^1\). Under stresses, different species of mussels vary in their ability to reduce metabolism. Therefore any change in the respiratory activities is very important tool to inspect stress in general and toxicant and chemical induced change in exposed animals in particular\(^2-5\). By evaluating an index of stress on metabolic rate respiratory study is a great device\(^6\).

MATERIALS AND METHODS

The freshwater bivalves, *P. cylindrica* were collected from Girna dam, Dist: Nasik, M.S. The animals were acclimatized to laboratory conditions for 4 days prior to experimentation. During experimentation, *P. cylindrica* (25 to 40 mm length) showing movements and in apparent good health, were used for investigation. *P. cylindrica*, divided into five groups, two groups were of tetracycline and Chloramphenicol treatment for acute and chronic treatment each and one group was maintained as control.
For acute treatment the acclimatized Parreysia cylindrica were exposed to tetracycline (166.54 PPM) and chloramphenicol (369.09 PPM) up to 96 hours. The concentration used for chronic treatment of tetracycline was (33.30 PPM) and chloramphenicol (73.81 PPM) up to 21 days. During exposure period, no special food was provided and the water with required concentration of trimethoprim was changed daily in the experimental set. Control set was provided with dechlorinated water only without addition of trimethoprim. After 24, 48, 72 and 96 hours of exposure for acute treatment and 7, 14 and 21 days for chronic exposure, the animals were used for measuring the rate of oxygen consumption in the respiratory chamber. The inflow and outflow of water was maintained to keep the water level constant. After the proper set up, inflow and outflow of the water was closed. After an hour the oxygen content of the water from closed respiratory chamber was estimated by Winkler's method7. The animals were weighed and volume of respiratory chamber was measured for the estimation of oxygen consumption in ml/gm of body weight/hr/Liter at NTP. The % variation and Student's 't' test was applied to the data for significance.

RESULTS AND DISCUSSION

The measurement of rate of oxygen consumption in P. cylindrica after acute and chronic exposure to tetracycline and chloramphenicol showed significant decrease in the rate of oxygen consumption. The results regarding P. cylindrica are depicted in Table 1 - 2 and Fig. 1 - 2.

From the above results it was clear that the rate of oxygen consumption is decreased after acute and chronic exposures of both tetracycline and chloramphenicol induced stresses. The significant results showed that the oxygen consumption rate was greatly affected in case of chloramphenicol than that of tetracycline. After acute treatment of chloramphenicol the oxygen consumption was reduced to 53.03 % and same after chronic exposure up to 79.06 %. Tetracycline also showed the reduction in oxygen consumption level 38.78 and 53.87 % after acute and chronic treatment.

The percent variations and SEM values are depicted in Table 1 and 2 along with the results of test of significance. The results indicate that the rate of oxygen consumption is reduced with the increase in concentration of the antibiotics as well as with the increase in the time of exposure.

Stressful conditions, lead towards the change, not only in metabolic activities but also in the behavior. The bivalves react differently under stressful condition by various ways in variable organisms. Hence the interpretation of the reduction in oxygen uptake due to effect of drug is difficult. Impact of antibiotics on invertebrates and specifically on molluscs has not been studied and hence references regarding effect of undesirable substances in the water are quoted.

The ample mucus secretion on the gills and body surface was observed during experimentation. It helps to minimize the toxic effect of toxicant on the body. The respiratory surface of gill alters in close contact with polluted water and in turn decreases the diffusion of gases through gills and severely affects the lamellar structure of gills in fresh and marine water shrimps10-12. The change in metabolic rate alters the biochemical pathways to resist the pollution stress13. Thus measurement of rate of oxygen consumption is one of the important tools used
to detect the effect of toxicant on metabolism\textsuperscript{14}.

Toxicant exposure causes respiratory disturbances and reduces oxygen consumption in fishes\textsuperscript{15}, in crabs\textsuperscript{16} and also in molluscs\textsuperscript{17-21}. The rate of oxygen consumption was decreased due to the role of toxicants as inhibitors acting between i) NAD+ and coenzymes ii) the chain of cytochrome b and c iii) and inhibitors of cytochrome C-oxidase depriving the energy derivation and affects oxygen uptake\textsuperscript{22}. It also divert the pathway to the anaerobic metabolism under stressful conditions\textsuperscript{23}.

