RESULTS

Physicochemical characteristics of the December,'94 effluent samples and their different concentrations, i.e., the effluent media to which the experimental animals were exposed, prior to the analysis of biochemical constituents, are given in Tables VI.1, VI.a.1 and VI.a.6. Glycogen, protein and lipid composition of muscle and liver tissues of *Oreochromis mossambicus* exposed to the sublethal concentrations of the effluents, are given in Tables VI.a.2 to VI.a.5 and represented in Figures VI.a.1 to VI.a.6. The biochemical composition of the foot muscle and hepatopancreas tissues of *Pila virens* are given in Tables VI.a.7 to VI.a.10 and represented in Figures VI.a.7 to VI.a.12. The values represent the mean of four observations, along with the standard deviation (SD ±) and the range.

GLYCOGEN

Muscle glycogen in *Oreochromis mossambicus* was found to be higher in higher concentrations of EF I treated fishes, though there was a decrease from the control value in the lowest concentration. The same trend was followed for effluents II and III as well, while in EF IV even in the lowest concentration, the value was higher than the control value.

In the lower concentration of 0.2% of the EF I, the glycogen content decreased to 2.78% from the control value of 3.24%. In the 2 higher concentrations of 0.6% and 1%, there was a sharp increase to 3.7% and 4.25% respectively. For EF II, the fall in glycogen content in the lower concentration was less, i.e., 2.93% and the increase in the 2 higher concentrations was also less, i.e., 3.5% and 4.16% respectively. For EF III, also, the same trend was seen, but the increase in the highest concentration was more conspicuous, i.e., 5.02%. For EF IV, an overall increase was observed in glycogen content in all the three sublethal concentrations, i.e., 3.93%, 5.06% and 6.02% respectively. Liver glycogen content was more in *O. mossambicus* compared to that in the muscle,
and the values showed the same trend, with the exception for EF II, where, in the lower concentration as well as in the next higher concentrations, the values were lower (4.01% and 4.61% respectively) than that of the control (4.69%) and only in the highest concentration alone, a higher value (5.24%) was observed. The values in the three sublethal concentrations for EF I were 4.80%, 5.77% and 6.59%; for EF III, 4.96%, 5.79% and 6.90% and for EF IV, 5.15%, 5.87%, and 6.96% respectively.

The muscle glycogen content of *P. virens* was found to be more than that of the fish, and the control value was 13.12%. The variations in glycogen content on exposure to the three sublethal concentrations of the effluents, also showed a different trend for Pila, in that, in all the cases there was a general decrease from the control value. Another notable feature was that the decrease was minimum in the medium concentration (1.5% effluent) compared to the lowest (0.5%) and highest (2.5%) concentrations in almost all the effluent media, except for EF IV, where the decrease was minimum in the highest concentration. The values for EF I, in the three concentrations were 7.09%, 9.36%, and 5.97%; those for EF II, 7.53%, 10.18% and 6.94%; those for EF III, 6.12%, 9.27% and 4.86% and those for EF IV, 5.95%, 9.75% and 11.21% respectively.

The hepatopancreas glycogen content was greater than that of muscle glycogen, and the control value was found to be 14.68%. The variations of hepatopancreas glycogen content showed a different trend of decrease on exposure to the 3 sublethal concentrations of the effluents, in that the decrease was maximum in the medium concentration. The glycogen content values for EF I in the 3 concentrations were 6.07, 5.16 and 7.53; those for EF II, 10.45, 5.61 and 8.07; those for EF III, 6.87, 5.03 and 7.40, and those for EF IV, 10.10, 8.96 and 9.40 respectively.

**PROTEIN**

Variations in the muscle protein content of *Oreochromis mossambicus* exhibited a particular pattern, in that in the lower concentration,
there was a slight increase from the control value, while in the medium and higher concentrations, it decreased gradually, except for EF III, where there was gradual decrease in all the three concentrations, from the control value. Also, for EF II, the decrease from the control value was only in the higher concentration. The values for EF I, in the three concentrations were 68.13%, 66.46% and 62.19% respectively, while the control value was 67.79%. For EF II, the values observed were 68.73%, 68.11% and 65.70%; those for EF III, 65.54%, 63.49% and 60.63% and for EF IV, 68.73%, 68.11% and 65.70% respectively. The protein content of liver in *O. mossambicus* was comparatively less and the control value recorded was 64.96%. The variations in liver protein content of the fishes showed a uniform trend, in that there was a general and gradual decrease as the concentration increased. The exception was EF IV, where there was an increase in liver protein content, from the control value in lower concentration. The liver protein content of the fishes treated with the three sublethal concentrations of EF I, were 63.07%, 60.55% and 59.69%; those of EF II, 64.6%, 63.51% and 62.52%; those of EF III, 64.37%, 62.47% and 60.20% and those of EF IV, 65.18%, 60.39% and 59.58% respectively.

