RESULTS
3.1 Effect of radiation on the specific activity of xanthine oxidase

To study the effect of radiation, animals were irradiated with various doses (1 to 9 Gy) at a dose rate of 0.023 Gy sec\(^{-1}\). The specific activity of XO was measured in the liver at different time intervals after irradiation. Results are shown in Table 1. No significant change in the activity of XO was found immediately after irradiation. No appreciable change in the activity was also observed up to 72 hours with 1 and 3 Gy doses. However, beyond 3 Gy and 6 hours after irradiation the activity of XO was increased significantly with dose. It may be mentioned that in the dose range between 5 and 9 Gy the activity of XO was enhanced with increase in post irradiation time up to 48 hours and then declined at 72 hours (Figure 1). With 9 Gy, however the decline started at 48 hours. At high doses of radiation and at longer time interval the decrease in the enzyme activity may be due to irreversible damage to the cell or the enzyme itself (Sharma and Kale, 1993). It was noteworthy that the sudden enhancement in the XO activity occurred at 24 hours interval. The change was almost two fold compared to the unirradiated controls. Moreover, the XO activity was found to increase earlier in terms of time as the dose of radiation increased. For example, the significant increase in the activity occurred at 24 hours with 5 Gy whereas it was 6 hours for 7 Gy.

Since the sudden two fold increase in the specific activity of XO was seen, unless otherwise mentioned further experiments were carried out at 24 hours post irradiation.

Km and Vmax of XO at different doses of radiation (1-9 Gy) were determined from Line Weaver-Burke plots. The Line Weaver Burke plots (Fig 2) were found to be linear which indicate that all doses between 1-9 Gy the Michaelis - Menten equation was applicable. The apparent Km was decreased and Vmax enhanced with the radiation dose (Table 2). The Line
Weaver Burke plot showed a positive modulation of the enzyme with the radiation.

3.2 Effect of gamma radiation on the specific activity of xanthine oxidase in the serum

Animals were irradiated with different doses of gamma radiation (1-9 Gy) and the specific activity of XO was determined in the serum. The pattern of change in the activity of XO in serum was almost same as that found in the liver (Figure 3). However, the extent of change in the activity of XO in serum was slightly lower than in liver.

3.3 Radiomodification of xanthine dehydrogenase (XDH)

Change in the activity of xanthine dehydrogenase (XDH) in the liver of mice exposed to various doses of radiation (1 to 9 Gy) is shown in the Table 3. The activity was measured at 24, 48 and 72 hours after irradiation and found to decline significantly with dose beyond 3 Gy at all the three time intervals. In terms of time, decline in the activity of XDH continued up to 48 hours but was slightly restored after 72 hours. Like XO, no appreciable change in XDH activity was observed at 1 and 3 Gy.

3.4 Radiomodulation of the ratio (XDH/XO) and total activity (XDH+ XO)

Above observations related to radiation induced changes suggested the possibility of a close link between the activities of XDH and XO. Therefore, effect of various doses of gamma rays (1 to 9 Gy) on the ratio of specific activities of XDH and XO and also on their total (XDH+XO) activities was examined in the liver of mice at 24 hours post irradiation. The ratio of XDH and XO remained almost constant below 3 Gy (Figure 4), then it sharply decreased between 3 and 5 Gy and thereafter the decrease was progressively slow (Figure 4). This sharp decrease corresponds (XDH/XO)
to decrease in the XDH (Table 3). The total activity (XDH + XO) remained constant (3.40 ± 0.22) at all the doses of radiation. Moreover the level of total activity was very close to the unirradiated control (3.23 ± 0.24) (Figure 4).

3.5 Effect of gamma radiation on different forms of xanthine oxidoreductase system

In the subsequent experiments the radio-response of three forms i.e. D-Form (XDH), O-Form (XO) and intermediate dehydrogenase - oxidase form (D/O) was investigated. Animals were irradiated with different doses (1 to 9 Gy) and the specific activities were measured in the liver 24 hours after irradiation. Results are presented in the Figure 5. As expected, a very small or no change in the specific activities of D-Form and O-Form of xanthine oxidoreductase system occurred at 1 and 3 Gy compared to their respective unirradiated controls. However, with the increase in the dose beyond 3 Gy, the activity of D-Form decreased and that of O-Form increased. It may be mentioned that changes in the activities of D-Form and O-Form were sharp between 3 and 5 Gy. In case of D/O-Form, unlike D and O-Forms, the decrease in the activity was quite low. Importantly total activity of all the forms at all the doses of radiation was found to be the same as that of unirradiated control (Radiation: 4.28 ± 0.29 and Control: 4.33 ± 0.25).

3.6 Effect of gamma radiation on specific activity of Lactate dehydrogenase

To examine the modulation of specific activity of lactate dehydrogenase (LDH), animals were irradiated with different doses of radiation from 1 to 9 Gy. The specific activity of LDH was measured in the liver 24 hours after irradiation. Results are shown in the Figure 6. Radiation influenced the activity of LDH. Significant enhancement was found 3 Gy
onwards. Therefore, these findings were suggestive of the close link between the radiation induced damage and the enhancement of XO activity.

3.7 Effect of gamma radiation on the lipid peroxidation

Apart from LDH, lipid peroxidation is considered to be a measure of biological damage. Lipid peroxidation is an important effect of radiations on the biological membranes. Therefore, we also studied the radiation induced lipid peroxidation using various doses of radiation between 1 to 9 Gy. Animals were irradiated with different doses (1-9 Gy) and microsomes were prepared from the liver at 24, 48 and 72 hours after radiation to determine the lipid peroxidation. Radiation induced the lipid peroxidation in the liver of mice particularly 3 Gy onwards (Table 4). Significant increase was also seen with 1 Gy of gamma rays at 72 hours (Table 4). It may be mentioned that relatively low levels of lipid peroxidation was seen with 9 Gy compared to other doses of radiation at all the intervals studied. At present we do not have an explanation for the same.

3.8 Modulation of GSH levels

GSH is an important factor in determining the inherent cellular radiosensitivity (Revesz., 1984; Sharma and Kale, 1993). GSH has a redox potential of \( \equiv(-) 230 \) mV which makes it behave as the primary nucleophile. Due to this, perhaps GSH preferentially reacts with free radicals and prevents any subsequent detrimental effect on biological systems. Thiols including the GSH are important in the maintenance of the redox state of cells. GSH is also one of the important factors for maintaining XDH in the reduced state (Kooij et al,1994). Therefore, influence of radiation on the GSH levels was studied. Results are shown in Figure 7. Radiation elevated the levels of GSH in the lower range of doses. However, the significant change was found at 3 Gy only. On the other hand, GSH was depleted in
higher dose range. But levels GSH were almost same at all the doses of radiation.

3.9 Effect of dose rate on the specific activity of xanthine oxidase

For ionising radiation, dose rate is one of the important factors which determine the biological consequence of the given absorbed dose (Hall, 1988). It was convincingly demonstrated that radiation effects are inversely related to dose rate (Konings et al., 1979; Kale and Samuels, 1987; Wolters et al., 1987; Kale and Sitasa had, 1990; Sharma and Kale, 1993). We have studied the dose rate effect at the radiation dose of 7 Gy. Animals were irradiated using three dose rates i.e. 0.02, 0.1, 0.43 Gy sec\(^{-1}\). The specific activity of XO was found to be increased with decrease in the dose rate (Figure 8).
Table 1: Effect of γ rays on Xanthine Oxidase in liver of mice at different post irradiation time

