International Journal for Pharmaceutical Research Scholars (IJPRS)

V-6, I-2, 2017 ISSN No: 2277 - 7873

RESEARCH ARTICLE

An Ethnobotanical Survey of Three Potent Natural Antihyperglycaemic Drugs

Shabeena P.R.*[1], Gowtham M.[1]

[1]Department of Pharmaceutics, Rajiv Gandhi Institute of Pharmacy, Meeliyat, Trikaripur, Kasargod district, Kerala, India - 671310

Manuscript No: IJPRS/V6/I2/00055, Received On: 07/06/2017, Accepted On: 16/06/2017

ABSTRACT

Diabetes mellitus is a chronic disease found in all parts of the world and is becoming a serious threat to humanity. Herbal medicines have been a highly esteemed source of medicine throughout the human history. The medicinal plants play a significant role in the health care management and different clinical problems in developing countries and developed countries as well. It has been proved that the medicinal plants are the main sources of chemical substances with potential therapeutical and pharmacological effects for treatment of many diseases. An alternative to synthetic agents, plants acts as a potential source of hypoglycemic drugs and are widely used to prevent diabetes. Various Phyto-compounds were characterized from plants which are now employed in the treatment of many diseases like diabetes either in single or as combination formulations. The allopathic system of medicine has certain side effects. Hence, turning to safe, effective Ayurvedic herbal formulation would be a preferable option. So there is a need to investigate antidiabetic herbal drugs for the better patient acceptance. Considering these facts the present review aims to reveal the up to date literature on recent ethnomedicinal uses with phytochemical review of three different medicinal plants, i.e., Trigonella foenum-graecum Linn, Salacia reticulata Wight, Pterocarpus marsupium Roxb which are commonly used for treatment of diabetes and these herbs have been selected on the basis of traditional system and scientific justification with modern methods.

KEYWORDS

Diabetes mellitus, Herbal drugs, Phytochemicals, Trigonella foenum-graecum Linn, Salacia reticulata Wight, Pterocarpus marsupium Roxb

INTRODUCTION

Diabetes mellitus (DM) commonly referred to as diabetes is a group of metabolic disorder in which is characterized by high blood sugar levels over a prolonged period. Diabetes is characterized by pancreatic beta cell dysfunction and insulin resistance in the liver and peripheral tissues1.

***Address for Correspondence:**
Shabeena P.R.,
Department of Pharmaceutics, Rajiv Gandhi Institute of Pharmacy, Meeliyat, Trikaripur, Kasargod district, Kerala, India – 671310.
E mail ID: ijprs.publication@gmail.com

The free radicals have been incriminated in the pathogenesis of membrane damage in diabetes. Therefore, this membrane damage has been linked to the generation the cascade process resulting in the cellular death of tissues. In diabetes, there is an increase in production of free radicals which affect the antioxidants reactions catalyzed by scavenging enzyme. There is evidence that β cell dysfunction results from prolonged exposure to high glucose, elevated free fatty acids level or a combination of both. A plant-based diet protects against chronic oxidative stress-related diseases2.

Though different types of oral hypoglycemic agents are available along with insulin for the

treatment of diabetes, there is increased demand by patients to use the natural products with anti-diabetic activity due to the side effect and adverse effect of allopathic medicines like hypoglycaemia, nausea, vomiting, hyponatremia, flatulence, diarrhoea or constipation, headache, weight gain, lactic acidosis, pernicious anaemia, dyspepsia etc3. Due to these features, plant drugs are being used on larger scale nowadays for the treatment of diabetes and also as an antioxidant. Despite the presence of known herbal antidiabetic medicine in the pharmaceutical market, diabetes and the related complications continued to be a significant medical problem4.

The focus of this review is to provide information on the Phytochemicals, Ethnomedicinal uses and Pharmacological activities of three medicinal plants(Trigonella foenum-graecum Linn, Salacia reticulata Wight, Pterocarpus marsupium Roxb)commonly used in Indian traditional medicine for the treatment of diabetes mellitus.

TRIGONELLA FOENUM-GRAECUM LINN

Fenugreek (Trigonella foenum-graecum)(fig.1) is an annual plant in the family Fabaceae, with leaves consisting of three small obovate to oblong leaflets. These seeds have shown potential as a dietary supplement and cause a marked decrease in the symptoms of DM such as polydipsia, polyuria, urine sugar, renal hypertrophy and glomerular filtration rate5.

These seeds are one of the oldest cultivated medicinal plants identified in written history, and many studies showed that the seeds acquire anti-oxidant properties in seeds and leaves of fenugreek. Taxonomists such as Linnaeus noted that 18 species of Trigonella are currently in a total of 260 species. These seeds have different pharmacological attributes such as a hypoglycemic, hypercholesterolemia, gastro protective, chemo-preventive, an anti-oxidant, and laxative and appetite stimulation[6].

Fig.1 Trigonella foenum-graecum Linn plants and seeds

TABLE 1:TAXONOMICAL CLASSIFICATION OF TRIGONELLA FOENUM-GRAECUM LINN[7].

Kingdom	Plantae
Subkingdom	Viridiplantae
Infra Kingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Sub division	Spermatophytina
Class	Magnoliopsida

Super order	Rosanae
Order	Fabales
Family	Fabaceae
Sub family	Faboideae
Tribe	Trifolieae
Genus	Trigonella
Species	*Trigonella foenum-graecum*

TABLE 2 : VERNACULAR NAMES OF *TRIGONELLA FOENUM-GRAECUM* LINN[8]

LANGUAGE	COMMON NAMES
Sanskrit	Methika, Chandrika
English	Fenugreek, Bird foot, Greek hayseed
Malayalam	Uluva, Ventiyam, Vendiyam
Kannada	Menthya
Tamil	Ventayam, Meti
Telugu	Menthulu
Hindi	Methi, Sag methi, Kasuri methi
Assamese	Methi
Punjabi	Metha, Shamli,
	Methi, Methini
Marathi	Methi
Bengali	Methis, Methi-shak, Methuka
Gujarati	Methi, Methini, Bhaji
Urdu	Methi
Kashmiri	Meth

TABLE 3 : ORGANOLEPTIC CHARACTERS OF TRIGONELLA FOENUM-GRAECUM LINN.

