### Results

In vitro experiment

Table 1. Effects of ethanolic extracts of selected plants on hepatic tissue lipid peroxidation and antioxidant profiles

<table>
<thead>
<tr>
<th>Groups</th>
<th>TBARS$^1$</th>
<th>TAA$^2$</th>
<th>SOD$^3$</th>
<th>CAT$^4$</th>
<th>GSH$^5$</th>
<th>GPx$^6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal control</td>
<td>0.74±0.11</td>
<td>52.45±0.90</td>
<td>4.57±0.43</td>
<td>62.06±3.12</td>
<td>42.04±1.38</td>
<td>8.18±0.21</td>
</tr>
<tr>
<td>F 1.5 ppm</td>
<td>0.83±0.07</td>
<td>50.18±1.71</td>
<td>3.78±0.22</td>
<td>53.45±4.19</td>
<td>37.28±1.12</td>
<td>6.86±0.56</td>
</tr>
<tr>
<td>F 2.5 ppm</td>
<td>0.87±0.08</td>
<td>46.37±2.94</td>
<td>3.12±0.18</td>
<td>45.18±3.33</td>
<td>31.43±0.93</td>
<td>5.55±0.44</td>
</tr>
<tr>
<td>F 3.5 ppm</td>
<td>1.27±0.12</td>
<td>44.41±1.89</td>
<td>2.42±0.28</td>
<td>37.69±2.09</td>
<td>25.74±0.67</td>
<td>4.05±0.62</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.96±0.11</td>
<td>55.72±1.45</td>
<td>3.34±0.23</td>
<td>42.10±1.19</td>
<td>32.42±0.84</td>
<td>5.26±0.70</td>
</tr>
<tr>
<td>Eo 25 mg/ml</td>
<td>(-24.41)</td>
<td>(+25.46)</td>
<td>(+38.01)</td>
<td>(+11.70)</td>
<td>(+25.95)</td>
<td>(+29.87)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.55±0.05</td>
<td>76.02±2.33</td>
<td>3.75±0.26</td>
<td>50.61±2.06</td>
<td>35.50±0.56</td>
<td>7.16±0.20</td>
</tr>
<tr>
<td>Eo 50 mg/ml</td>
<td>(-56.70)</td>
<td>(+71.17)</td>
<td>(+54.95)</td>
<td>(+34.27)</td>
<td>(+37.81)</td>
<td>(+76.79)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.77±0.01</td>
<td>50.28±2.00</td>
<td>3.02±0.19</td>
<td>39.18±1.79</td>
<td>32.44±0.52</td>
<td>6.38±0.57</td>
</tr>
<tr>
<td>Mi 25 mg/ml</td>
<td>(-39.38)</td>
<td>(+13.21)</td>
<td>(+24.79)</td>
<td>(+3.95)</td>
<td>(+26.02)</td>
<td>(+57.53)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.64±0.04</td>
<td>58.34±1.40</td>
<td>3.51±0.21</td>
<td>47.93±1.77</td>
<td>35.07±1.21</td>
<td>6.75±0.55</td>
</tr>
<tr>
<td>Mi 50 mg/ml</td>
<td>(-49.61)</td>
<td>(+31.36)</td>
<td>(+45.04)</td>
<td>(+27.16)</td>
<td>(+36.24)</td>
<td>(+66.66)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.97±0.02</td>
<td>48.68±0.61</td>
<td>2.60±0.22</td>
<td>38.07±1.77</td>
<td>31.20±1.17</td>
<td>6.37±0.34</td>
</tr>
<tr>
<td>La 25 mg/ml</td>
<td>(-23.63)</td>
<td>(+9.61)</td>
<td>(+7.43)</td>
<td>(+1.00)</td>
<td>(+21.21)</td>
<td>(+57.28)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.79±0.03</td>
<td>54.79±2.00</td>
<td>3.16±0.20</td>
<td>45.58±1.92</td>
<td>34.07±0.73</td>
<td>6.80±0.33</td>
</tr>
<tr>
<td>La 50 mg/ml</td>
<td>(-37.80)</td>
<td>(+23.37)</td>
<td>(+30.57)</td>
<td>(+20.93)</td>
<td>(+32.36)</td>
<td>(+67.90)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>1.13±0.07</td>
<td>45.85±0.81</td>
<td>3.35±0.29</td>
<td>38.05±1.32</td>
<td>27.12±0.70</td>
<td>5.22±0.42</td>
</tr>
<tr>
<td>Ac 25 mg/ml</td>
<td>(-11.03)</td>
<td>(+3.24)</td>
<td>(+38.42)</td>
<td>(+0.95)</td>
<td>(+5.36)</td>
<td>(+28.88)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.85±0.01</td>
<td>53.27±0.96</td>
<td>3.45±0.15</td>
<td>41.45±0.95</td>
<td>31.46±1.19</td>
<td>5.92±0.15</td>
</tr>
<tr>
<td>Ac 50 mg/ml</td>
<td>(-33.08)</td>
<td>(+19.95)</td>
<td>(+42.56)</td>
<td>(+9.97)</td>
<td>(+22.22)</td>
<td>(+46.17)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.83±0.05</td>
<td>47.58±1.22</td>
<td>2.54±0.17</td>
<td>43.58±1.20</td>
<td>28.90±0.48</td>
<td>4.73±0.23</td>
</tr>
<tr>
<td>Ti 25 mg/ml</td>
<td>(-34.65)</td>
<td>(+7.1)</td>
<td>(+4.95)</td>
<td>(+15.62)</td>
<td>(+12.27)</td>
<td>(+16.79)</td>
</tr>
<tr>
<td>F 3.5 ppm+</td>
<td>0.71±0.02</td>
<td>57.11±1.61</td>
<td>3.35±0.31</td>
<td>47.04±1.89</td>
<td>34.58±0.72</td>
<td>5.77±0.67</td>
</tr>
<tr>
<td>Ti 50 mg/ml</td>
<td>(-44.10)</td>
<td>(+28.59)</td>
<td>(+38.42)</td>
<td>(+24.80)</td>
<td>(+34.34)</td>
<td>(+42.46)</td>
</tr>
</tbody>
</table>

$^1$nM MDA / gm; $^2$μg/gm; $^3$U / mg protein; $^4$nm H$_2$O$_2$ decomposed/s/gm; $^5$mg / 100gm; $^6$U / mg protein; Values are represented as mean ± SEM (n=3). * indicates statistical significance in comparison with control group at p<0.05. b denotes statistical significance in comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with control and in treatment groups were in comparison with fluoride control group.

Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University
Table 2. Phytococonstituents of the specimen (Triplicate Values: mean ± SD)

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Fibers (gm%)</th>
<th>Phytosterols (gm%)</th>
<th>Saponins (mg%)</th>
<th>Ascorbic acid (gm%)</th>
<th>Polyphenols (gm %)</th>
<th>Flavonoids (gm %)</th>
<th>FRAP value (mMole/gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. officinalis</em></td>
<td>3.2±0.88</td>
<td>8.65±1.51</td>
<td>0.050±0.02</td>
<td>0.425±0.04</td>
<td>19.70±1.57</td>
<td>0.342±0.003</td>
<td>1.940±0.01</td>
</tr>
<tr>
<td><em>M. indica</em></td>
<td>0.9±0.11</td>
<td>7.09±0.24</td>
<td>0.045±0.04</td>
<td>0.212±0.08</td>
<td>4.89±0.46</td>
<td>0.181±0.009</td>
<td>1.132±0.07</td>
</tr>
<tr>
<td><em>L. acidissima</em></td>
<td>4.7±1.80</td>
<td>3.87±1.72</td>
<td>18.94±2.14</td>
<td>0.054±0.06</td>
<td>6.74±1.19</td>
<td>0.06±0.001</td>
<td>0.367±0.04</td>
</tr>
<tr>
<td><em>A. carambola</em></td>
<td>3.8±2.01</td>
<td>5.06±1.04</td>
<td>3.77±1.10</td>
<td>0.088±0.02</td>
<td>1.76±0.81</td>
<td>0.277±0.005</td>
<td>0.235±0.02</td>
</tr>
<tr>
<td><em>T. indica</em></td>
<td>1.6±0.51</td>
<td>4.89±0.08</td>
<td>11.0±2.32</td>
<td>0.219±0.07</td>
<td>3.85±0.59</td>
<td>0.369±0.008</td>
<td>1.258±0.05</td>
</tr>
</tbody>
</table>
Table 1. Effects of *Emblica officinalis* on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters →</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups ↓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>18.57±0.16</td>
<td>248.83±0.88</td>
<td>8.42±0.02</td>
</tr>
<tr>
<td>FC</td>
<td>21.06±0.16&lt;sup&gt;a&lt;/sup&gt; (+13.41)</td>
<td>210.17±1.55&lt;sup&gt;a&lt;/sup&gt; (-15.54)</td>
<td>6.77±0.09&lt;sup&gt;a&lt;/sup&gt; (-19.60)</td>
</tr>
<tr>
<td>FEO I</td>
<td>21.32±0.19&lt;sup&gt;a&lt;/sup&gt; (-1.23)</td>
<td>216.08±0.96&lt;sup&gt;ab&lt;/sup&gt; (+2.81)</td>
<td>6.91±0.07&lt;sup&gt;a&lt;/sup&gt; (+2.07)</td>
</tr>
<tr>
<td>FEO II</td>
<td>20.63±0.24&lt;sup&gt;ab&lt;/sup&gt; (-2.04)</td>
<td>219.17±0.80&lt;sup&gt;ab&lt;/sup&gt; (+4.28)</td>
<td>7.10±0.09&lt;sup&gt;ab&lt;/sup&gt; (+4.87)</td>
</tr>
<tr>
<td>FEO III</td>
<td>16.52±0.19&lt;sup&gt;ab&lt;/sup&gt; (-21.56)</td>
<td>230.83±0.81&lt;sup&gt;ab&lt;/sup&gt; (+9.83)</td>
<td>7.97±0.06&lt;sup&gt;ab&lt;/sup&gt; (+17.72)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of *Emblica officinalis* on plasma glucose, hepatic glycogen content, hepatic hexokinase and G-6-Pase activities

