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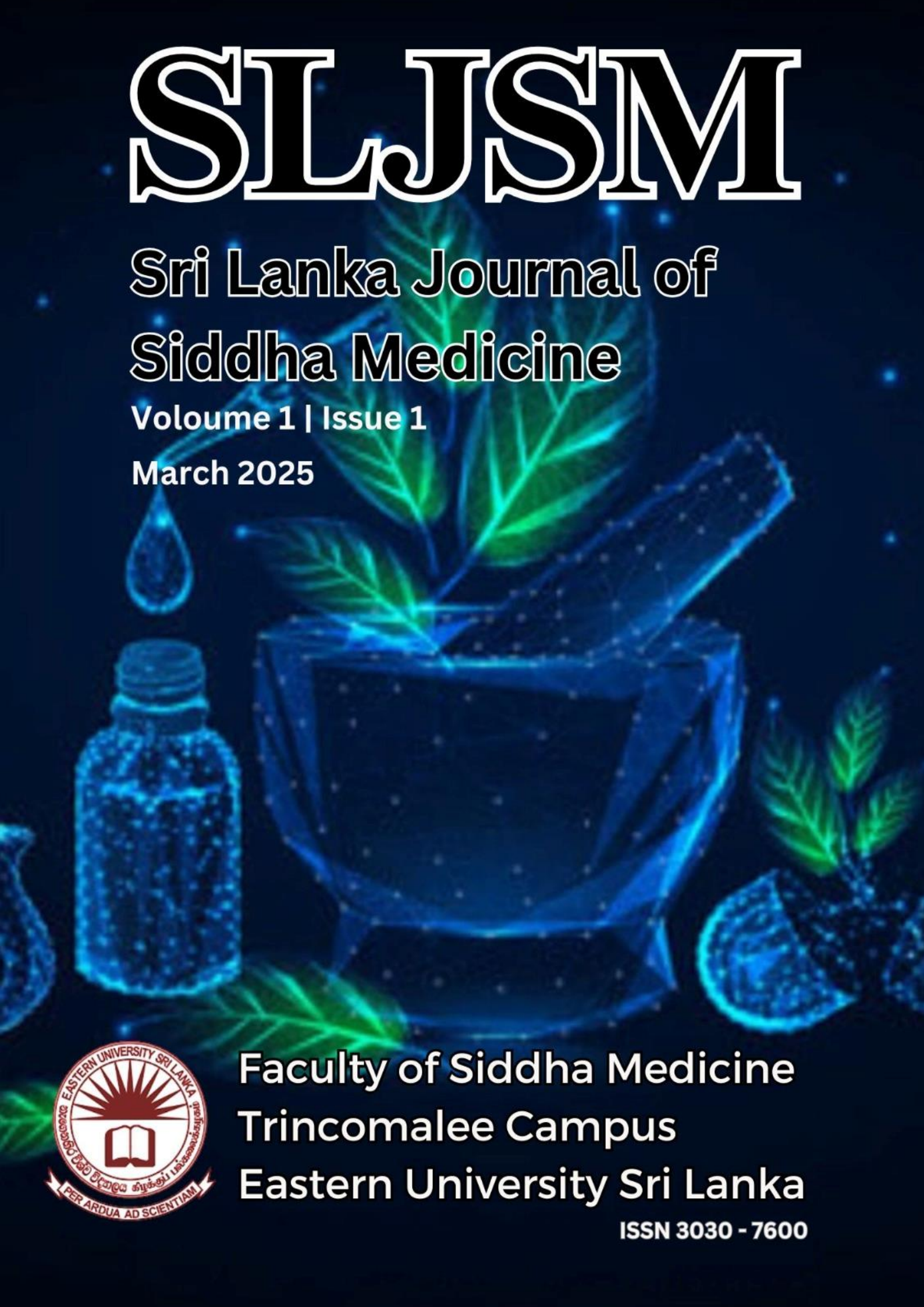

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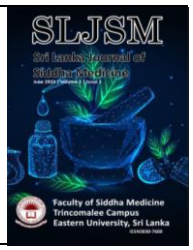

A Review of Wound Healing Potential of *Soodan* (Camphor) and Its Integration in Siddha Medicine

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ABSTRACT

Soodan (Camphor), derived from *Cinnamomum camphora*, exhibits significant potential as a wound healing agent due to its diverse pharmacological actions, including antibacterial, antifungal, analgesic, anti-inflammatory, antioxidative, antipruritic, and counterirritant effects. These therapeutic properties are attributed to its rich phytochemical composition, particularly monoterpenes, sesquiterpenes, and borneol. Siddha philosophy emphasizes its role in balancing tridoshas (vatham, pitham and kapham), a key factor in promoting healing.

Animal studies highlight *Soodan*'s efficacy in accelerating wound closure. In a Wistar rat model, 10% *Soodan* ointment significantly reduced wound size compared to controls, with highly significant outcomes by Day 14 ($p<0.000$). Camphor's antibacterial properties were demonstrated by its inhibitory effects on pathogens such as Staphylococcus aureus and Escherichia coli. Its anti-inflammatory effects include reducing cytokine levels like IL-1β and TNF-α. Additionally, its antioxidative action is supported by flavonoid-rich extracts that effectively neutralize free radicals.

Soodan's pharmacokinetics reveal rapid absorption and hepatic metabolism, though its ability to cross the placenta necessitates caution during pregnancy and lactation. While traditional Siddha texts align with modern evidence, further research is needed to explore its full therapeutic potential and optimize safe, effective clinical applications. *Soodan* integrates

Siddha principles with modern pharmacology, demonstrating remarkable promise as a wound-healing agent due to its multi-faceted therapeutic properties and clinical efficacy in accelerating healing.

Keywords: Anti-bacterial, Anti-inflammatory, chemical components of Camphor, Wound healing

INTRODUCTION

Wounds are a major global health concern, particularly in developing nations, where they contribute significantly to morbidity and permanent impairment. The growing challenges of drug resistance, allergies to synthetic pharmaceuticals, and limited access to affordable medications highlight the urgent need for alternative treatments. In Sri Lanka, the economic crisis has further restricted the availability of cost-effective wound care solutions (World Health Organization, 2008; Amini, et al., 2015).