Taste	Slightly bitter, Mucilaginous
Odour	Characteristic spicy
Colour	Caramel to light brownish-yellow
Texture	Slippery, Thick mouth feel

ETHNOMEDICINAL REVIEW

Good for fever treatment, vomiting, anorexia, cough, bronchitis, Hypercholesterolemia. They are used for boils & ulcers. Seed extract possesses antibacterial property, Antidiabetic activity, Immunomodulatory and anti-toxin activity, Anti-cataract activity, Anti-oxidant activity. It is gastroprotective, chemopreventive, laxative, appetite stimulant, Anti-atherogenic. The seeds are important in keeping a healthy digestive system; thus the continued and daily use of this spice may increase the digestibility of eating food, which may further promote the good absorbing capacity of food constituents in blood for best metabolic utilization in the body cells. It has

restorative and nutritive properties. The daily use of these seeds as the dietary supplement might help to cure anemia and have a good healthy life for longer duration in females of child bearing age. The seeds are hot, with a sharp bitter taste; tonic, antipyretic, anthelmintic, increase the appetite, astringent to the bowels, cure leprosy, " vata", vomiting, bronchitis, piles; remove bad taste from the mouth, useful in heart disease. The plant and seeds are hot and dry, suppurative, aperient, diuretic, emmenagogue, useful in dropsy, chronic cough, enlargement of the liver and the spleen. Fenugreek seeds are considered carminative, tonic and aphrodisiac[9].

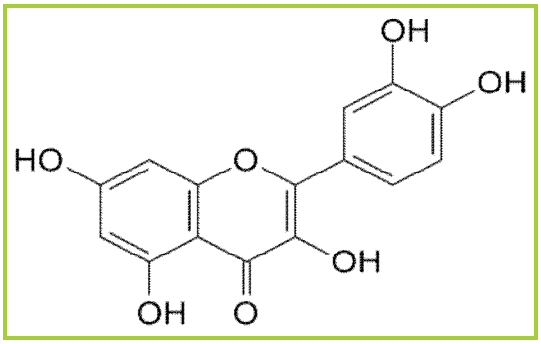
PHYTOCHEMICAL REVIEW

Fenugreek seeds mainly contain Scopoletin, Quercetin, Trigonelline, Fenugreekine, Nicotinic acid, 4-hydroxyisoleucine (4-HI), Galactomannan with Flavonoids, Carotenoids, Coumarins, Proteins, Saponins, and Lipids. The biological and Pharmacological effects of fenugreek have related to the variety of its components namely, Steroids, N-compounds, Polyphenolic substances, Volatile constituents, and Amino acids, etc. Fenugreek 45-60%, (Galactomannans), 20-30% proteins high in lysine ,Tryptophan, 5-10% (lipids), Pyridine alkaloids, Trigonelline (0.2-0.38%), Choline (0.5%), Carpaine, Gentianine, Flavonoids Luteolin, Apigenin, Quercetin, Orientin, Isovitexin Vitexin, Histidine, Arginine, Lysine, Calcium, Saponins, Glycosides, steroidal sapogenins, Yamogenin, Diosgenin, Neotigogenin,Tigogenin, Sitosterol, Cholesterol, Vitamin A, B1, C. It contains a number of chemical constituents including Steroidal sapogenins. Diosgenin component has been found in the oily embryo of fenugreek. There are two furastanol glycosides, F-ring opened precursors of diosgenin that have been reported in fenugreek also as hederagenin glycosides. Alkaloids such as Trigo-coumarin, nicotinic acid, trimethyl coumarin and trigonelline are present in the stem. The mucilage is a standing out constituent of the seeds. There is about 28% mucilage; a volatile oil; 2 alkaloids such as trigonelline and Choline, 5% of a stronger-smelling, bitter fixed oil, 22% proteins and a yellow coloring substance are present in the stem. Fenugreek contains 23–26% protein, 6–7% fat and 58% carbohydrates of which about 25% is dietary fiber. Fenugreek is also a rich source of iron, containing 33 mg/100 g dry weight. The seeds of fenugreek contain about 0.1–0.9% of diosgenin and are extracted commercially. The plant tissue cultures from seeds of fenugreek when grown under optimal conditions have been found to produce as much as 2% diosgenin with smaller amounts of trigogenin and gitongenin. Seeds also contain the saponin (fenugrin B). Fenugreek seeds have been found to contain several coumarin compounds as well as a number of alkaloids (e.g., trigonelline, gentianine, carpaine). A significant amount of trigonelline is degraded to nicotinic acid and related pyridines during roasting. The primary bioactive compounds in fenugreek seeds are believed to be polyphenol compounds, such as rhaponticin and isovitexin. A few volatile oils and fixed oil has been found in fenugreek seeds[10].

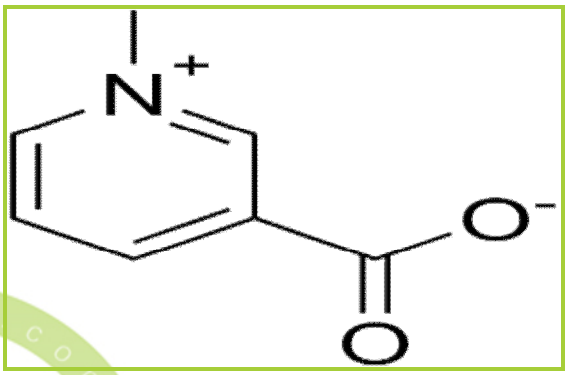
CHEMICAL CONSTITUENTS OF FENUGREEK

Alkaloids	Trimethylamine, Neurin, Trigonelline, Choline, Gentianine, Carpaine and Betain.
Amino acids	Isoleucine, 4-Hydroxyisoleucine, Histidine, Leucine, lysine, L-tryptophan, Arginine.
Saponins	Graecunins, fenugrin B, fenugreekine, trigofoenosides A–G
Steroidal sapinogens	Yamogenin, diosgenin, smilagenin, sarsasapogenin,

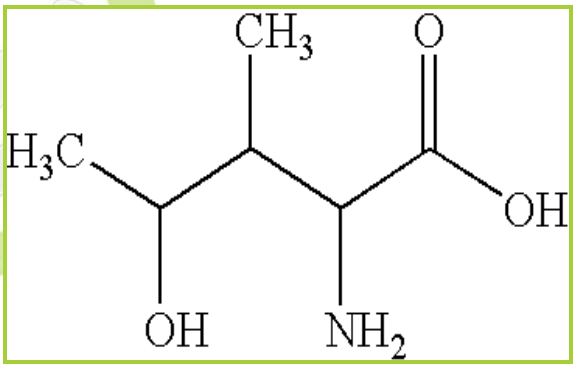
	tigogenin, neotigogenin, gitogenin, neogitogenin, yuccagenin, saponaretin.
Flavonoids	Quercetin, rutin, vitexin, isovitexin
Fibers	Gum, neutral detergent fiber.
Lipids	Triacylglycerols, diacylglycerols, monoacylglycerols, phosphatidylcholine phosphatidylethanolamine, phosphatidylinositol, free fatty acids.
Other	Coumarin, lipids, vitamins, minerals. 28% mucilage; 22% proteins; 5% of a stronger-swelling, bitter fixed oil.



