5.0. DISCUSSION

Natural products and biological substances with therapeutic effects are of increasing interest in present conditions of the environment. Human beings are under menace to face more environmental calamities, leading to increase in the ageing process which tends to turn back to the natural medicines. Algae are a rich and varied source of pharmacologically active natural products (Konig & Wright, 1993). Research and consumption of marine algae and its products have increased markedly in recent years. A number of products based on algae as a material have been developed and applied in many fields (Hoppe, 1982).

5.1. FLUORESENT ANALYSIS

Many phytocompounds fluorescence when suitably illuminated. The fluorescence colour is specific for each compound. A non fluorescent compound may fluoresce if mixed with impurities that are fluorescent. The fluorescent method is adequately sensitive and enables the precise and accurate determination of the analysis over a satisfactory concentration range without several time consuming dilution steps prior to analysis of pharmaceutical samples (Pimenta et al., 2006).

The powder as such of S. wightii exhibited fluorescent brownish green, powder+1N NaOH (aq.) showed brownish fluorescent green, powder+1N NaOH (me.) showed reddish fluorescent green, powder+1N HCl showed fluorescent brilliant green, powder+50% H₂SO₄ showed brownish fluorescent green and powder+50% HNO₃ showed reddish fluorescent green.
To understand the nature of the fluorescence emission from these crude preparations under different conditions, the preliminary phytochemical analysis of these crude preparations was compared. The comparative analysis clearly showed a correlation between a compound present in it and their fluorescent behavior under different conditions. The major bioactive compounds present in these crude preparations are the coumarins, flavones, tannins, alkaloids and saponins. Coumarin especially hydroxyl aminoacid derivatives like o-coumaric acid appears yellowish green in alkaline condition under short UV radiation. Flavones which are light yellow in aqueous condition under UV light turns to bright yellow under alkalin conditions. Similarly the phytosterosols when treated with 50% H₂SO₄ show green fluorescence under UV light. Terpenoids especially saponins exhibit yellow green fluorescence under UV light (Harborne, 1976). Quinine, aconitin, berberin and emetin show specific colour of fluorescence (aconitin-light blue; berberin-light yellow; emetin-orange). Fixed oils and fats fluoresce least, waxes more strongly and mineral salts most of all (Evans, 1996). Haydon (1975) studied the photophysical characters of coumarins. Hydroxy methyl coumarin fluoresced in the 420-440 nm when observed in different solvents with increasing polarity (Chattopadhyay, 2006).

5.2. PHYSICOCHEMICAL CONSTANTS

The physical constant evaluation of the drug is an important parameter in detecting adulteration or improper handling of drugs (African pharmacopoeia, 1986). Equally important in the evaluation of crude drugs, is the ash value and acid - insoluble ash value determination. The total ash is particularly important in the evaluation of purity of drugs, i.e., the presence or absence of foreign organic matter
such as metallic salts and/or silica. The ash value is indicative of the impurities present in the drug. Since the ash value is constant for a given drug, the value is also one of the diagnostic parameter of the drug. The ash value in generally an index of the purity as well as identity of the drug (Musa et al., 2006).

5.3. PHYTOCHEMICAL SCREENING

Presence or absence of certain important compounds in an extract is determined by colour reactions of the compounds with specific chemicals which act as dyes. This procedure is a simple preliminary pre-requisite before going for detailed phytochemical investigation. Various tests have been conducted qualitatively to find out the presence or absence of bioactive compounds. Different chemical compounds such as alkaloids, terpenoids, steroids, coumarin, tannin, saponin, flavonoids, quinones, anthroquinones, polyphenols, protein, carbohydrate, catachin and glycosides were detected in the various extracts of S. wightii.