Soodan (Camphor), derived from *Cinnamomum camphora*, is widely known in Sri Lanka for its use in traditional medicines and religious practices. Siddha Tamil literature emphasizes the therapeutic value of *Soodan*, particularly in wound healing, as noted in the following stanza:

"*Kirumisala thodang kilaivalippu sanni*
*porumu mantham angipatta **pun**nodu eru surangal*
vanthi pitham seethamuru vatham sevi muga noi
kanthi karupporamendrat saatru" (Thiyagarajan, 2009).

According to Siddha philosophy, diseases arise from imbalances in tridoshas (vatham, pitham, and kapham). *Soodan* is believed to balance these doshas, promoting healing by addressing the root cause. While traditional texts detail its use for wound care, scientific validation of these claims is necessary to ensure safety and efficacy (Vajiravelu, et al., 2019).

Despite its accessibility and potential therapeutic benefits, gaps in the literature exist regarding *Soodan*'s pharmacological mechanisms, clinical efficacy, and safety. This review aims to address these gaps by systematically analyzing *Soodan*'s wound-healing properties, integrating Siddha philosophy with contemporary scientific evidence to explore its potential as a viable alternative in wound care (Chambliss, 2010).

The hypothesis under review is whether *Soodan* (Camphor) effectively promotes healing of wounds. The overarching objective of this review is to assess the wound healing capabilities of *Soodan* (Camphor) by systematically evaluating existing literature and experimental data.

Specifically, the aims of this review are to identify and explore the chemical components of *Soodan*, focusing on their specific roles in promoting wound healing. This involves analyzing the known phytochemical profile of camphor, particularly compounds like camphor, borneol, and monoterpenes, which are implicated in its therapeutic effects. Additionally, the review will examine the pharmacological actions of these chemical components in the context of wound healing, such as their antimicrobial, anti-inflammatory, and antioxidative properties, and their mechanisms in promoting tissue repair and reducing infection. Finally, the review will evaluate the wound healing potential of *Soodan* by analyzing evidence from previous research, including in vitro, in vivo, and clinical studies. This will include assessing data on the efficacy of *Soodan* in accelerating wound closure, its impact on wound size reduction, and its safety profile. Through this comprehensive approach, the review will provide a well-rounded understanding of *Soodan*'s therapeutic benefits and limitations, contributing valuable insights into its clinical potential as a therapeutic agent for wound healing, grounded in both traditional Siddha knowledge and modern scientific evidence.

MATERIALS AND METHODS

This systematic review, guided by PRISMA guidelines, explores the wound healing properties of camphor through a rigorous and structured methodology. A comprehensive search strategy was employed using databases like PubMed, Scopus, and Web of Science, with keywords such as camphor, *Soodan*, wound healing, antimicrobial, and anti-inflammatory. Boolean operators refined the search results to ensure relevance. The review included studies published in English peer-reviewed journals that provided original data on camphor's wound healing potential, excluding those with insufficient methodological details, non-English publications, and reviews without original research. Data on study type, sample size, intervention, outcomes, and key findings were systematically extracted. To ensure quality, the Cochrane Risk of Bias tool was used to assess the methodological rigor of the included studies. Complementing this modern research, the review also incorporated insights from Siddha texts such as *Gunapadam Thathujeeva Vakuppu*, *Siddha Mooligai Thiravukol*, and *Siddha Maruthuvam Sirappu*. Information from indexed journals, microbiology references, dissertations, and online resources enriched the analysis, providing a holistic perspective that bridges traditional knowledge and contemporary scientific evidence.

RESULTS AND DISCUSSION

Gunapadam Aspect of *Soodan* (Camphor)

Botanical Name: *Cinnamomum camphora*

Family Name: *Lauraceae*

Vernacular name

Tamil name – *Soodan*

English name- Camphor

Sinhala name- *kapuru*

Other names – *karupooram, sudarkodiyon, pooram, theepam* (Nadkarni, 2010).

Organoleptic character

Suwai – Bitter and Pungent

Veeriyam - Hot

Vibakam – Pungent (Thiyagarajan, 2009).

General character of *Soodan*

"kirumisala thodang kilaivalippu sanni
*porumu mantham **angi patta punno**-derisurangal*
vanthipitham seethamuru vathanch sevimuga noi
kanthikarup pooramendrat sattru"

(Thiyagarajan, 2009).

According to above stanza *Soodan* is beneficial in wound healing. Wound is referred as *angi patta punn* in above stanza. *Soodan* mixed with *pattai sarayam* (alcohol) and brandy, which is used for *padukkai viranam* (bed sores) (Thiyagarajan, 2009).

"Podiththan kadhiron thirai nettrip
pugal mup pala neerp palingalai ingu
kaddipoo maalai yavaranthagi
kamal thamaraiththan kazh iyinan"

(Chinthamani – 2356)

Above stanza explained that soaked water of *kadukai*, *Thandrikkai* and *nellikai*; which mixed with *soodan* powder use to wash wounds externally (Thiyagarajan, 2009). According to siddha *sirappu maruthuvam; katpoora thailum* (Camphor oil) can be used for *koppulam* (blister) externally (Thiyagarajan, 1995).

Phytochemical Aspect

Soodan (Camphor) is derived from *Cinnamomum camphora* trees through distillation process. sometime which can be produce artificially from vicryl chloride and cyclopentadines (Guo, et al., 2016).

Chemical Composition

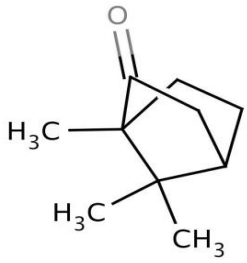

Figure 01- Structural formula of Camphor, a bicyclic monoterpene ketone

Pragadheesh et al. reported that extracts from *Cinnamomum camphora* leaves are rich in various compounds including camphor and monoterpenes, known for their antibacterial and antifungal properties. Additionally, they contain sesquiterpenes with antimicrobial and antioxidant effects, oxyterpenes with antioxidant properties, borneol with anti-inflammatory effects, 1,8-cineole also known for its anti-inflammatory properties, and α-terpineol acting as a counter irritant (Pragadheesh, et al., 2017).

The essential oil extracted from the bark comprises D-camphor, 3-methyl-2-butenoic acid (a fatty acid), and oct-3-en-2-yl ester, which exhibits antimicrobial properties. Furthermore, it contains γ-terpinene and isoterpinolene, known for their anti-inflammatory and antioxidant effects. Additionally, it includes 1,3,8-p-menthatriene, terpinen-4-ol, α-terpineol, eugenol, β-cadinene, and α-cubebene, all possessing anti-cancer properties (Tuntarawongsa & Phaechamud, 2012).