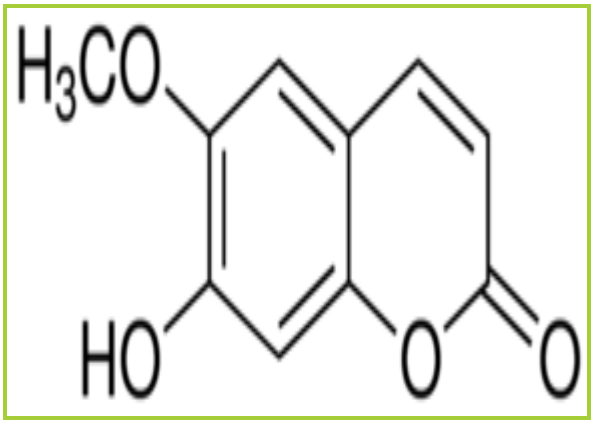
Quercetin



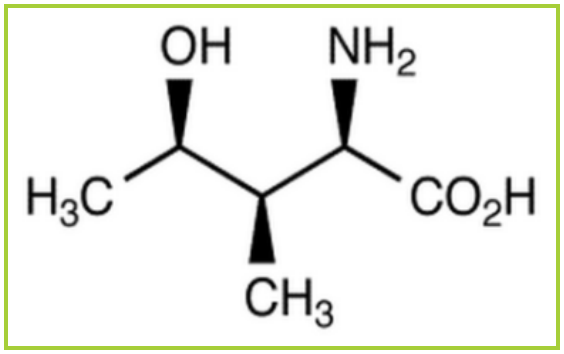
Trigonelline



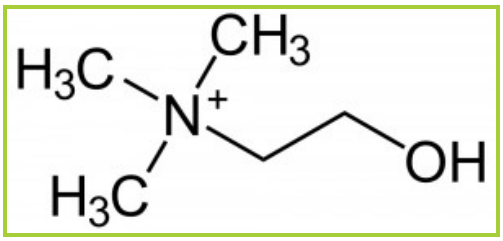
Fenugreekine



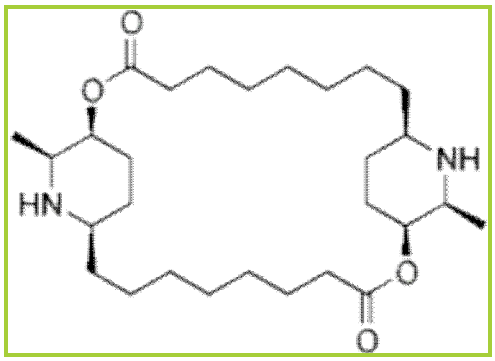
Scopoletin



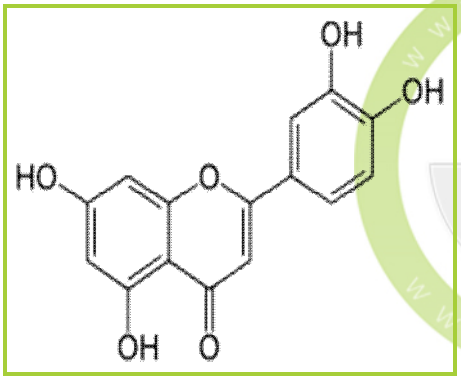
4-hydroxy isoleucine



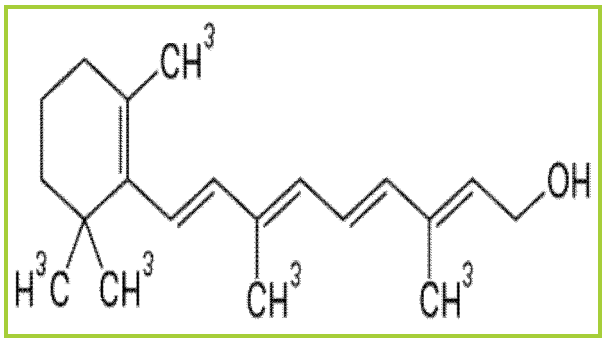
Choline



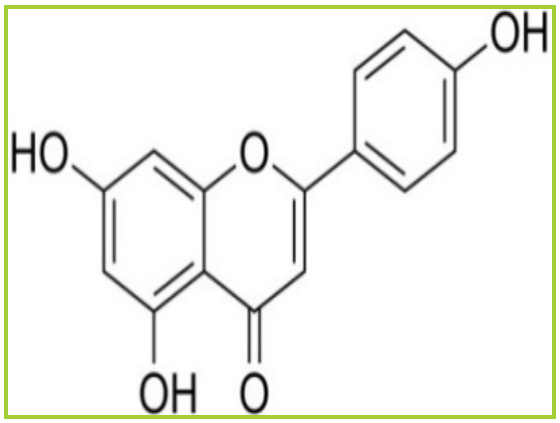
Carpaine



Luteolin



Vitamin A



Apigenin

SALACIA RETICULATA WIGHT

It consists of dried roots of Salacia reticulata(fig.2) belongs to the family Celastraceae/Hippocrateaceae. Salacia reticulata is a large, woody climber found in the rain forests of Sri Lanka and parts of western India11. The roots are acrid, bitter, Thermogenic, urinary astringent, anodyne, anti-inflammatory, depurative, vulnerary, liver tonic and stomachic. Its principal use in traditional medicine is the treatment of diabetes. It was believed to be so potent that patients were told to simply drink water left to sit overnight in a cup made from the wood of the plant12. The hard root of this plant is typically used in the extraction part. It is distinct from the yellow outer layer. Salacia reticulata contains Salaretin and mangiferin which reduces the sugar level and protect the body from any secondary side effect of Diabetes. Salacia reticulata has been reported to possess potent anti-diabetic activity in animal models. Also, other mechanisms such as increased insulin sensitivity, aldose reductase inhibition, etc., are also exhibited by components of Salacia reticulata. The plant is also reported to possess anti-obesity, hypolipidemic, hepatoprotective and antioxidant properties13.

