ejpmr, 2024, 11(5), 232-243

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

A REVIEW ON INDIAN HERBS AND HERBAL DRUGS USED FOR THE TREATMENT OF DIABETES & DIABETIC NEUROPATHY

Paswan Praveen Kumar*, Dr. Mihir Y. Parmar, Salaj Khare, Palak Landge, Devanshi Sharma, Bhumika Parmar and Zalak Dave

Department of Pharmacology, Krishna School of Pharmacy (Formerly, Babaria Institute of Pharmacy), Drs. Kiran and Pallavi Patel Global University, Krishna Edu Campus, Varnama, Vadodara, Gujarat, India.

***Corresponding Author: Paswan Praveen Kumar**

Department of Pharmacology, Krishna School of Pharmacy (Formerly, Babaria Institute of Pharmacy), Drs. Kiran and Pallavi Patel Global University, Krishna Edu Campus, Varnama, Vadodara, Gujarat, India.

Article Received on 13/03/2024 **Article Revised on 03/04/2024** **Article Accepted on 24/04/2024**

ABSTRACT

Approximately 60% of people on the planet utilize traditional medicines made from medicinal plants. This article focuses on Indian herbal remedies and botanicals, especially those used there to cure diabetes. Diabetes is a significant illness that affects people worldwide and from all walks of life. One of the most common complications of diabetes is neuropathy, which affects the peripheral nerve system's blood flow and can eventually lead to mortality, diabetic foot, injuries, and loss of sensation. The greatest known risk factor for diabetic neuropathy is uncontrolled hyperglycemia. Still, other important variables contributing to the rise in this condition include oxidative stress, inflammation, aging, elevated HbA1c levels, blood pressure, and body mass index (BMI). It is turning out to be a serious health issue in India, particularly in the cities. As an alternative to conventional methods of reducing the adverse outcomes of type 2 diabetes and its repercussions, herbal formulations are advised because they are less expensive and have less side effects. A collection of herbal medications used to treat diabetes as well as medicinal plants with demonstrated antidiabetic and neuropathy-related a list of therapeutic qualities is assembled. Among them are, *Allium Nigella sativa, Pterocarpus marsupium, Tinospora cordifolia, Trigonella foenum graecum, Eugenia jambolana, Momordica charantia, Ocimum sanctum,* and *Withania somnifera* are a few of these. Consequently, details regarding these medicinal plants' antioxidant benefits are also provided.

KEYWORDS: herbal remedy, anti-oxidant, diabetic neuropathy, and antidiabetic.

1. INTRODUCTION

Medicinal plants are the source of several commonly used traditional remedies, minerals, and organic matter. As a result of their natural origin and low side effects, herbal medicines have seen an exponential growth in popularity in the last few years, both in industrialized and underdeveloped nations.[1] Indian traditional medical systems use herbal concoctions that contain a number of medicinal herbs known as Ramayana, which have been used for over a millennium.[2] In Indian medical systems, the majority of practitioners create and administer their own formulas. The World Health Organization (WHO) lists 21,000 plants as being used medicinally across the globe in various locations. Out of these 2500 species, 150 are utilized in India's commercial contexts on a very big amount. India is thought of as the botanical paradise of the globe and the world's largest supplier of medicinal plants.[3] The current analysis focuses on plant preparations and herbal medication used to treat diabetes mellitus, a serious illness that cripples people worldwide and causes enormous financial losses.

1.1. Significance of Diabetes & Diabetes Neuropathy

Elevated postprandial blood sugar levels and increased fasting are hallmarks of diabetes, a chronic metabolic disorder affecting the lipid, protein, and carbohydrate metabolism. Globally, it is predicted that 5.4% of people would develop diabetes by 2025, up from 4% in 1995. Predictions from the WHO indicate that the majority of the burden will fall on poorer countries. Over the past ten years, research conducted in India has shown that Diabetes is more common than not only high but also rapidly increasing among urban populations.[4] A total of 33 million people are thought to in India suffer from diabetes. This number will most likely increase to 57.2 million by 2025.

Insulin that is either insufficient or not working properly causes diabetes mellitus, a complex metabolic disease. Insulin becomes insufficient due to a lack of beta cells in the body, which causes type I diabetes (insulin dependent). Because of this, people with this illness are totally dependent on outside supplies of insulin, while people with Insulin-independent type II diabetes does not

react to insulin and can be controlled with food changes, exercise, as well as medicine. The more prevalent kind of diabetes, known as type II diabetes, affects 90% of those with diabetes. For both types of diabetes, A few possible symptoms are: (i) elevated blood sugar levels; (ii) peculiar thirst; (iii) frequent urination; (iv) intense hunger and weight loss; (v) blurred vision; (vi) nausea and vomiting; (vii) excessive weakness and fatigue; (viii) irritability, mood swings, etc.

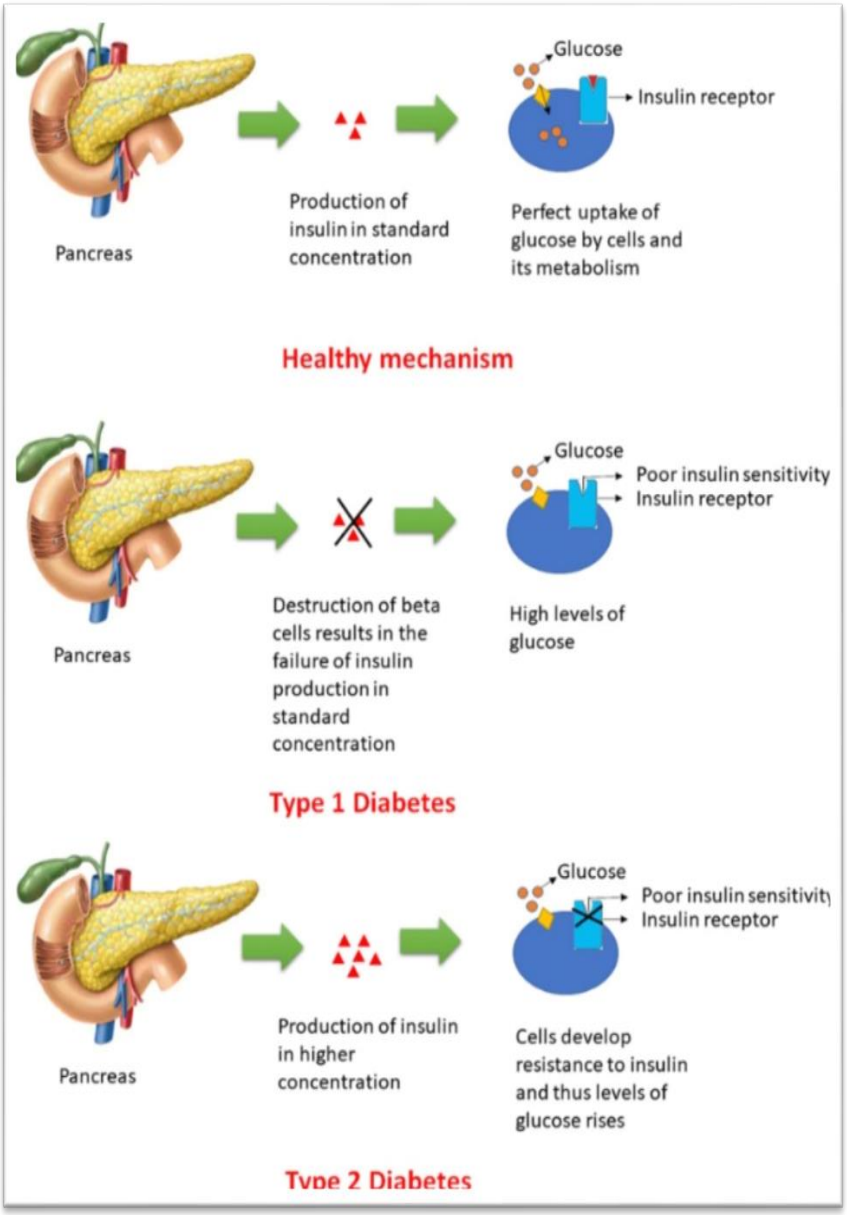

Fig. 1: Types 1 diabetes and Types 2 diabetes classification.