Pharmacological Actions

Text book of Gunapadam (*Dhathu Jeeva Vaguppu*) mentioned that *soodan* has stimulant, carminative, sedative, anodyne, antispasmodic, antiseptic, hypnotic, expectorant and aphrodisiac actions (Thiyagarajan, 2009). *Soodan* (Camphor) has pharmacological action of antimicrobial, counterirritant, anodyne, antipruritic, local anesthetic and rubefacient (Hercogov, 2005). For the wound healing; antibacterial, anti-inflammatory, antifungal, analgesic, antioxidative, antipruritic and counterirritant activities are very important (Salman, et al., 2012).

The previous animal study evaluating the wound healing efficacy of *Soodan* (Camphor) involved six groups of Wistar albino rats, each comprising six animals. Groups included untreated control, emulsifying ointment base, Neosporin powder, 10% Neosporin ointment, purified *Soodan* powder, and 10% purified *Soodan* ointment. Wound circumference measurements started with uniform sizes of approximately 120 mm^2 on Day 0. By Day 14, the 10% purified *Soodan* ointment group demonstrated the most significant reduction in wound size, with mean circumferences of 1–3 mm^2. Statistical analysis using ANOVA indicated significant differences in wound healing by Day 10 ($p=0.042$), with highly significant outcomes by Day 14 ($p=0.000$). Post Hoc Tukey tests confirmed that 10% *Soodan* ointment showed superior efficacy compared to untreated groups ($p=0.003$) and was statistically better than 5% *Soodan* ointment ($p=0.049$). The unit healing time was 0.0749 days/cm^2 for 10% *Soodan* ointment, significantly outperforming purified *Soodan* powder at 0.1176 days/cm^2 ($p=0.001$). Overall, the study highlighted the superior wound healing properties of 10% purified *Soodan* ointment, attributed to its enhanced penetration and retention due to the ointment base. The findings emphasize the potential for *Soodan* formulations in wound care, with concentrations below 11% deemed safe and effective (Thanushiyan, et al., 2024).

Antibacterial Activities

Chen et al.'s study investigates the antimicrobial potential of essential oils extracted from *Cinnamomum camphora* leaves and wood. The leaf oil demonstrated significant activity against various bacteria, including *Staphylococcus aureus, Enterococcus faecalis, Bacillus subtilis, Salmonella enterica gallinarum*, and *Escherichia coli*, with minimum inhibitory concentrations (MICs) ranging from 0.8 to 8.0 μg/mL (Moglad, et al., 2020). Notably, the wood oil exhibited notable antibacterial efficacy against Serratia marcescens. The study highlights the role of major components such as camphor, 1,8-cineole, α-terpineol, and safrole in contributing to the antimicrobial activity of the oils. Additionally, synergistic interactions between 1,8-cineole and camphor were suggested to enhance their antibacterial effects (Liu, et al., 2002). The research methodology involved antibacterial screening using tryptic soy agar medium and dilutions of essential oils in CAMHB, with microorganisms sourced from the American Type Culture Collection (ATCC) (Singh & Jawaid, 2012).

Table 01: Zone of inhibition using Standard Cultures

S. No.	Name of Organism	Camphor
1	*Escherichia coli* (ATCC 25922)	6 mm
2	*Escherichia coli* (ATCC 35218)	-ve
3	*Staphylococcus aureus* (ATCC 13565)	15 mm
4	*Staphylococcus aureus* (ATCC 25923)	-ve
5	*Pseudomonas aeruginosa* (ATCC 10145)	5 mm
6	*Pseudomonas aeruginosa* (ATCC 27853)	-ve
7	*Pseudomonas aeruginosa* (ATCC 15442)	-ve
8	*Salmonella typhi* (ATCC 19430)	-ve
9	*Bacillus subtilis* (ATCC 19659)	10 mm
10	*Bacillus subtilis* (ATCC 6033)	9 mm

Camphor showed antimicrobial activity against Staphylococcus aureus (15 mm), Escherichia coli (6 mm), Pseudomonas aeruginosa (5 mm), and Bacillus subtilis (9-10 mm). No activity was observed against other tested strains (Chen, et al., 2020).

Furthermore, the study elucidates the inhibitory effects of cinnamomin on solid melanoma growth in mice and the mechanism of action of D-camphor in hindering oxidative metabolism in E. coli. The findings suggest potential applications of ribosome-inactivating proteins (RIPs) in drug development and crop plant technology (Wang, et al., 2020).

Overall, the research underscores the diverse antimicrobial activities of *C. camphora* essential oils against a range of pathogens, both Gram-positive and Gram-negative (Viljoen, et al., 2003). It provides valuable insights into the bioactive components responsible for these effects and highlights potential synergistic interactions among them. The study's experimental design and methodology contribute to the understanding of the antimicrobial properties of *C. camphora* essential oils and their potential therapeutic applications (DeCarlo, et al., 2020).

Anti-inflammatory Activity

Cinnamomum camphora, when topically applied with 5% croton oil, shows dose-dependent effects on mouse ear edema: 110 to 220 mg/kg doses reduce edema, but 400 mg/kg increases it, an oily blend with *C. camphora*, Menthol, and Thymol exhibits potent anti-inflammatory effects in rats. Traditional use of camphor (*Soodan*) for inflammatory conditions is supported by its recognized anti-inflammatory and antioxidative properties, validated by in vitro studies on *C. camphora* leaf extract (Ghori, et al., 2016).

The study found that Borneol Essential Oil (BEO) exhibited strong human erythrocyte membrane stabilization, inhibiting both heat-induced and hypotonic solution-induced hemolysis with IC50 values of 5.29 mg/mL and 0.26 mg/mL, respectively. Topical application to mice auricles significantly reduced xylene-induced auricle swelling ($p < 0.0001$) and downregulated inflammatory mediators like IL-1β, IL-6, and TNF-α in both serum and tissue ($p < 0.05$ to $p < 0.001$). GC-MS analysis identified 43 components, with borneol being the most abundant (20.9%), followed by β-caryophyllene, camphor, and limonene. The skin permeability of BEO was evaluated, with BEO and its nano-emulsion showing steady-state transdermal diffusion rates of 6.7 mg/cm²·h and 8.9 mg/cm²·h, respectively (Lee, et al., 2016).