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>0</th>
<th>6</th>
<th>12</th>
<th>24</th>
<th>48</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.15 ± 0.13</td>
<td>1.14 ± 0.22</td>
<td>1.14 ± 0.06</td>
<td>1.03 ± 0.04</td>
<td>0.92 ± 0.10</td>
<td>1.05 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 11.3)</td>
<td>(100.0 ± 19.2)</td>
<td>(100.0 ± 5.3)</td>
<td>(100.0 ± 3.9)</td>
<td>(100.0 ± 10.9)</td>
<td>(100.0 ± 3.8)</td>
</tr>
<tr>
<td>1</td>
<td>1.20 ± 0.12</td>
<td>0.92 ± 0.37</td>
<td>0.93 ± 0.28</td>
<td>0.94 ± 0.12</td>
<td>1.03 ± 0.09</td>
<td>0.93 ± 0.10</td>
</tr>
<tr>
<td></td>
<td>(104.3 ± 10.0)</td>
<td>(80.9 ± 40.2)</td>
<td>(81.5 ± 30.1)</td>
<td>(91.3 ± 12.8)</td>
<td>(111.9 ± 8.7)</td>
<td>(88.6 ± 10.7)</td>
</tr>
<tr>
<td>3</td>
<td>0.98 ± 0.13</td>
<td>1.05 ± 0.16</td>
<td>1.07 ± 0.10</td>
<td>1.01 ± 0.19</td>
<td>0.94 ± 0.21</td>
<td>1.26 ± 0.13</td>
</tr>
<tr>
<td></td>
<td>(85.2 ± 13.3)</td>
<td>(92.1 ± 15.2)</td>
<td>(94.7 ± 23.1)</td>
<td>(98.1 ± 18.8)</td>
<td>(102.5 ± 22.2)</td>
<td>(120.0 ± 18.3)</td>
</tr>
<tr>
<td>5</td>
<td>1.05 ± 0.03</td>
<td>1.07 ± 0.02</td>
<td>1.08 ± 0.25</td>
<td>2.22 ± 0.21b</td>
<td>2.57 ± 0.31c</td>
<td>2.70 ± 0.30c</td>
</tr>
<tr>
<td></td>
<td>(91.3 ± 2.9)</td>
<td>(93.9 ± 1.9)</td>
<td>(94.7 ± 23.1)</td>
<td>(215.5 ± 9.5)</td>
<td>(279.3 ± 12.1)</td>
<td>(157.1 ± 18.5)</td>
</tr>
<tr>
<td>7</td>
<td>1.19 ± 0.11</td>
<td>1.31 ± 0.12c</td>
<td>1.31 ± 0.13c</td>
<td>2.42 ± 0.40b</td>
<td>2.60 ± 0.28b</td>
<td>2.20 ± 0.24b</td>
</tr>
<tr>
<td></td>
<td>(103.5 ± 9.2)</td>
<td>(114.9 ± 9.2)</td>
<td>(114.9 ± 9.9)</td>
<td>(234.9 ± 16.5)</td>
<td>(282.6 ± 10.8)</td>
<td>(209.5 ± 10.9)</td>
</tr>
<tr>
<td>9</td>
<td>1.15 ± 0.12</td>
<td>1.35 ± 0.13b</td>
<td>1.35 ± 0.13b</td>
<td>2.74 ± 0.23c</td>
<td>2.39 ± 0.38b</td>
<td>1.70 ± 0.18a</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 10.4)</td>
<td>(118.4 ± 9.6)</td>
<td>(118.4 ± 9.6)</td>
<td>(266.0 ± 8.4)</td>
<td>(259.8 ± 15.9)</td>
<td>(161.9 ± 10.5)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in parentheses represents the percentage change in the activity with respect to unirradiated control.

- **a** significantly different from unirradiated control (p < 0.001).
- **b** significantly different from unirradiated control (p < 0.005).
- **c** significantly different from unirradiated control (p < 0.01).
Table 2: Effect of various doses of γ rays on the kinetic parameters of xanthine oxidase in the liver of mice.

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>Km</th>
<th>Vmax</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.20</td>
<td>3.86</td>
</tr>
<tr>
<td>1</td>
<td>1.01</td>
<td>4.76</td>
</tr>
<tr>
<td>3</td>
<td>0.93</td>
<td>5.00</td>
</tr>
<tr>
<td>5</td>
<td>0.61</td>
<td>6.45</td>
</tr>
<tr>
<td>7</td>
<td>0.65</td>
<td>8.33</td>
</tr>
<tr>
<td>9</td>
<td>0.30</td>
<td>14.29</td>
</tr>
</tbody>
</table>
Table 3: Effect of γ rays on the Xanthine dehydrogenase in the liver of mice.

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>24</th>
<th>48</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose (Gy)</td>
<td>Control</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>2.40 ± 0.27 (100 ± 10.3)</td>
<td>2.42 ± 0.29 (100.9 ± 11.5)</td>
<td>2.38 ± 0.24 (98.3 ± 10.1)</td>
</tr>
<tr>
<td>48</td>
<td>2.23 ± 0.15 (100 ± 6.68)</td>
<td>2.21 ± 0.14 (99.1 ± 6.34)</td>
<td>2.27 ± 0.26 (101.9 ± 11.7)</td>
</tr>
<tr>
<td>72</td>
<td>2.19 ± 0.15 (100 ± 6.84)</td>
<td>2.16 ± 0.17 (99.1 ± 7.82)</td>
<td>2.25 ± 0.12 (102.8 ± 5.80)</td>
</tr>
</tbody>
</table>

Each value represents an average of at least three experiments ± S.D. The values in parentheses represents percentage change in the activity with respect to unirradiated control. The enzyme activity is represented in mU/mg protein.

a significantly different from unirradiated control (p<0.005).
b significantly different from unirradiated control (p<0.05).
c significantly different from unirradiated control (p<0.01).
Table 4: Effect of γ rays on lipid peroxidation at different time intervals in post irradiation in microsomes

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>24</th>
<th>48</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.86 ± 0.14</td>
<td>0.83 ± 0.11</td>
<td>1.02 ± 0.10</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 16.3)</td>
<td>(100.0 ± 13.3)</td>
<td>(100.0 ± 9.8)</td>
</tr>
<tr>
<td>1</td>
<td>0.91 ± 0.15</td>
<td>1.03 ± 0.03</td>
<td>1.35 ± 0.13</td>
</tr>
<tr>
<td></td>
<td>(105.8 ± 16.5)</td>
<td>(124.1 ± 2.9)</td>
<td>(132.2 ± 9.6)</td>
</tr>
<tr>
<td>3</td>
<td>1.18 ± 0.16b</td>
<td>1.31 ± 0.17c</td>
<td>1.29 ± 0.09a</td>
</tr>
<tr>
<td></td>
<td>(137.2 ± 13.6)</td>
<td>(157.8 ± 12.9)</td>
<td>(128.4 ± 6.9)</td>
</tr>
<tr>
<td>5</td>
<td>1.40 ± 0.22b</td>
<td>1.35 ± 0.17c</td>
<td>1.28 ± 0.10b</td>
</tr>
<tr>
<td></td>
<td>(162.7 ± 15.7)</td>
<td>(162.7 ± 12.6)</td>
<td>(125.5 ± 7.8)</td>
</tr>
<tr>
<td>7</td>
<td>1.68 ± 0.26a</td>
<td>1.29 ± 0.21c</td>
<td>1.52 ± 0.07a</td>
</tr>
<tr>
<td></td>
<td>(195.3 ± 15.5)</td>
<td>(155.4 ± 16.3)</td>
<td>(149.1 ± 4.6)</td>
</tr>
<tr>
<td>9</td>
<td>1.24 ± 0.06a</td>
<td>1.11 ± 0.07a</td>
<td>1.24 ± 0.10b</td>
</tr>
<tr>
<td></td>
<td>(144.1 ± 4.8)</td>
<td>(133.7 ± 6.3)</td>
<td>(121.5 ± 8.1)</td>
</tr>
</tbody>
</table>

Each value represents an average of at least three experiments ± S.D. The values in parentheses represents percentage change in the lipid peroxidation with respect to unirradiated control.

- **a** significantly different from unirradiated control (p<0.01).
- **b** significantly different from unirradiated control (p<0.05).
- **c** significantly different from unirradiated control (p<0.005).
Fig 1. Effect of gamma radiation (7 Gy) on the specific activity of xanthine oxidase in the liver of mice at different time intervals.

\( a (p < 0.05) \) significantly different from the unirradiated control.
Fig 2. Line Weaver burke plot of the radiation (5 - 7 Gy) induced xanthine oxidase in the liver of mice.
Fig. 3. Effect of various doses of gamma radiation on the specific activity of xanthine oxidase in the serum of mice.

a (p< 0.05) significantly different from unirradiated control.

b (p< 0.01) significantly different from unirradiated control.
Fig 4. Effect of various doses of gamma radiation on the ratio of XDH/XO and total XDH+XO activity. The total enzyme activity is expressed in mU/mg protein.
Fig 5. Effect of various doses of gamma radiation on the different forms of xanthine oxidoreductase system in the liver of mice after 24 hours of post irradiation.
Fig 6. Effect of various doses of gamma radiation on the specific activity of lactate dehydrogenase in the liver of mice.

