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PRELIMINARY PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF *TINOSPORA CORDIFOLIA*: A PROMISING MEDICINAL

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ABSTRACT

This study investigates the phytochemical properties, safety, and anti-diabetic potential of *Tinospora cordifolia* leaf extract (TCLE). Phytochemical screening indicated occurrence of glycosides, terpenoids, tannins, carbohydrates, along with high levels of volatile oils, which are associated with the plant's anti-diabetic effects. According to the OECD criteria, the aqueous extract of *Tinospora cordifolia* was deemed safe after an acute toxicity investigation revealed no toxicity or fatality at a dose of 2000 mg/kg. Based on these findings, doses of 100 mg per kg (low dose) or 400 mg per kg (high dose) were used for anti-diabetic evaluations in streptozotocin (STZ)-induced diabetic rats. Diabetes mellitus, characterized by impaired glucose metabolism due to beta-cell destruction in the pancreas, was induced by STZ. The study assessed the effect of TCLE on lipid profiles, antioxidant systems, and its antihyperglycemic action. Treatment with TCLE significantly reduced blood glucose levels and body weight loss compared to diabetic control rats, indicating its potential to counteract hyperglycemia and its anabolic effects. Glibenclamide, a standard anti-diabetic drug, showed rapid blood glucose normalization, and Extract exhibited a similar effect, highlighting its anti-diabetic efficacy. Additionally, TCLE therapy improved lipid profiles, raising HDL levels and decreasing LDL cholesterol, triglycerides, and total cholesterol, indicating a protective effect against diabetic dyslipidemia. These results confirm that *Tinospora cordifolia* leaf extract possesses significant anti-diabetic and lipid-lowering activities, making it a promising candidate for managing diabetes mellitus and associated complications.

KEYWORDS: Anti-Diabetic, Lipid-Lowering Activities, *Tinospora cordifolia.*

1. INTRODUCTION

Diabetes mellitus, also known as just diabetes (from the Ancient Greek "diabetes," which means "to pass through [urine]"), is a metabolic ailment that typically fallouts from a mix of environmental or genetic factors and causes hyperglycemia, or peculiarly elevated sugar levels in blood. Diabetes is sometimes referred to as "starvation in the midst of plenty" since body produces large amounts of glucose, but osmotic variations prevent the cells from consuming it. The pancreas produces the hormone insulin, which allows body cells to take up glucose and use it as fuel. Hyperglycemia is the result of glucose building up in the blood when body cells are unable to absorb it. In the long run, this can contribute to chronic microvascular problems and cause acute metabolic problems like ketoacidosis.

1.1 There are Three Main types of Diabetes

1. Type 1 Diabetes (T1D)

Cause: Pancreatic β cells accountable for manufacturing insulin are targeted and killed by immune system in the autoimmune disease known as type 1 diabetes.

Characteristics: Individuals with type 1 diabetes are dependent on external insulin injections or an insulin pump for the rest of their lives since they produce little to no insulin.

Onset: Although it can happen at any phase of life, it majorly occurs in kids as well as adults.

Management: Requires regular insulin administration, blood sugar monitoring, and a carefully managed diet.

2. Type 2 Diabetes (T2D)

Cause: Type 2 diabetes is frequently triggered by either resistance against insulin or pancreas producing insufficient amounts of insulin to maintain normal blood glucose levels.

Characteristics: It is the most prevailing type of diabetes and is often correlated with poor eating habits, obesity, and physical inactivity.

Onset: Due to increased obesity rates, type 2 diabetes is progressively being diagnosed in kids as well as adolescents, although it usually develops in adults.

Management: It can be controlled with oral drugs, insulin injections in certain situations, and lifestyle modifications like diet and exercise.

3. Gestational Diabetes (GDM)

Cause: High levels of sugar in blood during pregnancy are a symptom of GDM. It occurs if body is not able to generate ample insulin to meet increasing demands of pregnancy.

Characteristics: Although gestational diabetes often appears about week 24 of pregnancy and may decline post delivery, female who has it is more probable to acquire this type in the coming future.

Management: It is typically managed through diet, exercise, and, if necessary, insulin therapy during pregnancy.

