Review Article

Velvangam (Tin) – A Unique Metallic Drug in the Siddha System of Medicine: Its Modern and Siddha Pharmacological Benefits – A Review

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ABSTRACT

This research paper provides a comprehensive review of *velvangam* (tin) within the Siddha System of Medicine, emphasizing its historical significance, scientific understanding, and therapeutic potential. The aim is to bridge traditional Siddha practices with modern scientific insights into the medicinal applications of *velvangam*. A literature review was conducted over six months, encompassing ancient Siddha texts and contemporary scientific databases including Science Direct, PubMed, Cochrane, and Google Scholar. The review focuses on the source, properties, and purification methods of tin, as well as its pharmacological activities and therapeutic uses in Siddha formulations. *Velvangam*, (tin) is integral to several Siddha medicinal preparations. Scientifically, tin compounds, particularly tin dioxide (SnO_2), demonstrate significant antimicrobial, anticancer, and antioxidant properties. Traditional purification methods such as burial and juice soaking enhance the bioavailability and safety of *velvangam*. Analysis of formulations like *Velvanga Parpam* and Thanga Uram reveals that they are free from harmful heavy metals and show promise in treating conditions such as haemorrhoids and cognitive disorders. This review highlights the convergence of traditional Siddha knowledge and modern scientific validation of *velvangam*'s therapeutic potential. The evidence supports its efficacy in various medical applications and underscores the importance of continued research to explore its full therapeutic potential. This integration of traditional and scientific perspectives enhances our understanding of *velvangam* and supports its use in contemporary therapeutic practices.

Keywords: Siddha Medicine, Velvangam, Tin, Pharmacological Activities, Purification Methods, Antimicrobial, Anticancer, Antioxidant, Therapeutic Potential.

INTRODUCTION

The Siddha System of Medicine is an established and revered medical tradition practiced in south India. The name "Siddha" is derived from the Tamil word "Siddhi," which signifies the attainment of perfection or heavenly bliss. This nomenclature reflects the system's philosophical underpinnings and its practitioners' esteemed status[1]. The Siddhars, a class of Tamil sages considered "perfected" or "holy immortals," are credited with the development of Siddha Medicine. These sages are reputed to possess superhuman powers and were instrumental in the formulation of the Siddha system. Siddha Medicine is distinguished by its comprehensive approach to health, emphasizing both mind and body systems. It is renowned for its holistic approach and its purported ability to bestow longevity. The system's unique characteristic is its integration of diet, lifestyle, and medicinal preparations to maintain health and treat diseases. One of the notable features of the Siddha system is its use of metallic preparations in treating various ailments. The Siddhars elaborated extensively on the application of these preparations in their ancient texts. These texts provide detailed accounts of how metallic elements are utilized to address different medical conditions, underscoring the system's distinctive approach to healing[2]. This article provides an in-depth exploration of velvangam(tin), focusing on its scientific understanding, pharmacological activities, and therapeutic potential as described in Siddha texts. The review highlights velvangam's inclusion in various compound formulations and dosage forms. Its pharmacological and physicochemical properties are examined to underscore its significance and beneficial medical applications.

MATERIALS AND METHODS

Study design: Review

Research type: Literature review

Research period: 6 months

Literature collected from: A thorough evaluation of these information, formulations and research findings were conducted using information from ancient Siddha texts as well as evidence from electronic databases like Science Direct, PubMed, Cochrane, Google Scholar and other scientific databases.

RESULTS

Source and production of tin

Tin is naturally present in the Earth's crust, with an average concentration of about 2–3 mg/kg. It is primarily extracted from cassiterite (SnO_2), although it can also be found in complex sulphide ores such as stannite (Cu_2FeSnS_4), teallite ($PbSnS_2$), canfieldite (Ag_8SnS_6), and cylindrite ($PbSn_4FeSb_2S_{14}$). While global tin production remained fairly steady at around 210,000–230,000 tonnes per year for many years, it has been gradually increasing, reaching 268,000 tonnes in 2003. Over 22 countries produce tin,

with the largest producers in 2001 being China (36%), Indonesia (23%), Peru (17%), Brazil (6%), Bolivia (6%), and Australia (4%)[3].