\( ^a \) \((p < 0.01)\) significantly different from the unirradiated control.

\( ^b \) \((p < 0.05)\) significantly different from the unirradiated control.
Fig 7. Effect of different doses of radiation on the GSH content in the liver of mice.

a (p < 0.01) significantly different from the unirradiated control.
b (p < 0.05) significantly different from the unirradiated control.
Fig 8. Effect of different dose rates on the specific activity of xanthine oxidase in the liver of mice. Total dose exposed is 7 Gy.

a (p < 0.005) significantly different from unirradiated control.
b (p < 0.01) significantly different from unirradiated control.
3.10 Effect of Phenylmethysulphonylflouride (PMSF) on the specific activity of XO and XDH

PMSF is a protease inhibitor which may have a role in the inhibition of irreversible conversion of XDH into XO. Therefore, its effect on the specific activity of XO and XDH was studied. The animals were injected with single doses of 2.0, 4.0 and 6.0 mg/kg body weight intraperitoneally 30 minutes before irradiation to 5, 7 and 9 Gy (Dose rate: 0.023 Gy/second) and the specific activities of XO and XDH were determined in the liver after 24 hours.

As shown earlier, the irradiation caused the enhancement of specific activity of XO with increase in the radiation dose. However, administration of PMSF reduced the radiation induced specific activity of XO significantly. PMSF inhibited the specific activity in the dose dependent manner (Table 5).

In another set of experiments, post irradiation effect of PMSF was also examined in the liver. When PMSF was administered immediately (within 15 minutes) after irradiation to 5, 7 and 9 Gy. After 24 hours post irradiation, very small inhibition was observed the specific activity of XO (Table 5). These results showed that PMSF is effective in inhibiting the activity of XO if injected prior to irradiation (Table 5). For clarity, the effect of pre and post irradiation (7 Gy) treatment of PMSF is also shown in the figure 9.

Figure 11 showed the effect of pre irradiation treatment of PMSF on the ratio of specific activities of XDH and XO. Radiation decreased the ratio of XDH/ XO. However, the administration of PMSF resulted in the reversal of change in the XDH/XO ratio. 6.0 mg/kg dose of PMSF restored the XDH/XO ratio very close to unirradiated control (Figure 11A). The total (XDH + XO) specific activities remained constant (Figure 11B).
Post irradiation treatment of PMSF (1-3 mM) did not alter significantly the radiation induced decrease in the XDH/XO ratio (Figure 12). As expected total activities (XDH + XO) remained constant on administration PMSF.

3.11 Modulation of radiation induced changes in the specific activity of lactate dehydrogenase and lipid peroxidation

The effect of PMSF on the lipid peroxidation and the specific activity of LDH in the liver was also studied. PMSF (2, 4 and 6 mg/kg body weight) was administered intraperitoneally before or after irradiation to 5, 7 and 9 Gy. Modulatory effect of PMSF is shown in the Tables 7 and 8. Pre radiation treatment of PMSF decreased the radiation induced specific activity of LDH. The significant decrease in the activity of LDH with concentration of PMSF was mainly observed at 7 and 9 Gy. At 5 Gy, the change was quite small. No appreciable change in the specific activity was seen on the post irradiation treatment of PMSF (Table 8).

Similar trend was also found in the case of lipid peroxidation (Table 7). PMSF inhibited significantly lipid peroxidation in concentration (2-6 mg/kg body weight) dependent manner at all the doses of radiation (5, 7 and 9 Gy). As expected post irradiation treatment of PMSF did not show significant changes in the lipid peroxidation. These results are compared with the XDH and XO using 2 mg PMSF (Figure 13 and 14).
Table 5: Effect of various doses of γ rays on Xanthine Oxidase in liver of mice and its modification by PMSF.

<table>
<thead>
<tr>
<th>Concentration of PMSF (mg/kg body wt.)</th>
<th>Dose (Gy)</th>
<th>Pre irradiation</th>
<th>Post irradiation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>5 7 9</td>
<td>2.0 4.0 6.0</td>
</tr>
<tr>
<td>Control</td>
<td>1.15 ± 0.13</td>
<td>2.21 ± 0.21d</td>
<td>2.09 ± 0.10</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 11.2)</td>
<td>(192.2 ± 9.5)</td>
<td>(181.7 ± 4.8)</td>
</tr>
<tr>
<td></td>
<td>2.0 ± 0.12</td>
<td>1.35 ± 0.21c</td>
<td>1.98 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>(90.4 ± 11.5)</td>
<td>(119.6 ± 15.4)</td>
<td>(172.2 ± 4.1)</td>
</tr>
<tr>
<td></td>
<td>4.0 ± 0.13</td>
<td>1.12 ± 0.05b</td>
<td>1.98 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>(90.4 ± 12.5)</td>
<td>(99.8 ± 4.8)</td>
<td>(172.2 ± 4.1)</td>
</tr>
<tr>
<td></td>
<td>6.0 ± 0.15</td>
<td>1.08 ± 0.05c</td>
<td>1.98 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>(91.3 ± 14.3)</td>
<td>(93.9 ± 4.6)</td>
<td>(172.2 ± 4.1)</td>
</tr>
<tr>
<td></td>
<td>2.0 ± 0.12</td>
<td>1.05 ± 0.07c</td>
<td>1.85 ± 0.09a</td>
</tr>
<tr>
<td></td>
<td>(91.3 ± 14.3)</td>
<td>(91.3 ± 6.7)</td>
<td>(160.8 ± 4.9)</td>
</tr>
<tr>
<td></td>
<td>4.0 ± 0.13</td>
<td>1.23 ± 0.14b</td>
<td>2.03 ± 0.17</td>
</tr>
<tr>
<td></td>
<td>(90.4 ± 12.5)</td>
<td>(100.8 ± 4.3)</td>
<td>(176.5 ± 8.4)</td>
</tr>
<tr>
<td></td>
<td>6.0 ± 0.15</td>
<td>1.08 ± 0.09c</td>
<td>2.04 ± 0.09c</td>
</tr>
<tr>
<td></td>
<td>(91.3 ± 14.3)</td>
<td>(93.9 ± 6.7)</td>
<td>(177.4 ± 4.4)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in parentheses represents the percentage change in the activity with respect to unirradiated control. The activity is given in units/mg protein.

- significantly different from irradiated control (p< 0.005).
- significantly different from irradiated control (p< 0.01).
- significantly different from irradiated control (p< 0.05).
- significantly different from unirradiated control (p< 0.005).
- significantly different from unirradiated control (p< 0.01).
Table 6: Effect of different doses of γ rays on xanthine dehydrogenase in liver of mice and its modulation with the treatment of PMSF.

