Original Research Article

An Evaluation of Anti-Diabetic Activity of *Ficus benghalensis*on RatModel with Safety Profile Analysis

Abstract

Almost since the dawn of human civilization, people have been employing herbal medicine as a means of treatment for various ailments. In this study, we examined the lipid profile and antidiabetic effects of *Ficus benghalensis*. We used the alloxan-induced diabetic technique to assess the levels of antidiabetic activity. When compared to the control group, the doses of 500 mg/kg and 1000 mg/kg exhibited statistically significant ($p<0.05$) results in terms of their ability to inhibit the development of diabetes. In the case of total cholesterol, HDL and LDL groups 3,5 and 6 with doses of 100 mg/kg, 500 mg/kg, and 1000 mg exhibited outcomes that were statistically significant. In the case of triglycerides, the findings indicated that SGPT and SGOT group 4 and 5 with doses of 250 mg/kg and 500 mg/kg were statistically significant ($p<0.05$). The findings of the kidney function test showed that group 4, which received a dosage of 250 mg per kilogramme, had statistically significant ($p<0.05$) outcomes. According to the results, *Ficus benghalensis* has the potential to be used in the development of standardised phytomedicine for the treatment of patients suffering from diabetes, cardiovascular disease, liver disease, and renal sickness.

Keywords: Herbal medicine, *Ficus benghalensis*,SGPT,HDL,Diabetes.

Comment [O1]: Please make use of reported speech.

Comment [O2]: Try and give the full names then abbreviations can be used subsequently.

Comment [O3]: What is SGPT and SGOT?

Comment [O4]: Use the full word

Introduction

When glucose levels in the blood are consistently high, a disease known as diabetes develops. When this happens, insulin production and action are both impaired. The metabolic disorder known as diabetes mellitus is defined by long-term high blood sugar levels due to problems with

the metabolism of carbohydrates, lipids, and proteins, which in turn lead to insulin resistance, insufficiency, or both [1]. Diabetic complications include insulin resistance and beta-cell loss in the pancreas [2]. In 2017, there were about 462 million individuals living with type 2 diabetes, with a prevalence rate of 6059 cases per 100,000. Among those affected, 4.4% were in the 15–49 age group, 15% were in the 50–69 age group, and 22.0% were 70 and over. With more than one million lives lost every year, diabetes ranks as the ninth-leading killer. Although the rate of rise is fastest in industrialized nations and Western Europe, the incidence of diabetes mellitus is rising globally [3]. Acarbose, alpha-glucosidase, thiazolidinedione, biguanides, sulphonylureas, and meglitinides are among the many oral drugs used to treat diabetes [4]. Serious adverse effects, such as hypoglycemia, heart failure, gastrointestinal issues, fractured bones, and liver damage, are nevertheless possible with these drugs [5]. Not only may these synthetic drugs have deadly side effects, but the hefty cost of therapy can prevent the patient from finishing the whole course.

For as long as there have been people, they have relied on medicinal herbs. The extensive history of humankind's search for therapeutic substances in nature is attested to by documents, historical buildings, and even the original plant cures. [6]. Medical plant researchers have shown that some plant-derived chemicals may have medical uses. Therefore, researchers are continuously seeking herbal remedies derived from plants as a means to alleviate a broad variety of medical conditions. Many different chemical components, including phenols, alkaloids, terpenoids, saponins, glycosides, tannins, flavonoids, resins, polysaccharides, plant lipids, essential oils, and many more, allow these medicinal plants to exert a broad variety of pharmacological and therapeutic effects. [7]. One possible therapeutic outcome of plant genetic modification is an alteration in the concentration of the plant's chemical components, either an increase or a decrease. One use of reverse genetics is the enhancement of secondary metabolite biosynthesis, including alkaloid production. [8].

Ficus benghalensis, a member of the Moraceae family, is a tree that is usually referred to as the banyan, banyan fig, or Indian banyan. It is indigenous to the region. Tannins, alkaloids, and carbohydrates. Phytosterols, flavonoids, terpenoids, phenolic compounds, and other similar substances [9, 10] It has analgesic, anti-inflammatory, antihelmintic, antioxidant, antifungal, anti-tumour, wound healing, and anti-diabetic properties 11, 12]. Studies have shown that

phenolic compounds inhibit the enzymes alpha-amylase and alpha-glucosidase, leading to antidiabetic effects [13]. The total phenolic content (TPC) in plants may be the reason for this possible antidiabetic action [14].

The goal of this study was to find out how well an ethanolic extract from *Ficus benghalensis* woks against diabetes and lipid profile.

