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EVALUATION OF ANTIDIABETIC AND NEUROPROTECTIVE ACTIVITY OF METHANOLIC EXTRACT OF *EUPHORBIA HIRTA* IN STREPTOZOTOCIN-INDUCED DIABETIC RATS

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia. Herbal medicines are gaining attention due to their safety and therapeutic potential. This study evaluated the antidiabetic and neuroprotective activity of methanolic extract of *Euphorbia hirta* in streptozotocin (STZ)-induced diabetic rats. Methods: Diabetes was induced in Wistar rats using STZ (28 mg/kg, intraperitoneally). Animals were divided into five groups: normal control, diabetic

control, extract-treated groups (50 mg/kg and 100 mg/kg), and standard metformin-treated group (450 mg/kg). Blood glucose levels were estimated using the GOD/POD method. Diabetic neuropathy was assessed using tail flick and hot plate latency tests. Statistical analysis was performed using one-way ANOVA followed by Dunnett's test.

Results: The methanolic extract of *Euphorbia hirta* significantly reduced elevated blood glucose levels in a dose-dependent manner. The higher dose (100 mg/kg) demonstrated marked antihyperglycemic activity comparable to metformin. Significant improvement in thermal latency indicated protective effects against diabetic neuropathy. The findings suggest that *Euphorbia hirta* possesses significant anti-diabetic and neuro protective properties and may serve as a promising plant-based therapeutic agent for diabetes management.

Keywords: *Euphorbia hirta,* Methanolic extract, Antidiabetic activity, Neuroprotective activity, Streptozotocin-induced diabetes

1. INTRODUCTION

1.1 Diabetes Mellitus

Diabetes mellitus is one of the most common endocrine diseases in all populations and all age groups. It is a syndrome of disturbed intermediary metabolism caused by inadequate insulin secretion or impaired insulin action, or both. Diabetes mellitus comprises of heterogeneous group of disorders characterized by hyperglycemia, altered metabolism of carbohydrates, lipids and proteins. Diabetes mellitus is associated with complications such as nephropathy, retinopathy, neuropathy and cardiovascular disease **[1]**.

Diabetes is mainly classified into three types as: Type-I (Insulin-Dependent Diabetes Mellitus, IDDM) and Type-II (Non- Insulin-Dependent Diabetes Mellitus, NIDDM), Type-III (Gestational diabetes. Both these types are associated with excessive morbidity and mortality. Type I diabetes accounts for 5% to 10% of diabetes, usually occurs in children or young adults. This disease is caused by autoimmune destruction of the pancreatic β-cells that secrete insulin. The process involves a smoldering destructive process that can persist for several years and ultimately leading to failure of insulin secretion. Patients with type I diabetes require insulin therapy for survival and most patients ultimately develop devastating complications of this disease **[1]**.

Type II diabetes accounts for 90% to 95% of all patients with diabetes and is increasing in prevalence. Some of the known environmental factors that contribute to

development of type–II diabetes are obesity, a sedentary lifestyle, and aging. Insulin resistance is a characteristic metabolic defect in the great majority of patients with type II diabetes. As a consequence of insulin resistance, the β-cell produces increased amounts of insulin, and, if sufficient, the compensatory hyperinsulinemia maintains glucose levels within the normal range.

In those individuals destined to develop diabetes, β-cell function eventually declines, and relative insulin insufficiency occurs. Thus, insulin resistance combined with β-cell failure leads to the decompensated hyperglycemic diabetic state

Type-III diabetes are blood sugar elevation during pregnancy is called gestational diabetes. Diabetes can occur temporarily during pregnancy. Significant hormonal changes during pregnancy can lead to blood sugar elevation in genetically predisposed individuals. Gestational diabetes usually resolves once the baby is born.

Diabetes is emerging as major threat to human health. It is the fifth leading cause of death in most developed countries. The world health organization estimated that there were 135 million diabetics in 1995 and this number would increase to 235 millions by the year 2010. An expected incidence of diabetes mellitus is 300 million by the year 2025.