The presence of the various secondary metabolites in these seaweeds is a clear indication of their pharmaceutical potential. The secondary metabolites may be useful in containing infections, act as hypolipemic and hypoglycaemic agents, reduce blood pressure and regulate cholesterol levels (Krishnamurthy, 2005). Therapeutically terpenoids exert wide spectrum of activities such as antiseptic, stimulant, diuretic, anthelmintic, analgesic and counter-irritant (Gokhale et al., 2003). Many tannin containing drugs are used in medicine as astringent. They are used in the treatment of burns as they precipitate the proteins of exposed tissues to form a protective covering (Handa and Kapoor, 1992). They are also medically used as healing agents in inflammation, leucorrhoea, gonorrhoea, burns, piles and antidote (Ali, 1994). Similarly
saponins have great pharmaceutical importance because of their relationship to compounds such as the sex hormones, cortisones, diuretic steroids, vitamin D etc., (Evans and Saunders, 2001). From plant sapogenins a synthetic steroid is prepared and to treat a wide variety of diseases such as rheumatoid arthritis, collagen disorders, allergic and asthmatic conditions (Claus, 1956).

5.4. QUANTIFICATION OF BIOCHEMICALS

The results of the present investigation showed considerable variation in the amount of biochemicals in *S. wightii* earlier works, Dave et al. (1987) also confirmed the possibilities of variations in values of the biochemical composition of seaweeds. Higher carbohydrate, protein and organic carbon values in the brown seaweeds *S. wightii* are in conformity with earlier report of Ganesan and Kannan (1994). The presence of a very high amount of protein in the brown alga *S. wightii* is in consonance with earlier observations (Joshi, 1949; Selvaraj and Sivakumar, 1998). The presence of highest amount of organic carbon and maximum calorific value in *S. wightii* are agreeable to the values on these two parameters studied by Venkataraman Kumar (2005).

The presence of very high amount of primary metabolites (protein, carbohydrate and lipid) and fibre content in the seaweeds of the present study is indicative of nutritive rich nature of this marine organism and make this seaweed nutraceutical in nature (Krishnamurthy, 2005). The presence of fibre in the diet is necessary for digestion and elimination of wastes. Current dietary recommendations emphasize increased consumption of fibre-rich foods. These fibres have a variety of
physiological effects and provide many health benefits including satiety (Slavin, 2004).

In the present study, the amount of tannin and phenol in *S. wightii* was found to be more or less similar to that obtained is an earlier study (Poppy Mary Vimalabai *et al.*, 2004). It has been reported that the presence of phytoconstituents such as tannin and polyphenols help in preventing a number of diseases through free radical scavenging activity (Vasanthi *et al.*, 2006). The secondary metabolites, phenolics (tannin and phenol) are found to play a greater role in the maintenance of the human body (Latha and Daniel, 2001). The presence of anthocyanin, a class of flavonoid in the seaweeds gains significance because of the following facts. Anthocyanins protect tiny blood vessel free from radical damage and stimulate the formation of healthy connective tissue (Brown, 1997). Since anthocyanin helps in regenerating rhodopsin, a purple pigment needed for night vision and adaptation to light, a number of anthocyanin preparations are flooding the market (Latha and Daniel, 2001).

Higher value of nitrogen content in *S. wightii* is in close agreement with the earlier report (Dhargalkar *et al.*, 1980). The result of maximum amount of potassium, calcium and magnesium found in *S. wightii* in consonance with an earlier study (Venkataraman Kumar, 2005). These minerals are essential and therefore contribute towards the nutritional value of the brown seaweeds *S. wightii* (Krishnamurthy, 2005). The amount of vitamin C estimated in the seaweeds of the present study was found to exceed over the values reported in the earlier studies (Thivy, 1960; Poppy Mary Vimalabai *et al.*, 2003). Since vitamin C is an important antioxidant, its rich amount gains importance.
The presence of vitamin E in quantifiable amount again significance in this seaweed because this vitamin aids in the synergistic action of the flavonoids to exhibit the antioxidant role (Kaneko and Baba, 1999). Vitamin E acts as antioxidant against peroxidation of fatty acid contained in the cellular and subcellular membrane phospholipids leading to the formation of phenoxy free radicals. These free radicals formed may react with Vitamin C to regenerate tocopherol (Gutteridge, 1995).

