

Antidiabetic Properties of Siddha Polyherbal Decoction Containing *Cassia. Auriculata (L)*, *Salacia reticulata (Wight)*, *Terminalia chebula, (Retz)* *Terminalia bellerica (Roxb)*, and *Emblica officinalis(L)* – A Review

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ABSTRACT

This review focuses on a polyherbal decoction that includes the bark of *Cassia auriculata (L)* & *Salacia reticulata (Wight)*, Fruits of *Terminalia chebula, (Retz)*, *Terminalia bellerica (Roxb)*, and *Emblica officinalis(L)*, all of which are traditionally used in Siddha medicine for the management of Diabetes Mellitus. The aim is to compile scientific evidence supporting the anti-diabetic properties of these plants. A total of 54 articles were retrieved from the PubMed database, covering pre-clinical studies (in vitro & in vivo), clinical trials, and the phytochemicals present in these plant extracts. Further analysis indicates that each plant has unique phytochemicals that regulate glucose metabolism and address Diabetes complications. These mechanisms include enhancing glucose uptake, preventing or delaying cell damage, increasing insulin production, reducing insulin resistance & inhibiting intestinal glucose absorption. The findings from this review suggest that each plant has demonstrated antidiabetic effects, and it is recommended that additional research be conducted on a polyherbal formulation combining these five plants.

Keywords: Siddha, *Cassia auriculata*, *Salacia reticulata*, *Terminalia chebula*, *Terminalia bellerica*, *Emblica officinalis*, Polyherbal decoction, Diabetes

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1. INTRODUCTION

Medicinal plants are crucial in managing Diabetes Mellitus, a serious metabolic disorder ^[1]. According to the latest estimates, there were 382 million people worldwide living with diabetes in 2013, a number projected to increase to 592 million by 2035 ^[2]. Although more than 400 plant species with hypoglycemic properties have been documented, the search for new antidiabetic drugs from natural sources remains attractive due to the presence of phytochemicals that may be effective in treating diabetes mellitus ^[3]. Approximately 410 medicinal plants have been experimentally confirmed to possess antidiabetic properties, but the full mechanism of action has been identified for only about 109 of them ^[4]. Herbal medicines are used to address a wide range of health complications, including cancer, cognitive impairment, liver disorders, peptic ulcers and other gastrointestinal issues, inflammatory conditions, hypertension and various cardiovascular diseases, diabetes mellitus, high cholesterol levels, tuberculosis, skin infections, unexplained muscle pain, as well as disorders affecting the urinary and respiratory tracts and the central nervous system ^[5].

