CHAPTER VI
SUMMARY AND CONCLUSION
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1. The matured dry fruit of *Terminalia chebula* Rtz. was selected for present investigation to evaluate its hepatoprotective activity. The fruits were collected from Mandakata Medicinal Plant Garden, Assam, in ripe condition and taken for experiment after proper drying. The aqueous extract of *Terminalia chebula* has been prepared by standard method by using 1:4 ratio of fruit powder and distilled water.

   The aqueous extract was standardized prior to conducting the experiment by physicochemical test and quantitative analysis of Tannin. It was observed that the test for Tannine became positive. The Tannine assay by USSRP method revealed the content to be 49.88%.

2. The experiment was conducted in two phases as followed.

   Phase - I: To see the effect of aqueous.

   Extract of *Terminalia chebula* (200 mg/kg b.w./day) in different days of treatment viz. 7th, 14th, 21st and 28th day and compared with their control group (i.e. 0 day treatment).

   Phase - II: To evaluate the hepatoprotective activity in CCl₄ induced rat by administering in two different dose (200 mg and 500 mg/kg b.w.) of *Terminalia chebula* extract and correlating the biochemical effects with histological investigation of rat liver.
The experimental animals were randomly selected. The male spargue Dawley rats (body weight 120-150 gm) were taken for both the phase of experiment. The animal were fed with (approximately 12 gm/day) basal diet and water adlibitum.

3. The following biochemical parameters were selected for study in present investigation for both the phases.
   a) Serum Total Protein.
   b) Serum bilirubin.
   c) Serum Alkaline Phosphatase.
   d) SGOT
   c) SGPT

4. The liver tissue was collected for estimation of SGOT and SGPT activity in 1st phase of experiment. In 2nd phase of experiment wet weight of liver and its volume were measured to compare with CCl₄ treated group and other group treated by *Terminalia chebula*.

5. The structural change of liver was studied in 2nd phase of treatment, to correlate the changes in biochemical parameters and their reversibility in CCl₄ induced liver.

In 1st phase of experiment the no. of animal were taken minimum six and maximum 16. However in the 2nd phase of study the number of animal taken up were six for each group.
6. To evaluate the effect of *Terminalia chebula* in different biochemical parameters standard methods and kits were used for each experiment. The reproducibility and recovery test were adopted for correct and actual results.

7. To arrive at meaningful conclusion the data were analysed by standard statistical procedure for each of the parameter in different treatment groups. The one way ANOVA was carried out, whenever any effect was found to be significant further critical difference (C.D.) test were carried out to compare the significance among the experimental groups.

8. The level of blood glucose in control groups have been recorded 90.67 ± 5.7 mg. The highest value of Blood glucose was recorded in 28th day of treatment 101.57 ± 6.66 mg%, which is found to be insignificant. Similarly a little elevation has been noted in other treatment groups.

   The serum total protein level was recorded 6.5 ± 0.39 gm% in control groups however 7.5 ± 0.67 gm% was observed in 28th day treatment which is statistically insignificant.

   The serum albumin level was found unchanged after administration of aqueous extract of *Terminalia chebula*. The mean value of serum albumin was 4.3 ± 0.19 gm% in control and 4.3 ± 0.27 gm% in 28th day treated group.

   The serum bilirubin (total) has been observed 0.55 ± 0.12 after administration of *Terminalia chebula* extract, no any significant change has been noted. In 28th days of treatment, it was recorded 0.94 ± 0.27 mg% which is under normal range on the
other hand a significant decrease trend has been shown in serum bilirubin (direct) on 14th day $0.13 \pm 0.03$ mg% and 28th day $0.32 \pm 0.10$ mg%.

The serum alkaline phosphatase activity $32.89 \pm 6.57$ KA unit in control group, which was gradually become lower up to 28th day of treatment $24.03 \pm 4.07$ KA though the decrease trend was not statistically significant.

The serum glutamate pyruvate transaminase and serum glutamate oxaloacetic transaminase both the enzyme has been shown significant elevation in all the treatment group. The highest value of SGOT was noted on $89.86 \pm 9.01$ U/ml in 21st day of treatment and $62.43 \pm 4.74$ U/ml SGPT in 14th day of treatment.

The GOT and GPT level of liver tissue has been observed a significant rise of their activity. The LGOT level $84.17 \pm 6.70$ U/100 mg of liver tissue and LGPT level $74.33 \pm 10.54$ U 100mg of liver tissue in control group which was found to be in peak level in 21st day of treatment in LGOT level $162.17 \pm 5.90$ U/100 mg liver tissue and LGPT activity on 14th day treatment $163.33 \pm 10.64$ U/100 mg liver tissue.

9. The aqueous extract of *Terminalia chebula* has been administered on CCl₄ induced rat and the following biochemical parameters was studied to assess the recovery change in both serum liver tissue in experiment animal.

