International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 2, February 2021 |

Assessment of Tinospora Cordifolia Leaf Extract for Antidiabetic Potential in Experimental Animal

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ABSTRACT: Diabetes mellitus (DM) is a chronic disease caused by inherited and acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced. Tinospora cordifolia is used for folklore, but very little scientific evidence exists to support its use. In order to identify complementary or alternative approaches to existing medications, the present study explores the antidiabetic potential of the leaves of Tinospora cordifolia. For the purpose, antidiabetic effect of ethanolic and 50% v/v hydroalcoholic extract of the leaves of Tinospora cordifolia was assessed. The study investigated the effect of the extract on animal models of diabetes. Oral doses of ethanolic and hydroalcoholic extracts (100, 200 and 400 mg/kg) and Metformin (50 mg/kg) demonstrated significant strong antidiabetic effect. These attributes provide the rationale for the use of Tinospora cordifolia in diabetes by traditional healers in India. In conclusion, the present study demonstrated that the treatment of diabetic rats with ethanoland hydroalcoholic extract have exerted a consider-able hypoglycemic effect, thereby justifying the traditional claim.

KEYWORDS*:* ethanolic , hypoglycemic, hydroalcoholic .

I. INTRODUCTION

Diabetes Type II is an assorted bunch of metabolic conditions brought about by either an absence of insulin, protection from its belongings, or both (Daneman, 2006). Patients all around happened hyperglycaemia as a result of the body's lack of ability to keep up standard blood-glucose level through homeostatic component. It has been archived for centuries and. was until the create ment of insulin recuperating, a deadly ailment (Banting et al.1922). Presently diabetes mellitus (DM) are treat with insulin or against diabetic medications despite the fact that long haul inconvenience stays high. DM is the most noticeable reason of expire in the globe and it is assessed that one out of eight passings (12.2%) among 20 to 79-year-olds were attributabled to the circumstance in 2010 (International Diabetes Federation, 2009). Life desire is dense, all things considered, by over 20 years in natives with Type 1 diabetes and by up to 12 yrs in individuals with DM (Diabetes U.K., 2010). The affordable costs related with DM are tremendous. It is at present expected that 10 percent of the "NHS money related arrangement in the UK is spent on DM and its issues. This speaks to £10 billion a yr dependent on the 2009-2010 budget summaries for the NHS of pretty much £90.7 billion. What's more, one of every 10 individual's hostipice have diabetes. In 2006 30.4 million things to treat diabetes were given at an expense of £561.4 million (Diabetes U.K., 2010). The crash of this ceaseless condition on people and the social request can't be garish.

Classification

Diabetes mellitus is characterized by four unmistakable classes dependent on aetiopathogenesis albeit two principle classifications of diabetes make up the main part of cases. Type 1 Diabetes Mellitus (IDDM) (recently known as insulin subordinate diabetes mellitus (IDDM)) and Type 2 Diabetes Mellitus (recently known as non-insulin subordinate diabetes mellitus (NIDDM)) represent 99.4% of all cases in Scotland. They are the transcendent sorts in every aspect of the world. Different classes incorporate gestational diabetes and other explicit kinds of diabetes. The last are comprised of those related with quality deformities of pancreatic ß cell capacity and insulin obstruction; different disorders related with diabetes; maladies of the exocrine pancreas; and endocrinopathies and diabetes initiated by medications, synthetic concoctions or infective specialists (Table 1.1) (Expert Committee on the Diagnosis and Classification of Diabetes

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mellitus, 2003; American Diabetes Association, 2011). The above characterization incorporates changes to mirror the aetiopathogenesis as opposed to the helpful ramifications of the gatherings.
It additionally mirrors the way that there are a scope of introductions, just as helpful medicines, all of which can change with time, implying that patients ought not be grouped by these covering criteria. The terms insulin-subordinate diabetes mellitus and non-insulin-subordinate diabetes mellitus and their abbreviations, IDDM and NIDDM, were in this manner expelled from the grouping because of the disarray that their utilization created.
Type 2 diabetes mellitus incorporates the most pervasive type of diabetes, which results from insulin obstruction, with or without a secretory imperfection. It basically happens with expanding age and is related with hereditary and natural hazard factors. Type 2 diabetes is ordinarily gone before by a significant lot of strange glycaemic control and is a piece of the metabolic disorder related with hypertension, dyslipidaemia and hyperglycaemia. The condition has a more grounded hereditary etiology than T1DM albeit natural factors, for example, diet, exercise, weight and smoking will affect on the improvement of sort 2 diabetes (Stumvoll et al., 2005).