The genus Salacia consists of 407 species and is widely distributed in Sri Lanka, India, China, Vietnam, Indonesia, Brasil and other Asian

TABLE : 4 PHARMACOLOGICAL REVIEW

PHARMACOLOGICAL ACTIVITY	PLANT PARTS USED	EXTRACT USED	SCREENING MODELS	REFERENCE
Antidiabetic activity	Seed	Ethanol: water (70:30)	Normal and streptozotocin induced diabetic animal	Chetan P Kulkarni *et al*.,(2012)
Antioxidant activity	Seed	Ethanolic extract	DPPH Scavenging & Ferric reducing antioxidant power(FRAP) methods	Syeda birjees bukhari *et al*.,(2008)
Antihyperlipidaemic activity	Seed	Ethanolic extract	Normal rat & High cholesterol rat	Amish j Patel (2011)
Antibacterial activity	Leaves	Ethanolic extract	Minimum inhibitory concentration	Ramya premanath (2011)
Immunomodulatory activity	Whole plant	Methanolic extract	Delayed type hypersensitivity	Sneha j anarthe (2014)

countries. Out of 407 Salacia species, Salacia reticulata (Celastraceae) has been identified as the most potent species for treating diabetes. Its pharmacological properties including blood glucose-lowering activity, inhibition of adipocyte differentiation, suppression of the accumulation of visceral fat and metabolic disease prevention and suppression of fat accumulation have been scientifically validated. Further, the oral hypoglycemic activity, anti-rheumatic properties, curing of skin related ailments, hypoglycemic effects of Salacia reticulata extract has been investigating14.

Fig.2 *Salacia reticulata* Wight tree and roots

***TABLE 5: TAXONOMICAL CLASSIFICATION OF* SALACIA RETICULATA *WIGHT*[15]**

Super Kingdom	Eukaryota
Kingdom	Plantae
Sub Kingdom	Viridiplantae
Infra Kingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Sub division	Spermatophyta
Class	Magnoliophyta
Sub class	Rosids
Super order	Fabids
Order	Celastrales
Family	Celastraceae
Genus	Salacia
Species	*S.reticulata*

***TABLE 6: VERNACULAR NAMES OF* SALACIA RETICULATA *WIGHT*[16]**

LANGUAGES	COMMON NAMES
Sanskrit	Pitika
Malayalam	Ekanayakam, Ponkoranti
English	Salaretin
Tamil	Ponkoranti, Koranti
Telugu	Anukudu cettu
Kannada	Ekanayakam

TABLE 7: ORGANOLEPTIC CHARACTERS OF* SALACIA RETICULATA *WIGHT

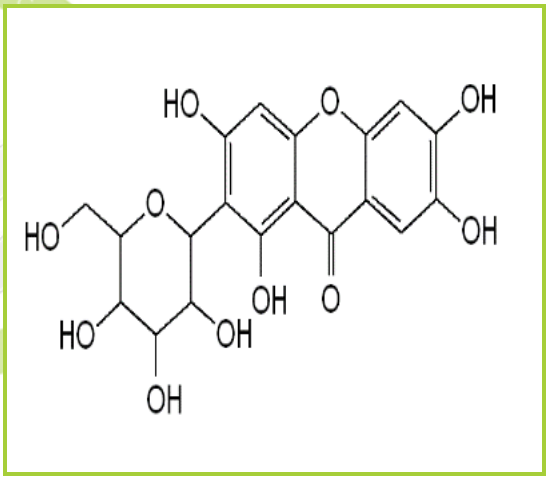
Taste	Sweet, Bitter, Acrid, Mucilaginous, Pleasant aromatic taste
Odour	Characteristic, Aromatic
Colour	Outer part of the root is straw yellow color Inner part of the root is brown color
Texture	Curved or irregularly channeled roots

ETHNO MEDICINAL REVIEW

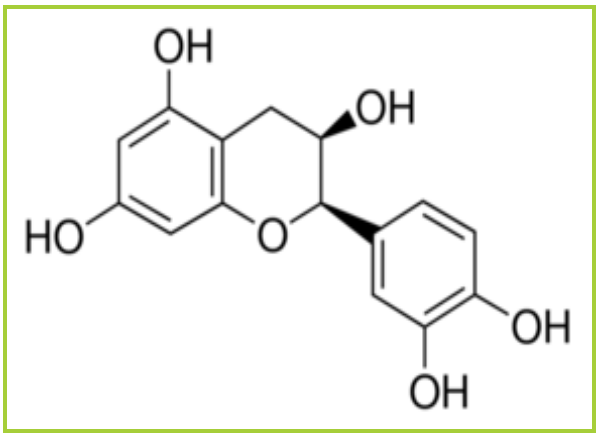
It is used in the treatment of hemorrhoids, inflammations, leprosy, skin disease, dysmenorrhea, wounds, ulcers, flatulence. Roots are used for the treatment of diabetes, bleeding piles, gonorrhea, leucorrhoea, indigestion, colic, and spermatorrhoea. *Salacia reticulata* (Celastraceae) has been identified as the most potent species for treating diabetes. Its pharmacological properties including blood glucose-lowering activity, inhibition of adipocyte differentiation, suppression of the accumulation of visceral fat and metabolic disease prevention and suppression of fat accumulation have been scientifically validated. Further, the oral hypoglycemic activity, anti-rheumatic properties, curing of skin related ailments, hypoglycemic effects of *Salacia reticulata* extract has been investigated[17].

PHYTOCHEMICAL REVIEW

Mangiferin, epicatechin, salacinol, epigallocatechin, kotalanol, Kotalagenin 16 acetate, 26-hydroxy 1, 3 friedelane dione; maytenfolic acid, 3 β 22-dihydroxy olean-12en-29 oic acid; (-)-Epicatechin; (-)-epigallocatechin, (-)-4'-O- methyl epigallocatechin, (-)-epiafzelechin-(4ß 8)-(-)-4'-O- methylepigallocatechin,(-)-epicatechin-(4ß 8)-(-)-4'-O-methyl- epigallocatechin, Salaciquinone; Isoiguesterinol; 30 hydroxy pristimerin; netzahualcoyene. The presence of mangiferin (C19H18O11), kotalanol (C12H24O12S2+) and salacinol (C9H18O9S2+) have been identified as the antidiabetic principles of *S. reticulata* through pharmacological studies (Yoshikawa *et al*. 1997, 1998; 2001). Other chemical constituents such as 1,3-diketones, dulcitol and leucopelargonidin (a linear isomer of natural rubber), iguesterin (quinone methides), epi-catechin, phlobatannin and glycosidal tannins, triterpenes, and 30-hydroxy-20(30) dihydroisoiguesterin, hydroxyl ferruginol, lambertic acid, kotalagenin 16-acetate, 26-hydroxy-1,3-friedelanedione, maytenfolic acid have also been detected in the root of *S. reticulata*[18].