<table>
<thead>
<tr>
<th>Groups→ Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Eo I</th>
<th>F Eo II</th>
<th>F Eo III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glucose (mg/dl)</strong></td>
<td>97.08±0.48</td>
<td>196.17±1.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>177.42±0.66&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>153.35±1.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>132.42±1.01&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(+102.07)</td>
<td>(-9.56)</td>
<td>(+21.83)</td>
<td>(+32.50)</td>
<td></td>
</tr>
<tr>
<td><strong>Glycogen (mg/gm)</strong></td>
<td>20.91±0.25</td>
<td>9.80±0.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.87±0.15&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.80±0.17&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.89±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-53.11)</td>
<td>(+31.33)</td>
<td>(+51.02)</td>
<td>(+92.75)</td>
<td></td>
</tr>
<tr>
<td><strong>Hexokinase (U/mg protein/min)</strong></td>
<td>8.45±0.06</td>
<td>4.17±0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.66±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>5.69±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.74±0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-50.65)</td>
<td>(+11.75)</td>
<td>(+36.45)</td>
<td>(+61.63)</td>
<td></td>
</tr>
<tr>
<td><strong>G-6-Pase (U/mg protein/min)</strong></td>
<td>0.198±0.002</td>
<td>0.496±0.003&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.420±0.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.380±0.003&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.301±0.003&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>(+150.50)</td>
<td>(-15.32)</td>
<td>(-23.39)</td>
<td>(-39.31)</td>
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</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

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**Fig. 1: Plasma and hepatic carbohydrate profiles**

- **Glucose**
- **Glycogen**
- **Hexokinase**
- **G-6-Pase**
Table 3. Effects of *Emblica officinalis* on SGOT, SGPT, ACP ALP activities and FRAP value

<table>
<thead>
<tr>
<th>Groups→</th>
<th>NC</th>
<th>FC</th>
<th>F Eo I</th>
<th>F Eo II</th>
<th>F Eo III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGOT</td>
<td>35.28±1.04</td>
<td>74.29±0.23</td>
<td>68.04±1.23</td>
<td>57.43±0.25</td>
<td>42.68±0.32</td>
</tr>
<tr>
<td>(U/L)</td>
<td>(+110.57)</td>
<td>(-8.41)</td>
<td>(-22.69)</td>
<td>(-42.55)</td>
<td></td>
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<tr>
<td>SGPT</td>
<td>40.15±0.75</td>
<td>77.69±0.28</td>
<td>72.20±0.73</td>
<td>65.67±1.09</td>
<td>51.91±0.64</td>
</tr>
<tr>
<td>(U/L)</td>
<td>(+93.50)</td>
<td>(-7.07)</td>
<td>(-15.47)</td>
<td>(-33.18)</td>
<td></td>
</tr>
<tr>
<td>ACP</td>
<td>6.53±0.73</td>
<td>18.62±0.68</td>
<td>16.76±0.32</td>
<td>13.87±0.97</td>
<td>10.85±0.87</td>
</tr>
<tr>
<td>(KA Units)</td>
<td>(+185.14)</td>
<td>(-9.99)</td>
<td>(-25.51)</td>
<td>(-41.73)</td>
<td></td>
</tr>
<tr>
<td>ALP</td>
<td>9.87±0.33</td>
<td>29.94±0.74</td>
<td>26.88±0.48</td>
<td>22.50±0.26</td>
<td>17.75±0.82</td>
</tr>
<tr>
<td>(KA Units)</td>
<td>(+203.34)</td>
<td>(-10.22)</td>
<td>(-24.85)</td>
<td>(-40.71)</td>
<td></td>
</tr>
<tr>
<td>FRAP</td>
<td>264.21±4.10</td>
<td>140.54±4.14</td>
<td>225.21±3.45</td>
<td>240.12±2.52</td>
<td>274.31±3.23</td>
</tr>
<tr>
<td>(µmole/L)</td>
<td>(-46.81)</td>
<td>(+60.25)</td>
<td>(+70.85)</td>
<td>(+95.18)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). "a" indicates the comparison with normal control group and "b" denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 2: Plasma SGOT, SGPT, ACP and ALP activities
Table 4. Effects of *Emblica officinalis* on plasma lipid profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>NC</th>
<th>FC</th>
<th>F Eo I</th>
<th>F Eo II</th>
<th>F Eo III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL (mg/dl)</td>
<td>328.70±0.85</td>
<td>475.33±1.52</td>
<td>419.40±1.31&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>368.99±2.13&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>303.86±1.64&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/dl)</td>
<td>110.19±0.86</td>
<td>174.80±1.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>142.01±0.89&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>123.52±0.61&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>97.26±0.71&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>73.95±0.76</td>
<td>106.91±0.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>89.89±0.64&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>70.78±0.55&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>61.51±0.71&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>HDL-C (mg/dl)</td>
<td>66.89±0.47</td>
<td>44.45±0.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50.37±0.44&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>54.05±0.31&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>64.50±0.25&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>LDL-C (mg/dl)</td>
<td>28.50±0.75</td>
<td>109.24±1.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>73.66±0.77&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>55.31±0.72&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>20.45±0.90&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>VLDL-C (mg/dl)</td>
<td>14.79±0.15</td>
<td>21.11±0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.97±0.13&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.15±0.11&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>12.30±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>AI (mg/dl)</td>
<td>1.65±0.01</td>
<td>3.94±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.87±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.28±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.51±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

**Fig. 3: Plasma lipid profiles**
Table 5. Effects of *Emblica officinalis* on hepatic lipid profiles, HMG-CoA reductase, bile acid content, fecal cholesterol and bile acid content

<table>
<thead>
<tr>
<th>Parameters</th>
<th>NC</th>
<th>FC</th>
<th>F Eo I</th>
<th>F Eo II</th>
<th>F Eo III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEPATIC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL (mg/gm)</td>
<td>35.08±0.20</td>
<td>55.10±0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.62±0.15&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>42.78±0.26&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>30.84±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/gm)</td>
<td>1.92±0.07</td>
<td>3.65±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.19±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.79±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.15±0.04&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TG (mg/gm)</td>
<td>12.14±0.16</td>
<td>22.88±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.98±0.27&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.47±0.13&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.18±0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>HMG-CoA reductase*</td>
<td>2.92±0.05</td>
<td>6.85±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.37±0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.61±0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.39±1.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Fecal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bile acid (mg/gm)</td>
<td>3.59±0.05</td>
<td>7.31±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.85±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.24±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11.82±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/gm)</td>
<td>1.78±0.05</td>
<td>5.45±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.04±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.87±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>7.52±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bile acid (mg/gm)</td>
<td>5.33±0.11</td>
<td>11.38±0.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.33±0.26&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.30±0.10&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>17.63±0.13&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup>denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group; *HMG- CoA reductase activity is inversely proportional to the ratio of HMG-CoA/ mevalonate*

![Fig. 4: Hepatic and fecal lipid profiles](chart.png)
Table 6. Effects of *Emblica officinalis* on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC (µM MDA/gm)</th>
<th>FC (µM MDA/gm)</th>
<th>F Eo I (µM MDA/gm)</th>
<th>F Eo II (µM MDA/gm)</th>
<th>F Eo III (µM MDA/gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEPATIC</td>
<td>TBARS</td>
<td>10.86±0.18</td>
<td>15.95±0.10</td>
<td>13.87±0.21</td>
<td>11.96±0.09</td>
<td>10.68±0.15</td>
</tr>
<tr>
<td></td>
<td>TAA</td>
<td>138.30±0.24</td>
<td>76.11±0.21</td>
<td>87.95±0.20</td>
<td>100.28±0.36</td>
<td>121.52±0.33</td>
</tr>
<tr>
<td></td>
<td>GSH</td>
<td>38.09±0.28</td>
<td>23.47±0.11</td>
<td>29.02±0.09</td>
<td>32.68±0.27</td>
<td>37.08±0.20</td>
</tr>
<tr>
<td>RENAL</td>
<td>TBARS</td>
<td>3.76±0.08</td>
<td>5.85±0.05</td>
<td>5.22±0.04</td>
<td>4.32±0.06</td>
<td>3.34±0.02</td>
</tr>
<tr>
<td></td>
<td>TAA</td>
<td>68.22±0.22</td>
<td>45.90±0.08</td>
<td>49.29±0.08</td>
<td>57.84±0.16</td>
<td>65.92±0.20</td>
</tr>
<tr>
<td></td>
<td>GSH</td>
<td>12.20±0.07</td>
<td>6.28±0.05</td>
<td>7.04±0.04</td>
<td>7.47±0.05</td>
<td>9.05±0.06</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). *a* indicates the comparison with normal control group and *b* denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Lipid peroxidation](image1)