Existence of signs and indications that may lead to the damage of peripheral nerves is a hallmark of diabetic neuropathy, a complex illness primarily caused by changed insulin levels.[5]

2. Etiology and risk factors

The primary cause of diabetic neuropathy is elevated plasma glucose levels (diabetes mellitus), which often impairs neuronal communication and weakens the blood vessels that nourish and oxygenate the nerves.[6] Moreover, insulin resistance, hyperglycemia, and dyslipidemia are additional risk factors that contribute to a disrupted metabolic pathway, which in turn produces a high level of reactive oxygen species (ROS) because of a disrupted mitochondrial redox status[7], finally culminating in the loss of axonal vitality. Therefore, neuronal dysfunction and eventual cell death can undoubtedly result from oxidative stress and inflammation.[8] Additional risk factors include smoking, high blood pressure, age, weight, body mass index, HbA1c levels, diabetic retinopathy, 2-h glucose C peptide, length (time span) of diabetes, fasting plasma glucose levels, blood urea nitrogen levels, and so on.[9,17]

Early alterations in type "C" unmyelinated fibers in diabetic neuropathy cause pain, physical sensitivity, allodynia, and loss of feeling in the body's distal regions (the foot and toe) mostly as a result of axonal degradation.[18,19] Peripheral neuropathy, autonomic neuropathy, focal neuropathy, and proximal neuropathy are the four primary classifications of diabetic neuropathy according to the part affected.[20] The most prevalent and generally upsetting condition affecting around 50% of people with diabetes is called peripheral neuropathy, which affects the motor and sensory nerves around the periphery of the brain.[21] Whole autonomic nervous system involvement occurs in autonomic neuropathy; focal neuropathy causes isolated mononeuropathies, radiculopathy, or polyradiculopathy, whereas proximal neuropathy causes intense unilateral anterior thigh pain, quadriceps muscle weakness, and loss of knee jerk.[22,23]

3. Indian Medicinal Plants with Beneficial Antidiabetic Effects

Numerous herbal treatments for diabetes and its consequences have been proposed. The primary components of these mixtures are medicinal herbs. Table 1[24] provides list of therapeutic herbs that have antidiabetic and associated effects. An overview among these arrangements can be found in Table 2.

Table 1: Herbal Remedies Including Anti diabetic and beneficial effects.

Indian medicinal herbs with therapeutic effects related to antidiabetic		
Plant Name	**Ayurvedic/common name/herbal formulation**	**In conventional medicine, antidiabetic and other positive effects**
Annona squamosa	Sugar apple	Ethanolic leaf extract's hypoglycemic and antihyperglycemic properties, as well as its increased plasma insulin level[25-27]
Artemisia pallens	Davana	When hypoglycemic, peripheral glucose consumption rises or glucose reabsorption is inhibited.[28]
Areca catechu	Supari	Hypoglycemic[29]
Beta vulgaris	Chukkander	improves OGTT glucose tolerance[30]
Boerhavia diffusa	Punarnava	Decrease in the activity of fructose bisphosphates and glucose-6-phosphatase, rise in the amount of plasma insulin, and antioxidant[31-33]
Bombax ceiba	Semul	Hypoglycemic[34]
Butea monosperma	Palasa	Antihyperglycemic[35]
Camellia sinensis	Tea	antioxidant and anti-hyperglycemic action[36-37]
Decidua Capparis	Karir or Pinju	antioxidant and anti-hyperglycemic action[33]
Caesalpinia bonducella	Sagarghota, Fevernut	antioxidant and anti-hyperglycemic action[38]
Coccinia indica	Bimb	Hypoglycemic[34]
Emblica officinalis	Amla, Dhatriphala, an ingredient in a herbal remedy, “Triphala”	Reduce lipid peroxidation, antioxidant, hypoglycemic[39,41]
Eugenia uniflora	Pitanga	hypoglycemic, preventing the action of lipase[42]
Enicostema littorale	Krimihrita	Reduce the activity of glucose 6-phosphatase and fructose 1,6 bisphosphatase while hexokinase activity is elevated. Hypoglycemic response contingent on dosage[43-44]
Ficus bengalenesis	Bur	Hypoglycemic, antioxidant[45]
Gymnema sylvestre	Gudmar or Merasingi	Effects against hyperglycemia and hypolipidemia[46-47]
Hemidesmus indicus	Anantamul	anti-inflammatory and resistant to snake venom[48]
Hibiscus rosa-sinesis	Gudhal or Jasson	starts releasing beta cells produce insulin. in the pancreas.[49]
Ipomoea batatas	Sakkargand	lowers the resistance to insulin[50]
Momordica cymbalaria	Kadavanchi	Hypoglycemic, hypolipidemic[51-52]
Murraya koenigii	Curry patta	Hypoglycemic; promotes glycogenesis while suppressing glycogenolysis and gluconeogenesis[53]

Musa sapientum	Banana	Antihyperglycemic, antioxidant[54-56]
Phaseolus vulgaris	Hulga, white kidney bean	Modified levels of insulin receptor and GLUT-4 mRNA in skeletal muscle, hypoglycemic, hypolipidemic, block alpha amylase activity, and antioxidant[57-59]
Punica granatum	Anar	antioxidative and hypoglycemic action[60]
Salacia reticulata	Vairi	inhibition of sucrase activity, α-glucosidase inhibitor[61]
Scoparia dulcis	*Sweet broomweed*	Activity as an insulin secretagogue and antihyperlipidemic, hypoglycemic, antioxidant[62]
Swertia chirayita	Chirata	encourages the release of insulin from islets[63]
Syzygium alternifolium	Shahajire	Hypoglycemic and antihyperglycemic[64]
Terminalia belerica	Behada, a constituent of "Triphala"	Antibacterial, hypoglycemic[65]
Terminalia chebula	Hirda	Antibacterial, hypoglycemic[66]
Tinospora crispa		anti-hyperglycemic, promoting islet release of insulin[67]
Vinca rosea	Sadabahar	Anti-hyperglycemic[68]
Withania somnifera	Ashvagandha, winter cherry	diuretic, hypocholesterolemia, and hypoglycemic[69]

Table 2: Medicinal Plants with Antidiabetic Ingredients.

