7. Results

7.1 *Spondias pinnata*

7.1.1 Food intake, Water intake and Body weight

- Food intake, water intake and body weight were decreased ($p<0.01$, $p<0.05$ & $p<0.01$ respectively) significantly among rats which received etoposide when compared to control group.

- There is a significant increase in food intake ($p<0.05$), water intake ($p<0.01$, $p<0.05$) and body weight ($p<0.05$) among the rats which received etoposide followed by *Spondias pinnata* (100 & 200mg/kg b.w) when compared to etoposide controls.

- Animals which received *Spondias pinnata* (100 & 200mg/kg b.w) before and after etoposide showed significant increase in food intake ($p<0.05$), water intake ($p<0.05$) and body weight ($p<0.05$) compared to etoposide controls.

- In *Spondias pinnata* group, food intake (15.89±0.26, 15.68±0.60), water intake (21.13±1.44, 21.19±1.13) and body weight (208.0±9.61, 215.0±8.48) remained same as that of normal controls.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Food intake (g/day) (Mean±SEM)</th>
<th>Water intake (ml/day) (Mean±SEM)</th>
<th>Body weight (g) (Mean±SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15.5±0.66</td>
<td>21.20±2.58</td>
<td>209.03±2.36</td>
</tr>
<tr>
<td>Etoposide (ET)</td>
<td>7.08±0.75 **</td>
<td>13.6±1.11*</td>
<td>176.8±4.8**</td>
</tr>
<tr>
<td>ET+SP (100)</td>
<td>12.7±0.26 #</td>
<td>21.1±0.32 #</td>
<td>194.4±13.01 #</td>
</tr>
<tr>
<td>ET+SP (200)</td>
<td>12.54±0.92 #</td>
<td>15.5±0.69 #</td>
<td>172.2±9.31</td>
</tr>
<tr>
<td>SP+ET+SP (100)</td>
<td>16.04±0.66 #</td>
<td>17.4±0.64 #</td>
<td>208.7±8.99 #</td>
</tr>
<tr>
<td>SP+ET+SP (200)</td>
<td>17.9±0.54 #</td>
<td>17.25±1.1 #</td>
<td>209.4±9.05 #</td>
</tr>
<tr>
<td>SP alone (100)</td>
<td>15.89±0.26</td>
<td>21.13±1.44</td>
<td>208.0±9.61</td>
</tr>
<tr>
<td>SP alone (200)</td>
<td>15.68±0.60</td>
<td>21.19±1.13</td>
<td>215.0±8.48</td>
</tr>
</tbody>
</table>

**Table R1:** Comparison of changes in body weight (g), food (g/day) and water (ml/day) intake.

*P values: * $<0.05$, ** $<0.01$ Control Vs etoposide; # $<0.05$ & ## $<0.01$, etoposide Vs treatment groups*
7.1.2 Estimation of Nitric oxide

![Graph showing nitric oxide levels across different groups](image)

**Figure R1**: Duodenal nitric oxide level (mg/g tissue) in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06)

- $P<0.0001$ & $F=6.591$
- group-1 Vs group-2, * $p<0.05$
- group-2 Vs group-3 & group-6, # $p<0.05$

- A significant increase in duodenal nitric oxide (NO) level was observed in the rats exposed to etoposide compared with the control group (group-1 Vs group-2, $p<0.05$).

- Animals which received etoposide followed by *Spondias pinnata* (100mg/kg b.w) treatment showed a significant decrease in duodenal nitric oxide level compared to rats which received etoposide alone (group-2 Vs group-3, $p<0.05$). But not in rats which received 200 mg/kg b.w.

- Animals which received *Spondias pinnata* (200mg/kg bw), both pre & post etoposide, duodenal nitric oxide level showed a tendency to return to normal and was significantly decreased when compared to etoposide control group (group-2 Vs group-6, $p<0.05$)

- NO level remains unaltered in *Spondias pinnata* treated animals (group-7 & group-8) in comparison with normal controls.
7.1.3 Estimation of Sucrase

![Graph showing sucrase activity levels in different groups](image)

**Figure R2:** Effects of etoposide and *Spondias pinnata* administration on the sucrase (µM/min/g tissue) level in the rat duodenum. 
ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group) 
\( P<0.0001 \) & \( F=13.49 \)  
- group-1 Vs group-2, *** \( p<0.001 \)  
- group-2 Vs group-3, group-4 & group-6, ### \( p<0.001 \)  
One Unit = one µmole of glucose produced/min/g tissue

