INTRODUCTION

Type-II diabetes mellitus is responsible as connection with increased oxidative stress (McCoy et al., 1997). During this process there will be formation of free radicals and lipid peroxides due to the oxidation of low density lipo proteins. In addition to this during diabetes there will be alteration of glucose metabolism and enhancement of hydroxyl radical formation. These free radicals which are formed through auto oxidation of unsaturated lipids of biological membranes. These free radicals can react with polyunsaturated fatty acids and leads to the formation of peroxidation of biological membrane (Baynes, 1991). The extract of lipid peroxidation is controlled by various mechanisms. Such as enzymatic and non enzymatic antioxidant systems (Halliwell and Gutterridge, 1994; Simmons, 1984). The activities and levels of above defense enzymes are controlled or altered in diabetes (Wohabieb and Godin, 1987). Therefore there is a need for the study of antioxidant effect of plant extract during diabetes. Ficus benghalensis fruits were chosen to prepare the aqueous extract with water. An earlier study on this plant has been made with bark only. Hence in this investigation an attempt has been made to study the effect of Ficus benghalensis fruit extract on tissue lipid peroxides and enzymatic antioxidants in rats with STZ induced diabetes.

MATERIALS AND METHODS

Male albino Wistar rats weighing 120-160g were used in the present investigation. They were brought from College of Veterinary Sciences, Sri Venkateswara Veterinary University, Tirupati and fed with normal laboratory pellet diet and water. The fruits of Ficus benghalensis were collected around Tirupati and after shade drying aqueous extract was prepared by continuous hot extraction method, then the extracts were evaporated to dryness using rotavapour at 40-60ºC under reduced pressure. The formed semi solid material was stored 0-4ºC and whenever it is required it is suspended in distilled water and used for the study.

A freshly prepared solution of streptozotocin (45 mg/Kg) in 0.1mol/L citrate buffer, pH 4.5, was injected intraperitoneally in a volume of mL/Kg (Siddique et al., 1987). After 48 h of streptozotocin administration, rats with moderate diabetes having glycosuria and hyperglycemia (i.e. with a blood glucose of 200-300 mg/dL) were taken for the experiment.

In the experiment a total of 40 rats (30 diabetic surviving rats, 10 normal rats) were used. The rats were divided into four groups of 10 rats each: group 1, normal rats; group 2, diabetic control; group 3, diabetic rats given aqueous fruit extract of Ficus benghalensis daily for 45 days (200 mg/Kg body weight
in aqueous solution administered with an intra gastric tube; Roman-Ramos et al., 1995) and group 4, diabetic rats given glibenclamide daily for 45 days (Pari and Maheswari, 2000). After 45 days, the animals were deprived of food over-night and killed by decapitation. Blood was collected for the estimation of glucose. The liver and kidneys were dissected out, washed in ice-cold saline, patted dry and weighed.

Fasting blood glucose was estimated by the O-toluidine method (Sasaki et al., 1972). Thiobarbituric acid reactive substances (TBARS) were estimated by the method of Fraga et al., (1988). Hydroperoxide was determined by the method of Jiang et al., (1992). Glutathione was estimated by the method of Ellman, (1959). The activity of superoxide dismutase (SOD) was assayed by the method of Sinha, (1972). The activities of glutathione peroxidases (GPx) and glutathione-S-transferase (GST) were assayed according to the method described by Rotruck et al., (1973) and Habig et al., (1974). Protein content in tissue homogenate was measured by the method of Lowry et al., (1951).

RESULTS

Table 1 demonstrates the level of blood glucose in normal and experimental animals. There was a significant elevation in blood glucose in diabetic rats compared to control rats. Administration of aqueous fruit extract of *Ficus benghalensis* and glibenclamide significantly decreased the level of blood glucose in treated diabetic rats compared to untreated diabetic rats. *Ficus benghalensis* fruit extract was more effective than glibenclamide.

Table 2 shows the concentration of TBARS and hydroperoxides in tissues of normal and experimental animals. There was a significant elevation in tissues TBARS and hydroperoxides during diabetes compared to the corresponding control group. Administration of aqueous fruit extract of *Ficus benghalensis* and glibenclamide significantly decreased the level of TBARS and hydroperoxides in rats with streptozotocin-induced diabetes. This table also shows the content of reduced glutathione (GSH) in tissues of normal and experimental groups. There was a significant decrease in the concentration of GSH in tissues during diabetes compared to the corresponding control groups. Administration of aqueous fruit extract of *Ficus benghalensis* and glibenclamide increased the content of GSH in the liver of diabetic rats. *Ficus benghalensis* fruit extract was more effective than glibenclamide.