![Total ascorbic acid content](image2)

![Glutathione content](image3)
### Table 7. Effects of *Emblica officinalis* on hepatic and renal enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Eo I</th>
<th>F Eo II</th>
<th>F Eo III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>18.18±0.12</td>
<td>9.27±0.10</td>
<td>10.01±0.07</td>
<td>12.60±0.12</td>
<td>15.45±0.09</td>
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<tr>
<td>HEPATIC</td>
<td></td>
<td>(-49.01)</td>
<td>(+7.98)</td>
<td>(+35.92)</td>
<td>(+66.67)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOD (U/mg protein)</td>
<td>4.45±0.10</td>
<td>1.40±0.08</td>
<td>3.28±0.07</td>
<td>3.90±0.04</td>
<td>4.36±0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-68.54)</td>
<td>(+134.28)</td>
<td>(+178.57)</td>
<td>(+211.43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GPx (U/mg protein)</td>
<td>8.06±0.06</td>
<td>4.70±0.03</td>
<td>4.45±0.07</td>
<td>5.68±0.07</td>
<td>6.83±0.04</td>
</tr>
<tr>
<td>RENAL</td>
<td></td>
<td>(-41.69)</td>
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<td>(+20.85)</td>
<td>(+45.32)</td>
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</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Fig. 6](image-url)
Table 1. Effects of *Mangifera indica* on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters →</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
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<tbody>
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<tr>
<td>Groups ↓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>17.47±0.03</td>
<td>252.83±1.56</td>
<td>8.34±0.02</td>
</tr>
<tr>
<td>FC</td>
<td>20.87±0.02&lt;sup&gt;a&lt;/sup&gt; (+19.46)</td>
<td>207.7±1.46&lt;sup&gt;a&lt;/sup&gt; (-17.85)</td>
<td>6.92±0.02&lt;sup&gt;a&lt;/sup&gt; (-17.03)</td>
</tr>
<tr>
<td>F Mi I</td>
<td>19.61±0.01&lt;sup&gt;ab&lt;/sup&gt; (-6.04)</td>
<td>214.58±1.49&lt;sup&gt;ab&lt;/sup&gt; (+3.31)</td>
<td>6.98±0.01&lt;sup&gt;a&lt;/sup&gt; (+0.87)</td>
</tr>
<tr>
<td>F Mi II</td>
<td>18.93±0.01&lt;sup&gt;ab&lt;/sup&gt; (-9.29)</td>
<td>228.42±1.25&lt;sup&gt;ab&lt;/sup&gt; (+9.97)</td>
<td>7.32±0.02&lt;sup&gt;ab&lt;/sup&gt; (+5.78)</td>
</tr>
<tr>
<td>F Mi III</td>
<td>18.08±0.01&lt;sup&gt;ab&lt;/sup&gt; (-13.37)</td>
<td>233.08±0.92&lt;sup&gt;ab&lt;/sup&gt; (+12.21)</td>
<td>8.02±0.02&lt;sup&gt;ab&lt;/sup&gt; (+15.89)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of *Mangifera indica* on blood glucose, hepatic glycogen content, hepatic hexokinase and G-6-Pase activities

<table>
<thead>
<tr>
<th>Groups</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Mi I</th>
<th>F Mi II</th>
<th>F Mi III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glucose (mg/dl)</td>
<td>96.37±0.55</td>
<td>197.06±0.37</td>
<td>182.13±0.30</td>
<td>165.12±0.53</td>
<td>146.74±0.80</td>
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<td>(+104.47)</td>
<td>(-7.58)</td>
<td>(-16.21)</td>
<td>(-25.53)</td>
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<tr>
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<td>Glycogen (mg/gm)</td>
<td>21.52±0.09</td>
<td>10.63±0.14</td>
<td>12.09±0.05</td>
<td>14.11±0.07</td>
<td>16.82±0.03</td>
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<tr>
<td></td>
<td></td>
<td>(-50.61)</td>
<td>(+13.73)</td>
<td>(+32.74)</td>
<td>(+58.23)</td>
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</tr>
<tr>
<td></td>
<td>Hexokinase (U/mg protein/min)</td>
<td>7.45±0.08</td>
<td>4.86±0.05</td>
<td>4.99±0.09</td>
<td>5.52±0.08</td>
<td>6.49±0.13</td>
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<tr>
<td></td>
<td></td>
<td>(-34.63)</td>
<td>(+13.35)</td>
<td>(+13.35)</td>
<td>(+33.26)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G-6-Pase (U/mg protein/min)</td>
<td>0.210±0.01</td>
<td>0.541±0.02</td>
<td>0.443±0.08</td>
<td>0.440±0.01</td>
<td>0.369±0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+157.62)</td>
<td>(-18.11)</td>
<td>(-18.67)</td>
<td>(-31.79)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). *a* indicates the comparison with normal control group and *b* denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Fig. 1: Plasma and hepatic carbohydrate profiles](image-url)
Table 3. Effects of *Mangifera indica* on plasma lipid profiles and FRAP value

<table>
<thead>
<tr>
<th>Groups →</th>
<th>NC</th>
<th>FC</th>
<th>F Mi I</th>
<th>F Mi II</th>
<th>F Mi III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters ↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL (mg/dl)</td>
<td>330.54±0.55</td>
<td>456.95±1.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>431.55±1.99&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>379.14±2.22&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>334.50±2.05&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/dl)</td>
<td>109.41±0.94</td>
<td>162.12±1.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>152.64±0.81&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>123.50±1.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>92.30±0.86&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>72.64±0.85</td>
<td>96.42±0.56&lt;sup&gt;a&lt;/sup&gt;</td>
<td>89.14±0.82&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>73.05±0.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>63.49±0.60&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>HDL-C (mg/dl)</td>
<td>67.66±0.28</td>
<td>50.54±0.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54.22±0.23&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>58.81±0.28&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>62.56±0.25&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>LDL-C (mg/dl)</td>
<td>27.22±0.82</td>
<td>92.31±1.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>80.60±0.86&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>50.08±0.72&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>17.04±0.78&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>VLDL-C (mg/dl)</td>
<td>14.52±0.17</td>
<td>19.28±0.11&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.82±0.16&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.61±0.14&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.69±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>AI (mg/dl)</td>
<td>1.61±0.01</td>
<td>3.20±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.81±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.09±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.47±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>FRAP (µmole/L)</td>
<td>275.63±4.15</td>
<td>155.21±4.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>210.04±3.70&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>235.43±3.16&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>262.65±3.54&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively. Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 4. Effects of *Mangifera indica* on hepatic lipid profiles

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>FC</th>
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<th>F Mi II</th>
<th>F Mi III</th>
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</thead>
<tbody>
<tr>
<td>Groups</td>
<td>TL (mg/gm)</td>
<td>TC (mg/gm)</td>
<td>TG (mg/gm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>32.68±0.08</td>
<td>1.93±0.01</td>
<td>12.12±0.22</td>
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</tr>
<tr>
<td>FC</td>
<td>49.92±0.12</td>
<td>3.74±0.01</td>
<td>21.53±0.20</td>
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<td></td>
</tr>
<tr>
<td>F Mi I</td>
<td>47.57±0.12</td>
<td>3.43±0.03</td>
<td>20.19±0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Mi II</td>
<td>42.80±0.12</td>
<td>3.06±0.02</td>
<td>18.14±0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Mi III</td>
<td>31.11±0.22</td>
<td>2.41±0.02</td>
<td>15.06±0.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). *a* indicates the comparison with normal control group and *b* denotes the comparison with fluoride control group at *p*<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

---

**Fig. 3: Hepatic lipid profiles**

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Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University
Table 5. Effects of *Mangifera indica* on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>NC</th>
<th>FC</th>
<th>F Mi I</th>
<th>F Mi II</th>
<th>F Mi III</th>
</tr>
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<td>Parameters ↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEPATIČ</td>
<td>TBARS (nM MDA/gm)</td>
<td>10.78±0.32</td>
<td>15.01±0.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.27±0.14&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.85±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(-14.39)</td>
<td>(-28.11)</td>
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<tr>
<td></td>
<td>TAA (µg/gm)</td>
<td>131.12±0.85</td>
<td>99.89±0.47&lt;sup&gt;a&lt;/sup&gt;</td>
<td>107.68±0.35&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>115.62±0.43&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
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<td>(-23.82)</td>
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<td>(+15.75)</td>
<td>(+38.20)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100 gm)</td>
<td>40.75±0.32</td>
<td>26.38±0.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.18±0.19&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>32.61±0.24&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
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<td>(-35.26)</td>
<td>(+6.82)</td>
<td>(+23.62)</td>
<td>(+44.50)</td>
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</tr>
<tr>
<td>RENAL</td>
<td>TBARS (nM MDA/gm)</td>
<td>2.62±0.65</td>
<td>5.80±0.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.39±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.89±0.23&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(+60.22)</td>
<td>(-7.07)</td>
<td>(-15.69)</td>
<td>(-40.17)</td>
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</tr>
<tr>
<td></td>
<td>TAA (µg/gm)</td>
<td>67.30±0.32</td>
<td>50.17±0.45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.23±0.25&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>55.50±0.26&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-25.45)</td>
<td>(+6.10)</td>
<td>(+10.62)</td>
<td>(+21.75)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100 gm)</td>
<td>11.28±0.16</td>
<td>7.89±0.58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.49±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.33±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-30.05)</td>
<td>(+7.60)</td>
<td>(+18.25)</td>
<td>(+34.73)</td>
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</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Lipid peroxidation](image1)

