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# Antidiabetic effect of *Ficus religiosa* extract in streptozotocin-induced diabetic rats

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ABSTRACT

*Aims of study:* In Indian traditional system of medicine, *Ficus religiosa* (Family Moraceae) is prescribed for the treatment of diabetes mellitus. In the present study, the antidiabetic effect of aqueous extract of *Ficus religiosa* bark (FRAE) was investigated in normal, glucose-loaded hyperglycemic and streptozotocin (STZ)-induced diabetic rats.
*Materials and methods:* Oral administration of FRAE at the doses of 25, 50 and 100 mg/kg was studied in normal, glucose-loaded and STZ-diabetic rats.
*Results:* The three doses caused significant reduction in blood glucose levels in all the models. The effect was more pronounced in 50 and 100 mg/kg than 25 mg/kg. FRAE also showed significant increase in serum insulin, body weight and glycogen content in liver and skeletal muscle of STZ-induced diabetic rats while there was significant reduction in the levels of serum triglyceride and total cholesterol. FRAE also showed significant antilipidperoxidative effect in the pancreas of STZ-induced diabetic rats. The antidiabetic effect of *Ficus religiosa* was compared with glibenclamide, a well-known hypoglycemic drug.
*Conclusion:* The results indicate that aqueous extract of *Ficus religiosa* bark possesses significant antidiabetic activity.

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## 1. Introduction

Diabetes mellitus (DM) consists of a group of syndromes characterized by hyperglycemia; altered metabolism of lipids, carbohydrates, and proteins; and an increased risk of complications from vascular disease (Davis, 2006). Apart from currently available therapeutic options for diabetes like oral hypoglycemic agents and insulin, which have limitations of their own, many herbal medicines have been recommended for the treatment of diabetes (Mukherjee et al., 2006). A variety of ingredients present in medicinal plants are thought to act on a variety of targets by various modes and mechanisms. They have the potential to impart therapeutic effect in complicated disorders like diabetes and its complications (Tiwari and Rao, 2002). Hence the present study was carried out to evaluate the antidiabetic activity of *Ficus religiosa.*

*Ficus religiosa*, belonging to family Moraceae, is commonly known as peepal in India. The plant is used in gout, stomatitis, leucorrhea, ulcers, inflammation and glandular swelling of the neck (Kirtikar and Basu, 2001). *Ficus religiosa* has been reported for its wound healing (Naira et al., 2009), antibacterial (Aqil and Ahmad, 2003) and acetylcholinesterase inhibitory (Vinutha and Prashanth, 2007) activity. *Ficus religiosa* has been used in the traditional system of ayurveda to treat diabetes (Simmonds and Howes, 2006). The leaves of *Ficus religiosa* have been studied for antihyperglycaemic activity (Deshmukh et al., 2007).

β-Sitosteryl-D-glucoside isolated from the bark of *Ficus religiosa* has shown hypoglycemic activity in normal rabbits (Ambike and Rao, 1967). The initial preliminary phytochemical screening of the plant powder showed the presence of tannins, saponins, polyphenolic compounds, flavonoids and sterols. Considering this information about the plant, stem bark of *Ficus religiosa* was chosen for the study.

## 2. Materials and methods

### 2.1. Chemicals

Streptozotocin was purchased from SISCO Research Laboratories Ltd., Mumbai. Glibenclamide was obtained as a gift sample from Sanofi Aventis India Ltd. All other chemicals and reagents used were of analytical grade.

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### 2.2. Plant material

The dried stem bark powder of *Ficus religiosa* was supplied and authenticated by Dr. Aashish Phadke, Ex-associate Professor & Head, Dept. of Dravyaguna (Ayurvedic Herbal Pharmacology), Y.M.T. Ayurvedic Medical College, Mumbai.

### 2.3. Preparation of plant extract

Stem bark powder of *Ficus religiosa* was macerated with distilled water for 48 h at room temperature with occasional stirring. It was then filtered through Whatman filter paper. The filtrate was air dried and stored in refrigerator for further use as FRAE (*Ficus religiosa* aqueous extract). The yield of the extract was 2% (w/w). During experiment the crude extract was diluted with distilled water just before administration to animals.

### 2.4. Experimental animals

Healthy adult male albino Wistar rats (150–200 g), in-house bred at the Animal House of Bombay College of Pharmacy, Mumbai, India were used for the study. Rats were housed in polypropylene cages lined with husk in standard environmental conditions (temperature 25 ± 2° C, relative humidity 55 ± 10% and 12:12 light:dark cycle). The rats were fed on a standard pellet diet (Amrut rat and mice feed, Sangli, India) *ad libitum* and had free access to water. The experiments were performed after approval of the protocol by the Institutional Animal Ethics Committee (IAEC) and were carried out in accordance with the current guidelines for the care of laboratory animals.

### 2.5. Experimental design

Antidiabetic activity of FRAE was assessed in normal, glucose-loaded hyperglycemic and streptozotocin-induced diabetic rats. In all studies, the animals were fasted overnight for 16 h with free access to water throughout the duration of the experiment.

