CHAPTER-7

SUMMARY, CONCLUSION AND RECOMMENDATIONS
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Summary

The present investigation comprises of the phytochemical and pharmacological investigations of aerial parts of *Grewia serrulata* DC for the antidiabetic activity. The research work encompasses an in depth and systematic phytochemical and investigation of various extracts of aerial parts of the plant.

The plant being authenticated and evaluated for different physicochemical properties which can be ash values, moisture content and extractive values etc. The acid insoluble ash value had been found to be less than the total ash value and water soluble ash value being found to be significantly less than total ash value within the proximate analysis. Alcohol soluble extractive value was significantly more than water soluble extractive value.

The aerial parts of *Grewia serrulata* DC had been extracted successively by using soxhlet extraction method with petroleum ether (60-80°C), chloroform, acetone, ethanol and water, their color consistency and the percent yield had been determined.

In preliminary phytochemical assessment, phytoconstituents like glycosides, saponins, phytosterols, flavonoids, phenols, steroids, terpenoids showed positive tests in the ethanolic extract and aqueous extract showed the presence of carbohydrates, saponins, phytosterols, flavonoids, steroids and terpenoids as phytoconstituents. The extracts
of petroleum ether, benzene, chloroform and acetone reveal the absence of many chemical constituents.

In acute toxicity study, it was revealed that there were no signs of toxicity observed at a dose of 2000mg/kg b. w after a dose that is single of aqueous and ethanolic extracts. During sub-acute toxicity study, there were no noticeable changes witnessed in biochemical indices of the rats treated with both extracts except the hypoglycemia, throughout the dosage schedule of 28 days.

Carbon tetrachloride induces the generation of toxins which affect antioxidant defense system, leading to the interruption of cellular functions, oxidative harm to membranes and increased susceptibility to lipid peroxidation. The experimental results discovered a noticeable amount of flavonoids in EEGS compared to AEGS which might subscribe to the reported anti-oxidant and antidiabetic potential for the extracts which in turn accountable for antidiabetic activity. Besides that, within the in-vitro experiments, among both the extracts ethanolic extract dramatically scavenge DPPH, Superoxide, Hydrogen peroxide and Nitric oxide radicals in a concentration dependent manner.

The potential that is significant by EEGS compared to AEGS in reduced amount of the liver lipid peroxidation products and high level associated with liver antioxidant enzymes into the diabetic rats, indicate that, ethanolic extract is having good potential to inhibit the oxidative harm of liver tissues in diabetes. The rise in the liver
enzymatic antioxidant status be due to decreased oxidative stress as evidenced by decreased lipid peroxidation into the extract treated animals.

The plant extracts, due to their free radical scavenging capability offer protection against oxidative damage in diabetes mellitus. Overall, it’s concluded that AEGS and EEGS have powerful antioxidant activity towards the presence of phytoconstituents like polypeh- nols and flavonoids, and but, the utmost strength rest with EEGS.

The results associated with antidiabetic study illustrates that, ethanolic extract is endowed with significant potential in reducing the blood glucose in both oral glucose loaded and streptozotocin induced hyperglycemic rats on acute study protocols. Sub-acute study protocols, including HFD fed-streptozotocin induced hyperglycemic rats treated with EEGS at dosed 200 and 400 mg/kg b. w suggests the presence of pancreatic and extra pancreatic actions. But, EEGS 400 mg/kg is found to be more significant in reducing the blood glucose levels than compared to EEGS-200mg/kg at the given experimental conditions.

Both the doses of ethanolic extract registered significant activity in increasing the peripheral glucose uptake by the isolated rat hemi diaphragm. The test doses additionally found to increase the glycogen degree that might be because of the increased transformation of glucose to glycogen that would be attributed as a result of reactivation of this glycogen synthetase system. The property for the test doses to
recuperate the body weight of animals suggesting increased usage and decreased retention of protein.

It’s beyond the doubt that the extract of both doses have insulinotrophic and cytoprotective effect as evidenced by the progressive rise in plasma insulin levels during the period of the research. The likely mechanism that can be done through which the plant extracts intercede their antidiabetic action, is potentiation of pancreatic release of insulin from established residual β-cell of islets and/or because of improved utilization of blood glucose by peripheral cells also.

The lipid profile and serum enzymatic research details are in an excellent agreement because of the support of anti-diabetic and hypoglycemic potential plus the safetyness regarding the plant extract.

Nevertheless, in every experimented activity, EEGS of dose 400mg discovered to be a more potent than compared to EEGS of 200mg.

The test doses (200mg & 400mg) showed no alteration in the significance for the haematological parameters and evidenced the safetyness of the test doses. The histopathology research of liver kidney and pancreas summarized that the test doses have a very good protection on the liver and renal cells of the diabetic animals.

Since the experiment report incarnated within the thesis confirmed that EEGS shows comparatively better activity, hence it implemented us to isolate compound that is present in the extract,
and found to be a flavonoid derivative through the combined fractions of Ethyl acetate and n-Hexane, having molecular formula C_{23}H_{24}O_{12}, bearing the IUPAC nomenclature as: 2-(3,5-dihydroxyphenyl)-5,7-dimethoxy-3-((3,4,5-trihydroxy-6-(hydroxymethyl)tetrahydro-2H-pyran-2-yl)oxy)-4H-chromen-4-one in line with the characteristics details of FTIR, $^{13}$C-NMR, $^1$H-NMR and LC-MS spectra.

2-(3,5-dihydroxyphenyl)-5,7-dimethoxy-3-((3,4,5-trihydroxy-6-(hydroxymethyl)tetrahydro-2H-pyran-2-yl)oxy)-4H-chromen-4-one isolated from ethanolic extract of aerial parts of *Grewia serrulata* DC (EEGS-C1) has promising anti-diabetic effect, which potentially improved abnormalities of diabetic conditions in high fat diet fed – streptozotocin (HFD-STZ) induced diabetic rats. The probable hypoglycemic effect of EEGS-C1 may be attributed to increase in serum and pancreatic insulin levels and due to its antioxidant property.

**Conclusion**

The present investigations concluded that the aerial parts of *Grewia serrulata* DC gifted with potential hypoglycemic and antihyperlipidemic activity which may be attributed by their possible multiple impacts on both pancreatic and extra-pancreatic site towards glucose and metabolic process of lipids. The extracts apply great potentials to scavenge toxic free-radicals combined with the inhibition of this liver lipid peroxidation products and activation of this enzymatic anti-oxidant defense process in diabetic rats that would be because of the existence of high levels of phenolics and flavonoids, which may be
accountable for the encouraging characteristics related to extract for their antidiabetic activity. Also, the sub-acute and histopathology studies revealed the safetyness regarding the extracts in animals. Compound isolated from ethanolic extract was found to be a flavonoid derivative that is responsible for free radical scavenging activity of the extract. The compound exhibits good hypoglycemic and hypolipidemic activity in diabetic rats. Hence the plant *Grewia serrulata* DC can show beneficial effects in normalizing the altered glycemia, carbohydrate and lipid metabolism and restores the antioxidant enzyme levels of liver and kidney.

**Recommendations**

It is recommended that further investigation is to be carried out for longer duration on chronic models on receptor level to know the exact mechanism of antidiabetic activity. In addition to, there is a need to isolate more bioactive principles and should evaluate for its antidiabetic activity on molecular basis.