Table 1: National Diabetes Data Group (NDDG) Conversion of O'Sullivan and Mahan Diagnostic Criteria

Time	Venous Blood	Venous Plasma
Fasting	90mg/dl	105mg/dl
1hour	170mg/dl	190mg/dl
2hours	145mg/dl	165mg/dl
3hours	125mg/dl	145mg/dl

1.2 TREATMENT OF DIABETES MELLITUS

Insulin therapy is required for all patients with type 1 Diabetes Mellitus and for those patients whose type 2 Diabetes Mellitus is not adequately controlled or is unresponsive to diet and oral medications. The goal of therapy is to maintain normal or near-normal blood glucose levels throughout the day. For type 2 Diabetes Mellitus, six classes of oral agents are available **[3]**.

Insulin is the primary hormone responsible for controlling the uptake, use, and storage of cellular nutrients. Insulin's anabolic actions include the stimulation of intracellular use and storage of glucose, amino acids, and fatty acids, whereas it inhibits catabolic processes such as the breakdown of glycogen, fat, and protein. It accomplishes these general purposes by stimulating the transport of substrates and ions into cells, promoting the translocation of proteins

between cellular compartments, activating and inactivating specific enzymes, and changing the amounts of proteins by altering the rates of gene transcription and specific mRNA translation **[4]**.

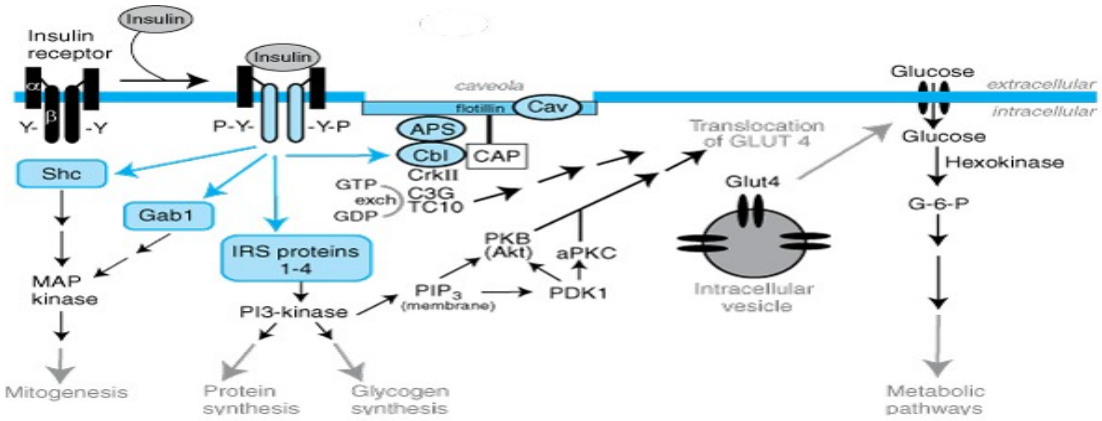

Figure 1: Pathways of insulin signaling [3]

Insulin stimulates stored glucose in the liver as glycogen and in adipose tissue as triglycerides and amino acid storage in muscle as protein; it also promotes utilization of glucose in muscle for energy. Insulin inhibits the breakdown of triglycerides, glycogen, and protein and the conversion of amino acids to glucose (gluconeogenesis). These pathways are increased during fasting and in diabetic states. The conversion of amino acids to glucose and of glucose to fatty acids occurs primarily in the liver **[5]** as shown in **Figure 2**.