Developed herbal medications with antidiabetic qualities		
Drug	**Company**	**Ingredients**
Diabecon	Himalaya	Gymnema Sylvestre The marsupium Pterocarpus, Glycyrrhiza glabra, Casearia esculenta, Syzygium cumini, Argania racemosa, Boerhavia diffusa Tribulus terrestris, Phyllanthus amarus, Gmelina arborea, Swertia chirata, Tinospora cordifolia, Sphaeranthus indicus, Astragalus herbaceum, As Berberis aristata, Aloe vera Triphala Shilajeet, Commiphora wightii, Mother-disease Charantia Piper nigrum Abutilon indicum, Ocimum sanctum, Longa Curcuma, Rumex maritimus
Diasulin		Cassia auriculata, Coccinia indica, Curcuma longa Momordica charantia, Gymnema sylvestre, and Emblica officinalis dulcis scoparia, Syzygium cumini, Trigonella foenum graecum and Tinospora cordifolia together
Pancreatic tonic 180 cp	herbal supplement used in Ayurveda	Gymnema sylvestre, Pterocarpus marsupium, Mother-disease Charantia Syzygium cumini, Trigonella graceum foenum, Azadirachta indica Ficus racemosa Aegle marmelos, Tamarindo Cinnamomum
Ayurvedic herbal remedy for diabetes alternative	Chakrapani Ayurveda	Gymnema sylvestre, or Gurmar (*Momordica charantia*) Karela Inula racemosa, or Pushkarmool Syzygium cumini, or Jamun Gutli Azadirachta indica, or neem Trigonella foenum gracecum, or Methika Tinospora cordifolia, or Guduchi
Powdered bitter gourd	Garry and Sun Natural Medicines	Mordica charantia, or bitter gourd

Dia-care	Admark Herbals Limited	Sanjeevan Mool; Himej, Jambu beej, Kadu, Namejav, Neem chal.
Diabetes: Everyday Management	The Natural Health Supply	Vanadium, Chromax, 4% cinnamon extract, 50% fenugreek extract, 25% Gymnema sylvestre, 25% Licorice Root (20%) extract, and 7% Momordica extract are all included in this mixture.
Powder Gurmar	Sun and Garry's Natural Curations	Gymnema sylvestre, or Gurmar
Epinsulin	Swastik Formulations	Pterocarpus marsupium, or vijaysar
Diabecure	Beaute naturelle	Berberis vulgaris, Juglans regia, Erytherea centaurium, Millefolium, and Taraxacum
Diabeta	Ayurvedic treatment Herbal Health Products Using Ayurveda	Gymnema Sylvestre Vinca rosea, also known as periwinkle, Curcuma longa, sometimes known as turmeric, Azadirachta indica, Pterocarpus marsupium, Momordica charantia, also known as bitter gourd, Syzygium cumini, also known as black plum, Acacia arabica, also known as black babhul, Tinospora cordifolia, and Zingiber officinale, also known as ginger

3.1. Indian Herbal Remedies for Diabetes Neuropathy Role of (Curcuma longa)

One of the more difficult spices to use in Indian cookery is *curcuma longa*. Curcumin is the active ingredient of Curcuma longa. Nevertheless, desmethoxycurcumin, bisdemethoxycurcumin, and volatile oils (atlantone, zingiberene, and turmeric) are additional active ingredients.[70] well-known for its amazing abilities to treat a variety of illnesses. It has anti-inflammatory, antioxidant, anti-diabetic, anti-viral, anti-infectious, healing, and hypolipidemic properties.[71,72] Curcumin, in particular, has been demonstrated to decrease the progression of type 2 diabetes, prevent beta cell death, enhance beta cell function, and lower the incidence of insulin resistance in diabetic neuropathy.[73,74] Some of the theories for how curcumin prevents the development of diabetic neuropathy include the obstructive mechanisms of NO (nitric oxide), TNF- Alpha, IL-Iβ (interleukin-lβ), IL-8 (interleukin-8), and the decrease of nitrite levels in the brain.[75,76] But the meta-analysis of randomized controlled trials by White et al.[77] observed that in people with chronic inflammation illnesses, there was no decrease in inflammatory marker levels (IL-1β, IL-6, and TNF-α). Also, in a double blind, randomized study of hyperlipidemic people with type 2 diabetes, consuming supplements containing turmeric significantly decreased triglycerides, body weight, lipoprotein cholesterol levels, total cholesterol, and body mass index (in comparison to standard).[78] In diabetic individuals, a daily dose of 1 g of curcumin reduces skin flow at the surface of the foot and enhances microangiography.[72] Poolsup et al. conducted a meta-analysis and discovered that giving 1.5 g of turmeric to prediabetic people for nine months resulted in lower HbA1c and fasting blood sugar levels. (Fig.2).[79,80]

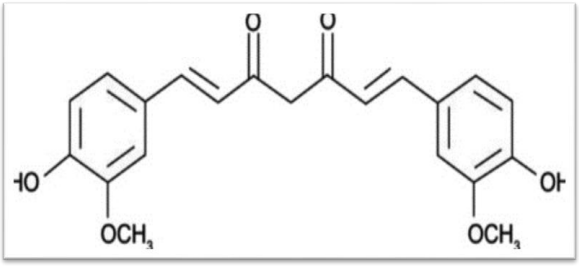

Fig. 2: The chemical makeup of curcumin reveals its anti-diabetic and anti-neuropathic effects.

3.1.1. Ginkgo biloba's Role

Gingko biloba a single member of the Ginkgoaceae family, making it a fossil living. Bioactive constituents ginkgolide B, trilactone terpenes, and flavonoids glycosides are in charge of the pharmacological effects.[81] The plant's vital and dazzling potential prompted researchers to look at its uses in a variety of industries, including dietary supplements and health care. Gingko leaf extract is used as a treatment for dementia-related illnesses, memory loss, and concentration issues. It also has anti-oxidant, wound-healing, neuroprotective, and anti-asthmatic qualities. Furthermore, a number of studies have been conducted and published that suggest it may have a role in the treatment of neuropathic pain. Previous research on rats with neuropathic pain revealed a significant reduction in pain after standardized *Ginkgo biloba* extract was given to the rats at several doses. The effects of gingko on rats exposed to pressure and cold were assessed using a variety of objective measures, and beneficial outcomes were observed for both stimuli. The study found that the more Use of ginkgo biloba extract, the more pronounced the pain-relieving effects were. The alleviating impact may be attributed to many mechanisms, such as antioxidant, neuroprotective, or

anti-inflammatory actions. In additional research, 156 individuals received either a placebo or an EGb 761 extract (120 mg/day) for the treatment of diabetic neuropathy over a 6-month period. The treatment was shown to have good aftereffects since, within six months, a notable decrease in pain intensity and an improvement in touch sensitivity were noted.[82] Additionally, combinatorial research showing promising outcomes when managing diabetic neuropathy has been conducted. Some Chinese researchers have advocated methylcobalamin with gingko. For a duration of 12 weeks, the medication was administered to 144 patients divided into three groups. Among the 3 groups, methylcobalmin and epalrestat pills, Ginkgo biloba tablets, and methylcobalmin tablets, and placebo, the ginkgo tablet and methylcobalmin treatment group exhibited more favorable outcomes (reduced bodily symptoms and enhanced neuronal function) than the placebo group. (Fig.3).