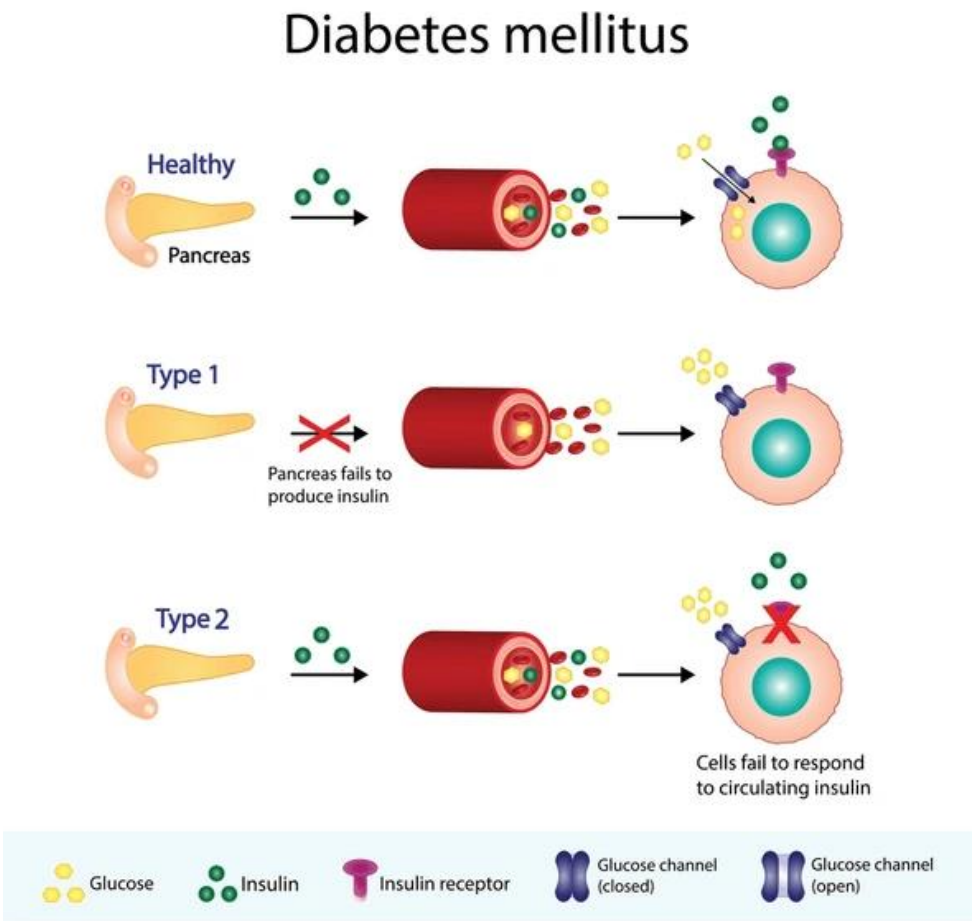

Fig. 1: Diabetes Mellitus.

