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PHARMACOGNOSTIC REVIEW ON *OCIMUM SANCTUM* LINN (TULSI)

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ABSTRACT

Ocimum sanctum also commonly known as “Tulsi” or “Holy basil” is a small, branched, and aromatic herb. It has height of about 70cm. This aromatic herb is widespread throughout India and is commonly cultivated near Hindu houses and Hindu temples. All the parts of this herb including roots, leaves, seeds have been widely used since thousands of years for various diseases and disorders with wide application in Ayurveda and Siddha system of medicines. Chemically, it is very complex as it contains a large number of healthy nutrients and various biologically active compounds. Various scientific studies have proved that it possesses antioxidant, anti-stress, hepatoprotective, immunomodulatory, anti-inflammatory, antimalarial, antiviral, antibacterial, antifungal, antidiabetic, and hypo-lipidemic properties with a wide margin of safety. In Ayurveda, out of many herbs “Tulsi” is known as “The incomparable one” and is used either alone or in combination with other herbs for treating chronic cough, cold, fever, bronchitis, and many other common disorders. The purpose of this review is to provide a brief overview of the plethora of research regarding the pharmacognosy, phytochemistry and various health benefits of Tulsi.

Keywords: Tulsi, *Ocimum sanctum*, Labiatae.

1. INTRODUCTION

Ocimum sanctum (Tulsi), Family Labiatae. This small herb is found and cultivated throughout India and is worshiped in temples and houses of Hindus. It is commonly known as Vishnu-Priya, Tulsi (Sanskrit), Kala Tulsi (Hindi) and India's Holy Basil (English). The leaves, roots and seeds of this plant has been used various Ayurvedic medicine. It has many properties like antioxidant, anti-stress, hepatoprotective, immunomodulating, anti-inflammatory, antibacterial, antiviral, antifungal, antipyretic, antidiuretic, antidiabetic, antimalarial and hypolipidemic with a wide margin of safety. Tulsi is being used either alone or in combination with others in Ayurvedic medicine, and in various clinical conditions like anxiety, chronic cough, bronchitis, fever, snake and scorpion bites.¹ The sacred basil Tulsi is renowned for its religious and spiritual holiness, and also for its important role in Traditional Unani and Ayurvedic systems of health and herbal medicine. The legendary “uncomparable one” (Tulsi) is one of the most holy, health-giving and healing herbs.

The objective of the present review was to provide a brief overview of the plethora of research regarding the pharmacognosy, phytochemistry and various health benefits of Tulsi.

2. HISTORY

According to some ancient Indian legend, the plant (Tulsi) came into being as an avatar (incarnation) of the Hindu goddess Tulsi. In the botanic form Tulsi is the favored herb of the lords Vishnu, Krishna, and Ram, and being greatly revered by lord Shiva and lord Brahma. Tulsi opens the heart and mind, confers love, compassion, trust, and devotion. Today, it is widely used and incorporated in religious rituals and auspicious ceremonies throughout the subcontinent and is worshipped and carefully grown by the traditional Hindu families ². From literature, it is said that Tulsi has been utilized therapeutically since 400-500 BC. Earliest references of this were found in Rigveda (3500-1600 BC) ³.

Two types of *Ocimum sanctum* L. (Tulsi) are met within cultivation:

- (i) Sri Tulsi- Tulsi plants with green leaves and
- (ii) Krishna Tulsi- Tulsi plants with purple leaves ⁴.

3. PROPERTIES

Tulsi is acrid (pungent) and bitter in taste, pungent in the post digestive effect and has hot potency. It facilitates vata and kapha doshas, but slightly worsens the pitta dosha. It also possesses light and dry property. On the opposite side, seeds are slimy and oily in property and have cold potency. It is known to be a good stimulant, an aromatic herb and efficiently reduces fever ⁵.

4. MORPHOLOGY

Tulsi belonging to family Labiatae, is an aromatic herb, is native across the Eastern World tropics and distributed as a cultivated herb and weed. The herb is an erect with many branched sub-shrub.

Height: 30-75 cm.

Stems: Hairy.

Leaves: Green with petiole, ovate or oblong, 5 cm long and slightly toothed, acute with entire or serrate margin, pubescent on either sides and minutely gland dotted. Slightly pungent taste and aromatic flavor with strong odor.

