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Exploring the therapeutic potential- A comprehensive review of the medicinal properties of *Senna auriculata* Linn The god gifted plant

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Abstract
Senna auriculata L is well known for its enormous medicinal properties. Senna extracts are found in leaves, stems, roots, flowers, buds, bark, seeds, and fruits. They are used in the treatment of various ailments and chronic diseases such as diabetic mellitus, hyperlipidemia, sclerosis, cancer, nephritis, hyper melanosis, inflammation, ulcers, fever, psoriasis, viral infection, helminth infection, hepatitis, etc. Still, there are numerous ailments that can be controlled, prevented, or cured by extracts of *Senna auriculata*. The purpose of the study is to investigate the potential concept and use of *Senna auriculata* Linn, which has numerous phytochemicals like steroids, proteins, alkaloids, cytoprotective agents, secondary metabolites, antioxidants, cardio protectants, etc. We also reviewed their phytopharmacological properties. In this review, we had selected more than 50 original articles for review and the data was aggregated based on its medicinal activity. We have also attached this review article with some home remedies of *Senna auriculata* Linn. There are numerous marketed formulations that have plant extracts *of Senna auriculata* as active pharmaceutical components. *Senna auriculata* is used as traditional remedies by a smaller group of people. Our main goal is to enlighten the importance to professionals and the public about the miraculous plant *Senna auriculata* L as a traditional medicine for future drug discovery.

Keywords: *Senna auriculata*, potential of phytoconstituents, ethnopharmacology, decoction and macerations, traditional healing, anti-diabetic, anti-bacterial, bio absorbent, hyperlipidemic, antioxidant, anti-inflammatory, hepatoprotective, anti-pyretic, anti-ulcer, anti-malarial, anti-arthritic

Introduction
In recent years, the use of traditional medicinal herbs for therapeutic purposes has become more and more common. *Senna auriculata L* (Fabaceae) widely synonyms *Senna auriculata*, commonly known as "Tanner's Cassia" or "Avaram Senna," is a tall, evergreen shrub that grows quickly and has many branches. It typically reaches a height of 1.2–3.0 m, but it can occasionally exceed 6.0 m. [1]. It is one of these botanical jewels that is particularly valued for its extensive history of ethnopharmacological uses. The purpose of this review is to examine the many applications of *Senna auriculata L* in diverse cultures and geographical areas, providing insight into its pharmacological characteristics, traditional usage, and possible contemporary therapeutic uses. *Senna auriculata* has a rich history in traditional medicine, and more investigation into its ethnomedicinal significance could reveal even more information and avenues for future research and application. Traditional techniques of extracting the herbal medicine from *Senna auriculata L* have been considered safe. However, technology-based and/or solvent-based extracts should be recognized as novel entities and should not be deemed safe for human usage [2]. Both the homoeopathic and allopathic fields are becoming more interested in using plants that have medicinal qualities. Particularly in underdeveloped nations, where it is thought that extensive use of plants with therapeutic effects does not result in intoxication, these medicinal plants are vital to public health. Most people in this world countries cannot afford the cost of the pharmaceuticals now in use; hence it is inevitable that they will look for inexpensive sources of antibacterial compounds in nature. New safe, renewable, and biodegradable medications can be found in plants. Plants have historically been utilized not only as food but also as medicinal substances. *Senna auriculata* L is appropriate for household gardens and road landscaping. It can withstand some dryness and drought, but not too much cold. Racemes of flowers are very visually appealing.

This plant produces anthraquinones in its leaves, bark, and sap; the latter contains tannins. It is also reported to have a cardiac glucoside called sensapicrin [3]. The root is utilized in infusions to treat diabetes, fevers, kidney disorders, and constipation. The leaves have diuretic qualities. For those with diabetes, dried flowers and flower buds are used in place of tea The production of Kalpa herbal tea (Avarai panchaga chooranam) involves using the five plant parts like roots, leaves, flowers, bark, and unripe fruits to make an herbal tea [4]. People in Asian countries are the primary consumers of this tea because it helps lower blood sugar and manage diabetes symptoms. The antidiabetic properties of *C. auriculata* L. have been reported for its numerous components, including leaves [5] and flowers [6]. However, people have long consumed the plant's buds to help manage their diabetes. It is also thought to make women's skin seem better. Applying the ground seed to the eye is another use for it in the event of persistent purulent conjunctivitis.