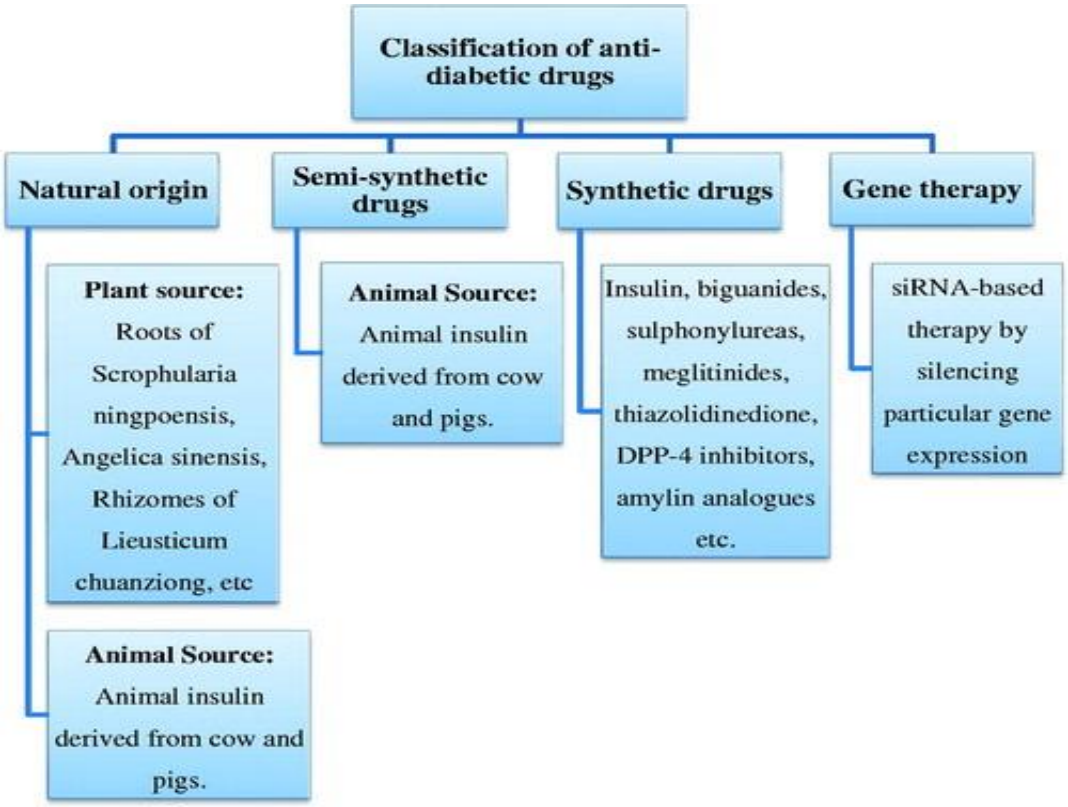

Fig. 2: Anti Diabetes Drugs.

2. PLANT PROFILE

Fig. 3: *Tinospora cordifolia.*

2.1 Taxonomy

- **Kingdom:** Plantae
- **Order:** Gentianales
- **Family:** Rubiaceae
- **Genus:** Haldina
- **Species:** Cordifolia

2.2 Vernacular Names

Table 1: Vernacular Names.

Malayalam	Manjakadumbu
Tamil	Mannakadambu
Hindi	Karam
English	Haldina
Kannada	Yettiga

2.3 Plant Description

With succulent stems and papery bark, this huge, widely spreading glabrous perennial deciduous twine is common in Sri Lanka, India, and Myanmar. It is indigenous to India's tropical regions, which reach elevations of 500 meters and have temperatures between 25 and 45 degrees Celsius. The leaves are dark bright green, simple, and shaped like a heart. Additionally, it is estipulate, complete, and alternating. The lamina is widely ovate, measuring 10–12 cm in length and 8–15 cm in width, with multicoated reticulate venation. The stems' surface skin is longitudinally fissured, measuring 3–8 mm in diameter and 3-5 cm in length, and they appear to be tightly studded with warty tubercles. Large lenticels that resemble rosettes and deep clefts are features of the succulent bark. Bark is either creamy white or grey in color. The branches give rise to long aerial roots that resemble threads. The branches are tall, filthy, and either pale greyish brown or white. The auxiliary and terminal racemes bear tiny, greenish yellow, unisexual flowers. While female flowers typically reside in a single inflorescence, male flowers are grouped together. A flower has six sepals, which are free and arranged in two series of three each, and six petals, which are membranous and oval, and smaller than sepals. Summer (March to June) is when flowers grow, while winter (November) is when fruits develop. Fruits have a subterminal style scars, are juicy, orange-red in color, and collect in 1-3 ovoid, smooth droplets on a thick stalk. Guduchi have been reported to have curved seeds and embryos.10. The family is therefore known as the Moonseed family. The endocarp is also decorated in different ways.

2.4 Phytochemistry

Its primary constituents include a variety of fatty acids, proteins, polysaccharides, calcium, phosphorus, aliphatic chemicals, alkaloids, glycosides, steroids, and essential oils.