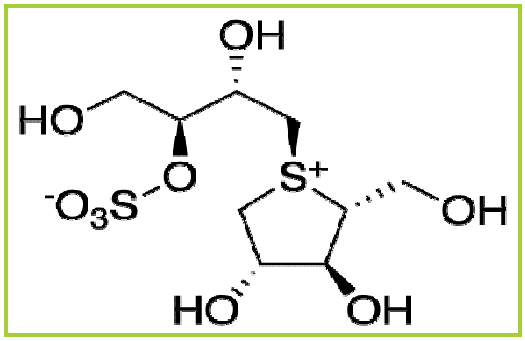
Mangiferin



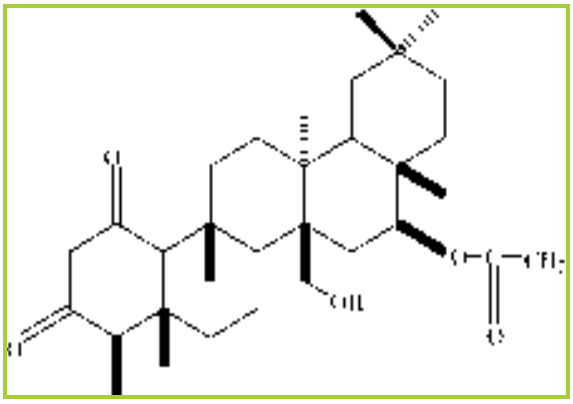
Epicatechin

TABLE 8: PHARMACOLOGICAL REVIEW

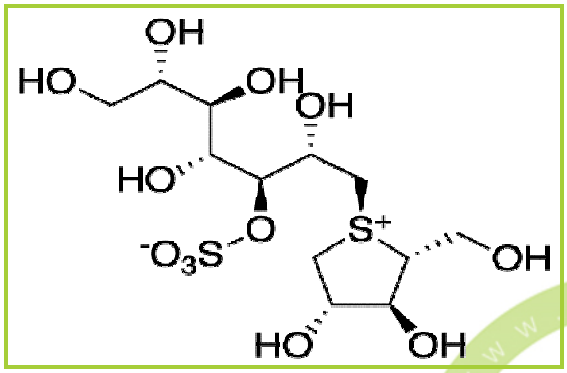
PHARMACOLOGICAL ACTIVITY	PLANT PART USED	EXTRACT USED	SCREENING MODELS	REFERENCE
Antidiabetic activity	Root	Methanolic extract	Normal & steptozotocin induced diabetic animals	Matsuda *et al* .,(1999)
Hepatoprotective activity	Root	Methanolic extract	Oxidative stress induced liver injury model	Yoshikawa *et al*.,(2002)
Antioxidant activity	Root	Methanolic extract	DPPH scavenging activity	Yoshikawa *et al*.,(2002,2003)
Antiobese activity	Root	Methanolic extract	Inhibition of pancreatic lipase activity in small intestine	Yoshikawa *et al*.,(2002)
Antiproliferative activity	Leaves	Methanolic extract	Interleukin-1-β-activated cells	Sekiguchi *et al*.,(2012)
Anti-inflammatory activity	Root	Methanolic extract	Carrageenan-induced paw oedema	Ismail *et al.*, (1997)
Antimicrobial activity	Root	Methanolic extract	Minimum inhibitory concentration	Deepa & Narmathabai (2004)



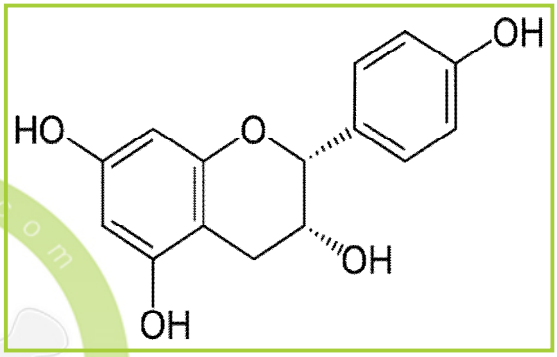
Salacinol



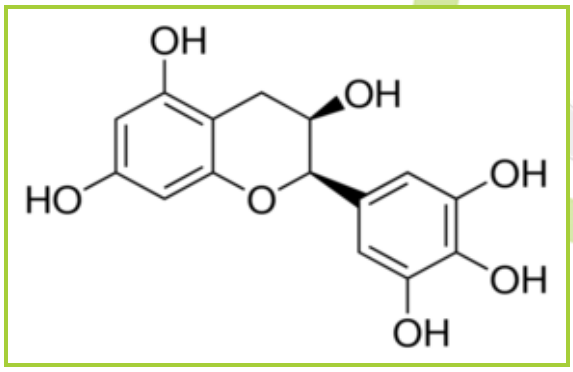
Kotalagenin 16-acetate



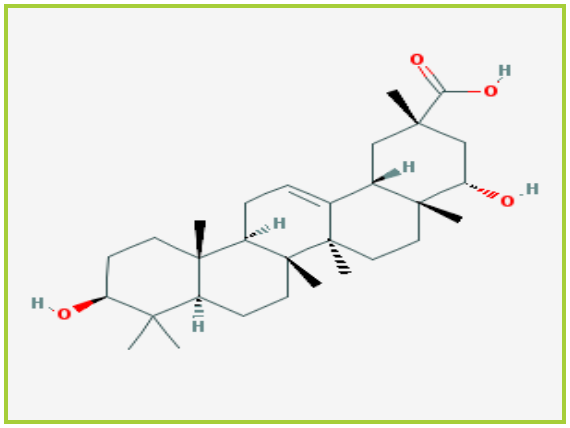
Kotalanol



Epiafzelechin



Epigallocatechin



Maytenfolic acid

PTEROCARPUS MARSUPIUM ROXB

Pterocarpus marsupium Roxb (family Fabaceae/Leguminosae) (fig.3) is a large tree that commonly grows in central, western and southern parts of India and Sri Lanka. The bark of this tree is used for heartburn and management of diabetes. The leaves of *P. marsupium* are used for boils, sores, and various skin diseases. Overnight water stored in tumblers made out of the heartwood of *P.marsupium* is used as traditional therapy for the patients with diabetes mellitus[19].

The antidiabetic and other pharmacological activities of various parts of the *P.marsupium* are reported. An aqueous infusion along with ethanolic extract of *P.marsupium* heartwood is widely known for hypoglycemic activity. Antidiabetic activity of *P.marsupium* is the result of its ability to decrease glucose absorption from the gastrointestinal tract that leads to improving insulin and proinsulin levels in the blood. *P.marsupium* has also

been documented to help in regeneration of pancreatic beta cells[20].

