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Research

Pharmacological Evaluation of Antioxidant and Antidiabetic Activity of *Acacia arabica* whole plant in streptozotocin -Induced Diabetic Albino Wistar Rats

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Abstract

Acacia Arabica, commonly found in West Africa, Australia, Colombia, and India, is a potential source of bioactive compounds with antioxidant and antidiabetic properties. This study aimed to assess its proximate composition, phytochemicals, antioxidant, and antidiabetic activities. Phytochemical screening of aqueous and alcoholic leaf extracts revealed the presence of alkaloids, flavonoids, tannins, saponins, phenols, and other active constituents. Antioxidant potential was evaluated using FRAP, metal chelating, DPPH, superoxide, and hydrogen peroxide scavenging assays. The alcoholic extract exhibited stronger antioxidant activity, likely due to phenolic hydroxyl groups. Acute oral toxicity studies showed no adverse effects up to 2000 mg/kg body weight. Antidiabetic activity was tested in alloxan-induced diabetic rats using 20 and 30 mg/kg doses. Fasting blood glucose levels (FBGL) were recorded on days 7, 14, and 21, and oral glucose tolerance tests (OGTT) on days 8, 15, and 22. The extracts significantly reduced blood glucose levels and showed hypoglycemic activity in normal rats. Effects were comparable to standard drug Glibenclamide. The results suggest that Acacia Arabica leaves may help regenerate insulin-secreting β-cells and could serve as a natural therapeutic option for diabetes management, warranting further isolation and characterization of active compounds.

Keywords: *Acacia Arabica*, Alloxan monohydrate, Glibenclamide, FBGL, OGTT, antidiabetic activity and Antioxidant activity.

INTRODUCTION

Medicinal Plants

Medical plants have started to consider an essential source in treating/preventing a various kind of disease [1]. Each plant consists of several important ingredients that can be used in medical field, and can be involved in the development of different kind of drugs. A lot of undeveloped countries or even developed countries are using herbal medicine in maintain human wellbeing, personal health condition, and treating certain type of disease such as cough. These plants include Echinacea, Garlic, Ginger, Gingko, Ginseng, and others [2]. The knowledge of their healing properties has been transmitted over the centuries within and among human communities. Active compounds produced during secondary metabolism are usually responsible for the biological properties of plant species used throughout the globe for various purposes, including treatment of infectious diseases [3]. Currently, many studies are warned people about the risk and dangerous of pathogenic microorganisms that have become resistance to discovered antimicrobials [4].

Antioxidant

Antioxidants are molecules that prevent or slow the oxidation of other molecules, protecting cells from damage by unstable free radicals byproducts of metabolism that, in excess, cause oxidative stress**.** This stress is linked to conditions like cancer, cardiovascular diseases, neurodegeneration, and diabetes [5,6]. The body's defense includes endogenous antioxidants like superoxide dismutase, glutathione peroxidase, and vitamins C and E. However, when these are insufficient, exogenous antioxidants often derived from plants can offer support. Many herbs and natural sources contain polyphenols, alkaloids, and terpenoids**,** which have demonstrated potent antioxidant effects [7]. Studies using in vitro and in vivo models show that long-term consumption of antioxidant-rich foods may help reduce disease risk [8]. Natural antioxidants**,** especially those with multiple hydroxyl groups, are often more effective than synthetic ones. Lichens, rich in unique compounds like depsides, are gaining interest for their medicinal and biotechnological potential [9,10].

Mechanism of action of antioxidants

Two principle mechanisms of action have been proposed for antioxidants. The first is a chain- breaking mechanism by which the primary antioxidant donates an electron to the free radical present in the systems. The second mechanism involves removal of ROS/reactive nitrogen species initiators (secondary antioxidants) by quenching chain-initiating catalyst. Antioxidants may exert their effect on biological systems by different mechanisms including electron donation, metal ion chelation, co-antioxidants, or by gene expression regulation.