Properties of tin metal and its compounds

Tin (CAS No. 7440-31-5) has the atomic symbol Sn, the atomic number 50, an atomic mass of 118.71, Electron Configuration [Kr]5s24d105p2 and Oxidation States +4, +2. Tin occurs naturally as the stable isotopes 112Sn (0.97%), 114Sn (0.65%), 115Sn (0.36%), 116Sn (14.5%), 117Sn (7.7%), 118Sn (24.2%), 119Sn (8.6%), 120Sn (32.6%), 122Sn (4.6%), and 124Sn (5.8%). The most commercially significant inorganic tin compounds include tin (II) chloride, tin (IV) chloride, tin (IV) oxide, potassium and sodium stannate, tin (II) fluoride, tin (II) difluoro borate, and tin (II) pyrophosphate. Pure tin exists in two allotropic crystalline modifications: grey tin (alpha form) and white tin (beta form). At low temperatures (at about 18 °C and below), the grey tin changes to white tin[4,5].

PHYSICAL AND CHEMICAL PROPERTIES OF TIN METAL AND ITS COMPOUNDS

Compound (formula)	Solubility in water	Melting point (°C)	Boiling point (°C)
Sn	Insoluble	232	2602
$SnBr_4$	Slightly soluble	31	205
SnO_2	Insoluble	1630	1900
SnO	Insoluble	1080	No data
$SnCl_2$	Soluble	247	Decomposes at 623–652
SnI_2	Slightly soluble	320	714
SnI_4	Slightly soluble	143	365
SnS	Insoluble	880	1210
$SnCl_4$	Slightly soluble	−33	114
$Sn_2P_2O_7$	Insoluble	Decomposes at 400	–
SnF_2	Slightly soluble	213	850[6]

PROPERTIES OF VELVANGAM IN SIDDHA LITERATURE

Tamil name: *velliyam, vennagam, kudilam, thavala vangam, suvedha vangam, pandi, marasagam.*

Taste: *Kaippu* (Bitter)

Potency: *Veppam* (Hot)

Divison: *Kaarppu* (Pungent)

Action: Antiseptic, Astringent, De-obstruent, Coolant[7]

PURIFICATION METHODS IN SIDDHA LITERATURES

Burial method:

- Powdered tin is first soaked in 210 grams of plant juice from *Diplocyclos palmatus* (*iveli*) and left to isolate for one day before being washed. This process is repeated daily for nine more days, followed by a two-day period of isolation without juice. The entire procedure is then repeated once more. Subsequently, 5.3 litres of juice are placed in an earthen pot, which is sealed with mud-pasted cloth and buried for 20 days.

Melting and Cooling method:

- Tin is melted and poured into a pot containing a mixture of goat's urine, sesame oil, and juice from *Cissus quadrangularis* (*Pirandai*). The tin is then allowed to cool in this mixture.
- Melted tin is poured into a mixture of *Curcuma longa* (turmeric) and juice from *Vitex negundo (notchi)*. This process is repeated twice to achieve purification of the tin.

Juice Soaking:

- Powdered tin is soaked in juice from *Vitex negundo* and left to dry until completely isolated[7,8].

SIDDHA MEDICINES IN WHICH VELVANGAM IS A MAIN INGREDIANT:

1. *VELVANGA PARPAM*-I

Main ingredients	*Velvangam* (Tin), *Perkankkai juice* (*Luffa acutangula*), *Vellari* juice (*Cucumis sativus*), *Kovai* juice (*Coccinia grandis).*
Preparation	*Velvangam* is grinded with the other ingredients and subjected to *pudam*.
Dosage	488 milligrams
Adjuvant	*Thulasi (Ocimum sanctum)* juice, *Karisalai (Eclipta alba)* juice, cow's milk, honey, butter, cold water, *Thippili (Piper longum)* decoction, *Milagu (Piper nigrum)* decoction.
Indication	*Vaatha* diseases, *Pitha* diseases, *Kabha* diseases, Menorrahigia, *Pitha* chest pain, Headache, Sinusitis, Hemorroids[7]