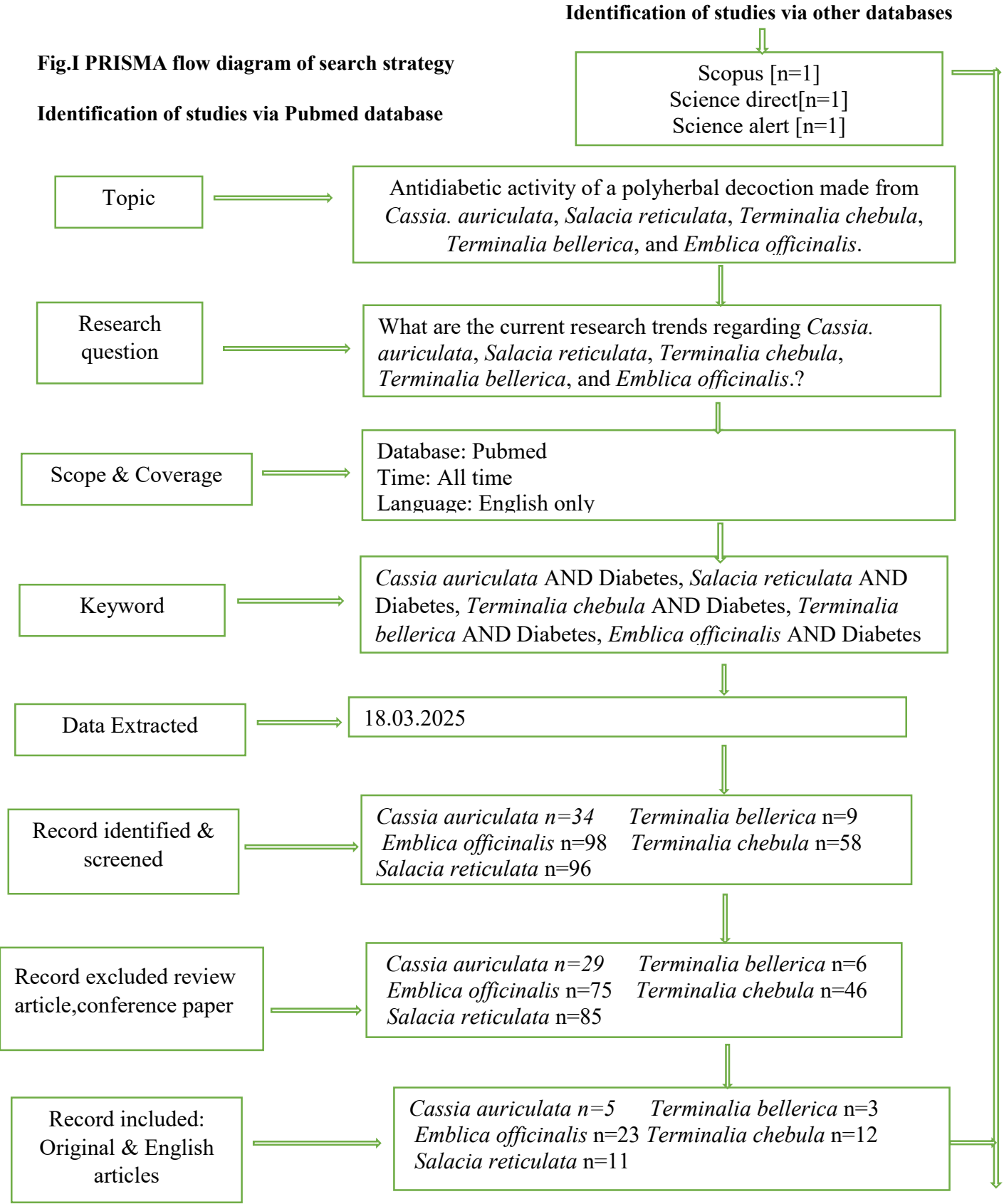
The latest NAPRALERT database includes over 1,300 plant species from more than 750 genera across 190 families, ranging from lower organisms like algae and fungi to nearly all types of higher plants. A significant number of these have been traditionally used in ethnopharmacology to treat diabetes, especially type 2 diabetes mellitus [T2DM] ^[6]. This study reviews the antidiabetic activity of ingredients in a Siddha polyherbal decoction made from *C. auriculata*, *Salacia reticulata*, *Terminalia chebula*, *Terminalia bellerica*, and *Emblica officinalis*. This research investigates the potential synergistic effects of these plants on antidiabetic activity, providing a fresh outlook on the future application of this polyherbal formulation in advancing diabetes treatment research ^[7].

2.MATERIALS & METHODS

2.1. Search Strategy

The data for this review were extracted from the Pubmed database on 18th March 2025 using the following search terms *Cassia auriculata* AND Diabetes, *Salacia reticulata* AND Diabetes, *Terminalia chebula* AND Diabetes, *Terminalia bellerica* AND Diabetes, *Emblica officinalis* AND Diabetes. Pubmed was chosen in this study because it covers a wide range of journals and more comprehensive than other journals. Few studies were included from scopus & science direct. The PRISMA flow chart is described in Fig.I Inclusion criteria included original articles & English language. We excluded the literature research based on the review article, conference paper, book chapter. This polyherbal decoction is composed of the bark of *Cassia auriculata* and *Salacia reticulata*, the dried fruits of *Emblica officinalis*, and the fruits of *Terminalia chebula* and *Terminalia bellerica*. Therefore, the review focuses solely on studies examining the antidiabetic activity of these specific plant parts.