![Total ascorbic acid content](image2)

![Glutathione content](image3)
Table 6. Effects of *Mangifera indica* on hepatic and renal enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups →</th>
<th>Parameters ↓</th>
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<th>FC</th>
<th>F Mi I</th>
<th>F Mi II</th>
<th>F Mi III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>17.70±0.15</td>
<td>8.66±0.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.25±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>10.50±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>12.55±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>HE</td>
<td>SOD (U/mg protein)</td>
<td>4.66±0.12</td>
<td>1.63±0.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.91±0.13&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.20±0.16&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.19±0.27&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>PATIC</td>
<td>GPx (U/mg protein)</td>
<td>7.41±0.14</td>
<td>4.11±0.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.65±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.92±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>5.81±0.24&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>5.94±0.12</td>
<td>2.79±0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.00±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.20±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.65±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>RENAL</td>
<td>SOD (U/mg protein)</td>
<td>3.96±0.28</td>
<td>2.02±0.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.13±0.13&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.52±0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.90±0.1&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>GPx (U/mg protein)</td>
<td>3.42±0.45</td>
<td>1.98±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.35±0.11&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.08±0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.35±0.11&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 5

![Bar charts showing catalase, superoxide dismutase, and glutathione peroxidase activities](image-url)
Table 1. Effects of *Limonia acidissima* on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters →</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
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<td>17.47±0.03</td>
<td>252.83±1.56</td>
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<td>FC</td>
<td>20.87±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>207.7±1.46&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
<td>(+19.46)</td>
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<td>(-17.03)</td>
</tr>
<tr>
<td></td>
<td>F La I</td>
<td>19.46±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>211.75±1.24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-6.76)</td>
<td>(+1.95)</td>
<td>(+12.14)</td>
</tr>
<tr>
<td></td>
<td>F La II</td>
<td>18.80±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>231.50±1.04&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(+9.92)</td>
<td>(+11.46)</td>
<td>(+16.33)</td>
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<tr>
<td></td>
<td>F La III</td>
<td>17.72±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>243.08±0.99&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-15.09)</td>
<td>(+17.03)</td>
<td>(+28.32)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of *Limonia acidissima* on blood glucose, hepatic glycogen content, hepatic hexokinase and G-6-Pase activities

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<th>FLa II</th>
<th>FLa III</th>
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<tr>
<td>Glucose (mg/dl)</td>
<td></td>
<td>96.37±0.55</td>
<td>197.06±0.37</td>
<td>183.86±0.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>177.74±0.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>147.94±0.66&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Glycogen (mg/gm)</td>
<td></td>
<td>21.52±0.09</td>
<td>10.63±0.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.21±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.40±0.17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.80±0.08&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hexokinase (U/mg protein/min)</td>
<td></td>
<td>7.45±0.08</td>
<td>4.86±0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.17±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.85±0.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.14±0.09&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>G-6-Pase (U/mg protein/min)</td>
<td></td>
<td>0.210±0.01</td>
<td>0.541±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.475±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.406±0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.378±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 1: Plasma and hepatic carbohydrate profiles
Table 3. Effects of *Limonia acidissima* on plasma lipid profiles and FRAP value

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<th>Groups</th>
<th>Parameters</th>
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<th>FC</th>
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<th>F La II</th>
<th>F La III</th>
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<tr>
<td></td>
<td>TL (mg/dl)</td>
<td>330.54±0.55</td>
<td>456.95±1.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>435.02±1.38&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>382.85±1.50&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>366.46±1.38&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TC (mg/dl)</td>
<td>109.41±0.94</td>
<td>162.12±1.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>153.67±0.80&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>129.48±1.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>99.31±0.87&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TG (mg/dl)</td>
<td>72.64±0.85</td>
<td>96.42±0.56&lt;sup&gt;a&lt;/sup&gt;</td>
<td>90.64±0.77&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>76.11±0.49&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>66.81±0.4&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>HDL-C (mg/dl)</td>
<td>67.66±0.28</td>
<td>50.54±0.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>55.15±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>60.24±0.24&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>61.96±0.25&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>LDL-C (mg/dl)</td>
<td>27.22±0.82</td>
<td>92.31±1.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>80.39±0.96&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>54.02±0.79&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>23.98±0.82&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>VLDL-C (mg/dl)</td>
<td>14.52±0.17</td>
<td>19.28±0.11&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.12±0.16&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>15.22±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>13.36±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AI (mg/dl)</td>
<td>1.61±0.01</td>
<td>3.20±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.78±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.14±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.60±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>FRAP (µmole/L)</td>
<td>275.63±4.15</td>
<td>155.21±4.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>187.32±3.24&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>202.43±3.45&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>238.15±2.84&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup>denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 2: Plasma lipid profiles
Table 4. Effects of *Limonia acidissima* on hepatic lipid profiles

<table>
<thead>
<tr>
<th>Groups→</th>
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<th>F La II</th>
<th>F La III</th>
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<tbody>
<tr>
<td>Parameters↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL (mg/gm)</td>
<td>32.68±0.08</td>
<td>49.92±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.21±0.11&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>43.74±0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>38.75±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/gm)</td>
<td>1.93±0.01&lt;sup&gt;+&lt;/sup&gt;</td>
<td>3.74±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.61±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.07±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.90±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TG (mg/gm)</td>
<td>12.12±0.22&lt;sup&gt;+&lt;/sup&gt;</td>
<td>21.53±0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.50±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>19.72±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.12±0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup>denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Fig.3: Hepatic lipid profiles](image-url)
Table 5. Effects of *Limonia acidissima* on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Parameters ↓</th>
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<th>FC</th>
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<th>F La III</th>
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<tr>
<td>HEPATIC</td>
<td>TBARS</td>
<td>10.78±0.32</td>
<td>15.01±0.43(^a)</td>
<td>14.35±0.87(^a)</td>
<td>13.06±0.63(^b)</td>
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<tr>
<td></td>
<td>(nM MDA/gm)</td>
<td>(+39.24)</td>
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<td>(-12.99)</td>
<td>(-17.72)</td>
</tr>
<tr>
<td>TAA</td>
<td>131.12±0.85</td>
<td>99.89±0.47(^a)</td>
<td>107.36±0.54(^a)</td>
<td>109.50±0.76(^b)</td>
<td>125.00±0.92(^ab)</td>
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<tr>
<td>(µg/gm)</td>
<td>(-23.82)</td>
<td>(+7.48)</td>
<td>(+9.62)</td>
<td>(+25.14)</td>
<td></td>
</tr>
<tr>
<td>GSH</td>
<td>40.75±0.32</td>
<td>26.38±0.25(^a)</td>
<td>26.85±0.77(^a)</td>
<td>29.38±0.11(^ab)</td>
<td>33.03±0.62(^ab)</td>
</tr>
<tr>
<td>(mg/100 gm)</td>
<td>(-35.26)</td>
<td>(+1.78)</td>
<td>(+11.37)</td>
<td>(+25.21)</td>
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<tr>
<td>RENAL</td>
<td>TBARS</td>
<td>2.62±0.65</td>
<td>5.80±0.18(^a)</td>
<td>5.54±0.62(^a)</td>
<td>4.99±0.33(^b)</td>
</tr>
<tr>
<td></td>
<td>(nM MDA/gm)</td>
<td>(+60.22)</td>
<td>(-4.48)</td>
<td>(-13.96)</td>
<td>(-34.65)</td>
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<tr>
<td>TAA</td>
<td>67.30±0.32</td>
<td>50.17±0.45(^a)</td>
<td>52.91±0.18(^a)</td>
<td>54.57±0.51(^b)</td>
<td>58.69±0.26(^ab)</td>
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<tr>
<td>(µg/gm)</td>
<td>(-25.45)</td>
<td>(+5.46)</td>
<td>(+8.77)</td>
<td>(+16.98)</td>
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<tr>
<td>GSH</td>
<td>11.28±0.16</td>
<td>7.89±0.58(^a)</td>
<td>8.45±0.86(^a)</td>
<td>9.16±0.27(^b)</td>
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<td>(mg/100 gm)</td>
<td>(-30.05)</td>
<td>(+7.10)</td>
<td>(+16.10)</td>
<td>(+26.49)</td>
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</table>

Values are represented as mean ± SEM (n=6). \(^a\) indicates the comparison with normal control group and \(^b\) denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 6. Effects of *Limonia acidissima* on hepatic and renal enzymatic antioxidant profiles