Table 1: Plant description of *Senna auriculata*

Taxonomy of *Senna auriculata* Linn	
Kingdom	Plantae
Clade	Tracheophytes, Eudicots, Rosids.
Order	Fabales
Family	Fabaceae
Genus	Senna
Species	*S. auriculata*
Binomial name	*Senna auriculata* (L.) Roxb.
Synonym	*Cassia auriculata* L. and *Cassiadensistipulata Taub.*

Regional and Other Names

Tanner's Cassia, Tanner's Senna, Mature Tea Tree (English) Avartaki, Pitapuspa, Pitkalika, Manojyna, Pitkala, Charmaranga (Sanskrit), Tarwar, Awal, Tarval (Hindi), Tangedu, Merakatangeedu (Telegu), Arsual, Tara Vada, Tarwad (Marathi) [1]

Botanical description of *Senna auriculata*

Leaves: Leaves 16–24, very shortly stalked 2-2.5 cm long 1-1.3 cm broad, slightly overlapping, oval oblong, obtuse, at both ends, mucronate, glabrous or minutely downy, dull green, paler beneath; stipules extraordinary, reniform-rotund, produced at based on side of subsequent petiole into a filiform point and persistent. alternating, stipulate, paripinnate compound, very numerous, closely spaced, rachis 8.8–12.5 cm long, narrowly furrowed, slender, pubescent, with an erect linear gland between each pair of leaflets. The plant has compound leaves, made up of 5–8 pairs of shortly stalked oval lanceolate leaflets (2.5 cm × 1.5 cm) and produce successive flush of flowering shoots both in axillary and subterminal position 60–70 days after sowing [8].

Flowers: Large (about 5 cm in diameter), bright yellow, irregular, bisexual, and glabrous pedicels that are 2.5 cm long. To generate a huge terminal inflorescence, the racemes are short, erect, few, and packed in the axils of the top leaves (leaves save stipules are suppressed at the upper nodes). With the two outer petals somewhat larger than the inner ones, the five distinct, imbricate, glabrous, concave, membranous, and unequal sepals are present. Additionally, there are five petals: they are bright yellow with orange veins, free, imbricate, and crisp along the margin. The ovary is superior, unilocular, with marginal ovules; the ten distinct anthers are barren; and there are three upper stamens shown in fig1 [8].

Fig 1: flowers of *Senna auriculata Linn.*

The fruit: A short, oblong, obtuse legume that is 1.5 cm broad, 7.5–11 cm long, flat, thin, papery, undulate, crimpled, pilose, and pale brown in color. It is also topped with a long style base. Each fruit has 12–20 seeds, each of which is carried in a distinct cavity [10,11].

Fig 2: Fruits of *Senna auriculata Linn.*

Geographical distribution: It can be found all over India's hot deciduous forests. Wild in Tamil Nadu's and Madhya Pradesh's arid regions Rajasthan and other Indian regions.

Cultivation and collection: a plant native to primarily arid tropical climates, yet it can also withstand much wetter weather. It can withstand mean annual precipitation as low as 400 mm or as high as 4,300 mm and grows best in regions with mean annual temperatures between 16 and 27 °C [9]. needs to be positioned in direct sunlight [9]. Acceptable in a wide range of soil conditions, even salty ones, but favors a reasonably rich, well-drained soil [9]. With a stem diameter of 35 mm, plants can grow to a height of around 3 meters in 2 years and a height of approximately 5 meters in 4 years, according to certain sources [9]. Coppicing is positively received by plants [9]. After the third year, plants can be picked for their tannins and colors.

Substituents and adulterations: *Senna auriculata* drugs are substituted with *Cassia angustifolia*, Cassia abovata [10]

Various parts and their phytoconstituents:

Table 2: various parts of plant and their phytoconstituents

Part of plant	Constituents	Reference number
Leaves	Alkaloids, flavonoids, terpenoids, phenols, tannins, steroids, saponins	[11-14]
Flowers	Tannins, terpenoids, alkaloids, carbohydrates, steroids,	[11,15, 16]
Root	7,4-dihydroxyflavone-5-O-beta-D-galactopyranoside	[12, 17]
Bark	Anthraquinones, triterpenoid glycosides, 3-hydroxy 6,8-dimethoxy-2methyl anthraquinone 1-0-beta-d- Galactonide	[3,12, 18]
Seed	benzoic acid, 2- hydroxyl methyl ester (0.07%), glycine, N-(trifluroacetyl), 1- methylbutyl ester (0.10%), 2,3 dihydro-3,5 dihydroxy- 6 methyl-4H-pyran-4-one (0.12%), Capric acid, oleic acid, steric acid, palmitic acid, ethyl ester (0.16%), Resorcinol (0.21%) Water soluble galactomannan from the seed of the plant furnishedbeta-D-mannopyranosyl-(1to4)-O-beta-D-mannopyranosyl (1to4)-O-beta-D-mannopyranose by partial hydrolysis	[12, 19, 20]
Stem	Kaempferol-3-O-rutinoside, Rutin, Kaempferol, Glycine, N-(trifluoro acetyl)-, 1-methylbutyl ester, Quercetin, Luteolin	[21]

