Analysis of the Phytochemical and Hypoglycemic Properties of Some Medicinal Plants of Indian Origin

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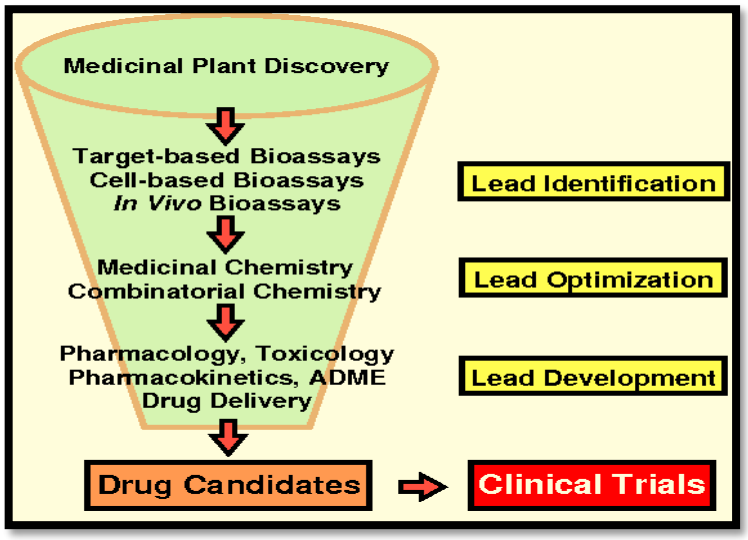
Abstract
An herb with a long history of medicinal usage, Artemisia indica, is the subject of this investigation into its possible anti-diabetic benefits. Studies that looked at acute toxicity found that a hydroalcoholic extract of the terpenoids, alkaloids, and flavonoids found in Artemisia indica leaves was safe to use. Experiments on rats with streptozotocin-induced diabetes revealed that the extract has potent anti-diabetic properties. In contrast to the diabetic control group, the treatment groups showed dramatic improvements in oral glucose tolerance, higher serum insulin levels, and much lower fasting blood glucose levels. Histological analysis confirmed that the pancreatic islet structure had been preserved, and the discovery of increased insulin expression in beta cells provided further support. Furthermore, the extract reduced oxidative stress markers and demonstrated a high level of antioxidant activity. Artemisia indica may offer an alternative to current diabetic treatments due to its antioxidant and antihyperglycemic effects, according to this study's findings. Artemisia indica may have natural anti-diabetic properties; however, more study of the plant's molecular mechanisms and therapeutic uses is required.

Keywords: pancreatic islet, Artemisia indica, DPPH assay, behavioral abnormalities, ect.

1. Introduction

Hyperglycemia, a symptom of the metabolic disease diabetes mellitus, occurs when either the body does not produce enough insulin or some tissues become resistant to its effects [1]. It was determined that diabetes mellitus is a fatal and debilitating disease. The cardiovascular system is vulnerable to the many effects of hyperglycemia, whether it's acute or chronic. Diabetic coma, nonketotic hyperosmolar coma, diabetic ketoacidosis, coronary artery disease, and myocardial infarction are among these consequences. Microvascular problems such nephropathy, neuropathy, and retinopathy can also be caused by hyperglycemia [2]. Disruptions to glucose, lipid, and protein metabolism are caused by chronic hyperglycemia, which is a risk factor for many diseases [3]. With over 30 million individuals diagnosed with the ailment in the US, India, and China alone, diabetes is rapidly increasing in prevalence around the globe [4]. Supplemental dietary approaches to diabetes mellitus have been investigated for their ability to alter fatty acid availability, reduce gluconeogenesis [5, 6], and enhance lipolysis [5].