<table>
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<tr>
<th>Parameters ↓</th>
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<th>F La II</th>
<th>F La III</th>
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<tr>
<td><strong>Hepatic</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CAT (nM H&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt; decomposed/s/gm)</td>
<td>17.70±0.15</td>
<td>8.66±0.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.96±0.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.60±0.61&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.82±0.27&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>SOD (U/mg protein)</td>
<td>4.66±0.12</td>
<td>1.63±0.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.94±0.82&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.15±0.17&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.59±0.96&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td><strong>Renal</strong></td>
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<tr>
<td>CAT (nM H&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt; decomposed/s/gm)</td>
<td>5.94±0.12</td>
<td>2.79±0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.90±0.11&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.01±0.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.29±0.51&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>SOD (U/mg protein)</td>
<td>3.96±0.28</td>
<td>2.02±0.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.07±0.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.21±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.73±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
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</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

---

**Fig. 5**

Catalase activity

Superoxide dismutase activity

Glutathione peroxidase activity
Table 1. Effects of *Averrhoa carambola* on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters →</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
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</thead>
<tbody>
<tr>
<td>Groups ↓</td>
<td></td>
<td></td>
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<tr>
<td>NC</td>
<td>18.85±0.17</td>
<td>243.83±0.82</td>
<td>8.11±0.03</td>
</tr>
<tr>
<td>FC</td>
<td>21.10±0.19&lt;sup&gt;a&lt;/sup&gt; (+11.94)</td>
<td>213.83±1.66&lt;sup&gt;a&lt;/sup&gt; (-12.30)</td>
<td>7.03±0.07&lt;sup&gt;a&lt;/sup&gt; (-13.32)</td>
</tr>
<tr>
<td>F Ac I</td>
<td>20.55±0.19&lt;sup&gt;a&lt;/sup&gt; (-2.61)</td>
<td>215.17±1.97&lt;sup&gt;a&lt;/sup&gt; (+0.63)</td>
<td>7.10±0.06&lt;sup&gt;a&lt;/sup&gt; (+0.99)</td>
</tr>
<tr>
<td>F Ac II</td>
<td>19.81±0.09&lt;sup&gt;ab&lt;/sup&gt; (-6.11)</td>
<td>217.58±2.02&lt;sup&gt;a&lt;/sup&gt; (+1.75)</td>
<td>7.26±0.90&lt;sup&gt;a&lt;/sup&gt; (+3.27)</td>
</tr>
<tr>
<td>F Ac III</td>
<td>18.84±0.13&lt;sup&gt;b&lt;/sup&gt; (+10.71)</td>
<td>220.33±2.09&lt;sup&gt;a&lt;/sup&gt; (+3.04)</td>
<td>7.88±0.08&lt;sup&gt;b&lt;/sup&gt; (+12.09)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6).<sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of *Averrhoa carambola* on blood glucose, hepatic glycogen content, hepatic hexokinase and G-6-Pase activities

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Ac I</th>
<th>F Ac II</th>
<th>F Ac III</th>
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</thead>
<tbody>
<tr>
<td><strong>Glucose</strong> (mg/dl)</td>
<td>97.10±0.35</td>
<td>193.36±1.07a</td>
<td>178.79±0.32ab</td>
<td>173.11±0.29ab</td>
<td>144.36±0.69ab</td>
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<tr>
<td><strong>Glycogen</strong> (mg/gm)</td>
<td>21.92±0.25</td>
<td>10.60±0.16a</td>
<td>11.28±0.14a</td>
<td>13.10±0.08ab</td>
<td>17.15±0.22ab</td>
<td></td>
</tr>
<tr>
<td><strong>Hexokinase</strong> (U/mg protein/min)</td>
<td>7.51±0.04</td>
<td>4.54±0.10a</td>
<td>4.98±0.07ab</td>
<td>5.49±0.08ab</td>
<td>6.09±0.04ab</td>
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</tr>
<tr>
<td><strong>G-6-Pase</strong> (U/mg protein/min)</td>
<td>0.170±0.002</td>
<td>0.467±0.003a</td>
<td>0.461±0.004a</td>
<td>0.419±0.002ab</td>
<td>0.346±0.003ab</td>
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</tr>
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</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 1: Plasma and hepatic carbohydrate profiles
Table 3. Effects of *Averrhoa carambola* on SGOT, SGPT, ACP, ALP activities and FRAP value

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC (U/L)</th>
<th>FC (U/L)</th>
<th>F Ac I (U/L)</th>
<th>F Ac II (U/L)</th>
<th>F Ac III (U/L)</th>
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<tr>
<td></td>
<td>SGOT</td>
<td>31.47±0.23</td>
<td>77.89±0.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>67.75±0.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57.80±0.19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>42.13±0.17&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(U/L)</td>
<td>(+147.50)</td>
<td>(-13.02)</td>
<td>(-25.79)</td>
<td>(-45.91)</td>
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<tr>
<td></td>
<td>SGPT</td>
<td>37.85±0.14</td>
<td>79.89±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72.44±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>68.85±0.16&lt;sup&gt;b&lt;/sup&gt;</td>
<td>52.06±0.21&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(U/L)</td>
<td>(+111.07)</td>
<td>(-9.32)</td>
<td>(-13.82)</td>
<td>(-34.83)</td>
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<tr>
<td></td>
<td>ACP</td>
<td>6.64±0.10</td>
<td>21.44±0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.82±0.16&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.70±0.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.70±0.08&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
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<td>(KA Units)</td>
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<tr>
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<td>ALP</td>
<td>9.39±0.08</td>
<td>29.95±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.82±0.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>22.76±0.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.64±0.04&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>(KA Units)</td>
<td>(+218.96)</td>
<td>(-7.11)</td>
<td>(-24.00)</td>
<td>(-37.76)</td>
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<tr>
<td></td>
<td>FRAP</td>
<td>286.12±0.35</td>
<td>159.49±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>195.67±0.38&lt;sup&gt;b&lt;/sup&gt;</td>
<td>219.96±0.20&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>(µmole/L)</td>
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<td>(+37.91)</td>
<td>(+54.53)</td>
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</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 2: Plasma SGOT, SGPT, ACP and ALP activities
Table 4. Effects of *Averrhoa carambola* on plasma lipid profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Ac I</th>
<th>F Ac II</th>
<th>F Ac III</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL</td>
<td>(mg/dl)</td>
<td>317.37±0.76</td>
<td>470.17±0.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>445.60±1.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>390.31±1.81&lt;sup&gt;ab&lt;/sup&gt;</td>
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</tr>
<tr>
<td>TC</td>
<td>(mg/dl)</td>
<td>111.25±0.71</td>
<td>160.52±0.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>151.84±0.44&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>123.81±0.61&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>97.77±0.40&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(+44.29)</td>
<td>(-5.41)</td>
<td>(-22.87)</td>
<td>(-39.09)</td>
<td></td>
</tr>
<tr>
<td>TG</td>
<td>(mg/dl)</td>
<td>75.53±0.31</td>
<td>102.37±0.48&lt;sup&gt;a&lt;/sup&gt;</td>
<td>96.16±0.20&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>80.06±0.85&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>70.83±0.32&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>HDL-C</td>
<td>(mg/dl)</td>
<td>70.50±0.55</td>
<td>47.92±0.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.89±0.36&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>53.39±0.40&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>59.33±0.17&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>LDL-C</td>
<td>(mg/dl)</td>
<td>25.64±1.13</td>
<td>92.12±0.46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>82.64±0.61&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>54.41±0.73&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>24.27±0.46&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>VLDL-C</td>
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<td>20.47±0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.23±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>16.01±0.17&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>AI</td>
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<td>1.58±0.01</td>
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<td>2.31±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.65±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>(-8.71)</td>
<td>(-30.63)</td>
<td>(-50.45)</td>
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</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

**Fig. 3: Plasma lipid profiles**

Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University
Table 5. Effects of *Averrhoa carambola* on hepatic lipid profiles, HMG-CoA reductase, bile acid content, fecal cholesterol and bile acid content

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Ac I</th>
<th>F Ac II</th>
<th>F Ac III</th>
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<tr>
<td>HEPATIC</td>
<td>TL (mg/gm)</td>
<td>33.47±0.15</td>
<td>56.00±0.29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.61±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>48.29±0.10&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>35.88±0.23&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
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<td></td>
<td>(+67.31)</td>
<td>(-4.27)</td>
<td>(-13.77)</td>
<td>(-35.93)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TC (mg/gm)</td>
<td>1.70±0.02</td>
<td>3.79±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.61±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.10±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.69±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(+122.94)</td>
<td>(-4.75)</td>
<td>(-18.20)</td>
<td>(-29.02)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>TG (mg/gm)</td>
<td>11.43±0.13</td>
<td>21.74±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.67±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.46±0.10&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>16.32±0.10&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(-15.08)</td>
<td>(-24.93)</td>
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<tr>
<td></td>
<td>HMG-CoA reductase&lt;sup&gt;*&lt;/sup&gt;</td>
<td>3.87±0.02</td>
<td>8.10±0.86&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.68±0.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.93±0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.98±0.45&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Fecal</td>
<td>Bile acid (mg/gm)</td>
<td>4.93±0.03</td>
<td>8.18±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.67±0.16&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>10.12±0.30&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>12.39±0.41&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(+23.72)</td>
<td>(+51.47)</td>
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</tr>
<tr>
<td></td>
<td>TC (mg/gm)</td>
<td>1.81±0.02</td>
<td>7.33±0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.04±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.17±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11.22±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(+304.97)</td>
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<td>(+25.10)</td>
<td>(+53.07)</td>
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<td></td>
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<tr>
<td></td>
<td>Bile acid (mg/gm)</td>
<td>7.02±0.03</td>
<td>13.94±0.06&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>(+23.31)</td>
<td>(+38.88)</td>
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</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup>denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group; <sup>*</sup>HMG-CoA reductase activity is inversely proportional to the ratio of HMG-CoA/mevalonate