- Rats exposed to etoposide showed a significant decrease (\( p<0.001 \)) in sucrase activity in the duodenum compared to normal controls (group-1 Vs group-2).  
- Animals exposed to etoposide followed by *Spondias pinnata* (100 & 200mg/kg b.w) showed a significant increase in sucrase activity in the duodenum compared to etoposide treated rats (group-2 Vs group-3, \( p<0.001 \), group-2 Vs group-4, \( p<0.001 \)).  
- Animals which received pre and post treatment with *Spondias pinnata* (200mg/kg b.w) showed a significant increase in sucrase activity in the duodenum compared to etoposide control rats (group-2 Vs group-6, \( p<0.001 \)). However group-5 did not show any difference in sucrase activity compared to animals exposed to etoposide alone.  
- In *Spondias pinnata* alone group, no significant change in the activity of sucrase was observed compared to normal controls.
7.1.4 Estimation of reduced glutathione

Figure R3: Duodenal reduced glutathione level (mg/g tissue) in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06)
P<0.0014 & F=4.160
• Rats which received etoposide alone (group-2) showed a significant decrease (p<0.01) in the GSH levels compared to controls (group-1 Vs group-2).
• Animals which received etoposide followed by Spondias pinnata (100mg/kg b.w) showed a significant increase (p<0.01) in the GSH level when compared to animals exposed to etoposide alone (group-2 Vs group-3). In group-4, GSH levels tend to rise towards normal. However, it was found to be statistically not significant.
• Animals exposed to both pre & post treatment with Spondias pinnata showed a significant increase in GSH level when compared to etoposide control rats (group-2 Vs group-5, p<0.01 and group-2 Vs group-6, p<0.05)
• Animals which received Spondias pinnata alone (group-7 & group-8) were found have normal levels of GSH.
7.1.5 Sodium potassium ATPase

Figure R4: Duodenal Na\textsuperscript{+},K\textsuperscript{+} -ATPase activity (µM/min/g tissue) in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group) 
\( P=0.0001 \) & \( F=10.37 \) 
group-1 Vs group-2, *** \( p<0.001 \) 
group-2 Vs group-6, ## \( p<0.01 \) 
One unit= one µmole of Pi produced/min/g tissue

- Rat duodenal Na\textsuperscript{+},K\textsuperscript{+} -ATPase activity was decreased significantly (\( p<0.001 \)) in the group which received etoposide (group-2) compared to normal controls.
- Animals which received etoposide followed by Spondias pinnata (both 100 & 200mg/kg b.w) did not show any significant alteration in Na\textsuperscript{+},K\textsuperscript{+} -ATPase activity when compared to etoposide (group-2) treated group.
- An increase in Na\textsuperscript{+},K\textsuperscript{+} -ATPase activity was observed in group-6 compared to etoposide control, which was statistically (\( p<0.01 \)) significant.
- Rats which received Spondias pinnata (group-7 & group-8) showed no significant variation in Na\textsuperscript{+}, K\textsuperscript{+} -ATPase activity compared to normal controls.
7.1.6 Estimation of Myeloperoxidase (MPO)

The MPO activity was significantly increased \((p<0.01)\) in animals exposed to etoposide alone (group-2) compared to controls (group-1 Vs group-2).

- **Spondias pinnata** treated groups did not show any changes in MPO levels compared to etoposide.
- MPO activity remained unaltered in animals exposed to **Spondias pinnata** treatment (group-7 & group8) alone compared to normal controls (group-1).

**Figure R5**: Estimation of MPO activity in rats.

ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group)

\[ P=0.0001 \text{ & } F=5.863 \]

group-1 Vs group-2, ** \( p<0.01 \)

One unit= One µmole of \( \text{H}_2\text{O}_2 \) in to water per min
7.1.7 Estimation of Cyclooxygenase (COX)

- Activity of COX was significantly increased after etoposide (group-2) compared to normal controls (group-1 Vs group-2, $p<0.001$).
- Post treatment with *Spondias pinnata* showed significant decrease ($p<0.001$) COX activity in the rat duodenum compared to etoposide controls.
- In both (100 & 200mg/kg) the groups of pre & post treatment, COX activity remained in the normal range, and showed a significant decrease ($p<0.001$) in comparison with etoposide controls.
- No significant change in COX activity was observed in animals which received *Spondias pinnata* (group-7 & group-8) treatment alone compared to normal controls.