Anti-diabetic activity

Diabetes Mellitus (DM)

Diabetes is one of the most common non-communicable diseases and a serious life-long condition appearing worldwide. The etiology of diabetes is a complex interaction of genetic and environmental factors. It is a heterogeneous group of metabolic disorders characterized physiologically by dysfunction of pancreatic beta cells and deficiency in insulin secretion or insulin activity and clinically by hyperglycemia or impaired glucose tolerance and other manifestable disorders. It is an endocrinological syndrome abnormally having high levels of sugar in the blood. This may be either due to insulin not being produced at all, is not made at sufficient levels, or is not as effective as it should be. Diabetes is still a serious health problem all over the world since it is associated with increased morbidity and mortality rate. When compared with the general population, mortality and morbidity increase in diabetes is mainly due to the associated chronic complications both specific (microvascular) and nonspecific (macrovascular). Since the disease prevails in both genders and in all age groups, the general public has a concern about its control and treatment.

Classification of DM

Diabetes is classified by underlying cause. The most common forms of diabetes are categorized as

Type 1, or insulin-dependent diabetes mellitus (IDDM) - an autoimmune disease in which the body's own immune system attacks the pancreatic beta cells, rendering it unable to produce insulin and

Type 2, or non-insulin-dependent diabetes mellitus (NIDDM) - in which there is resistance to the effects of insulin or a defect in insulin secretion.

Type 2 diabetes commonly occurs in adults associated with obesity. There are many underlying factors that contribute to the high blood glucose levels in these individuals. An important factor is the resistance to insulin in the body essentially ignoring its insulin secretions. A second factor is the decreased production of insulin by the cells of the pancreas. Therefore, an individual with Type 2 diabetes may have a combination of deficient secretion and deficient action of insulin. In contrast to Type 2 diabetes, Type 1 diabetes most commonly occurs in children and is a result of the body's immune system attacking and destroying the beta cells. The trigger for this autoimmune attack is not clear, but the result is the end of insulin production[11].

Epidemiology

India bears a significant burden, with over 31 million diabetics, making it one of the countries with the highest prevalence. The global surge in diabetes is primarily driven by obesity, sedentary lifestyles, and diets rich in calories. Developing nations are witnessing a faster rise in cases, especially among younger age groups.

Type 2 diabetes constitutes about 90–95% of cases and now occurs even in children and adolescents, a trend once rare. In contrast, Type 1 diabetes makes up only 5–10% of cases. The widespread impact of Type 2 diabetes extends beyond individual health, affecting quality of life, life expectancy, and placing a significant strain on healthcare systems worldwide.

Pathophysiology [12]

Diabetes results from an imbalance between the demand and production of insulin. After food intake, carbohydrates are broken down into glucose, which enters the bloodstream. Insulin, secreted by pancreatic beta cells, facilitates the uptake of glucose by cells for energy and storage. It also promotes glycogen formation in the liver and fat synthesis in adipose tissue.

Treatment: An approach to botanicals [13]

India is rich in plant diversity, with about 45,000 species**,** of which over 800 have been identified with potential antidiabetic activity. Although many traditional herbal treatments lack rigorous scientific validation, the World Health Organization (WHO) recommends research into their pharmacological properties and safety. Studies have confirmed the hypoglycemic effects of several herbal extracts in both animal and human models. Well-studied plants include Ginseng**,** Momordica charantia (bitter melon), Trigonella foenum-graecum (fenugreek), Gymnema sylvestre**,** Allium cepa (onion), Allium sativum (garlic), Aloe vera, and Petrocarpus marsupium**.** These plants contain active compounds like alkaloids, flavonoids, glycosides, and terpenoids, which help regulate blood glucose. The combination of plant extracts with existing treatments may offer synergistic benefits**,** and ongoing research continues to explore their full therapeutic potential in managing type 2 diabetes**.**

Aim & Objectives

To evaluate the antioxidant and antidiabetic potential of aqueous and alcoholic extracts of the *Acacia arabica* whole plant in streptozotocin-induced diabetic albino Wistar rats.