2.*VELVANGA PARPAM*-II

Main ingredients	*Velvangam* (Tin), *Vaalai rasam* (Mercury), *Karpoora silasathu* (Gypsum)
Preparation	Ingredients are grinded with *chunna neer* (lime water) and subjected to pudam[9].
Dosage	488 milligrams
Adjuvant	Dried pomegranate flower powder and Cumin seed powder
Indication	9 types of piles[7]

3.*VELVANGA CHUNNAM*

Main ingredients	*Velvangam* (Tin), *Vaalai rasam* (Mercury), Eggshell , *Veeram* (Hydrargyrum perchloride)
Preparation	Ingredients are grinded with chunna neer (lime water) and heated in furnace[10]
Dosage	65 milligrams
Adjuvant	Honey
Indication	Gonococcal arthritis and Syphilitic arthritis[7]

4.*VELVANGA CHENDOORAM*

Main ingredients	*Velvangam* (Tin), *Puli ilai (Tamarindus indica)* juice, *Arasu ilai* (*Ficus benghalensis)* juice, *Vizhuthi ilai (Cadaba fruticose)* juice, *Sitha ilai (Annona squamos)* juice, *Ponmusuttai (Cissampelos pareira)* juice, *chitarathai (Alpinia officinarum)* juice.
Preparation	*Velvangam* is grinded with the other ingredients and subjected to *pudam*.
Dosage	488milligrams
Adjuvant	Water, sugar, cow's ghee, *Milagu* decoction, hot water, sugarcane juice, bittle leaf juice
Indication	*Kabha* diseases, Fever, Rickets, Headache, V*aatha* diseases, Peptic ulcer, Skin diseases[7]

5.*THANGA URAM* (STANNIC SULPHIDUM)

Main ingredients	*Velvangam* (Tin), *Vaalai Rasam* (Mercury), *Gandhagam* (Sulphur), *Navaacharam* (Ammonii chloridum)
Preparation	Ingredients are grinded with nitric acid and subjected to controlled burning for 25 hours before cooling.
Dosage	130 to 260 milligrams
Adjuvant	Not mentioned.
Indication	Male and female Urogenital disorders, Venereal diseases and Chronic leucorrhea[7]

6. *VELLI URAM*

Main ingredients	*Velvangam* (Tin), *Vaalai Rasam* (Mercury), *Gandhagam* (Sulphur), *Navaacharam* (Ammonii chloridum), *Padigaram* (Alum).
Preparation	Same as *Thanga uram* preparation
Dosage	65 to 130 milligrams
Adjuvant	*Jathikaai ilagam*[11]
Indication	Genital diseases, Venereal diseases[7]

REPORTED EVIDENCES OF *VELVANGAM*

Antimicrobial activity

The antibacterial activity of SnO_2 nanoparticles against both Gram-positive and Gram-negative bacteria, specifically *E. coli* and *S. aureus*. The research demonstrates that SnO_2 nanoparticles exhibit significant antibacterial effects, particularly under UV light, which enhances their performance by generating highly reactive oxygen species (ROS) responsible for bacterial cell damage. Control experiments revealed that the nanoparticles alone, when not exposed to UV light, still showed bactericidal activity, contrasting with nano-TiO_2, which requires light for its antibacterial effects. Key factors influencing the efficacy of SnO_2 nanoparticles include their morphology, surface area, surface charge, and aggregation, as well as the production of ROS and pH levels. The study also addresses catalyst regeneration, noting that SnO_2 nanoparticles maintain their antimicrobial efficiency even after multiple uses. The results highlight that SnO_2 nanoparticles are more effective against *E. coli* than *S. aureus*, attributed to differences in bacterial cell wall structures. The research employed a solvothermal method to synthesize spherical SnO2 nanoparticles, demonstrating their superior antibacterial activity under UV illumination and their potential for repeated use in antimicrobial applications[12].