Mucoid secretion on the gills and body surface hinder the pathway, and decrease the oxygen consumption under stressful condition\textsuperscript{24}. In the present investigation tremendous amount of mucus secretion was observed suggesting it as one of the causes of reduction in the rate of oxygen consumption. The bivalves, oysters and shrimps are also severely affected by the different pathogens leading to dramatic diseases and mortality in farms during their culture. These diseases are caused by viruses, bacteria, rickettsia-like organisms etc.\textsuperscript{25}. The manila clam, Ruditapes philippinarum, suffered by bacteria Vibrios tapetis in France\textsuperscript{26-28}.

When a parasite attempts to infect a host, multiple reactions occur, initiated by the parasite in an attempt to survive or by the host in attempting to eliminate or segregate the parasite. Mollusc hemocytes respond to appropriate stimuli with a burst of respiratory activity as that of the mammalian phagocytes\textsuperscript{29}. Contacts with a pathogen activates the bivalves NAD(P)H-oxidase to generate free radicals and synergistic effects with lysosomal enzymes, kill the pathogens\textsuperscript{30}.

Tetracycline and chloramphenicol added in water got rid of the pathogens and hence the rate of oxygen consumption decreased due to decreased burden of pathogen. Thus the cumulative effect or one of the causes as metabolic stress, mucus secretion and pathogen free condition reduced the rate of oxygen uptake and altered the metabolic pathway.

\textbf{Table 1: Rate of oxygen consumption of P. cylindrica on acute exposure to antibiotics.}
Each value represents a mean of three observations + S.E.M.; Indicates percent variation over the control; Values are significant at * = \(P<0.05\); ** = \(P<0.01\); *** = \(P<0.001\) and NS = Non significant

\begin{tabular}{|c|c|c|c|c|}
\hline
Sr. No. & Treatment & \multicolumn{4}{|c|}{Average oxygen consumption (ml/gm /hr/lit)} \\
& & 24 hrs & 48 hrs & 72 hrs & 96 hrs \\
\hline
1 & Control & 0.0442 & 0.0401 & 0.0349 & 0.0330 \\
& & \(\pm 0.0000\) & \(\pm 0.0001\) & \(\pm 0.0000\) & \(\pm 0.0009\) \\
\hline
2 & Tetracycline & 0.0377 & 0.0285 & 0.0225 & 0.0202 \\
& & \(\pm 0.0015^{***}\) & \(\pm 0.0007^{***}\) & \(\pm 0.0010^{***}\) & \(\pm 0.0012^{***}\) \\
& & \(-14.5927\) & \(-28.9027\) & \(-35.3724\) & \(-38.7878\) \\
\hline
3 & Chloramphenicol & 0.0302 & 0.0272 & 0.0197 & 0.0155 \\
& & \(\pm 0.0007^{***}\) & \(\pm 0.0013^{***}\) & \(\pm 0.0014^{***}\) & \(\pm 0.0013^{**}\) \\
& & \(-31.6816\) & \(-32.2580\) & \(-43.5530\) & \(-53.0303\) \\
\hline
\end{tabular}
Table 2: Rate of oxygen consumption of *P. cylindrica* on chronic exposure to antibiotics. (Each value represents a mean of three observations + S.E.M); Indicates percent variation over the control; Values are significant at * P<0.05; ** = P< 0.01, *** P<0.001 and NS= Non significant

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Average oxygen consumption (ml/gm/hr/lit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7 days</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>0.0606</td>
</tr>
<tr>
<td></td>
<td>± 0.0021</td>
<td>± 0.0018</td>
</tr>
<tr>
<td>2</td>
<td>Tetracycline</td>
<td>0.0451</td>
</tr>
<tr>
<td></td>
<td>± 0.0025*</td>
<td>± 0.0012**</td>
</tr>
<tr>
<td></td>
<td>-25.5592</td>
<td>-39.6551</td>
</tr>
<tr>
<td>3</td>
<td>Chloramphenicol</td>
<td>0.0339</td>
</tr>
<tr>
<td></td>
<td>± 0.0019***</td>
<td>± 0.0012**</td>
</tr>
<tr>
<td></td>
<td>-43.9944</td>
<td>-56.8965</td>
</tr>
</tbody>
</table>

REFERENCES