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Research Article

EVALUATION OF ANTI DIABETIC AND ANTIOXIDANT EFFICACY OF ALSTONIA SCHOLARIS

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ABSTRACT:
Background: Diabetes mellitus (DM) is a chronic metabolic disorder with increasing global prevalence, leading to significant morbidity and mortality. The search for effective antidiabetic agents from natural sources is ongoing.
Objective: To evaluate the antioxidant and antidiabetic efficacy of Alstonia scholaris in experimental models.
Methods: The study involved induction of diabetes in Sprague Dawley rats using streptozotocin (STZ) and subsequent treatment with ethanolic extract of Alstonia scholaris. Biochemical parameters including blood glucose, lipid profile, and oxidative stress markers were measured.
Results: Alstonia scholaris extract demonstrated significant reduction in blood glucose and improvement in lipid profile and oxidative stress markers compared to diabetic controls.
Conclusion: Alstonia scholaris exhibits promising antidiabetic and antioxidant properties, warranting further investigation.
Keywords: Alstonia scholaris, Diabetes mellitus, Streptozotocin, Antioxidant, Lipid profile

INTRODUCTION

Diabetes Mellitus: Diabetes mellitus (DM) is a chronic, multifactorial metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The disease manifests as a spectrum of metabolic abnormalities, primarily affecting carbohydrate, fat, and protein metabolism. The hallmark symptoms of DM include polyuria, polydipsia, polyphagia, unexplained weight loss, and fatigue. Chronic hyperglycemia is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels.

Historical Perspective

Diabetes has been recognized as a debilitating disease for over two millennia. The term "diabetes" was first coined by Aretaeus of Cappadocia in the first century A.D., who described the condition as a "siphon" due to the excessive urination observed in patients. In the 17th century, Dr. Thomas Willis identified the sweet nature of diabetic urine, leading to the term "diabetes mellitus," from the Latin for "honeyed." The management of diabetes remained largely unchanged until the discovery of insulin in 1921 by Frederick Banting and Charles Best, which revolutionized the treatment and prognosis of the disease (Bach et al., 1995). Subsequent decades witnessed significant advances, including the development of oral hypoglycemic agents, improved insulin formulations, and technologies for self-monitoring of blood glucose.

Prevalence and Epidemiology

The prevalence of diabetes mellitus has reached epidemic proportions globally. According to the World Health Organization (WHO), the number of adults with diabetes is projected to rise from 135 million in 1995 to over 300 million by 2025 (King H et al., 1998). Recent estimates suggest that at least 177 million people worldwide were affected by diabetes in 2002, with the greatest increases expected in developing countries. India, in particular, is experiencing a rapid surge in diabetes cases, earning the designation "diabetic capital of the world." Type 2 diabetes mellitus (T2DM) accounts for more than 95% of cases in India and is largely attributed to urbanization, sedentary lifestyles, and dietary shifts.

Etiology and Risk Factors

The etiology of DM is complex, involving both genetic and environmental factors. Type 1 diabetes mellitus (T1DM) is primarily an autoimmune disorder resulting in the destruction of pancreatic β-cells, accounting for about 10% of all cases. In contrast, T2DM, which represents the majority of cases, is characterized by insulin resistance and a relative deficiency in insulin secretion. Heredity plays a significant role, with the risk of developing diabetes markedly increased among individuals with a family history of the disease. Other risk

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factors include obesity, physical inactivity, poor dietary habits, advancing age, and certain viral infections. Additionally, secondary forms of diabetes can result from pancreatic disorders, endocrinopathies, or drug-induced hyperglycemia (Leboviz, 1997; Goodman and Gillman, 2001).

Complications and Societal Impact

Diabetes is a leading cause of morbidity and mortality worldwide, contributing to cardiovascular disease, renal failure, neuropathy, retinopathy, and limb amputations. It is the sixth leading cause of death by disease in adults and the foremost cause of new cases of blindness among adults aged 20–75 years. The economic burden of diabetes is substantial, straining healthcare systems, especially in low- and middle-income countries.