The liver volume and wet weight of liver both were increase in CCl₄ treated group. $7.07 \pm 0.12$ ml and $7.28 \pm 0.11$ / 100 gm of rat respectively. In the control group liver volume was noted to be $5.15 \pm 0.25$ ml and liver weight $5.25 \pm 0.18$ gm. The
volume and weight of liver were found to be lowered to (500/mg kg/b.w.) which was recorded of aqueous extract of *Terminalia chebula* group.

Total serum protein level remain unchanged in all the group which was recorded as statistically insignificant. The serum bilirubin level has been altered significantly. In control group it was noted to be $1.23 \pm 0.26$ mg% which became very high $10.28 \pm 1.76$ mg% in CCl₄ treated group. A little reduction of serum bilirubin level was noted in group D in comparison to Group B which was further statistically insignificant.

The serum alkaline phosphatase activity has been raised in CCl₄ treated group $17.5 \pm 0.60$ KA unit which was not controlled by aqueous extract of *Terminalia chebula* in both the concentration (200 mg and 500 mg/kg b.w.) in group C and D.

The SGOT level was observed high in CCl₄ treated group $34.67 \pm 1.76$ U/ml, which became under control in group C and D and recorded upto $29.50 \pm 2.08$ U/ml and $28.67 \pm 1.86$ U/ml respectively.

The SGPT activity was noted after CCl₄ administration $28.0 \pm 1.46$ U/ml which was statistically not significant in comparison to other treatment groups.

10. The histological study of rat liver showed fatty change, haemorrhage with centrolobular necrosis in CCl₄ treated group. However, few normal hepatocytes has been noted in group D. The group C (200 mg/lg b.w. *Terminalia chebula* extract has no any recovery in terms of normal liver cell or fatty change etc. are depicted in comparison to group B.
11. The blood glucose, total protein, albumin, serum bilirubin, serum alkaline phosphatase, transaminase activity of serum were compared with those of previous studies made by different workers in normal albino rat and found to be almost similar.

The elevation of blood sugar level in 28th day treatment may due to inhibition of dopanergic center since these mechanism has been found to implicate the release of insulin from pancreatic β - cells. On the other hand there is a fall of BG level in 14th day of treatment was noted which may due to the presence of anticipatory signals from the gastro-intestinal tract to pancreas.

The serum total protein level was slightly elevated but albumin level was remain unchanged, hence the globulin fraction of treated groups were raised, though the albumin globulin ratio were maintained within the normal range.

The aqueous extract of *Terminalia chebula* has not affected the bilirubin metabolism. Though a rising trend in serum total bilirubin has been depicted in fist phase of experiment but it was statistically insignificant. In second phase of study the higher dose of aqueous extract of *Terminalia chebula* (500mg / kg b.w.) has controlled the serum bilirubin level which was raised up to 10.28 ± 1.76 mg% after administration of CCl₄ in group B.

The serum alkaline phosphatase activity was noted to be lowered after administering the aqueous extract of *Terminalia chebula* The SGOT and SGPT activity in present investigation though observed higher after administering the aqueous extract of *Terminalia chebula*, in different days of treatment but it tends to normal limit in 28th day of treatment. The similar observation has been noted in GOT and GPT activity
of liver tissue. Hence, from the above value, suggests that the enzyme activity does not produce liver damage as the elevation of serum transaminase may reach up to 15 times of its normal limit. In second phase of experiment the elevation of SGOT and SGPT level after administering CCl₄ in group B, could not bring to its normal range by aqueous extract of *Terminalia chebula* in both the concentration. (200 mg and 500 mg/kg b.w.)

12. In the present investigation the higher dose of (500 kg /b.w.) Terminalia chebula group was capable to significantly reduce the liver volume and weight in CCl₄ treated rat indicating the hepatoprotective activity of the fruit.

   In histopathological investigation of 2nd phase of experiment, there was gross necrosis and fatty changes in CCl₄ treated group. Improvement of hepatic lesions produced by CCl₄ along with reappearance of normal hepatocytes was noted in the group receiving 500mg aqueous extract of *Terminalia chebula*. 
CONCLUSION

Liver is the vital organ of the body and is continuously exposed to a great variety of endogenous and exogenous products including the toxic agents of metabolic and therapeutic nature. The effects of *Terminalia chebula* on the intestine, kidney have been studied but investigation relating to its effects on the liver functions has not been properly worked out.

Present work on experimental animals has shown that *Terminalia chebula* is not at all hepatotoxic; rather it has got the hepatoprotective action as observed by structural and functional improvement of liver when administered on a group of rats whose livers were subjected to the injurious effect of Carbon tetrachloride. Further study in this line is necessary to come to a definite conclusion.