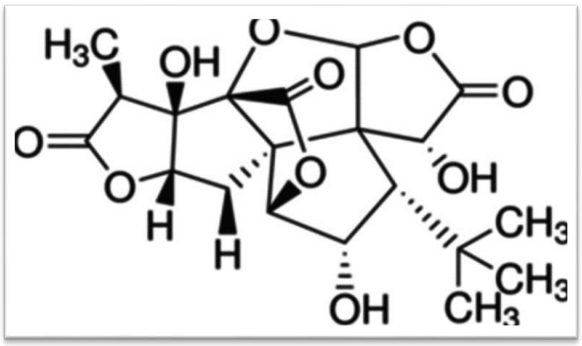

Fig. 3: The molecular structure of ginkgolide B reveals its anti-diabetic and anti-neuropathic characteristics.

3.1.2. Citrullus colocynthis Role

Citrullus colocynthis is a belonging to the Cucurbitaceae family. Common names for this widely used like bitter apple and tumba, bitter cucumber, wild gourd, vine-of-Sodom, and colocynth are examples of traditional fruit.[83] There have been reports of its anti-oxidative, anti-cancer, analgesic, gastrointestinal, and hypolipidemic properties.[84,85] The plant is also widely known for its anti-diabetic qualities and medicinal properties. Among the bioactive substances that could potentially aid in the managment of diseases are cucurbitacins (a, b, c, d), α-aelaterin, phenolics, and flavonoids.[86] Citrullus colcynthis is a pharmaceutical substance used to treat neuropathy caused by diabetes because it has anesthetic and anti-oxidative properties. Preliminary interventional trial, eight adults with a diagnosis of diabetic neuropathy were treated topically with Citrullus colocynthis for three months, twice a day, and their pain levels were assessed. There was a notable decrease in the average pain scores, and neither local nor systemic effects were mentioned.[87] Because there is so little study to support it, it is practically not recommended to administer this extract orally. (Fig.4).

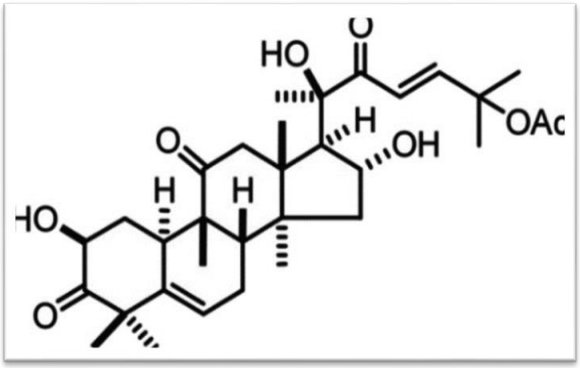

Fig. 4: Cucurbutacin's chemical composition an example of anti-neuropathic and anti-diabetic action.

3.1.3 Ocimum sanctum Role

Ocimum sanctum, a member of the Liliaceae family, is also known by the popular name Tulsi.[88] This traditional plant has a wealth of bioactive medicinal components, including linalool, ursolic acid, caryophyllene, Rosmarinus acid, saponin, and eugenol.[89] This plant is a fantastic bush in the health area because of its amazing ability to treat a wide range of ailments. The elixir of life, tulsi, is revered and valued for its healing and spiritual qualities; as such, the ancient Indian medical school (Ayurveda) calls her "The Incomparable One," "The Queen of Herbs," and "Mother Medicine of Nature".[90] It has biological properties that include memory-boosting, anti-inflammatory, anti-bacterial, anti-oxidant, anti-pyretic, anti-diabetic, and anti-allergic properties.[91] Its function towards lessening neuropathic pain in individuals Having neuropathy caused by diabetes is also well established. Studies show that when Ocimum sanctum is taken for 14 days at dosage of 100 to 200 mg/kg p.o. in conjunction with saponins, a bioactive component, it has a restorative or therapeutic effect on neuropathic pain. Also, the treatment reduces oxidative stress and calcium levels.[92] A different study looked at the combined effects of metformin and *Ocimum sanctum* (Alcoholic leaf extract) on neuropathic pain management and reduction. The results showed considerable anti-nociceptive benefits in contrast to the group that received metformin alone. (Fig.5).[93]

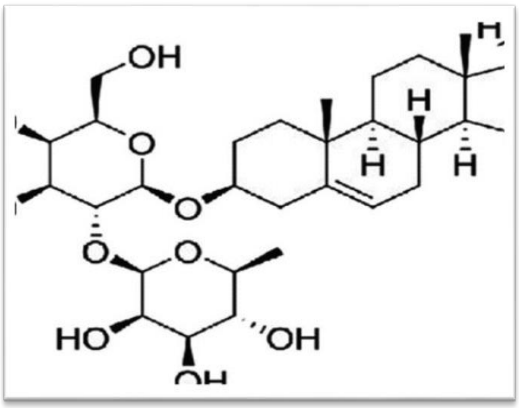

Fig. 5: Saponin's chemical structure demonstrating its anti-neuropathic and anti-diabetic properties.

3.1.4. Artemisia dracunculus's role

The genus Artemisia, which is a part of the Asteraceae family, comprises about 1500 species. Research has shown that plants can be used to cure and manage a number of illnesses. In pharmacological investigations, the plant's anti-inflammatory, antibacterial, hepato- and gastroprotective, antifungal, anti-convulsant, and anti-diabetic qualities were discovered. Essential oils, flavonoids, coumarins, and phenol carbonic acids are the biologically active and important chemicals. Among the constituents methyl eugenol is an essential oil., estragole & additional monoterpenoids; methyl eugenol functions as a painkiller and blocks channels known as TRP (Transient Receptor Potential).[94, 95] An extract of Artemisia dracunculus in methanol, PMI-5011, was proven to alleviate neuropathy caused by a high-fat diet. The Mice C57Bl6/J were given a high-fat diet for 16 weeks to be able to induce neuropathy. As a result of the high-fat diet, the mice experienced obesity, hyperglycemia, hypoalgesia, allodynia, and impairments in nerve conduction. Additionally, they demonstrated nitrosative stress, buildup of 12(S)-hydroxy eicosatetraenoic acid, and overexpression of 12/15-lipoxygenase in the spinal cord and peripheral neurons. For seven weeks, daily 500 mg/kg doses of PMI-5011 brought blood sugar levels back to normal, eased pain perception, and decreased the overexpression of 12/15-lipoxygenase and nitrated protein levels inside the peripheral nerve. Consequently, the study's findings demonstrated that PMI-5011 is a safe and non-toxic extraction that can be utilized to treat neuropathic pain. (Fig.6).[96]

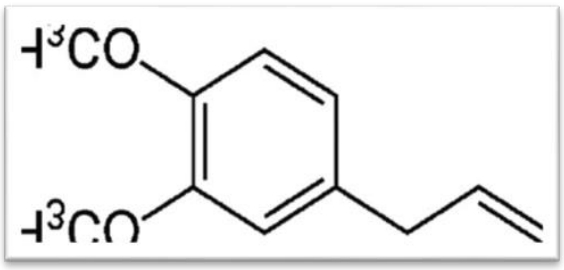

Fig. 6: Methyl eugenol's chemical composition demonstrating its anti-diabetic and anti-neuropathic properties.