Methods of extraction of active phytoconstituents from various parts of plant *C. auriculata:* Level or percentage of active constituents present in extract depends on two main factors, namely they are type of solvent used for extraction and method of extraction technique followed [11].

Leaves: Fresh C. auriculata leaves are collected, shade-dried for approximately a week, and then crushed into 100g. This powder is then used for extraction with several solvents, including petroleum ether, chloroform, and methanol, using a Soxhlet's apparatus at 40°C for 6–8 h. Distilled water was used for the maceration to extract the polar and non-polar compounds and then subjected to different solvent extraction [11, 22, 23]

Flowers: There are different methods of extraction for flower extracts, fresh flowers are collected, and shade dried for about 1week then 100 g of the dried powdered flowers of C. auriculata were mixed with 500 mL of methanol and magnetically agitated. Filtration was used to get rid of the residue. 10 g of crude extract (10%) were produced by condensing the filtrate at 60±10 ◦C in a rotary evaporator with decreased pressure [15, 23, 25, 27, 48], also Extract of dried flower was carried out by continuous hot percolation method using Soxhlet apparatus another method carried out [31], 90% ethanol was steeped in 2 kg of fresh *Senna auriculata* flowers at room temperature (25–30 degrees Celsius). The ethanolic extract was filtered after 72 hours. This extract was concentrated in a vacuum, and the resulting dry powder was then dissolved in Dimethyl sulfoxide (DMSO) to obtain the necessary quantities, which were then applied to anti-cancer activity screening [24].

Root: The root was rinsed thoroughly in distilled water and alcohol, shade-dried, coarsely powdered in a hammer mill, Using the decoction process, the plant's powdered roots were extracted with the use of water. A particular precaution was taken throughout the decoction process to ensure that the temperature did not rise over 40 °C or 5 °C since this could precipitate or crystallize some phytoconstituents that will never dissolve in any solvents during the process. After filtering the liquid extract, alcohol (ethanol) was gradually added to the liquid extract to precipitate out the polysaccharides found in each plant's roots. Following filtering, the solution's filtrate was evaporated to one-fourth of its original volume. Following the evaporation of one-fourth of the solution's volume, an equivalent volume of ethyl acetate after one-fourth of its total volume evaporated, yielding a distinct fraction of ethyl acetate from the plant's roots. Subsequently, the ethyl acetate extract was acidified using 0.1 N HCL to boost the extract yield. The plant's root ethyl acetate part was then evaporated to produce a precipitate, which was later dissolved in methanol and gently evaporated to produce crystalline flavonoid powder [17] powdered root is also extracted with hexane at room temperature [25].

Seed: Using a Soxhlet apparatus, 500g of *Senna auriculata* seeds were shade dried, ground into a powder, and extracted with ethanol over a period of 6 to 8 hours. After that, 2g of sodium sulfate and Whatmann filter paper No. 41 were added to the extract to help filter out any remaining sediments and water traces. Absolute alcohol is used to moisten the filter paper and sodium sulfate prior to filtering. After that, the filtrate is concentrated by adding nitrogen gas to the mixture and lowering the volume to one milliliter. Both polar and non-polar phytocomponents are present in the extract [19].

Ethnopharmacological use of *C. auriculata*

Senna auriculata has a wide spectrum of ethnopharmacological use in our traditional medicinal system, various part of the plant has different medicinal values they are isolated by different methods of separation which are mentioned in above topic, the concentration of active constituent depends upon type of solvent used, the various ethnopharmacological uses of plants are enlisted below with their references in Table:3.

Pharmaceutical action of extracts of *Senna auriculata*: *Senna auriculata* (L.) Roxb. was traditionally used to treat inflammation, particularly in Maharashtra, Andhra Pradesh, and Gujarat. The leaf macerate of the plant effectively reduces pain and inflammation in joint disorders. The flower, leaves, roots, and seed were investigated with advanced spectroscopic and chromatographic techniques, and various active metabolites with therapeutic implications against different diseases were found. The flowers of *Senna auriculata* (L.) reported a considerable number of alkaloids, glycosides, saponins, polyphenols, tannins, phlorotannin, terpenoids, triterpenes, carbohydrates, proteins, amino acids and sitosterol's. These metabolites were attributed towards the pharmacological action in diabetes mellitus muscle pain, irregular muscle contraction, body pain, gastritis, skin sores and ulcers, and other ailments.