5.5. HPTLC ANALYSIS

Evaluation of active compounds (secondary metabolites) in S. wightii by HPTLC confirmed the presence of alkaloid, glycoside, saponins, steroid (stigmasterol) and trepenoid but flavonoid was found to be absent in this brown seaweed S. wightii in ethanolic extract. These secondary metabolites which may be useful in controlling infection, act as hypolipemic and hypoglycaemic agents, reduced blood pressure and regulated blood cholesterol level (Krishnamurthy, 2005).

5.6. HPLC ANALYSIS

The result exhibited identification and quantification of 21 amino acids by HPLC analysis. Glycine was the maximum followed by threonine and cystine. In a previous study (Vinoj Kumar and Kaladharan, 2007), the amount of aspartic acid and glutamic acid in S. wightti from Kerala coast was found to exceed other amino acids. In the present study, S. wightti from Tuticorin coast showed maximum amount of glycine when compared to other amino acids. Moreover, the total amount of essential amino acid was found to be more in the present study when compared to previous work (Vinoj Kumar and Kaladharan, 2007). The total score on essential amino acids was found to be 4.5169% while that of non-essential amino acids 5.9095%. This
clearly showed that brown seaweed *S. wightii* possessed an equally rich amount of essential amino acids which make this seaweed an important nutraceutical (Krishnamurthy, 2005).

Among the fatty acids palmitic acid content was high in *S. wightii*. In the present study, the saturated fatty acid content score (2.655%) was higher than the mono-unsaturated fatty acid score (0.1121%). These results are in conformity with the previous reports (Khotimchenko *et al.*, 2002; Khotimchenko, 2003; Venkatesalu *et al.*, 2003a, 2003b, 2004; Venkataraman Kumar, 2005 and Prabhakar *et al.*, 2011). Among the unsaturated fatty acids, the poly-unsaturated fatty acid and linolenic acid was present to an extent next to the saturated fatty acid, palmitic acid. This observation is very interesting because the aforesaid fatty acid, mono-unsaturated fatty acid, oleic acid and the poly-unsaturated fatty acid, linolenic acid have been found to possess antimicrobial activity (Mundt *et al.*, 2003), antioxidant activity and antiarthritic activity (Ruberto *et al.*, 2001; Kokata *et al.*, 2003; Athukorala *et al.*, 2006; Cheek *et al.*, 2006). Fatty acids are important for a wide range of cell structure components and for many biochemical reactions occurring in the body including hormonal and energy activities. Moreover they play a significant role in establishing a lipid barrier in the skin to block irritants and infectious agents from entering the body and some of them are reported to have beneficial effects on human health such as cardioprotective, anticytotoxic, antimitotic, anticancer, and antimutagenic activities (Prabhakar *et al.*, 2011).
5.7. ANTIDIABETIC PROPERTY (ANTIOXIDANT ACTIVITY OF *S. WIGHTII* ON ALLOXAN INDUCED DIABETIC RATS)

Alloxan is a commonly employed compound for induction of diabetes mellitus in experimental rats (Tomlinson *et al.*, 1992). Recently, it has been reported that long standing hyperglycaemia with diabetes mellitus leads to the formation of advanced glycosylated end products which are involved in the generation of ROS, suggesting the mechanism by which hyperglycaemia causes oxidative damage (Mohamed *et al.*, 1999).

Thus, it is worthwhile to study the lipid peroxidation in long standing cases of diabetes mellitus by quantification of tissue MDA levels. Also, it is of interest to elucidate the alterations in the activities of antioxidant enzymes if there would be any mitigation or a compensatory exacerbation of their activities in diabetic animals.

The present study revealed that the enzyme CAT and SOD activities were significantly inhibited along with an elevation of MDA levels in liver and kidneys of alloxan-induced diabetic rats, whereas there was an increase in the enzyme CAT and SOD activities in heart. In spite of the elevation of these antioxidant enzymes, there was a significant increase in MDA levels in heart. This could be possibly explained by the compensatory mechanism in heart tissue in order to overcome the oxidative damage.