1. To perform phytochemical screening of *Acacia arabica* to identify key bioactive compounds such as phenols, flavonoids, alkaloids, tannins, and saponins.
2. To assess antioxidant activity of aqueous and alcoholic extracts using multiple in vitro assays.
3. To evaluate the antidiabetic activity of the extracts in both normal and streptozotocin-induced diabetic rats by:
    - Measuring fasting blood glucose levels (FBGL) on days 7, 14, and 21
    - Conducting oral glucose tolerance tests (OGTT) on days 8, 15, and 22
4. To compare the effects of plant extracts with the standard antidiabetic drug Glibenclamide.
5. To investigate potential mechanisms of action such as beta-cell regeneration, insulin secretion enhancement, or glucose uptake improvement.

MATERIALS AND METHODS

Sodium hydroxide (Analytical grade, Fisher Chemicals Inc., Fair Lawn, NJ), citric acid (analytical grade), hexanes (HPLC grade, EMD Chemicals Inc., Gibbstown, NJ), methanol (HPLC grade, EMD Chemicals Inc., Gibbstown, NJ), ethyl acetate (HPLC grade, EMD Chemicals Inc., Gibbstown, NJ), BCL3-methanol (Supelco Inc., Belletonte, PA), 98% 2, 2- Dimethoxypropane (Sigma-Aldrich Inc., St. Louis, MO), Anhydrous sodium sulfate (10-60 mesh, Fisher Chemicals Inc., Fair Lawn, NJ), cholesterol (Aldrich Chem. Co., Milw., WI), 5α- cholestane (Sigma-Aldrich Co., St. Louis, MO), heptadecanoic acid (Sigma chemical Co., St.Louis, MO), DHA (cis-4, 7, 10, 13, 16, 19-Docosahexaenoic acid, Sigma-Aldrich Inc., St. Louis, MO). Drugs and Chemicals used in this study were of analytical grade and of highest purity procured from standard commercial sources in India.

Table 1: Drugs and Chemicals

S.No	Materials	Company Name
1.	Alloxan	Quali Kems Fine Chem Pvt, Ltd, Vadodara.
2.	Methanol	ChangshuYangyuan Chemicals, China.
3.	Alcohol	ChangshuYangyuan Chemicals, China.
4.	Glibenclamide	Orchid Pharma Ltd, Chennai.

Table 2: List of Instruments

Name of the instrument	Source
Centrifuge	Dolphin
Digital weighing balance	Horizon
Glucometer	Horizon
Heating mantle	ASGI®
Refrigerator	Videocon
Soxhlet extractor	ASGI®
Condenser	ASGI®
Burette stand	Dolphin
Round bottom flask	ASGI®, Amar
Mixer	Videocon
Oven	ASGI®
Water bath	ASGI®
Stirrer/glass rod	ASGI®
Watch glass	ASGI®
Whatmann filter paper	Manipore microproducts, Ghaizabad.
Butter paper	ASGI®
Spatula	ASGI®
Rubber pipes	ASGI®

Plant Material Collection

The leaves of *Acacia Arabica* were collected and was identified and authenticated from Department. The plant material was cleaned, reduced to small fragments, air dried under shade at room temperature and coarsely powdered in a mixer. The powdered material was stored or taken up for extraction process.

Preparation of plant extracts

Preparation of Aqueous Extract

Fresh leaves of *Acacia Arabica* were collected and washed under tap water. The leaves extract used was prepared by taking 20gms of finely cut leaves into 250ml beaker containing 200ml of water. The contents were mixed well and then the mixture was boiled up to 80-100^{0}C for 4-5hrs. Further the extract was filtered with whatmann filter paper. The filtrate was boiled until the concentrated residue is formed. The concentrated product was sealed in sample covers and stored under room temperature and used for further experiment for evaluating biological activities.