Antifungal Activity

A concentration of 5000 ppm of *Cinnamomum camphora* oil inhibited Aspergillus flavus growth, with complete inhibition at 4000 ppm, demonstrating fungistatic properties. Ho Chen-Lung et al. found antifungal activity in essential oils from *C. camphora* leaves, flowers, and twigs, with the leaf oil showing the highest potency (Mishra, et al., 2018). Antifungal screening involved culturing fungi on yeast-nitrogen base medium, with essential oil dilutions prepared in DMSO. Fresh fungi were added to microdilution plates and incubated, with DMSO and amphotericin B as negative and positive controls, respectively (Elfadil, et al., 2015).

Table 2: The inhibition of camphor in vivo against different species of *Fusarium*.

Camphor Contents (mg/mL)	*F. oxysporum* G5 **(%)**	*F. solani* G9 **(%)**	*F. verticillioide* **(%)**	*F. graminearum* **(%)**
0.125	3.80 ± 1.43 a	14.55 ± 4.70 a	9.36 ± 1.34 a	7.37 ± 4.78 a
0.25	11.18 ± 1.22 ab	13.60 ± 2.53 a	15.88 ± 2.29 b	33.46 ± 7.80 b
0.50	23.61 ± 4.72 b	15.64 ± 0.52 a	23.99 ± 1.78 c	45.79 ± 3.95 b
1.00	54.63 ± 9.76 c	34.59 ± 4.98 b	54.36 ± 1.34 d	89.41 ± 5.17 c
2.00	83.65 ± 2.37 d	91.98 ± 3.51 c	82.61 ± 3.29 e	95.84 ± 0.13 c
4.00	100.00 e	100.00 c	94.60 ± 0.11 f	100.00 c

Camphor demonstrated a dose-dependent inhibitory effect against various *Fusarium* species. At the lowest concentration (0.125 mg/mL), inhibition rates were minimal, ranging from 3.80% to 14.55%. As the concentration increased to 0.25 mg/mL, there was a noticeable increase in inhibition, especially for *F. graminearum*, which reached 33.46%. At 0.50 mg/mL, inhibition further increased, with *F. oxysporum* and *F. verticillioide* showing significant inhibition (23.61% and 23.99%, respectively). At 1.00 mg/mL, inhibition rates rose substantially for all species, with *F. graminearum* exhibiting the highest inhibition (89.41%). At 2.00 mg/mL,

camphor achieved near-complete inhibition of *F. oxysporum* (83.65%) and *F. graminearum* (95.84%), while *F. solani* (91.98%) and *F. verticillioide* (82.61%) also showed high inhibition. By the highest concentration tested (4.00 mg/mL), camphor completely inhibited *F. oxysporum*, *F. solani*, and *F. graminearum*, and nearly completely inhibited *F. verticillioide* (94.60%). These results indicate that camphor exhibits strong antifungal activity, especially against *F. oxysporum* and *F. graminearum*, with its effectiveness increasing as the concentration is raised (Hammer, et al., 2013).

Analgesic Activity

Swiss albino mice, common subjects in biomedical research due to their genetic homogeneity, were administered an oil preparation containing *Cinnamomum camphora*, Menthol, and Thymol. This formulation, selected for its potential therapeutic effects, was tested at doses of 110 mg/kg and also 250 mg/kg (Ghori, et al., 2016)].

Table 3: Analgesic Activity in Mice Using Hot Plate Method at Different Intervals of Time

Treatment Group	Dose (mg/kg) Initial	Reaction Time in Minutes (mean ± SEM) 30	Sig
Control	10 ml/kg	1.46 ± 0.11	1.000
Diclofenac Sodium	50 mg/kg	1.81 ± 0.20	0.0005
Test-1	100 mg/kg	1.61 ± 0.41	0.0083
Test-2	200 mg/kg	1.83 ± 0.23	0.0067

Note: P<0.01 considered significant, **P<0.001** extremely significant.

Table 4: Paw Volumes of Rats in Different Experimental Groups

Treatment Group	Dose (mg/kg) 0h	Paw Volume (mean ± SEM) at Different Hours 1h	Sig
Control	5 ml/kg	0.50 ± 0.01	1.000
Indomethacin	10 mg/kg	0.76 ± 0.02	0.0005
Test-1	250 mg/kg	0.55 ± 0.02	0.0081

Test-2	500 mg/kg	0.51 ± 0.01	0.0078

Note: P<0.01 significant.

The results from Table 3 (Analgesic Activity in Mice Using Hot Plate Method) indicate that Diclofenac Sodium exhibited a significant increase in reaction time, with the most pronounced effect (P<0.001). Both Test-1 (100 mg/kg) and Test-2 (200 mg/kg) demonstrated a gradual Significant effect. With Test-1 showing a stronger analgesic effect, (P<0.01). The Control group showed minimal response, highlighting the effectiveness of the test substances at higher doses (Xu, et al., 2015).

In Table 4 (Paw Volumes of Rats in Different Experimental Groups), both Test-1 (250 mg/kg) and Test-2 (500 mg/kg) showed a significant reduction in paw volume compared to the Control, With Test-2 yielding a more pronounced decrease at all time points. The effects were similar to the standard Indomethacin group. These findings suggest that the treatments, particularly at the higher dose of 500 mg/kg, possess notable anti-inflammatory properties (Xu, et al., 2015). The composition of camphor oil typically includes 21% of camphor dissolved in an oil base. This formulation finds common use in home remedies for common colds and sinusitis condition due to its purported decongestant properties. Furthermore, camphor used in balms and ointments as analgesics for reduce pain and discomfort (Zhu, et al., 2020).

Antioxidative Activities

Liu et al. and Lee et al. found that the extraction of *Cinnamomum camphora* leaves, rich in flavonoids, demonstrated stronger antioxidant effects compared to other commercially available antioxidant medications. This was evidenced through a free radical scavenging assay using DPPH. Additionally, extracts of butanol and ethanol from *C. camphora* exhibited high efficacy in neutralizing free radicals, indicating significant antioxidant activity (Cardullo & Gilroy, 1975).

