CHAPTER II

GROWTH RATE STUDIES
INTRODUCTION

Growth can be expressed as the increase with time of length, volume, wet weight or dry weight. In organisms lacking an exoskeleton, length changes continuously, but in those such as Crustacea which have a large inextensible exoskeleton, growth becomes essentially a discontinuous process. There is a succession of molts (or ecdysis) separated by inter-molts. At each molt the old integument is shed, rapid and extensive growth occurs during the short period before the new integument hardens. Growth can be examined as an integrated measure of the sublethal effects of toxic pollutants on the biochemistry and physiology of organisms but with homeostatic mechanisms operating, the effects on growth may be minimal. Edwards and Brown (1966) found no difference in growth rate between experimental and control rainbow trout. Pickering (1968) and Brungs (1969) observed that endrin and malathion reduced growth in the flag fish, Jordanella floridae, Sprague (1971) pointed out, that growth can be easily measured and is an important criterion of

In the present investigation an attempt has been made to study the effect of benzene on growth rate of freshwater prawn, *Macrobrachium lamerrii*. 
MATERIAL AND METHODS

The freshwater prawns, *Macrobrachium lamerrii*, were collected from Kham river, near Aurangabad, and were acclimatized to laboratory conditions for a period of 4 - 5 days in shallow water tanks with aeration. The prawns were maintained at 12L : 12D throughout the experiment. After acclimatization to the laboratory condition they were subjected to experiment.

A chronic experiment was conducted for a period of 30 days to determine the effect of benzene on growth rate. The healthy juvenile (1 to 1.5 Cm) prawns were separated, divided into two groups. One group was exposed to 0.1 ppm benzene, and the other group remained as control. The experimental media was changed daily and animals were fed with algae twice in a week to avoid the effect of starvation on growth. After one week interval, growth was measured to determine the changes in weight, length and width of the animals; dead individuals were removed and their weight, length and width was measured.
OBSERVATIONS AND RESULTS

Growth was measured as mean increase in live weight, length and width during 30 days period. Normal growth rate was recorded in the control group and in experimental group (benzene exposed) growth rate was progressively reduced.

There was significant changes in the weight, length and width of the control prawns (Table 1, Fig. 1 a, b and c). After 7 days, changes in weight was insignificant. However, after 14 days the weight increased significantly \( (P < 0.05) \) from 121.28 ± 16.11 to 140.0 ± 3.39. After 21 days the weight was significantly \( (P < 0.05) \) increased to 143.2 ± 3.03 and after 30 days a significant increase to 148.05 ± 2.94 was observed.

After 7 days and 14 days, insignificant changes were observed in length. However after 21 days the length was increased significantly \( (P < 0.05) \) from 2.31 ± 0.13 to 2.41 ± 0.01. The length increased significantly \( (P < 0.05) \) to 2.45 ± 0.01 after 30 days.
Table 1

Effect of sub-lethal concentration (0.1 ppm) benzene on growth rate of freshwater prawn, *Macrobrachium lamarrii*

<table>
<thead>
<tr>
<th>Duration of test (days)</th>
<th>Mean (Control)</th>
<th>Mean (Experimental)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight (mg)</td>
<td>Length (Cm)</td>
</tr>
<tr>
<td>0</td>
<td>121.28 ± 16.11</td>
<td>2.31 ± 0.13</td>
</tr>
<tr>
<td>7</td>
<td>136.0 NS 2.73</td>
<td>2.36 NS 0.03</td>
</tr>
<tr>
<td>14</td>
<td>140.0 * 3.39</td>
<td>2.38 NS 0.02</td>
</tr>
<tr>
<td>21</td>
<td>143.2 * 3.03</td>
<td>2.41 * 0.01</td>
</tr>
<tr>
<td>30</td>
<td>148.05 ** 2.94</td>
<td>2.45 * 0.01</td>
</tr>
</tbody>
</table>

NS = Not significant;  * = P < 0.05  ** = P < 0.01  *** = P < 0.001
Fig. 1: Effect of sublethal concentration (0.1 ppm) of benzene on growth rate of freshwater prawn, Macrobrachium lamerrii

a: Effect on body weight
b: Effect on body length
c: Effect on body width
Similarly, in width insignificant changes was observed after 7 days. After 14 days the width increased significantly (P < 0.05) from 0.37 ± 0.2 to 0.42 ± 0.04. A significant (P < 0.01) increase in width was observed (0.43 ± 0.01 and 0.44 ± 0.01) after 21 and 30 days respectively.

Variations in growth rate of freshwater prawn Macrobrachium lamerrii after sublethal exposure to benzene.

After 7 days of exposure to benzene, insignificant changes in weight was observed. However, after 14 days the weight decreased significantly (P < 0.05) from 127.7 ± 5.4 to 117.6 ± 2.07. Highly significant (P < 0.001) decrease in weight 114 ± 1.58 and 109.07 ± 1.63 was observed after 21 and 30 days respectively.

In length and width no statistical significant changes was observed after 7, 14, 21 and 30 days of exposure.
DISCUSSION

In the present study, exposure to benzene caused reduction in the growth rate of prawn, *Macrobrachium lamerei*. Edwards (1978) observed the effect of water soluble oil fraction on growth of the shrimp, *Crangon crangon* and suggested that lower rate of growth is related to high rate of molting. A possible explanation is that the WSF affected the hormone system, controlling molting with a subsequent increase in molt frequency. In this way, the energy which would be normally used for growth, was used for the molt cycle. Stoner and Livingston (1978) found that although the overall growth may not be affected by pollutant but the composition of the body may be changed and further noted that the exposure of pinfish, *Lagodon rhomboides* to 1 percent bleached kraft mill effluent resulted in a reduced total lipid content and an increase in protein content. Wang and Stickle (1987) reported that scope for growth in juvenile blue crab, *Callinectes sapidus* is inversely related to sublethal levels of petroleum.
hydrocarbon exposure. The decrease in scope for growth of crabs exposed to hydrocarbons, by as much as 60% compared to control crabs, was not only due to decreased energy intake but also to a dose related increase in energy expenditure. Decreased growth was significantly correlated to alterations in the energy budget. The reduced energy available for growth in crabs exposed to crude oil was used for synthesis of energy reserves. 

Widdows et al. (1987) studied physiological responses of Mytilus edulis, during chronic oil exposure and observed marked reduction in scope for growth rate and food absorption efficiencies. Axic et al. (1987) reported a number of physiological responses of the bivalve, Venus verrucosa on long term exposure to petroleum hydrocarbons such as significant decrease in clearance or feeding rate and in the food absorption efficiencies as well as enhanced oxygen consumption and ammonia excretion. The integration of such physiological responses to assess the scope of growth indicates that such exposure led to a significant drop in energy available for somatic growth and reproduction and enhanced protein catabolism (this being indicative of stress...
condition). Wang and Stickle (1988) observed that the large decrease in amount of lipid content was due to difference in the pattern of energy utilisation among crab, *Callinectes sapidus*, exposed to crude oil.

From the above discussion, a similar explanation for the benzene stress on the growth rate of *M. lamerrii* may be postulated. Benzene increased the molting frequency probably due to inhibition of MIH (Chapter - I). An increased utilization of energy is required to overcome the stress imposed by benzene. This may lead to decrease in the biochemical constituents (Chapter III). Thus the energy required for the growth would be utilized for the molt cycle. However, after long term exposure, the length and width did not show any variations which may be due to the fact that the animals were fed during the course of experiment, where the energy in the form of food was made available. The continuous decrease in the weight reflects to an increased energy expenditure.