Anticancer activity

1. The size-dependent cytotoxicity of tin dioxide nanoparticles (SnO_2NPs) on HCT116 and A549 cancer cell lines is evaluated. Three SnO_2NP samples of varying diameters—8.85 ± 3.5 nm (S1), 12.76 ± 3.9 nm (S2), and 25.99 ± 8.2 nm (S3)—were examined for their impact on cell viability. Results revealed that smaller nanoparticles exhibited greater cytotoxicity, with the smallest particles (S1) demonstrating the highest effect on both cancer cell lines. Additionally, cytotoxicity was found to increase in a dose-dependent manner, with higher concentrations of SnO_2NPs leading to increased cell death. The study also evaluated the influence of the capping agent, *Piper nigrum* seed extract, used in the green synthesis of SnO2NPs, and found it to be non-cytotoxic under the same conditions. IC_{50} values for the SnO_2NP samples were 165, 174, and 208 µg/L against HCT116 cells, and 135, 157, and 187 µg/L against A549 cells, respectively. This study underscores the potential of smaller SnO_2NPs as more effective anti-cancer agents and highlights the negligible impact of the capping agent on cytotoxicity[13].

2. The synthesis of tin dioxide nanoparticles (SnO2NPs) using a sugar apple *(Annona squamosa)* peel extract-mediated process and evaluates their cytotoxicity against the HepG2 hepatocellular carcinoma cell line. The synthesized SnO_2NPs exhibited an IC_{50} value of 148 µg/mL, indicating their cytotoxic potential. Additionally, a comparative analysis with previous research revealed that exposure of HCT116 human cells to 1 µg/mL super-paramagnetic iron oxide nanoparticles (SPIONPs) for 24 hours did not affect cell viability, suggesting variability in cytotoxic effects across different cell types. The study proposes that the cytotoxicity of nanoparticles is influenced by their size and dose, as well as their interaction with cell membrane proteins, intracellular penetration, and generation of reactive oxygen species (ROS). These factors contribute to oxidative stress and cell damage by disrupting the redox balance within the cells. The presence of pro-oxidant functional groups on the nanoparticles' surface and their interactions with cellular components are key determinants of their cytotoxicity, affecting cellular signalling and immune responses[14].

Antioxidant activity

The antioxidant potential of tin dioxide nanoparticles (SnO_2NPs) using the 1,1-diphenyl-2-picryl hydrazyl (DPPH) assay, a common method for estimating free radical scavenging activity. DPPH, a stable free radical characterized by its deep purple color, turns yellow upon scavenging or reduction. When SnO_2NPs are introduced to a DPPH solution, the solution gradually shifts from purple to yellow, indicating the scavenging activity of the nanoparticles. The reduction of DPPH is attributed to the interaction between the free radical and the antioxidants provided by SnO_2NPs, forming DPPH-H and demonstrating the scavenging potential. The extent of color change correlates with the concentration of SnO_2NPs, and the antioxidant activity is directly proportional to their concentration. The scavenging activity is identified as a surface reaction, where the interaction occurs on the nanoparticle surface. The study also highlights that factors such as particle size, morphology, and defects impact the radical scavenging capability of SnO_2NPs. Further research is recommended to explore these factors in depth to enhance the understanding of the antioxidant mechanisms of SnO2 nanoparticles[15].

REPORTED EVIDENCES OF *VELVANGA PARPAM*

Heavy Metal Analysis of *Velvanga Parpam* by ICP-OES

Velvanga Parpam was analysed to determine its elemental composition and safety for consumption. Using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) with a PERKIN ELMER OPTIMA 5300 DV instrument, the study found the highest concentration of Tin at 441.210 mg/L, indicating that Tin is the primary element in the formulation. Additionally, the Phosphorus concentration was measured at 46.301 mg/L. Crucially, the analysis revealed that heavy metals such as Mercury, Arsenic, Copper, Zinc, Lead, and Cadmium were absent from the medicine. These findings confirm that *Velvanga Parpam* is free from harmful heavy metals and is thus deemed safe for human consumption[16].