Table 5: Effect of Camphor on Rat Thymocyte Cytotoxicity

Concentration (µg/mL)	Cytotoxicity (CCK-8 Assay) (Absorbance Ratio ± SD)	Significance (vs. Control)
0.5	0.927 ± 0.132	-
5	1.024 ± 0.083	-
50	1.111 ± 0.033	*

Control	0.999 ± 0.005	-

Table 6: Effect of Camphor on Intracellular ROS Production

Concentration (µg/mL)	Intracellular ROS Production (Ratio ± SD)	Significance (vs. Control)
0.5	1.413 ± 0.068	***
5	1.399 ± 0.093	**
50	1.251 ± 0.049	*
Control	1.000 ± 0.042	-

The analysis of camphor's effects on rat thymocytes reveals significant findings regarding cytotoxicity and oxidative stress. In terms of cytotoxicity, camphor demonstrated a concentration-dependent increase in toxicity, as measured by the CCK-8 assay. At a concentration of 50 µg/mL, a statistically significant increase in cytotoxicity ($*p < 0.05$) was observed compared to control cells, while lower concentrations (0.5 and 5 µg/mL) did not show significant changes (Farasati Far, et al., 2023).

Regarding intracellular reactive oxygen species (ROS) production, camphor induced a notable rise in ROS levels across all tested concentrations. The most pronounced increase was at 0.5 µg/mL, with a highly significant change ($**p < 0.001$) compared to controls. At 5 µg/mL, the increase was also significant ($**p < 0.01$), and at 50 µg/mL, a moderate but still significant rise was observed ($*p < 0.05$). These results indicate that camphor's cytotoxicity may be partially mediated by oxidative stress (Valdez, et al., 2019).

Overall, camphor's impact on rat thymocytes highlights its potential to induce cytotoxic effects and elevate oxidative stress at higher concentrations. Further studies exploring mitochondrial membrane potential and other markers of cellular health could provide deeper insights into the mechanisms underlying these effects (Sweetman, 2018).

Antipruritic and counterirritant

Camphor demonstrates the capacity to activate TRP and TRPV1 channels at the level of the dorsal root ganglion, while also inhibiting TRPA1 channels. Consequently, it functions as a TRPV1 agonist. This activity contributes to the antipruritic and counterirritant effects observed in camphor (*Soodan*) (Xu, et al., 2015).

Pharmacokinetics

Camphor exhibits good absorption across various routes of administration, including intranasal, intraoral, and topical application. Orally, it enters the bloodstream independently within three hours, but when combined with solvents like Tween 80, it reaches plasma levels within one hour. Dermal application results in relatively slower absorption compared to other routes. However, caution is advised during pregnancy and lactation, as camphor can cross the placenta and distribute throughout the body. It has a plasma protein binding capacity of 61%. Following absorption, camphor is metabolized in the liver, and its metabolites are conjugated with glucuronic acid and excreted via urine. The half-life of camphor significantly decreases when combined with solvents like Tween 80 (Masuram, et al., 2014).

In topical application, the rate of absorption is higher than the volume of absorption. A study demonstrated that after applying camphor topically, small patches were formed on the skin, facilitating absorption (Masuram, et al., 2014).

Relationship based on the Siddha aspect

According to siddha philosophy, wounds develop as a result of *vatha dosha* imbalance. It will have an impact on the *charam* and *cenneer*. It will then have an impact on other *thathukal* and cause a wound. Initially the *vatha dosha* influences, then the *pitha dosha* then the *kapha dosha.* The disease becomes more severe as a result. Thus, the medication used to treat wounds should balance the three *doshas* of *vata*, *pitta, and kapha* (Thanushiyan, et al., 2024). *Soodan* has a powerful ability to aggravates *pitham*, while it lowers down *Vatham* and *Kabham*. It tastes bitter and pungent. In contrast to aggravating *pitham* and *vatham*, it reduces *kapham* (Thanushiyan, et al., 2024). To heal a wound, a medicine should balance the *tridoshas*, according to Siddha philosophy. This medication has a hot potency and a pungent, bitter taste. Combinations can maintain the equilibrium of the *tridosha* and balance the *vatha, pitha,* and *kabha doshas*. Therefore, it is obvious that the *Soodan* is helpful at promoting wound healing.

CONCLUSION

In conclusion, *Soodan* (Camphor), derived from *Cinnamomum camphora*, demonstrates a range of pharmacological actions, including antibacterial, antifungal, analgesic, anti-inflammatory, antioxidative, and counterirritant effects, all of which contribute to its wound healing potential. The rich phytochemical composition of camphor underpins these therapeutic properties, with key compounds such as camphor, borneol, and monoterpenes playing vital roles in tissue repair and infection control. Studies have shown that *Soodan*, particularly in

topical formulations like ointments, can effectively promote wound healing, potentially offering an alternative to synthetic drugs. However, pharmacokinetic studies highlight the rapid absorption of *Soodan* and its hepatic metabolism, with caution advised during pregnancy and lactation due to its ability to cross the placenta. While *Soodan* exhibits promising potential, further research is needed to optimize its use in modern medical settings, including precise dosage and formulation guidelines. Future studies should focus on in depth clinical trials, exploring the efficacy of different *Soodan* concentrations and its safety profile across diverse patient populations. Additionally, further research should address the long-term effects and any potential interactions with other medications.

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LIST OF ABBREVIATIONS

1. NADH - Nicotinamide adenine dinucleotide
2. DCPIP - Dichlorophenolindophenol
3. MIC - Minimum inhibitory concentrations
4. TRPV1 - Transient receptor potential V
5. TRP - Transient receptor potential

LEGEND

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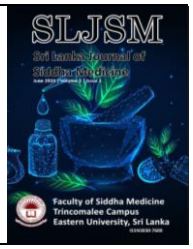

Review of Selected Siddha Herbal and Herbo-Mineral Formulations in Treating Eye Diseases

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ABSTRACT

Vision is the predominant of our senses which plays an indispensable role in each and every sphere of our lives. Ophthalmology has been practiced by part of Tamil civilization since ages. The Classical Siddha text *Agasthiyar Nayana Vidhi* describes 96 types of Eye diseases. Most common Eye diseases affecting worldwide are *Kann kasam* (Cataract), *Padalam* (Keratitis), *Pillam* (Trachoma). Cataract results from opacification of lens fibers. Trachoma is the leading infectious cause of blindness, caused by Chlamydia trachomatis. Keratitis is the inflammation of the cornea, it may be infectious or non-infectious origin. Though surgery and antibiotics are treatment strategies in modern medicine, there are numerous highly effective Siddha formulations for treating these eye diseases. The objective is about reviewing 5 external Siddha formulations - *Chandra Prakasam, Suriyagandhi Kayiru, Neelakanda Mathirai, Anjanaathi Mathirai and Thambirathi Mathirai* obtained from *Agathiyar Nayana Vidhi* 500, for their effectiveness in treating *Kann Kaasam, Padalam, Pillam* and comparing them with Cataract, Keratitis and Trachoma respectively.