Type 1 diabetes (ß-cell destruction, usually leading to absolute insulin deficiency).
A. Immune mediated
B. Idiopathic
Type 2 diabetes (may be principally insulin resistance with insulin deficiency to a principally secretary defect with insurlin resistance)
II. Other category
A. Genetic defects of ß-cell function
B. Genetic defects in insulin action
C. Diseases of the exocrine pancreas
D. Endocrinopathies
    1. Acromegaly
    2. Cushing's syndrome
    3. Glucagonoma
    4. Pheochromocytoma
    5. Others
E. Drug- -inducedInfections
F. Uncommon forms of immune-mediated diabetes
G. Other genetic syndromes sometimes associated with diabetes.
III. Gestational diabetes mellitus (GDM).

Causes of Diabetes
The causes of diabetes are not known. The following risk factors may increase your chance of getting diabetes: Family history of diabetes African-American, Hispanic, Native American, or Asian-American race, Pacific Islander or ethnic background Being overweight Physical stress (such as surgery or illness) Use of certain medications, including steroidsInjury to the pancreas (such as infection, tumor, surgery or accident) Autoimmune disease.

- High blood pressure
- Abnormal blood cholesterol or triglyceride levels
- Age (risk increases with age)

Smoking

- History of gestational diabetes

It is important to note that sugar itself does not cause diabetes. Eating a lot of sugar can lead to tooth wastage, but it does not cause diabetes.

Antioxidant
Free radicals such as, hydrogen-peroxide, superoxide-anions and hydroxyl, nitric oxide radicals, grounds degenerative human disorders such as cancer, and cerebrovascular disease, CHF through many mechanisms (Wang H et al., 1996).
Antioxidant components delay or slow down lipid oxidation, by inhibit the beginning or proliferation of oxidizing chain reactions, and are also implicated in scavenging free radicals.
In current years, research in this area has listening carefully on the finding of antioxidants in food, because there is proof that they could play an chief role in the safety of several illnesses as well as in the retardation of the age process (Katalinic V et al., 2004) Herbs are reported to contain a broad variety of antioxidant components including phenolic compounds (Ames BN et al., 1993).

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Plant Profile (Tinospora Cordifolia)

Figure 1: Leaves of Tinospora Cordifolia

Tinospora Cordifolia is a shrub in the Menispermaceae family. It is also referred to as Guduchi, Amrita, Gurach, and Tinospora. It's a big, glabrous leaky shrub. With long filiform fleshy aerial roots, the stalks are very suculent. The bark is brown gray and watersome. The leaves are cordatous and membranous. The flowers are tiny and yellowish greenish. This herb is present in tropical Asia up to 300 meters in height.

Pharmacognosy of Tinospora Cordifolia:

1. Stems – Fleshy
2. Roots - long thread like, aerial, arise from branches.
3. Bark - Thin, greyish or creamy white in colour, when peeled fleshy stem is exposed.
4. Leaves - Cordate (heart shaped), membranous, juicy. Leaves simple, alternate, exstipulate, long petioles up to 15 cm long, roundish, pulvinate, both at the base and apex with the basal one longer and twisted partially and half way around.
5. Flowers - Bloom during summer Flowers unisexual, small on separate plant appearing when plant is leafless, greenish yellow on axillary and terminal racemes. Male flowers clustered, female usually solitary. Sepals 6, free in two series of three each, the outer ones are smaller than the inner.
    a. Male flower - Small, yellow or green coloured occur in clusters.
    b. Female flower - Occur singly.
6. Fruits - Pea-shaped, fleshy, red shiny switch in winter, when cooked. The total fruit is 1-3, ovoid smooth drupelets with dense stalks and scars, scarlet or orange colors in subterminal style.
7. Seeds - curved, pea sized.
8. Petals - Petals 6 free smaller than sepals, obovate and membranous.
9. Distribution: The plant is present in all tropical regions of India, from Kumaon to Assam and Myanmar, Bihar and Konkan to Sri Lanka. It is the great climber who grows through the highest trees in the forests and casts aerial roots which exceed 10 m (10 m).
10. Cultivation: Soil And Climate: It grows well in almost any type of soils and under varying climatic conditions.
11. Nursery raising and planting: The plant is produced in May-June by stem cutting. It is ideally sponsored by neem and mango trees, and those plants should have stronger therapeutic qualities.
12. Weeding and Hoeing: Periodical hoeing is done, both in the nursery and field as per requirement.
13. Manures, Fertilizers and Pesticides: Medicinal plants must be managed without artificial fertilizers and pesticides. Natural manures such as Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used according to particular species specifications. Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc.. Toprevent diseases, bio-pesticides can be prepared (either single or combinations).
14. Irrigation: The field after plantation should be irrigated periodically as and when required weekly or fortnightly.
15. Harvesting/Post Harvesting Operation: Mature plants are collected, cut into small pieces and dried in shad.
16. Yield: Approximately 8-10 q./ha.

Chemical Constituents

The plant mainly contains:

- Alkaloids
- Glycosides

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- Steroids
- Aliphatic compound
- Essential oils
- Mixture of fatty acids
- Polysaccharides

The alkaloids include berberine, bitter gilonin, non-glycoside gilonin gilostero.

Medicinal Uses

Tinospora Cordifolia is used as anodyne, antiphlogistic, carminative, depurative, expectorant, dispels clots. The juice of the root is used in the treatment dispels clots s also added to bath water in order to relieve body aches caused by hard physical work. A poultice made from the pounded root is applied to the forehead to relieve headaches. The juice of the bark, mixed with equal quantities of the juice from the bark of Ficus semicordata and Myrica esculenta is used in the treatment of menstrual disorders.

II. MATERIALS AND METHODS

Chemicals and Reagents

To evaluate the antidiabetic activity of Tinospora cordifolia leaves extracts against diagnostic kits were used and all chemicals were of analytical grade, and were purchased from Loba Chem. Ltd., Ahmedabad and SD-Fine Chemicals Ltd., Mumbai, India. Diagnostic kits (Erba diagnostic) were used in the estimation of biochemical parameters.

Instruments

Electronic Balance (Citizen Pvt. Ltd.), Soxhlet Assembly (Perfit India), Heating Mantle (Perfit India), Rotatory Evaporator (Perfit India),Water Bath (Navyug India), Micro Centrifuge (Remi India Pvt. Ltd), Semi-autoanalyzer (Systronics India) were used to carry out the research work.

Collection and Authentification of Plant

The plant leaves of Tinospora cordifolia were collected from the field of Mubarik Pur, Mawana in the month of Nov and was identified and authenticated from Mr. Rajesh Kumar Associate Professor, Meerut College Meerut and deposited it to T.I.P.E.R. for future reference.

Physicochemical Parameters of Tinospora Cordifolia Leaves

Determination of Moisture Content

The leaves of Inula cappa was dried in shade and grounded to a moderately coarse powder and moisture content was determined as follows: 5.0 gm of the powdered drug was weighed and transferred to clean, dried and weighed porcelain dish and placed in hot air oven at 105° C for 15 minutes. Porcelain dish was cooled in dessicator and weighed. The procedure was repeated till the constant weight was obtained. The loss in weight as compared to initial weight was considered as moisture content.

$$\text{Moisture content } (\%) = \left[\frac{\text{Loss in weight}}{\text{Weight of drug taken}} \right] X\ 100$$

Determination of Ash Values

Ash values are indicative to some extent of care taken in collection and foreign matter content in natural drug. Total ash, acid insoluble ash and water soluble ash of leaves of Tinospora cordifolia was determined by reported methods.

Total Ash Value

5.0 gm of the powdered drug was weighed and transferred to clean, dry and weighed porcelain and allowed to incinerate in muffle furnace at 600° C for 4-6 hours. The ash obtained was weighed and the percentage total ash was calculated.