Flowers: Purplish in elongate racemes in close whorls.

Seeds: Reddish black.

Nutlets: Pale brown or red and slightly compressed.

Two important morphotypes of Tulsi are green and purple leaves, cultivated majorly in India and Nepal. Parts of Tulsi like root, seed, stem, etc. are used in medicine, with the major use of fresh as well as dried leaves ⁵⁻⁸.



Fig. 1: Inflorescence of Tulsi



Fig. 2: Tulsi Leaves

5. MICROSCOPY OF TULSI LEAF

Transverse section of the Tulsi leaf is represented in Figure – 3. A thick plano-convex midrib is present in the leaf.

Leaf contains: Non glandular trichomes: present in adaxial part of the midrib (550 um thick and 700 um wide).

Epidermis (Figure-6) and collenchyma cells: present in adaxial part.

Parenchyma cells: present in ground tissue.

Xylem vessels (20 um): present in vascular strand (400 um wide and 150 um thick).

Phloem: present in vascular strand (400 um wide and 150 um thick).

Lamina: It is bifacial which is present into adaxial side and abaxial side.

Mesophyll tissue: present in lower part of the lamina.

Epidermal Trichomes: distributed both on the adaxial and abaxial surfaces of the lamina.

Two types of Trichomes are present:

(a) Non-Glandular (Covering) Trichomes (Figure-4)

(b) Glandular Trichomes (Figure-5).

(i) Peltate type of Trichomes.

(ii) Capitulate type of trichome⁹⁻¹¹.

Epidermis contains diacytic stomata (Figure-6).

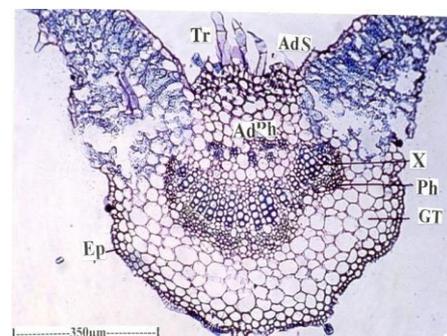


Fig. 3: Transverse Section of leaf through midrib with lamina¹¹

(GT- glandular trichome, Ep- epidermis, X- xylem, Ph- phloem, AdS- adaxial side, Tr- trichomes)



Fig. 4: Covering trichomes¹¹



Fig. 5: Glandular trichomes¹¹



Fig. 6: Epidermis - diacytic stomata¹¹

6. AYURVEDA AND TULSI

Ayurveda being one of the world's oldest medical system, has a philosophical approach in health promoting and disease prevention by practicing healthy lifestyle. Some of these practices include the preparation and use of Ramayana's (formulas) to eradicate ageing and also sometimes for the disease, regular consumption of adaptogenic herbs and plants which enhances body's ability to maintain balance during various stress conditions. India has incredible biodiversity of ayurvedic herbs but yet out of all the herbs, no herb has a status that can be compared to tulsi or holy basil.¹² Tulsi in Ayurveda is very well known as Dashemani Shwasaharni (anti-asthmatic) and kaphaghna (antikapic).¹³ *Ocimum sanctum* has been widely used as a principle medicinal herb for around thousands of years in Indian Ayurveda for its diverse, health promoting and multi healing properties. It is sacred and is also worshipped in its own sanctorum in Hindu temples and households in the subcontinent. Thus, its synonym Tulsi is more popular in Indian literature¹⁴. Whole plant including parts like leaves and roots along with stems and essential oil were used for medicinal properties like inhibiting the growth of *Escherichia coli*, *Bacillus anthracis*, *Mycobacterium tuberculosis* etc. Trials on Tulsi has shown its excellent antimalarial activity. Also, the extracts of *Ocimum sanctum* have potent activity against different allergies, asthma, stress, and diabetes. Tulsi extracts are also used in Heart ailments and as Blood purifier.

Tulsi tea relieves cough and cold, seasonal fever and other ailments related with 'Kapha' dosha in the human body. Tulsi leaf juice cures catarrh and bronchitis amongst children. Gargle with warm Tulsi leaves relieves throat irritation and pain. Other usage were to cure constipation or indigestion or to enhance appetite and reduce acidity. The herb was also highly recommended in women with menstrual problem and in pregnancy. Different extracts have been used for treating urinary tract infection. Also, it strengthens and enhances the immune system amongst children ¹⁵.