The phytochemicals present in the raw drugs of the 2 selected Siddha formulations, *Chandra Prakasam* (herbal) and *Suriyagandhi Kayiru* (herbo-mineral), are reviewed elaborately for their action against *Kann Kasam, Padalam, and Pillam,* and their signs and symptoms are compared with those of Cataract, Keratitis, and Trachoma, respectively. *Chandra Prakasam* and *Suriyagandhi kayiru* synergistically act as antioxidants, anti-cataract, anti-inflammatory, anti-microbial, anti-fungal, and radioprotective. Important phytochemicals found in selected formulations are alkaloids, polyphenols, tannins, lanosterol, carotenoids, flavonoids, and antioxidant enzymes, which are integral in the management of eye diseases.

Keywords: Antioxidant, *Chandra Prakasam*, *Kann Kasam*, *Padalam, Suriyagandhi kayiru.*

INTRODUCTION

Siddha is one of the traditional systems of medicine practiced in South India and Sri Lanka. The Siddha system of medicine is as old as mankind. This system is not only a treatment approach but also encompasses mental, physical, emotional and social well-being of an individual by adopting proper lifestyle practices, dietary abstinence, potent medicinal drugs and various therapies specific to this system.

Ophthalmology *(Kann noi iyal)* is a clinical and surgical specialty with medicine that deals with the diagnosis and treatment of eye disorders. Ophthalmology has been practiced and a part of ancient Tamil civilization since ages. Siddhars, especially *Agathiyar and Nagamuni* explained a wide variety of eye diseases, treatment, prevention and its surgical methods. A few Tamil palm-leaf manuscripts belonging to the 4 th, 7th, and 12th centuries have also been found. However, well- compiled literature evidence of eye diseases from Siddha palm- leaf manuscripts have been found since the 17th century. The evolution of modern ophthalmology started only after 1851 with the invention of the ophthalmoscope by Helmholtz (Jeyavenkatesh, 2022).

Numerous formulations were mentioned in the Classical Siddha Texts, *Agathiyar Nayana Vidhi* 500, *Nagamuni Nayana Vidhi* 200. This review focuses on comparative study of eye diseases in modern and siddha system of medicine. This documentation discusses Siddha Herbal and a Herbo- mineral formulation for their effectiveness in treating eye diseases like *Kann Kasam* (Cataract), *Padalam* (Keratitis) and *Pillam* (Trachoma) (Jeyavenkatesh, 2022).

MATERIALS AND METHODS

Extensive literary searches were made regarding many eye diseases. Among the various Siddha literatures, *Agathiyar Nayana Vidhi 500* and *Nagamuni Nayana Vidhi* 200 were selected. Regarding the eye diseases, *Kann Kasam* (Cataract), *Padalam (*Keratitis*), and Pillam* (Trachoma) are highlighted in this work, which are also mentioned in figure 1.

Common Etiology of Eye disorders according to Siddha:

Changes in five fundamental elements of life - Earth, Water, Fire, Air and Space.

Changes in *Thirithoda - Vatha, Pitha, kabam.*

Improper diet.

Consumption of excessive toddy and alcohol.

Exposure of eyes to irritating stimuli like dust, smoke and so on.

Exposure to excessive heat and cold weather.

Sleeplessness

Classification of 96 eye disease mentioned in *Agathiyar Nayana Vidhi* 500

Based on affected part of eye:

1. *Paavai* (Diseases of lens and pupil) - 27
2. *Karu vizhi* (Diseases of black of the eye) - 10
3. *Vellai vizhi* (Diseases of white of the eye) - 13
4. *Karuppu vizhikum Vellai vizhikum idaiyil* (Diseases of binding unions) - 9
5. *Kuvalai* (Diseases of upper and lower eyelids) - 24
6. *Kann muzhuvathum* (Diseases of the eyeball) - 13

Based on *Thirithoda (3 humours):*

1. Impaired *vatham* - 45
2. Impaired *pitham* - 31
3. Impaired *kabham* - 20

Of the above diseases, *Kann Kasam, Padalam, Pillam, Timiram, Poo, Vizhi ganam Kann pugaichal* are considered to be the most occurring eye diseases. According to *Agathiyar Nayana Vidhi* 500, *Kasam, Padalam, Pillam* are sub classified as follows:

***Kann Kaasam*- 17 (Cataract)**

Neelakasam, Pitthakasam, Vathakasam, Valakasam, Mantharakasam, Silettumakasam, Valiyunkasam, Udaithezhu kasam, Maalaikasam, Uurukasam, Manineelakasam, Neerezhukaasam, Thunnukasam, Thutthidukasam, Vaarezhukasam, Kuvalai kasam and Anthirakasam.

The symptoms of *Kann kasam* and Cataract are mentioned in the table 1.

***Padalam* – 5 (Keratitis)**

Nagapadalam, Vellaipadalam, Panchuneerpadalam, Ratthapadalam and *Neerpadalam*

The symptoms of *Padalam* and Keratitis are mentioned in the table 2.

***Pillam - 3* (Trachoma)**

Pillam, Soozhnthidum pillam and *Neer pillam.*

The symptoms of *Pillam* and Trachoma are mentioned in the table 3.

Siddha formulations from *Agathiyar Nayana Vidhi 500 like CHANDRA PRAKASAM, SURIYAGANDHI KAYIRU, NEELAKANDA MATHIRAI, ANJANAATHI MATHIRAI, THAMBIRATHI MATHIRAI* are used for the treatment of *Kann Kasam* (Cataract), *Pillam* (Trachoma), *Padalam* (Keratitis), *Thimiram ,Kann pugaichal, Aani poo , Kuntham, Amaram, Oon valarchi, Vizhi ganam, Kann neer vadithal* . Ingredients and uses of the selected medicines are mentioned in the table 4 and figure 2.