Fig.1 Flow diagram showing the natural product drug discovery &development from plants



2. The pharmacological actions of natural plants

There has been a shift in focus away from synthetic chemicals and toward natural items, especially plants, due to their potential to lower the risk of getting diabetes. There are fewer side effects and less toxicity in these natural products [7, 8]. According to the World Health Organization (WHO), almost 70% of people with diabetes get their antidiabetic components from plants [9]. One perennial shrub that may reach a height of two to eight meters and is commonly known as "mugwort" is Artemisia indica. It is a member of the Astereaceae family. Its native habitats include the cold temperate zone of Asia and northern India. Among the many pharmacological actions demonstrated by Artemisia indica are those that combat parasites [10], smooth muscle spasms and bronchodilators [11], hypertension [12], allergies [13], liver protection [14], bacteria [15], and pain [16]. Studies have shown that each of these pharmacological effects are real. The Indian artemisia A lot of variety exists within Linn populations, and the species as a whole is widely dispersed and extremely polymorphic. Several intraspecific taxa within this species have been recognized and identified because of this. This species of plant is extremely widespread, with a distribution that includes not only Europe and North Africa but also Turkestan, Siberia, Iran, Afghanistan, Pakistan, and India. It is worth noting that Artemisia indica Linn contains a wide array of active phytochemical substances. Alkaloids, glycosides, flavonoids, terpenoids, phenols, steroids, tannins, saponins, and tannin are all parts of this compound. It has also been brought to North America, where it has become a naturalized species [17]. Artemisia indica, especially, is regarded for its antibacterial, anthelmintic, expectorant, and antispasmodic qualities. It has been found that many portions of the plant, including the aerial parts, can be exploited for a variety of therapeutic application [18]. As an illustration, an infusion of Artemisia indica is utilized for the treatment of infections that affect the central nervous system as well as for the purpose of enhancing hunger. The juice of the plant is applied to ease symptoms such as diarrhea, gastrointestinal pain, and inflammation. Additionally, the juice can be used as an eye wash to alleviate pain, burning sensation, and inflammation due to conjunctivitis. When it comes to traditional medicine, the numerous applications of Artemisia species illustrate both the medical significance of these plants as well as the cultural significance of these plants in a variety of communities. In addition, the tomentum, which is the fine, soft hair of the plant, is used as moxa, which is a traditional kind of heat therapy [19]. Both antidiabetic and antioxidant activity were investigated in this study. The streptozocin-induced diabetic model and the DPPH assay were utilized to evaluate the respective properties of the compounds.

3. Material and methods [20]

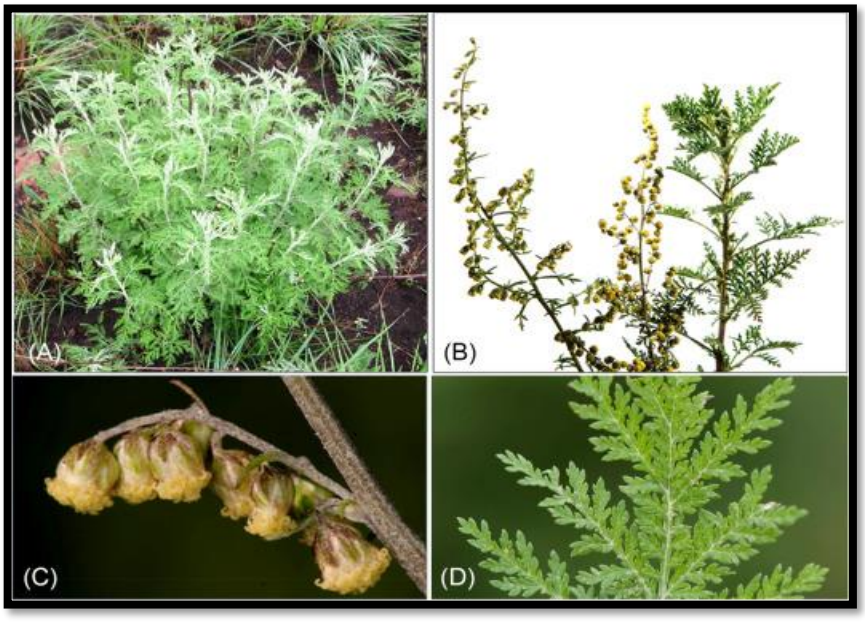
Gathering and verifying plant

Artemisia indica plants were collected from the higher elevations of the Dehradun district. It was Professor Pramod Mishra of Mangalayatan University in Aligarh, who is both a taxonomist and the head of the department of agriculture, who identified the plant. A voucher sample of the plant seeds was authenticated by Dr. Sharad Srivastava, Chief Scientist & Head Pharmacognosy Division CSIR-National Botanical Research Institute, Lucknow.

