Results
3. RESULTS

Results of the experimental work carried out are presented in the following tables.

3.1 CHANGES IN GLYCOLYTIC ENZYMES OF THE KIDNEY MEDULLA

The effect of gentamicin and α-lipoic acid is shown in Table 1. Since glycolytic enzymes are present only in the renal medulla, their activities were not determined in the renal cortex. There was a significant decrease in hexokinase activity in gentamicin administered rats (Group II) (6.15 ± 1.1) as compared with controls (8.40 ± 0.9), whereas phosphoglucoisomerase activity showed negligible change. Aldolase activity was found to be decreased with respect to the controls (p < 0.05).

Lipoic acid (2 mg) administration (Group III) brought about a significant increase in the activities of hexokinase (p < 0.01) and phosphoglucoisomerase (p < 0.01) when compared to the controls. No significant change was observed in the aldolase activity of rats treated with both gentamicin and lipoic acid. The activity of phosphoglucoisomerase (6.56 ± 1.85) decreased significantly when gentamicin and lipoic acid was administered concomitantly.

With respect to the controls, there was a significant increase observed in the activities of hexokinase (14.81 ± 1.7), phosphoglucoisomerase (20.14 ± 2.1) and aldolase (13.15 ± 1.1) when 5 mg of lipoic acid was administered. Treatment of the gentamicin administered rats with a high dosage of lipoic acid (5 mg) was effective in increasing the hexokinase activity (p < 0.01) but no significant change was observed in the activities of phosphoglucoisomerase and aldolase.
<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipolic acid (2mg)</th>
<th>Group IV Gentamicin + Lipolic acid (2 mg)</th>
<th>Group V Lipoicacid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexokinase</td>
<td>8.40 ± 0.9</td>
<td>6.15 ± 1.1†</td>
<td>14.01 ± 2.3‡</td>
<td>6.6 ± 1.5</td>
<td>14.81 ± 1.7†‡</td>
<td>9.2 ± 0.7†‡</td>
</tr>
<tr>
<td>Phosphogluco Isomerase</td>
<td>13.10 ± 1.1</td>
<td>10.47 ± 4.2</td>
<td>19.83 ± 2.6‡</td>
<td>6.56 ± 1.85‡</td>
<td>20.14 ± 2.1‡</td>
<td>13.1 ± 3.7</td>
</tr>
<tr>
<td>Aldolase</td>
<td>10.90 ± 0.8</td>
<td>8.95 ± 2.0§</td>
<td>14.35 ± 3.6</td>
<td>10.75 ± 1.2</td>
<td>13.15 ± 1.1§</td>
<td>11.63 ± 2.7</td>
</tr>
<tr>
<td>Lactate dehydrogenase (LDH)</td>
<td>0.40 ± 0.01</td>
<td>0.35 ± 0.11</td>
<td>0.42 ± 0.03</td>
<td>0.41 ± 0.05</td>
<td>0.62 ± 0.15§</td>
<td>0.85 ± 0.11§</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S D for 6 rats

The duration of treatment was for 10 days in all the groups
One unit of enzyme activity is expressed as Hexokinase nanomole of glucose-6-phosphate, Phosphoglucoisomerase nanomole of fructose, Aldolase nanomole of glyceraldehyde, LDH, micromole of pyruvate, formed per minute per milligram protein at 37°C

Comparison were made between a groups I and II, b groups I and III, c groups I and IV, d groups I and V, e groups I and VI
f groups II and IV and g groups II and VI

The symbols represent statistical significance $ = p < 0.05$, # = p <0.01, @ = p <0.001
LDH showed no significant change in the kidney of the nephrotoxic rats (0.35 ± 0.106) when compared to controls (0.40 ± 0.01). Treatment with 5 mg of the drug brought about an increase in its activity (0.845 ± 0.113) when compared to the gentamicin administered rats (0.350 ± 0.106) and also the control rats (0.40 ± 0.01).

3.2 CHANGES IN THE GLUCONEOGENIC ENZYMES OF THE KIDNEY CORTEX

The effect of gentamicin and lipoic acid treatments on certain gluconeogenic enzymes in the kidney is tabulated in Table 2.

The activity of glucose-6-phosphatase, a multifunctional enzyme, was decreased (24.75 ± 0.9) significantly when compared to the control rats (27.85 ± 0.7) along with a concomitant decrease in fructose-1,6-diphosphatase activity (15.33 ± 1.4). 2 mg of lipoic acid was effective in decreasing the activities of these two enzymes in both gentamicin and lipoic acid treated group (p < 0.01). The activities of these 2 major regulatory enzymes of gluconeogenesis namely glucose-6 phosphatase (p < 0.001) and fructose 1,6-diphosphatase (13.74 ± 2.1) were significantly decreased in lipoic acid (5 mg) administered rats, when compared to the gentamicin administered rats.