The important phytochemicals, chemicals, pharmacological actions, and uses in Siddha of all the ingredients of *Chandra Prakasam* and *Suriyagandhi Kayiru* are detailed below and also mentioned in the table 5 and 6.

DISCUSSION

Chandraprakasam

1) *Piper nigrum*

Piperine- Antioxidant property (Monika Chamoli, 2021).

Due to flavonoids and phenol content (Satyanshu Kumar, 2021).

IC_{50} value – (85.35 ± 3.45)

Ant inflammatory activity

Xenobiotic agent which can inhibit IL6, IL 1B, Ig E and Histamine

2) *Coscinium fenestratum*

Phenols (benzaldehyde) - Quenching of oxygen free radicals

Tannins - antioxidant (Krishnamoorthy Karthika, 2018). and anti-inflammatory activity causes protein precipitation

Flavonoids (coumarin, pyranthrene) show potent antioxidant properties

(Krishnamoorthy Karthika, 2018).

Good antioxidant activity (53.3–73.1%) against the linoleic acid emulsion. The IC50 value of MeOHCf was 182.48 µg/Ml

3) *Cyperus rotundus*

Bio active phenols, quercetin and chlorogenic acid- Antioxidant property

Cyperone anti-inflammatory Inhibit lipopolysaccharide (LPS-) stimulated inflammatory response in a murine BV-2 microglia cell line, Antibacterial activity (Arunagiri Kamala, 2018).

4) *Azadirachta indica*

Azadirachtin-tetra, triterpenoid compound, Anti trypanosomal activity (block the development of T. cruzi and induce a permanent resistance)

Pyrenated flavones isolated from flowers- Antimutagenic property

Gallic acid, epicatechin and catechin - Anti-inflammatory and immunomodulatory

Nimbidin, Nimbin - Antifungal, anti-microbial (Mohammed A. Alzohairy, 2016).

Anti-oxidant, Anti-inflammatory (Subendu Sarkar, 2021).

Flower possesses highest free radical scavenging activity

AR Inhibition - control the diabetes induced cataract (Sunday E Atawodi, 2009).

IC_{50} value -57

Polyol accumulation -25.04%

5) *Terminalia chebula*

Chebulic acid, Neo Chebulic acid, gallic acid, ellagic acid -Anti-oxidant, free radical scavenging activity, cytoprotective, Anti cataract (Suresh Kumar Gupta, 2010).

Hydroxybenzoic acid - anti-oxidant (Anwesa Bag, 2013).

6) *Embelia ribes*

Embellin- Antihyperlipidemic, anti-inflammatory, anti-oxidant, radioprotective, antimitotic (Pratik R Wankhade, 2021).

Anti-oxidant properties

Phenol derivatives 3-benzenediol, 5-(8-pentadecenyl)-1, 5-(8, 11-heptadecadienyl)-1, 3-benzenediol, 3-methoxy-5-pentane-1-phenol, 5-pentadecyl-1, 5-(8-heptadecenyl)-1, 3-benzenediol, 3, 5-dimethoxy-4-hydroxyphenyl-1-O-β-D-glucopyranoside.

Ethanol extract 5.8 mg/g (Gallic Acid Equivalent is 5-25 mg/g)

Vilangin (volatile oil and embelin) 72.35 mg Radical scavenging property

Anti-aging, Anti-cancerous and Anti-helminthic.

Suriyaqandhi Kayiru

1) *Alternathera sessilis*

Extract –Antioxidant (Due to high total phenolic content) (Thomas M. Walter, 2014).

ethyl acetate extract (67.75 µg GAE/mg) followed by

methanolic (44 µg GAE/mg),

High percentage of DPPH radical scavenging activity

acetone (57.6%) and

ethyl acetate (64.73%) extracts

Anti -cataract (Sobha kota,2017) and Antimicrobial (Sivakumar, 2018).

2) *Macrotyloma uniflorum*

Antioxidant property (Manisha Gautam, 2020).

Polyphenols -vanillic acid, caffeic acid (Shuchita Sah, 2023). and tannins

Flavonoids kaempferol, quercetin and myricetin, Isoflavones daidzein and genistein

3) *Tamarindus indica*

Tartaric acid

Leaves 2 triterpenes, lupanone, lupeol

High Antioxidant property (64.5-71.7%) which is higher than the Butylated hydroxyanisole and ascorbic acid.

Wound healing activity

L-(-)-Di-n-butyl maleate -Cytotoxic activity

Sterols and triterpenes -Analgesic, anti-inflammatory activity and treatment of eye inflammation (Richard Komakech, 2019).

Methanol and acetone - Anti-microbial

4) *Azima tetracantha*

Alkaloids, Tannins, Phenols-Antioxidant property (Thendral Hepsibha, 2010).

Ascorbic acid potent reducing agent and free radical scavenger.

5) *Muthu* (Pearl)

(86% $CaCO_3$, 2-4% water, 10% conchiolin which is an organic binding agent)

Bicarbonate ion and prostaglandins - Cytoprotective effects

Antioxidative- metal chelating, O_2 scavenging

Oxidative index-Total Anti oxidative capacity TBARS, Total thiols, GSH, Ascorbic acid

Anti-oxidative enzymes -SOD, GPx, GR

Anti-aging - prolongs C. elegans life span

6) *Pavalam* (Coral)

Terpenoids, Steroid, N_2 containing compounds sesquiterpenes, diterpenes (tetradecane ring) Analgesic, anti-inflammatory, antioxidant, anti-bacterial, Neurological activity (Mengtian Han, 2023).

Antioxidant IC50 value of 27.28 μM

Sterols anti-inflammatory activity

Ceramides, alkaloids (deoxythymidine, thymine, methyluracil and urea) antifungal, antibacterial and cytotoxic activities. It can also inhibit acetylcholestan-converting protease (Mengtian Han, 2023).

7) *Thurusu* (Copper sulfate)

Copper potent biocidal properties and is used to eliminate bacteria, viruses and parasites (Sonitha, 2022).

Wound healing and Antifungal (Ethel Shiny, 2023). activity promotes angiogenesis and skin extracellular matrix formation.