Preparation of Alcoholic Extract

Fresh leaves of *Acacia Arabica* were collected and washed under tap water. The leaves extract used was prepared by taking 20gms of finely cut leaves into 250ml beaker containing 200ml of alcohol. The contents were mixed well and then the mixture was boiled up to 50-60^{0}C for 4-5hrs. Further the extract was filtered with whatmann filter paper. The filtrate was boiled until the concentrated residue is formed. The concentrated product was sealed in sample covers and stored under room temperature and used for further experiment to check the activities.

***In vitro* methods of anti-oxidant activity**

Antioxidant activity should not be determined by a single test method, as different in vitro assays vary in principles and sensitivity. Therefore, multiple assays are typically employed to evaluate antioxidant potential more accurately. Each method has its strengths and limitations, so researchers must critically assess and select the most suitable one for their specific objectives. Among free radical scavenging assays, the DPPH method is widely used for its simplicity, speed, and low cost. The ABTS assay is advantageous as it measures both hydrophilic and lipophilic antioxidants. In this study, five different in vitro methods were used, highlighting that no single assay is definitive**,** and method optimization is essential for reliable results.

Statistical analysis

The values were expressed as mean ± SEM data was analyzed using one-way ANOVA followed by T-test. Two sets of comparison had made. i.e.

1. Normal control Vs All treated groups.

2. Diabetic Control Vs All treated groups.
Differences between groups were considered significant at P<0.001 and $P < 0.05$ levels.

RESULTS

Phytochemical screening of *Acacia Arabica.*

The present investigation concluded that the isolated compounds from the plant *Acacia Arabica* are pure and the plant *Acacia Arabica* shows the various Anti-Diabetic effects against different phytochemical compounds. Further study is needed for the isolation of the constituents present in the plant and its individual pharmacological activity should need to consider and ultimately it should be implemented for the benefit to human beings.

Table 3: Phytochemical screening of *Acacia Arabica*

S.No.	Phytoconstituents	Aqueous	Alcoholic
1.	Alkaloid	-	+
2.	Flavonoids	+	-
3.	Tannins	+	+
4.	Saponins	-	+
5.	Phenols	+	+

Antioxidant properties of *acacia arabica*

Several mechanisms have been proposed to be involved in antioxidant activity such as hydrogen donation, termination of free radical mediated chain reaction, prevention of hydrogen abstraction, chelation of catalytic ions and elimination of peroxides (Gordon, 1990). Antioxidant activity is system-dependent and characteristic of a particular system can influence outcome of analysis. Hence, a single assay would not be representative of antioxidant potential of plant extracts. In this present study, different models of antioxidant assays were employed, which could provide a more consistent approach to assess antioxidant activity of leaves of *Acacia Arabica.*

Hypoglycemic activity in normal rats

Fasting Blood Glucose Levels (FBGL) were within the range of 90-105 mg/dl in all the groups at 0 day. Repeated treatment with the doses of aqueous and alcoholic extract (100 and 200 mg/kg) significantly decrease the blood glucose level on 7^{th}, 14^{th} and 21^{st} day, indicating that the extract produce significant hypoglycemic activity after repeated administration. Glibenclamide (10mg/kg) also significantly reduced Fasting Blood Glucose Level (FBGL) after repeated administration as compare to normal control group. Changes in FBGL in different groups after repeated dose administration are summarized in Table No.

Repeated administration of both aqueous and alcoholic extracts had significantly (p<0.005) reduced the FBGL on 7^{th}, 15^{th} and 21^{st} day, indicating these extracts can produce hypoglycemia on repeated administration. However hypoglycemic activity was more significant on 7^{th}, 14^{th} and 21^{st} day for Glibenclamide treated as compare with other groups. The results suggest that the both aqueous and alcoholic extracts possess significant hypoglycemic activity after repeated dose administration. The detailed results are summarized in Table 4.