Table 3 illustrates the activities of SOD, catalase, GPx, and GST in the liver of normal and experimental groups. During diabetes there was a significant reduction in the activities of SOD, catalase, GPx, and GST in tissues such as liver. Administration of aqueous fruit extract of *Ficus benghalensis* and glibenclamide increased the activity of SOD, catalase, GPx, and GST in diabetic rats. *Ficus benghalensis* fruit extract was more prominent compared with glibenclamide.

DISCUSSION

Lipid peroxidation is one of the characteristic features of chronic diabetes. Tissue antioxidant status is suggested to be an improvement factor in the development of diabetic complications (Wohaieb and Godin, 1987). Low levels of...
lipoxigenase peroxides stimulate the secretion of insulin, but when the concentration of endogenous peroxides increase it may initiate uncontrolled lipid peroxidation leading to cellular infiltration and islet cell damage in type I diabetes (Metz, 1984). The increased susceptibility of the tissues of diabetic animals to lipid peroxidation may be due to the observed increased concentration of TBARS and hydroperoxides in the liver of diabetic rats (Stanely et al., 2001). An increase in lipid peroxide concentration in the liver of diabetic animals has been observed (Nakakimura and Mizuno, 1980). Administration of aqueous fruit extract of Ficus benghalensis and glibenclamide significantly decreased the level of TBARS and hydroperoxides in rats with streptozotocin-induced diabetes. We observed a decrease in GSH in the liver during diabetes. GSH is the most important biomolecule against chemically induced toxicity and can participate in the elimination of reactive intermediates by reducing hydroperoxides in the presence of GP, (Meister, 1984; Nicotera and Orrenius, 1986). The decrease in the GSH level represents increased utilization due to oxidative stress (Anuradha and Selvam, 1993). Administration of Ficus benghalensis aqueous fruit extract and glibenclamide increased the content of GSH in the liver of diabetic rats.

Superoxide dismutase is an important defense enzyme that catalyses the dismutation of superoxide radicals (McCord and Fridovich, 1969). Catalase is a hemoprotein that catalyses the reduction of hydrogen peroxides and protects the tissues from highly reactive hydroxyl radicals (Chance et al., 1952). Therefore, the observed reduction in the activity of these enzymes (SOD, catalase) may result in a number of deleterious effects due to the accumulation of superoxide anion radicals and hydrogen peroxide. Administration of aqueous fruit extract of Ficus benghalensis and glibenclamide increased the activities of SOD and catalase in diabetic rats. The activities of GP, and GST are observed to decrease significantly in diabetic rats. Glutathione peroxidases, an enzyme with selenium, and GST catalyze the reduction of hydrogen peroxide and hydroperoxides to non-toxic products (Bruce et al., 1982). The depletion in the activity of these enzymes may result in deleterious oxidative changes due to accumulation of toxic products. In this context, other workers also reported a decrease in the activities of these antioxidant enzymes (SOD, Catalase, GP, and GST) in the liver of diabetic rats (Stanely et al., 2001; Anuradha and Selvam, 1993). As the alterations produced the antioxidant activities indicate the involvement of deleterious oxidative changes, increased activities of the components of this defense system would therefore be important in protection against radical damage. Administration of Ficus benghalensis aqueous fruit extract and glibenclamide increased the activities of GP, and GST in the liver of diabetic rats. The over expression of these antioxidant enzymes in diabetic rats treated with aqueous fruit extract of Ficus benghalensis implies that this potential oxidant defense is reactivated by the active principles of Ficus benghalensis. This results in an increase in the capacity of detoxification through enhanced scavenging of oxy radicals. In conclusion, the present investigation shows that aqueous fruit extract of Ficus benghalensis possesses an antioxidant activity that may contribute to its protective action on lipid peroxidation and to enhancing its effect on cellular antioxidant defense. This activity contributes to the protection against oxidative damage in streptozotocin induced diabetes.

REFERENCES