<table>
<thead>
<tr>
<th>Concentration of PMSF (mg/kg body wt)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose (Gy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>2.41 ± 0.27 (100.0 ± 11.2)</td>
<td>1.30 ± 0.21 &lt;sup&gt;d&lt;/sup&gt; (53.9 ± 16.3)</td>
<td>1.22 ± 0.14 &lt;sup&gt;e&lt;/sup&gt; (51.6 ± 11.5)</td>
<td>0.92 ± 0.13 &lt;sup&gt;e&lt;/sup&gt; (38.1 ± 14.3)</td>
</tr>
<tr>
<td>2.0</td>
<td>2.20 ± 0.12 (91.2 ± 5.5)</td>
<td>1.91 ± 0.16 &lt;sup&gt;a&lt;/sup&gt; (79.3 ± 8.1)</td>
<td>1.82 ± 0.23 &lt;sup&gt;b&lt;/sup&gt; (75.5 ± 9.5)</td>
<td>1.57 ± 0.09 &lt;sup&gt;b&lt;/sup&gt; (65.1 ± 5.7)</td>
</tr>
<tr>
<td>4.0</td>
<td>2.34 ± 0.13 (92.9 ± 5.8)</td>
<td>2.10 ± 0.05 &lt;sup&gt;a&lt;/sup&gt; (87.1 ± 2.4)</td>
<td>2.21 ± 0.05 &lt;sup&gt;b&lt;/sup&gt; (91.7 ± 2.3)</td>
<td>2.03 ± 0.14 &lt;sup&gt;b&lt;/sup&gt; (84.2 ± 6.9)</td>
</tr>
<tr>
<td>6.0</td>
<td>2.25 ± 0.15 (93.4 ± 6.7)</td>
<td>2.13 ± 0.05 &lt;sup&gt;a&lt;/sup&gt; (88.4 ± 2.3)</td>
<td>2.38 ± 0.07 &lt;sup&gt;b&lt;/sup&gt; (98.8 ± 2.9)</td>
<td>2.15 ± 0.16 &lt;sup&gt;b&lt;/sup&gt; (89.2 ± 7.4)</td>
</tr>
<tr>
<td>Pre irradiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.30 ± 0.21 &lt;sup&gt;d&lt;/sup&gt; (53.9 ± 16.3)</td>
<td>1.22 ± 0.14 &lt;sup&gt;e&lt;/sup&gt; (51.6 ± 11.5)</td>
<td>0.92 ± 0.13 &lt;sup&gt;e&lt;/sup&gt; (38.1 ± 14.3)</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>1.91 ± 0.16 &lt;sup&gt;a&lt;/sup&gt; (79.3 ± 8.1)</td>
<td>1.82 ± 0.23 &lt;sup&gt;b&lt;/sup&gt; (75.5 ± 9.5)</td>
<td>1.57 ± 0.09 &lt;sup&gt;b&lt;/sup&gt; (65.1 ± 5.7)</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>2.10 ± 0.05 &lt;sup&gt;a&lt;/sup&gt; (87.1 ± 2.4)</td>
<td>2.21 ± 0.05 &lt;sup&gt;b&lt;/sup&gt; (91.7 ± 2.3)</td>
<td>2.03 ± 0.14 &lt;sup&gt;b&lt;/sup&gt; (84.2 ± 6.9)</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>2.13 ± 0.05 &lt;sup&gt;a&lt;/sup&gt; (88.4 ± 2.3)</td>
<td>2.38 ± 0.07 &lt;sup&gt;b&lt;/sup&gt; (98.8 ± 2.9)</td>
<td>2.15 ± 0.16 &lt;sup&gt;b&lt;/sup&gt; (89.2 ± 7.4)</td>
<td></td>
</tr>
<tr>
<td>Post irradiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.21 ± 0.13 (50.2 ± 10.7)</td>
<td>1.10 ± 0.08 (45.6 ± 7.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>0.79 ± 0.10 &lt;sup&gt;a&lt;/sup&gt; (32.7 ± 4.2)</td>
<td>1.21 ± 0.13 (50.2 ± 10.7)</td>
<td>1.10 ± 0.08 (45.6 ± 7.3)</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>1.03 ± 0.08 (42.7 ± 7.8)</td>
<td>1.37 ± 0.19 (56.9 ± 13.9)</td>
<td>1.24 ± 0.08 &lt;sup&gt;b&lt;/sup&gt; (51.5 ± 6.5)</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>1.20 ± 0.09 &lt;sup&gt;c&lt;/sup&gt; (49.8 ± 7.5)</td>
<td>1.39 ± 0.17 (57.7 ± 12.2)</td>
<td>1.49 ± 0.09 &lt;sup&gt;b&lt;/sup&gt; (61.8 ± 6.0)</td>
<td></td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated control. The enzyme activity is represented in the units/mg protein.

- <sup>a</sup> significantly different from irradiated control (p < 0.005).
- <sup>b</sup> significantly different from irradiated control (p < 0.01).
- <sup>c</sup> significantly different from irradiated control (p < 0.05).
- <sup>d</sup> significantly different from unirradiated control (p < 0.005).
- <sup>e</sup> significantly different from unirradiated control (p < 0.05).
Table 7: Effect of various doses of \( \gamma \) rays on lipid peroxidation in liver of mice and its modification with the treatment of PMSF.

<table>
<thead>
<tr>
<th>Concentration of PMSF (mM/kg body wt)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre irradiation</td>
<td>Post irradiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0.87 ± 0.14 (100.0 ± 16.1)</td>
<td>1.40 ± 0.22 (160.9 ± 15.7)</td>
<td>1.68 ± 0.26 (193.1 ± 15.5)</td>
<td>1.24 ± 0.06 (142.5 ± 4.8)</td>
</tr>
<tr>
<td></td>
<td>0.75 ± 0.11 (86.4 ± 14.7)</td>
<td>0.79 ± 0.14&lt;sup&gt;a&lt;/sup&gt; (90.8 ± 17.7)</td>
<td>0.81 ± 0.10&lt;sup&gt;a&lt;/sup&gt; (92.4 ± 12.4)</td>
<td>0.73 ± 0.09&lt;sup&gt;b&lt;/sup&gt; (83.9 ± 12.3)</td>
</tr>
<tr>
<td>2.0</td>
<td>0.70 ± 0.08 (80.6 ± 11.3)</td>
<td>0.59 ± 0.04&lt;sup&gt;b&lt;/sup&gt; (67.8 ± 6.8)</td>
<td>0.73 ± 0.09&lt;sup&gt;b&lt;/sup&gt; (83.9 ± 12.3)</td>
<td>0.73 ± 0.12&lt;sup&gt;a&lt;/sup&gt; (83.9 ± 16.4)</td>
</tr>
<tr>
<td>4.0</td>
<td>0.79 ± 0.09 (90.8 ± 11.4)</td>
<td>0.60 ± 0.04&lt;sup&gt;b&lt;/sup&gt; (68.9 ± 6.7)</td>
<td>0.71 ± 0.09&lt;sup&gt;b&lt;/sup&gt; (81.6 ± 12.7)</td>
<td>0.71 ± 0.12&lt;sup&gt;b&lt;/sup&gt; (81.6 ± 16.7)</td>
</tr>
<tr>
<td>6.0</td>
<td>0.75 ± 0.05 (86.2 ± 6.7)</td>
<td>1.20 ± 0.10 (137.9 ± 8.3)</td>
<td>1.27 ± 0.13&lt;sup&gt;b&lt;/sup&gt; (145.9 ± 10.2)</td>
<td>1.23 ± 0.09 (141.4 ± 7.3)</td>
</tr>
<tr>
<td></td>
<td>0.70 ± 0.07 (80.6 ± 10.0)</td>
<td>1.05 ± 0.09 (120.7 ± 8.6)</td>
<td>1.23 ± 0.05&lt;sup&gt;a&lt;/sup&gt; (141.3 ± 4.1)</td>
<td>1.13 ± 0.11&lt;sup&gt;a&lt;/sup&gt; (129.8 ± 9.7)</td>
</tr>
<tr>
<td>4.0</td>
<td>0.79 ± 0.07 (90.8 ± 8.9)</td>
<td>1.03 ± 0.11 (128.4 ± 10.7)</td>
<td>1.17 ± 0.09&lt;sup&gt;a&lt;/sup&gt; (134.5 ± 7.7)</td>
<td>1.24 ± 0.08&lt;sup&gt;a&lt;/sup&gt; (128.7 ± 7.1)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in parentheses represents the percentage change in the activity with respect to unirradiated control. Lipid peroxidation is expressed in terms of nM MDA/mg protein.

- <sup>a</sup> significantly different from irradiated control (p< 0.01).
- <sup>b</sup> significantly different from irradiated control (p< 0.05).
- <sup>c</sup> significantly different from unirradiated control (p< 0.01).
- <sup>d</sup> significantly different from unirradiated control (p< 0.05).
Table 8: Effect of different doses of $\gamma$ rays on lactate dehydrogenase in liver of mice and its modulation by PMSF.