Effect of extracts of *Acacia Arabica* on fasting blood glucose level (FBGL) in normal rats

Table 4: Effect of extracts of *Acacia Arabica* on fasting blood glucose level (FBGL) in normal rats.

Treatment	Dose (mg/kg)	Blood glucose level (mg/dl)		
		7^{th} day	14^{th} day	21^{st} day
Normal control	-	90.21±1.51	78.10±2.01	73.24±1.10
Glibenclamide	10	83.81±2.31	76.41±0.81	71.30±2.39
AQAA1	20	92.56±2.52	83.69±3.51	79.06±1.68
AQAA2	30	84.92±1.06	78.21±1.86	70.36±0.68
ALAA1	20	78.2±1.06	67.15±3.51	62.52±4.12
ALAA2	30	89.3±2.61	78.52±0.10	72.21±2.21

Values are expressed as mean± S.E.M. n=6. Significant values were compared with p<0.005, normal control Vs all groups. Parent thesis indicates % reduction in BGL.

Oral glucose tolerance test (OGTT)

Both the aqueous and alcoholic extracts of *Acacia Arabica* significantly (P<0.005) suppress the rise in FBGL after glucose load (2g/kg) in rats, at first half-an-hour and up to 2hr time period as compare with other groups extract Glibenclamide on 8th, 15th and 22nd day. While aqueous and alcoholic extracts produced significant reduction in FBGL. Glibenclamide (10mg/kg) showed (P<0.005) significant suppression in FBGL rise at first half-an-hour, 1hr and normalized FBGL within 2hr. The detailed results are summarized in Table 5.

Table 5: Effect of extracts of *Acacia Arabica* on 8th, 15th and 22nd day in normal rats.

Treatment	Dose (mg/kg)	Blood glucose level (mg/dl)		
		8th day	15th day	22st day
Normal control	-	91.25±1.26	83.53±2.51	77.13±1.06
Glibenclamide	10	87.06±1.02	77.12±1.81	72.90±1.20
AQAA1	20	88.12±3.21	81.69±2.60	70.19±3.26
AQAA2	30	85.29±4.82	79.52±3.56	67.51±0.52
ALAA1	20	92.19±3.95	83.26±1.80	73.49±1.10
ALAA2	30	78.11±3.10	67.15±3.52	60.27±3.56

Values are expressed as mean ± S.E.M. n=6. Significant values were compared with P<0.005. Normal control Vs all groups. Paranthesis indicates % reduction in BGL.

Anti-diabetic activity in alloxan induced diabetic rats

Changes in the fasting blood glucose levels in different groups are tabulated in Table. This data shown that blood glucose level of normal control animals has maintained throughout the study period. The diabetic control group has shown significant increase in fasting blood glucose levels during this 21st day study period. Glibenclamide (10mg/kg) treated group has shown (p<0.05) significant decrease in fasting blood glucose level during 7th, 14th and 21st day of study period.

Effect of *Acacia Arabica* extracts on antidiabetic activity in alloxan induced diabetic rats

The animals treated with 100 and 200mg/kg of aqueous and alcoholic of different extracts shown significant decrease (P<0.05) in FBGL on 7th, 14th and 21st day of treatment when compare to other groups of animals. The aqueous extracts have reduced more (%) in FBGL when compared to alcoholic extracts except standard group. The detailed results are summarized in Table 6.

Table 6: Effect of extracts of *Acacia Arabica* on fasting blood glucose level (FBGL) in Alloxan induced diabetic rats.

