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Antidiabetic and cholesterol lowering activities of the stem bark of *Ficus bengalensis* L.

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ABSTRACT

The antidiabetic activity of aqueous extract of the stem bark of *Ficus bengalensis* L. (Moraceae) has been studied on streptozotocin induced diabetic rats. In doses of 250 mg/kg and 500 mg/kg, the aqueous extract showed significant decrease in blood glucose level. It also decreased total cholesterol level and increased high density lipid cholesterol significantly.

KEYWORDS

Ficus bengalensis;
Streptozotocin;
Diabetes mellitus;
Cholesterol;
Lipid profile.

INTRODUCTION

Diabetes is a chronic disorder of carbohydrate, fat and protein metabolism characterized by increased fasting and post prandial blood sugar levels. The global prevalence of diabetes is estimated to increase, from 4 % in 1995 to 5.4 % by the year 2025[1]. According to WHO, 346 million people worldwide have diabetes and more than 80% of people with diabetes live in low- and middle-income countries. WHO projects that diabetes death will double between 2005 and 2030[2]. Statistical projections from India suggested that the number of diabetes will rise from 15 million in 1995 to 57 million in the year 2025, thus making India the country with the highest numrber of diabetics in the world[3,4]. Studies conducted in India in the last decade have highlighted that not only is the prevalence of diabetes high but also that it is increasing rapidly in the urban population[5].

A number of medicinal plants, traditionally used for over 1000 years named rasayana are used in herbal preparations in Indian traditional health care systems[6]. The most Indian practitioners formulate and dispense their own recipes. The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale. India is the largest producer of medicinal herbs and is called as botanical garden of the world[7]. Two of the largest users of medicinal plants are China and India. Traditional Chinese Medicine uses over 5,000 plant species; India uses about 7,000 herbal drugs. China's share in world herbal market is US$ 6 billion while India's share is only US$1 billion. The annual production of traditional plant remedies in China was valued at US$ 571 million and the countrywide sales of crude plant drugs at US$ 1400 million[8].

About 25% of all prescriptions dispensed between 1959 and 1980 from community pharmacies in the United States of America contained plant extract or active principles prepared from higher plants[9]. Many traditional medicines in use are derived from medicinal

plants, minerals and organic matter[10]. Although several therapies are in use for treatment, there are certain limitations due to high cost and side effects such as development of hypoglycaemia, weight gain, gastrointestinal disturbances, and liver toxicity[11]. There are many herbal remedies suggested for diabetes and diabetic complications[12].

Ficus bengalensis L. (Moraceae), commonly known as the banyan tree, occurs throughout the forest tracts of India, both in the sub-Himalayan region and in the deciduous forest of southern India. It attains large dimensions, the leafy crown sometimes attaining a circumference of 300-700 m. It is evergreen except in dry localities where it is leafless for a short time. It is drought resistant; it withstands mild frost[13]. Its bark is used in traditional medicine for its antidiabetic effect[14] and exhibited antidiarrhoeal[15], antioxidant[16], antiasthmatic[17], hypocholesterolemic[14,18] and wound healing activities[19]. Earlier flavonoids, aliphatic ketones, methyl ethers of leucoanthocyanins[20], β-sitosterol-α-D-glucoside and meso-inositol have been reported[21]. The present paper describes antidiabetic activity and lipid profile of aqueous extract of the bark of *F. bengalensis* in streptozotocin induced diabetic rats.

MATERIALS AND METHODS

Plant material

The bark of *F. bengalensis* was collected from the campus of Jamia Hamdard, New Delhi. The plant was identified by Dr. M.P. Sharma, Taxonomist and Professor, Department of Botany, Faculty of Science, Jamia Hamdard, New Delhi. A voucher specimen (PRL/JH/07/28) of drug is diposited in the herbarium of Phytochemistry Research Laboratory, Department of Pharmacognosy and Phytochemistry, Faculty of Pharmacy, Jamia Hamdard, New Delhi.

Preparation of the extracts

The air dried powdered drug (500 g) was extracted with water in a Soxhlet apparatus for 6 hour. Aqueous extract of the plants was evaporated to dryness under pressure to give a solid residue. The residue was stored at 4 ºC for subsequent experiment.

Experimental animals

Wistar albino rats (150-200 g) were obtained from Central Animal House Facility, Jamia Hamdard, New Delhi and the Institutional Animal Ethics Committee (IAEC) approved the experiments (Form no. 483, 2009). The animals were housed in polypropylene cages with dust-free rice husk as bedding material renewed every 24 h under 12/12 h light/dark cycles at 25 ± 2°C and at 55 ± 5 % relative humidity were provided with food (Lipton rat feed Ltd., India) and water *ad libitum*. All the extracts and the standard drugs were administered orally.

Chemicals

All chemicals and reagents used were of analytical grade. Streptozotocin (Spectrochem Pvt. Ltd., India) was obtained from Chopra chemicals (India).

Drugs

Standard drug: Glimepiride prepared in Tween 80 solution (1 %); Test drug: plant extract, in CMC (1 %) solution.