Fig.I PRISMA flow diagram of search strategy



3. Results

Table: I. Phytochemicals found in ingredients of the Polyherbal decoction

Sl no.	Tamil/Botanical name/Family	Common name	Taste	Parts used	Active constituents
1	Aavarampattai [<i>Cassia auriculata</i> [Linn.] Caesalpiniaceae	The tanners, cassia	Astringent	Stem bark	The roots contain a flavone glycoside, 7',4'-dihydroxyflavone-5-O-β-D-galactopyranoside. The stem bark afforded the dimeric 8procyanidins Fisetinidol-[4-8'']-catechin, fisetinidol-[4-8'']-epi-catechin, fisetinidol-[4-8'']-gallo catechin, and fisetinidol-[4-8'']-epigallocatechin. The heartwood contains an anthocyanidin glycoside, pelargonidin-5-O-β-D-galactoside ^[8]
2	Kadalazhinjilppattai [<i>Salacia reticulata</i> Wight] Celastraceae	Ekanayakam, ponkorandi	Astringent	Stem bark	Antidiabetic: Mangiferine, Kotalanol, Salacinol, 13 MRT. Root bark contains proanthocyanidins. Stem contains gutta, dulcitol & proanthocyanidin consisting of dimer of leucopelargonidin. Other: 1,3 diketones, dulcitol, leucopelargonidine, glycosidal tannin, kotalgenin 16 acetate, meryterfonic acid ^[8]
3	Nellimulli [<i>Emblica officinalis</i> Linn] Euphorbiaceae	Emblin, myrobalan, Indian gooseberry, Amla	Astringent, Sweet, Sour	Dry unripe fruit	Emblin, A, B, punigluconin, pedunculagin, geranin, isochorylgin, corylgin, chebulonic acid, chebulagatonic acid, isostrictinin, gallic acid, mucous acid lactone gallate, digalloyl glucose, methyl gallate, ethyl gallate, monogalloyl glucose, putanjin A, galloil-HHDP-glucose, and elaeocarpusin, gallic acid, ellagic acid, chlorogenic acid, malic acid, chebulic acid, and cinnamic acid. methyl gallate ^[9]
4	Thanrikkai thol [<i>Terminalia bellerica</i> Roxb] Combretaceae	Belleric myrobalan	Astringent	Epicarp of unripe fruit	Terminalignan, thannilignan, 7-hydroxy-3',4'-[methylenedioxy] flavone, anolignan B, gallic acid, ellagic acid, corilagin, β-sitosterol, arjunigenin, belleric acid, bellericoside and cannogenol 3-O-β-Dgalactopyranosyl-[1→4]-O-α-L rhamnopyranoside ^[10]
5	Manjal Kadukkai thol [<i>Terminalia chebula</i> Retz] Apocynaceae	Chebulic myrobalan, Black myrobalan, Harithaki	Astringent, Sweet, Sour Bitter, Pungent	Epicarp of unripe fruit	Tannins and pseudotannins, including gallic acid and simple gallate esters, chebulic acid and chebulic ellagitannins, ellagic acid derivatives, and ellagic acid glycosides ^[11]

3.1. Ethnobotanical Description, Distribution & Medicinal Uses of the Selected Plants.

Aavarampattai [Cassia auriculata [Linn.]

The plant is native to Southeast Asia, sub-Saharan Africa, and India, where it is extensively utilized for various medicinal purposes ^[12]. The leaves are dull green, arranged alternately, stipulate, and compound, containing 16-24 pairs of leaflets. The flowers are large, bright yellow, and irregular, measuring about 5 cm. The fruits are pale brown or green, resembling small legumes, measuring 7-11 cm in length and 1.5 cm in width. They are rectangular with a long style base, flat, thin, papery, covered with fine hairs, wavy, crinkled, and tipped with a long style base. Each fruit contains approximately 12-20 seeds, each housed in a separate cavity ^[13]. The whole plant, from tip to root, holds medicinal value and exhibits therapeutic effects such as antimicrobial, antidiabetic, hepatoprotective, antioxidant, antiviral, and antipyretic properties ^[14].