Current Management and Limitations

The management of diabetes involves lifestyle modification, pharmacotherapy with oral hypoglycemic agents or insulin, and regular monitoring of blood glucose levels. Despite advances in therapy, achieving optimal glycemic control remains challenging, and many patients develop complications over time. The limitations of current treatments, including side effects and the progressive nature of the disease, have fueled the search for alternative and adjunctive therapies.

Role of Oxidative Stress in Diabetes

Emerging evidence implicates oxidative stress as a key contributor to the pathogenesis and complications of diabetes mellitus. Chronic hyperglycemia leads to increased production of reactive oxygen species (ROS), overwhelming the endogenous antioxidant defense mechanisms. This oxidative imbalance damages cellular components, exacerbates insulin resistance, and accelerates the development of microvascular and macrovascular complications.

Rationale for Herbal and Natural Therapies

Given the limitations of conventional therapies and the pivotal role of oxidative stress in diabetes, there is growing interest in the use of medicinal plants with antioxidant and antidiabetic properties. Herbal medicines are often considered safer, more affordable, and culturally acceptable, especially in developing countries. Numerous plants have demonstrated potential in lowering blood glucose and ameliorating oxidative damage in experimental and clinical studies.

Alstonia scholaris: A Promising Medicinal Plant

Alstonia scholaris, commonly known as the "devil's tree," is a traditional medicinal plant widely used in Ayurveda and other systems of medicine. It is reputed for its diverse pharmacological activities, including anti-inflammatory, antimicrobial, and antioxidant effects. However, scientific validation of its antidiabetic and antioxidant efficacy remains limited. The present study aims to evaluate the oxidant efficacy of Alstonia scholaris in experimental models of diabetes, with a focus on its potential to ameliorate hyperglycemia and oxidative stress.

Materials and Methods

Plant Material and Extraction

Collection and Authentication:

Fresh leaves of Alstonia scholaris were collected from local area. The plant material was authenticated and a voucher specimen was deposited in the herbarium for future reference.

Preparation of Extract:

The collected leaves were washed, shade-dried, and coarsely powdered using a mechanical grinder. The powdered material (500 g) was subjected to Soxhlet extraction with ethanol (95%) for 48 hours (see Figure 9). The extract was concentrated under reduced pressure using a rotary evaporator to yield a semisolid mass, which was stored at 4°C in an airtight container until further use.

Chemicals and Reagents

- Streptozotocin (STZ) (Sigma-Aldrich, USA)
- Glipizide (standard drug, [manufacturer])
- Carboxy Methyl Cellulose (CMC) as vehicle
- Biochemical assay kits for glucose, lipid profile, SGOT, SGPT, G6PD, total protein, SOD, and catalase ([manufacturer])
- All other chemicals and reagents were of analytical grade.

Experimental Animals

Species and Housing:

Healthy adult Sprague Dawley (SD) rats of either sex, weighing 150–200 g, were procured from [animal supplier]. Animals were housed in polypropylene cages under standard laboratory conditions (temperature 22±2°C, humidity 55±5%, 12 h light/dark cycle) with free access to standard pellet diet and water ad libitum.

Induction of Diabetes

After one week of acclimatization, diabetes was induced by a single intraperitoneal injection of streptozotocin (STZ) at a dose of 50 mg/kg body weight, dissolved freshly in cold 0.1 M citrate buffer (pH 4.5). Control rats received an equivalent volume of citrate buffer. To prevent initial drug-induced hypoglycemia, rats were provided with 5% glucose solution for 24 hours after STZ administration. After 72 hours, fasting blood glucose

was measured using a glucometer (GOD-POD method). Rats with fasting blood glucose levels above 250 mg/dL were considered diabetic and included in the study.

Experimental Design

Rats were randomly divided into the following groups (n=6 per group):

- **Group I:** Normal control (vehicle only, 0.5% CMC)
- **Group II:** Diabetic control (STZ only)
- **Group III:** Diabetic + Glipizide (5 mg/kg, p.o.)
- **Group IV:** Diabetic + Alstonia scholaris extract (100 mg/kg, p.o.)
- **Group V:** Diabetic + Alstonia scholaris extract (200 mg/kg, p.o.)
- **Group VI:** Diabetic + Alstonia scholaris extract (400 mg/kg, p.o.)

All treatments were administered orally once daily for 21 consecutive days.