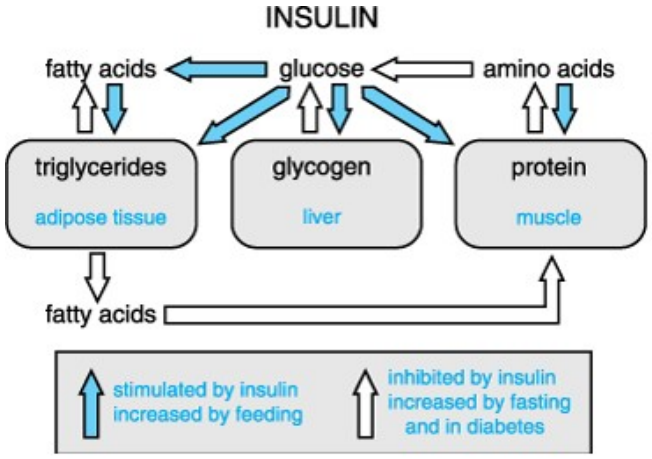

Figure 2

➢ Sulfonylureas of 1st generation drugs (Tolbutamide and chlorpropamide) and

second generation drugs (Glibenclamide and Glipizide) main action is on B cells stimulate insulin secretion; their use also results in reduction of hepatic glucose production, reversal of the post-receptor defect, and increase in the number of insulin receptors **[6]**.

- Biguanides, such as Metformin, increase glucose uptake and utilization in skeletal muscle and reduce hepatic glucose production.
- The nonsulfonyl urea insulin secretagogues repaglinide and nateglinide bind to a specific site on the sulfonylurea receptor and increase insulin secretion, although they are short-acting agents **[7]**.
- Thiazolidinediones, such as Pioglitazone and Rosiglitazone, bind to a nuclear receptor called peroxisome proliferator-activated receptor-Y (PPAR-□□ which is complexed with retinoid X receptor (RXR) increases lipogenesis and enhances uptake of fatty acids and glucose, decrease insulin resistance by enhancing insulin-mediated glucose disposal by muscle.
- α-glucosidase inhibitors, such as acarbose and miglitol, block starch, sucrose, and maltose absorption **[8]**.

METHODOLOGY

Collection and Authentification of Plant Material

The Aerial Parts of *Euphorbia hirta were* collected and authenticated

Root Material and Extraction

Euphorbia hirta were collected from the Kakatiya University, Warangal, Telangana, India, during month of May and authenticated by botanist Prof. Musthafa, Department of Botany, Kakatiya University, Warangal, Telangana, India. The collected plant was shade dried, powdered and extracted using Soxhlet apparatus using methanol as solvent.

Extraction of Plant Material

Plant material was washed with water and then allowed to dry in shade for about 3 to 4 weeks. Dried plant materials were grinded by using the electronic grinder. The powder of the whole plants of *Euphorbia hirta* was extracted with methanol. The dried plants sample was powered and filed into the soxhlet using methanol respectively.

Evaporation of Solvent The filtrates (methanol extract) obtained were evaporated to dryness. Dried extract of *Euphorbia hirta* was taken and treated with n-hexane with chloroform and separated using a separating funnel. Both the n-hexane and aqueous fractions are collected.

2.1. PLANT DESCRIPTION

2.1.1. *EUPHORBIA HIRTA*

Euphorbia hirta sometimes called asthma-plant is a pantropical weed, possibly native to

India. It is a hairy herb that grows in open grasslands, roadsides and pathways. It is widely used as a medicinal herb.

Telugu: Reddivari Nanabalu, Reddinananbrolu, Bidarie

2.1.2. MORPHOLOGY

E. hirta belongs to the plant family Euphorbiaceae and genus Euphorbia. It is a slender- stemmed, annual hairy plant with many branches from the base to top, spreading upto 40 cm in height, reddish or purplish in color. Leaves are opposite, elliptic - oblong to oblong- lanceolate, acute or subacute, dark green above, pale beneath, 1- 2.5 cm long, blotched with purple in the middle, and toothed at the edge. The fruits are yellow, three- celled, hairy, keeled capsules, 1-2 mm in diameter, containing three brown, four-sided, angular, wrinkled seeds **[9]**.

2.1.3. CHEMICAL CONSTITUENTS

E. hirta has been studied by various workers and a number of active constituents have been isolated. Afzelin (I), quercitrin (II), and myricitrin (III) have been isolated from the methanolic extract of *E. hirta* .[13] The chemical investigation of *E. hirta* has led to the isolation of rutin (IV), quercitin (V), euphorbin-A (VI), euphorbin-B (VII), euphorbin-C (VIII), euphorbin-D (IX), 2,4,6-tri-O-galloyl-β-d-glucose, 1,3,4,6-tetra-O-galloyl-β-d-glucose, kaempferol, gallic acid, and protocatechuic acid. *E. hirta* also contains β-amyrin, 24-methylenecycloartenol, β-sitosterol, heptacosane, nnonacosane, shikmic acid, tinyatoxin, choline, camphol, and quercitol derivatives containing rhamnose and chtolphenolic acid **[10]**.