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>Concentration of PMSF (mg/kg body wt)</th>
<th>Pre irradiation</th>
<th>Post irradiation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concentration</td>
<td>Concentration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of PMSF</td>
<td>of PMSF</td>
</tr>
<tr>
<td>0</td>
<td>0.0 ± 11.9</td>
<td>12.5 ± 1.49</td>
<td>12.3 ± 1.28</td>
</tr>
<tr>
<td>5</td>
<td>15.8 ± 10.7</td>
<td>15.3 ± 1.14</td>
<td>15.0 ± 1.13</td>
</tr>
<tr>
<td>7</td>
<td>19.9 ± 3.16</td>
<td>19.2 ± 0.90</td>
<td>17.2 ± 0.74</td>
</tr>
<tr>
<td>9</td>
<td>20.3 ± 1.70</td>
<td>19.5 ± 0.79</td>
<td>18.6 ± 1.07</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated controls. The enzyme activity is given in units/mg protein.

- $^a$ significantly different from unirradiated control (p< 0.01).
- $^b$ significantly different from unirradiated control (p< 0.05).
- $^c$ significantly different from irradiated control (p< 0.005).
- $^d$ significantly different from irradiated control (p< 0.01).
Fig 9. Effect of pre and post irradiation treatment of PMSF (4 mg/kg body wt.) on the radiation induced (7Gy) alterations in the specific activity of xanthine oxidase.

C : Control; C+P : PMSF only; R : Radiation; R+P : Radiation+PMSF.

a (p < 0.005) significantly different from the unirradiated control.

b (p < 0.01) significantly different from the irradiated control.
Fig 10. Effect of pre and post irradiation treatment of PMSF (4 mg/kg body wt.) on the xanthine dehydrogenase in the liver of mice.

C : Control; C+P : PMSF only; R : Radiation; R+P : Radiation+PMSF.

\textsuperscript{a} (P < 0.05) significantly different from the unirradiated control.

\textsuperscript{b} (P < 0.01) significantly different from irradiated control.
Fig 11. Effect of different doses (2-6 mg/kg body wt.) of PMSF on: (A) the ratio (XDH/XO) and (B) total (XDH+XO) activity of xanthine oxidoreductase system in the liver of mice.
Fig 12. Effect of different concentration (2-6 mg/kg body wt.) of PMSF on (A): XDH/XO(A) ratio and (B): total (XDH+XO) activity in the liver of mice at various doses of radiation.
Fig 13. Effect of pre irradiation treatment of PMSF on the xanthine oxidase (XO), xanthine dehydrogenase (XDH) and lipid peroxidation (LP).

C: Control; C+P: only PMSF; R: Radiation; R+P: Radiation+PMSF.

a (p<0.005) and b (p<0.05) significantly different from their respective unirradiated control.

c (p<0.05) and d (p<0.01) significantly different from their respective irradiated control.
Fig 14. Effect of post irradiation treatment of PMSF (4.0 mg/kg body wt.) on the radiation (7 Gy) induced changes in the xanthine oxidoreductase system and lipid peroxidation.

C : Control ; C+P : Only PMSF ; R : Radiation ; R+P : Radiation+PMSF. 

\( a (p<0.005) \) and \( b (p<0.05) \) significantly different from unirradiated controls.

\( c (p<0.01) \) significantly different from their respective controls.
3.12 Modulation of radiation induced changes in the specific activities of xanthine oxidase and xanthine dehydrogenase by dithiothreitol (DTT).

Dithiothreitol (DTT) is an inhibitor of reversible conversion of xanthine oxidoreductase system. It inhibits the oxidation of thiol groups and thus prevents the reversible conversion in xanthine oxidase system. Therefore, its effect on the specific activities of XDH and XO was studied. Three different doses of DTT (3-12 mg/kg body weight) were injected intraperitoneally to Swiss albino mice and animals were irradiated after 30 minutes with 5, 7 and 9 Gy of gamma radiation. The specific activities of XO and XDH were determined in the liver 24 hr post irradiation. Modulatory effect of DTT has been depicted in the Tables 9 and 10.

The presence of DTT during irradiation caused the inhibition of specific activity of XO at all the three different doses of radiation (Table 9). However the change was quite small as compared to PMSF. Similarly, DTT could not change the activity of XDH (Table 10). Thus DTT which is a reversible conversion blocker was not effective in modulating the radiation induced specific activities of both XO and XDH enzymes.

Figure 15 depicts the effect of DTT on the XDH/XO ratio. As shown earlier XDH/XO ratio decreased with dose of radiation. However administration of DTT could not change the mode and magnitude of the XDH/XO ratio significantly. DTT also showed no effect on the total activity of xanthine oxidoreductase system (XDH+XO).

3.13 Modulation of specific activity of LDH and lipid peroxidation by DTT

Modulation of radiation induced lipid peroxidation and the specific activity of LDH by DTT is also studied. Single doses of DTT (3-12 mg/kg body weight) were injected intraperitoneally and animals were irradiated with
XO AND RADIATION

5, 7 and 9 Gy after 30 minutes. The levels of lipid peroxidation and the specific activity of LDH were determined at 24 hours post irradiation. DTT did not affect the level of lipid peroxidation significantly (Table 11). In case of LDH, the specific activity was declined predominantly at 7 and 9 Gy (Table 12). No change in lipid peroxidation but the inhibition of the specific activity of LDH at 7 and 9 Gy was an interesting observation.
Table 9: Effect of various doses of gamma radiation on the xanthine oxidase in the liver and its modulation by treatment with dithiothreitol (DTT).

<table>
<thead>
<tr>
<th>Concentration of DTT (mg/kg body wt.)</th>
<th>Dose (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>1.15 ± 0.13</td>
<td>2.21 ± 0.21</td>
<td>2.32 ± 0.41</td>
<td>2.74 ± 0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 11.3)</td>
<td>(192.2 ± 9.5)</td>
<td>(201.7 ± 17.6)</td>
<td>(238.3 ± 8.4)</td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td>1.12 ± 0.13</td>
<td>2.15 ± 0.23</td>
<td>2.39 ± 0.18</td>
<td>2.58 ± 0.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(99.2 ± 11.5)</td>
<td>(186.9 ± 10.7)</td>
<td>(207.8 ± 7.5)</td>
<td>(224.3 ± 11.2)</td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td>1.18 ± 0.19</td>
<td>2.01 ± 0.24</td>
<td>2.34 ± 0.21</td>
<td>2.50 ± 0.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.8 ± 16.5)</td>
<td>(174.7 ± 11.9)</td>
<td>(203.5 ± 8.9)</td>
<td>(217.4 ± 11.6)</td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td>1.18 ± 0.20</td>
<td>2.01 ± 0.11</td>
<td>2.25 ± 0.18</td>
<td>2.36 ± 0.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.8 ± 19.8)</td>
<td>(174.7 ± 5.5)</td>
<td>(195.6 ± 8.0)</td>
<td>(205.2 ± 13.1)</td>
</tr>
</tbody>
</table>

Each value represents the mean of at least three experiments ± S.D. The values in the parenthesis represents percentage change with respect to unirradiated controls. The enzyme activities are given in units/mg protein.
Table 10: Effect of various doses of gamma radiation on the xanthine dehydrogenase in the liver and its modulation by treatment with dithiothreitol (DTT).

<table>
<thead>
<tr>
<th>Concentration of DTT (mg/kg body wt.)</th>
<th>Dose (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>2.41 ± 0.27</td>
<td>1.30 ± 0.21</td>
<td>1.22 ± 0.14</td>
<td>0.92 ± 0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 11.2)</td>
<td>(53.9 ± 16.1)</td>
<td>(50.6 ± 11.5)</td>
<td>(38.1 ± 14.3)</td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td>2.31 ± 0.13</td>
<td>1.07 ± 0.18</td>
<td>1.08 ± 0.13</td>
<td>0.53 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(95.9 ± 5.6)</td>
<td>(44.4 ± 16.8)</td>
<td>(44.8 ± 12.0)</td>
<td>(22.0 ± 16.9)</td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td>2.41 ± 0.29</td>
<td>1.08 ± 0.17</td>
<td>1.24 ± 0.17</td>
<td>0.69 ± 0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 12.0)</td>
<td>(44.8 ± 15.7)</td>
<td>(51.5 ± 13.7)</td>
<td>(28.6 ± 10.1)</td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td>2.36 ± 0.20</td>
<td>1.08 ± 0.11</td>
<td>1.30 ± 0.18</td>
<td>0.68 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(97.9 ± 8.5)</td>
<td>(44.8 ± 20.3)</td>
<td>(53.9 ± 13.8)</td>
<td>(28.2 ± 13.2)</td>
</tr>
</tbody>
</table>

Each value represents the mean of at least three experiments ± S.D. The values in the parenthesis represents percentage change with respect to unirradiated controls. The enzyme activities are given in units/mg protein.
Table 11: Effect of various doses of gamma radiation on the lipid peroxidation in the liver and its modulation by treatment with dithiothreitol (DTT).