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$$\text{Total ash value (\%w/w)} = \left[\frac{\text{Weight of ash}}{\text{Weight of drug taken}}\right] \text{ X } 100$$

Acid Insoluble Ash Value

The ash obtained from above method was washed with 25 ml of dilute hydrochloric acid and transferred to 100 ml beaker and boiled for 5 minutes. The content was filtered through ash less filter paper and washed with hot water. The filter paper was incinerated on a crucible till all carbon was removed. The residue was weighed and acid insoluble ash value was calculated as-

$$\text{Acid insoluble ash value} = \left[\frac{\text{Weight of residue}}{\text{Weight of drug taken}}\right] \text{ X } 100$$

Water Insoluble Ash Value

The total ash obtained was washed with 25 ml of distilled water and transferred to 100 ml beaker and boiled for 5 minutes. The content was filtered through ash less filter paper and washed with hot water. The filter paper was incinerated on a crucible till all carbon was removed. The residue was weighed and water soluble ash value was calculated as-

$$\text{Water insoluble ash value} = \left[\frac{\text{Weight of residue}}{\text{Weight of drug taken}}\right] \text{ X } 100$$

Water soluble Ash Value

It was calculated by subtracting water insoluble ash value from total ash value.

Water soluble ash value = Total ash – water insoluble ash value.

III. RESULTS

Preliminary Phytochemical Analysis of the Extracts

Phytochemical examination of various extracts of *Tinospora cordifolia* uncovered the nearness of alkaloids, saponins, diminishing sugars, sterols, terpenoids, starches, steroids, flavanoids and tannins as secondary metabolites.

Table 3.1: Phytochemical analysis of extracts of Tinospora cordifolia

Constituents	Ethanol Extract	Hydroalcohol Extract
Alkaloids	+	+
Protein & Amino Acid	-	-
Saponins	+	+
Reducing sugars	-	+
Sterols	+	+
Terpenoids	+	+
Carbohydrates	+	+
Steroids	-	+
Flavanoids	-	+
Tannins	+	+

+ Sign shows Secondary metabolite is available; - Sign demonstrates secondary metabolite is absent.

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Physicochemical Parameters

The loss on drying, total ash, acid insoluble ash, water soluble and water insoluble ash content was calculated of Tinospora cordifolia leaves, the results are shown in the Table 3.2

Table 3.2: Physicochemical parameters of *Tinospora cordifolia*

S.No.	Parameter	Result
1.	Loss on Drying at 105°C	2.62%w/w
2	Total Ash	6.84 %w/w
3.	Acid Insoluble Ash	2.51 %w/w
4.	Water Soluble Ash	3.61 %w/w
5.	Water Insoluble Ash Content	0.72%w/w

Acute Toxicity Testing

Acute toxicity studies uncovered that the hydroalcohol and ethanol extracts of Tinospora cordifolia were protected up to 2000 mg/kg of body weight and inexact LD50 is in excess of 2000 mg/kg. No lethality or any dangerous responses or incurable state was seen up to the finish of the study period.

Hypoglycemic Activity of Tinospora Cordifolia Leaves Extracts

3.4.1 Effect of Tinospora cordifolia Leaves Extracts on Oral Glucose Tolerance Test

Tinospora cordifolia leaves ethanolic (TCEE) and hydroalcohol (TCHE) extracts (100, 200 & 400 mg/kg, p.o.), pass the Oral Glucose Tolerance Test. Both the extracts showed better effect on reducing glucose in the blood. Overall better effect was found in the TCHE 100, 200 and 400 mg/kg p.o, b.wt. TCEE 100, 200, 400 also showed comparatively effect on glucose tolerance.