2.5 Uses

***Tinospora cordifolia*,** also referred to as **Guduchi** or **Giloy**, is a multipurpose medicinal plant that is utilized in Ayurvedic and other traditional medical systems. Its many medicinal qualities make it extremely valuable. Here are a few of its primary applications:

Immune System Booster: The ability of *Tinospora cordifolia* to modulate the immune system is well known. By producing more white blood cells and boosting their function, it fortifies the immune system. It is frequently used to strengthen immunity and combat diseases.

Anti-Diabetic: The plant is said to help control diabetes. By lowering blood glucose and increasing insulin sensitivity, it aids in blood sugar regulation. According to a number of studies, its extract may help diabetic individuals experience less hyperglycemia.

Anti-Inflammatory and Anti-Arthritic: Because of its well-known anti-inflammatory qualities, *Tinospora cordifolia* is frequently used to treat inflammatory diseases such as rheumatism and arthritis. By regulating the body's inflammatory reactions, it aids in the reduction of pain and swelling.

Detoxification: It acts as a natural detoxifier and is often used in cleansing the body of toxins. It supports liver function, detoxifies the blood, and promotes overall wellness.

Antioxidant Properties: The plant's potent antioxidant properties aid in the neutralization of free radicals, minimizing oxidative stress and shielding the body from age, cancer, and heart disease.

Liver Health: It is traditionally used to promote liver health, treat jaundice, and support the liver in detoxifying the body. It may help protect the liver from toxins and improve liver function.

Digestive Health: *Tinospora cordifolia* is used to treat various digestive disorders such as indigestion, bloating, constipation, and gastritis. It has a mild laxative effect and supports gut health.

Fever and Malaria Treatment: In traditional medicine, the plant is often used to treat fevers and is known for its antipyretic properties. It is also used in the treatment of malaria and other infections due to its ability to combat fever-causing pathogens.

Respiratory Health: *Tinospora cordifolia* is beneficial for respiratory conditions like asthma, bronchitis, and cough. It helps to clear respiratory passages, reduce inflammation, and improve lung function.

Stress and Anxiety Relief: It is recognized to possess adaptogenic qualities, which aid the body in managing stress and anxiety. Frequent use may enhance mental clarity and encourage relaxation.

3. MATERIALS AND METHODS

3.1 Authentication of Plant and Plant Collection

Siddha Government of India's research officer and The Botany Central Council for Research in Ayurvedia provided plus verified the powdered leaf (dried) of *Tinospora cordifolia*. Using Soxhlet equipment and a variety of solvents, the weighed coarse powder was extracted successively.

3.2 Extraction Procedure

The weighted coarse particles were combined in equal amounts and blended. Several solvents were utilized in a Soxhlet system to extract the coarse power through sequential solvent extraction.

Petroleum ether extract: Using a Soxhlet apparatus, 2.5 liters of petroleum ether (60–80°C) were used to

continuously hot percolate 500 grams of coarse material. The extraction process was carried out for a full day. Following it's completion, the ether extract of petroleum was filtered, and the solvent was eliminated using reduced pressure distillation. After that, a desiccator was used to store the residue.

Chloroform extract: Marc, which was extracted from the aforementioned extract, was dried and extracted using a Soxhlet apparatus with 2.5 times as much chloroform (79–81°). The extraction process was carried out for a full day. Following the extraction process, chloroform was filtered, then solvent was eliminated by distillation at a lower pressure. After that, it was kept in a desiccator.

Alcoholic extract: After drying and extracting Marc from the aforementioned extract, 2.5 liters of 90% ethanol were used. After filtering, it was kept in a desiccator.

Aqueous extract- Cold maceration: Following the removal of the alcoholic extract, the marc was macerated for three days in a narrow-mouthed bottle with three litters of 0.25 percent chloroform water. Following the completion of the extraction procedure, it is filtered employing the appropriate technique, then solvent is eliminated by distillation at lowered pressure. After that, the extract was kept in a desiccator.

3.3 Phytochemical Screening

The following compounds, including lipids, protein, and carbohydrates, are present in the plant. That is what humans use as food. It has the same compound as well. Alkaloids, glycosides, and tannins. oils that are volatile. the substance that gives it many therapeutic benefits.