Fig.3 *Pterocarpus marsupium* Roxb tree and heartwood

TABLE 9: TAXONOMICAL CLASSIFICATION OF *PTEROCARPUS MARSUPIUM* ROXB[21]

Domain	Eukaryota
Kingdom	Plantae
Subkingdom	Viridaeplantae
Super division	Angiosperms
Division	Eudicots
Phylum	Magnoliophyta
Subphylum	Euphyllophytina
Class	Magnoliopsida
Subclass	Rosidae
Super order	Fabanae
Order	Fabales
Family	Fabaceae
Subfamily	Faboideae
Tribe	Dalbergieae
Genus	Pterocarpus
Species	*P.marsupium*

TABLE 10: VERNACULAR NAMES OF *PTEROCARPUS MARSUPIUM* ROXB

LANGUAGE	COMMON NAMES
Sanskrit	Bijaka, Pitasara, Pitashalaka
English	Indian kino tree
Bengali	Pitshal
Marathi	Asan, Bible
Gujarati	Biyo
Telugu	Yegi, Peddagi
Hindi	Bigasal
Kannada	Honne,Bange
Oriya	Byasa
Malayalam	Venga
Tamil	Vengai

TABLE 11: ORGANOLEPTIC CHARACTERS OF* PTEROCARPUS MARSUPIUM *ROXB

Taste	Astringent
Odour	No specific odor
Colour	Golden brown to reddish brown
Texture	Angular, Glistering, Brittle fragments, Irregular pieces of variable size

ETHNO MEDICINAL REVIEW

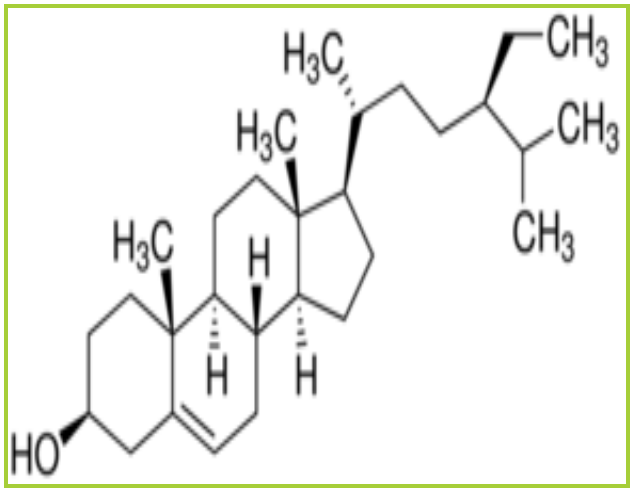
The medicinal utilities have been described, especially for leaf, fruit, and bark. The bark is used for the treatment of stomach ache, cholera, dysentery, urinary complaints, tongue diseases and toothache. The gum exudes 'kino', derived from this tree, is used as an astringent. The gum is bitter with a bad taste. However, it is antipyretic, anthelmintic and tonic to the liver, useful in all diseases of body and styptic, vulnerant and good for gripping and biliousness, ophthalmia, boils and urinary discharges. The flowers are bitter, improve the appetite and cause flatulence. *P. marsupium* has a long history of use in India as a treatment for diabetes. It is a drug that is believed to have some unique features such as beta-cell protective and regenerative properties apart from blood glucose reduction [antidiabetic activity].In the treatment of ophthalmopathy, hemorrhages, diarrhea, asthma, gout, inflammations, fractures, leprosy, skin disease[22].

PHYTOCHEMICAL REVIEW

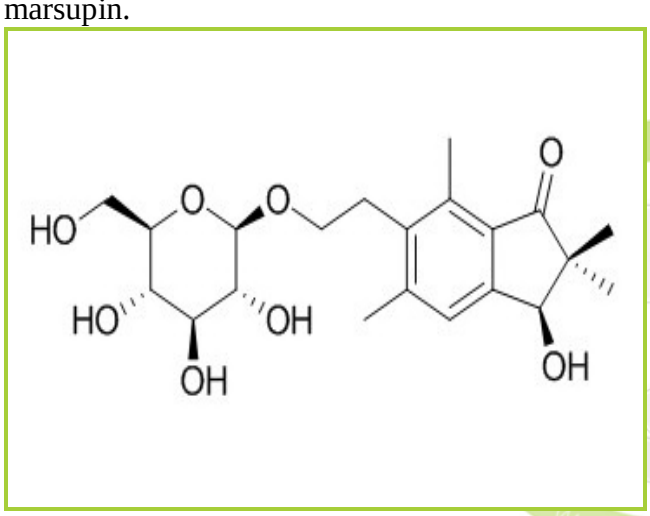
Pteroside, Epicatechin, Sitosterol, Lupeol are present in the heartwood of the *Pterocarpus marsupium* Roxb.

Mitra and Joshi (1982) isolated an isoflavone glycoside from the heartwood of the *Pterocarpus marsupium* and identified it as 5, 4'-dimethoxy-8-methylisoflavone. Three isoflavone glycosides namely retusin 7-glucoside, irisolidone 7-rhamnoside and 5, 7-dihydroxy-6-methoxyisoflavone-7-rhamnoside were isolated by Mitra and Joshi (1983). A eudesmane type sesquiterpene alcohol, selin-4(15)-en-1β, 11-diol was reported from the heartwood of the *P. marsupium* (Adinarayana and Syamsundar, 1982). Subba Rao and Mathew (1982) characterized a naturally occurring hydrobenzoin,marsupol, 4, 4'-dihydroxy-a-methylhydrobenzoin and a novel 2-hydroxy-2-benzylcoumaranone,carpucin, characterized as 2-benzyl-2,4',6-trihydroxy-4-methoxybenzo(b) furan-3(2H)one from the *P. marsupium* heartwood. From the heartwood, propterol-B-1-(2, 4-dihydroxyphenyl)-3-(4-hydroxyphenyl) propan-2-ol identified by Mathew and Subba Rao (1983). Subba Rao et al., (1984) isolated propterol: A 1, 3-bis (4-hydroxyphenyl) propan-2-ol as one of the extractives of heart wood. Bezuidenhoudt *et al.*, (1987) reported two flavonoid analog, 8-C-β-D-glucopyranosyl-3, 7, 4-trihydroxyflavone and 3, 7, 4'-tetrahydroxy flavone from the heart wood which are representatives of the first 5-deoxy-C-C-coupled flavonol glucosides, and rare 3'-C-β-D-glucopyranosyl-α-hydroxydihydrochalcone. A novel 6,7,3', a 4-tetraoxygeneted homo isoflavonoid, which has been characterized as 6-hydroxy-7-O-methyl-3-(3-hydroxy-4-O-methylbenzyl) chronan-4-one from ether soluble fractions of *Pterocarpus marsupium* heart wood and 6-hydroxy-3, 5, 7, 4'-tetramethoxyflavone 6-O-rhamnopyranoside, a flavonol glycoside was characterized from the root(Yadav and Singh, 1998). An aqueous extract of heart wood yielded an isoaurone C-glycoside (Handaet al., 2000). Eight compounds, pterostilben, isoliquiritigenin, liquiritigenin, carpucin, propterol, propterol-B, oleanolic acid, and marsupol were isolated from the heart wood of *Pterocarpus marsupium* (http//www.silbinol.com., 2009). Mohan and Joshi (1989) analyzed flower of *P. marsupium*

