CHAPTER 6: DISCUSSION

Human race is largely dependant on the plant kingdom which is not only providing a source of vital nutrients, but also caters to the needs of humans by providing remedies to different types of ailments. This has lead to the evolution of plant science dealing with the usage of plants in treating and controlling many different diseases by trial and error. Herbal medicine is referred to use of plant products to treat or prevent a disease. Herbal medicine is also known as a subset of larger term “Complementary and alternative medicine” (CAM). Long before the advent of modern medicine herbs were the mainstream remedies for nearly all ailments. Now a days due to the adverse effects of modern medicine, people have been turning in increasing numbers to the use of herbal medicine as both an alternative and adjunct to modern drugs\textsuperscript{232}.

Medicinal plants have their values due to the presence of chemical constituents, commonly known as secondary metabolites, present in various plant tissues. These substances are alkaloids, glycosides, essential and fatty oils, resins, gums, mucilage, tannins etc. of large use. These active principles may be present in the storage organs of plant, viz. roots, seeds, leaves, wood etc.

The present study was undertaken to assess the antioxidant, antidiabetic and hepatoprotective activities of selected medicinal plants i.e. \textit{Bauhinia variegata} root, \textit{Tectona grandis} bark and \textit{Schebera swietenoides} fruit.

Oxygen derived free radical reactions have been implicated in the pathogenesis of many human diseases including diabetes and liver disease\textsuperscript{233}. Antioxidants are radical scavengers which protect the human body against free radicals. Flavonoids, flavones, sterols,
quinone, terpenoids etc are widely distributed secondary metabolites with antioxidant and antiradical properties in the plant\textsuperscript{234-237}.

*Bauhinia variegata* root, *Tectona grandis* bark and *Schebera swietenioides* fruit are traditionally used in diabetic and liver disease condition. The preliminary qualitative examination of these plant extracts (petroleum ether 40-60°C, ethanolic 95%, and aqueous extract) has indicated the presence of flavonoids, sterols, quinines, carbohydrates, glycosides and triterpenoids constituent.

The 1, 1-diphenyl -2-picryl hydrazyl (DPPH) radical was widely used as the model system to investigate the scavenging activities of several natural compounds. The antioxidant activity exerted by ethanolic extract of *Bauhinia variegata* root, *Tectona grandis* bark and *Schebera swietenioides* fruit exhibited maximum percentage inhibition of free radicals i.e. DPPH radical, in less amount of concentration when compared with their aqueous and petroleum ether extracts. Further, potent antioxidant activity exhibiting ethanolic extract of these selected medicinal plants were subjected for antidiabetic & hepatoprotective study.

Acute oral toxicity studies were conducted to find out LD\textsubscript{50} values of these selected medicinal plants, which were found safe (no mortality) even when given at the dose of 2000 mg/kg body weight with no signs of acute oral toxicity at respective dose. Hence, 1/10\textsuperscript{th} of this lethal dose was taken as effective dose (therapeutic dose) for subsequent antidiabetic and hepatoprotective activity i.e. 200 mg/kg b.w.p.o.

**Anti-diabetic activity:**

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. Long term diabetes leads
to a series of metabolic aberration causing vascular pathology. Diabetes patients usually show varied symptoms of polyurea, polydypsea and polyphagia. In severe forms weight loss can be seen, while in some cases, symptoms may be absent and consequently hyperglycemia may remain undetected. Many synthetic drugs, though capable of managing the disease, produce number of adverse effects. Hence, a new approach of plants or herbs with blood glucose lowering capacity was preferred.

When these selected medicinal plants ethanolic extract subjected for antidiabetic activity in OGTT, it was observed that these plants possess antihyperglycemic activity which is confirmed by improvement of glucose tolerance test. This indicates the possible action including acting though pancreatic mechanism or by inhibition of glucose absorption though gastrointestinal tract.

In my present study, a single i.p. injection of alloxan (120 mg/kg of body wt.) to rats resulted in severe hyperglycemia, damage of Islets of Langerhans and β cells, elevation in cholesterol level and decreased body weight in albino Wistar rats. Alloxan has been widely used for the induction of diabetes mellitus in various experimental animals, it produce diabetes mellitus by cytotoxic action on pancreatic β- cells results in insulin deficiency. Extract of these medicinal plants were given orally with the help of a gastric tube to alloxan induced diabetic rats. Further, samples of blood were collected at 30 min, 1 h, 2 h, 4 h and 6 h in single dose treatment study (Acute study), where as on day 5th, 10th and 15th in multi dose treatment study (Sub acute study). Control animals received equal volume of 1% gum acacia.