7. TRADITIONAL USES

Ocimum sanctum or commonly known as Tulsi is highly sacred and medicinal plant and finds enormous and extensive application in various systems of medicines in Asian, African, and South American countries. Pharmacological studies along with physiological studies carried out in the last few decades, reported anti stress, anabolic, anti-hypertensive, and cardiac depressant properties of this herb ¹⁶. The aerial parts like leaves, flowers, stems and underground parts like roots, seeds, of Tulsi are known to possess potential therapeutic use and been widely used by traditional medical practitioners as analgesic, expectorant, antiemetic, anticancer, antidiabetic, diaphoretic, hepato-protective, antifertility, anti-stress, hypotensive, etc. Tulsi preparation are suggested to shorten the course and duration of illness, clinical symptoms, biomedical and related parameters in patients suffering from viral hepatitis infection. Ophthalmic preparations, those which contains Tulsi leaf juice is recommended for painful eye diseases and other ophthalmic conditions like glaucoma, cataract, chronic conjunctivitis. Fresh juice of Tulsi is used to manage and cure patients with chronic fever and in diarrhea and dysentery, hemorrhage, and dyspepsia. Tulsi decoction is a popular remedy for cough and cold. It is also known to prevent emesis and has been used as anthelmintic too ¹³.

8. GEOGRAPHICAL STATUS

Ocimum sanctum is native to tropical and subtropical regions of Asia and found in Latin America as well as in Southern hemisphere. ¹⁷⁻¹⁹

9. BIO-POTENTIAL OF TULSI

9.1 Analgesic Activity

Fixed oil from the seeds of *Ocimum sanctum* (OS) gives analgesic activity. The inhibiting activity of the oil is centrally mediated due to combined inhibitory effects of histamine, prostaglandins, and acetyl choline ²⁰.

9.2 Anti-asthmatic Activity

Analgesic activity is seen from 50% aqueous ethanol extract of dried and fresh leaves and the volatile and fixed oils from seeds of *Ocimum sanctum*. It protects against acetylcholine and histamine induced pre-convulsive dyspnea ²¹.

9.3 Antibacterial Activity

Aqueous, alcoholic, chloroform extract and oil obtained from leaves of *Ocimum sanctum* gives antibacterial activity. Extracts were equally effective against pathogenic gram-positive and gram- negative bacteria ²².

9.4 Anticancer Activity

The 50% alcoholic aqueous leaf extract of various species of *Ocimum Sanctum* shows Antimelanoma activity. Orally administered extract (200 mg/kg, p.o.) showed significant reduction in tumor volume and increase in average body weight ²³.

9.5 Anticataleptic Activity

Aqueous extract (300 mg/kg, i.p.) and the alcoholic extract (300 mg/kg, i.p.) of the leaves of *Ocimum sanctum* showed anticataleptic activity ²⁴.

9.6 Anticonvulsant Activity

Ethanol and chloroform extracts of stem, leaf and stem callus of *Ocimum sanctum* showed anticonvulsant activity. This extracts mainly prevent tonic convulsions ²⁵.

9.7 Antiemetic Activity

Leaves of Tulsi are used for antiemetic action ²⁶.

9.8 Anti-helminthic Activity

Eugenol and the essential oil of *Ocimum sanctum*, gives potent anthelmintic activity ²⁷.

9.9 Antihyperlipidemic and Cardioprotective Activity

Antiartherogenic and cardioprotective actions were observed from fixed oil. It effectively decreased the high serum lipid profile against hyperlipidemia. Anti-hyperlipidemic action was also given by fixed oil which mainly resulted from the suppression of liver lipid synthesis. Linolenic acid and linoleic acid present in *Ocimum sanctum* fixed oil were probably responsible for both lipid-lowering and cardiac protective action against hyperlipidemia ²⁸.