Treatment	Dose (mg/kg)	Blood glucose level(mg/dl)		
		7th day	14th day	21st day
Normal control	-	88.12±4.01	77.12±1.92	69.34±1.62
Diabetic control	**10**	299.24±10.50	274.12±24.34	260.21±10.24
Glibenclamide	**10**	265.23±11.30	248.36±71.10	230.21±10.05
AQAA1	**20**	378.12±36.10	362.14±10.06	333.15±10.60
AQAA2	**30**	383.11±05.15	370.31±21.10	353.15±36.12
ALAA1	**20**	294.26±12.92	273.10±11.09	220.81±30.35
ALAA2	**30**	225.13±16.09	186.21±02.12	155.34±55.89

Values are expressed as mean ± S.E.M. n=6. Significant values were compared with P<0.05. Normal control Vs all groups. Paranthesis indicates % reduction in BGL.

Oral glucose tolerance test (OGTT) on 8th, 15th and 22nd day-

Both the aqueous and alcoholic extracts of *Acacia Arabica* are significantly (P<0.05) suppress the rise in FBGL after glucose load (2g/kg) in rats, at first half-an-hour and up to 2hr time period as compare with other groups extract Glibenclamide on 8th,15th and 22nd day. While aqueous and alcoholic extracts produced significant reduction in FBGL. Glibenclamide (10mg/kg) showed (P<0.05) significant suppression in FBGL rise at first half-an-hour, 1hr and normalized FBGL within 2hr. The detailed results are summarized in Table 7.

Table 7: Effect of extracts of *Acacia Arabica* on 8th, 15th and 22nd day in Diabetic rats.

Treatment	Dose (mg/kg)	Blood glucose level(mg/dl)		
		8th day	15th day	22st day
Normal control	**-**	85.12±2.85	75.28±1.91	63.14±2.89
Diabetic control	**10**	283.25±11.71	251.14±20.95	221.39±19.86
Glibenclamide	**10**	365.89±75.50	286.15±39.52	275.93±15.78
AQAA1	**20**	262.13±72.89	232.71±25.53	198.17±13.99
AQAA2	**30**	283.82±10.27	262.13±10.78	242.89±15.32
ALAA1	**20**	264.18±93.56	221.80±96.15	186.55±11.89
ALAA2	**30**	363.12±10.28	321.18±25.98	282.15±19.12

Values are expressed as mean ± S.E.M. n=6. Significant values were compared with P<0.05. Normal control Vs all groups. Paranthesis indicates % reduction in BGL.

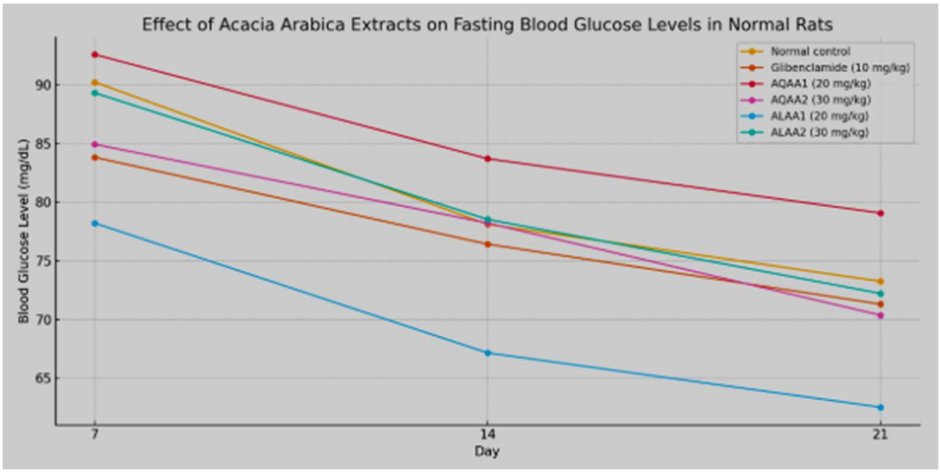

Fig 1: Effect of *Acacia arabica* Extracts on Fasting Blood Glucose Levels (FBGL) in Normal Rats

Line graph showing FBGL measurements on Days 7, 14, and 21 for different treatment groups including aqueous (AQAA1, AQAA2) and alcoholic (ALAA1, ALAA2) extracts of *Acacia arabica*, compared with Glibenclamide and normal control. Both extracts demonstrated a time-dependent decrease in glucose levels, with alcoholic extracts showing the most pronounced effect.