Preparation of plant extract of Artemisia indica [21]

For three weeks, the newly sprouted plant portions were allowed to dry at room temperature in the shade. Throughout this period, the material was continually moved about to forestall the growth of fungus. The dried plant was then ground into a coarse powder by crushing its aerial portions. It was then followed by a hot extraction in which n-butanol, ethyl acetate, chloroform, and methanol were used as solvents. To carry out the extraction, the Soxhlet apparatus was utilized. Following the completion of the extraction procedure, the solvent was evaporated using a rotary evaporator manufactured by Heilbach Laborata and running at 450^0 C.

Fig.2 Diagram represent the plant and leaf part of Artemisia indica wild.



4. Analysis of Artemisia indica's phytochemical profile[22]

The phytochemical assays performed on the Artemisia indica extract included those in methanolic, chloroform, ethyl acetate, n-butanol, and n-hexanol, among others. These analyses aimed to determine whether the product included any active components like tannins, triterpenoids, alkaloids, glycosides, or flavonoids.

Animals used in trials

Many studies were conducted using adult Sprague Dawley rats weighing 150 to 200 grams. The rats lived in the university-maintained animal home and had unfettered access to regular food and water.

Acute oral toxicity study[23] According to the standards established by the Organization for Economic Co-operation and Development (OECD 423, 2001), the determination of acute oral toxicity was carried out. In a nutshell, rats were given extracts of varying quantities on an oral basis, and they were regularly observed for any signs of behavioral abnormalities or mortality over the course of the subsequent fourteen days. The LD50 value of extracts was calculated based on the results of this experiment.

5. Result and Discussion

Percentage yield of plant extracts

The obtained percentage yield of different plant extracts is summarized in Table 1.

Table 1: Percentage yield of different plant extracts

Plant extracts	Weight	Percentage yield (%)
Crude methanolic extract	400 gm	90.11
n-hexane fraction	150 gm	20.5
Chloroform fraction	200 gm	54.33
Ethyl acetate fraction	100 gm	20.22
n-butanol fraction	120gm	12.30
Aqueous fraction	200 gm	40.46

Initial examination of phytochemical compounds

Table 2 summarizes the results showing that the methanolic, chloroform, ethyl acetate, n-butanol, n-hexane, and water-based extracts of Artemisia indica contained alkaloids, flavonoids, glycosides, terpenoids, saponins, and tannins.

Table 2: Preliminary phytochemical analysis of various extracts of *Artemisia indica*

Plant extracts	Flavonoids	Glycosides	Alkaloids	Saponins	Tannins	Terpenoids
Crude methanolic ext	++	++	++	++	++	++
***n*-hexane fraction**	++	_	++	++	++	++
Ethyl acetate fraction	++	++	_	++	++	_
Chloroform fraction	++	++	_	++	_	++
Aqueous fraction	_	++	_	++	_	_
***n*-butanol fraction**	_	++	_	++	_	_

++ (Positive): Presence of phytochemical constituents

- (Negative): Absence of phytochemical constituents Acute oral toxicity study

Acute oral toxicity testing showed that the plant extracts had an LD50 value of 2000 mg/kg. Chloroform, ethyl acetate, n-butanol, and n-hexane were all used in tests that followed, with dosages of 200 mg/kg for methanolic extract and 400 mg/kg for other solvents.

Antihyperglycemic Effect of *Artemisia indica*

On rats with normal and diabetic blood sugar levels, Table No.3 shows the effects of glibenclamide, the crude methanolic extract of Artemisia indica, and various fractions on blood glucose levels.