The results of blood glucose level estimation obtained from alloxan induced diabetic rats, in single dose treatment study, indicated that the ethanolic extract of Bauhinia
variegata root (P<0.01), ethanolic extract of Tectona grandis bark (P<0.01) and standard drug-Glibenclamide (P<0.01) showed highly significant antidiabetic activity at 1 h, 4 h and 6 h, while ethanolic extract of Schebera swietenioides fruit extract at the same time showed significant antidiabetic activity (P<0.05) whereas in multidose treatment study these extracts and Glibenclamide had shown highly significant (P<0.01) antidiabetic activity on 10th and 15th day of study when compared with diabetic control rats.

Induction of diabetes with alloxan is associated with a characteristic loss of body weight, which is due to increased muscle wasting, loss of tissue proteins. In this study, highly significant prevention of reduction in body weight observed from 5th day onwards (P <0.001), during the period of treatment of the rats, with Bauhinia variegata root (200 mg/kg/day), Tectona grandis bark (200 mg/kg/day) and Glibenclamide (2.5 mg/kg/day) treated group.

In present study, serum TC, TG, VLDL, LDL cholesterol levels were elevated in untreated diabetic rats. Extract and standard drug treatment for 15 days in diabetic rats showed significant reduction in all these lipid profiles. The observation indicates that, these selected medicinal plant extracts were beneficial in enhancing HDL cholesterol and lowering TG, TC, LDL, VLDL cholesterol, thereby reveals its useful therapeutic value. It is evidenced that glucose lowering activity of selected medicinal plant extracts is responsible for controlling and correcting the altered lipid profile, this effect may be due to the presence of active constituents in selected medicinal plants. Histological examination of pancreas of these animals, showed comparable regeneration of Islets of Langerhans and β cells by ethanolic extract of Bauhinia variegata root, Tectona grandis bark, Schebera swietenioides fruit and Glibenclamide standard drug, which were earlier, necroses by alloxan.
Hepatoprotective activity:

CCl$_4$ mediated hepatic toxicity was taken as an experimental model for liver injury. It has been shown that CCl$_4$ gets accumulated in the hepatic parenchymal cell and metabolically activated by cytochrome P450 dependant monooxygenases to form a trichloromethyl free radical (CCl$_3$), which alkylates cellular proteins (including cytochrome P450) and ether macromolecules with a simultaneous attack on polyunsaturated fatty acids in the presence of oxygen to produce lipid peroxides leading to liver damage. In the present study, CCl$_4$ treatment significantly elevated the enzyme levels of SGOT, SGPT, SALP and total bilirubin indicating significant hepatic damage. Ethanolic extract of Bauhinia variegata root, Tectona grandis bark and Liv 52 syrup showed significant reduction in the elevated enzyme level induced by CCl$_4$ treatment, whereas, Schebera swietenioides fruit extract exhibited least activity. This subsequent recovery towards normalization of the enzymes suggesting the capability of the above extracts to condition the hepatocytes (seen in histopathological observation) so as to accelerate parenchymal regeneration, thus protecting against membrane fragility and subsequently decreasing leakage of marker enzymes into the circulation. The histological observation of these selected medicinal plants ethanolic extract treated liver found to have normal architecture with very mild fatty changes when compared with CCl$_4$ treated liver, which signifies hepatoprotective activity of these selected medicinal plants. The probable mechanism of protective action of these extracts, against CCl$_4$ induced hepatic metabolic alterations, can be either though an enhanced protein synthesis, or interference with the microsomal activation of CCl$_4$ or its accelerated detoxification (free radical scavenging activity) or excretion.
Further, the selected extracts of medicinal plants were subjected for various fractionations with different solvents in the column chromatography for separating active phytoconstituents. Totally around 10 fractions were collected from each extract. These obtained column fractions were characterized by qualitative chemical test and TLC. These column fractions shown the presence of following important phytoconstituents,

- sterols & flavonoids in *Bauhinia variegata* root ethanolic extract
- quinones & sterols in *Tectona grandis* bark ethanolic extract &
- triterpenoids in *Schebera swietenioides* fruit ethanolic extract.

The presence of these active phytoconstituents in the extract is one of the mechanism associated for antioxidant, antidiabetic and hepatoprotective effect.