Measurement of Biochemical Parameters

Blood Collection:

Blood samples were collected from the retro-orbital plexus under mild anesthesia on days 0, 7, 14, and 21. Serum was separated by centrifugation at 3000 rpm for 15 minutes and stored at -20°C until analysis.

Parameters Assessed:

- **Blood Glucose:** Measured using a commercial glucose oxidase-peroxidase (GOD-POD) kit.
- **Lipid Profile:** Total cholesterol, triglycerides, HDL-c, LDL-c, and VLDL-c were estimated using standard enzymatic kits.
- **Liver Enzymes:** Serum SGOT and SGPT levels were determined by colorimetric methods.
- **Oxidative Stress Markers:** Activities of superoxide dismutase (SOD), catalase (CAT), and glucose-6-phosphate dehydrogenase (G6PD) were measured using established protocols.
- **Total Protein:** Determined by the Biuret method.
- **Body Weight:** Recorded on days 0, 7, 14, and 21.

Preliminary Phytochemical Screening

The ethanolic extract of Alstonia scholaris was subjected to qualitative phytochemical screening for the presence of alkaloids, flavonoids, saponins, tannins, glycosides, and phenolic compounds using standard procedures (see Table 3).

Statistical Analysis

All data are expressed as mean ± standard deviation (SD). Statistical analysis was performed using one-way analysis of variance (ANOVA) followed by Tukey's post hoc test for multiple comparisons. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Preliminary Phytochemical Screening

The ethanolic extract of Alstonia scholaris leaves was found to contain a variety of bioactive compounds. Qualitative tests indicated the presence of alkaloids, flavonoids, saponins, tannins, glycosides, and phenolic compounds. These constituents are known for their potential antioxidant and antidiabetic properties, supporting the rationale for evaluating the extract in diabetic models.

Effect on Blood Glucose Levels

Induction of diabetes with streptozotocin led to a marked increase in fasting blood glucose levels in rats, confirming the establishment of a diabetic state. Throughout the course of the study, diabetic rats that received the ethanolic extract of Alstonia scholaris showed a significant, dose-dependent reduction in blood glucose levels compared to untreated diabetic controls. The hypoglycemic effect was evident as early as the first week of treatment and became more pronounced by the end of the experimental period. The highest dose of the extract produced a glucose-lowering effect comparable to that observed with the standard antidiabetic drug, glipizide. In contrast, diabetic rats that did not receive any treatment maintained persistently elevated blood glucose levels.

Effect on Body Weight

Rats with streptozotocin-induced diabetes exhibited progressive weight loss over the study period, reflecting the catabolic effects of uncontrolled hyperglycemia. Administration of Alstonia scholaris extract mitigated this weight loss in a dose-dependent manner. Treated rats maintained or even gained weight compared to diabetic controls, indicating an improvement in their overall metabolic state and suggesting a protective effect of the extract against diabetes-induced muscle wasting.

Effect on Lipid Profile

Diabetic rats displayed significant dyslipidemia, characterized by elevated levels of total cholesterol, triglycerides, LDL-cholesterol, and VLDL-cholesterol, along with a reduction in HDL-cholesterol. Treatment with Alstonia scholaris extract resulted in a marked improvement in the lipid profile. There was a significant reduction in total cholesterol, triglycerides, LDL-cholesterol, and VLDL-cholesterol, while HDL-cholesterol levels increased towards normal values. These effects were more pronounced with higher doses of the extract and were comparable to those achieved with glipizide.

Effect on Liver Enzymes

Elevations in serum SGOT and SGPT levels were observed in diabetic rats, indicating hepatic dysfunction commonly associated with diabetes. Administration of the plant extract significantly reduced the levels of these liver enzymes, suggesting a hepatoprotective effect and improved liver function in treated animals.

Effect on Oxidative Stress Markers

Diabetes induction led to a decrease in the activities of key antioxidant enzymes, such as glucose-6-phosphate dehydrogenase (G6PD), and a reduction in total protein levels. Treatment with Alstonia scholaris extract restored G6PD activity and increased total protein levels in a dose-dependent manner. These findings indicate that the extract enhances the antioxidant defense system and improves protein metabolism in diabetic rats.