3.3 CHANGES IN THE TCA CYCLE ENZYMES OF THE KIDNEY

The effect of gentamicin and lipoic acid treatments on certain gluconeogenic enzymes in the kidney is shown in Table 3.

The activities of ICDH, SDH, MDH were decreased significantly in the kidney of gentamicin treated group (p < 0.05) when compared to the control. Administration of
TABLE - 2
EFFECT OF GENTAMICIN AND α-LIPOMIC ACID ADMINISTRATIONS ON CERTAIN GLUCONEOGENIC ENZYMES IN KIDNEY

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipoic acid (2mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoic acid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose-6-phosphatase</td>
<td>27.85 ± 0.7</td>
<td>24.75 ± 0.9#</td>
<td>20.50 ± 0.7 b@</td>
<td>16.8 ± 1.9 c@</td>
<td>15.16 ± 1.18 d@</td>
<td>10.14 ± 0.32 e@</td>
</tr>
<tr>
<td>Fructose-1,6-diphosphatase</td>
<td>21.50 ± 0.9</td>
<td>15.33 ± 1.4#</td>
<td>16.16 ± 2.1 b@</td>
<td>13.61 ± 2.41 c@</td>
<td>12.0 ± 0.81 d@</td>
<td>13.74 ± 2.12 e@</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S.D. for 6 rats.

The duration of treatment was for 10 days in all the groups.
One unit of enzyme activity is defined as: glucose-6-phosphatase and fructose-1,6-diphosphatase, nanomole of inorganic phosphorus released per milligram protein per minute at 37°C.

Comparison were made between a groups I and II, b groups I and III, c groups I and IV, d groups I and V, e groups I and VI f groups II and IV and g groups II and VI.

The symbols represent statistical significance  $ = p < 0.05$, # = $p < 0.01$, @ = $p < 0.001$. 
### TABLE - 3

**EFFECT OF GENTAMICIN AND α-LIPOIC ACID ADMINISTRATIONS ON CERTAIN TCA CYCLE ENZYMES IN KIDNEY**

<table>
<thead>
<tr>
<th>Enzyme (Units/mg protein)</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b w/day)</th>
<th>Group III Lipoic acid (2mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoicacid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isocitrate dehydrogenase (ICDH)</td>
<td>536 ± 220</td>
<td>19 ± 0.2²š</td>
<td>599 ± 203</td>
<td>17 ± 0.6²š</td>
<td>62 ± 194</td>
<td>23 ± 0.2²š³š</td>
</tr>
<tr>
<td>Succinate dehydrogenase (SDH)</td>
<td>1880 ± 341</td>
<td>130 ± 2.0²š</td>
<td>192 ± 240</td>
<td>143 ± 1.8²š</td>
<td>2101 ± 17</td>
<td>1687 ± 2.1²š</td>
</tr>
<tr>
<td>Malate dehydrogenase (MDH)</td>
<td>571 ± 27</td>
<td>169 ± 0.04²š</td>
<td>109 ± 2.5²š</td>
<td>194 ± 0.06²š³š</td>
<td>1284 ± 1.6³š</td>
<td>318 ± 0.4³š³š</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S D for 6 rats.

The duration of treatment was for 10 days in all the groups.

One unit of enzyme activity is defined as
- ICDH  nanomole α-ketoglutarate formed,
- SDH  micromole of succinate formed,
- MDH  nanomole of NADH oxidised per milligram protein per minute at 37°C

Comparison were made between a groups I and II, b groups I and III, c groups I and IV, d groups I and V, e groups I and VI f groups II and IV and g groups II and VI

The symbols represent statistical significance  S = p < 0.05 ,  # = p < 0.01,  @ = p < 0.001
lipoic acid (5 mg) to the gentamicin injected animals brought about a significant elevation in the activities of ICDH (p <0.05), SDH (p <0.05) and MDH (p <0.001). Minimal changes were observed when lipoic acid (2 mg) was given except in the case of MDH (p <0.001), where there was an increase.

3.4 CHANGES IN THE PHOSPHOHYDROLASES OF THE KIDNEY

The effects of various treatments on the phosphohydrolases were studied and comparisons were made suitably (Table 4).