#### 2.5.1. Evaluation of extract on normal healthy rats (Kar et al., 2006)

At the end of the fasting period, taken as zero time (0 h), blood was withdrawn from the retro-orbital plexus of the eye under mild ether anaesthesia. Serum was separated by centrifugation and glucose was estimated. The animals were then randomly divided into four groups of six animals each. Group I served as control and received distilled water. Groups II, III and IV received FRAE orally at the dose of 25, 50, 100 mg/kg. Blood glucose levels were determined 1, 2, 3 and 4 h following treatment.

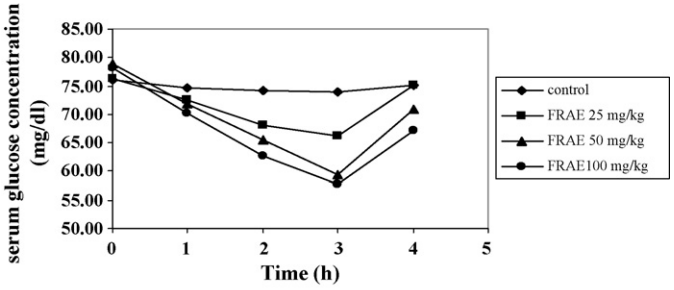
#### 2.5.2. Evaluation of extract in oral glucose tolerance test (Prakasam et al., 2003)

Healthy rats were divided into four groups of six animals each: Group I served as control received only vehicle (distilled water) and Groups II, III and IV received FRAE orally at the dose level of 25, 50 and 100 mg/kg, respectively. All the animals were given glucose (2 g/kg) 60 min after dosing. Blood samples were collected from the retro-orbital plexus of the eye just prior to (0 h) and at 30, 60, 90 and 120 min after the glucose loading, and blood glucose levels were estimated.

#### 2.5.3. Evaluation of extract in streptozotocin-induced diabetic rats (Arulselvan and Subramanian, 2007)

Experimental diabetes was induced by single intraperitoneal injection of 55 mg/kg of streptozotocin (STZ), freshly dissolved in cold citrate buffer, pH 4.5. Control animals received only citrate buffer. After 5 days of STZ injection, animals with fasting blood glucose above 250 mg/dl were considered as diabetic and included in the study. The animals were randomly assigned into six groups of six animals each and received the following treatments: Group I: Normal control + distilled water, Group II: Diabetic control + distilled water, Group III: Diabetic + FRAE (25 mg/kg), Group IV: Diabetic + FRAE (50 mg/kg), Group V: Diabetic + FRAE (100 mg/kg) and Group VI: Diabetic + glibenclamide (10 mg/kg).

The freshly prepared solutions were orally administered daily for 21 days. Body weights and blood glucose analysis was done weekly on overnight fasted animals. At the end of the experimental period, the animals were fasted overnight and blood was collected for various biochemical estimations. The animals were sacrificed by cervical decapitation. Organs like liver, pancreas and skeletal muscle were dissected out, immediately rinsed in ice cold saline and stored for further biochemical estimations.

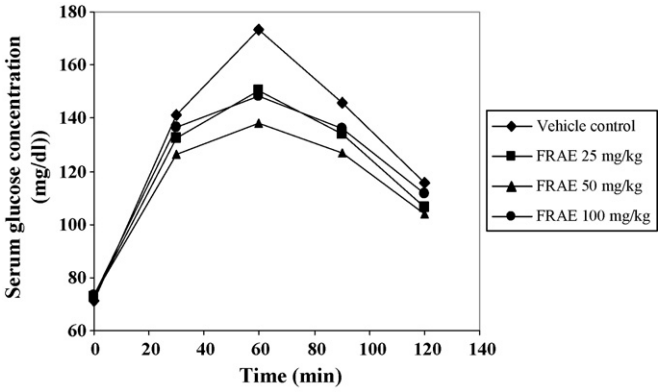



Each value is expressed as mean of six observations
*$P < 0.05$ when compared with values of 0h of the same group

**Fig. 1.** Effect of FRAE on blood glucose levels in normoglycemic rats. Each value is expressed as mean of six observations. *$P < 0.05$ when compared with values of 0 h of the same group.

#### 2.5.4. Biochemical analysis

Serum glucose analysis was done by GOD-POD method using Glucose Estimation Kit (Erba Diagnostics, India). Other serum estimations were done spectrophotometrically using standard kits available which included serum insulin (RIA kit provided by BRIT, BARC, India), serum triglycerides (GPO-Trinder method, Erba Diagnostics), and serum total cholesterol (CHOP-PAP method, Erba Diagnostics). Glycogen was estimated in liver and skeletal muscle by the method of Good et al. (1933). *In vivo* lipid peroxidation, expressed as TBARS (thiobarbituric acid reactive substances) was




Each value is expressed as mean of six observations
*$P < 0.05$ when compared with the corresponding values of the control group

**Fig. 2.** Effect of FRAE on oral glucose tolerance in rats. Each value is expressed as mean of six observations. *$P < 0.05$ when compared with corresponding values of the control group.

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