![Graph showing COX activity in rats](image)

**Figure R6:** Duodenal COX activity ($\mu$M/ml/min) in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group)

- Group-1 Vs group-2, *** $p<0.001$
- Group-2 Vs group-3, group-4, group-5 & group-6, ### $p<0.001$

One unit= amount of enzyme required to cause a change in TMPD per min
7.1.8 Estimation of Tumor necrosis factor-alpha (TNF-α)

Figure R7: Duodenal Tumor necrosis factor-alpha level (ng/g tissue) in rats. Non-parametric test (Kruskall wallies test) and Mann-Whitney test

- Tumor necrosis factor-alpha levels were significantly increased ($p<0.01$) in rat duodenal tissue in the animals which received etoposide compared to controls.

- Animals which received etoposide followed by *Spondias pinnata* (100 & 200mg/kg b.w) showed a significant decrease (group-2 Vs group-3, $p<0.01$, group-2 Vs group-4, $p<0.01$) in TNF-α levels when compared to etoposide controls.

- Rats exposed to pre and post treatment with *Spondias pinnata* (100 & 200mg/kg b.w) showed significant decrease in TNF-α level compared to etoposide controls (group-2 Vs group-5, $p<0.01$ & group-2 Vs group-6, $p<0.01$)

- TNF-α level remains unaltered in *Spondias pinnata* treatment group when compared to normal controls.
7.1.9 Interleukin-6 (IL-6) levels in rats.

The level of IL-6 in etoposide group was observed to be significantly higher ($p<0.001$) than the normal control rats.

IL-6 level was significantly decreased in all the treatment groups compared to etoposide (group-2 Vs group-3 $p<0.05$; group-2 Vs group-5 $p<0.01$; group-2 Vs group-4 & group-6 $p<0.001$).

In *Spondias pinnata* group show no significant change in IL-6 levels was observed (group-7 & group-8) compared to normal controls.

7.1.10 TUNEL ASSAY

In etoposide, there was a significant increase in apoptosis (76.3%) in rat duodenum compared to normal controls.

Animals exposed to etoposide treatment followed by *Spondias pinnata* (both 100 & 200mg/kg b.w) showed a significant decrease (27.3% & 16.9% respectively) in duodenal apoptotic cells when compared to etoposide group.
Results

- Rats which received (pre & post) *Spondias pinnata* (100 & 200mg/kg b.w) showed a decrease (27.3% and 28.3% respectively) in extent of apoptosis.
- Extent of apoptosis remained unaltered in *Spondias pinnata* treatment group when compared (group-7 and group-8) to normal control (Table R2 & Fig R9).

**Table R2:** Cell population analysis by Fluorescence flow cytometry (expressed in percentage)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Apoptotic cells (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>28.5</td>
</tr>
<tr>
<td>Etoposide (ET)</td>
<td>76.3</td>
</tr>
<tr>
<td>ET+ <em>Spondias pinnata</em> (S.P) (100mg/kg)</td>
<td>27.3</td>
</tr>
<tr>
<td>ET +SP (200mg/kg)</td>
<td>16.9</td>
</tr>
<tr>
<td>SP+ ET +SP (100 mg/kg)</td>
<td>27.3</td>
</tr>
<tr>
<td>SP+ ET +SP (200 mg/kg)</td>
<td>28.3</td>
</tr>
<tr>
<td>SP alone (100 mg/kg)</td>
<td>31.5</td>
</tr>
<tr>
<td>SP alone (200 mg/kg)</td>
<td>30.3</td>
</tr>
</tbody>
</table>

Figure R9: A photograph showing Apoptotic Cells stained with Br-dUTP
Apoptotic cells exhibited green fluorescence. Normal cells exhibited strong red counter staining. (magnification 40x) a) Control b) Etoposide c) ET+SP (100mg) d) ET+SP (200mg) e) SP+ET+SP (100mg) f) SP+ET+SP (200mg) g) SP (100mg) h) SP (200mg)
7.1.11 Histology of Duodenum

- On treatment with etoposide, a significant disruption of the villi in duodenum was observed compared to control rats.
- Administration of etoposide followed by *Spondias pinnata* (100 & 200mg/kg b.w) minimised the destruction of villi compared to etoposide control.
- The groups which were pre and post treated with *Spondias pinnata* (100 & 200mg/kg b.w) showed intact villi.
- In the animals which received *Spondias pinnata* (100 & 200mg/kg b.w) alone, undamaged villi were observed (Fig R10)