For protein content also, the variations were of a different trend, in the case of *Pila virens* when exposed to the three sublethal concentrations of the four effluents. In the lower concentration of EF I, there was an increase in muscle protein content from the control value of 64.66% to 70.83%. In the medium concentration, it increased further to 71.39%, while in the higher concentration, it decreased drastically to a mere 51.05%. For EF II, the increase in the lower concentration was to 69.82% and in the next two higher concentrations, there was a gradual decrease to 55.15% and 42.15% respectively. EF III also followed the same trend and the values were 69.39, 66.58 and 55.14. EF IV repeated the trend shown by EF I, but the variations were highly significant in that the increase in the medium concentration (84.35%) and the decrease in higher concentration (45.13%) were very high. The increase in lower concentration was to 70.73%. 

The hepatopancreas protein content showed a varying trend on exposure to the effluent concentrations. Compared to muscle, the protein content was less in hepatopancreas and the control value recorded was 61.54%. For EF I, there was a drastic increase in protein content in the lower concentration to 79.49% and a further decline in the next two higher concentration to 74.43% and 65.41% respectively. However, all the values were higher than the control value. The trend was just the reverse for EF II, in that there was a drastic decrease in lower concentration to 45.43% and further increase in the medium concentration to 56.16%. Again, there was a decline in the higher concentration to 50.92%. EF III exhibited the same trend as that of EF I, but the protein content value in the higher concentration was lower than the control value. For EF IV there was considerable decrease in the protein content in all the three concentrations, and the fall was steady and gradual as the concentration increased. All the values (50.31%, 47.90% and 28.78%) were below the control level.

LIPID

Variations in the lipid content of muscle and liver of *O. mossambicus* on exposure to the sublethal concentrations of the effluents showed a distinct and regular pattern. There occurred a general steady decrease in the percentage of lipid, as the concentration increased, from the control value. In the control muscle tissue the percentage of lipid was 22.73, and it decreased to 20.63 in the lower concentration and to 16.28 and 13.46 respectively in the medium and higher concentration of EF I. For EF II, the values were 21.72%, 19.74% and 18.56%; those for the EF III, 19.54%, 15.07% and 14.57% respectively in the three concentrations. Variations in the liver lipid content also, showed more or less the same trend. In the case of EF I, there was an increase in lipid content in the higher concentration, in contrast to the general trend. In the lower concentration, the lipid content decreased to 25.24% from the control value of 26.09%, and the trend continued for the medium concentration also, with a further decrease to 21.01%, while in the higher concentration, there occurred an increase to 26.30%. For EF II, the values recorded were 26.32%, 24.51% and
22.47%; those for EF III, 26.15%, 22.33% and 20.03% and those for EF IV, 23.58%, 20.41% and 16.26% respectively in the three sublethal concentrations.

The lipid content in the tissues of *Pila virens* were less compared to the fish, and the control muscle tissue showed 9.94% of lipid. The variations of lipid content in the tissues of snails exposed to the effluent concentrations, showed a uniform pattern, slightly different from the pattern observed for the fish. Generally, there was a decrease in the lipid content, as the concentration increased. In the case of EF II, there was an increase in the lower concentration followed by a gradual decrease in the next two higher concentrations. The decrease was very slight in the lower concentration of EF I, i.e., to 9.66% from the control value of 9.94%. But, in the next two concentrations, the fall in the lipid content was quite significant, i.e., 7.72% and 5.8% respectively. The values for EF II, were 10.34%, 8.64% and 7.11%; those for EF III, 9.22%, 7.39% and 5.68% and those for EF IV, 7.86%, 6.28% and 4.93% respectively. The hepatopancreas lipid content also followed the same trend of general decrease corresponding to the increase in concentration. In the lower concentration of EF I, the lipid content decreased to 9.51% from the control value of 11.54%, and there was further decrease in the medium and higher concentrations to 7.72% and 5.80% respectively. The values for EF II, were 10.61%, 9.26% and 6.77%; those for EF III, 8.34%, 7.18% and 5.71% and those for EF IV, 8.17%, 6.18% and 5.18% respectively.

In general, the variations in the biochemical constituents of the tissues exposed to the effluent concentrations revealed that EF IV brought about profound changes which were most significant. EF II influenced in such a way that the changes were the least, while the other two effluents behaved more or less in a similar manner, and the changes brought about by these effluents (I and III) were of an intermediate nature between the other two cases.