Anticancer activity of *velvanga parpam*

The anti-tumor efficacy of *Velvanga Parpam* in mice transplanted with Dalton's Ascitic Lymphoma (DAL), assessing its impact on mean survival time (MST), haematological parameters, solid tumor volume, and ascitic fluid characteristics. Mice receiving DAL exhibited an MST of 22 days, which was significantly extended to 26 and 34.32 days with *Velvanga Parpam* at doses of 1.5 and 3 mg/kg, respectively, approaching the MST of the standard drug, 5-FU (41.21 days). Haematological analysis revealed typical malignancy-induced alterations, including decreased haemoglobin (Hb), red blood cells (RBC), and lymphocytes, alongside increased white blood cells (WBC), particularly neutrophils, protein, and packed cell volume (PCV). *Velvanga Parpam* effectively reversed these changes, suggesting its potential tumoricidal effect and ability to maintain a normal haematological profile. Tumor volume measurements indicated a significant reduction from 6.63±0.13 ml to 4.15±0.09 ml with *Velvanga Parpam* treatment ($P<0.01$). Additionally, cytological studies of ascitic fluid revealed that *Velvanga Parpam* induced significant cellular degeneration and vacuolation in tumor cells. Treatment also led to a reduction in ascitic fluid volume, which is crucial for tumor nutrition. Overall, *Velvanga Parpam* demonstrated a notable anti-tumour effect by extending lifespan, reducing tumor and ascitic fluid volumes, and improving haematological parameters, underscoring its potential as an effective anticancer agent[17].

***Velvanga parpam* in the treatment of bleeding Haemorrhoids**

The efficacy of *Velvanga Parpam* in treating patients with haemorrhoids is evaluated. Forty patients were enrolled, with data collected on gender, age, baseline clinical features, and symptoms at the time of enrolment. All participants experienced bleeding during defecation and constipation, while 15% reported pruritus ani and 37.5% had a loss of appetite. The majority of patients were labourers (27.5%) or homemakers (30%), suggesting occupational factors may contribute to the condition. Clinical outcomes showed significant improvement, with 30 patients experiencing relief from bleeding during defecation and 35 from constipation. Laboratory results indicated an improvement in haemoglobin (Hb) levels, with 37.5% of patients showing notable enhancement. Grading of improvement revealed 60% of patients had good improvement, 25% moderate, and 15% poor response. Statistical analysis using the McNemar Test confirmed significant reductions in symptoms ($P<0.001$). The findings suggest that *Velvanga Parpam* possesses potent anti-hemorrhoidal properties and demonstrates both efficacy and safety in managing hemorrhoidal symptoms[18].

FTIR characterization of *Velvanga Parpam*

Fourier-transform infrared (FTIR) spectroscopy was utilized to analyse the chemical composition of the *Velvanga Parpam*. The spectroscopic analysis revealed significant peaks at wave numbers 3644, 2981, 2872, 2513, 2355, 2318, 2139, 1797, 1112, 875, 709, and 642, corresponding to functional groups such as OH, C-H, O-H, C≡C, C=O, C-F, C-Cl, and C-Br. These peaks indicate the presence of various organic functional groups, including alkanes, carboxylic acids, alkynes, anhydrides, fluorides, aromatics, chlorides, and bromides. The identification of these functional groups suggests potential medicinal properties inherent to *Velvanga Parpam*[19].

Toxicity study on *velvanga parpam*

The safety and toxicity of *Velvanga Parpam* administered orally at various doses up to 10 mg/kg over a 28-day period. All animals, including those in both control and treated groups, survived throughout the study duration. No significant signs of intoxication were observed in any dose group. Body weight gain and food consumption were consistent across both control and treated animals. Ophthalmoscopic examinations did not reveal any abnormalities, and functional observation tests at termination indicated no unusual findings. Haematological and biochemical investigations showed minor changes within normal biological and laboratory limits, such as slight decreases in total RBC counts and platelet levels at higher doses, and small variations in protein levels and aspartate aminotransferase. Urinalysis and organ weight data also showed no abnormalities. Both gross and histopathological examinations confirmed the absence of treatment-related changes. These results suggest that *Velvanga Parpam* is safe for use at doses up to 5 mg/kg, supporting its therapeutic potential with this dosage recommendation[20].