![Figure R10: Histology (5 micron sections) of duodenum with the magnification (20X) a) Control b) Etoposide c) ET+SP (100mg) d) ET+SP (200mg) e) SP+ET+SP (100mg) f) SP+ET+SP (200mg) g) SP alone (100mg) h) SP alone (200mg)](image-url)
7.2 Whey preparation

7.2.1 Food intake, water intake and body weight

- Food intake, water intake and body weight were decreased (P<0.05) among rats which received etoposide compared to control group.
- An increase in food intake (P<0.05), water intake (P<0.05) and body weight (P<0.05) was found in the rats which received etoposide followed by whey preparation (100 & 200mg/kg b.w) when compared to etoposide group.
- Rats that were subjected to pre and post treatment with whey preparation (100 & 200mg/kg b.w) showed significant increase in food intake (p<0.05, p<0.01), water intake (p<0.05, p<0.05) and body weight (p<0.01, p<0.05) compared to etoposide group.
- In whey preparation group, food intake, water intake and body weight remained unaltered when compared to normal controls.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Food intake (g/day) (Mean±SEM)</th>
<th>Water intake (ml/day) (Mean±SEM)</th>
<th>Body weight (g) (Mean±SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15.5±0.66</td>
<td>21.20±2.58</td>
<td>209.03±2.36</td>
</tr>
<tr>
<td>Etoposide (ET)</td>
<td>7.08±0.75 *</td>
<td>13.66±0.76 *</td>
<td>176.8±4.8 *</td>
</tr>
<tr>
<td>ET+WP (100)</td>
<td>13.79±0.50 #</td>
<td>21.5±0.32 #</td>
<td>212.5±9.66 #</td>
</tr>
<tr>
<td>ET+WP (200)</td>
<td>14.04±0.75 #</td>
<td>15.10±0.80 #</td>
<td>183.3±10.83 #</td>
</tr>
<tr>
<td>WP+ET+WP (100)</td>
<td>16.66±1.73 #</td>
<td>11.95±1.0 #</td>
<td>204.2±8.65 #</td>
</tr>
<tr>
<td>WP+ET+WP (200)</td>
<td>17.3±1.39 ##</td>
<td>12.7±1.15 #</td>
<td>200.6±8.84 #</td>
</tr>
<tr>
<td>WP alone (100)</td>
<td>15.62±0.74</td>
<td>21.45±1.79</td>
<td>208.37±3.48</td>
</tr>
<tr>
<td>WP alone (200)</td>
<td>15.75±0.44</td>
<td>21.25±2.31</td>
<td>208.6±7.88</td>
</tr>
</tbody>
</table>

Table R3: Comparison of changes in body weight (g), food (g/day) and water (ml/day) intake.

*P values: * <0.05, Control Vs etoposide; # <0.05 & ## <0.01, etoposide Vs treatment groups
7.2.2 Estimation of Nitric oxide

**Figure R11:** Duodenal nitric oxide level (mg/g tissue) in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06)

- A significant increase in duodenal nitric oxide level was observed in the rats exposed to etoposide compared with the control group (group-1 Vs group-2, \( p<0.05 \)).
- Animals which received etoposide followed by whey preparation (100mg/kg b.w) showed a significant decrease in duodenal nitric oxide level compared to rats which received etoposide alone (group-2 Vs group-3, \( p<0.01 \)). However group 4 did not show significant difference when compared to control group.
- Animals which received whey preparation (100 & 200mg/kg b.w) before and after etoposide, showed significant decrease in duodenal nitric oxide level when compared to etoposide group (group-2 Vs group-5, \( p<0.01 \), group-2 Vs group-6, \( p<0.05 \))
- Nitric oxide level remains unaltered in whey preparation alone treatment (group-7 & group-8) in comparison with normal controls.
7.2.3 Estimation of Sucrase

![Bar graph showing sucrase activity levels across different treatment groups.](image)

**Figure R12**: Effects of etoposide and whey preparation administration on the sucrose activity level in the rat duodenum. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group)

- Control
- Etoposide (ET)
- ET+WP (100)
- ET+WP (200)
- WP+ET+WP (100)
- WP+ET+WP (200)
- WP (100)
- WP (200)