3.4 Pharmacological Studies

- Induction of animal that is diabetic
- By STZ, it induces diabetes in rats
- Measurement of the bodyweight
- Assessing the amount of blood glucose
- Acute toxicity studies (according to OECD guidelines)
- Assessing the level of plasma glucose
- Lipids' determination

4. RESULTS AND DISCUSSION

4.1 Soxhlet Extraction of *Tinospora cordifolia* Leafs

Numerous extracts, including chloroform, petroleum ether (60–80°C), water, and ethanol, had respective percentage yields of 0.2%, 0.6%, 1.65%, and 1.3%w/w.

Table 2: Soxhlet Extraction of *Tinospora cordifolia* Leafs.

Name of the Plant	Name of the plant part utilized	Extraction Method	Name of the solvent	% Yield (%W/V)
TINOSPORA CORDIFOLIA	Leaves(dry)	Cold maceration for aqueous extraction and continuous hot percolation using Soxhlet equipment	Ethanol (95%)	1.65
			Petroleum ether (60-80°C)	0.20
			Chloroform (60-80°C)	0.6
			Aqueous	1.3

4.2 Preliminary Phyto Chemical Screening

Table 3: Qualitative Phyto Chemical Screening of Leaf Extracts of *Tinospora cordifolia.*

PLANT CONSTITUENT	INFERENCES			
	Aqueous extract	Ethanol extract	Chloroform Extract	Pet ether extract
Carbohydrate	-	-	-	-
Terpenoids	+	+	-	-
Tannins	-	+	-	+
Flavonoids	-	-	+	+
Volatile oil	-	-	-	-
Fixed Oil	-	+	+	+
Proteins and amino acids	-	-	+	+
Glycosides	-	-	-	-
Alkaloids	+	+	-	-

4.3 Oral Glucose Tolerance Test

Table 4: Oral Glucose Tolerance Test of TCLE.

Group	Blood Glucose Levels (mg/dl)					
	0min	30min	1st hour	2nd hour	3rd hour	8th hour
Standard Glibenglamide (5mg/kg)	86.5±10.163	70.1 ± 7.2	89.0 ±10.61	86.6±12.32	82.5 ±7.80	80.3 ±7.23
TCLE 400mg /kg	88.5 ±1.22	81.5 ±0.22	79.05± 1.22	79.3 ±2.5	79.5 ±2.5	80.3 ±2.1

TCLE 200mg/kg	85.7±5.262*	82.6±5.89*	82.9 ±1.93	90.1±2.41*	80.5±1.52*	83.8±2.10
TCLE 100mg/kg	82.2 ±1.23	111.8 ±2.4	142.23 ±5.6	131.11±8.6	129.42 ±4.7	126.12±8.23
Control	83.5 ± 1.15	120.4±1.41	161.81 ±11.60	140± 2.64	110.13±5.75	93.7 ±1.14

4.4 Effects of TCLE on Level of Glucose in Serum in Normal Control and STZ induced Diabetic Rats

Table 5: Influence of Level of Glucose in Serum in Normal Control and STZ induced Diabetic Rats.

Treatment	Level of Glucose in Serum				
	Initial	7th day	14th day	21st day	28th day
Diabetic control	103.32	262.4±3.62	300.2±5.4	373.3±1.7	404.9±1.63
Normal control	90.17±1.47	95.94±1.30	104.3±4.1	102±2.13	89.52±2.16
Standard + Diabetic	104.11±1.3	268.7±3.45	150.1±1.4	145.8±0.6	129.6±1.13
TCLE 400mg /kg + Diabetic	93.9±5.8	259.6±7.7	98.3±1.5	112±1.4	111±3.92
TCLE 200mg/kg + Diabetic	97.8±1.25	240.5±1.23	240.1±0.7	236.2±1.8	225.3±2.79
TCLE 100mg/kg + Diabetic	84.13±1.5	237.0±2.85	270.5±2.3	298.78±1.4	324.3±2.57

4.5 Influence of TCLE on Body Weight in Normal Control and STZ induced Diabetic Rats

Table 6: Influence of TCLE on Body Weight.