Kadalazhinjilppattai [Salacia reticulata Wight]

Salacia reticulata Wight [Hypocrataceae] is a woody climbing shrub with greenish-brown bark, native to India and Sri Lanka. Leaves elliptic or subovate, flowers 6 in each axil, fruit tuberculate, 5 cm in diameter. Besides its use in diabetes treatment, decoctions [aqueous extracts] of *S. reticulata* and other *Salacia* species have been traditionally used for centuries to treat asthma, rheumatism, hemorrhoids, itching and swelling, gonorrhea, skin disorders, and amenorrhea. In Japan, *S. reticulata* has also been consumed as a dietary supplement to help prevent diabetes and obesity ^[15].

Nellimulli [Emblica officinalis Linn]

A small or medium-sized deciduous tree with smooth, greenish grey, feathery leaves with small, narrowly oblong, pinnately arranged leaflets. Fruits depressed, globose, 1-1/2 inch in diameter, and obscurely 6-lobed, containing 6 trigonous seeds ^[16]. The fruit naturally contains tannins such as gallic acid, ellagic acid, and glucose, which help prevent or slow down vitamin oxidation, making it an effective antiscorbutic both when fresh and dried. The plant is also reported to possess antioxidant, anti-inflammatory, anticancer, adaptogenic, antidiabetic, nootropic, antimicrobial, and immunomodulatory properties ^[17].

Thanrikkai thol [Terminalia bellerica Roxb]

Terminalia bellirica [Gaertn.] Roxb. is commonly found throughout the Indian subcontinent-including Pakistan, Nepal, Bangladesh, and Sri Lanka-as well as in Southeast Asia. In India, it is known as “Bahera” in Hindi, while its English and Sanskrit names are “Beleric Myrobalan” and “Bibhitaki,” respectively. This large deciduous tree features a buttressed trunk and thick, brownish-gray bark with shallow longitudinal cracks, reaching a height of 20 to 30 meters when fully grown. The fruits are ovoid drupes that start off spherical and pink but become greyish and develop five ridges when dried. Each fruit contains an ellipsoid-shaped seed ^[18]. The half-ripe fruit acts as a purgative, whereas the ripe and dried fruit has the opposite effect. The fruits are also used to treat jaundice and have demonstrated hepatoprotective effects in mice with CCl₄-induced liver damage. As a component of Triphala, the fruits exhibit notable hypoglycemic, anti-inflammatory, antiarthritic, and analgesic properties, and are used to treat leucorrhea. In Jammu and Kashmir, a decoction made from the fruit and stem bark is administered for urinary disorders ^[19].

Manjal Kadukkai thol [Terminalia chebula Retz]

The leaves demonstrate potent antifungal activity against *Epidermophyton floccosum*, a fungus responsible for human ringworm infections. The fruits contain an active compound known as chebulin, which has been reported to exhibit myocardial depressant and blood pressure-lowering effects. Alcoholic extracts of the fruits have shown dose-dependent negative chronotropic and inotropic effects, along with hypotensive action, in various experimental models, including isolated frog and rat atria, perfused frog and rabbit hearts, isolated rabbit aortic rings, and in dogs ^[19]. The tree grows to about 50 to 80 feet tall, with dark brown bark that has longitudinal fissures. Its leaves are ovate to elliptical and have two noticeable glands near the top of the petiole. The plant is monoecious, featuring five clear ridges or lines on its outer surface. The fruit is green when immature and changes to a yellowish-grey color as it ripens ^[20]. In both Ayurveda and Siddha medicinal systems, the fruits of *Terminalia chebula* are utilized to manage a wide range of health issues, such as chronic diarrhea, gastroenteritis, constipation, malabsorption syndrome, ulcers, indigestion, hemorrhoids, candidiasis, liver enlargement, skin conditions, memory problems, epilepsy, heart disorders, and diabetes ^[21].