Statistical Analysis

All results were statistically analyzed and showed significant differences between treated and untreated groups. The improvements observed in blood glucose, body weight, lipid profile, liver enzymes, and oxidative stress markers in extract-treated groups were statistically significant when compared to diabetic controls, with higher doses of the extract generally producing greater effects.

Table 1. Preliminary Phytochemical Screening

Phytochemical Constituent	Test Performed	Result
Alkaloids	Mayer's test	+
Flavonoids	Shinoda test	+
Saponins	Foam test	+
Tannins	Ferric chloride test	+
Glycosides	Keller-Killiani test	+
Phenolic compounds	Lead acetate test	+

Table 2. Blood Glucose Levels (mg/dL) in Different Groups

Group	Day 0	Day 7	Day 14	Day 21
Normal Control	85.2±3.4	87.3±2.9	86.5±3.1	88.1±2.8
Diabetic Control	275.6±12.3	289.4±14.2	298.7±15.6	312.5±16.8
Diabetic + Glipizide (5 mg/kg)	272.3±11.8	198.6±10.2	142.5±8.7	112.3±7.5
Diabetic + *A. scholaris* (100 mg/kg)	278.1±12.5	245.3±11.6	210.4±10.8	185.6±9.7
Diabetic + *A. scholaris* (200 mg/kg)	274.5±11.9	228.7±10.5	182.3±9.5	148.7±8.2
Diabetic + *A. scholaris* (400 mg/kg)	276.8±12.1	215.4±10.1	162.8±8.9	124.5±7.8

Table 3. Lipid Profile in Different Groups (mg/dL)

Group	Total Cholesterol	Triglycerides	HDL-c	LDL-c	VLDL-c
Normal Control	92.5±4.2	88.3±3.9	42.6±2.1	32.3±1.8	17.6±0.8
Diabetic Control	185.7±8.6	172.4±7.8	28.3±1.4	122.9±6.2	34.5±1.6
Diabetic + Glipizide	112.3±5.3	105.6±4.8	38.7±1.9	52.5±2.6	21.1±1.0
Diabetic + *A. scholaris* (100 mg/kg)	156.8±7.2	148.2±6.7	32.1±1.6	95.1±4.8	29.6±1.4
Diabetic + *A. scholaris* (200 mg/kg)	132.5±6.1	125.7±5.7	35.4±1.7	72.0±3.6	25.1±1.2
Diabetic + *A. scholaris* (400 mg/kg)	118.2±5.5	112.3±5.1	37.5±1.8	58.2±2.9	22.5±1.1

Table 4. Oxidative Stress and Liver Function Parameters

Group	SGOT (IU/L)	SGPT (IU/L)	G6PD (U/g Hb)	Total Protein (g/dL)
Normal Control	32.5±1.6	28.7±1.4	12.8±0.6	7.2±0.4
Diabetic Control	78.3±3.8	72.5±3.5	5.3±0.3	4.8±0.2
Diabetic + Glipizide	42.6±2.1	38.4±1.9	10.5±0.5	6.7±0.3
Diabetic + *A. scholaris* (100 mg/kg)	65.2±3.2	61.8±3.0	7.2±0.4	5.4±0.3
Diabetic + *A. scholaris* (200 mg/kg)	52.7±2.6	48.5±2.4	8.9±0.4	6.1±0.3
Diabetic + *A. scholaris* (400 mg/kg)	45.3±2.2	41.2±2.0	9.8±0.5	6.5±0.3

Note: *All values are expressed as mean ± SD (n=6). The numerical values presented are representative examples and should be replaced with your actual experimental data.*

DISCUSSION

The present study demonstrates the potential antidiabetic and antioxidant effects of Alstonia scholaris in STZ-induced diabetic rats. The extract significantly reduced blood glucose and improved lipid profile and oxidative stress parameters. These effects may be attributed to the presence of bioactive constituents such as alkaloids and flavonoids.

The findings are consistent with previous reports on the efficacy of plant-based therapies in diabetes management. Further studies are warranted to elucidate the mechanisms of action and to evaluate the clinical relevance of these findings.

CONCLUSION

Alstonia scholaris exhibits significant antidiabetic and antioxidant activities in experimental models. It holds promise as a complementary therapy for diabetes mellitus but requires further clinical validation.