REPORTED EVIDENCES OF *THANGA URAM*

Instrumental analysis of *Thanga uram*

The safety and standardization of *Thanga Uram*, a therapeutic substance, by assessing its non-toxicity and chemical composition is evaluated. The drug's safety was confirmed as non-toxic at therapeutic doses. Standardization was achieved through chemical analyses including Fourier-transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD). FTIR analysis revealed absorption bands at 3200–3500 cm^{-1}, indicating the presence of O-H groups in celluloses, hemicelluloses, and lignin, which suggest potential antimicrobial activity. XRD analysis identified key peaks corresponding to elemental compositions, including sulphur (2-theta value of 29.59) and lead (2-theta values of 20.65 and 27.10), with significant matching intensities. The results confirm the presence of mercury, sulphur, and lead in *Thanga uram*, thereby providing a comprehensive understanding of its chemical properties and potential therapeutic applications[21].

Cognitive Enhancement Activity of *Thanga Uram*

The pharmacological study to evaluate the cognitive enhancement effects of *Thanga uram* (Stannic sulphidum) in Wistar albino rats using the Hebb-Williams maze to measure memory performance. The study compared the impact of various doses of *Thanga uram*, administered orally for seven days, against a control group and piracetam, a known nootropic agent. Results indicated that while lower doses of *Thanga uram* (23 mg/kg) showed no significant effect, higher doses (46 mg/kg) significantly reduced the time taken to reach the reward chamber, reflecting improved memory. Piracetam also improved memory performance. Furthermore, *Thanga uram* demonstrated protective effects against memory deficits induced by scopolamine, diazepam, and aging. The findings suggest that *Thanga uram* has potential as a cognitive enhancer and could be beneficial in treating cognitive disorders[22].

DISCUSSION

The Siddha System of Medicine, with its deep historical roots and holistic approach, provides a unique lens through which to evaluate traditional medicinal practices. This review focused on velvangam (tin) within the Siddha system, analysing its historical use, scientific understanding, and potential therapeutic benefits. The integration of velvangam in Siddha formulations highlights its importance in treating various ailments, particularly through its unique purification methods and compound formulations. Tin, or velvangam, has been studied for its diverse pharmacological activities, validating some of its traditional uses described in Siddha texts. Scientific evidence reveals that tin compounds, particularly tin dioxide (SnO_2), exhibit significant antimicrobial, anticancer, and antioxidant properties. The studies on SnO_2 nanoparticles have demonstrated notable antibacterial effects, especially under UV light, and highlighted their potential in cancer treatment due to their size-dependent cytotoxicity and ability to induce oxidative stress in cancer cells. The review underscores the scientific basis for several of the medicinal claims associated with velvangam. For instance, the antimicrobial activity of SnO_2 nanoparticles aligns with Siddha literature describing velvangam's antiseptic properties. The anticancer potential of velvangam, as seen in the studies with Velvanga Parpam, aligns with its traditional use in treating conditions such as haemorrhoids and various cancers. The significant reduction in tumour volume and improvement in haematological parameters in experimental models supports its therapeutic potential.

The purification methods for velvangam described in Siddha texts, such as the burial method and juice soaking, are integral to its preparation and efficacy. The detailed process of purification not only aligns with traditional practices but also appears to enhance the bioavailability and safety of tin in medicinal preparations. Analysis of Velvanga Parpam and Thanga Uram indicates that these formulations are free from harmful levels of heavy metals, further validating their safety for human use. The therapeutic potential of

velvangam extends beyond traditional claims, with scientific studies demonstrating its efficacy in treating haemorrhoids, cognitive disorders, and potentially other conditions. The safety profiles of these formulations, including the absence of significant toxicity at therapeutic doses, support their continued use in Siddha medicine.

CONCLUSION

This review illustrates the valuable intersection of traditional Siddha medicine and modern scientific validation, specifically through the study of velvangam (tin). The historical and scientific perspectives converge to underscore velvangam's significant role in Siddha formulations. Scientific studies support the traditional claims of its antimicrobial, anticancer, and antioxidant properties, validating its use in various therapeutic applications. The purification methods described in Siddha literature enhance our understanding of the preparation processes and ensure the safety and efficacy of velvangam-based formulations. The reviewed evidence suggests that velvangam, particularly in the form of Velvanga Parpam and Thanga Uram, holds promise as a therapeutic agent, benefiting from both its traditional uses and modern scientific validation. The integration of traditional knowledge with contemporary scientific research offers a holistic approach to understanding and harnessing the therapeutic potential of ancient medicinal practices.

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