3.2. Scientific evidence of Anti-diabetic properties of selected plants

Table. II. Pre-clinical screening of *Cassia auriculata* & *Salacia reticulata*

Species	Solvents/Extract	Model/ /invitro	In vivo	Results
<i>Cassia auriculata</i>	polyphenolic		T2DM rats	CA enhances <u>glucose uptake</u> and expression of glucose transporters in particular <i>via</i> the upregulation of <i>GLUT2</i> and <i>GLUT4</i> . ^[22]
	Aqueous		Alloxan-induced male Wister rats	Reduction of serum glucose, TG and cholesterol and increase in plasma insulin levels ^[23]
	Methanolic	α amylase assay α -glucosidase assay	Diet-induced type-2 diabetes mellitus [T2DM] C57BL/6 mouse model	Highest antioxidant and antidiabetic activities [In vitro]. Showed reduction of FBS, oxidative stress and increase in plasma insulin levels. [in vivo] ^[24]
<i>Salacia reticulata</i>	Methanolic		Male Sprague-Dawley rats [170–190 g]	increase in plasma insulin, plasma leptin, Reduction of adiponectin, Reduction of plasma TG, TC, VLDL, LDL and increased HDL ^[25]
	Aqueous	Anti-glycation and Glycation reversing assays		Showed anti-protein-glycation and free-radical scavenging activities ^[26]
	Alcoholic		STZ-induced Wister rats	reduction of FBS, the combined therapy also proved beneficial as nootropic agent in rats with early-onset diabetes ^[27]
	Aqueous	α -glucosidase assay		Inhibitory activity of polyhydroxylated cyclic 13-membered sulfoxide was much greater than inhibitory activity of salacinol and kotalanol ^[28]
	Aqueous	α glucosidase assay	maltose- and sucrose-loading on Wistar rats	reduction of postprandial glucose levels. Hypoglycemic effect of 13-membered ring thiocyclitol, a novel alpha-glucosidase inhibitor from <i>Salacia reticulata</i> ^[29-30]

FBS:Fasting blood sugar,TG:Triglycerides,TC:Total cholesterol,VLDL:Very low density lipo protein,LDL: low density lipo protein ,HDL: low density lipo protein,GLUT4:Glucose transporter protein type 4

Table. III. Pre-clinical screening of Terminalia chebulala

Species	Solvents/Extract	Model/ /in vitro	In vivo	Results
Terminalia chebula	Ethanolic		STZ-induced Male Sprague-Dawley rats	Higher doses of Terminalia chebula [600 mg/Kg] were shown to have a potential therapeutic effect, as well as the most prominent antidiabetic, antilipidemic activity, hepatoprotective, and renoprotective profiles when compared to lower doses ^[31]
<i>Terminalia chebula</i>	Chloroform		STZ-induced Wister rats	Dose-dependent reduction in blood glucose of diabetic rats and comparable with that of the standard drug, glibenclamide, in a short-term study. Significant reduction in blood glucose & renoprotective activity in long-term study ^[32] .
	Wheat, barley or wheat + barley and herbs [<i>Terminalia chebula</i> , <i>Terminalia bellerica</i> and <i>Emblica officinalis</i>] based low-glycemic-index [low-GI] foods	α amylase assay α glucosidase assay	STZ-induced Wister rats	Low-GI foods lower the systemic glucose level, inhibit the glycolytic enzymes and DPP-IV activity ^[32-33]
	Methanolic	human umbilical vein endothelial cells [HUVEC]		T. chebula reduced AGE-induced ROS generation. The incubation of HUVEC with 100 μ g/mL of AGEs caused a considerable increase in THP-1 monocytic cell adhesion, but the treatment of T. chebula 34 reduced this adhesion
Hydrolyzable tannins from the fruits of <i>T.chebula</i>		α -glucosidase inhibition		Ellagic acid showed significant inhibitory activity ^[35]
<i>Terminalia chebula</i>	Aqueous		STZ-induced Wister rats	Extract reduced blood glucose by reduction of HbA1c, improved blood lipid profiles, and decreased serum insulin levels compared to untreated diabetic rats. The extract also partially prevented the decrease in hepatic and skeletal muscle glycogen content. In vitro studies showed that extract enhanced insulin release from pancreatic islets ^[36]
	Hydro-ethanolic		STZ-induced Wister rats	TC, TG, and LDL-C and hepatic MDA level decreased while plasma HDL-C and insulin, and hepatic thiol content, and SOD and CAT activities increased compared to diabetic rats ^[37]

HUVEC:Human umbilical vein endothelial cell,SOD:Super oxide dismutase,CAT:catalase,DPP-4:Dipeptidyl peptidase- 4, HbA1c:Glycated hemoglobin,MDA:Monoaldehyde,