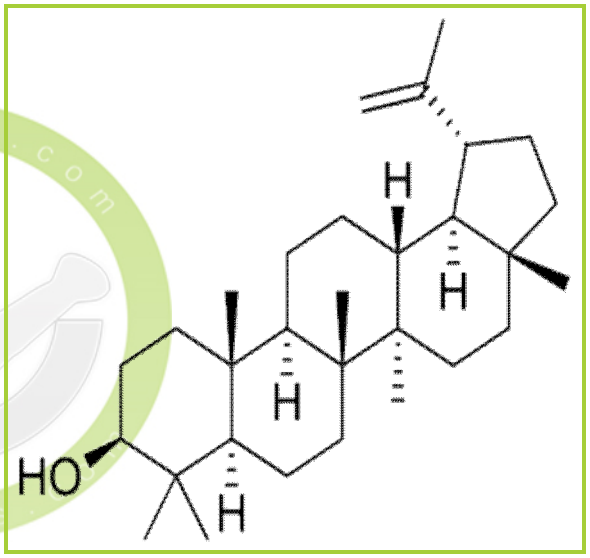
and reported two aurone glycosides, 4, 6, 4'-trihydroxyaurone 6-O-rhamnopyranoside and 4, 6, 4'-trihydroxy-7-methylaurone 4-O-rhamnopyranoside. They also reported another two aurone glycoside from the heart wood and characterized as 6,4'-dihydroxy-7-methylaurone 6-Orhamnopyranoside and 4,6,3',4'-tetrahydroxyaurone 6-O-rhamnopyranoside. From the roots of this plant, Tripathi and Joshi (1988) isolated two flavone glycosides, 7-hydroxy-6, 8-dimthyl flavanon-7-O-α-L-arbinopyranoside and 7,8,4'-trihydroxy-3',5'-dimethoxyflavanone-4'-O-beta D glucopyranoside. Srikrishna and Mathew (2009) synthesized a dimethyl ether of marsupin.



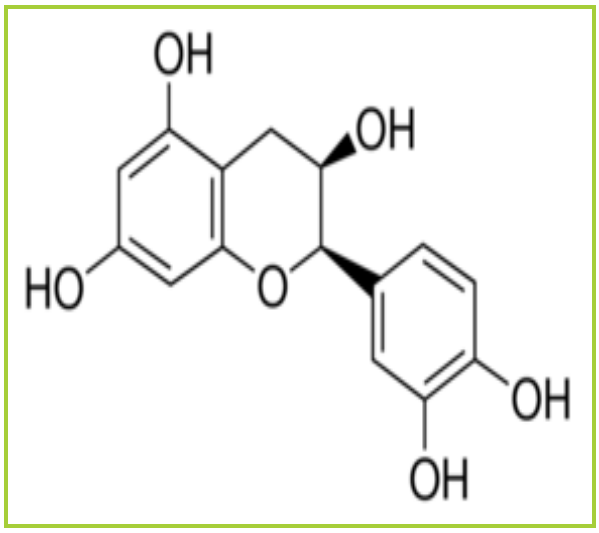
Sitosterol



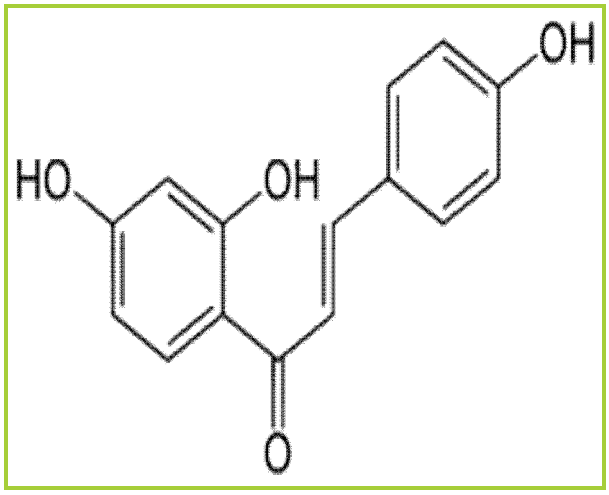
Pteroside



Lupeol



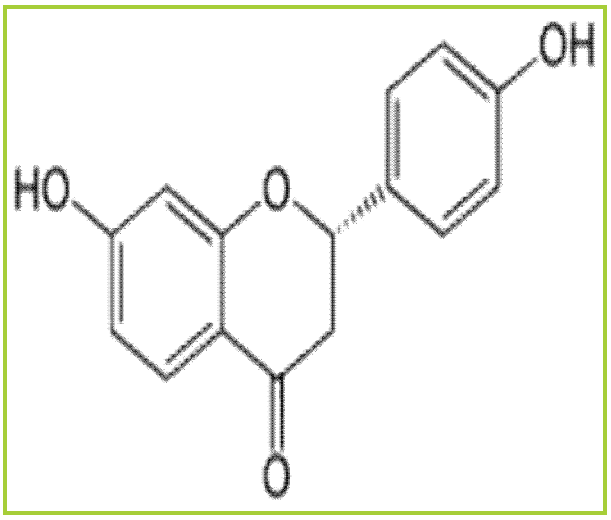
Epicatechin



Isoliquiritigenin

TABLE 12: PHARMACOLOGICAL REVIEW

PHARMACOLOGICAL ACTIVITY	PLANT PARTS USED	EXTRACT USED	SCREENING MODELS	REFERENCE
Antidiabetic activity	Heart wood	Ethanolic extract	Alloxan induced diabetic rat	Ahmad *et al.,* (1991)
Anti hyperinsulinaemic activity & anti hypertriglyceridaemic activity	Heart wood	Ethyl acetate extract	Normal rat model	Jahromi and ray (1993)
Cardiotonic activity	Heart wood	Aqueous extract	Perfused frog heart model	B.K Chakravarthy & K.D Gode (1985)
Anti-cataract activity	Bark	Aqueous extract	Alloxan induced diabetic rat model	Vats *et al.,* (2004)
Hepatoprotective activity	Heart wood	Methanolic extract	Alloxan induced diabetic rat model	Rane and Grampurohit N D (1998)
Analgesic activity	Leaves	Methanolic extract	Swiss albino mice model	Arpita sikdar *et al.,* (2013)
Antibacterial activity	Bark & Leaves	Methanolic extract	Minimum inhibitory concentration	Nair R *et al.,* (2005)



Liquiritigenin

CONCLUSION

Diabetes mellitus is a debilitating and life threatening chronic disorder with multi manifestations which is considered as a "global epidemic".

