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Astringent Siddha Botanicals: Bridging Traditional Wisdom and Modern Pharmacology

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Abstract

The Siddha system of medicine—one of India's oldest codified traditions—classifies materia medica by taste (suvai), potency (veeryam), post-digestive effect (pirivu), and unique therapeutic actions (siddhi). "Astringent" (thuvarppu suvai) herbs are prized in Siddha for their ability to "bind and consolidate" tissues, arrest secretions, and promote wound healing. Modern phytochemistry attributes

these actions mainly to tannins and other polyphenols with protein-precipitating capacity. Beyond their sensory signature, astringent Siddha botanicals exhibit a breadth of bioactivities substantiated by in vitro, in vivo, and emerging clinical data, ranging from antidiabetic and anti-ulcer effects to antiviral and nephro-protective actions. This narrative review integrates traditional concepts with contemporary pharmacological evidence, highlights formulation science, and identifies research gaps that must be bridged to translate ancient wisdom into validated therapeutics.
Keywords: Siddha medicine, astringency, tannins, polyphenols, antidiabetic, anti-ulcer, antiviral, nephroprotective

1 Introduction

The Siddha system of medicine—one of India's oldest codified traditions—classifies materia medica by taste (*suvai*), potency (*veeryam*), post-digestive effect (*pirivu*), and unique therapeutic actions (*siddhi*). "Astringent" (*thuvarppu suvai*) herbs are prized in Siddha for their ability to "bind and consolidate" tissues, arrest secretions, and promote wound healing. Modern phytochemistry attributes these actions mainly to tannins and other polyphenols with protein-precipitating capacity. Beyond their sensory signature, astringent Siddha botanicals exhibit a breadth of bioactivities substantiated by **in vitro**, **in vivo**, and emerging clinical data, ranging from antidiabetic and anti-ulcer effects to antiviral and nephro-protective actions. This narrative review integrates traditional concepts with contemporary pharmacological evidence, highlights formulation science, and identifies research gaps that must be bridged to translate ancient wisdom into validated therapeutics.

2 Concept of Astringency in Siddha Doctrine

In Siddha physiology, astringent taste (*thuvarppu*) is cooling, absorbent, and anti-secretory. It is believed to:

- Pacify aggravated *pitham* (fire element) and *kapam* (water element).
- Consolidate bodily tissues (*saareeram urukku*) and promote wound contraction.
- Arrest deranged fluid loss—diarrhoea, polyuria, menorrhagia.

Traditionally, astringent herbs are prescribed alone or as synergy-enhancing components in **chooranam** (powders), **kudineer** (decoctions), and **parpam** (calcined preparations).

3 Phytochemistry of Astringent Siddha Herbs

1. **Hydrolysable tannins** – gallotannins, ellagitannins in *Terminalia chebula* (Kadukkai).
2. **Condensed tannins** – proanthocyanidins in *Diospyros peregrina* (Vilaampu).
3. **Flavonoids & flavonol glycosides** – quercetin, kaempferol in *Cassia auriculata* (Avarai).
4. **Saponins** – gymnemic acids in *Gymnema sylvestre* (Sirukurinjan).
5. **Alkaloids** – trigonelline in *Trigonella foenum-graecum* (Venthayam).

These secondary metabolites confer antioxidant, enzyme-inhibitory, and membrane-stabilising properties that align with Siddha indications.

4 Pharmacological Evidence

4.1 Antidiabetic Activity

Herb / formulation	Model & dose	Key findings	Reference
Gymnema sylvestre leaf extract	STZ-induced rats; 200 mg kg^{-1}	↓ fasting glucose (48 %), ↑ plasma insulin, β-cell regeneration	(Jeyanthi 2017)
Trigonella foenum-graecum seed powder	T2D patients; 25 g day^{-1}/3 mo	↓ HbA1c 1.0 %, improved lipid profile	(Madar 2015)
Cassia auriculata flower decoction	Caco-2 glucose uptake	43 % SGLT1 inhibition	(Krishnan 2019)
Kazharchi Chooranam (*Sida cordifolia* + adjuvants)	HFD/STZ rats; 400 mg kg^{-1}	↓ HOMA-IR, renal antioxidant restoration	(Parvathy 2023)

Mechanisms encompass α-glucosidase inhibition, pancreatic β-cell protection, and modulation of GLUT-4 translocation.

4.2 Anti-ulcer and Gastro-protective Effects

Azadirachta indica flower powder (*Vempam Poo Choornam*) protected Wistar rats against ethanol-induced gastric lesions, reducing ulcer index by 68 % and inhibiting H^+/K^+-ATPase with an IC_{50} of 34 µg mL^{-1}, comparable to omeprazole (P et al. 2024). Polyphenols (nimbin, quercetin) enhanced mucin secretion and scavenged mucosal ROS.

4.3 Anthelmintic Properties

Aqueous extracts of *Acalypha indica* (Kuppaimeni) and *Allium sativum* (Poondhu) induced paralysis and death of *Pheretima posthuma* within 20 min at 25 mg mL^{-1}—activity linked to tannins and organosulphur compounds (Neela 2017). Siddha texts recommend these for paediatric worm infestations.