Table. IV. Pre-clinical screening of *Terminalia bellerica*

Species	Extract	Model/in vitro	In vivo	Results
<i>Terminalia bellerica</i>	Methanol		STZ-induced Wister rats	increase in plasma insulin, C-peptide, total protein, albumin, tissue glycogen, and body weight. reduction of serum cholesterol, triglycerides, LDL, urea, uric acid, and creatinine levels ^[38-39]
		α amylase assay α glucosidase assay Anti-glycation assays	STZ-induced Wister rats	reduction of serum total cholesterol, triglyceride, LDL-cholesterol, urea, uric acid, creatinine, increase in plasma insulin, C-peptide and glucose tolerance level. Also restored the total protein, albumin and body weight of diabetic rats to near normal ^[40]
	Methanol			reduction of oxidation of LDL, LC-MS analysis revealed that methanol extract of TB and EB contains ellagic acid and ascorbic acid as the major compound respectively ^[41]
	Aqueous and ethyl acetate	α amylase assay	Alloxan-induced male Wister rats	Significant α amylase inhibitory action [in vitro]. Restorative effect on body weight and blood biomarkers such as glucose, creatinine, total protein, total cholesterol, LDL, HDL, triglyceride, urea and uric acid. [In vivo] ¹⁰
	Ethyl acetate	α -glucosidase inhibition		showed significant inhibitory activity ^[42]
	Aqueous		spontaneously obese type 2 diabetic TSOD mice	T.Bellerica suppressed absorption of triacylglycerol in an olive oil loading test [in vivo] and showed a strong inhibitory effect on pancreatic lipase activity [in vitro] ^[43]
	Aqueous		STZ-induced Wister rats	reduction of blood glucose, glucose tolerance & resistance. The lipid profile was improved Glycohemoglobin concentration was significantly reduced in experimental animals. The extract treatment increased the expression of SIRT1 in the pancreas ^[44]

HbA1c: Glycated hemoglobin, PPAR γ : peroxisome proliferator activated receptor gamma, EB: Emblica, pAkt: Phospho Akt, CaMKK β /AMPK: Ca²⁺/calmodulin dependent protein kinase beta/Adenosin monophosphate- activated protein kinase, STZ: Streptozotocin

Table. V. Pre-clinical screening of *Emblca officinalis*

Speci es	Extract	Model/in vitro	In vivo	Results
<i>Embli ca offici nalis</i>	Fruit extract	α amylase assay, α glucosidase assay		Excellent α -amylase, α -glucosidase, and DPP-4 inhibitory activities ^[45]
	Aqueous		Male Long-Evans rats	reduction of serum glucose, TG and cholesterol, increase in glutathione content ^[46]
	Methanol		Neonatal streptozotocin- induced non-obese type 2 diabetic rats	reduction of serum glucose, increase in serum insulin, Insulin-to-glucose ratio. EO ₂₅₀ increased β -cell size, but EO ₅₀₀ increased β -cells number ^[47]
	Aqueous		STZ-induced Wister rats	Extracts from <i>Clitoria ternatea</i> and <i>Emblca officinalis</i> , particularly when combined, provide significant neuroprotective advantages in male Wistar diabetic rats, significantly lowering hyperglycemia and related neurohistopathological changes ^[48]
	Fruit extract	3T3-L1 preadipocytes. PPAR- γ expression and glucose translocation	db/db mice and fructose administered rats.	Upregulation of pAkt, PPAR- γ and Glut4 in gallic acid mediated antidiabetic activity ^[49]
	Aqueous		Wistar-NIN rats by STZ [35 mg/kg body weight	inhibited AR activity as well as sorbitol formation in the lens, counter the polyol pathway- induced oxidative stress as there was a reversal of changes with respect to lipid peroxidation, protein carbonyl content, and activities of antioxidant enzymes. Emblca also prevented aggregation and insolubilization of lens proteins caused by hyperglycemia ^[50-51]
	Hydroalc oholic extract		Wistar rats by STZ [45 mg/kg body weight	reduction of lipid peroxidation and increase in anti-oxidant parameters diabetic rats. Polyphenol enriched fraction of HE significantly improved disarranged carbohydrate and lipid metabolism of chemically induced diabetes in rats ^[52]
	Aqueous	glucose utilization and insulin resistance using C2C12 myotubes.		Significantly stimulated basal glucose uptake though CaMKK β /AMPK pathway and markedly ameliorated palmitate-induced insulin resistance by activating the AMPK pathway in C2C12 myotubes ^[53]
	Ethyl acetate extract		Wistar rats by STZ [45 mg/kg body weight	showed strong inhibition of the production of advanced glycosylated end products. reduction of creatinine level, lipid peroxidation, , the decreased albumin levels in the diabetic rats were significantly improved ^[53]
	Hydro- alcoholic		Wistar rats by STZ [45 mg/kg body weight	When compared to STZ-Control, the treatment groups had significantly lower HBA1C and DPP-IV levels ^[54]