In this review article, a comprehensive study on ethnobotanical uses, phytochemical constituents and pharmacological activities of 3 major antidiabetic plants namely, Trigonella foenum-graecum Linn, Salacia reticulata Wight, Pterocarpus marsupium Roxb have been done. This may have paramount importance in pharmacy and ethnoherbal utility for diabetes treatment. Plants and their extracts have immense potential for the management of diabetes. Herbal medications are considered safer than allopathic medicines which are associated with side effects. These herbs have been selected by the traditional system and scientific justification with modern uses.

ACKNOWLEDGEMENT

The authors express their sincere thanks to management and staffs of Rajiv Gandhi Institute Of Pharmacy, Trikaripur, Kasaragod(Dist), Kerala, for giving all encouragement and valuable support to carry out this research work.

REFERENCES

1. Alberti, K. G. M. M., & Zimmet, P. F. (1998). Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus. Provisional report of a WHO consultation. *Diabetic medicine*, *15*(7), 539-553.

2. Wadkar, K. A., Magdum, C. S., Patil, S. S., & Naikwade, N. S. (2008). Anti-diabetic potential and Indian medicinal plants. *Journal of herbal medicine and toxicology*, *2*(1), 45-50.

3. KADIFKOVA PANOVSKA, T. A. T. J. A. N. A., KULEVANOVA, S., & STEFOVA, M. (2005). In vitro antioxidant activity of some Teucrium species (Lamiaceae). *Acta Pharmaceutica*, *55*(2), 207-214.

4. Sundaram, R., Naresh, R., Shanthi, P., & Sachdanandam, P. (2012). Antihyperglycemic effect of iridoid glucoside, isolated from the leaves of Vitex negundo in streptozotocin-induced diabetic rats with special reference to glycoprotein components. *Phytomedicine*, *19*(3), 211-216.

5. Fæste, C. K., Namork, E., & Lindvik, H. (2009). Allergenicity and antigenicity of fenugreek (Trigonella foenum-graecum) proteins in foods. *Journal of Allergy and Clinical Immunology*, *123*(1), 187-194.

6. Sreeja, S., & Anju, V. S. (2010). In vitro estrogenic activities of fenugreek Trigonella foenum graecum seeds.

7. Mitra, A., & Bhattacharya, D. (2006). Dose-dependent effects of Fenugreek composite in Diabetes with dislipidaemia. *Internet J Food Safety*, *8*, 49-55.

8. Vijayakumar, M. V., Singh, S., Chhipa, R. R., & Bhat, M. K. (2005). The hypoglycaemic activity of fenugreek seed extract is mediated through the stimulation of an insulin signalling pathway. *British journal of pharmacology*, *146*(1), 41-48.

9. Khosla, P., Gupta, D. D., & Nagpal, R. K. (1995). Effect of Trigonella foenum graecum (Fenugreek) on blood glucose in normal and diabetic rats. *Indian journal of physiology and pharmacology*, *39*, 173-173.

10. Khosla, P., Gupta, D. D., & Nagpal, R. K. (1995). Effect of Trigonella foenum graecum (Fenugreek) on blood glucose in normal and diabetic rats. *Indian journal of physiology and pharmacology*, *39*, 173-173.

11. Serasinghe, S., Serasinghe, P., Yamazaki, H., Nishiguchi, K., Hombhanje, F., Nakanishi, S., ... & Namba, T. (1990). Oral hypoglycemic effect of Salacia reticulata in the streptozotocin induced diabetic rat. *Phytotherapy Research*, *4*(5), 205-206.

12. Kishino, E., Ito, T., Fujita, K., & Kiuchi, Y. (2006). A mixture of the Salacia reticulata (Kotala himbutu) aqueous extract and cyclodextrin reduces the accumulation of visceral fat mass in mice and rats with high-fat diet–induced obesity. *The Journal of nutrition*, *136*(2), 433-439.

13. Shimada, T., Nagai, E., Harasawa, Y., Watanabe, M., Negishi, K., Akase, T., ... & Aburada, M. (2011). Salacia reticulata inhibits differentiation of 3T3-L1 adipocytes. *Journal of ethnopharmacology*, *136*(1), 67-74.

14. Choudhary, G. P., & Kanth, M. V. (2005). Antimicrobial Activity of Root bark of Salacia reticulata. *Ancient Science of Life*, *25*(1), 4.

15. Aswal, B. S., Bhakuni, D. S., Goel, A. K., Kar, K., Mehrota, B. N., Mukhrjee, K.C. (1984) . Screening of Indian plants for biological activity: Part X. *Indian J Exp Biol*., 22, 312–32.

16. Basu, S., & Pant, M. (2013). Phytochemical evaluation and HPTLC profiling of extracts of Salacia oblonga. *International Journal of Pharmaceutical Sciences and Research*, *4*(4), 1409.

17. Im, R., Mano, H., Matsuura, T., Nakatani, S., Shimizu, J., & Wada, M. (2009). Mechanisms of blood glucose-lowering effect of aqueous extract from stems of Kothala himbutu (Salacia reticulata) in the mouse. *Journal of ethnopharmacology*, *121*(2), 234-240.

18. Dhanabalasingham, B., Karunaratne, V., Tezuka, Y., Kikuchi, T., & Gunatilaka, A. L. (1996). Biogenetically important quinonemethides and other triterpenoid constituents of Salacia reticulata. *Phytochemistry*, *42*(5), 1377-1385.

19. Hariharan, R. S., Venkataraman, S., Sunitha, P., Rajalakshmi, S., Samal, K. C., Routray, B. M., ... & Gupta, A. K. (2005). Efficacy of vijayasar (Pterocarpus marsupium) in the treatment of newly diagnosed patients with type 2 diabetes mellitus: a flexible dose double-blind multicenter randomized controlled trial. *Diabetologia Croatica*, *34*(1), 13-20.

20. Ahmad, F., Khalid, P., Khan, M. M., Chaubey, M., Rastogi, A. K., & Kidwai, J. R. (1991). Hypoglycemie activity of

Pterocarpus marsupium wood. *Journal of ethnopharmacology*, *35*(1), 71-75.

21. Salunkhe, V.R., Kane, S.R. Kulkarni, A.S. (2005). Anti-inflammatory acitivity of hydrogels of extracts of *Pterocarpus marsupium* and *Coccinia indica*. *Indian Drugs*., 42, 319-321.

22. Dhanabal, S. P., Kokate, C. K., Ramanathan, M., Kumar, E. P., & Suresh, B. (2006). Hypoglycaemic activity of Pterocarpus marsupium Roxb. *Phytotherapy research*, *20*(1), 4-8.

HOW TO CITE THIS ARTICLE

Shabeena, P. R., Gowtham, M. (2017). An Ethnobotanical Survey of Three Potent Natural Antihyperglycaemic Drugs. *International Journal for Pharmaceutical Research Scholars (IJPRS)*, *6(2)*, 171 - 188.