9.10 Antihypertensive Activity

The *Ocimum sanctum* fixed oil administered intravenously produced hypotensive effect due to its peripheral vasodilatory action. Important fatty acids like linoleic and linolenic acid present in *Ocimum sanctum* oil gives series 1 and 3 (PGE1 and PGE3) prostaglandins and inhibit the formation of series 2 prostaglandins (PGE2).²⁹

9.11 Anti-stress Activity

Fresh leaves of *Ocimum sanctum* showed antistress activity against oxidative stress.³⁰

9.12 Antianxiety and Antidepressant Activity

Ethanol extract of leaves of *Ocimum sanctum* showed this activity. It showed activity against both anxiety and depressive disorder. The *Ocimum sanctum* extracts show both properties at same dose and can be a potential therapeutic agent against mixed anxiety and depressive syndrome ³¹.

9.13 Demulcent/Stimulant/Expectorant

Juice of leaves of *Ocimum sanctum* are used as demulcent, stimulant and expectorant. The seeds of *Ocimum sanctum* are mucilaginous and demulcent and they are given in different ailments of genito-urinary system. An infusion of leaf has been used as anti-spasmodic in gastric disorders of childrens ³².

9.14 Eye Disease

Triphala is used along with the leaf juice of *Ocimum sanctum* in ayurvedic eye drop preparations. It is used for glaucoma, chronic conjunctivitis, and other painful eye diseases. In day to day life, one can use three drops of Tulsi oil with honey and it is beneficial in improving eyesight ³³.

9.15 Hepatoprotective Activity

Alcoholic leaf extract of *Ocimum sanctum* is used for hepatoprotective activity. Extract shows synergism with silymarin ³⁴.

9.16 Immunomodulatory Activity

Aqueous extract of *Ocimum sanctum* at the oral doses of 100, 200 mg/kg/day enhances the Immunomodulatory Activity. The activity is seen with the enhanced production of RBC, WBC, hemoglobin and also the production of antibodies without affecting the biochemical parameters ³⁵.

9.17 Neuroprotective Activity

Neuroprotective activity is shown by administration of *Ocimum sanctum* (100 and 200 mg/kg p.o.) and its saponin rich fraction (100 and 200 mg/kg p.o.) for significantly 14 days. It reduced vincristine-induced neuropathic pain and also decreased oxidative stress and calcium levels³⁶.

9.18 Radio-protective Activity

Ocimum sanctum and amifostine pre-supplemented showed Radio-protective Activity. Flavonoids extracted from the leaves of *Ocimum sanctum* showed radio-protective activity on the erythrocyte antioxidants in oral cancer. Erythrocytes from cancer patients reacted to oxidative stress by elevating the glutathione level, but a decrease in the glutathione level was observed in *Ocimum sanctum* flavonoids treated patients due to the free radical scavenging effect of *Ocimum sanctum* flavonoids, sparing the glutathione^{37,38}.

10. CULTIVATION PRACTICES

- Soil: Climate requirement: Wide range of soils can be used to cultivate Tulsi plant.
- Cultivation: Rich loam, saline and alkaline to moderately acidic soils.
- Vegetative growth: Well drained soil.
- Root-rot and stunted growth occurs due to waterlogged conditions.
- Fairly heavy rainfall and humid climate nurtures and flourishes the plant well. Longer days higher temperatures are favorable conditions for the growth of plant and production of oil. It can be cultivated at higher altitude of around 900 meters.
- Propagation and planting period: Propagation of Tulsi occurs through seeds. The plant and nursery can be propagated February and transplantation can be done in the month of April.
- Nursery: About 300 gm of seeds can be used to raise the seedlings. The seeds being small in size are mixed with the sand and sown to a depth of 2 cm.
- Transplanting: Seedlings with 5-6 leaves are transplanted to get high oil yield. It is irrigated immediately after transplantation. By the time of second irrigation, the seedlings develop well.
- Irrigation: Three irrigations per month are done in summer season and during other seasons it is done as and when required except during rainy season when no irrigation is required.
- Harvesting: Maximum and better-quality oil is obtained when the seedlings are completely bloomed and harvested. The cut should be given at 15-20 cm above the ground level.
- Yield: 5 tons of freshly harvested plant per hectare gives 0.1-0.23% essential oil and an oil yield of 10-23 kg³⁹.

11. PHYTOCHEMICALS PRESENT IN *OCIMUM SANCTUM*

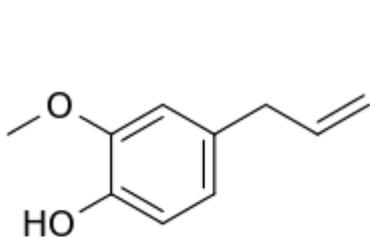
Tulsi is highly complex, containing many chemical constituents, nutrients, and other biologically active compounds. The composition of tulsi may vary considerably between strains and among the plants within the same field. By different growing, harvesting, processing and storage conditions the quantity of many of these chemical constituents is significantly affected and are not yet well understood.