Table 3.3: Effect of *Tinospora cordifolia* Leaves Extracts on OGTT

Groups	Blood Glucose Level (mg/dL)			
	0 min	30 min	60 min	120 min
Normal Control	99.43±1.05	121.20±3.02	115.03±2.02	101.70±1.12
Metformin (50 mg/kg)	96.72±2.32	115.34±2.77	99.03±1.26	90.08±2.06
TCEE (100 mg/kg)	95.05±2.12	119.72±1.02	118.12±2.12	116.80±1.90
TCEE (200 mg/kg)	96.72±1.04	117±2.01	116.20±2.01	105.44±2.21
TCEE (400 mg/kg)	98.45±1.85	123.03±0.81	113.28±1.56	99.05±1.15
TCHE (100 mg/kg)	99.80±2.15	118.04±2.63	113.54±0.95	112.94±1.81
TCHE (200 mg/kg)	97.23±2.12	117.05±2.12	115.20±2.15	112.30±2.12
TCHE (400 mg/kg)	98.31±2.51	115.86±0.92	106.24±1.20	99.86±2.46

Data represented as mean ± SEM values of 6 animals/group.

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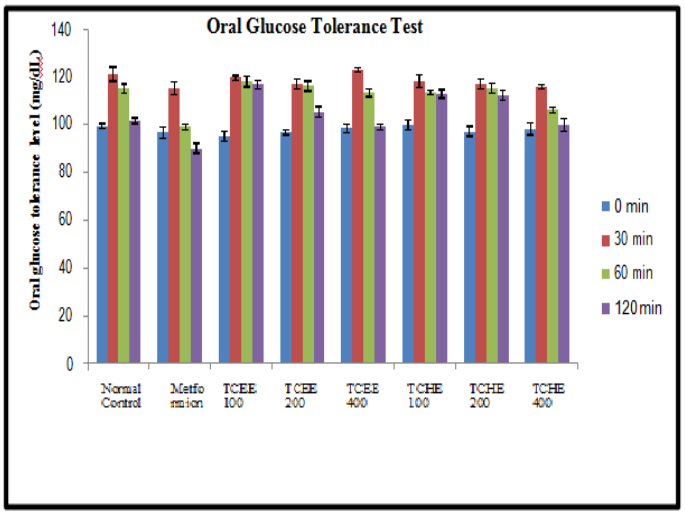

Figure 2: Effect of Extracts of Tinospora cordifolia Leaves on OGTT.

Table 3.4: Effect of *Tinospora cordifolia* leaves extracts on fasting blood glucose in STZ induced diabetic rats

Groups	Blood Glucose Level (mg/dL)		
	0 Day	10th Day	21st Day
Normal Control	85±2.14	86.5±2.53	92±2.19
Diabetic control	234±4.9**	240±2.8**	246±2.4***
Metformin (50 mg/kg)	245±4.2***	162±7.3	102±5.1
TCEE (100 mg/kg)	254±6.9***	224±3.0*	185±5.2
TCEE (200 mg/kg)	258±9.5***	223±5.0*	174±7.48
TCEE (400 mg/kg)	278±3.7***	219±3.1*	113±4.8
TCHE (100 mg/kg)	248±8.6**	179±7.4	138±6.2
TCHE (200 mg/kg)	273±7.9***	224±7.4*	135±3.2
TCHE (400 mg/kg)	263±5.60	190±6.3	103±6.3

Data represented as mean ± SEM values of 6 animals/group. ***p<0.001, **p<0.01 and *p<0.05; all groups compared with the normal control group.

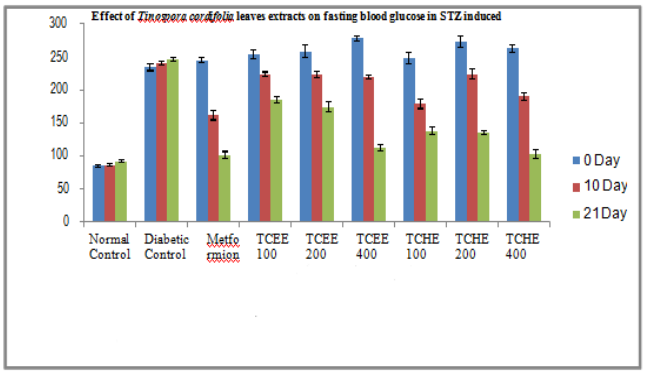

Figure 3: Effect of Tinospora cordifolia leaves extracts on fasting blood glucose in STZ instigated diabetic rodents