Decreased activities of Na⁺,K⁺ ATPase (p <0.05) and Mg⁺⁺ ATPase (p <0.01) are some of the changes observed in the kidney of the gentamicin administered group, where as no remarkable change in the activity of Ca²⁺ ATPase was observed.

Alkaline phosphatase activity also showed a very significant decrease in the gentamicin group (0.34 ± 0.013). Administration of lipoic acid (2 mg) decreased the activities of Na⁺, K⁺-ATPase (0.491 ± 0.126), Mg⁺⁺ ATPase (0.26 ± 0.092), Ca⁺⁺ ATPase (0.310 ± 0.011) and alkaline phosphatase (0.30 ± 0.008).

An increase in the membrane ATPase and alkaline phosphatase activities are some of the salient features observed when lipoic acid (5 mg) was given.

3.5 CHANGES IN GLYCOLYTIC ENZYMES IN LIVER

The changes in certain liver glycolytic enzymes observed during the administration of gentamicin and lipoate are tabulated in Table 5.
TABLE - 4
EFFECT OF GENTAMICIN AND α-LIPEROIC ACID ADMINISTRATIONS ON PHOSPHOHYDROLASES IN KIDNEY

<table>
<thead>
<tr>
<th>Enzyme (Units/mg protein)</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipoic acid (2 mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoic acid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺, K⁺ ATPase</td>
<td>0.52 ± 0.11</td>
<td>0.21 ± 0.03$^S$</td>
<td>0.45 ± 0.11</td>
<td>0.49 ± 0.13$^S$</td>
<td>0.59 ± 0.07</td>
<td>0.64 ± 0.01$^S$</td>
</tr>
<tr>
<td>Mg²⁺ ATPase</td>
<td>0.54 ± 0.02</td>
<td>0.35 ± 0.04$^g$</td>
<td>0.49 ± 0.07</td>
<td>0.26 ± 0.09$^g$</td>
<td>0.60 ± 0.18</td>
<td>0.82 ± 0.19$^g$</td>
</tr>
<tr>
<td>Ca²⁺ ATPase</td>
<td>0.40 ± 0.07</td>
<td>0.32 ± 0.02</td>
<td>0.55 ± 0.12</td>
<td>0.31 ± 0.01$^S$</td>
<td>0.55 ± 0.09$^g$</td>
<td>0.53 ± 0.17$^g$</td>
</tr>
<tr>
<td>Alkaline Phosphatase</td>
<td>2.27 ± 0.04</td>
<td>0.34 ± 0.01$^g$</td>
<td>1.84 ± 0.01$^b$</td>
<td>0.30 ± 0.01$^g$</td>
<td>3.41 ± 0.41$^d$</td>
<td>2.12 ± 0.39$^g$</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S D for 6 rats

The duration of treatment was for 10 days in all the groups
One unit of enzyme activity is defined as Na⁺, K⁺, Mg²⁺, Ca²⁺ ATPases micromole of P_i, Alkaline phosphatase micromole of P_i, formed per minute per milligram protein at 37°C

Comparison were made between $^a$ groups I and II, $^b$ groups I and III, $^c$ groups I and IV, $^d$ groups I and V, $^e$ groups I and VI $^f$ groups II and IV and $^g$ groups II and VI

The symbols represent statistical significance  $^S = p < 0.05$, $^g = p < 0.01$, $^@ = p < 0.001$
### TABLE - 5

**EFFECT OF GENTAMICIN AND α-LIPOIC ACID ADMINISTRATIONS ON CERTAIN GLYCOLYTIC ENZYMES IN LIVER**

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipoic acid (2mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoic acid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexokinase</td>
<td>17.70 ± 0.7</td>
<td>10.41 ± 1.9^a#</td>
<td>19.8 ± 0.8^b^</td>
<td>15.40 ± 3.1^f^</td>
<td>20.5 ± 1.54^d^</td>
<td>18.41 ± 2.14^f^</td>
</tr>
<tr>
<td>Phosphogluco Isomerase</td>
<td>17.60 ± 1.6</td>
<td>9.17 ± 1.0^a^</td>
<td>22.6 ± 2.6^b^</td>
<td>6.20 ± 0.1^f^</td>
<td>25.1 ± 3.4^d^</td>
<td>9.45 ± 0.07^c@</td>
</tr>
<tr>
<td>Aldolase</td>
<td>15.42 ± 2.8</td>
<td>11.15 ± 2.0^a^</td>
<td>21.6 ± 2.3^b^</td>
<td>17.80 ± 4.2^f^</td>
<td>21.6 ± 2.25^d^</td>
<td>24.6 ± 2.49^e@</td>
</tr>
<tr>
<td>Lactate dehydrogenase (LDH)</td>
<td>0.42 ± 0.2</td>
<td>0.29 ± 0.06^a#</td>
<td>0.38 ± 0.1</td>
<td>0.46 ± 0.07^f^</td>
<td>0.65 ± 0.08^d^</td>
<td>0.71 ± 0.05^c@</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S.D. for 6 rats.