Induction of diabetes

The animals were fasted for 16 hour prior to the induction of diabetes. STZ freshly prepared in citrate buffer (pH 4.5) was administered i.p. at a single dose of 50 mg/kg. Diabetes was confirmed by measuring blood glucose concentrations 72 hour after injection of STZ. Rats with blood glucose level of 250 mg/dl or higher were considered to be diabetic and selected for experiment. Diabetic animals were randomly assigned to groups. Group I served as normal control and Group II served as diabetic control (toxic). Groups I and II received vehicle during the experiments, while the Group III received the reference standard drug glimeperide (0.1 mg/kg wt) and groups from IV and V received the aqueous extracts of *F. bengalensis* (250 mg/kg wt, and 500 mg/kg wt), respectively.

Biochemical estimation

Non fasting blood glucose levels were determined on 1st, 8th, 14th and 21st day after administering the drugs. Serum was separated from the blood by centrifuging at 2500 rpm for 20 minutes for biochemical estimations of TC and HDL-C. The blood glucose level

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was estimated with One Touch Basic Glucometer (Accu Chek Active, Roche Diagnostics, Germany) and Serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), were determined by using standard enzymatic colorimetric kits (Span diagnostic Ltd., India)[22,23].

Statistical analysis

Data obtained from pharmacological experiments are expressed as mean ± SD. Differences between the control and the treatments in these experiments were tested for significance using ANOVA followed by Dunnet2 s *t*–test. p value < 0.01 were considered as significant (TABLE 1 and TABLE 2).

RESULTS & DISCUSSION

In the present study, an aqueous extract of the bark of *F. bengalensis* showed significant reduction of the blood glucose level when compared to the control group after eight days of the extract administration as regard to the dose of 250 mg/kg and the reference glimeperide. After 14th and 21st days of the administration of the extract, the blood glucose level was decreased. The dose of 500 mg/kg was found to be more effective after 14 and 21st days in glycaemic change than the 250 mg/kg dose of the extract. The aqueous extract in 500 mg/kg dose showed the blood glucose level almost similar to the controlled group after 21st days.

Treatment with aqueous extract of the bark of *F. bengalensis* decreased total cholesterol level and increased high density lipid cholesterol level, which was statistically significant when compared with normal control (TABLE 2). The above findings justified the antidiabetic activity of the bark of *F. bengalensis* which proved the traditional claim of antidiabetic activity.

TABLE 1 : Antidiabetic activity of aqueous extract of *F. bengalensis* bark

Treatment (group)	Blood glucose level (mg per 100 mL) after day			
	1	8	14	21
Normal controls (I)	113.83±4.79	115.67±1.02[b]	115.50±1.56[b]	118.50±1.15[b]
Streptozotocin (STZ, 50 mg kg^{-1} bw) (II)	368.33±5.05	373.50±1.76	367.33±3.22	375.33±4.46
Glimeperide (standard) mg kg^{-1}, (III)	374.67±5.06	161.33±2.21[b]	124.67±1.80[b]	104.50±3.12[b]
Aqueous extract of *F. bengalensis* bark (FB_1, 250 mg kg^{-1} bw) (IV)	368.67±5.90	180.50±3.25[b]	160.07±3.80[b]	129.67±2.88[b]
Aqueous extract of *F. bengalensis* bark (FB_2, 500 mg kg^{-1} bw) (V)	365.67±9.99	167.67±3.58[b]	142.12±2.75[b]	119.17±2.28[b]

[a]Mean ± SEM; n=6; [b] Statistically significant difference ($p < 0.01$) *versus* diabetic control (II); FB_1 and FB_2 (250 and 500 mg/kg bw)

TABLE 2 : Effect of aqueous extracts of *F. bengalensis* bark on lipid profile

Treatment (group)	Lipid Profile		Body weight (g)	
	TC	HDL-C	Initial	Final
Normal controls (I)	114.17±2.84*	47.50±1.18*	156.83±3.28	179.83
Streptozotocin (STZ, 50 mg kg^{-1} bw) (II)	252.83±2.70*	35.67±0.42*	158.67±2.45	166.50
Glimeperide (standard) mg kg^{-1}, (III)	113.00±2.37	44.33±0.95	160.00±2.94	184.50
Aqueous extract of *F. bengalensis* bark (FB_1, 250 mg kg^{-1} bw) (IV)	134.33±2.28*	36.67±1.33*	169.83±3.54	196.83
Aqueous extract of *F. bengalensis* bark (FB_2, 500 mg kg^{-1} bw) (V)	126.33±2.09*	39.33±0.84*	164.83±2.68	187.67

Values are Mean ± SEM; n=6; *P<0.01 when compared with normal control group

CONCLUSION

The present investigation reveals that the aqueous extract of *F. bengalensis* stem bark is found to be a good natural antidiabetic and cholesterol lowering agent. Attempts will be made to isolate and identify the phytoconstituents of the aqueous extract responsible for the antidiabetic and cholesterol lowering activities. The biological efficacy of *F. bengalensis* stem bark may be even higher after the isolation and purification of the compound (s).

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