Table 3: Effect of daily oral administration of *Artemisia indica* extracts and glibenclamide on blood glucose level of STZ-induced diabetic rats

S.No.	Groups	Dose (mg/kg)	1st day	4th day	7th day	10th day	15th day
1	Diabetic control	0.4 ml	371.3±37	384.7± 30	400.8± 50	406±34	**416.7±50**
2	Normal control saline	0.4 ml	98 ±11	82.3±8	82.3±6	81.3±7	**81.5 ±5**
3	Gliben clamide	0.5	360.8±43	320.7± 45**	280.5± 50**	250.8± 53**	**200.2±40 ****
4	Crude methanolic Ext	200	377.7±18	376.3± 22	345.7± 20**	300.5± 12**	**250.3±12 ****
5	Crude methanolic Ext	400	450.7±53	37.2±8	300.8± 10**	320.8± 7**	**310.6±10 ****
6	**Chloroform fraction**	**200**	**480±52**	**240.8± 58****	**252.1± 16****	**230.2± 14****	**240.8±13 ****

The values are expressed as mean ± SEM. n = 8 in each group. **p < 0.01 as compared with diabetic control at the same time (One-way ANOVA followed by Dunnett's multiple comparison test).

Effects of *Artemisia indica* on Body Weight in Diabetic Rats

Table 4 summarises the weight changes of rats treated with glibenclamide and the control group that received the extracts.

Table 4, we can see how different Artemisia indica extracts affected the weight of diabetic rats induced by STZ.

S.No.	Treatments	Dose (mg/kg)	Change in body weight (g) at days					% Change in body weight
			0	**4**	**7**	**10**	**15**	
1	Normal (Control)	0. 4 ml	143±0.5	145±9	155±0.9	160±0.9	170±3	
2	Diabetic (Control)	0.4 ml	150± 7	148±5*	146±5**	143±3*	145±4***	**-11.5**
3	Glibenclamide	0.5	155±4	159±3*	162±6*	165±4**	170±5**	**+ 10.8**
4	Crude methanolic Ext	200	152±3	155±5*	157±7*	160±5**	164±4**	**+8.8**
5	Crude methanolic Ext	400	154±4	155±6*	158±4*	162±3**	165±6**	**+8.1**
6	**Chloroform fraction**	**200**	**151±5**	**154±5***	**156±3***	**162±4****	**167±5****	**+10.6**

The values are expressed as mean ± SEM. Each value corresponds to a mean of8 animals. *p<0.05, **p<0.01, ***p<0.001; comparison of [a](normal control) vs [b](diabetic control) (Student t- test) *p<0.05, **p<0.01; comparisonof [b](diabetic control) vs [c](Glibenclamide and extracts treated groups) (One way ANOVA followed by Dunnett's posthoc multiple comparison test).

$$\% \text{ Change in B.W} = \frac{\text{Initial weight (g)- Final weight (g)}}{\text{Initial weight (g)}} \times 100$$

In rats, artemisia indica extracts and fractions showed antihyperlipidemic efficacy after streptozotocin-induced diabetes.

The lipid profiles of both control and experimental rats are presented in Table No.5.

Table 5: Extracts and fractions of Artemisia indica have an antihyperlipidemic activity in rats that have been induced diabetes by streptozotocin.