<table>
<thead>
<tr>
<th>Concentration of DTT (mg/kg body wt.)</th>
<th>Dose (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>0.87 ± 0.14</td>
<td>1.40 ± 0.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.68 ± 0.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.24 ± 0.06&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 16.1)</td>
<td>(53.9 ± 15.2)</td>
<td>(193.1 ± 15.5)</td>
<td>(142.5 ± 4.8)</td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td>0.81 ± 0.13</td>
<td>1.39 ± 0.18</td>
<td>1.34 ± 0.13</td>
<td>1.23 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(93.1 ± 16.0)</td>
<td>(159.7 ± 12.9)</td>
<td>(154.0 ± 9.7)</td>
<td>(141.3 ± 7.3)</td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td>0.91 ± 0.19</td>
<td>1.35 ± 0.17</td>
<td>1.34 ± 0.17</td>
<td>1.19 ± 0.07</td>
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<tr>
<td></td>
<td></td>
<td>(104.6 ± 20.9)</td>
<td>(15.2 ± 12.6)</td>
<td>(154.0 ± 12.7)</td>
<td>(136.8 ± 5.8)</td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td>0.89 ± 0.20</td>
<td>1.23 ± 0.11</td>
<td>1.33 ± 0.18</td>
<td>1.13 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(102.2 ± 22.1)</td>
<td>(141.7 ± 8.9)</td>
<td>(152.9 ± 113.5)</td>
<td>(129.9 ± 8.0)</td>
</tr>
</tbody>
</table>

Each value represents the mean of at least three experiments ± S.D. The values in the parenthesis represents percentage change with respect to unirradiated controls. The lipid peroxidation is expressed in terms of nM MDA formed/mg protein.

<sup>a</sup> significantly different from the unirradiated controls (p<0.01).

<sup>b</sup> significantly different from the unirradiated controls (p<0.05).
Table 12: Effect of various doses of γ rays on lactic dehydrogenase in liver of mice and its modification with the treatment of DTT (dithithreitol).

<table>
<thead>
<tr>
<th>Concentration of DTT (mg/kg body wt)</th>
<th>DOSE (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>12.5 ± 1.49</td>
<td>15.8 ± 1.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.9 ± 3.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.3 ± 1.70&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 11.9)</td>
<td>(126.4 ± 10.7)</td>
<td>(159.2 ± 15.8)</td>
<td>(162.4 ± 8.4)</td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td>12.0 ± 1.12</td>
<td>15.2 ± 1.61</td>
<td>13.7 ± 0.27&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.9 ± 0.59&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(96.0 ± 9.3)</td>
<td>(121.6 ± 10.5)</td>
<td>(109.6 ± 1.9)</td>
<td>(111.2 ± 4.2)</td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td>11.9 ± 1.13</td>
<td>15.1 ± 1.34</td>
<td>13.0 ± 0.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.6 ± 0.60&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(95.2 ± 9.5)</td>
<td>(120.8 ± 8.9)</td>
<td>(104.0 ± 3.8)</td>
<td>(100.8 ± 13.3)</td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td>12.4 ± 0.95</td>
<td>15.0 ± 1.32</td>
<td>12.32 ± 0.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.9 ± 0.81&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(99.2 ± 7.6)</td>
<td>(120.0 ± 8.8)</td>
<td>(98.6 ± 4.0)</td>
<td>(95.2 ± 6.8)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to the unirradiated controls. The enzyme activity is given in units/mg protein.

<sup>a</sup> significantly different from unirradiated control (p< 0.01).

<sup>b</sup> significantly different from irradiated control (p< 0.01).
Fig 15. Effect of various doses of DTT (3-12 mg/kg body wt.) on the radiation (5-9 Gy) induced alterations in (A): the ratio (XDH/XO) and (B): total (XDH+XO) activity in the liver of mice.
3.14 Effect of allopurinol on the specific activity of xanthine oxidase and xanthine dehydrogenase

Allopurinol is the most specific inhibitor of xanthine oxidoreductase system. Table 13 and Table 14 show its effect on the specific activities of xanthine oxidase and xanthine dehydrogenase respectively. Animals were administered allopurinol intraperitoneally (12.5, 25 and 50 mg/kg body weight) 30 minutes before irradiation with 5, 7 and 9 Gy and specific activities of XO and XDH in the liver were determined after 24 hours. Allopurinol significantly inhibited the activity of XO at all the three doses of radiation. The inhibition was increased with the increase of dose of allopurinol (Table 13).

Unlike XO, the specific activity of XDH was progressively decreased with the dose of radiation. The treatment of allopurinol significantly inhibited its activity in concentration dependent manner (Table 14). For clarity, the change in the specific activities of XO and XDH due to allopurinol administration is shown in the Figure 17.

Figure 16A shows the effect of allopurinol (12.5-50 mg/kg body wt.) on the XDH/XO ratio at various doses of radiation (5,7 and 9 Gy). No appreciable change in the XDH/XO ratio of specific activities was observed in presence of allopurinol. However, total activity (XDH + XO) was decrease as a result of allopurinol administration (Figure 16B).

3.15 Effect of allopurinol on the specific activity of LDH and lipid peroxidation

Modulation of the specific activity of LDH and lipid peroxidation by allopurinol is studied and the results are shown in Tables 15 and 16. Allopurinol was administered (12.5, 25 and 50 mg/kg body weight) and after 30 minutes animals were irradiated with 5,7 and 9 Gy. The activity of LDH
and extent of lipid peroxidation was determined after 24 hours. Radiation induced activity of LDH was inhibited by allopurinol in concentration independent manner (Table 16). The inhibition was predominantly found at 5 and 9 Gy. The extent of change in the activity of LDH due to 25 and 50 mg/kg body weight of allopurinol was almost the same at given dose (e.g. $13.3 \pm 0.44$ and $13.2 \pm 0.44$ at 5 Gy and $17.8 \pm 0.31$ and $17.8 \pm 0.27$ at 7 Gy).

In case of lipid peroxidation a significant decline was caused by allopurinol (Table 15). With increase in concentration of allopurinol, lipid peroxidation was decreased at all the three doses of radiation i.e. 5, 7 and 9 Gy. From the above results it was quite clear that both LDH and lipid peroxidation in the liver of mice were significantly reduced due to pre-radiation treatment of allopurinol.
Table 13: Effect of various doses of γ rays on xanthine oxidase and its modulation with allopurinol.

<table>
<thead>
<tr>
<th>DOSE (Gy)</th>
<th>Concentration of Allopurinol (mg/kg body weight)</th>
<th>Control</th>
<th>12.5</th>
<th>25</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>1.15 ± 0.13 (100.0 ± 11.3)</td>
<td>1.20 ± 0.12 (104.3 ± 10.0)</td>
<td>0.86 ± 0.13 (74.8 ± 16.6)</td>
<td>0.85 ± 0.15 (73.9 ± 17.6)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2.21 ± 0.21d (192.2 ± 9.5)</td>
<td>1.80 ± 0.14c (156.6 ± 7.8)</td>
<td>1.32 ± 0.15c (114.8 ± 0.20)</td>
<td>1.04 ± 0.07c (90.4 ± 6.7)</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>2.32 ± 0.41d (201.7 ± 17.6)</td>
<td>1.83 ± 0.23c (159.9 ± 12.5)</td>
<td>1.44 ± 0.20b (125.2 ± 13.9)</td>
<td>1.17 ± 0.08b (1.02 ± 6.8)</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2.74 ± 0.23e (238.2 ± 8.3)</td>
<td>2.14 ± 0.28c (186.1 ± 13.1)</td>
<td>1.50 ± 0.15b (130.4 ± 10.0)</td>
<td>1.34 ± 0.10b (107.8 ± 8.1)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated controls. The enzyme activity is represented in mUnits/mg protein.