Comment [O5]: aim

Methods and material

Drugs, chemicals, and instruments

We bought ethanol and alloxan from the German company Sigma-Aldrich.Healthcare Pharmaceutical Limited sent us a complimentary sample of metformin, a commonly used medication for diabetes. Plasmatic Laboratory Product Ltd. of the UK supplied the HDL, LDL, triglyceride, SGOT, SGPT, and creatinine blood serum analysis kits. Shahbag in Dhaka, Bangladesh, provided the Alere GI glucometer from Alere Inc., USA, and the Humalyzer 3000, a semiautomated clinical chemistry analyzer, was used to assess the biochemical parameters.

Comment [O6]: Use reported speech

Plant collection and extraction

The leaves of *Ficus benghalensis* were gathered in three different places in Bangladesh: North Bengal, a hilly area, and a lowland area. The next step included authentication and taxonomic identification. The researchers complied with Bangladeshi legislation and kept the plant specimen at the National Herbarium. The leaves were dried in the shade for seven to ten days before being finely powdered. During the steeping process in 70% ethanol, we vigorously stirred the powdered leaves for 96 hours. After completing the soaking process, we filtered the extract and collected the filtered liquid. The researchers concentrated the extracted solution using a rotary evaporator. Afterwards, we carefully collected and preserved the dried extract for future use.

Comment [O7]: Reported speech

Experimental animal handling

Male Wistar rats weighing between 125 and 200 grams were obtained from the Pharmacy Department of Jahangirnagar University in Dhaka, Bangladesh. The rats were housed in the Institute of Nutrition and Food Science at the University of Dhaka under a 12-hour light/dark

cycle and maintained at a constant temperature of 25°C. We consistently provided the rats with a standard pellet diet and freshwater. In order to prepare the rats for the experiment, they were housed in such an environment. We adhered to the protocols established by the Institutional Animal Ethics Committee (IEAC) in all rat experiments.The Swiss Academy of Sciences (SCNAT) and the Swiss Academy of Medical Sciences (SAMS) established protocols for the care and handling of animals.

Comment [O8]: Paraphrase using reported speech

Comment [O9]: Same as above, then reference for this ethical protocol should be added.

Comment [O10]: Reference

Experimental guideline

We followed the guidelines laid forth in the 2013 Declaration of Helsinki while conducting all of our testing. We maintained strict adherence to the "3R" criteria, which form the basis of Swiss and international laws controlling the use of animals in research, throughout the course of this investigation. In scientific contexts, the prefix "R" stands for "replacement." This phrase may refer to either absolute or relative replacements, depending on the context. Absolute replacements include things like using computer-generated models instead of actual animals or invertebrates as study subjects. Researchers used animal models to ensure accurate results. Rats were chosen as test subjects for antidiabetic research, in contrast to invertebrates, due to their unique pancreas and beta cells. By "reduction," we mean any strategy that leads to using fewer animals to get sufficient data to answer the study goals or that maximises the information obtained from each animal. This is what the second "R" stands for. Following this recommendation, we collected ten rats for the study by estimating the sample size using the "power analysis method". The third "R" stands for "refinement," which means reducing the experimental animals' agony by making their suffering less severe. Rats had their tail tips massaged with isopropyl alcohol both before and after blood glucose level measurements to alleviate pinching pain and make the procedure more bearable. After being appropriately fed during the study, the rats were painlessly euthanized in accordance with the 2013 revision to the Guidelines for the Euthanasia of Animals.

Comment [O11]: Explaining the 3 Rs in an experimental report is not relevant.

Comment [O12]: Paraphrase

Comment [O13]: Reference

Experimental design

The results of the anti-hyperglycemic activity tests conducted on rats, which were individually weighed and then grouped according to body weight, are shown in Table 1. Ten rats per group were used to classify the rodents according to their weight. Table 1 shows the alloxan-only group

Comment [O14]: rephrase

of rats as the control group. The rats in this group did not receive any therapeutic treatment, as shown by the absence of a value.

Comment [O15]: How long did this experiment last?

Statistical Analysis

The statistical significance of intergroupheterogeneity was evaluated using the "one-wayANOVA test" to compare the groups across arange of biological characteristics. The "SPSS16" application was used for the analysis.Results were considered statistically significantwhen the "p" value was less than 0.05 (p< 0.05)and highly significant when the "p" value wasless than 0.01 (p <0.01).