Fig.4: Hepatic and fecal lipid profiles

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*Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University*
Table 6. Effects of *Averrhoa carambola* on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Ac I</th>
<th>F Ac II</th>
<th>F Ac III</th>
</tr>
</thead>
<tbody>
<tr>
<td>H EP T I C</td>
<td>TBARS (nM MDA/gm)</td>
<td>9.47±0.03</td>
<td>16.41±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.49±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>13.33±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>12.26±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(+73.28)</td>
<td>(-5.61)</td>
<td>(-18.77)</td>
<td>(-25.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAA (µg/gm)</td>
<td>141.04±0.70</td>
<td>78.45±0.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>87.72±0.51&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>98.30±0.28&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>115.17±0.34&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
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<td>(-44.38)</td>
<td>(+11.82)</td>
<td>(+25.30)</td>
<td>(+46.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100 gm)</td>
<td>38.81±0.09</td>
<td>21.01±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.77±0.20&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>25.40±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>28.60±0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
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<td>(-45.86)</td>
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<td>(+20.89)</td>
<td>(+36.12)</td>
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<td></td>
</tr>
<tr>
<td>R E N A L</td>
<td>TBARS (nM MDA/gm)</td>
<td>3.43±0.02</td>
<td>5.25±0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.16±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.77±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>(+53.06)</td>
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<td>TAA (µg/gm)</td>
<td>64.45±0.30</td>
<td>37.74±0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>41.74±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>43.83±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>51.00±0.31&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-41.44)</td>
<td>(+10.60)</td>
<td>(+16.14)</td>
<td>(+351.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100 gm)</td>
<td>12.35±0.03</td>
<td>7.04±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.49±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.03±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.93±0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(-42.99)</td>
<td>(+6.39)</td>
<td>(+14.06)</td>
<td>(+26.85)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup>denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Results

*Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University*
Table 7. Effects of *Averrhoa carambola* on hepatic and renal enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>F Ac I</th>
<th>F Ac II</th>
<th>F Ac III</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEPATIC</td>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>16.76±0.10</td>
<td>7.81±0.10a</td>
<td>8.16±0.05ab</td>
<td>9.49±0.07ab</td>
<td>11.41±0.15ab</td>
</tr>
<tr>
<td></td>
<td>SOD (U/mg protein)</td>
<td>4.16±0.04</td>
<td>1.89±0.03a</td>
<td>2.26±0.03ab</td>
<td>2.69±0.03ab</td>
<td>3.33±0.03ab</td>
</tr>
<tr>
<td></td>
<td>GPx (U/mg protein)</td>
<td>8.62±0.06</td>
<td>4.26±0.07a</td>
<td>4.96±0.04ab</td>
<td>5.12±0.06ab</td>
<td>5.67±0.06ab</td>
</tr>
<tr>
<td>RENAL</td>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>5.43±0.03</td>
<td>2.65±0.03a</td>
<td>2.78±0.03a</td>
<td>3.17±0.04ab</td>
<td>3.82±0.02ab</td>
</tr>
<tr>
<td></td>
<td>SOD (U/mg protein)</td>
<td>3.76±0.02</td>
<td>2.00±0.03a</td>
<td>2.18±0.02ab</td>
<td>2.23±0.03ab</td>
<td>2.61±0.01ab</td>
</tr>
<tr>
<td></td>
<td>GPx (U/mg protein)</td>
<td>3.90±0.03</td>
<td>2.09±0.02a</td>
<td>2.23±0.03ab</td>
<td>2.40±0.02ab</td>
<td>2.63±0.02ab</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Catalase activity](image1)

![Superoxide dismutase activity](image2)

![Glutathione peroxidase activity](image3)

Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University
Table 1. Effects of *Tamarindus indica* on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters → Groups ↓</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>18.91±0.45</td>
<td>245.50±2.38</td>
<td>8.35±0.12</td>
</tr>
<tr>
<td>FC</td>
<td>21.69±0.32&lt;sup&gt;a&lt;/sup&gt; (+14.70)</td>
<td>213.75±3.11&lt;sup&gt;a&lt;/sup&gt; (-12.93)</td>
<td>6.84±0.06&lt;sup&gt;a&lt;/sup&gt; (-18.08)</td>
</tr>
<tr>
<td>FTi I</td>
<td>21.15±0.27&lt;sup&gt;a&lt;/sup&gt; (-2.49)</td>
<td>215.92±2.87&lt;sup&gt;ab&lt;/sup&gt; (+1.01)</td>
<td>7.10±0.08&lt;sup&gt;a&lt;/sup&gt; (+3.80)</td>
</tr>
<tr>
<td>FTi II</td>
<td>20.50±0.15&lt;sup&gt;a&lt;/sup&gt; (-5.49)</td>
<td>217.40±1.92&lt;sup&gt;a&lt;/sup&gt; (+1.71)</td>
<td>7.25±0.10&lt;sup&gt;ab&lt;/sup&gt; (+5.99)</td>
</tr>
<tr>
<td>FTi III</td>
<td>18.82±0.17&lt;sup&gt;b&lt;/sup&gt; (-13.23)</td>
<td>228.08±3.05&lt;sup&gt;a&lt;/sup&gt; (+6.70)</td>
<td>7.86±0.09&lt;sup&gt;ab&lt;/sup&gt; (+14.91)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of *Tamarindus indica* on blood glucose, hepatic glycogen content, hepatic hexokinase and G-6-Pase activities

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>FTi I</th>
<th>FTi II</th>
<th>FTi III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glucose (mg/dl)</td>
<td>96.47±1.34</td>
<td>191.75±0.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>177.26±0.75&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>171.42±0.59&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>143.07±1.63&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Glycogen (mg/gm)</td>
<td>19.91±0.24</td>
<td>10.12±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.10±0.30&lt;sup&gt;d&lt;/sup&gt;</td>
<td>13.92±0.41&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.14±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Hexokinase (U/mg protein/min)</td>
<td>8.35±0.19</td>
<td>4.73±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.04±0.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.79±0.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.36±0.23&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>G-6-Pase (U/mg protein/min)</td>
<td>0.179±0.003</td>
<td>0.477±0.002&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.455±0.02&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.394±0.001&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.333±0.002&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup>indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

**Fig. 1: Plasma and hepatic carbohydrate profiles**
Results

**Table 3. Effects of *Tamarindus indica* on SGOT, SGPT, ACP ALP activities and FRAP value**

<table>
<thead>
<tr>
<th>Groups→</th>
<th>NC</th>
<th>FC</th>
<th>FTi I</th>
<th>FTi II</th>
<th>FTi III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGOT (U/L)</td>
<td>32.81±1.09</td>
<td>76.90±0.27&quot;a&quot;</td>
<td>67.48±2.13&quot;ab&quot;</td>
<td>59.07±0.52&quot;ab&quot;</td>
<td>43.25±0.02&quot;ab&quot;</td>
</tr>
<tr>
<td>SGPT (U/L)</td>
<td>39.51±0.82</td>
<td>79.92±0.21&quot;a&quot;</td>
<td>73.15±0.55&quot;ab&quot;</td>
<td>67.02±0.67&quot;ab&quot;</td>
<td>51.91±0.64&quot;ab&quot;</td>
</tr>
<tr>
<td>ACP (KA Units)</td>
<td>7.03±0.15</td>
<td>19.26±0.76&quot;a&quot;</td>
<td>17.67±0.23&quot;a&quot;</td>
<td>14.78±0.59&quot;ab&quot;</td>
<td>11.42±0.31&quot;ab&quot;</td>
</tr>
<tr>
<td>ALP (KA Units)</td>
<td>10.12±0.57</td>
<td>28.82±0.31&quot;a&quot;</td>
<td>26.71±0.49&quot;ab&quot;</td>
<td>23.05±0.45&quot;ab&quot;</td>
<td>19.53±0.29&quot;ab&quot;</td>
</tr>
<tr>
<td>FRAP (µmole/L)</td>
<td>292.31±4.38</td>
<td>168.12±3.41&quot;a&quot;</td>
<td>206.44±4.23&quot;ab&quot;</td>
<td>227.29±3.76&quot;ab&quot;</td>
<td>252.63±4.12&quot;ab&quot;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). "a" indicates the comparison with normal control group and "b" denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