2.3. LITERATURE REVIEW

Mohammad Abu Bin Nyeem *et al*., 2017

Euphorbia hirta L. belonging to the family Euphorbiaceae which is frequently seen occupying open waste spaces and grasslands, road sides, and pathways in many parts of the world. The aim of the present study investigation was carried out to compile the medicinal properties of different plant parts of *E. hirta* L. and to compare their traditional uses with scientific evidences. The leaves of *E. hirta* are found to contain flavonoids, polyphenols, tannins, sterols, alkaloids, glycosides and triterpenoides. The plant has a reputation for increasing milk flow in women because of its milky latex and is used for other female complaints as well as diseases like bronchitis, asthma, eczema, dysentery. It is used as antidiarrheal, antispasmodic, anti-inflammatory, antifungal, anticancer, antimalarial, antiamoebic, antibacterial and antihelmentic etc. **[11]**.

Juveriyah Kausar *et al*., 2016

The use of plant extract to cure diseases has been the traditional way used in many parts of

the world. The synthetic drugs used now are more prone to cause side effects than curing the disease. Hence, the use of plant extract has now emerged due to their effective action against the disease Without causing any side effects. The plants belonging to the family called Euphorbia are widely used in medicine for its wide medicinal properties. The plant *Euphorbia hirta* has properties like anti-bacterial, anti-diarrheal, anti-allergic, diuretic, anti-oxidant, anti-tumor, anti-diabetic, anxiolytic nd sedative activity. This review contains the detailed information about all the properties of *E. hirta* **[12]**.

Anup Kumar Maurya *et al*., 2012

Anti-diabetic activity potential of *Euphorbia hirta* leaves against streptozotocin (STZ) induced experimental rats. Ethanolic extract of *E. hirta* leaves was administered to streptozotocin induced rats. Glibenclamide was used as a standard drug. Blood glucose levels were determined after oral administration of a dose of *Euphorbia hirta* (400 mg/kg b. wt) in diabetic groups. Blood glucose levels were determined on 0, 7th, 14th and 21st day after oral administration of ethanolic extracts of *E. hirta* (400 mg/kg). An ethanolic extract of *Euphorbia hirta* was found to reduce blood sugar in streptozotocin induced diabetic rats. Reduction in blood sugar could be seen from 7th day after continuous administration of the extract. The effect of extracts of *Euphorbia hirta* on serum lipid profile like total cholesterol, triglycerides, low density lipoprotein (LDL), very low-density lipoprotein (VLDL) and high-density lipoprotein (HDL) were also measured in the diabetic and non-diabetic rats. There was significant reduction in total cholesterol, LDL cholesterol, VLDL cholesterol and improvement in HDL cholesterol in diabetic rats. These results indicated that *Euphorbia hirta* possesses significant hypoglycemic and antihyperlipidemic effect **[13]**.

Goldie Uppal *et al*., 2012

Diabetes mellitus (DM) is a chronic disease caused by inherited and acquired deficiency in production of insulin by the pancreas, or by ineffectiveness of insulin produced, such a deficiency results in increased concentration of glucose in the blood, which in turn damages many of the body's systems in particular the blood vessels and nerves. *Euphorbia hirta* Linn (Euphorbiaceae) is commonly used in traditional medicine for the treatment of various diseases. The present study was carried out to evaluate the anti-diabetic effect of ethanolic extract of *Euphorbia hirta* Linn using various animal screening models. The ethanolic extract of *Euphorbia hirta* showed a significant hypoglycemic effect in the

alloxan-induced diabetic rats. This laid the foundation to study the active compounds of such anti-diabetic plants that are responsible for the hypoglycemic activities **[14]**.