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Table 3.5: Effect of *Tinospora cordifolia* leaves extracts on average body weight in STZ induce diabetic rat

Groups	Average Body Weight (gm)		
	0th Day	10th Day	21st Day
Normal Control	170±5.16	179±4.55	189±3.75
Diabetic control	175±7.19	162±6.01	148±7.03***
Metformin (50 mg/kg)	180±4.47	188±4.22	198±4.77
TCEE (100 mg/kg)	173±6.67	180±5.77	188±6.67
TCEE (200 mg/kg)	173±6.67	178±6.01	190±7.75
TCEE (400 mg/kg)	171±4.90	176±4.36	187±6.15
TCHE (100 mg/kg)	165±4.28	172±4.41	178±5.58
TCHE (200 mg/kg)	163±5.58	172±4.47	178±3.33
TCHE (400 mg/kg)	170±5.16	179±4.55	189±3.75

Data represented as mean ± SEM values of 6 animals/group. ***p<0.001, **p<0.01 and *p<0.05; all groups compared with the normal control group for respective days.

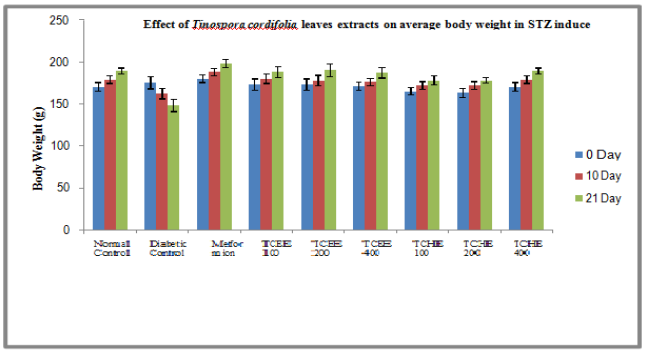

Figure 4: Effect of Tinospora cordifolia leaves extracts on average body weight in STZ induce diabetic rat

3.5 Antioxidant assay

The free radical scavenging action was assessed by different in vitro examines. DPPH radical was utilized as a substrate to assess free radical searching exercises of concentrates. The rummaging impact of ethanolic concentrate of Tinospora cordifolia on the DPPH radical was 86.42%, at a concentration of 2500 µg/ml though searching impact of Tinospora cordifolia hydroalcohalic concentrate was 89.15%. These outcomes showed that concentrates have noteworthy impact on rummaging the free radicals. Figure 3.4 delineates a noteworthy decline in the centralization of DPPH radical because of the searching capacity of Tinospora cordifolia leaves remove. BHA, ascorbic corrosive and α-tocopherol were taken as standards.

Table 3.6: Antioxidant profile of plant extracts

Sample Tested	Sample concentration (µg/mL)	DPPH radical scavenging activity (% inhibition)	Superoxide anion scavenging activity (% inhibition)	Hydrogen peroxide scavenging activity (% inhibition)	Hydroxyl scavenging activity (% inhibition)	Nitric oxide scavenging activity (% inhibition)	Reducing power activity (a) (absorbance)
TCEE	2500	86.42±2.8	75.24±3.8	74.23±3.5	78.54±3.7	74.38±4.2	1.621
TCHE	2500	89.15±3.7	79.71±3.4	80.37±4.2	81.27±3.2	76.83±2.7	0.884
Ascorbic Acid	50	89.45±1.1	85.57±2.5	--------	--------	--------	--------
BHA	50	83.22±1.1	68.08±4.6	89.25±3.1	83.22±3.2	--------	2.164
α-Tocopherol	50	67.54±0.8	74.45±2.7	94.54±2.5	--------	--------	0.405

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[a]Increased absorbance indicates increased reducing power