However, liver and kidneys were found to be extremely damaged as reflected by the elevated MDA levels with a reduced CAT and SOD activities in tissue homogenates. The erythrocyte MDA levels were significantly increased in diabetic rats without significant alteration in the antioxidant enzyme activities as compared to
normal rats. Similarly, repeated administration of S.wightii reduced the levels of MDA significantly, but exhibited an insignificant role in altering the antioxidant enzyme activities of erythrocyte in diabetic rats.

The most possible mechanism by which diabetes mellitus induces the pathological changes is by hyperglycaemia-induced non-enzymatic modification of sugar moieties on other proteins leading to the formation of advanced glycosylation end products, which can generate ROS for the oxidative damage (Mohamed et al., 1999). Significant elevation of glycosylated haemoglobin and CPK in alloxan-treated animals indicated the long-standing diabetes mellitus had caused the advanced glycosylation and tissue damage, respectively. Administration of S. wightii (25 and 50 mg/kg) could significantly reduce the tissue MDA levels and ameliorate the alterations in the biochemical markers.

The possibility of the antioxidant activity of S.wightii could not be ruled out for the potent protection offered in S.wightii treated diabetic animals. Although, it is difficult to explain presently regarding the quantity of S.wightii for daily consumption with foods, it was attempted to extrapolate the 25, 50 mg/kg dose of S.wightii that showed effects on trial conducted in rats to an adult man. Based on the dose equivalent extrapolation system (Van Miert, 1999), where rat weighing 150 g was considered to have dose equivalent of 6.3 units, while adult man weighing 60 kg was equated with the dose equivalent value of 1, the possible daily requirement of S.wightii at 1–2 lit/kg might be considered for an adult man.

However, the assumption needs detailed investigation and cannot be explained presently at least due to the lack of bioavailability studies of S.wightii on human
subjects. Thus, the study shows that oxidative damage appears to play a major role in alloxan-induced liver (hepatic), heart (cardiac) and kidney (renal) toxicity as evidenced by significant inhibition of antioxidant defense mechanism in kidney (renal) and liver (hepatic) tissues or a compensatory elevation of antioxidant defense mechanism in cardiac tissue accompanied by an elevation of lipid peroxidation end products in both the tissues. Oral administration of *S. wightii* partially ameliorated the diabetic glycosylated haemoglobin levels and exhibited a potent antioxidant effect in the diabetic animals.

5.8. ANTIDIABETIC PROPERTY (HYPOGLYCAEMIC ACTIVITY OF *S. WIGHTII* ON ALLOXAN INDUCED DIABETIC RATS)

Since alloxan can act as diabetogenic agent (Gunnarsson, 1975) and can be used to induce experimental diabetes in rodents (Agarwal, 1980), when animals are injected with alloxan (65 or 75 mg/kg), it produces a significant hyperglycaemia (Kumar *et al.*, 2006). In the present study rats treated with extracts of *S. wightii* showed marked hypoglycaemic effect. The blood glucose lowering effect in the absence of a significant change in plasma insulin concentration suggests that the *S. wightii* treatment may involve an insulin independent mechanism.

The present investigation showed that treatment with *S. wightii* reduces the blood sugar level and it may be due to stimulating effect on insulin release from regenerated beta cells of the pancreas or may be due to increased cellularity of the islet tissues and regeneration of the beta cells. The aqueous extract might be producing its hypoglycaemic effect by an extra-pancreatic action e.g. possibly by stimulating glucose utilization in peripheral tissues (Naik *et al.*, 1991; Obatomi *et al.*, 1994). Also,
it could be the result of an increase in glycolytic (Steiner and Williams, 1959) and/or
glycogenic enzymes activity in peripheral tissues (Naik et al., 1991). Although it
might be possible that the aqueous extract may decrease the secretion of the counter
regulatory hormones (glucagons, cortisols and growth hormones) further studies are
required to confirm this. Since the blood glucose lowering effect of the extract of
*S.wightii* was observed in alloxan diabetic rats as well as in fasted normal rats, this
effect could, possibly be due to inhibition of the proximal tubular reabsorption
mechanism for glucose in the kidney, if any, which can also contribute towards blood
lowering effect (Sharma et al., 1983). From the above results, we observed that the
crude extract of *S.wightii* produced a significant decrease of blood glucose levels, and
this effect was more potent after repeated oral administration than after single oral
administration. These results suggest that the effectiveness of the drugs depend,
probably, on the accumulative effect of active principles (Obatomi et al., 1994;
Peungvicha et al., 1998).