Linfang Huang *et al*., 2012

A bibliographic investigation was carried out by gathering and analyzing the recognized books, including Chinese herbal classic, the Internet (Google Scholar, Baidu Scholar), and scientific databases (Pubmed, Scifinder, Scopus, CNKI, ACS, and Web of Science) for available information on *Euphorbia hirta*. Whole plants of *E. hirta* have been used in traditional Chinese medicine (TCM) due to its properties that can cure and detoxify fever, promote diuresis, stop itching, and induce prolactin. Traditional uses of *E. hirta* are also recorded in some other pan-tropical areas, where it has been used for over 10 types of diseases. A number of chemical constituents, including flavonoids, terpenoids and phenols, have been isolated and identified from *E. hirta*. Various biological evaluations have been reported for its importance. Modern pharmacological investigation demonstrated that its crude extracts and active compounds possess wide pharmacological effects, such as antibacterial, anti-inflammatory, antioxidant, sedative and anti-allergy. The current study summarizes the updated information concerning the ethno pharmacology, phyto chemistry, and pharmacology of *E. hirta* as well as its toxicology, and discusses the existing problem and future research direction of *E. hirta* **[15]**.

3. AIM & OBJECTIVES:

AIM: The present study is aimed to evaluate the anti-diabetic activity of *Euphorbia hirta.* The activity was measured by estimating various biomarkers like blood glucose levels, in experimental rats.

OBJECTIVES

- To evaluate the anti-diabetic activity and also protection for diabetic neuropathy of *Euphorbia hirta* in rats.

4. MATERIALS AND METHODS

4.1. MATERIALS AND SOURCE

Materials	Source
n-Hexane	Finar Chemicals Ltd., Ahmedabad, India
Methanol	E-Merck, Mumbai, India
Normal Saline	Claris Life Sciences, Ahmedabad, India
Chloroform	Molychem, Mumbai, India
Streptozotocin	Sigma, St. Louis, USA
Metformin	MSN Formulations, Hyderabad, India
Glucose Assay Kit	SPAN Diagnostics Pvt. Ltd., India

4.2. EQUIPMENTS USED

Equipment/Instrument	Source
Centrifuge	Remi Equipments Pvt. Ltd., Hyderabad, India
Electronic Balance	Toshvin Analytical Pvt. Ltd., India
UV-Visible Spectrophotometer	Toshvin Analytical Pvt. Ltd., Mumbai, India

5. RESULTS & DISCUSSION

5.1. Glucose

Table 2: Effect of *Euphorbia hirta* on serum glucose levels (mg/dl) in diabetic rats

Groups/Interval	0th Day	7th Day	15th Day
Normal	82.3±4.23	78.1±5.36	788.7±5.62
Diabetic control	284.8±5.01	285.4±12.4	299.3±8.64
E. hirta (50mg/kg)	294.1±9.83	193.1±12.3**	101.3±12.5**
E. hirta (100mg/kg)	281.5±42.4	186.2±11.2***	95.2±7.2***
Metformin (450mg/kg)	270.0±13.5	82.2±6.4***	71.1±6.3***

*All the values are expressed asmean±SD; n=6; ** indicates p<0.01, *** indicates ªp<0.001 vs diabetic control*