- a significantly different from irradiated control (p< 0.005).
- b significantly different from irradiated control (p< 0.01).
- c significantly different from irradiated control (p< 0.05).
- d significantly different from unirradiated control (p< 0.005).
- e significantly different from unirradiated control (p< 0.01).
Table 14: Effect of different doses of $\gamma$ rays on xanthine dehydrogenase and its modification with Allopurinol in liver of mice.

<table>
<thead>
<tr>
<th>DOSE (Gy)</th>
<th>Concentration of Allopurinol (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td>0</td>
<td>2.41 ± 0.30 (100 ± 12.5)</td>
</tr>
<tr>
<td>5</td>
<td>1.30 ± 0.20 (53.2 ± 15.4)</td>
</tr>
<tr>
<td>7</td>
<td>1.23 ± 0.14 (51.1 ± 11.4)</td>
</tr>
<tr>
<td>9</td>
<td>0.92 ± 0.13 (38.7 ± 14.1)</td>
</tr>
<tr>
<td>12.5</td>
<td>0.76 ± 0.08 (31.5 ± 10.5)</td>
</tr>
<tr>
<td>25</td>
<td>0.68 ± 0.12 (28.2 ± 17.6)</td>
</tr>
<tr>
<td>50</td>
<td>0.69 ± 0.11 (28.6 ± 15.9)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.83 ± 0.07 (34.4 ± 8.4)</td>
</tr>
<tr>
<td></td>
<td>0.83 ± 0.08 (34.4 ± 9.6)</td>
</tr>
<tr>
<td></td>
<td>0.83 ± 0.12 (34.0 ± 16.2)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated controls. The enzyme activity is represented in Units/mg protein.

- a significantly different from irradiated control (p< 0.005).
- b significantly different from irradiated control (p< 0.01).
- c significantly different from irradiated control (p< 0.05).
- d significantly different from unirradiated control (p< 0.005).
- e significantly different from unirradiated control (p< 0.05).
Table 15: Effect of various doses of γ rays on lipid peroxidation in liver of mice and its modulation with the treatment of allopurinol.

<table>
<thead>
<tr>
<th>Concentration of Allopurinol (mg/kg body weight)</th>
<th>DOSE (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.87 ± 0.14</td>
<td>1.40 ± 0.22</td>
<td>1.68 ± 0.26</td>
<td>1.24 ± 0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(100.0 ± 16.1)</td>
<td>(160.9 ± 15.7)</td>
<td>(193.1 ± 15.4)</td>
<td>(142.5 ± 4.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.75 ± 0.11</td>
<td>1.10 ± 0.08</td>
<td>0.93 ± 0.06</td>
<td>0.85 ± 0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(86.2 ± 12.6)</td>
<td>(106.9 ± 6.5)</td>
<td>(97.7 ± 3.5)</td>
<td>(97.7 ± 3.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.70 ± 0.08</td>
<td>0.94 ± 0.10</td>
<td>0.80 ± 0.05</td>
<td>0.66 ± 0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(80.5 ± 11.4)</td>
<td>(108.1 ± 10.6)</td>
<td>(91.9 ± 6.3)</td>
<td>(75.8 ± 6.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.79 ± 0.09</td>
<td>0.84 ± 0.10</td>
<td>0.76 ± 0.05</td>
<td>0.66 ± 0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(90.8 ± 11.4)</td>
<td>(96.6 ± 11.9)</td>
<td>(87.3 ± 6.6)</td>
<td>(75.8 ± 6.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. Values in parenthesis represents the percentage change with respect to untreated unirradiated control. The lipid peroxidation is expressed in terms of nM MDA formed/mg protein.

- a significantly different from irradiated untreated control (p< 0.05).
- b significantly different from irradiated untreated control (p< 0.01).
- c significantly different from unirradiated control (p< 0.05).
- d significantly different from unirradiated control (p< 0.01).
Table 16: Effect of γ rays on lactic dehydrogenase in liver of mice with the treatment of allopurinol.

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>Concentration of Allopurinol (mg/kg body wt)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.5 ± 1.49</td>
<td>15.8 ± 1.69&lt;sup&gt;d&lt;/sup&gt;</td>
<td>19.9 ± 3.18&lt;sup&gt;d&lt;/sup&gt;</td>
<td>20.3 ± 1.70&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 11.9)</td>
<td>(126.4 ± 10.7)</td>
<td>(159.2 ± 15.9)</td>
<td>(162.4 ± 8.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.5 ± 1.12</td>
<td>13.2 ± 0.70&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.9 ± 0.33</td>
<td>19.4 ± 0.45&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(96.0 ± 9.33)</td>
<td>(105.6 ± 5.3)</td>
<td>(143.2 ± 18.4)</td>
<td>(155.2 ± 2.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25 ± 1.13</td>
<td>13.3 ± 0.48&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.8 ± 0.31</td>
<td>19.2 ± 0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(100.8 ± 8.9)</td>
<td>(106.4 ± 3.6)</td>
<td>(142.4 ± 17.1)</td>
<td>(153.6 ± 12.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 ± 0.95</td>
<td>13.2 ± 0.44&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.8 ± 0.27</td>
<td>19.2 ± 0.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(96.8 ± 7.8)</td>
<td>(105.6 ± 3.3)</td>
<td>(142.4 ± 1.5)</td>
<td>(153.6 ± 0.9)</td>
<td></td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in parenthesis represents the percentage change with respect to the unirradiated untreated controls. The enzyme activity is represented in mU/mg protein.

<sup>a</sup> significantly different from irradiated untreated control (p< 0.01).
<sup>b</sup> significantly different from irradiated untreated control (p< 0.05).
<sup>c</sup> significantly different from irradiated untreated control (p< 0.005).
<sup>d</sup> significantly different from unirradiated control (p< 0.01).
Fig 16. Effect of various doses of allopurinol (12.5-50 mg/kg body wt.) on the radiation induced changes (5-9 Gy) in (A): the ratio of XDH/XO and (B): total specific activity (XDH+XO) in the liver of mice.

a (p<0.05) significantly different from unirradiated untreated control.
b (p<0.05) and c (p<0.005) significantly different from irradiated control.
Fig 17. Effect of allopurinol (25.0 mg/kg body wt.) on the radiation induced (7Gy) changes in xanthine oxidase, xanthine dehydrogenase and lipid peroxidation.

C: Control; C+P: Only Allopurinol; R: Radiation; R+P: Radiation+Allopurinol.

a (p< 0.005), b (p< 0.05) and c (p< 0.01) significantly different from respective unirradiated controls.

d (p< 0.05) and e (p< 0.01) significantly different from respective irradiated control.
3.16 Effect of folic acid on the radiation induced alterations in the activities of XO and XDH

Folic acid is a competitive inhibitor of xanthine oxidase. We have studied its effect on the specific activities of XO and also XDH. Single doses of folic acid (12.5, 25 and 50 mg/kg body weight) were administered intraperitoneally and animals were irradiated with 5, 7 and 9 Gy after 30 minutes. The specific activities were determined at 24 hours post irradiation. Results are shown in the Tables 17 and 18. Folic acid inhibited the radiation enhanced specific activity of XO in concentration dependent manner at all the three doses of radiation i.e. 5, 7 and 9 Gy (Table 17).

As found earlier, the specific activity of XDH was decreased with dose of radiation which further decreased due to treatment of folic acid. The inhibition was enhanced with the dose of folic acid (12.5, 25 and 50 mg/kg body weight) (Table 18).

Results of the Figures 17 and 19 clearly showed the inverse relationship of XO and XDH in terms of their response towards ionising radiation. Radiation enhanced the activity of XO and increased the activity of XDH. In both cases folic acid inhibited their activities.

Effect of radiation (5, 7 and 9 Gy) on the ratio of specific activities of XDH and XO and their modification by folic acid (12.5, 25 and 50 mg/kg body weight) were also studied. The presence of folic acid during the irradiation did not alter the XDH/XO ratio significantly compared to respective controls (Figure 18A). However, the total activity (XDH+XO) was decreased due to folic acid treatment in concentration dependent manner at all the three doses of radiation (Figure 18B).
3.17 Effect of folic acid on specific activity of LDH and lipid peroxidation with radiation

Effect of folic acid (12.5, 25 and 50 mg/kg body weight) on the specific activity of LDH and lipid peroxidation using 5, 7 and 9 Gy radiation doses is shown in Tables 19 and 20. Folic acid did not affect the specific activity of LDH appreciably (Table 20). However, folic acid was significantly effective in reducing the radiation induced lipid peroxidation at all the three doses of radiation (Table 19). The relationship of lipid peroxidation with the activities of XDH and XO is compared (Figure 19).
Table 17: Modulation of the effect of γ rays on xanthine oxidase in liver of mice with the treatment of folic acid.