Protein fractions of *Cystoseria corniculata* from Turkish coast of
Mediterranean sea showed lipolytic and hypoglycaemic activity (Guven, 1980). There
are reports that *Cystoseira barbata* has lipolytic and hypoglycaemic effects (Guven &
Aktin, 1964; Guven & Bergiadi, 1973; Guven et al., 1974). Extract of *Caulerpa
racemosa* showed hypotensive activity (Naqui, 1981). *Sargassum fusiforme* and
*Laminaria japonica* in China are used for producing cooling and blood clearing effect
for treatment of glandular weakness, apoplexy and for normalizing blood pressure
(Chiu, 1956). Substances obtained from *Sargassum vulgare* and *Polysiponia
subulifera* are effective in increasing serum lipolytic activity. A certain percentage was
shown to have antilipemic activity and a polypeptide structure (Aktin & Guven, 1965; Guven & Tekinalp, 1971; Guven & Guven, 1975). A substance isolated from the alga *Phyllophora nervosa* also showed antilipemic properties (Guven & Akin, 1962).

*S.wightii* contains an amorphous saponin, a non-nitrogenous bitter amorphous glucoside called Trichosanthin (Shastri, 1952) terpenes, fixed oil, starch, reducing sugars (Chopra *et al.*, 1956) and bitter natural principles, cucurbitacins (Narayan Das Prajapati *et al.*, 2003). Mono-unsaturated fatty acid (MUFA) oleic acid and Poly-unsaturated fatty acid (PUFA) linolenic acid found in *S. wightii* could be responsible for the antioxidant and hypoglycemic activities pertaining to diabetes.

**5.9. ANTIOBESITIC PROPERTY OF S. WIGHTII ON ALLOXAN INDUCED DIABETIC RATS**

Diabetes is associated with profound alterations in the plasma lipid, triglycerides and lipoprotein profile and with an increased risk of coronary heart disease (Huang *et al.*, 1988; Fontbonne *et al.*, 1989). High level of total cholesterol is one of the major factors for coronary heart diseases and it is well known that hyperlipidemia and the incidence of atherosclerosis is increased in diabetes. The liver and some other tissues participate in the uptake, oxidation and metabolic conversion of free fatty acids, synthesis of cholesterol and phospholipids and secretion of specific classes of plasma lipoprotein. Lowering of serum lipid levels through dietary or drug therapy seems to be associated with a decrease in the risk of vascular disease and related complications (Betteridge, 1997).

Many herbs and marine plant products have been shown to have antihyperglycemic and antihyperlipidemic properties (Brown *et al.*, 1993). Diabetes is
generally associated with hyperlipidemia, which has been found to be mainly due to overproduction of VLDL-triglycerides in type 2 diabetes (Kissebah et al., 1982; Blades and Garg, 1995; Bourgeois et al., 1995), besides abnormalities in lipid metabolism, characterized by severe hypertriglyceridemia and hypercholesterolemia (Levy et al., 1988; Greene et al., 1991; Alauopvic and Fernandes, 1985; Levy et al., 1993). The present studies show that the crude extract possesses definite hypotriglyceridemic and antiatherogenic properties in alloxan diabetic rats after 3 weeks of treatment.

The repeated administration of S. wightii extract for a period of 21 days resulted in a significant decrease in lipid parameter levels of various tissues when compared to the diabetic control. It is not known whether S. wightii has a direct effect on lipids or the present hypolipidemia is achieved due to controlled hyperglycaemia.