3.1.5. Nigella sativa Role

Nigella sativa, a member of the Ranunculaceae family, known in India for its black seeds. Fixed oil and volatile substances are the plant's active ingredients with the latter consisting of thymoquinone and monoterpenes such as α-piene and p-cymene. Numerous medicinal properties of the plant, including antibacterial, hepatoprotective, immunomodulatory, hypotensive, and anti-diabetic properties, have been documented.[97] Kanter looked into the healing properties of black seeds and their active ingredient thymoquinone in relation to the histological alterations of sciatic nerves in rats given streptozotocin (STZ) to cause diabetes. Serum glucose levels and serum insulin concentrations significantly decreased in streptozotocin (STZ)-induced diabetic mice while 400 mg/kg of black seeds and 50 mg/kg of thymoquinone were given orally once daily [95]. Furthermore, histological examination of the nerve tissue of treated rats revealed less morphological changes. Using black seed and thymoquinone together dramatically decreased the breakdown of myelin. A notable enhancement was observed in the ultra-structural properties of axons. Therefore, if the therapies (thymoquinone and black seeds) are advanced to pre-clinical research, they may prove to be effective treatments for diabetic neuropathy. (Fig.7).[97]

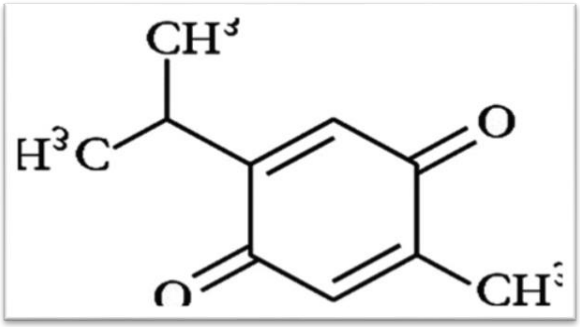

Fig. 7: Thymoquinone's chemical composition demonstrating its anti-neuropathic and anti-diabetic properties.

4. Discussion & future Challenge

It is crucial to control neuropathic pain since Diabetes is an imperceptible cause of death that gradually develops into neuropathy and causes excruciating pain.[98] Since many adverse reactions and poor pharmacokinetics have been recorded against synthetic medications, herbal medicines with anti-diabetic, anti-oxidant and its anti-inflammatory effects have to be the primary consideration for controlling neurological discomfort and reducing blood sugar. [99]. Thus, with little to no adverse effects, the therapeutic herbs can be used as an alternative to currently available synthetic medications.[100,102] It is necessary to make persistent efforts to keep using medicinal plants. They ought to follow Primary Healthcare Center (PHC) in order to preserve the value and progress of the global market's.

The continued use of therapeutic herbs requires effort. Data must be preserved regionally and in tabular form to guarantee reliable information about the existence of vegetation in particular domains.[103] To avoid duplication, R&D should be shared frequently. Standardization of medicinal plants is crucial for future research on them, and safety should be taken into account.[104] When creating herbal medicines, the dose amount is also important to consider. If the amount is too high, the medication will become too poisonous and ineffective. Additionally, since certain medications are thought to communicate with a chemical Pharmaceuticals, it's critical to ascertain the pharmacokinetic profile of bioactive substances for the least amount of herb-drug interactions. For example,

Ginkgo biloba is a herb that has been licensed to treat neuropathic pain; however, it also thins the blood, so anybody using aspirin, non-steroidal anti-inflammatory medicines, or any type of anticoagulant should avoid using it.[82,105] Furthermore, in order to determine the required bioactive chemicals, effective and Reliable bioassays had to be developed. There have not yet been any clinical trials, and the majority of anti-diabetic compounds derived from medicinal plants are preventive rather than therapeutic in character. There could be more herbal medications for human use in the near future if these investigations are supported and carried out.

5. CONCLUSION

Diabetes and diabetic neuropathy are significant, complicated lifestyle-related disorders that are rapidly getting worse and have the potential to become one of the world's health crises. Excessive sugar consumption, obesity, physical inactivity, and environmental variables raise blood glucose levels, which damage the brain's peripheral nerves and result in diabetic neuropathy. Its development is also significantly influenced by other lifestyle factors and a lack of understanding about good nutritional practices. Due to their negative side effects and poor pharmacokinetics, the currently available drugs are not used very often. If persistent efforts are made to use medicinal plants, herbal remedies and the bioactive substances they contain may be able to cure diabetic neuropathy with as few side effects as possible. These compounds possess analgesic properties and participate in pathways that include anti-inflammatory, neuroprotective, antioxidant, anti-apoptotic and calcium channels blocker. Although mentioned, the potential benefits of plants when managing diabetic neuropathy have not yet been explored in human research. Therefore, it is important to promote and encourage herbal formulation as it has been mentioned in order to prevent the problems related to synthetic pharmaceuticals.

6. REFERENCES

1. Grover J.K., Yadav S., Vats V. Medicinal plants of India with antidiabetic potential. *J. Ethnopharmacol*, 2002; 81: 81–100.
2. Scartezzini P., Sproni E. Review on some plants of Indian traditional medicine with antioxidant activity. *J. Ethnopharmacol*, 2000; 71: 23–43.
3. Seth S.D., Sharma B. Medicinal plants of India. *Indian J. Med. Res*, 2004; 120: 9–11.
4. Ramachandran A., Snehalatha C., Viswanathan V. Burden of type 2 diabetes and its complications- the Indian scenario. *Curr. Sci.*, 2002; 83: 1471–1476.
5. Bansal V, Kalita J, Misra UK. Diabetic neuropathy. *Postgrad Med J.*, 2006; 82(964): 95–100.
6. Liu X, Xu Y, An M, Zeng Q. The risk factors for diabetic peripheral neuropathy: a meta-analysis. *PLoS ONE*, 2019; 14(2).
7. Sajic M. Mitochondrial dynamics in peripheral neuropathies. *Antioxid Redox Signal*, 2014; 21(4): 601–620.
8. Feldman EL, Nave KA, Jensen TS, Bennett DLH. New horizons in diabetic neuropathy: mechanisms, bioenergetics, and pain. *Neuron*, 2017; 93(6): 1296–1313.
9. Kiani J, Moghimbeigi A, Azizkhani H, Kosarifard S. The prevalence and associated risk factors of peripheral diabetic neuropathy in Hamedan, Iran. *Arch Iran Med.*, 2013; 16(1): 17–19.
10. Tesfaye S, Stevens LK, Stephenson JM, Fuller JH, Plater M, Ionescu-Tirgoviste C, et al. Prevalence of diabetic peripheral neuropathy and its relation to glycaemic control and potential risk factors: the EURODIAB IDDM Complications Study. *Diabetologia*, 1996; 39(11): 1377–1384.
11. Nie C, Bao HP. Analysis of the related risk factors of diabetic peripheral neuropathy. *Chin J Exp Clin Virol*, 2012; 26(6): 467–9.
12. Mahroos AF, Roomi AK. Diabetic neuropathy, foot ulceration, peripheral vascular disease and potential risk factors among patients with diabetes in Bahrain: a nationwide primary care diabetes clinic-based study. *Ann Saudi Med.*, 2007; 27(1): 25–31
13. Maser RE, Steenkiste AR, Dorman JS, Nielsen VK, Bass EB, Manjoo Q, et al. Epidemiological correlates of diabetic neuropathy. Report from Pittsburgh epidemiology of diabetes complicationsstudy. *Diabetes*, 1989; 38(11): 1456–61.
14. Chen X, Bi Y, Hu Y, Tong G, Zhu D. Prevalence and risk factors of diabetic peripheral neuropathy. *J Med Postgrad*, 2011; 24(10): 1035–1038.
15. Wei W, Wang Z, Zhou L, Zhao S, Mao H. Risk factors analysis of diabetic peripheral neuropathy in patients with type 2 diabetes. *Hainan Med J.*, 2017; 28(20): 3379–81.
16. Chen L, Zheng F, Li H. A change of serum cystatin C in diabetic peripheral neuropathy in type 2 diabetic patients and its clinical significance. *Chin J Diabetes*, 2014; 22(8): 700–703.
17. Xu F, Zhao LH, Su JB, Chen T, Wang XQ, Chen JF, et al. The relationship between glycemic variability and diabetic peripheral neuropathy in type 2 diabetes with well-controlled HbA1c. *Diabetol Metab Syndr*, 2014; 6(1): 139.
18. Green AQ, Krishnan S, Finucane FM, Rayman G. Altered C-fiber function as an indicator of early peripheral neuropathy in individuals with impaired glucose tolerance. *Diabetes Care*, 2010; 33(1): 174–176.
19. Malik RA, Veves A, Walker D, Siddique I, Lye RH, Schady W, et al. Sural nerve fibre pathology in diabetic patients with mild neuropathy: relationship to pain, quantitative sensory testing and peripheral nerve electrophysiology. *Acta Neuropathol*, 2001; 101(4): 367–374.