<table>
<thead>
<tr>
<th>Concentration of Folic acid (mg/kg body wt)</th>
<th>Dose (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>1.15 ± 0.13</td>
<td>2.21 ± 0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.32 ± 0.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.74 ± 0.23&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(100.0 ± 11.3)</td>
<td>(192.2 ± 9.5)</td>
<td>(201.7 ± 17.6)</td>
<td>(238.2 ± 8.3)</td>
</tr>
<tr>
<td>12.5</td>
<td></td>
<td>0.92 ± 0.12</td>
<td>1.32 ± 0.09&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.39 ± 0.10&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.43 ± 0.07&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(83.6 ± 12.4)</td>
<td>(114.8 ± 8.3)</td>
<td>(120.8 ± 8.7)</td>
<td>(124.3 ± 4.9)</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>0.87 ± 0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.12 ± 0.08&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.12 ± 0.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.29 ± 0.07&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(90.4 ± 12.5)</td>
<td>(97.4 ± 7.1)</td>
<td>(101.7 ± 10.3)</td>
<td>(112.2 ± 15.5)</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>0.85 ± 0.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.04 ± 0.05&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.08 ± 0.95&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.19 ± 0.05&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(73.9 ± 17.6)</td>
<td>(90.4 ± 6.7)</td>
<td>(93.9 ± 4.6)</td>
<td>(103.5 ± 12.6)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parentheses represents the percentage change with respect to unirradiated control. The enzyme activity is given in units/mg protein.

- <sup>a</sup> significantly different from unirradiated control (p< 0.005).
- <sup>b</sup> significantly different from irradiated control (p< 0.01).
- <sup>c</sup> significantly different from irradiated control (p< 0.05).
Table 18: Effect of various doses of $\gamma$ rays on xanthine dehydrogenase in liver of mice and its modulation with the treatment of Folic acid.

<table>
<thead>
<tr>
<th>Concentration of Folic acid (mg/kg body wt.)</th>
<th>DOSE (Gy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Control</td>
<td>2.41 ± 0.30</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 12.4)</td>
</tr>
<tr>
<td>12.5</td>
<td>2.10 ± 0.78</td>
</tr>
<tr>
<td></td>
<td>(91.3 ± 17.2)</td>
</tr>
<tr>
<td>25</td>
<td>1.90 ± 0.13$^a$</td>
</tr>
<tr>
<td></td>
<td>(93.8 ± 5.8)</td>
</tr>
<tr>
<td>50</td>
<td>1.78 ± 0.15$^a$</td>
</tr>
<tr>
<td></td>
<td>(94.6 ± 6.6)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated controls. The enzyme activity is represented in Units/mg protein.

$^a$ significantly different from irradiated control (p< 0.005).

$^b$ significantly different from irradiated control (p< 0.01).

$^c$ significantly different from irradiated control (p< 0.005).

$^d$ significantly different from irradiated control (p< 0.01).
Table 19: Effect of different doses of γ rays on lipid peroxidation in liver of mice and its modification with the treatment of folic acid.

<table>
<thead>
<tr>
<th>Concentration of Folic acid (mg/kg body wt)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.87 ± 0.14</td>
<td>1.40 ± 0.22</td>
<td>1.68 ± 0.26</td>
<td>1.24 ± 0.06</td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 16.1)</td>
<td>(160.9 ± 15.7)</td>
<td>(193.1 ± 15.5)</td>
<td>(142.5 ± 4.8)</td>
</tr>
<tr>
<td>12.5</td>
<td>0.75 ± 0.11</td>
<td>0.95 ± 0.19</td>
<td>0.79 ± 0.08b</td>
<td>0.75 ± 0.08b</td>
</tr>
<tr>
<td></td>
<td>(86.2 ± 15.7)</td>
<td>(109.2 ± 20.0)</td>
<td>(90.1 ± 10.3)</td>
<td>(86.2 ± 10.6)</td>
</tr>
<tr>
<td>25</td>
<td>0.70 ± 0.08</td>
<td>0.74 ± 0.2a</td>
<td>0.78 ± 0.06a</td>
<td>0.76 ± 0.06a</td>
</tr>
<tr>
<td></td>
<td>(80.5 ± 9.2)</td>
<td>(85.6 ± 2.7)</td>
<td>(89.7 ± 7.6)</td>
<td>(87.3 ± 7.9)</td>
</tr>
<tr>
<td>50</td>
<td>0.79 ± 0.09</td>
<td>0.72 ± 0.15a</td>
<td>0.75 ± 0.05a</td>
<td>0.79 ± 0.05a</td>
</tr>
<tr>
<td></td>
<td>(90.1 ± 9.0)</td>
<td>(81.3 ± 19.3)</td>
<td>(86.2 ± 6.7)</td>
<td>(90.8 ± 6.3)</td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to the unirradiated controls. The lipid peroxidation is represented in terms of nM MDA formed/mg protein.

a significantly different from irradiated control (p< 0.01).
b significantly different from irradiated control (p< 0.05).
c significantly different from unirradiated control (p< 0.01).
d significantly different from unirradiated control (p< 0.05).
Table 20: Effect of various doses of γ rays on lactic dehydrogenase in liver of mice and its modulation with the treatment of folic acid.

<table>
<thead>
<tr>
<th>Concentration of Folic acid (mg/kg body wt)</th>
<th>Dose (Gy)</th>
<th>0</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.5 ± 1.49</td>
<td>15.8 ± 1.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.9 ± 3.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.3 ± 1.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(100.0 ± 11.9)</td>
<td>(126.4 ± 10.7)</td>
<td>(159.2 ± 15.9)</td>
<td>(162.4 ± 8.4)</td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td>12.0 ± 1.12</td>
<td>15.1 ± 0.73</td>
<td>18.6 ± 0.43</td>
<td>20.2 ± 0.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(96.0 ± 9.3)</td>
<td>(120.8 ± 4.8)</td>
<td>(148.8 ± 2.3)</td>
<td>(162.4 ± 1.6)</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>11.9 ± 1.13</td>
<td>15.3 ± 1.02</td>
<td>18.6 ± 0.42</td>
<td>20.1 ± 0.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(95.2 ± 9.5)</td>
<td>(122.4 ± 6.7)</td>
<td>(148.8 ± 2.3)</td>
<td>(160.8 ± 2.4)</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>12.4 ± 0.95</td>
<td>14.9 ± 0.71</td>
<td>18.9 ± 0.15</td>
<td>19.4 ± 1.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(99.2 ± 7.7)</td>
<td>(119.2 ± 4.8)</td>
<td>(151.2 ± 0.8)</td>
<td>(155.2 ± 6.2)</td>
<td></td>
</tr>
</tbody>
</table>

Each value represents average of at least three experiments ± S.D. The values in the parenthesis represents the percentage change with respect to unirradiated controls. The enzyme activity is expressed in the units/mg protein.

<sup>a</sup> significantly different from unirradiated control (p< 0.01).

<sup>b</sup> significantly different from unirradiated control (p< 0.01).
Fig 18. Effect of various doses of folic acid (12.5-50 mg/kg body wt.) on the radiation induced changes in (A) the XDH/XO ratio and (B) on the total activity (XDH+XO) in the liver of mice.

a (p < 0.01) significantly different from the unirradiated control.
b (p < 0.05) and c (p < 0.005) significantly different from the irradiated control.
Fig 19. Effect of various doses of folic acid (12.5-50 mg/kg body wt.) on the radiation induced alterations in the xanthine oxidase (XO), xanthine dehydrogenase (XDH) and lipid peroxidation.

C : Control; C+P : Only PMSF; R : Radiation; R+P : Radiation+PMSF

\( a (p < 0.005), b (p < 0.05) \) significantly different from the unirradiated control.

\( c (p < 0.05), d (p < 0.01) \) values are significantly different from the irradiated controls.