The various phytoconstituents present in the different parts (Leaves, Seeds and other aerial parts) of Tulsi are summarized in Table-1.

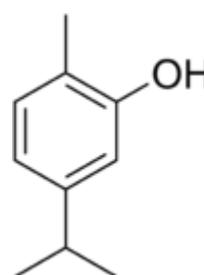
Table-1: Summary of Phytochemicals present in Tulsi ³⁸

Sr. No.	Type	Phytochemicals
1.	Fixed oil	Linoleic acid, Oleic acid, Palmitic acid, Stearic acid
2.	Essential oil	Benzaldehyde, Borneol, bornyl acetate, Camphor, Caryophyllene oxide, cis- α - Terpineol, Cubenol, Frualdeheyde, Limonene, n-butylbenzoate, Ocimene, Oleic acid, sebinene, Phytol, Veidifloro, β -Pinene, α -Thujjene, Methyl chavicol and linalool.
3.	Mineral contents	Vitamin C, Vitamin A, Calcium, Phosphorous. Chromium, Copper, zinc, Iron.
4.	Alcoholic extract	Aesculin, Apgenin, Caffiiec acid, Chlorganic Acid, Circineol, Gallic Acid, Isorientin, Luteolin, Molludistin, Procatechuic acid, Urosolic acid, Vallinin, Vallinin acid.

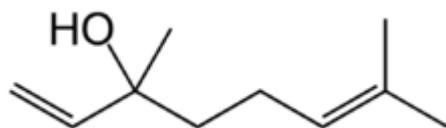
The synergistic interactions of many different active phytochemicals arise from the nutritional and pharmacological properties of the whole herb in its natural form and hence it is used traditionally. The overall effects of Tulsi cannot be fully duplicated with isolated compounds or extracts, because of its inherent botanical and biochemical complexity, Tulsi standardization has, so far, eluded modern science. The leaf volatile oil ^{40,41} contains eugenol, euginal (also known as eugenic acid), urosolic acid ^{41,44} carvacrol, linalool, limatrol, caryophyllene, methyl carvicol (also known as Estragol. The seed volatile oil contains fatty acids and sitosterol. The seed mucilage contains some levels of sugars and green leaves contains anthocyanins. The composition of sugars are xylose and polysaccharides. Tulsi is also known as a general vitalizer and it increases physical endurance. It contains no caffeine or other stimulants. The stem and leaves of tulsi also contain different types of constituents that have biological activity, including saponins, flavonoids, triterpenoids, and tannins.^{41,43} Additionally, some phenolic compounds have been identified, which also exhibit antioxidant and anti-inflammatory activities, Rosmarinic acid, propanoic acid, apigenin, circimaritin, isothymusin and isothymonin. Two water-soluble flavonoids:^{41,44} Orientin and Vicenin, have also shown to provide protection against radiation-induced chromosomal damage in human blood lymphocytes. The chemical structure of few important phytoconstituents are depicted in Figure-7.