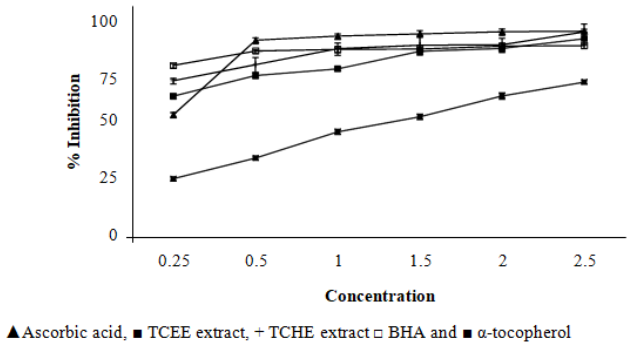

Figure 5: Free radical scavenging action of TCEE, TCHE, BHA, Ascorbic acid, and α- tocopherol by 2, 2-diphenyl-1-picrylhydrazyl radicals. Results are mean ± SD of three parallel estimations. (Concentrations of TEE and TCHE are communicated in mg/ml though concentrations of BHA, Ascorbic acid and α-tocopherol are communicated in 20 x □g/ml).

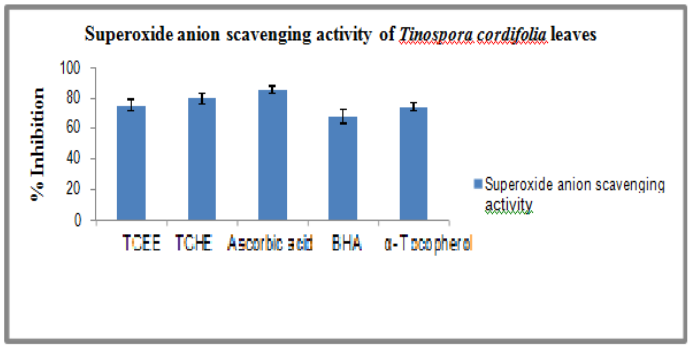

Figure 6: Examination of percentage inhibition of Superoxide radicals generation by 50 µg/ml concentration of ascorbic acid, BHA, α-tocopherol and 2500 µg/ml of TCEE and TCHE using PMS-NADH-NBT Method

H2O2 is significant as a result of its capacity to enter organic films. H2O2 itself isn't exceptionally receptive; however it can some of the time be poisonous to cell since it might offer ascent to hydroxyl radical in the cells. In this manner, expulsion of H2O2 is significant for insurance of nourishment frameworks. Figure 3.6 demonstrates the H2O2 rummaging action by TCEE and TCHE at grouping of 2500 µ/ml. This is contrasted and 50 □/ml of BHA and α-tocopherol. The level of H2O2 rummaging action of TCEE, TCHE, BHA and α-tocopherol was found as 74.23, 80.37, 89.25 and 94.54%, individually.

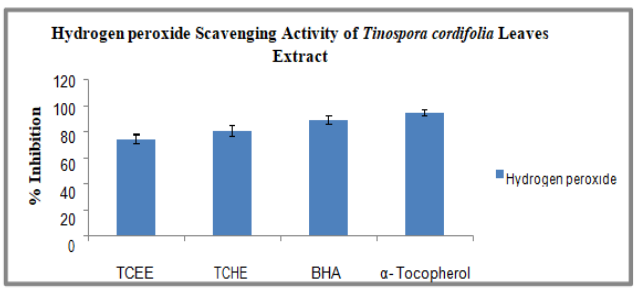

Figure 7: Comparison of percentage inhibition of Hydrogen Peroxide by TCEE, TCHE, BHA and α- Tocopherol (Concentrations of CA and VT are expressed in mg/ml whereas Concentration of BHA and α- Tocopherol is expressed in 20 x □g/ml).

Hydroxyl radicals are the significant dynamic oxygen species causing lipid oxidation and gigantic natural harm (Aurand LW et al., 1977). The level of hydroxyl radical rummaging was fundamentally expanded with the expanding convergences of concentrates (Figure 8). The cancer prevention agent movement of concentrates and standard mixes was analyzed by utilizing explicit in vitro techniques.