The duration of treatment was for 10 days in all the groups.

One unit of enzyme activity is expressed as Hexokinase nanomole of glucose-6-phosphate, Phosphoglucoisomerase nanomole of fructose, Aldolase nanomole of glyceraldehyde, LDH, micromole of pyruvate, formed per minute per milligram protein at 37°C.

Comparison were made between ^a^ groups I and II, ^b^ groups I and III, ^c^ groups I and IV, ^d^ groups I and V, ^e^ groups I and VI, ^f^ groups II and IV and ^g^ groups II and VI.

The symbols represent statistical significance: ^$^ = p < 0.05, ^#^ = p < 0.01, ^@^ = p < 0.001.
In the liver, the activities of the major glycolytic enzymes, hexokinase (10.41 ± 1.9), phosphoglucoisomerase (9.17 ± 1.0) and aldolase (11.15 ± 2.0) decreased significantly in the gentamicin administered rats when compared to the control rats. When 2 mg of lipoic acid was administered to the experimental rats, a significant fall in phosphoglucoisomerase activity was observed when compared to the Group II rats. But the other two glycolytic enzymes did not show any significant change.

This dose of lipoic acid was substantial enough to increase the aldolase (17.83 ± 4.2), phosphoglucoisomerase (22.60 ± 2.6) and hexokinase (19.80 ± 0.8) when compared to the controls.

Hexokinase (20.56 ± 1.54), phosphoglucoisomerase (25.10 ± 3.4) and aldolase activities were increased when 5 mg of lipoic acid was administered. The other salient features of the drug treatment include a decrease in phosphoglucoisomerase (9.45 ± 0.075) with a concomitant increase in aldolase (24.63 ± 2.49) with respect to the controls. When compared to the Group II rats, there was an increase observed in the hexokinase (18.4 ± 2.14) and aldolase (24.63 ± 2.49) activities after the administration of 5 mg of lipoic acid.

The liver LDH activity showed a significant decrease in Group II (0.296 ± 0.069) when compared to Group I (0.42 ± 0.02). Treatment with 2 mg of lipoic acid to the gentamicin administered rats brought about an increase in LDH activity (0.455 ± 0.075) when compared to the test animals (0.296 ± 0.069).
3.6 CHANGES IN GLUCONEOGENIC ENZYMES IN LIVER

Table 6 depicts the effect of gentamicin and lipoic acid on certain gluconeogenic enzymes in the liver of rats.

In the Group II rats, no significant change in the activities of glucose-6-phosphatase (14.78 ± 0.85) and fructose-1,6-diphosphatase (15.33 ± 4.0) was observed when compared to the Group I animals. A fall in the activities of glucose-6-phosphatase (10.14 ± 1.27) and fructose-1,6-diphosphatase are some of the remarkable changes observed in the drug treated group (2 mg). The other observations include a decreased activity of glucose-6-phosphatase (12.3 ± 0.1) when compared to the control (15.10 ± 0.7) and gentamicin administered rats (14.78 ± 0.85) respectively.

Lipoic acid (5 mg) administration (Group V) was successful in decreasing the activities of glucose-6-phosphatase and fructose-1,6-diphosphatase. A similar decrease in these two gluconeogenic enzymes was observed in the Group VI rats. Glucose-6-phosphatase alone showed a significant decrease (12.3 ± 0.1) in its activity when Group VI was compared with the gentamicin group (14.78 ± 0.85).

3.7 CHANGES IN THE TCA CYCLE ENZYMES IN LIVER

Table 7 represents the changes in the TCA cycle enzymes due to various treatments.