Comment [O16]: Spacing

Table 1: Anti-hyperglycemic Activity Analysis

Group number	**Group Status**	**Treatment specimen**	**Dose of treatment specimen (mg/kg)**	**Group Abbreviation**
1	Negative Control	Physiological Saline	10 mL/kg	N
2	Alloxan control	Alloxan	150 mg/kg	A
3	Alloxan + Metformin	Alloxan + Metformin	150 mg/kg + 100mg	A + M100
4	Alloxan + *F. benghalensis*	Alloxan + *F. benghalensis* eaves extract low dose	150 mg/kg + 500 mg/kg	A + FB_{500}
5	Alloxan + *F. benghalensis*	Alloxan + *F. benghalensis* leaves extract medium dose	150 mg/kg + 1000 mg/kg	A + FB_{1000}
6	Alloxan + *F. benghalensis*	Alloxan + *F. benghalensis* leaves	150 mg/kg + 1500 mg/kg	A+FB_{1500}

		extract high dose		
7	Metformin	Metformin	100 mg/kg	M
8	*F. benghalensis*	*F. benghalensis* leaves extract low dose	500 mg/kg	FB_{500}
9	*F. benghalensis*	*F. benghalensis* leaves extract medium dose	1000 mg/kg	FB_{1000}
10	*F. benghalensis*	*F. benghalensis* leaves extract high dose	1500 mg/kg	FB_{1500}

Comment [O17]: describe the experimental design without the use of tables.

Biological sample collection

Blood samples were collected from a rat's tail to measure blood glucose levels. We punctured a rat's tail to obtain blood samples for measuring blood glucose levels. On the other hand, blood was drawn from the animal as soon as its heart was punctured and transferred to a microcentrifuge tube after killing. Following 5 minutes of centrifugation at 5,000 rpm, the collected samples yielded the supernatant fluid. For biochemical testing, this fluid was then transferred to an additional microcentrifuge tube. After sacrificing the animals, we quickly extracted and carefully cleansed their organs in ice-cold saline to assess their function.

Comment [O18]: What was used to sedate the animals, please state it in your report.

Estimation of Biochemical Parameters

By using a glucometer, the blood glucose level was ascertained. The Humaluzer 3000 was one of many tests administered, along with those for the lipid profile, kidneys, and liver.We also tested liver and kidney samples for gluconeogenic and glycolytic enzyme activity.

Comment [O19]: State the biochemical parameters evaluated.

Comment [O20]: Reported speech

Statistical Analysis.

For each group, the mean and standard deviation (SD) of each research parameter are displayed. The "one-way ANOVA test" was used to examine the statistical significance of intergroup

heterogeneity by evaluating differences across groups in terms of different biological parameters. The application "SPSS 16" was used for the analysis. The result was considered statistically significant when the "P" value was less than 0.05 ($p<0.05$) and highly significant when it was less than 0.01 ($p <0.01$).

Results and Discussion

Herbal medicine refers to the use of medicinal plants for the purpose of preventing and treating illnesses. This practice encompasses a wide variety of remedies, including both traditional and popular treatments from many countries, as well as the use of standardised and concentrated herbal extracts. This research assessed the antidiabetic efficacy and lipid profile of mice treated with the herb *Ficus benghalensis*. Diabetes poses significant difficulties in the realm of health throughout the 21st century. Diabetic macro- and microvascular complications are a significant contributor to mortality and are responsible for a rise in disability and substantial healthcare expenses.

Regarding the antidiabetic efficacy, the doses of 500 mg/kg and 1000 mg/kg demonstrated a statistically significant ($p<0.05$) outcome compared to the control group, as seen in figure 1. Consistent findings were seen in other investigations conducted on animal models and in vitro experiments [15–17].

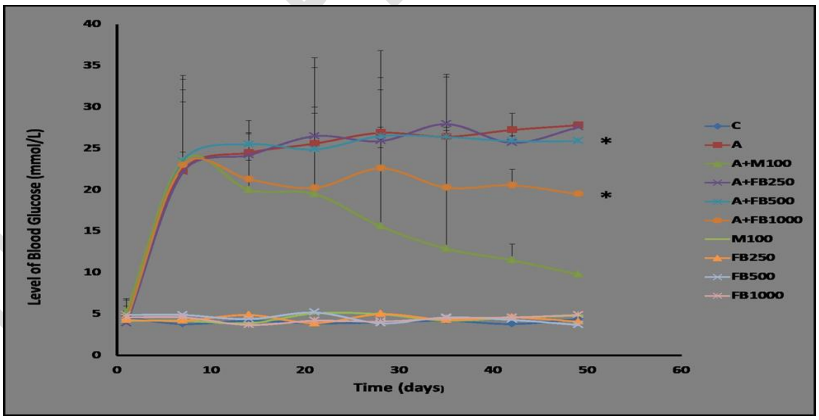

Figure 1: Antidiabetic activity of different dose of *Ficus benghalensis*

In the case of total cholesterol, HDL and LDL groups 3,5 and 6 with doses of 100 mg/kg, 500 mg/kg, and 1000 mg exhibited outcomes that were statistically significant. There were findings that were comparable in the species of *Ficus religiosa* [18]. In the case of triglycerides, the findings indicated that SGPT and SGOT groups 4 and 5 with doses of 250 mg/kg and 500 mg/kg were statistically significant ($p<0.05$). The findings of two more experiments on *F. benghalensis* [19, 20] were comparable to those of the first study. The findings of the kidney function test showed that group 4, which received a dosage of 250 milligrammes per kilogramme, had statistically significant ($p<0.05$) outcomes. A further examination of *F. benghalensis* [21] came to the same conclusions as the previous one.