DISCUSSIONS

Despite the fact that diabetes has high prevalence, morbidity and mortality globally, it is regarded as non curable but controllable disease. [15] Different synthetic drugs, plant remedies and dietary modification play an effective role in the reduction of the suffering that it causes. The potential role of medicinal plants as antidiabetic agents has been reviewed by several authors. [16] In order to identify the plants with antidiabetic properties various plants have been tested *in-vivo* using animal models, for example rats, against the complications caused by inducers of diabetes, and it has been established that many plants possesses the potential to lower the fasting blood glucose levels and besides help in improving other diabetic complications. [17] The sustained reduction in hyperglycemia automatically decreases the risk of other major complications of diabetes. Effective glucose control is the key for preventing or reversing the diabetic complications and improving the quality of life of the diabetics. [18]

Many natural active compounds have been isolated from plants of different species. These active principles are complex Alkaloids, Tannins, Anthraquinones, Flavonoids, Saponins, Triterpenes, Sterols, Coumarin and others.[19] These compounds have been shown to produce potent hypoglycemic, anti-hyperglycemic and glucose suppressive activities. These effects might be achieved by facilitating insulin release from pancreatic ß-cells, inhibiting glucose absorption in gut, stimulating glycogenesis in liver and/ or increasing glucose utilization by the body. [20]

Crude aqueous and alcoholic extracts of leaves of *Acacia Arabica* at a dose of 20 and 30mg/kg showed significant effect on the glucose tolerance of rats and it also showed reduction in the fasting blood glucose levels

of the normoglycaemic rats, thus revealing the hypoglycemic nature of the extracts. The effect was more pronounced for both extracts. These findings indicate that the extracts might be producing hypoglycaemic effect by a mechanism independent from the insulin secretion e.g. by the inhibition of endogenous glucose production or by the inhibition of intestinal glucose absorption.

Alloxan monohydrate is one of the chemical agents used to induce diabetes mellitus in animals. It induces diabetes by dose dependent destruction of β -cells of islets of langerhans. [21] It is a generator of free radicals of oxygen which cause extensive DNA damage. [22] It was observed that single intravenous dose of alloxan exhibited significant hyperglycemia. Excessive hepatic glycogenolysis and gluconeogenesis associated with decreased utilization of glucose by tissues is the fundamental mechanism underlying hyperglycemia in the diabetic state. As the hyperglycemia induced by alloxan falls under category of mild diabetes and may reverse after a few weeks, the hypoglycemic effect of the plant in hyperglycemic rats was studied during 22 days treatment. The difference observed between the initial and final fasting serum glucose levels of extract treated hyperglycemic rat's revealed an hyperglycemic effect of leaves of *Acacia Arabica* throughout the period of study. The effect of the extracts was compared to that of reference standard, Glibenclamide and was found to be significant.

Phytochemical analysis of extracts of leaves of *Acacia Arabica* revealed the presence of secondary metabolites that have been shown to possess antidiabetic effect in other plants. Flavonoids, alkaloids and Steroids which were responsible for the antidiabetic effect in other plants were also detected in the extracts of this plant. The presence of phenols in the plant could also be responsible for the antidiabetic effect have been shown to prevent the destruction of β-cells by inhibiting the peroxidation chain reaction and thus they may provide protection against the development of diabetes. [23] Extracts of leaves of *Acacia Arabica* appear to be attractive materials for further studies leading to possible drug development for diabetes. Development of phytomedicine is relatively inexpensive and less time consuming; it is more suited to our economic conditions than allopathic drug development which is more expensive and spread over several years.