Administration of gentamicin brought about a significant reduction (p <0.001) in the activity of ICDH. SDH and MDH showed no change in their activities.
### TABLE - 6

**EFFECT OF GENTAMICIN AND α-LIPOIC ACID ADMINISTRATIONS ON CERTAIN GLUCONEOGENIC ENZYMES IN LIVER**

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipic acid (2mg)</th>
<th>Group IV Gentamicin + Lipic acid (2mg)</th>
<th>Group V Lipic acid (5mg)</th>
<th>Group VI Gentamicin + Lipic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose-6-phosphatase</td>
<td>15.1 ± 0.7</td>
<td>14.7 ± 0.85</td>
<td>10.14 ± 1.27^b#</td>
<td>12.3 ± 0.1^c#</td>
<td>10.14 ± 1.27^d#</td>
<td>12.3 ± 0.18^e#</td>
</tr>
<tr>
<td>Fructose-1,6-</td>
<td>15.7 ± 0.9</td>
<td>15.33 ± 4.0</td>
<td>9.01 ± 2.48^b#</td>
<td>15.0 ± 2.0</td>
<td>9.01 ± 2.48^d#</td>
<td>10.4 ± 1.28^c#</td>
</tr>
<tr>
<td>diprophosphatase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values represent the Mean ± S.D. for 6 rats.

The duration of treatment was for 10 days in all the groups.

One unit of enzyme activity is defined as: glucose-6-phosphatase and fructose-1,6-diphosphatase: nanomole of inorganic phosphorus released per milligram protein per minute at 37°C

Comparison were made between
a) groups I and II,
b) groups I and III,
c) groups I and IV,
d) groups I and V,
e) groups I and VI
f) groups II and IV and
g) groups II and VI

The symbols represent statistical significance: $ = p < 0.05$; $# = p < 0.01$; @ = p < 0.001.
**TABLE - 7**

**EFFECT OF GENTAMICIN AND α-LIPOIC ACID ADMINISTRATIONS ON CERTAIN TCA CYCLE ENZYMES IN LIVER**

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipoic acid (2mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoicacid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isocitrate dehydrogenase (ICDH)</td>
<td>3.35 ± 0.12</td>
<td>1.75 ± 0.01</td>
<td>4.65 ± 0.2$^d$</td>
<td>1.1 ± 0.06</td>
<td>5.1 ± 0.24$^d$</td>
<td>1.4 ± 0.5</td>
</tr>
<tr>
<td>Succinate dehydrogenase (SDH)</td>
<td>11.60 ± 2.31</td>
<td>11.00 ± 2.0</td>
<td>6.25 ± 1.51$^b$s</td>
<td>9.8 ± 1.76</td>
<td>8.8 ± 2.0</td>
<td>10.4 ± 2.32</td>
</tr>
<tr>
<td>Malate dehydrogenase (MDH)</td>
<td>2.08 ± 1.53</td>
<td>1.69 ± 0.02</td>
<td>4.45 ± 2.3</td>
<td>1.5 ± 0.9</td>
<td>4.7 ± 2.1$^d$s</td>
<td>1.6 ± 0.88</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S.D. for 6 rats.

The duration of treatment was for 10 days in all the groups.
One unit of enzyme activity is defined as: ICDH: nanomole α-ketoglutarate formed; SDH: micromole of succinate formed; MDH: nanomole of NADH oxidised per milligram protein per minute at 37°C

Comparison were made between $^a$ groups I and II, $^b$ groups I and III, $^c$ groups I and IV, $^d$ groups I and V, $^e$ groups I and VI $^f$ groups II and IV and $^g$ groups II and VI

The symbols represent statistical significance: $^d$ = p <0.05 ; $^d$ = p <0.01; $@$ = p <0.001.
Lipoic acid administration at both 2 mg and 5 mg, was effective in decreasing the ICDH (1 1 ± 0.06, 1.4 ± 0.5) activity when compared to the control rats (3.35 ± 0.12). The other two enzymes showed no change at both the dosages of lipoic acid.

3.8 CHANGES IN THE PHOSPHODILOGASES IN LIVER

The effect of gentamicin and lipoic acid administrations on phosphohydralases in liver is tabulated in Table 8.

The activities of phosphohydralases namely Na\(^+\), K\(^+\)-ATPase, Mg\(^{++}\)-ATPase, Ca\(^{++}\)-ATPase and alkaline phosphatase showed a statistically significant decrease in Group II when compared to that of Group I rats. 2 mg of lipoic acid (Group III) had no considerable effect on the activities of phosphohydralases when compared to that of the controls. 2 mg of lipoic acid (Group IV) administered rats depicted decreased activities of Na\(^+\), K\(^+\)-ATPase (0.258 ± 0.06), Ca\(^{++}\)-ATPase (0.131 ± 0.028) and Mg\(^{++}\) ATPase (0.2129 ± 0.29) with respect to its controls (0.40 ± 0.06, 0.21 ± 0.02, 0.35 ± 0.04). Another remarkable observation includes decreased activity of alkaline phosphatase (0.63 ± 0.4) from that of control rats (0.75 ± 0.06).

