MONTHLY VARIATIONS OF PROTEASES AND LIPASES IN THE
ALIMENTARY CANAL OF SCHIZOTHORAX RICHARDSONII (GRAY).

(Received February 18, 1990; Accepted April 30, 1990)

B. P. Madhwal1, A. K. Chopra2, & H. R. Singh3

1. Coldwater Fisheries Research Station, Haldwani (Nainital), India
2. Department of Zoology, Gurukula Kangri University, Haridwar, India
3. Department of Zoology, H. N. B. Garhwal University, Srinagar-Garhwal, India

The study on proteases and lipases of Schizothorax richardsonii showed that among proteases, trypsin and peptidase were the main enzymes of secretion. The weak activity of lipase was observed occasionally. The secretion of enzymes is related to the feeding intensity of the fish in different months.

Since a study has been made on monthly variations of carbohydrases in the alimentary canal of an economically important coldwater fish, Schizothorax richardsonii, the present study was undertaken to find out the monthly variations in the occurrence and distribution of various proteases and lipases in different parts of the alimentary canal of S. richardsonii.

Fishes, S. richardsonii (10-12) freshly obtained from river Alaknanda (Srinagar-Garhwal) were dissected every month, and the oesophagus, intestinal-bulb and intestine were taken out. The contents of each part were also separated and studied. The tissues oesophagus, intestinal-bulb and intestine were taken and processed as described earlier1 and the enzymes were analysed following standard methods2-3.

The monthly variations in the occurrence and distribution of various proteases and lipases in the alimentary canal of S. richardsonii are indicated in table 1. The site of secretion of proteases in fishes has been interpreted differently by different workers. The proteolytic activity has been observed in the liver of Culisca fasciata4, Nandus nandus5, and Channa gachua6; in the stomach of carnivorous fishes like Carassius auratus and

2 for correspondence.
Table — Monthly variations of proteases and lipases in the alimentary canal of *S. richardsonii* (IB—intestinal-bulb, IS—intestine).

<table>
<thead>
<tr>
<th>Months</th>
<th>Pepsin IB</th>
<th>Pepsin IS</th>
<th>Trypsin IB</th>
<th>Trypsin IS</th>
<th>Peptidase IB</th>
<th>Peptidase IS</th>
<th>Lipase IB</th>
<th>Lipase IS</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>FEB</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>MAR</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>APR</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>MAY</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>JUN</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>JUL</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AUG</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SEP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OCT</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NOV</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEC</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Oesophagus did not show any enzyme activity, Activity: ++ moderate, + weak, - absent.

*Micropterus salmoides*; *Tilapia* and *Dicentrarchus labrax*; and in the intestine of *Clarias batrachus*, *Anabas testudineus* and *S. richardsonii*. A lipolytic activity has been shown in intestinal mucosa of stomach-less fishes and in *Tilapia* and *Anabas testudineus*. But, there seems to be no report on the monthly variations in the activity of proteases and lipases in different parts of the alimentary canal of fishes.

During present study no protease and lipase activity was observed in oesophagus of *S. richardsonii*. A weak/moderate activity of proteolytic enzymes was observed in the intestinal-bulb and intestine of *S. richardsonii* during active feeding months. There was more activity of proteases in the intestine than in the intestinal-bulb. Among proteases, presence of moderate activity of trypsin and peptidase in the intestine during March-April may possibly be due to more availability of incidental food like insect matter that comes into the alimentary canal and may partially be digested there by these digestive enzymes. A weak activity of pepsin was also observed in intestinal-bulb and intestine from December to July. Lipase activity was completely absent in the intestinal-bulb throughout the year. However, weak activity of lipase was observed in the intestine from November to April. The proteases and lipase were completely absent in the months of August and September, when
feeding becomes low and fish seems almost starved because of spawning.

The higher activity of carbohydrates, weak to moderate activity of proteases and weak activity of lipases during the present study confirmed herbivorous nature of S. richardsonii. Besides this, it was indicated that the degree of various enzymes varies not only in different regions of alimentary canal of S. richardsonii but also in different months. Thus, the study revealed that secretion of digestive enzymes is definitely related to feeding intensity of the fish in different months.

ACKNOWLEDGEMENTS

The financial assistance from Council of Scientific and Industrial Research, New Delhi is gratefully acknowledged.

REFERENCES