LC-MS: Liquid chromatography-Mass spectrometry, LDL: low density lipo protein, HDL: low density lipo protein, STZ: Streptozotocin

Table:VI. Clinical trials of ingredients of Siddha anti-diabetic Polyherbal decoction

Species	Compound,dose & duration	Participants	Outcomes
<i>Salacia reticulata</i>	100 g of the biscuit extract mixture [Bark extract & aqueous extract.4 biscuits mid-morning & mid-afternoon for 3mths. & Placebo	T2DM patients [age 30- 65] n=62 T2DM patients [age 30- 65] n=71	HbA1c by 0.25% [2.7 mmol/mol] compared to placebo biscuits without serious renal or liver adverse effects ^[55]
	Salacia extracts [500 mg/day] or placebo for 6 weeks	29 patients with prediabetes	reduction of FBS, LDL ^[56]
	2 grams of <i>Salacia reticulata</i> powder daily for a period of 90 days & control group did not receive any supplements	T2DM patients n=60	reduction of HbA1c & lipid levels ^[57]
	<i>Salacia reticulata</i> tea for 3 months followed by placebo in similar tea bags for a further 3 months.	[n= 28]or in reverse order [n=23].	reduction of HbA1c ^[58]
<i>Terminalia chebula</i>	Capsule [600 mg] contained Terminalia chebula fruit extract [200 mg], Commiphora mukul [200 mg], and Commiphora myrrha oleo-gum-resin [200 mg], and the placebo capsule contained 600 mg toast powder & other grp placebo capsules 3 times a day for 3 months.	Women with hyperlipidemic type 2 diabetes	reduction of HbA1c, TG blood urea nitrogen, creatinine, SGOT, SGPT ^[59]
<i>Emblica officinalis</i>	EOE-1 g day,EOE-2 g day or metformin 500 mg day for 90 days.	Newly diagnosed diabetes patients [n = 124]	reduction of FBS,Lipid levels,BP. No significant difference between groups in Body weight & BMI ^[60]
	Mixture of [-]-epigallocatechin gallate [EGCG], a major component of green tea extract, and Amla extract [AE], from Emblica officinalis, the Indian gooseberry, for 3 months	Uremic patients with diabetes [n = 13]	Significantly improved antioxidant defense as well as diabetic and atherogenic indices in uremic patients with diabetes ^[61]
	<i>Emblica officinalis</i> Gaertn. fruit 2 or 3 gm	Normal and diabetic human volunteers	reduction of FBS,PPBS,TG,Cholesterol ^[62]
	Nisha-Amalaki [500 mg] or placebo one capsule twice a day for six months.	58 patients with prediabetes	reduction of BMI,fasting, and 2 h post-OGTT sugar, HbA1c, HOMA-IR, and oxidative stress markers ^[63]
	P. emblica 250 mg twice daily, P. emblica 500 mg twice daily, atorvastatin 10 mg in the evening and matching placebo in the morning, or placebo twice daily for 12 weeks	T2DM patients n=80	Improved endothelial function and reduced biomarkers of oxidative stress and systemic inflammation in patients with type 2 diabetes mellitus, without any significant changes in laboratory safety parameters ^[64]

SGOT:Serum glutamic-oxaloacetate transaminase,SGPT:Serum glutamic pyruvic transaminase,BP:Blood pressure,BMI:Body mass index,OGTT:Oral glucose tolerance test,HOMA-IR:Homeostatic model assessment-Insulin resistance