**Fig. 2: Plasma SGOT, SGPT, ACP and ALP activities**

![Bar chart showing plasma SGOT, SGPT, ACP and ALP activities](chart.png)
Table 4. Effects of Tamarindus indica on plasma lipid profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameter</th>
<th>NC (mg/dl)</th>
<th>FC (mg/dl)</th>
<th>FTi I (mg/dl)</th>
<th>FTi II (mg/dl)</th>
<th>FTi III (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TL</td>
<td>319.50±2.30</td>
<td>471.86±3.08</td>
<td>448.99±3.89</td>
<td>389.63±3.87</td>
<td>346.95±3.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+47.69)</td>
<td>(-4.85)</td>
<td>(-17.43)</td>
<td>(-26.47)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TC</td>
<td>112.97±2.31</td>
<td>166.43±3.19</td>
<td>157.96±1.96</td>
<td>127.31±2.60</td>
<td>99.29±2.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+47.32)</td>
<td>(-5.09)</td>
<td>(-23.50)</td>
<td>(-40.34)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TG</td>
<td>70.65±2.08</td>
<td>102.89±1.38</td>
<td>95.77±1.90</td>
<td>79.65±1.20</td>
<td>68.47±1.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+45.63)</td>
<td>(-6.92)</td>
<td>(-22.59)</td>
<td>(-33.45)</td>
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<tr>
<td></td>
<td>HDL-C</td>
<td>69.59±0.70</td>
<td>43.84±0.65</td>
<td>45.92±0.51</td>
<td>52.61±0.59</td>
<td>58.46±0.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-37.00)</td>
<td>(+4.74)</td>
<td>(+20.00)</td>
<td>(+33.35)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LDL-C</td>
<td>29.25±2.01</td>
<td>102.01±3.19</td>
<td>92.92±2.35</td>
<td>58.78±1.94</td>
<td>27.34±1.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+248.75)</td>
<td>(-8.91)</td>
<td>(-42.38)</td>
<td>(-73.20)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VLDL-C</td>
<td>14.13±0.42</td>
<td>20.58±0.27</td>
<td>19.15±0.38</td>
<td>15.93±0.23</td>
<td>13.69±0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+45.65)</td>
<td>(-6.95)</td>
<td>(-22.59)</td>
<td>(-33.48)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AI</td>
<td>1.62±0.02</td>
<td>3.80±0.07</td>
<td>3.44±0.05</td>
<td>2.42±0.07</td>
<td>1.70±0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+134.57)</td>
<td>(-9.47)</td>
<td>(-36.31)</td>
<td>(-55.26)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 3: Plasma lipid profiles
Table 5. Effects of *Tamarindus indica* on hepatic lipid profiles, HMG-CoA reductase and bile acid content, fecal cholesterol and bile acid content

<table>
<thead>
<tr>
<th>Groups→ Parameters↓</th>
<th>NC</th>
<th>FC</th>
<th>FTi I</th>
<th>FTi II</th>
<th>FTi III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEPATIC</strong>&lt;br&gt; TL  (mg/gm)</td>
<td>30.66±0.20</td>
<td>56.12±0.29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.16±0.29&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>48.24±0.18&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>35.13±0.22&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/gm)</td>
<td>1.90±0.04</td>
<td>3.64±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.45±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.97±0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.58±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TG (mg/gm)</td>
<td>11.88±0.55</td>
<td>22.85±0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.70±0.35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.33±0.24&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>16.02±0.19&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>HMG-CoA reductase*</td>
<td>2.85±0.07</td>
<td>7.04±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.76±0.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.82±0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.68±1.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Fecal</strong>&lt;br&gt; Bile acid (mg/gm)</td>
<td>4.38±0.06</td>
<td>7.67±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.95±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.88±0.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>10.52±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>TC (mg/gm)</td>
<td>1.52±0.04</td>
<td>5.59±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.25±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.93±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>7.33±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bile acid (mg/gm)</td>
<td>6.42±0.22</td>
<td>12.83±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.64±0.28&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.94±0.31&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>16.38±0.10&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6).<sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

![Fig. 4: Hepatic and fecal lipid profiles](image)
Table 6. Effects of *Tamarindus indica* on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→ Parameters ↓</th>
<th>NC</th>
<th>FC</th>
<th>FTi I</th>
<th>FTi II</th>
<th>FTi III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEPATIC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBARS (nM MDA/gm)</td>
<td>11.63±0.32</td>
<td>16.16±0.43a</td>
<td>15.91±0.87a</td>
<td>13.68±0.63a</td>
<td>11.59±0.71b</td>
</tr>
<tr>
<td>TAA (µg/gm)</td>
<td>124.48±0.85</td>
<td>78.14±0.47a</td>
<td>86.57±0.54ab</td>
<td>95.69±0.76ab</td>
<td>107.32±0.92ab</td>
</tr>
<tr>
<td>GSH (mg/100 gm)</td>
<td>42.49±0.32</td>
<td>25.59±0.25a</td>
<td>26.85±0.77a</td>
<td>29.60±0.11ab</td>
<td>33.94±0.62ab</td>
</tr>
<tr>
<td><strong>RENAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBARS (nM MDA/gm)</td>
<td>3.14±0.65</td>
<td>5.44±0.18a</td>
<td>5.10±0.62a</td>
<td>4.36±0.33ab</td>
<td>3.17±0.76ab</td>
</tr>
<tr>
<td>TAA (µg/gm)</td>
<td>60.23±0.32</td>
<td>41.09±0.45a</td>
<td>43.89±0.18ab</td>
<td>45.64±0.51ab</td>
<td>52.83±0.26ab</td>
</tr>
<tr>
<td>GSH (mg/100 gm)</td>
<td>10.72±0.16</td>
<td>7.00±0.58a</td>
<td>7.52±0.86a</td>
<td>8.20±0.27ab</td>
<td>9.32±0.48b</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). * indicates the comparison with normal control group and ** denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

**Fig. 5**

Lipid peroxidation

Total ascorbic acid content

Glutathione content

Rupal A. Vasant, Ph. D. Thesis (Zoology), Department of Biosciences, Sardar Patel University
Table 7. Effects of *Tamarindus indica* on hepatic and renal enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Parameters ↓</th>
<th>NC</th>
<th>FC</th>
<th>FTi I</th>
<th>FTi II</th>
<th>FTi III</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT (nM H₂O₂ decomposed/s/gm)</td>
<td>14.89±0.15</td>
<td>6.19±0.42a</td>
<td>6.51±0.38a</td>
<td>7.80±0.61a</td>
<td>9.35±0.27ab</td>
</tr>
<tr>
<td>SOD (U/mg protein)</td>
<td>4.70±0.12</td>
<td>2.13±0.74a</td>
<td>2.67±0.22a</td>
<td>3.45±0.17ab</td>
<td>4.10±0.26ab</td>
</tr>
<tr>
<td>GPX (U/mg protein)</td>
<td>8.06±0.14</td>
<td>4.68±0.37a</td>
<td>5.06±0.58a</td>
<td>5.49±0.16a</td>
<td>6.58±0.49ab</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 1. Effects of dietary variations on food intake, body weight and liver weight

<table>
<thead>
<tr>
<th>Parameters →</th>
<th>Food intake (gm/day)</th>
<th>Body weight (gm)</th>
<th>Liver weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups ↓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>16.32±0.01</td>
<td>225.55±2.43</td>
<td>7.99±0.02</td>
</tr>
<tr>
<td>FC</td>
<td>16.46±0.02&lt;sup&gt;a&lt;/sup&gt; (+0.86)</td>
<td>201.75±0.67&lt;sup&gt;a&lt;/sup&gt; (-10.55)</td>
<td>6.77±0.01&lt;sup&gt;a&lt;/sup&gt; (-15.27)</td>
</tr>
<tr>
<td>F Basal</td>
<td>16.21±0.02&lt;sup&gt;ab&lt;/sup&gt; (-1.52)</td>
<td>207.5±1.75&lt;sup&gt;a&lt;/sup&gt; (+2.85)</td>
<td>6.81±0.01&lt;sup&gt;a&lt;/sup&gt; (+0.59)</td>
</tr>
<tr>
<td>F HCLP</td>
<td>16.13±0.01&lt;sup&gt;ab&lt;/sup&gt; (-2.00)</td>
<td>221.08±1.07&lt;sup&gt;b&lt;/sup&gt; (+9.58)</td>
<td>7.84±0.01&lt;sup&gt;ab&lt;/sup&gt; (+15.80)</td>
</tr>
<tr>
<td>F HPLC</td>
<td>16.00±0.01&lt;sup&gt;ab&lt;/sup&gt; (-2.79)</td>
<td>218.75±2.44&lt;sup&gt;b&lt;/sup&gt; (+8.43)</td>
<td>7.70±0.01&lt;sup&gt;ab&lt;/sup&gt; (+13.74)</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 2. Effects of dietary variations on plasma glucose, hepatic glycogen content, hexokinase and G-6-Pase activities