4.4 Antiviral and Immunomodulatory Potential

During the COVID-19 pandemic, Siddha physicians prescribed *Zingiber officinale* (Inji), *Ocimum sanctum* (Thulasi), *Tinospora cordifolia* (Seenthil), and *Adathoda vasica* (Adathodai) in *Kabasura Kudineer*. In silico docking indicated strong binding of 6-gingerol and vasicine to SARS-CoV-2 main protease (Muralidass & Devi 2021). A pragmatic clinical study (n = 60) reported faster symptom resolution (median 4 days vs 7) when *Kabasura Kudineer* was added to standard care (Rajendran 2022).

4.5 Renal and Reproductive Indications

Tribulus terrestris-based *Yanai Thalai Chooranam* mitigated cisplatin nephrotoxicity in mice via up-regulating Nrf2 and down-regulating TGF-β1 (Kowsalya 2024). For polycystic ovary syndrome, *Kazharchi Chooranam* normalised oestrous cycling and reduced ovarian cyst diameter in letrozole-induced rats (Parvathy 2023).

5 Formulations and Delivery Systems

1. **Choornam** (powder) – e.g., *Mallikai Choornam* (Jasmine bud powder) exhibited broad-spectrum antimicrobial action against uropathogens, MIC 64 µg mL^{-1} (Rathiga 2018).
2. **Kudineer** (water decoction) – rapid extraction of heat-stable tannins; shelf-life 24 h, prompting spray-dried instant granule development.
3. **Mathirai** (tablets) – compression of *Triphala* polyherbal blend; enteric coating masks astringency and improves patient compliance.
4. **Nanophytosomes** – encapsulation of gymnemic acid in phospholipid vesicles enhanced intestinal permeability 2-fold (Arutselvan 2021).

6 Mechanistic Insights

- **Protein Precipitation & Mucosal Sealing:** Ellagitannins from *Terminalia chebula* crosslink mucins, explaining anti-diarrhoeal use.
- **Enzyme Inhibition:** Gymnemic acids block sweet receptor TAS1R2/TAS1R3, reducing glucose absorption—an astringent mouth-feel cue aligns with functional antagonism.
- **Ion-Transport Modulation:** Catechins from *Cassia auriculata* inhibit gastric H^+/K^+-ATPase, underpinning anti-ulcer claims.
- **NF-κB and Nrf2 Crosstalk:** Polyphenols from *Azadirachta* and *Tinospora* suppress pro-inflammatory signalling while boosting antioxidant defences.

7 Safety, Toxicology, and Regulatory Considerations

Most Siddha astringent herbs are classified "Schedule E1" by AYUSH and require dose vigilance. Sub-acute toxicity studies indicate NOAELs of 1000 mg kg^{-1} for *Gymnema* leaf powder (Subramanian 2019). However, high tannin loads can impair iron absorption; standardisation to polyphenol thresholds (< 5 % w/w) has been proposed. Herb–drug interactions—e.g., synergistic hypoglycaemia with metformin—necessitate pharmacovigilance.

8 Analytical Quality Control

- **HPLC-DAD** profiling of gallic acid (Triphala); gymnemagenin (Gymnema) as chemical markers.
- **FT-IR chemometrics** authenticate *Cassia auriculata* raw drug against adulterants.
- **In-vitro protein precipitation index** predicts sensory astringency, aiding formulation balance.
- **DNA barcoding** (ITS, rbcL) secures botanical identity of powdered materials.

9 Limitations and Research Gaps

1. Scarcity of randomised controlled trials with adequate blinding and sample size.
2. Need for **systems-pharmacology** models to capture multi-component, multi-target interactions.

3. Validation of traditional processing (e.g., *saaththu patham* calcination) on tannin polymerisation and bio-availability.
4. Harmonised **Good Manufacturing Practice (GMP)** guidelines for Siddha pharmacies.
5. Inclusion of **patient-reported outcome measures** to capture sensory acceptance vis-à-vis inherent astringency.

10 Future Directions

- CRISPR-engineered hairy-root cultures for sustainable production of gymnemic acids.
- **Nano-tribological** sensors to quantify mucosal friction changes induced by Siddha decoctions.
- **Precision-Herbomics:** tailoring prescriptions to salivary protein genotypes affecting astringency perception.
- Integrative clinical trials combining Siddha and allopathic standards for chronic metabolic diseases.

11 Conclusion

Astringent Siddha botanicals constitute a pharmacopeia rich in tannins, flavonoids, and saponins that impart both characteristic mouth-feel and multifaceted therapeutic actions. Contemporary research corroborates their antidiabetic, gastro-protective, antiviral, nephro-protective, and antimicrobial effects, though rigorous clinical validation remains limited. Advances in analytical standardisation, delivery technologies, and mechanistic biology are gradually converting ancient empirical remedies into evidence-based adjuncts of modern healthcare. Bridging remaining gaps will require interdisciplinary collaboration, robust clinical methodologies, and regulatory support to harness the full potential of astringent Siddha medicine.

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