Table 3: Various ethnopharmacological of various plant parts and their respective solvents of extraction

s.no	Part of plant	Phytoconstituent	Solvent for extraction	uses	Mechanism of activity	reference
01	Flower	Tannins, terpenoids, alkaloids, carbohydrates, steroids Hydroxylated phenolic substances, Alkaloids, flavonoids, saponins	Methanol Chloroform, ethyl acetate, acetone, ethanol	Anti-diabetic activity Anti-plasmodial activity, Antibacterial Bio adsorbent Anti-hyperlipidemic	Alpha glucosidase inhibition Amylase inhibition Inhibits Gram positive bacteria. Remove fluorine from wastewater. Inhibit peroxidation, inhibits TAG (Tri Acyl Glycerol)	[11, 12, 15, 17, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 35, 43, 34, 35, 36]
02	Leaves	Alkaloids, terpenoids, phenols, tannins, steroids, saponins	Methanol Methanol Ethylene acetate Dry powder	Anti-bacterial Antioxidant, anticytotoxic, hepatoprotective action Anti-inflammatory action, anti-pyretic Anti-diabetic Wound healing Anti-arthritic Anti-ulcer - 300mg/kg/p/o	Inhibits gram positive bacteria. Scavenges the free radicals. Inhibit protein denaturation. Same as in flower Invitro study states that these extracts promote wound healing rate. Immunomodulation-increase T cell production, integration of joints.	[11, 12, 22, 28, 34, 37, 38, 39, 40, 45, 22, 12]
03	Root	Polyphenols	Methanol	Diabetes mellitus	Same as in flower	[25]
04	Bark	Anthraquinones, triterpenoid glycosides,3hydroxy 6,8-dimethoxy-2methyl anthraquinone 1-0-beta-galactonide	Methanol	Anti-malarial, anti-hepatotoxic, anti-diabetes	Same as in flower	[41, 50]
05	Seed	benzoic acid, 2- hydroxyl methyl ester (0.07%), glycine, N-(trifluroacetyl), 1- methylbutyl ester (0.10%), 2,3 dihydro-3,5 dihydroxy- 6 methyl-4H-pyran-4-one (0.12%), Capric acid, oleic acid, steric acid, palmitic acid, ethyl ester (0.16%), Resorcinol (0.21%) Water soluble galactomannan from the seed of the plant furnishedbeta-D-mannopyranosyl-(1to4)-O-beta-D-mannopyranosyl (1to4)-O-beta-D-mannopyranose by partial hydrolysis	Acetyl ether	Anti-diabetic action	Same as in flower	[19]