Many studies have shown that the increase in fatty acid delivery to the liver leads to increased triglyceride synthesis accompanied by increases in VLDL secretion (Richards et al., 1968; Heimberg and Wilcox, 1972; Jones et al., 1967). It is an important factor in controlling the hepatic triglyceride secretion, and inhibition of protein synthesis has been shown to reduce VLDL, triglyceride secretion. Additionally, insulin is a well-known acute inhibitor of VLDL secretion (Sparks et al., 1986; Durrington et al., 1982; Forget et al., 1974), and insulin resistance is associated with increased VLDL, triglyceride secretion. Most of them demonstrated promising results in lowering the serum cholesterol, triglycerides and LDL-cholesterol level followed by an increase in HDL-cholesterol as have been observed with other natural hypo-cholesterolaemic agents (Singer, 1981; Tsi et al., 1995). Epidemiological studies
have demonstrated a direct relationship of low density of lipoprotein cholesterol to the incidence of coronary heart diseases (Miller & Miller, 1975; Gordon et al., 1977; Gordon et al., 1985, Castelli et al., 1986). The protective role of HDL-cholesterol in atherogenesis was shown by Frick et al., (1987) emphasizing that an 11 % increase in HDL-cholesterol concentration can reduce myocardial infarction by 34 %. Diet-induced hyperlipidaemic rats showed significant decrease in serum cholesterol, triglycerides and LDL-cholesterol when treated with ethanolic extracts of S. wightii. The uptake of lipoproteins from the circulation by extra-hepatic tissues was blocked, resulting in an increase in the level of circulatory lipids (Schurr et al., 1972).

Pharmacological studies have shown that the protein part extracted from Corallina rubens had lipolytic effect (Guven and Guven, 1975). The antilipemic properties of the alga Gelidium latifolium and Gracilaria confervoides (= G. verrucosa) have been studied. It was concluded that heparin-induced lipase has the same characteristics as the lipase released by the substance obtained from G. latifolium Greville (Aktin & Guven, 1969). It has been demonstrated by Ito & Tsuchiya (1972) that an alga Hetrochordaria abielina had a high potency for lowering the blood cholesterol level for rats and the substances responsible for this potency for lowering the blood cholesterol level for rats and the substances responsible for this effect was phaeophytin, phaeophorbide and iodoamino acids. Rhodophyta contain sitosterol, fucosterol, cholesterol level for rats and the substances responsible for this effect was phaeophytin, phaeophorbide and iodoamino acids. Rhodophyta contain sitosterol, fucosterol, cholesterol, chalinasterol. Cholesterol is the most commonly occurring sterol in red algae and has the ability to reduce blood cholesterol level (Bhakuni &
Silva, 1974). The effectiveness of green algae and *Porphyra* on the lowering of the plasma cholesterol level in rats was studied by Abe & Kaneda, (1972), betaines as well as an unidentified compound were detected in the active fraction of seaweed.

The most likely mechanism of action may be due to direct effect on cholesterol biosynthesis (Vazquez-Freire *et al.*, 1996). Our results can also be explained by the evidence that hypolipidaemic action of other natural products is linked with an increase fecal bile acid excretion and with inhibition of cholesterol biosynthesis (Khanna *et al.*, 1992; Singh *et al.*, 1992). The reduced LDL-cholesterol level in hyperlipidaemic rats possibly may be due to receptor-mediated catabolism of LDL and enhance hepatic biosynthesis of protein and nucleic acid (Singh *et al.*, 1992). For a pharmacological agent to be effective for combating hyperlipidemia, it should act to reduce high LDL-cholesterol level. Because low density lipoprotein transport, approximately 70% of plasma cholesterol in human (Spilman *et al.*, 1992).

Algae from Rhodophyta contain nontoxic sterols that have the ability to reduce blood cholesterol level and also reduced far accumulation in liver and heart (Patterson, 1977). Similarly sterols from *Sargassum muticum* and *Fucus gardneri* significantly reduced plasma cholesterine level in experimental animals (Reiner, 1962). In the present study showed the presence of steroid and terpenoid in *S. wightii* could be active principle for reducing cholesterol. From this study, we can conclusively state that *S. wightii* extract has beneficial effects on hyperlipidaemia due to diabetes. Further pharmacological and biochemical investigations are under way to elucidate the mechanism of the antiobesitic effect and hypolipidaemic effect of *S. wightii*. 
5.10. CARDIOPROTECTIVE PROPERTY OF S. WIGHTII ON ISOPROTERENOL-HCL INDUCED MYOCARDIAL INFRACTED RATS