- Rats exposed to etoposide showed a significant decrease ($p<0.05$) in sucrose activity in the duodenum compared to normal control.
- Animals exposed to etoposide followed by whey preparation (100 & 200mg/kg b.w) showed a significant increase in sucrose activity compared to etoposide treated rats (group-2 Vs group-3, $p<0.001$, group-2 Vs group-4, $p<0.001$).
- In pre and post treatment groups, animals which received whey preparation (100 & 200mg/kg b.w) showed a significant increase in sucrose activity compared to etoposide controls (group-2 Vs group-5, $p<0.001$, group-2 Vs group-6, $p<0.001$).
- In whey preparation group, no significant change in the level of sucrose was observed in the animals that were administered only whey preparation (100 & 200mg/kg b.w) compared to normal control.
### Results

#### 7.2.4 Estimation of reduced glutathione

![Graph showing reduced glutathione levels in different groups](image)

**Figure R13:** Duodenal reduced glutathione level (mg/g tissue) in rats. Non-parametric test (kruskall wallies test) and Mann- whitney test

- $P<0.018$
- group-1 Vs group-2, **$p<0.01$
- group-2 Vs group-3, group-4, group-5 & group-6, ## $p<0.01$, # $p<0.05$

- Rats which received etoposide alone (group-2) showed a significant decrease in the GSH levels compared to control (group-1 Vs group-2, $p<0.01$).
- Animals which received etoposide followed by whey preparation (100 & 200mg/kg b.w) showed a significant increase the GSH levels when compared to animals exposed to etoposide (group-2 Vs group-3, $p<0.05$, group-2 Vs group-4, $p<0.01$).
- Animals exposed to both pre & post treatment with whey preparation showed significant increase in GSH levels when compared to etoposide (group-2 Vs group-5, $p<0.05$ and group-2 Vs group-6, $p<0.01$).
- However, there was no change in GSH levels in animals which received whey preparation (group-7 & group-8) alone.
7.2.5 Sodium potassium ATPase

Figure R14: Duodenal Na⁺, K⁺ -ATPase activity in rats. Non-parametric test (Kruskull Wallies test) and Mann-whitney test

- Rat duodenal Na⁺,K⁺ -ATPase activity level was decreased significantly ($p<0.01$) in the animals which received etoposide (group-2) compared to normal controls.
- Animals which received etoposide followed by whey preparation (both 100 & 200mg/kg b.w) show a significant increase in Na⁺K⁺ -ATPase activity when compared to groups on etoposide treatment (group-2).
- An increase in Na⁺,K⁺ -ATPase activity was observed in group-5 compared to etoposide, which was observed to be statistically significant ($p<0.05$).
- Whey preparation group (group-7 & group-8) showed no significant variation in Na⁺,K⁺ -ATPase activity compared to normal controls.
7.2.6 Estimation of Myeloperoxidase (MPO)

The MPO activity was significantly increased ($p<0.001$) in the animals exposed to etoposide alone (group-2) compared to controls group.

Animals exposed to etoposide followed by whey preparation (100 & 200mg/kg b.w) showed a significant decrease in MPO level in the duodenum compared to etoposide treated rats (group-2 Vs group-3 & group-4, $p<0.01$).

Animals which received whey preparation (100 & 200mg/kg b.w) before and after etoposide showed a significant decrease in MPO level in the duodenum compared to etoposide controls (group-2 Vs group-5 & group-6, $p<0.01$).

MPO activity remains unaltered in animals administered whey preparation (group-7 & group-8) alone compared to normal controls.
7.2.7 Estimation of Cyclooxygenase

![Graph showing COX activity levels across different groups.]

Figure R16: Duodenal COX activity in rats. ANOVA significance (Bonferroni’s test, each bar represents mean±SEM, n=06 per group) $P=0.0001$ & $F=13.17$

group-1 Vs group-2, *** $p<0.001$
group-2 Vs group-3, group-4, group-5 & group-6, ### $p<0.001$
One unit= amount of enzyme required to cause a change in TMPD per min

- Activity of COX was significantly increased after etoposide (group-2) compared to normal controls (group-1 Vs group-2, $p<0.001$).
- Post treatment with whey preparation showed significant decrease ($p<0.001$) in the COX activity in the rat duodenum compared to etoposide controls.
- The groups which received pre & post treatment (100 & 200mg/kg b.w) with whey preparation showed decrease in COX activity compared to etoposide treatment, which was found to be statistically significant (group-2 Vs group-5 & group-6, $p<0.001$).
- No significant change in COX activity was observed in the animals which received whey preparation (group-7 & group-8) alone compared to normal control.
### Results