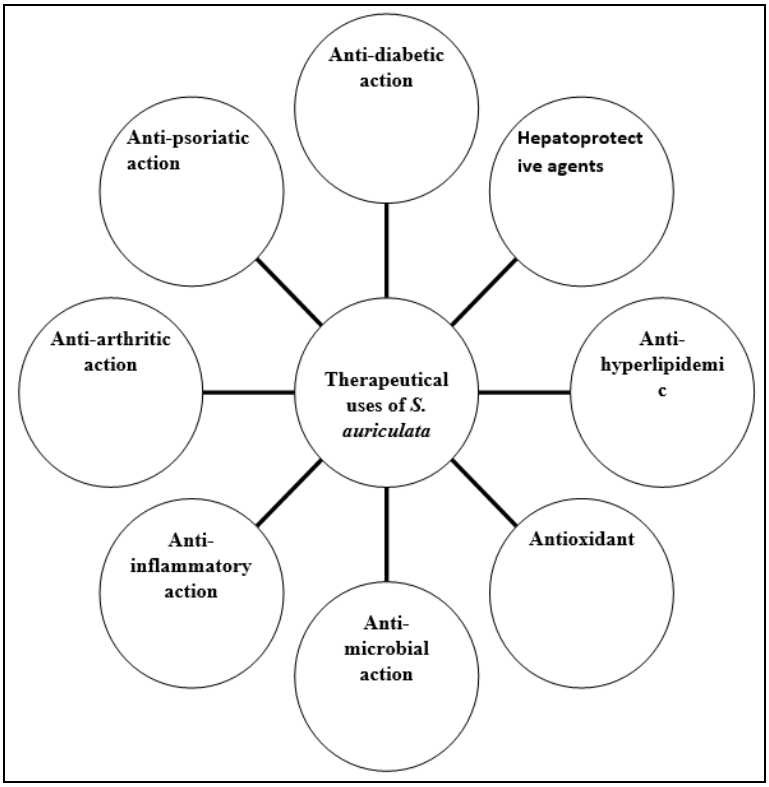

Fig 3: Therapeutical use of *Senna auriculata Linn.*

Anti-diabetic use: Among the many solvents used to extract these phytoconstituents, methanol yields an excellent percentage of drug concentration. These phytoconstituents, which are found in seeds, bark, roots, leaves, and flowers, reduce hyperglycemia and act as an antidiabetic drug. They do this by inhibiting the enzymes alpha amylase and alpha glucosidase, which both lower blood sugar levels by preventing oxidative stress in beta cells. The study was conducted within three groups of rats: one as the control, sample 1, and sample 2 (metformin drug as the control, dried flower extract as sample 1, and dried flower bud extract as sample 2) This study demonstrates unequivocally that the methanol extract of *Senna auriculata* flower buds extract exhibit greater efficacy than the extract of mature dried flowers of *Senna auriculata* [17, 25, 27, 42] this antidiabetic action also occurs by inhibiting PTP1B enzyme [43].

Hepatoprotective action: In experimental hepatotoxicity, supplementing with *Senna auriculata* leaf extract may provide protection against oxidative stress mediated by free radicals. Furthermore, research on the liver's histopathology supported the therapeutic effects of *Senna auriculata* leaf extract [8]. Because root extract inhibits hepatic metabolic pathways, it has strong hepatoprotective effects against ethanol and antitubercular drug-induced hepatotoxicity in rats [44].

Hyperlipidemic agent: Hydroalcoholic Senna extracts are prescribed to treat hyperlipidemia and can prevent rats from gaining weight due to a high-fat diet. It was found that consuming a high-fat diet (HFD) causes concentrations of triglycerides, cholesterol, LDL-C, and HDL-C to fall and rise, respectively.
However, more research is needed to find the mechanism underlying these effects. The biological and pharmacological qualities, antioxidant activities, and other protective qualities of Senna extract may oversee some of these benefits [12, 36, 40, 42]

Antioxidant activity: Alkaloids, flavonoids, terpenoids, and phenolic compounds were found in *Senna auriculata* (L) ethanolic extract based on preliminary phytochemical screening. These chemicals are vital for preventing diseases and preserving health. Current research has concentrated on showing the natural part of medicinal plants that can counteract macromolecular damage by reducing oxidative stress and inflammation. Reactive oxygen species are known to interact with important molecules, including proteins and enzymes, to modulate essential metabolic pathways and reduce their functional efficiency. There are many bioactive chemicals in *Senna auriculata* that have antioxidant properties. The results of the quantitative study showed that *Senna auriculata* is rich in flavonoids and phenolic compounds. It is commonly known that flavonoids found in plants and phenols in general are particularly good at protecting live cells from free radical damage and scavenging them. Many disorders that are primarily linked to free radicals have been treated and prevented with polyphenols and flavonoids that have been extracted from medicinal plants [41, 45, 46]

Anti-microbial activity: *Senna auriculata*-flower extract from Avaram exhibits potent antibacterial properties in Escherichia coli, a type of Gram-negative bacteria, outperforms Staphylococcus aureus, a type of Gram-positive bacteria, while *Candida tropicalalis*, a type of fungus, outperforms *Candida albicans*. the various phytochemical components found in the plant extracts. Terpenoids, phenol, and alkaloids are among the chemicals that oversee the antibacterial activity that was obtained [12, 22, 32, 34]

Anti-inflammatory action: In both acute and chronic animal models, methanolic extract of *Senna auriculata* flowers (MECA) and leaves shown strong anti-inflammatory effect. Additionally, in rats with oedema caused by carrageenin, a 50% acetone extract of the C. auriculata flower was seen to show strong anti-inflammatory activity. The flavanol glycoside 5-O-methylquercetin 7-O-glucoside, as well as tannin and steroids, were found in the flowers and leaves, which is why the effect occurred [12, 30, 32, 45].