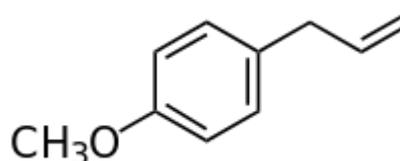
a) Eugenol



b) Carvacrol



c) Linalool



d) Estragole

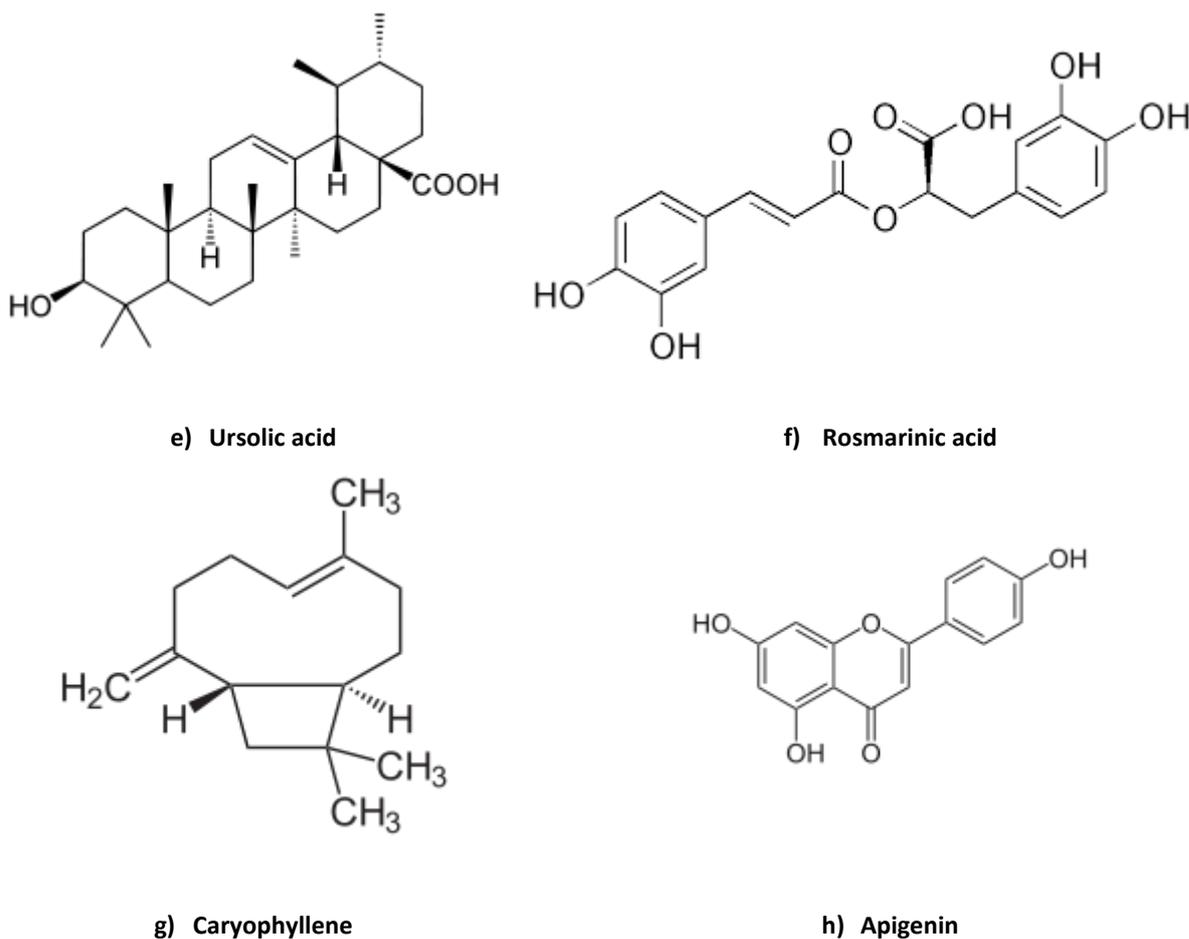


Fig. 7: Structures of chemical constituents of Tulsi ⁴⁵

12. NUTRITION VALUE

Tulsi acts as a source of vitamin C and A, and minerals like zinc, calcium, iron, and many other phytonutrients. It also enhances the digestive system and absorption of nutrients from food. Protein: 30 Kcal, 4.2 g; Fat: 0.5 g; Carbohydrate 2.3 g; Calcium: 25 mg; Phosphorus 287 mg; Iron: 15.1 mg and Edible portion 25 mg vitamin C per 100 g ^{41,46}.

13. AYURVEDIC FORMULATIONS OF TULSI

Ayurvedic formulation of tulsi includes: Tulsi Leaf Powder, Amruthamla Tulasi Churna, Basil Powder, Tulsi Leaves or Powder or Juice, Tulsi Panchang Powder, Basil Extract, Holy Basil Tea, Neem Tulsi soap Bar ¹⁵.

14. CONCLUSION

Tulsi being indigenous to the entire Indian continent is useful in managing and treating many disorders. It possesses a greater bio-potential activity right from being simply used as an analgesic or for cancer or as a radio protective agent. The use of Tulsi in daily rituals is a testament to Ayurvedic wisdom and provides an example of ancient knowledge offering solutions to modern problems.

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