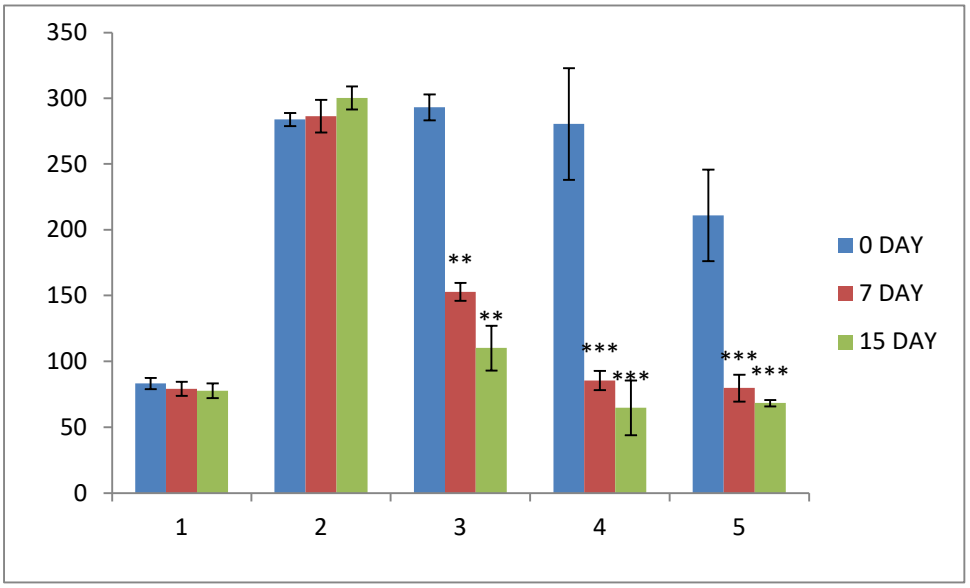

Figure 3: Effect of EEEH on serum glucose levels (mg/dl) in diabetic rats

Table 3: Diabetic Neuropathy screening by tail flick response

Group	Mean latency period			
	0	30	60	90
Normal	2.28±0.12	*2.31±0.10*	2.43±0.24	2.49±0.22
E. hirta (50mg/kg)	2.79±0.10	2.94±0.24	3.10±0.35	3.19±0.30
E. hirta (100mg/kg)	3.11±0.26	3.28±0.38	3.42±0.14	3.55±0.19
Diclofenacsodium (100mg/kg)	2.25±0.34	6.91±0.21*	9.74±0.35*	11.32±0.24*

*All the values are expressed asmean±SD; n=6; * indicates p<0.05 vs. diabetic control.*

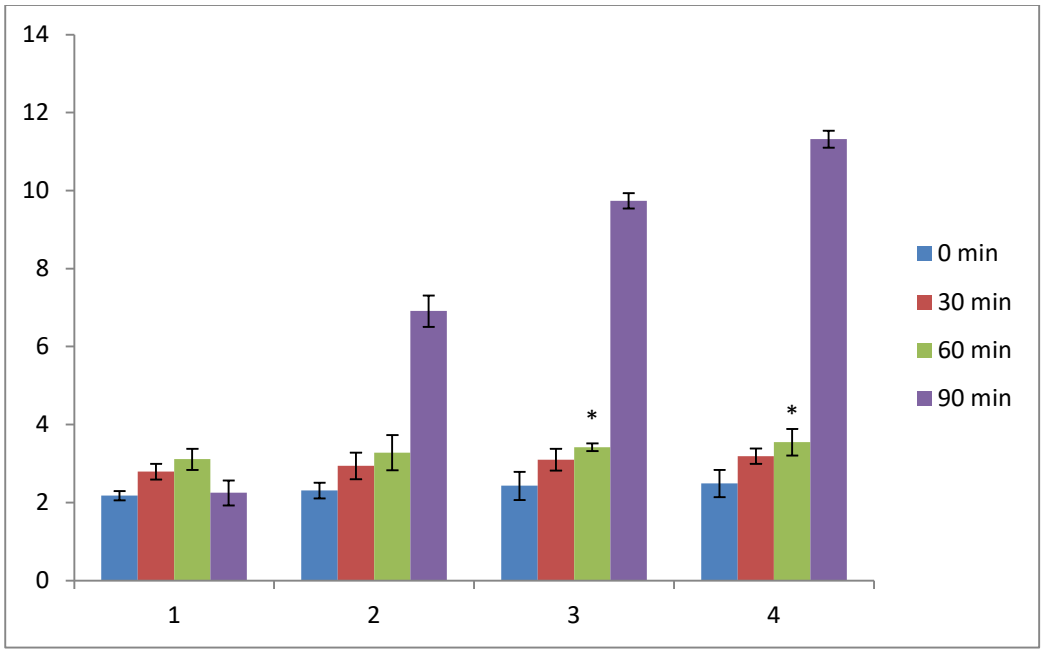

Figure 4: Effect of *Euphorbia hirta* on Diabetic neuropathy by tail flick in diabetic rats