Treatment	Body Weight				
	Initial	7th day	14th day	21st day	28th day
Diabetic control	148.9±1.4	144.8±5.55	135.1±2.3	129.88±3.2	115.2±1.5
Normal control	142.9±3.5	157.8±1.33	174.1±2.333	183.11±8.5	204±1.75
Glibenclamide + Diabetic	151.5±1.5	144.2±4.89	145.1±3.3	146.2.1±1.3	152.7±1.5
TCLE 400mg/kg + Diabetic	148.6±3.9	143.1±4.8	149.2±2.48	145.2±3.24	160.1±1.4
TCLE 200mg/kg + Diabetic	152.5±3.9	148.1±1.32	150.12±4.2	160.1±2.3	164.2±2.8
TCLE 100mg/kg + Diabetic	147.2±2.1	146.2±3.7	152.1±4.2	158.5±3.7	164.2±2.7

4.6 Influence of TCLE on Food intake in Normal Control and STZ induced Diabetic Rats

Table 7: Influence of TCLE on Food intake in Normal Control and STZ Induced Diabetic Rats.

Animal	Normal control	Diabetic control	AEHC (400mg/kg) + Diabetic	AEHC (200mg/kg) + Diabetic	AEHC (100mg/kg) + Diabetic	Glibenclamide (5mg/kg) + Diabetic
Food intake Day 1,3, 6, 9, 12, 15, 18, 21	32.8±2.3	48.9±5.61**	37.12±22	38.23±1.89	40.4±4.09	36.2±2.34

4.7 Influence of TCLE on Water intake in Normal Control and STZ Induced Diabetic Rats

Table 8: Influence of TCLE On Water intake in Normal Control and STZ Induced Diabetic Rats.

Animal	Normal control	Diabetic control	AEHC (400mg/kg) + Diabetic	AEHC (200mg/kg) + Diabetic	AEHC (100mg/kg) + Diabetic	Glibenclamide (5mg/kg) + Diabetic
Water intake Day 1, 3, 6, 9, 12, 15, 18, 21	41.5±3.52	68.4±7.02**	45.23±1.3	47.26±1.23	48.3±3.14	45.1±3.71

4.8 Effect of TCLE on Serum Lipids

Table 9: Effect of TCLE On Serum Lipids.

S.No	Treatment	Triglycerides (mg/Dl)	HDL (mg/Dl)	LDL (mg/Dl)	VLDL (mg/Dl)	Total Cholesterol (mg/Dl)
1.	Normal control	85.42±1.6	41.4±1.31	90.3±1.27	45.5±1.22	86.13±4.1
2.	Diabetic control	188.96±1.	21.3±1.23	128±1.68	54.1±2.28	154.8±3.4
3.	TCLE (400mg/kg) + Diabetic	92.1±3.66	32.42±1.28	97.6±1.58	26.74±2.13	88.2±1.23
4	TCLE (200mg/kg) + Diabetic	113±3.22	47.5±1.37	105±2.22	38.2±2.26	125±3.12
5.	TCLE (100mg/kg) + Diabetic	146.1±2.3	45.5±2.3	112.1±2.42	40.4±1.43	141.4±3.8
6.	Glibenclamide (5mg/kg) + Diabetic	101±2.90	45.4±1.48	102±2.56	33.2±1.65	94.2±2.35

5. CONCLUSION

Anti-diabetic impact of an alcoholic extract of leaves of Tinospora cordifolia on STZ in albino rats with induced diabetes is examined in this study. The phytochemical screening identified occurrence of flavonoids, tannins, carbohydrates, and decreasing sugar, all of which are involved in anti-diabetic effect. Following rats' induction using STZ at a dosage of 5 mg per kg intraperitoneally, diabetic mice were administered an alcoholic extract of Tinospora cordifolia leaf extract (100, 200, and 400 mg per kg) orally for 28 days. Liver glycogen, lipid profile, body weight, and serum glucose were tested using pancreatic homogenate, which exhibited substantial action. Alcoholic extract of Tinospora cordifolia leaf extract may be investigated as a protective agent against Streptozotocin-induced toxicity, according to the presence study's findings. The fundamental mechanism of protective advantages in attracting areas that require more research is revealed by clinical evaluations of Tinospora cordifolia alcoholic extract.

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