Myocardial infarction carries a high mortality rate and is the commonest single cause of death in developing countries. Immediately after an acute coronary occlusion, blood flow ceases in the coronary vessels beyond the occlusion except for small amounts of collateral flow from surrounding vessels. The area of muscle that cannot sustain cardiac function is said to be infarcted. The overall process is called a myocardial infarction. The biochemical and physiological changes associated with naturally occurring infarction has very close resemblance with that produced by inducing with isoproterenol hydrochloride. The macromolecules known to leak from the damaged tissues, enzymes, because of their damage (Arthur et al., 1996).

The mechanism by which isoproterenol damages the membrane is still not clearly understood. The release of cellular enzymes reflect a non- specific in the plasma membrane integrity / or permeability as a response to β- adrenergic stimulation. Laminaria species were employed mainly in Japanese folk medicine for lowering the blood pressure. L. angustata extracts have shown a benign effect on patients with artherosclerosis and hypertension, the amino acid laminine was the active principle (Kameda, 1966). Laminine, a choline like basic amino acid has also been reported to suppress heart action and depressed blood pressure (Funayama & Hikino, 1981).

When the myocardial cells containing lactate dehydrogenase, aspartate aminotranseferase, and aspartate aminotranseferase are damaged or destroyed due to deficient oxygen supply or glucose, during myocardial ischemic the cell membrane
becomes permeable or may rupture and results in the leakage of enzymes. Free radicals reactions have been implicated in the pathology of many human diseases (Maxwell, 1995). Radicals and other reactive oxygen species are constantly in the body and are removed by enzymic antioxidants defense mechanisms. The deleterious effect produced by free radicals depends up on the balance between oxidant and antioxidant capacity of the system.

Lipid peroxidation is an important pathogenic event in myocardial infarction and the accumulated lipid peroxides reflect the various stages of diseases and their complications (Golekov et al., 1989) free radicals may be formed by infiltration of white cells in to the ischemic myocardium or may be formed by the action xanthine oxidase during the period of ischemia (Jennings et al., 1975). It is generally, that oxygen-centered free radicals are key mediators associated with ischemia – reperfusion injury of heart (David et al., 1990). Isoproterenol administered rats showed increased level of TBA reactants in serum and heart. Sushmakumari et al., (1987) reported enhanced lipid peroxidation in serum and heart of isopropterenol treated rats when compared to control. Maximum induction of lipid peroxides in the serum and heart was noticed in isopropterenol-administered group when compared to control. This distorted metabolic change was recovered by the administered of S. wightii extract.

Glutathione is widely distributed in biological system. In tissues, glutathione is predominantly maintained in the reduced form (Davenport, 1953). Glutathione has a direct antioxidant function besides participating as a hydrogen donor in the Glutathione peroxidase reaction. SOD and CAT activities were decreased on
isoproterenol administration, which is in accordance with the observation of (Manjula et al., 1994) CAT and SOD play vital role in body defense mechanisms against the harmful effect of oxygen free radicals (Sushmakumari et al., 1989). During myocardial infarction, superoxide radicals are generated at the site of damage modulates SOD and CAT resulting in the loss of activity and accumulation of super oxide anion, which damages myocardium. Pretreatment with S. wightii extract increased the activity of SOD and CAT, which scavenge, super oxide radicals and reduced the myocardial damage caused by free radicals upon isoproterenol administration.

Isoproterenol is well known cardiotoxic agent due to its ability it will destruct myocardial cells. As a result of this, myocardial damage was regain and it was resembles with normal heart after the treatment of S. wightii, which closely similar with local myocardial infarction-like pathological changes seen in human myocardial infarction (Karthick and Prince, 2006 and Thippeswamy et al., 2009). The rich amount of mono-unsaturated oleic acid and poly-unsaturated alpha linolenic acid in S. wightii could be the active principles responsible for the cardioprotective remedy.