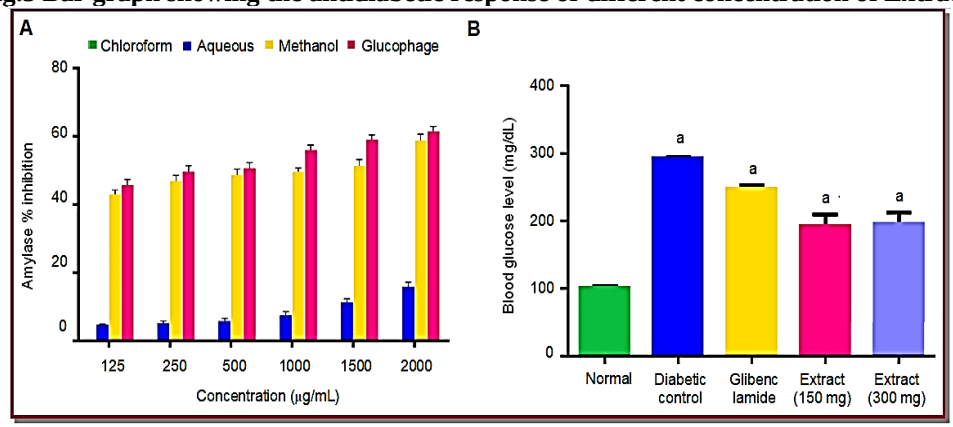
S.No.	Treatment	Dose (mg/k g)	Total cholesterol(mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
1	[a]Normal control	0.4 ml	120 ± 9.12	125±8.80	34±2.2	**81± 2.5**
2	[b]Diabetic Control	0.4 ml	185.3±4.4**	169.0±7.9**	30.2±2.4*	**177.4±8 .9****
3	Glibenclamide	0.5	137.7±5.3**	128.3±6.5**	39.1±2.3**	90.3±3. 5***

4	Crude methanolic Ext	200	144.2±4.3**	138.5±4.7**	37.5±3.1**	95.6±3.2***
5	Crude methanolic Ext	400	140.5±7.5**	136.8±4.5**	35.6±5.5**	93.5±3.6***
6	Chloroform fraction	200	134.4±2.7**	136.2±8.1**	38.2±1.5**	81.3±4.0***

*t-test (*p < 0.05, **p < 0.01) and between ^{b}diabetic control to ^{c}(Glibenclamide/extracts) treated groups using one way ANOVA followed by Dunnett's posthoc multiple comparison test (* p < 0.05,** p < 0.01, ***p < 0.001).*

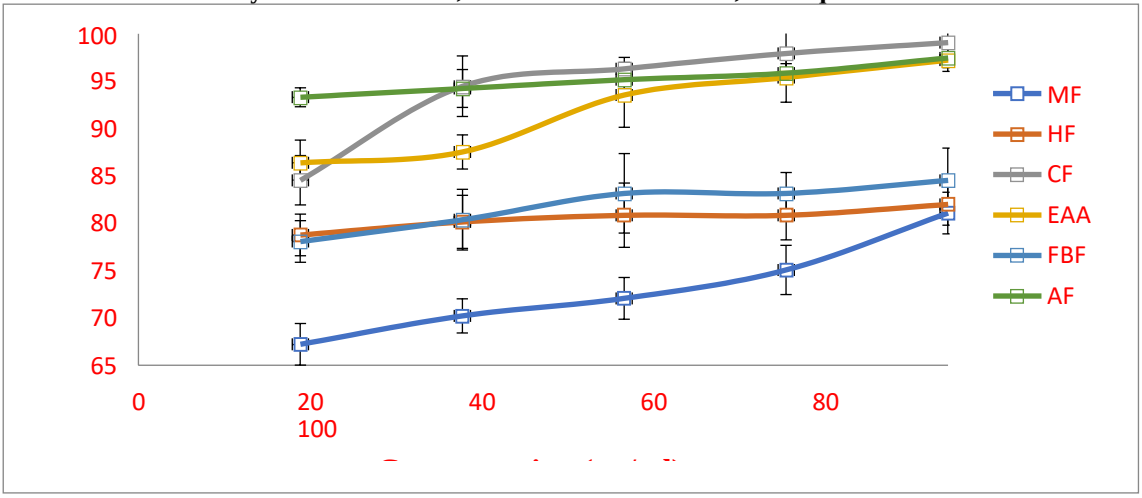
Each value is mean ± SEM of 8 animals. Comparisons were made between ^{a}normal control to ^{b}diabetic control usingstudent

Fig.3 Bar graph showing the antidiabetic response of different concentration of Extracts



Antioxidant activity of *Artemisia indica*

Fig.4 : Percentage inhibition of DPPH. MF-Methanolic Fraction, HF-n- Hexane Fraction, CF-Chloform Fraction, EAA-Ethyl Acetate Fraction, BF-n- Butanol Fraction, AF-Aqueous Fraction



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