20. Llewelyn GJ. The diabetic neuropathies: types, diagnosis and management. *J Neurol Neurosurg Psychiatry*, 2003; 74(2): 15–19.
21. Vinik A, Casellini C, Nevoret LM. Diabetic Neuropathies. 2018, Endotext [Internet]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. South Dartmouth (MA).
22. Feldman LE, Callaghan CB, Pop-Busui R, Zochodne WD, Wright ED, Bennett LD, Bril V, Russell WJ and Viswanathan V. Diabetic neuropathy. Nature Reviews | DiSeASePrimerS | Article citation ID, 2019; 5: 41. 1–18.
23. Koca TT. Concomitance of diabetic neuropathic amyotrophy and cachexia: a case report with review of the literature. *North Clin Istanb*, 2015; 2(2): 165–170.
24. Dixit P.P., Londhe J.S., Ghaskadbi S.S., Devasagayam T.P.A. In: *Antidiabetic and related beneficial properties of Indian medicinal plants, in Herbal Drug Research- A twenty first century perspective.* Sharma R.K., Arora R., editors. Jaypee brothers medical publishers (New Delhi, India) Limited, 2006; 377–386.
25. Kaleem M., Asif M., Ahmed Q.U., Bano B. Antidiabetic and antioxidant activity of *Annona squamosa* extract in streptozotocin-induced diabetic rats. *Singapore Med. J.*, 2006; 47: 670–675.
26. Gupta R.K., Kesari A.N., Murthy P.S., Chandra R., Tandon V., Watal G. Hypoglycemic and antidiabetic effect of ethanolic extract of leaves of *Annona squamosa* L. in experimental animals. *J. Ethnopharmacol*, 2005; 99: 75–81.
27. Gupta R.K., Kesari A.N., Watal G., Murthy P.S., Chandra R., Tandon V. Nutritional and hypoglycemic effect of fruit pulp of *Annona squamosa* in normal healthy and alloxan-induced diabetic rabbits. *Ann. Nutr. Metab*, 2005; 49: 407–413.
28. Subramonium A., Pushpangadan P., Rajasekharan A., Evans D.A., Latha P.G., Valsaraj R. Effects of *Artemisia pallens* Wall. On blood glucose levels in normal and alloxan-induced diabetic rats. *J. Ethnopharmacol*, 1996; 50: 13–17.
29. Chempakam B. Hypoglycemic activity of arecoline in betel nut *Areca catechu* L. *Ind. J. Exp. Biol.*, 1993; 31: 474–475.
30. Yoshikawa M., Murakami T., Kadoya M., Matsuda H., Muraoka O., Yamahara J., Murakami N. Medicinal foodstuff. III. Sugar beet. Hypoglycemic oleanolic acid oligoglycosides, betavulgarosides I, II, III and IV, from the root of *Beta vulgaris* L. *Chemical and Pharmaceutical Bulletin*, 1996; 44: 1212–1217.
31. Pari L., Amarnath Satheesh M. Antidiabetic activity of *Boerhavia diffusa* L. effect on hepatic key enzymes in experimental diabetes. *J. Ethnopharmacol*, 2004; 91: 109–113.
32. Satheesh M.A., Pari L. Antioxidant effect of *Boerhavia diffusa* L. in tissues of alloxan induced diabetic rats. *Indian J. Exp. Biol.*, 2004; 42: 989–992.
33. Pari L., Amarnath Satheesh M. Antidiabetic effect of Boerhavia diffusa: effect on serum and tissue lipids in experimental diabetes. *J. Med. Food*, 2004; 7: 472–476.
34. Saleem R., Ahmad M., Hussain S.A., Qazi A.M., Ahmad S.I., Qazi H.M., Ali M., Faizi S., Akhtar S., Hussain S.N. Hypotensive, hypoglycemic and toxicological studies on the flavonol C-glycoside shamimin from *Bombax ceiba*. *Planta Medica*, 1999; 5: 331–334.
35. Somani R., Kasture S., Singhai A.K. Antidiabetic potential of *Butea monosperma* in rats. *Fitoterapia*, 2006; 77: 86–90.
36. Gomes A., Vedasiromoni J.R., Das M., Sharma R.M., Ganguly D.K. Antihyperglycemic effect of black tea (*Camellia sinensis*) in rats. *J. Ethnopharmacol*, 1995; 45: 223–226.
37. Devasagayam T.P.A., Kamat J.P., Mohan H., Kesavan P.C. Caffeine as an antioxidant: Inhibition of lipid peroxidation induced by reactive oxygen species in rat liver microsomes. *Biochim. Biophys. Acta*, 1996; 1282: 63–70.
38. Chakrabarti S., Biswas T.K., Seal T., Rokeya B., Ali L., Azad Khan A.K., Nahar N., Mosihuzzaman M., Mukherjee B. Antidiabetic activity of *Caesalpinia bonducella* F. in chronic type 2 diabetic model in Long-Evans rats and evaluation of insulin secretagogue property of its fractions on isolated islets. *J. Ethnopharmacol*, 2005; 97: 117–122.
39. Bhattacharya A., Chatterjee A., Ghosal S., Bhattacharya S.K. Antioxidant activity of active tannoid principles of *Emblica officinalis* (amla) *Indian J. Exp. Biol.*, 1999; 37: 676–680.
40. Kumar K.C.S., Muller K. Medicinal plants from Nepal, II. Evaluation as inhibitors of lipid peroxidation in biological membranes. *J. Ethnopharmacol*, 1999; 64: 135–139.
41. Devasagayam T.P.A., Subramanian M., Singh B.B., Ramanathan R., Das N.P. Protection of plasmid pBR322 DNA by flavonoids against single-strand breaks induced by singlet molecular oxygen. *J. Photochem. Photobiol*, 1995; 30: 97–103.
42. Arai I., Amagaya S., Komatzu Y., Okada M., Hayashi T., Kasai M., Arisawa M., Momose Y. Improving effects of the extracts from *Eugenia uniflora* on hyperglycemia and hypertriglyceridemia in mice. *J. Ethnopharmacol*, 1999; 68: 307–314.
43. Maroo J., Vasu V.T., Gupta S. Dose dependent hypoglycemic effect of aqueous extract of *Enicostema littorale blume* in alloxan induced diabetic rats. *Phytomedicine*, 2003; 10: 196–199.
44. Vijayvargia R., Kumar M., Gupta S. Hypoglycemic effect of aqueous extract of *Enicostema littorale Blume* (chhota chirayata) on alloxan induced diabetes mellitus in rats. *Indian J. Exp. Biol.*, 2000; 38: 781–784.