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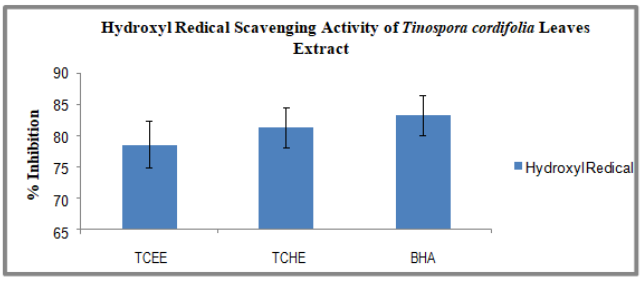

Figure 8: Comparison of percentage inhibition of Hydroxyl redical by TCEE, TCHE and BHA

Nitric oxide (NO) is an effective pleiotropical mediator of physiological processes such as smooth muscle relaxation, neuronal signalling, platelet aggregation inhibitors and cell mediated toxicity regulations. It is a broadcast free radical that plays several functions, including neuronal messengers, vasodilation, antimicrobial and antitumping activities as an effector molecule in different biological systems (Hagerman AE et al., 1998).

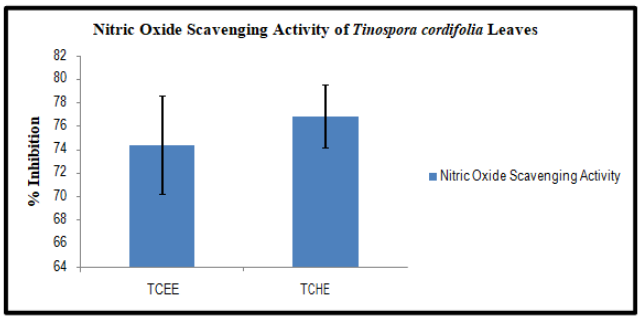

Figure 9: Comparison of percentage inhibition of Nitric Oxide scavenging activity by TCEE, TCHE, BHA

For the estimations of the decreasing capacity, "Fe3+-Fe2+ change" within the sight of TCEE and TCHE was found. The diminishing limit of a compound may fill in as a noteworthy pointer of its potential cancer prevention agent action. The reductive capacities of concentrates were contrasted and α-Tocopherol. The diminishing forces of TCEE and TCHE were found to increment with expanding focuses (Figure 10).

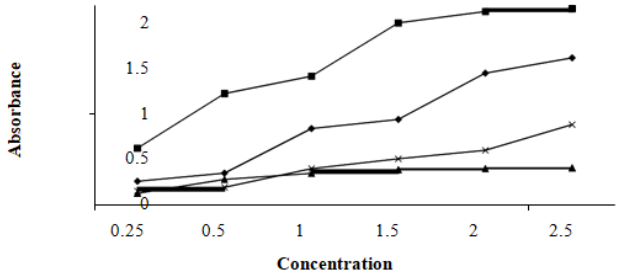

Figure 10: Reducing power of TCEE, TCHE and α-tocopherol. Results are mean ± SD of three parallel measurements. (Concentrations of TCEE and TCHE are expressed in mg/ml whereas concentration α-Tocopherol is expressed in 20 x g/ml)

IV. CONCLUSION

From the present study it is concluded that morphological and microscopical characterisation helps in establishment of the pharmacognostical standards for the plant. Phytochemical screening is essential for qualitative analysis of the plant materials to screen various active phytoconstituents. When screened for phytochemical constituents whole plant extracts of Tinospora cordifolia showed the presence of flavonoids, phenols, tannins, terpenoids and saponins. The ethanolic and hydroalcoholic extracts of Tinospora cordifolia leaves demonstrated significant strong antidiabetic effect. These attributes provide the rationale for the use of Tinospora cordifolia in diabetes by traditional healers in India. In conclusion, the present study demonstrated that the treatment of diabetic rats with ethanol and hydroalcoholic extract have exerted a consider-able hypoglycemic effect, thereby justifying the traditional claim. Based on the consequences of this investigation, it is presumed that both the extracts have critical cell reinforcement movement contrasted with

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

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other all around described, standard cancer prevention agent frameworks in vitro. Moreover, the cancer prevention agent action might be because of phenolic mixes in the two plants. Be that as it may, the parts in charge of the antioxidative action of TCEE and TCHE are at present indistinct. In this manner, it is proposed that further work be performed on the seclusion and ID of the cancer prevention agent segments of Tinospora cordifolia.
Further, research is to be carried out to fractionate the extracts and to isolate the molecule(s) responsible for the antidiabetic activity.

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