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REFERENCES:

1. Agrawal, P., Rai, V., Singh, R.B., et.al. Randomized placebo controlled single blind trial of holy basil leaves in patients with non insulin-dependent diabetes mellitus. Indian Journal of Experimental Biology. 1996; 34: 406-409.
2. Aragno M, E.Tamagno, V.Gato, E.Brignardello, S.Parola, O.Danni, Boccuzzi,et.al. Dehydro epiandrosterone protects tissues of streptozotocin-treated rats against oxidative stress. Free Radic. Biol. Med .1999; 26(11/12): 1467–1474.
3. Arky, R.A., et.al. Clinical correlates of metabolic derangements of Diabetes Mellitus. In: Kozak, G.P. (Ed.), Complications of diabetes mellitus. W.B. Saunders, Philadelphia, 1982: 16–20.
4. Bach, J.F,et.al. Insulin-dependent diabetes mellitus as a β-cell targeted disease of immuno regulation. J. Autoimmunol.1999;58: 439–463.
5. Bailey CJ and Day C.et.al. Traditional plant medicines as treatments for diabetes. Diabetes Care.1989;12: 553–564.
6. Baynes JW,et.al. Role of oxidative stress in development of complications in diabetes. Diabetes.1991;40: 405–412.
7. Baynes JW, Thorpe SR,et.al. Role of oxidative stress in diabetic complications. A new perspective on an old paradigm. Diabetes.1999;48: 1-9.
8. Bhattacharyya, P., Chowdhury, B.K,et.al. Glycolone, a quinolone alkaloid from Glycosmis pentaphylla. Phytochemistry.1985;24: 634–635.
9. Bolzain, A.D., Bianchi, M.S,et.al. Genotoxicity of streprozocin. Mutation Research.2002;512: 121-134.
10. Bhatnagar M et al., Antiulcer and Antisecretory activity of Asparagus racemosus Willd (Shatawari) and Withania somnifera Dunal (Ashwagandha) root extract. IJPSR.2011:54:87-94.
11. Bhatnagar M et al., Antisecretory and antiulcer activity of Asparagus racemosus Willd. (methanolic extract) and its action against indomethacin. J. Ethnopharmacol. 2009;84: 247–249.
12. Briones, E.R., Mao, S.J.T., Palumbo, P.J., O'Fallon, W.M., Chenoweth, W., Kottke, B.A,et.al. Analysis of plasma lipids and lipoproteins in insulin dependent and non-insulin dependent diabetics. Metabolism.1984;33: 42–49.

13. Brownlee.M ,et.al. Biochemistry and molecular cell biology of diabetic complications. Nature.2001; 414: 813-820.
14. Celik, Yegin IE, Odabasoglu F,et.al. Effect of experimental diabetes mellitus on plasma lactate dehydrogenase and glutamic oxaloacetic transaminase levels in rabbits. Turkish J. Biol.2002;26: 51–154.
15. Chattopadhyay.R, R. Bandyopadhyay, et.al. Effect of Azadirachta indica on serum lipid profile changes in normal and streptozotocin induced diabetic rats. African Journal of Biomedical Research.2005;8: 101-104.
16. Chifundera K et al., Aqueous and ethanolic extracts from five plants: Maesa lanceolata, Chenopodium ugandae, Asparagus racemosus, Phyllanthus nummulariifolius and Crinum zeylanicum, exhibited high mortality rate (100%) against Biomphalaria pfeifferi and Lymnaea natalensis. Indian Journal of Experimental Biology. 2011; 39: 748-759.
17. Cooke DW, Plotnick L,et.al. "Type 1 diabetes mellitus in pediatrics". Pediatr Rev.2008;29 (11): 374–84.
18. Christina AJ et al., The ethanolic extract of Asparagus racemosus Willd have inhibitory potential on lithiasis (stone formation).IJP.2011:54:43-49.
19. Dalvi SS et.al., Asparagus racemosus (Shatavari) is used in Ayurveda for dyspepsia (amlapitta) and as a galactogogue. Indian Journal of Experimental Biology. 2008; 39: 748-759.
20. Datta GK et al., Antiulcer activity of Asperagus racemosus rhizoms.IRJPC.2010:66:432-440.