5 mg of lipoic acid (Group VI) administration to gentamicin treated rats brought about an increase in the activities of Na\(^+\), K\(^+\)-ATPase, Mg\(^{++}\)-ATPase and Ca\(^{++}\)-ATPase. It was also effective in increasing the alkaline phosphatase activity (1.74 ± 0.16) from that observed in the gentamicin administered group (0.41 ± 0.1).
TABLE - 8
EFFECT OF GENTAMICIN AND α-LIPOIC ACID ADMINISTRATIONS ON PHOSPHOHYDROLASES IN LIVER

<table>
<thead>
<tr>
<th>Enzyme (Units/mg protein)</th>
<th>Group I Control</th>
<th>Group II Gentamicin (100 mg/kg b.w/day)</th>
<th>Group III Lipoic acid (2mg)</th>
<th>Group IV Gentamicin + Lipoic acid (2 mg)</th>
<th>Group V Lipoicacid (5mg)</th>
<th>Group VI Gentamicin + Lipoic acid (5mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺, K⁺-ATPase</td>
<td>0.40 ± 0.06</td>
<td>0.20 ± 0.03*#</td>
<td>0.39 ± 0.05</td>
<td>0.26 ± 0.06c$</td>
<td>0.54 ± 0.18</td>
<td>0.57 ± 0.10#d$</td>
</tr>
<tr>
<td>Mg²⁺-ATPase</td>
<td>0.35 ± 0.04</td>
<td>0.12 ± 0.02a@</td>
<td>0.35 ± 0.08</td>
<td>0.21 ± 0.03b#c$</td>
<td>0.45 ± 0.09</td>
<td>0.42 ± 0.09a@</td>
</tr>
<tr>
<td>Ca²⁺-ATPase</td>
<td>0.21 ± 0.02</td>
<td>0.11 ± 0.01a@</td>
<td>0.30 ± 0.10</td>
<td>0.13 ± 0.03c#</td>
<td>0.31 ± 0.16</td>
<td>0.31 ± 0.13a#</td>
</tr>
<tr>
<td>Alkaline Phosphatase</td>
<td>0.75 ± 0.06</td>
<td>0.41 ± 0.24</td>
<td>0.65 ± 0.31</td>
<td>0.63 ± 0.4c$</td>
<td>0.81 ± 0.21</td>
<td>1.74 ± 0.16a@</td>
</tr>
</tbody>
</table>

Values represent the Mean ± S.D. for 6 rats.

The duration of treatment was for 10 days in all the groups.
One unit of enzyme activity is defined as: Na⁺, K⁺-, Mg²⁺-, Ca²⁺ - ATPases: micromole of Pi; Alkaline phosphatase micromole of Pi, formed per minute per milligram protein at 37°C.

Comparison were made between a groups I and II, b groups I and III, c groups I and IV, d groups I and V, e groups I and VI f groups II and IV and g groups II and VI.

The symbols represent statistical significance: $ = p <0.05 ; # = p <0.01; @ = p <0.001.$
3.9 MORPHOLOGICAL ANALYSIS

Examination of paraffin sections stained with hematoxylin-eosin failed to reveal consistent differences, in the histology of lipoic acid treated animals (Fig.3.10D & 3.10F) compared to controls (Fig.3.10A). Those treated with gentamicin alone (Fig.3.10B) showed the presence of homogenous material in the form of droplets and masses in the proximal convuluted tubules and the interstitium showed inflammatory infiltrate as reported by Kishore et al (1990).

Lipoic acid administration at both 2mg and 5 mg dosages to control rats (Group III and Group V) showed no significant changes and maintained the normal architecture (Fig.3.10C & 3.10E).
Fig. 3.10 A: Group I Section of kidney showing normal architecture

(H & E x 200)

Fig. 3.10 B: Group II Section of kidney showing eosinophilic homogenous material in the glomerular capillaries and in the proximal convoluted tubules.

(H & E x 200)
Fig 3 10 C  Group III Section of kidney showing no granular deposits

(H & E x 200)

Fig 3 10 D  Group IV Section of kidney showing normal architecture

(H & E x 200)
Fig 3 10 E : Group V Section of kidney showing no significant change

(H & E x 200)

Fig 3 10 F : Group VI Section of kidney showing normal glomeruli tubules

(H & E x 200)