45. Augusti K.T., Daniel R.S., Cherian S., Sheela C.G., Nair C.R. Effect of Leucoperalgonin derivative from *Ficus bengalensis* Linn. on diabetic dogs. *Indian J. Med. Res.*, 1994; 99: 82–86.
46. Chattopadhyay R.R. A comparative evaluation of some blood sugar lowering agents of plant origin. *J. Ethnopharmacol*, 1999; 67: 367–372.
47. Preuss H.G., Jarrell S.T., Scheckenbach R., Lieberman S., Anderson R.A. Comparative effects of chromium, vanadium and *Gymnema sylvestre* on sugar-induced blood pressure elevations in SHR. *J. Am. Coll. Nutr.*, 1998; 17: 116–123.
48. Alam M.I., Gomes A. Viper venom-induced inflammation and inhibition of free radical formation by pure compound (2-hydroxy-4-methoxy benzoic acid) isolated and purified from anantamul (*Hemidesmus indicus* R. BR) root extract. *Toxicon*, 1998; 36: 207–215.
49. Sachadeva A., Khemani L.D. A preliminary investigation of the possible hypoglycemic activity of *Hibiscus rosa-sinensis*. *Biomed. Environ. Sci.*, 1999; 12: 222–226.
50. Kusano S., Abe H. Antidiabetic activity of whites skinned potato (Ipomoea batatas) in obese Zucker fatty rats. *Biolog. Pharmaceut. Bull.*, 2000; 23: 23–26.
51. Nagaraju N. *Biochemical studies on some medicinal plants of Rayalaseema region.* PhD thesis. S.V. University; Tirupathi, 1992.
52. Rao B.K., Kessavulu M.M., Giri R., Apparao C. Antidiabetic and hypolipidemic effects of *Momordica cymbalaria* Hook fruit powder in alloxan-diabetic rats. *J. Ethnopharmacol*, 1999; 67: 103–109.
53. Khan B.A., Abraham A., Leelamma S. Hypoglycemic action of *Murraya koenigii* (curry leaf) and *Brassica juncea* (mustard) mechanism of action. *Ind. J. Biochem. Biophys*, 1995; 32: 106–108.
54. Dhanabal S.P., Sureshkumar M., Ramanathan M., Suresh B. Hypoglycemic effect of ethanolic extract of *Musa sapientum* on alloxan induced diabetes mellitus in rats and its relation with antioxidant potential. *J. Herb. Pharmacother,* 2005; 5: 7–19.
55. Pari L., Umamaheswari J. Antihyperglycaemic activity of *Musa sapientum* flowers: effect on lipid peroxidation in alloxan diabetic rats. *Phytother. Res.*, 2000; 14: 136–138.
56. Pari L., Maheswari J.U. Hypoglycemic effect of *Musa sapientum* L. in alloxan-induced diabetic rats. *J. Ethnopharmacol*, 1999; 68: 321–325.
57. Tormo M.A., Gil-Exojo I., Romero de Tejada A., Campillo J.E. Hypoglycemic and anorexigenic activities of an alpha-amylase inhibitor from white kidney beans (*Phaseolus vulgaris*) in Wistar rats. *Br. J. Nutr.*, 2004; 92: 785–790.
58. Pari L., Venkateswaran S. Protective role of *Phaseolus vulgaris* on changes in the fatty acid composition in experimental diabetes. *J. Med. Food.*, 2004; 7: 204–209.
59. Knott R.M., Grant G., Bardocz S., Pusztai A., de Carvalho., Hesketh J.E. Alterations in the level of insulin receptor and GLUT-4 mRNA in skeletal muscle from rats fed a kidney bean (*Phaseolus vulgaris*) diet. *Int. J. Biochem*, 1992; 24: 897–902.
60. Jafri M.A., Aslam M., Javed K., Singh S. Effect of *Punica granatum Linn.* (flowers) on blood glucose level in normal and alloxan induced diabetic rats. *J. Ethnopharmacol*, 2000; 70: 309–314.
61. Yoshikawa M., Murakami T., Yashiro K., Matsuda H. Kotalanol, a potent α-glucosidase inhibitor with thiosugar sulfonium sulphate structure, from antidiabetic Ayurvedic medicine *Salacia reticulata*. *Chem Pharma. Bulletin.* 1998;46: 1339–1340.
62. Pari L., Latha M. Antidiabetic effect of *Scoparia dulcis*: effect on lipid peroxidation in streptozotocin diabetes. *Gen. Physiol. Biophys*, 2005; 24: 13–26.
63. Pari L., Latha M. Antihyperlipidemic effect of *Scoparia dulcis* (sweet broomweed) in streptozotocin diabetic rats. *J. Med. Food.*, 2006; 9: 102–107.
64. Latha M., Pari L., Sitasawad S., Bhonde R. Insulin-secretagogue activity and cytoprotective role of the traditional antidiabetic plant *Scoparia dulcis* (Sweet Broomweed) *Life Sci.*, 2004; 75: 2003–2014.
65. Saxena A.M., Bajpai M.B., Murthy P.S., Mukherjee S.K. Mechanism of blood sugar lowering by a Swerchirin-containing hexane fraction (SWI) of *Swertia chirayita*. *Ind. J. Exp. Biol.*, 1993; 31: 178–181.
66. Rao B.K., Rao C.H. Hypoglycemic and antihyperglycemic activity of *Syzygium alternifolium* (Wt.) Walp. seed extracts in normal and diabetic rats. *Phytomedicine*, 2001; 8: 88–93.
67. Sabu M.C., Kuttan R. Antidiabetic activity of medicinal plants and its relationship with their antioxidant property. *J. Ethnopharmacol*, 2002; 81: 155–160.
68. Noor H., Ashcroft S.J. Pharmacological characterization of the anti-hyperglycemic properties of *Tinospora crispa* extract. *J. Ethnopharmacol*, 1998; 62: 7–13.
69. Chattopadhyay S.R., Sarkar S.K., Ganguly S., Banerjee R.N., Basu T.K. Hypoglycemic and anti-hyperglycemic effect of *Vinca rosea Linn*. *Ind. J. Physiol. Pharmacol*, 1991; 35: 145–151.
70. Adallu B., Radhika B. Hypoglycemic, diuretic and hypocholesterolemic effect of winter cherry (*Withania somnifera, Dunal*) root. *Indian J. Exp. Biol.*, 2000; 38: 607–609.
71. Dasgupta A. Chapter 4 - antiinflammatory herbal supplements. Translational inflammation. Perspectives in translational cell biology, 2019; 69–91.
72. Krup V, Hedge Prakash L, Harini A. Pharmacological activities of turmeric (*Curcuma longa*linn): a review. *J Homeop Ayurv Med.*, 2013; 2(4).