Table 2: Lipid profile of mice after the administration of different dose of extract

	Total Cholesterol	HDL	LDL	Triglyceride	SGPT	SGOT	Urea	Creatinine
N	94.22±4.15	70.46±2.20	35.19 ±4.10	52.40±2.32	35.20±1.29	46.21±2.46	28.40±3.09	0.7±0 .09
A	142.32±5.19	47.30±3.15	75.63±4.88	109.43±4.50	84.53±4.20	93.45±4.26 *	99.43±9.35	2.5±0 .08
A+M_{100}	112.22±4.36	61.29±4.20	60.70±3.26*	68.57±5.26	62.60±3.29	58.50±4.29	62.40±4.59	1.4±0 .06
A+FB_{250}	140.50±4.23	48.33±2.08	74.91±4.24	106.42±2.21 *	82.20±3.19	90.46±5.57	96.93±2.41	2.1±0 .08*
A+FB_{500}	135.29±6.18*	53.29±1.80*	71.29±2.99*	98.25±2.49*	79.20±2.19 *	89.24±7.29	92.17±4.43	1.6±0 .07
A+F_{B1000}	130.22±4.36*	57±4.01*	66.36±4.16*	91.70±3.30*	74.51±4.53	85.29±6.18	86.21±3.22	1.2±0 .06

M_{100}	92.59±5.50	70.22±3.18	36.25±3.21	55..59±2.30	36.65±2.26	44.56±1.82	25.23±2.10	0.5±0.05
FB_{250}	95.40±4.25	73.87±4.9	37.66±1.66	57.20±2.10	31.49±3.56	43.19±2.80	29.91±1.93	0.7±0.08
FB_{500}	97.90±5.30	70.46±3.25	38.34±2.45	53.25±3.83	33.30±4.26	49.65±3.24	20.46±2.20	0.7±0.06
FB_{1000}	92.25±4.63	72.18±4.50	32.35±3.29	57.10±2.85	35.43±2.25	46.33±4.22	27.51±2.95	0.8±0.

Comment [O21]: ALL RESULTS SHOULD COME BEFORE DISCUSSON, RESULTS SHOULD CONTAIN FOOTNOTES EXPLAINING THE DIFFERENT GROUPS, ALSO AND SERIAL NUMBERS.

Table 2. contd…..

	Total Cholesterol	HDL	LDL	Triglyceride	SGPT	SGOT	Urea	Creati
N	94.22±4.15	70.46±2.20	35.19 ±4.10	52.40±2.32	35.20±1.29	46.21±2.46	28.40±3.09	0.7±0.09
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$A+M_{100}$	112.22±4.36	61.29±4.20	60.70±3.26*	68.57±5.26	62.60±3.29	58.50±4.29	62.40±4.59	1.4±0.06
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Comment [O22]: Units not given

M_{100}	92.59±5.50	70.22±3.18	36.25±3.21	55..59±2.30	36.65±2.26	44.56±1.82	25.23±2.10	0.5±0.05
FB_{250}	95.40±4.25	73.87±4.9	37.66±1.66	57.20±2.10	31.49±3.56	43.19±2.80	29.91±1.93	0.7±0.08
FB_{500}	97.90±5.30	70.46±3.25	38.34±2.45	53.25±3.83	33.30±4.26	49.65±3.24	20.46±2.20	0.7±0.06
FB_{1000}	92.25±4.63	72.18±4.50	32.35±3.29	57.10±2.85	35.43±2.25	46.33±4.22	27.51±2.95	0.8±0.09

The results were expressed in Mean±SEM (standard mean error) *p< 0.05,**p< 0.01, and ***p< 0.001 were considered as statistically significant. The statistical analysis followed by one-way analysis of variance (Dunnett's test) compared to the control.

Conclusion

Extracting *Ficus benghalensis* with ethanol may protect against diabetes, hyperlipidemia, liver damage, and renal function, according to this study. Despite possessing anti-hyperlipemic and anti-diabetic properties, the plant extract has little effect on its own. As a result, additional study is required to identify the active element in the complete extract that causes the intended anti-diabetic and anti-hyperlipidemic activity. Once the active compounds are separated, researchers can conduct further extensive investigation.

Comment [O23]: The conclusion contradicts the discussion. Also the study was not about the efficacy of ethanol as an extraction solvent. Rewrite the conclusion be at tandem with your study.

Comment [O24]:

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Comment [O25]: Why upper case?