Anti-arthritic action: In rats with arthritis produced by Freund's complete adjuvants (FCA), the ethyl acetate fraction of *Senna auriculata* leaves (EACA) proves a positive therapeutic effect on arthritis symptoms. EACA has the potential to reduce arthritis through several pathways, including immune suppression, anti-inflammatory, analgesic, and improved joint structural and functional integrity. Due to their ability to modulate bone erosion, the quercetin and gallic acid found in the f ethyl acetate fraction of EACA have promising anti-arthritic effect [47, 49].

Anti-psoriatic activity: In an animal model generated by formaldehyde and Freund's adjuvant, the anti-psoriatic effect of an ethanol extract derived from *Senna auriculata* flowers was assessed. Following psoriasis induction, the animals were given an ointment (0.5% and 1% w/w) holding an ethanol extract of *Senna auriculata* flowers. The ointment's preparation reduced mean PSI and psoriasis signs, which may have been caused by the polyphenols (tannins and flavonoids) it held. Thus, we deduce that the plant *Senna auriculata* flowers have anti-psoriatic action consistent with its traditional application.

Adverse effects of prolonged use: there is no clinical evidence known by us on adverse effects of prolonged use of C. auriculata extract.

Marketed formulation: the various formulations which holds *C. auriculata* extracts as their major active pharmaceutical ingredients they are enlisted below in table Table:4.

Homemade remedies [1]

- Decorticated seeds are finely powdered and made into paste is used for ophthalmia purulent discharge and conjunctivitis known as country's sore eye [1].
- Seeds with their Testa and kernels are Powdered and mixed with coconut oil or gingelly oil is also used for country's sore eye [1].
- Flower buds are powdered and mixed with honey and made into tea or decoction used in chylous urine and diabetes mellitus [1].
- Tea leaves can be substituted with these leaves for daily consumption [1].

Table 4: list of marketed formulation of *Senna auriculata*

S. No	Drug name	Formulation type	Marketed name	Dose	Price (INR.)	Indication/ Therapy
1	Diasulin	Inj	Diasulin®	40IU/ml	120-150/inj	Diabetes mellitus
2	Sugnil	Tab	Sugnil plus	25gm	270	Microvascular complications in Diabetes mellitus
3	Kalpa herbal tea	Powder	Ayush Kalp™	1teaspoon powder in 8 ounces of water (BD)	319.20/	Diabetes mellitus Diabetes mellitus, Obesity
4	Hyponidd	Tab	Hyponidd®	45mg	120/30 Tabs	Polycystic ovarian syndrome, DM
5	Diamed	Capsule	Diamos™	2Cap-BD	297	Diabetes mellitus
6	Día Sakthi	Tab	Dia Sakthi™	25mg	130	Diabetes
7	Mersina	Tab	Mersina™	70mg	49	Diabetes mellitus
8	Diabkil	Capsule	Pravek Diabkalp Plus	1-2 cap /day	595	Diabetes mellitus
9	Diakyur	Capsule	Diakyur Cap	1-2 cap /day	169	Diabetes mellitus
10	Dianex	Tab	Dianex	50mg	111.0	Diabetes mellitus, Rheumatoid arthritis
11	Avarai kudineer	Powder	Skm Avarai Kudineer	1teaspoon powder in 8 ounces of water (BD)	520	Microbial and fungal infection
12	Diazen	Tab	Diazen™	50/750/250mg	140	Diabetes mellitus
13	Talapotaka churna	Powder	Talapotaka Churna®	300-600mg/kg	97	Diabetes mellitus, Obesity

Conclusion

These days, we prefer traditional medicine over modern treatment because herbal remedies are abundant in bioactive compounds with a wide range of pharmacological effects, and many modern medications are made from natural sources and are used to treat a variety of illnesses and chronic conditions, nature is a rich source of potent remedies. The primary topic of this thorough review was *Senna auriculata*, also known as tanner's or avaram senna. This medicinal plant is rich in phytoconstituents and owns pharmacological properties that include hepatoprotective, antioxidant, antidiabetic, and anti-inflammatory properties. It is also a promising natural cure that may lead to advancements in therapy. In complementary and alternative medicine, *Senna auriculata* may prove to be an invaluable asset, providing innovative therapeutic interventions for a range of medical ailments. Drawing from these primary studies, it is also a promising natural cure that may lead to advancements in therapy. In complementary and alternative medicine, *Senna auriculata* may prove to be an invaluable asset, providing innovative therapeutic interventions for a range of medical ailments. We would like to conclude that *Senna auriculata* is a truly divinely blessed plant with great medical properties, making it one of the most effective and safest drugs available. This is based on these original research findings.

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