Table 4: Diabetic Neuropathy screening by Thermal hypoalgesia response

Group	Mean latency period				
	0	30	60	90	120
Normal	3.08± 0.4	3.1± 0.33	3.13± 0.6	3.01± 0.51	2.95± 0.34
E. hirta (50mg/kg)	3.31± 0.29	3.48± 0.30	3.51± 0.34	3.54± 0.42	3.55± 0.25
E. hirta (100mg/kg)	3.01± 0.35	3.19± 0.30	3.22± 0.40	3.27± 0.37	3.25± 0.32
Diclofenacsodium 100mg/kg)	2.70± 0.40	4.08± 0.38*	4.35± 0.45*	4.70±0.19*	5.40±0.22*

All the values are expressed asmean±SD; n=6; * indicates p<0.05 vs. diabetic control

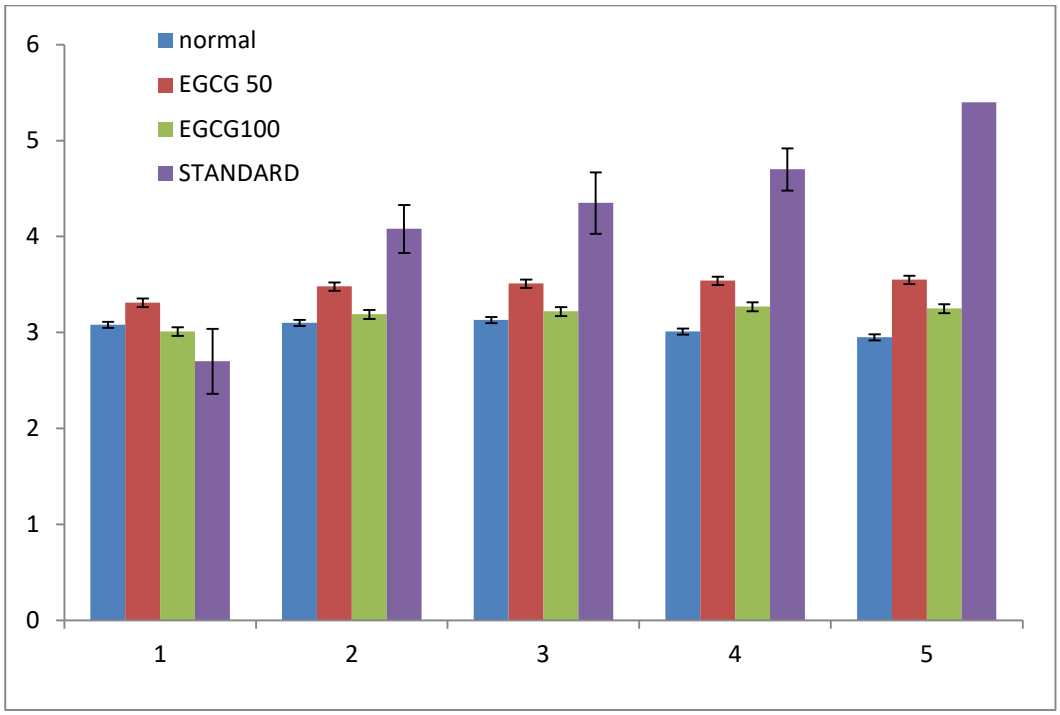

Figure 5: Effect of *Euphorbia hirta* on Diabetic neuropathy by Thermal hypoalgesia method in diabetic rats

5.2. DISCUSSION

The present study was aimed to evaluate the anti-diabetic activity and diabetic neuropathy protective activity of *Euphorbia hirta.* The activity was measured by estimating various biomarkers like blood glucose levels, in experimental rats.

In the previous studies it was shown that streptozocin induced diabetes mellitus. When given in a dose of 28mg/kg to rats intraperitoneally as evidenced in study **[13]**. In the present study streptozocin was administered in a single dose to induce diabetes mellitus in rats at the dose of 28mg/kg.

The *Euphorbia hirta* as reported anti-microbial properties but the effect of the plant extract on antidiabetic, were not reported yet and so the plant was chosen for the study.