#### 7.2.8 Estimation of Tumor Necrosis Factor-alpha (TNF-α)

**Figure R17**: Duodenal tumor necrosis factor-alpha level (ng/g tissue) in rats. Non-parametric test (Kruskal wallis test) and Mann-Whitney test

*P*<0.0008

- **group-1** Vs **group-2, ** *p*<0.01
- **group-2** Vs **group-3, group-4, group-5 & group-6, ** *p*<0.01, * *p*<0.05

- Tumor necrosis factor-alpha level was significantly increased (*p*<0.01) in rat duodenal tissue of the animals which received etoposide compared to normal controls.
- Animals which received etoposide followed by whey preparation (100 & 200mg/kg b.w) showed a significant decrease (group-2 Vs group-3, *p*<0.05, group-2 Vs group-4, *p*<0.01) in TNF-α levels when compared to etoposide treated rats.
- Rats exposed to pre and post treatment with whey preparation (100 & 200mg/kg b.w) showed significant decrease in TNF-α level compared to etoposide (group-2 Vs group-5, *p*<0.01 & group-2 Vs group-6, *p*<0.01).
- TNF-α level remains unaltered in the animals exposed whey preparation (group-7 & group-8) alone compared to controls.
7.2.9 Estimation of Interleukin-6 (IL-6) levels in rats.

The level of IL-6 in etoposide group was observed to be significantly higher ($p<0.05$) than the normal control rats.

The IL-6 level was significantly reduced in both (100 & 200mg/kg b.w) the post treatment groups compared to etoposide group (group-2 Vs group-3, $p<0.05$, group-2 Vs group-4, $p<0.05$).

In pre & post treatment groups, animals which received whey preparation (100 & 200mg/kg b.w) before and after etoposide showed a significant decrease in the IL-6 levels compared to etoposide (group-2 Vs group-5, $p<0.01$ & group-2 Vs group-6, $p<0.01$).

In whey preparation treated group show no significant change in IL-6 levels was observed (group-7 & group-8) compared to normal controls.
7.2.10 TUNNEL assay

- Etoposide treatment showed a significant increase in apoptosis (76.3%) in rat duodenum compared to control group.
- Animals exposed to etoposide treatment followed by whey preparation (100 & 200mg/kg b.w) showed a significant decrease (29.5% & 28.3% respectively) in duodenal apoptotic cells when compared to etoposide group.
- Rats which received (pre & post) whey preparation (100 & 200mg/kg b.w) showed a decrease (26.9% and 24.4% respectively) in extent of apoptosis.
- Extent of apoptosis remained unaltered in whey preparation group (group-7 and group-8) when compared to normal control (Table R4 & Fig R19)

Table R4: Cell population analysis by fluorescence flow cytometry (expressed in percentage)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Apoptotic cells (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>28.5</td>
</tr>
<tr>
<td>Etoposide (ET)</td>
<td>76.3</td>
</tr>
<tr>
<td>ET+ whey preparation (WP) (100 mg/kg)</td>
<td>29.5</td>
</tr>
<tr>
<td>ET+ WP (200 mg/kg)</td>
<td>28.3</td>
</tr>
<tr>
<td>WP+ ET+ WP (100 mg/kg)</td>
<td>26.9</td>
</tr>
<tr>
<td>WP+ ET+ WP (200 mg/kg)</td>
<td>24.4</td>
</tr>
<tr>
<td>WP alone (100 mg/kg)</td>
<td>26.7</td>
</tr>
<tr>
<td>WP alone (200 mg/kg)</td>
<td>26.7</td>
</tr>
</tbody>
</table>
7.2.11 Histology of Duodenum

- On treatment with etoposide, a significant disruption of the villi in duodenum was observed compared to control rats.
- Administration of etoposide followed by whey preparation (100 & 200mg/kg b.w) showed intact villi compared to etoposide group.
- Pre and post treatment with whey preparation (100 & 200mg/kg b.w) showed restoration of villi near to normal compared to etoposide rats (group-2 Vs group-5 & group-6).
- In the animals which received whey preparation (100 & 200mg/kg b.w) alone, undamaged villi were observed as in normal control (Fig R20)