73. Ahmad RS, et al. Biochemistry, safety, pharmacological activities, and clinical applications of turmeric: a mechanistic review. *Evid Based Complement Alternat Med*., 2020.
74. Seo KI, Choi MS, Jung UJ, et al. Effect of curcumin supplementation on blood glucose, plasma insulin, and glucose homeostasis related enzyme activities in diabetic db/db mice. *Mol Nutr Food Res.* 2008;52: 995–1004.
75. Jang EM, Choi MS, Jung UJ, et al. Beneficial effect of curcumin on hyperlipidaemia and insulin resistance in high-fat-fed hamsters. *Metabolism.* 2008;57: 1576–1583.
76. Sharma S, Kulkarni SK, Agrewala JN, Chopra K. Curcumin attenuates thermal hyperalgesia in a diabetic mouse model of neuropathic pain. *Eur J of Pharmacol*, 2006; 536(3): 256–261.
77. Kulkarni SK, Dhir A. An overview of curcumin in neurological disorders. *Indian J Pharm Sci.,* 2010; 72(2): 149–154.
78. White MC, Pasupuleti V, Roman MY, Li Y, Hernandez VA. Oral turmeric/curcumin effects on inflammatory markers in chronic inflammatory diseases: a systematic review and meta-analysis of randomized controlled trials. *Pharmacol Res.,* 2019; 146: 104280.
79. Adab Z, et al. Effect of turmeric on glycemic status, lipid profile, hs-CRP, and total antioxidant capacity in hyperlipidemic type 2 diabetes mellitus patients. *Phytother Res.,* 2019; 33(4): 1173–1181.
80. Singletary K. Turmeric: potential health benefits. *Nutr Today,* 2020; 55(1): 45–56.
81. Sasaki K, Wada K, Haga M. Chemistry and biological activities of Ginkgo Biloba. Stud Nat Prod Chem., 2003; 28(Part I): 165–198.
82. Numan A, Masud F, Khawaja IK, Khan FF, Qureshi BA, Burney S, Ashraf K, Ahmad N, Yousaf SM, Rabbani I, Zaneb H, Rehman H. Clinical and electrophysiological efficacy of leaf extract of *Gingko biloba* L (Ginkgoaceae) in subjects with diabetic sensorimotor polyneuropathy. *Trop J Pharm Res.,* 2016; 15(10): 2137–2145.
83. Sebbagh N, Cruciani-Guglielmacci C, Ouali F, Berthault MF, Rouch C, Sari DC, et al. Comparative effects of *Citrullus colocynthis*, sunflower and olive oil-enriched diet in streptozotocin-induced diabetes in rats. *Diabetes Metab*, 2009; 35(3): 178–184.
84. Al-Snafi EA. Chemical constituents and phar macological effects of Citrullus. *IOSR J Pharm.*, 2016; 6(3): 57–67.
85. Bansal D, Badhan Y, Gudala K, Schifano F. Ruboxistaurin for the treatment of diabetic peripheral neuropathy: a systematic review of randomized clinical trials. *Diabetes Metab J.*, 2013; 37(5): 375–384.
86. Oryan A, Hashemnia M, Hamidi RA, Mohammadalipour A. Effects of hydro-ethanol extract of *Citrullus colocynthis* on blood glucose levels and pathology of organs in alloxan-induced diabetic rats. *Asian Pac J Trop Dis.,* 2014; 4(2): 125–130.
87. Mojtaba H, Kaynoosh H, Hashem MH, Mesbah S. Topical Citrullus colocynthis (bitter apple) extract oil in painful diabetic neuropathy: a double-blind randomized placebo-controlled clinical trial† *J Diabetes*, 2016; 8(2): 246–252.
88. Cohen MM. Tulsi - *Ocimum sanctum*: A herb for all reasons. *J Ayurveda Integr Med.* 2014;5(4):251–259.
89. Upadhyay KR. Tulsi: a holy plant with high medicinal and therapeutic value. *Int J Green Pharm.,* 2017; 11(1):S1–S12.
90. Singh N, Hoette Y, Miller R. *Tulsi: the mother medicine of nature.* 2. Lucknow: International Institute of Herbal Medicine, 2010; 28–47.
91. Pandey G, Sharma M. Pharmacological activities of Ocimum sanctum (Tulsi): a review. *Int J Pharm Sci Rev Res.*, 2010; 5(1): 61–66.
92. Kaur G, Bali A, Singh N, Jaggi SA. Ameliorative potential of *Ocimum sanctum* in chronic constriction injury-induced neuropathic pain in rats. *An Acad Bras Cienc*, 2015; 87(1): 417–29.
93. Kumar S, Manjunath, Prem Kumar N. Preventive and curative effect of METHANOLIC leaves extract of *Ocimum sanctum* with metformin in diabetes induced neuropathy in rats. 3rd World Congress on Diabetes & Metabolism, 2012.
94. Obolskiy D, Pischel I, Feistel B, Glotov N, Heinrich M. *Artemisia dracunculus* L. (tarragon): a critical review of its traditional use, chemical composition, pharmacology and safety. *J Agric Food Chem.*, 2011; 59(21): 11367–11384.
95. Watcho P, Stavniichuk R, Ribnicky DM, Ilya R, Obrosova IG. High-fat diet induced neuropathy of prediabetes and obesity: effect of pmi-5011, an ethanolic extract of *Artemiesiadracunculus* L. *Mediators Inflamm*, 2010.
96. Watcho P, Stavniichuk R, Tane P, Shevalye H, Maksimchyk Y, Pacher P, Obrosova IG. Evaluation of PMI-5011, an ethanolic extract of *Artemisia dracunculus* L., on peripheral neuropathy in streptozotocin-diabetic mice. *Int J Mol Me.*, 2011; 27(3): 299–307.
97. Kanter M. Effects of Nigella sativa and its major constituent 21. thymoquinone on sciatic nerves in experimental diabetic neuropath. *Neurochem Res.*, 2008; 33: 87–96.
98. Kaur S, Pandhi P, Dutta P. Painful diabetic neuropathy: an update. *Ann Neurosci*, 2011; 18(4): 168–175.
99. Salehi B, Ata A, V Anil Kumar N, Sharopov F, Ramírez-Alarcón K, Ruiz-Ortega A, Abdulmajid Ayatollahi S, Valere Tsouh Fokou P, Kobarfard F, Amiruddin Zakaria Z, Iriti M. Antidiabetic potential of medicinal plants and their active components. Biomolecules, 2019; 9(10): 551.
100. Karimi A, Majlesi M, Rafieian-Kopaei M. Herbal versus synthetic drugs; beliefs and facts. *J Nephropharmacol*, 2015; 4(1): 27–30

101. Oyenihi AB, Ayeleso AO, Mukwevho E, Masola B. Antioxidant strategies in the management of diabetic neuropathy. *Biomed Res Int.*, 2015; 2015.
102. Choudhury H, Pandey M, Hua CK, Mun CS, Jing JK, Kong L, Ern LY, Ashraf NA, Kit SW, Yee TS, Pichika MR. An update on natural compounds in the remedy of diabetes mellitus: a systematic review. *J Tradit Complement Med*, 2018; 8(3): 361–376.
103. Chen LS, Yu H, Luo MH, Wu Q, Li FC, Steinmetz A. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chin Med.*, 2016; 11: 37.
104. Quality control of herbal medicines and associated fields: Eldin BIA. Rijeka: InTech, 2011 EdnTrdine, Janeza, 2011; Janeza Trdine. 105. AltCareDex intranet database System. Version 5.1. Thomson Healthcare, Greenwood Village.