Streptozocin forms an increased glucose levels that generates diabetes. Pretreatment with *Euphorbia hirta* produced significant decrease in glucose levels indicating the protective effect of tissue. On streptozocin treatment a dose dependent decrease in glucose levels were observed. Pretreatment with *Euphorbia hirta* and metformin produced significant alteration in levels.

Diabetic neuropathy alterations were tested using thermal hypoalgesia and Tail flick response **[15]** and thus *Euphorbia hirta* is Neuro protective in diabetic animals.

6. CONCLUSION

- *Euphorbia hirta* have different medicinal properties and may able to treat diabetes & diabetics complications.
- The *Euphorbia hirta* was found to be in dose dependent way against streptozocin induced diabetes in rats. The reduction of the elevated blood glucose levels in diabetic rats on treatment with the extract at two different concentrations confirmed that methanolic extract of *Euphorbia hirta* possess Antidiabetic activity & has shown significant effect when compared to streptozocin administration
- *Euphorbia hirta* had shown protection in neuropathy of diabetes

REFERENCES

[1] Alberti KGMM, Zimmet PZ Definition diagnosis and classification of diabetes mellitus and its complications. Part I. Diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diab. Med.*1998; 13: 539-53.

[2] American diabetes association:

Diagnosis and Classification of diabetes mellitus. *Diabetes Care* 2010; 33(suppl.1): S62-S69.

[3] Anup Kumar Maurya, Smriti Tripathi, Zabeer Ahmed, Ram Kumar Sahu, Antidiabetic and antihyperlipidemic effect of *Euphorbia hirta* in streptozotocin induced diabetic rats, Der Pharmacia Lettre, 2012, 4 (2):703-707.

[4] Aliyu R, Adebayo AH, Gatsing D, Garba IH. The effects of ethanolic leaf extract of Commiphora Africana (Burseraceae) on rat liver and kidney functions. *J. Pharmacol. Toxicol* 2007; 2:373-79.

[5] Anne-Sophie Wattiez, David André Barrière, Amandine Dupuis and Christine Courteix, Rodent Models of Painful Diabetic Neuropathy: What Can We Learn from Them? *J Diabetes Metab* 2012, S:5 http://dx.doi.org/10.4172/2155-6156.S5-008

[6] American diabetes association: Nephropathy in diabetes. *Diabetes care*, volume 27, (suppl.1), January 2004, S79-S82.

[7] Bonses, R.W. & Tausskay. Creatinine (alkaline picrate method) J. Biol, Chem.1945;158;581.

[8] Elegami, AA; Bates, C; Gray, AI; MacKay, SP; Skellern, GG; Waigh, RD "Two very unusual macrocyclic flavonoids from the water lily Nymphaea lotus". Phytochemistry, 2003, 63 (6): 727–31

[9] Ewa Konduracka1, Andrzej Gackowski Diabetes-specific cardiomyopathy in type 1 diabetes mellitus: no evidence for its occurrence in the era of intensive insulin therapy. European Heart Journal 2007;28; 2465

[10] Fawzi Irshaid, Kamal Mansi, Ahmad Bani-Khaled and Talal Aburjia, Hepatoprotetive, Cardioprotective and Nephroprotective Actions of Essential Oil Extract of *Artemisia Sieberi* in Alloxan-Induced Diabetic Rats International Conference on Chemical, Environmental and Biological Sciences 2011;362-366

[11] Goldie Uppal, antidiabetic activity of ethanolic extract of *Euphorbia hirta* Linn, Der Pharmacia Lettre, 2012, 4 (4):1155-1161

[12] Heiko Buggerand E. Dale Abel Rodent models of diabetic

cardiomyopathy Disease Models & Mechanisms 2009, 2, 454-466.

[13] Heffner J.E, Brown CK. Estimation o LDH; 1997;11(4):970-80

[14] H. K. I. Perera., Antidiabetic Effects of *Pterocarpus marsupium* (Gammalu)., European Journal of Medicinal Plants 13(4): 1-14, 2016

[15] Evedo., Sandra P. Silveiro., Lu'is Henrique Canani., Maria Luiza Caramori., Themis zelmanovitz., "diabetic nephropathy: diagnosis, prevention, and treatment". Diabetes care 2005; 28: 176-188.