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters</th>
<th>NC</th>
<th>FC</th>
<th>F Basal</th>
<th>F HCLP</th>
<th>F HPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mg/dl)</td>
<td>98.77±0.23</td>
<td>195.78±0.28(^a)</td>
<td>194.12±0.25(^a)</td>
<td>197.40±0.33(^a)</td>
<td>146.71±0.50(^ab)</td>
<td></td>
</tr>
<tr>
<td>Glycogen (mg/gm)</td>
<td>20.46±0.02</td>
<td>10.08±0.03(^a)</td>
<td>10.18±0.04(^a)</td>
<td>10.25±0.04(^a)</td>
<td>16.12±0.02(^ab)</td>
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</tr>
<tr>
<td>Hexokinase (U/mg protein/min)</td>
<td>7.20±0.03</td>
<td>4.28±0.03(^a)</td>
<td>4.46±0.02(^a)</td>
<td>4.77±0.02(^ab)</td>
<td>6.24±0.10(^b)</td>
<td></td>
</tr>
<tr>
<td>G-6-Pase (U/mg protein/min)</td>
<td>0.194±0.003</td>
<td>0.557±0.007(^a)</td>
<td>0.554±0.005(^a)</td>
<td>0.550±0.007(^a)</td>
<td>0.354±0.004(^ab)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). \(^a\) indicates the comparison with normal control group and \(^b\) denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

Fig. 1: Plasma and hepatic carbohydrate profiles
### Table 3. Effects of dietary variations on plasma lipid profiles

<table>
<thead>
<tr>
<th>Parameters</th>
<th>NC</th>
<th>FC</th>
<th>F Basal</th>
<th>F HCLP</th>
<th>F HPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL</td>
<td>323.44±1.43</td>
<td>454.35±2.10</td>
<td>437.63±1.36</td>
<td>449.75±1.25</td>
<td>391.27±1.07</td>
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<tr>
<td></td>
<td>(+40.47)</td>
<td>(-3.68)</td>
<td>(-1.01)</td>
<td>(-13.88)</td>
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</tr>
<tr>
<td>(mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>110.79±0.90</td>
<td>152.06±0.86</td>
<td>151.18±0.53</td>
<td>156.75±0.69</td>
<td>111.60±0.89</td>
</tr>
<tr>
<td></td>
<td>(-37.25)</td>
<td>(-0.58)</td>
<td>(+3.08)</td>
<td>(-26.61)</td>
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<tr>
<td>(mg/dl)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TG</td>
<td>69.80±0.41</td>
<td>89.78±1.15</td>
<td>85.51±0.31</td>
<td>93.26±0.70</td>
<td>69.45±0.53</td>
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<tr>
<td></td>
<td>(+28.62)</td>
<td>(-4.76)</td>
<td>(+3.88)</td>
<td>(-22.64)</td>
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<tr>
<td>(mg/dl)</td>
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<tr>
<td>LDL-C</td>
<td>35.31±0.93</td>
<td>90.30±0.98</td>
<td>89.93±0.48</td>
<td>94.41±0.61</td>
<td>41.78±0.95</td>
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<td>(+155.73)</td>
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<td>(+4.55)</td>
<td>(-53.73)</td>
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<td>(mg/dl)</td>
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<tr>
<td>VLDL-C</td>
<td>13.96±0.08</td>
<td>17.95±0.23</td>
<td>17.06±0.05</td>
<td>18.65±0.14</td>
<td>13.89±0.11</td>
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<td>(-4.96)</td>
<td>(+3.90)</td>
<td>(-22.62)</td>
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<tr>
<td>(mg/dl)</td>
<td></td>
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<tr>
<td>HDL-C</td>
<td>61.51±0.31</td>
<td>43.81±0.26</td>
<td>44.18±0.18</td>
<td>43.68±0.26</td>
<td>55.90±0.14</td>
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<td>(-28.77)</td>
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<td>(+27.60)</td>
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<tr>
<td>(mg/dl)</td>
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<tr>
<td>AI</td>
<td>1.79±0.01</td>
<td>3.46±0.02</td>
<td>3.42±0.01</td>
<td>3.58±0.02</td>
<td>1.99±0.02</td>
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<tr>
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<td>(+93.30)</td>
<td>(-1.16)</td>
<td>(+3.47)</td>
<td>(-42.68)</td>
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<tr>
<td>(mg/dl)</td>
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</tbody>
</table>

Values are represented as mean ± SEM (n=6). *a* indicates the comparison with normal control group and *b* denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.

---

**Fig. 2: Plasma lipid profiles**

Legend:
- NC
- FC
- F Basal
- F HCLP
- F HPLC
Table 4. Effects of dietary variations on hepatic lipid profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>NC</th>
<th>FC</th>
<th>F Basal</th>
<th>F HCLP</th>
<th>F HPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters ↓</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>TL</td>
<td>29.17±0.15</td>
<td>42.30±0.10a</td>
<td>41.62±0.14a</td>
<td>41.46±0.11a</td>
<td>28.52±0.10ab</td>
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<tr>
<td>(mg/gm)</td>
<td>(+45.01)</td>
<td>(-1.61)</td>
<td>(-1.98)</td>
<td>(-1.61)</td>
<td>(-32.58)</td>
</tr>
<tr>
<td>TC</td>
<td>2.02±0.01</td>
<td>3.84±0.02a</td>
<td>3.78±0.01a</td>
<td>3.82±0.04a</td>
<td>2.12±0.02b</td>
</tr>
<tr>
<td>(mg/gm)</td>
<td>(+90.09)</td>
<td>(-1.56)</td>
<td>(-0.52)</td>
<td>(-44.79)</td>
<td></td>
</tr>
<tr>
<td>TG</td>
<td>11.87±0.34</td>
<td>19.12±0.26a</td>
<td>19.80±0.25a</td>
<td>19.66±0.29a</td>
<td>14.03±0.52ab</td>
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<tr>
<td>(mg/gm)</td>
<td>(+61.08)</td>
<td>(+3.56)</td>
<td>(+2.82)</td>
<td>(-26.62)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
Table 5. Effect of dietary variations on hepatic and renal lipid peroxidation and non-enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters ↓</th>
<th>NC</th>
<th>FC</th>
<th>F Basal</th>
<th>F HCLP</th>
<th>F HPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HEPATITIS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>TBARS (mM MDA/100gm)</td>
<td>10.41±0.22</td>
<td>15.73±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.50±0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.37±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.29±0.21&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TAA (µg/gm)</td>
<td>(+51.10)</td>
<td>(-1.46)</td>
<td>(-2.29)</td>
<td>(-21.87)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100gm)</td>
<td>130.46±0.34</td>
<td>103.88±0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>104.97±0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>105.80±0.35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>121.37±0.43&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TBARS (mM MDA/100gm)</td>
<td>4.16±0.16</td>
<td>6.25±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.24±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.22±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.83±0.15&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TAA (µg/gm)</td>
<td>(+50.24)</td>
<td>(-0.16)</td>
<td>(-0.48)</td>
<td>(-22.72)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSH (mg/100gm)</td>
<td>69.21±0.28</td>
<td>52.47±0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.62±0.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.59±0.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>64.87±0.43&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td></td>
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<td>(-24.19)</td>
<td>(+2.19)</td>
<td>(+0.23)</td>
<td>(+23.63)</td>
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<tr>
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<td>(-29.09)</td>
<td>(+4.05)</td>
<td>(+0.22)</td>
<td>(+40.81)</td>
<td></td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). <sup>a</sup> indicates the comparison with normal control group and <sup>b</sup> denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.
### Table 6. Effect of dietary variations on hepatic and renal enzymatic antioxidant profiles

<table>
<thead>
<tr>
<th>Groups→</th>
<th>Parameters ↓</th>
<th>NC</th>
<th>FC</th>
<th>F Basal</th>
<th>F HCLP</th>
<th>F HPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>CAT (nM H₂O₂ decomposed/sec/gm)</td>
<td>17.53±0.08</td>
<td>8.51±0.07a</td>
<td>8.67±0.06a</td>
<td>8.56±0.05a</td>
<td>12.10±0.05b</td>
</tr>
<tr>
<td>P</td>
<td>SOD (U/mg protein)</td>
<td>4.36±0.20</td>
<td>2.82±0.14a</td>
<td>2.90±0.18a</td>
<td>2.97±0.20a</td>
<td>4.16±0.27b</td>
</tr>
<tr>
<td>A</td>
<td>GPx (U/mg protein)</td>
<td>7.05±0.29</td>
<td>4.25±0.08a</td>
<td>4.30±0.05a</td>
<td>4.34±0.07a</td>
<td>6.11±0.25b</td>
</tr>
<tr>
<td>T</td>
<td>CAT (nM H₂O₂ decomposed/sec/gm)</td>
<td>6.06±0.04</td>
<td>2.89±0.02a</td>
<td>2.97±0.02a</td>
<td>2.92±0.02a</td>
<td>3.72±0.02ab</td>
</tr>
<tr>
<td>I</td>
<td>SOD (U/mg protein)</td>
<td>3.06±0.15</td>
<td>2.14±0.15a</td>
<td>2.22±0.10a</td>
<td>2.15±0.13a</td>
<td>3.00±0.09b</td>
</tr>
<tr>
<td>C</td>
<td>GPx (U/mg protein)</td>
<td>3.24±0.14</td>
<td>2.17±0.06a</td>
<td>2.31±0.10a</td>
<td>2.22±0.08a</td>
<td>2.74±0.11ab</td>
</tr>
</tbody>
</table>

Values are represented as mean ± SEM (n=6). a indicates the comparison with normal control group and b denotes the comparison with fluoride control group at p<0.05 respectively; Percent changes (figures in parenthesis) in fluoride control group were in comparison with normal control and in treatment groups were in comparison with fluoride control group.