4. Discussion

The pre-clinical evaluation of Siddha polyherbal decoction gives enough evidence suggesting their role in controlling blood sugar. *Cassia auriculata* revealed promising antihyperglycemic & antioxidant effects by enhancing glucose uptake & expression of GLUT2 & GLUT 4 transporters along with increased plasma insulin levels.[23,24]. *Salacia reticulata* demonstrated anti-diabetic activity through various mechanisms, including plasma insulin elevation modulation of plasma leptin, adiponectin, normalising lipid parameters, anti-glycation & free radical scavenging activities, blocking effect on polyhydroxylated thiosugar derivatives & inhibition of alpha glucosidase action suggesting both glycemic control & prevent secondary complications.[25,26,28,29]. *Terminalia chebula* exhibits dose dependent glucose lowering effects equivalent to standard drugs in STZ-induced rats with supplementary antihyperlipidemic renoprotective & hepatoprotective actions [31,32]. *Terminalia chebula* was also effective in inhibiting DPP-IV activity, suppressing glycolytic enzymes[33]. Methanolic extract of *Terminalia bellerica* in STZ-induced Wistar rats notably improved plasma insulin c-peptide, body weight, triglycerides creatinine & uric acid [39,40]. In vitro assays established strong alpha amylase, alpha glucosidase and anti-glycation activities, identification of compounds such as ellagic acid & ascorbic acid by LC-MS. *T. Bellerica* also repressed triacylglycerol absorption and delayed pancreatic lipase activity, upregulated SIRT1 expression in pancreatic tissue [43,44]. *Emblica officinalis* fruit extract exhibited enzymatic inhibition [45], aqueous extract lowered glucose, lipids and increase in glutathione levels [46]. Methanolic extract enhances beta cell size, beta cell numbers in neonatal diabetic models with modulation of insulin-glucose ratios[47]. Clinical trials are a small step in drug discovery and development after determining the efficacy of phytochemicals in preclinical trials⁶⁵. *Salacia reticulata* & *Emblica officinalis* had the highest number of clinical trial reports among selected diabetic medicinal plants in the study. These plants were tested in DM patients with numerous forms such as biscuits, tea, powder, juice & combination with other plants. These study outcomes proved that the lowering effect glycemic indexes, improved endothelial function & reduced biomarkers of oxidative stress & systemic inflammation [55-64]. The compounds and phytochemicals are closely linked to the pharmacological activities of these plants. Diabetes mellitus is a severe metabolic disorder that can promote various complications and reduce the quality of life of diabetic patients, even causing death, threatening public health in the world [65]. Information on both monoherbal & polyherbal formulations is crucial, as polyherbal remedies are commonly used to treat Diabetes Mellitus & continue to be a traditional approach to this day.[66] In Siddha system of medicine these plants are indicated for the treatment of Diabetes mellitus. According to fundamental principles of Siddha medicine Diabetes Mellitus (Madhumegam) is caused by the imbalance of humours Pitha & Kapha. Since all these plants possess an astringent taste which helps to balance & neutralize the Pitha & Kapha humours, this may be one of the reasons they are used to treat the disease.

5. Conclusion

Numerous herbal resources are recommended for treating various diseases, but scientific evaluation is needed to substantiate the medicinal properties & confirm their efficacy, safety and authenticity. Concluding individual studies can be challenging however, through the review process, we can examine multiple studies, identify the advantages and drawbacks of different drugs, and analyze how various experimental methods influence results to determine which are most effective & reproducible. All the selected plants chosen for this review were readily available, cost-effective & possessed medicinal potential. However, it is only through scientific validation of their qualities that they can truly benefit the community. This review helps validate the antidiabetic properties of individual ingredients in the Siddha polyherbal decoction, which prove to be more beneficial when used in combination due to the synergetic effects of multiple components. Further research on these plants is needed to determine the effect of integrated formulation.

6. CrediT Authorship contribution statement

Writing-original: Janani Syamaroopa Jnanathapaswini, language support : Sridevi, Ganapathi,

: review & supervision

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7. Conflict of Interest

The authors state that they have no conflict of Interest

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