SUMMARY

Phytochemical research has advanced rapidly, with plant-based products gaining popularity in traditional and alternative medicine due to their potent pharmacological properties and minimal side effects**.** Food-derived bioactives like those in *Acacia arabica* offer potential as preventive and protective agents**,** particularly for populations at risk of chronic diseases.

This study confirms that *Acacia arabica* leaves possess notable biological activity, especially due to their high phenolic content and strong antioxidant potential**.** Alcoholic leaf extracts showed low cytotoxicity and provided protection against oxidative damage to lymphocytes under ex vivo conditions. Additionally, the extract demonstrated therapeutic potential for conditions such as diarrhea and other traditional ailments including wounds, eczema, headaches, and burns**.**

In anti-diabetic studies, both aqueous and alcoholic extracts (20 and 30 mg/kg) significantly reduced fasting blood glucose levels and improved oral glucose tolerance (OGTT) in normal and alloxan-induced diabetic rats, with effects observed from the 7th to 21st day**.** These results indicate that repeated administration leads to potent anti-diabetic effects**.**

Overall, *Acacia arabica* shows strong potential as a natural therapeutic agent for managing oxidative stress and diabetes. However, further in vivo studies are needed to validate the protective effects observed in vitro.

CONCLUSION

The present study demonstrated that both aqueous and alcoholic extracts of *Acacia arabica* possess significant antioxidant and antidiabetic properties. The antioxidant potential is attributed to the presence of phenolic and flavonoid compounds**,** which act as free radical scavengers**,** preventing lipid peroxidation and oxidative damage. Among the antioxidant assays performed DPPH, FRAP, metal chelation, superoxide**,** and hydrogen peroxide scavenging both extracts showed consistent and potent activity.

The solvent used influenced the extraction of phenolic compounds, with alcoholic extracts exhibiting stronger antioxidant potential due to the high hydroxyl content in phenolics. These natural antioxidants suggest possible applications in medicine and food preservation**.**

In diabetic studies, both extracts significantly lowered blood glucose levels in normoglycemic and alloxan-induced diabetic rats**.** Doses of 20 and 30 mg/kg showed a marked hypoglycemic effect beginning from the 7th day, with effects comparable to the standard drug Glibenclamide (10 mg/kg) by the 22nd day.

The mechanism behind the hypoglycemic effect may be independent of insulin secretion**,** possibly involving inhibition of glucose production or absorption**.** The extracts also improved glucose tolerance and fasting blood sugar levels, supporting their use in managing diabetes.

These findings validate the traditional use of *Acacia arabica* in Indian medicine for diabetes treatment. The plant's bioactive compounds including flavonoids, alkaloids, tannins, and saponins contribute to its

therapeutic effects with fewer side effects**.** Thus, *Acacia arabica* represents a promising natural alternative for developing safe and effective antidiabetic therapies.

Abbreviations

DM	-	Diabetes Mellitus
IDDM	-	insulin-dependent diabetes mellitus
NIDDM	-	non-insulin-dependent diabetes mellitus
HDL	-	High density lipoprotein
GLUT2	-	Type 2 glucose transporters
K^+	-	potassium ions
Ca^{2+}	-	calcium ions
ATP	-	Triphosphate
Hb A1C	-	Glycated hemoglobin
dL	-	Deci litre
mg	-	Milligram
ALT	-	alanine transferase
AST	-	aspartate transferase
HDL	-	High Density Level
LDL	-	Low Density Level
OECD	-	Organization for Economic Co-operation and Development
OGTT	-	Oral Glucose Tolerance Test
FBGL	-	Fasting Blood Glucose Test
I.P	-	Intra-Peritoneal
IAEC	-	Institutional Animal Ethical committee
SEM	-	Standard Error of the Mean
ANOVA	-	Analyzed by One-way Analysis of Variance
AQAA	-	Aqueous extract of *Acacia Arabica*
ALAA	-	Alcoholic extract of *Acacia Arabica*

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