Two formulations—Herbal (*Chandra Prakasam)* and Herbal mineral (*Suriya gandhi kayiru*)—were selected from the Classical Siddha literature to document their clinical efficacy in the management of Eye diseases.

Kann kasam (Cataract) is the primary cause of blindness. Cataract is mainly developed due to oxidative stress (Devesh Tewari, 2019). For the homeostasis of the antioxidant system and ROS, enzymes like catalase, SOD, and GPX are pivotal. Ellagic Acid present in *Terminalia chebula* which is a polyphenol compound, possesses antioxidant properties that can scavenge both oxygen and hydroxyl radicals and inhibit lipid peroxidation. Oxidative stress has been implicated in cataractogenesis, thus Ellagic acid exhibits anti-cataractogenic potential.

Lutein and zeaxanthin can filter high-energy photons of blue light to prevent the formation of reactive oxygen species. *Piper nigrum* increases transport rates of the xanthophylls, lutein, zeaxanthin, and isoflavones. Leaves of *Tamarindus indica, Alternanthera sessilis*, and *Azima tetracantha* possess lutein, zeaxanthin, and carotenoid compounds.

Diabetes is one of the major risk factors for Cataractogenesis and Aldose Reductase (AR) enzymes play an important role in sugar-induced cataracts. Lens AR inhibitors are isoflavones, quercetin, quercetin 2 acetate, Genistein. These are present in the extracts of *Azadirachta indica* and *Macrotyloma uniflorum* (Manisha Gautam, 2020). Genistein increases connexin (Cx) 43 expression.

Flavonoids like Chrysin, apigenin, and baicalin are the bioactive compounds inhibiting glycation, glycation-induced lens opacity, AGEs, AR, and lens protein aggregation. Flavonoids are present in almost all the ingredients of the selected Siddha herbal and herbal mineral formulations, such as Chandra *Prakasam and Suryagandhi Kayiru.*

Oxysterols improve or reverse the lens opacity in cataractogenesis—Lanosterol, N-acetylcarnitine, and 5-cholesterin-3 b,25-diol combat the aggregation of crystallines. Crystallins, the major structural lens proteins have an imperative role in lens transparency and acquire post-translational alterations during cataract formation, which lead to protein insolubility, aggregation, and loss of lens transparency (Bryanna J Lee, 2023). Alpha spinasterol, stigmasterol, and Campesterol in *Alternanthera sessilis* and *Macrotyloma uniflorum*, beta-sitosterol in *Azadirachta indica*, sterols in *Terminalia chebula* and also in Calcium carbonate of coral are the compounds which prevent crystalline formation.

Antioxidant properties of polyphenolic compounds (Mario C Foti, 2007; Rong Tsao, 2010). can be significantly credited to three mechanistic pathways, including ROS scavenging by hydrogen atom transfer (HAT), single electron transfer (SET), and metal chelating mechanisms. Polyphenols are present in *Tamarindus indica, Alternathera sessilis, Azima tetracantha, Embelia ribes, Cyperus rotandus* and *Coscinium fenestratum.*

*Pillam (*Trachoma) is a disease complex composed of two linked chronic processes: a recurrent, subclinical infectious–inflammatory disease and a non-communicable, cicatricial owing to trichiasis, *for* the Global Eradication of Trachoma, WHO launched the 'SAFE' strategy (surgery, antibiotics, facial cleanliness, and environmental improvement). Antibiotics directly inhibit bacterial *DNA synthesis* and replication (Anti-microbial, Anti-bacterial). Hydrolyzable tannins (gallic acid, chebulic acid, ellagic acid, chebulogic acid, chebulanin) present in *Terminalia chebula* and *Azadirachta indica* have antiviral, anti-fungal, and anti-microbial action; Xenobiotic agent in *Piper nigrum* has anti-inflammatory action which works efficiently in treating Trachoma. Cyperone in *Cyperus rotundas* has anti-inflammatory action by inhibiting lipopolysaccharide-stimulated inflammatory response in the microglial cell line.

Padalam (Keratitis) may or may not be associated with infection. Nimbin present in *Azadirachta indica* has anti-fungal and anti-microbial properties. Ceramides, and alkaloids (deoxythymidine, thymine, methyluracil, and urea) present in *Pavalam* possess antifungal, antibacterial, and cytotoxic activities. These phytochemicals help in the treatment of Keratitis (Anwer S El –Brady, 2015).

This study shows that most of the components of the selected Siddha herbal and herbal mineral formulation possess antioxidant, Anti-inflammatory, anti-microbial, anti-fungal, and Anti-aging properties which are needed to cure diseases like *Kann Kasam* (Cataract), *Padalam* (Keratitis) and *Pillam*(Trachoma) (Michael Rhone, 2008). The Pharmacological actions and Main Mechanism for the Treatment of Eye Diseases are explained in figure 4 and Figure 6 respectively. The Phytochemicals possessing Antioxidant properties are mentioned in the figure 4.

CONCLUSION

In this study, we conclude that aging (free radicals' formation) and infections are the main factors which lead to the most common eye diseases like *Kann kasam* (Cataract), *Padalam* (Keratitis) and *Pillam* (Trachoma). Thus, the selected Siddha formulations possess the anti-oxidant, anti-inflammatory, antimicrobial, radio protective antifungal, antimitotic properties which can combat and resist the eye infections. Alkaloids, flavonoids, tannins, terpenes, anti-oxidative enzymes, lanosterol, carotenoids and polyphenols are the important phytochemicals present in the Siddha herbal – *Chandra prakasam* and herbo mineral formulation - *Suriyagandhi kayiru* which are essential for the required pharmacological actions in treating eye diseases. By studying the Therapeutic properties and Pharmacological actions of all the ingredients of *Chandra Prakasam and Suriyagandhi kayiru*, we conclude that it has a tremendous power to cure the eye diseases like Kann *kasam* (Cataract), Pillam (Trachoma) and *Padalam* (Keratitis). Further clinical and preclinical studies are needed to study the efficacy of *Chandra prakasam and Suryagandhi kayiru.*

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CONFLICT OF INTEREST

The authors reported that there were no competing interests.

ABBREVIATIONS

Abbreviations	Definitions
IC50	Half-maximal inhibitory concentration
IL	Interleukin
Ig	Immunoglobulin
DPPH	2,2-Diphenyl-1-picrylhydrazyl
LPS	Lipopolysaccharide
LPO	Lipid peroxidation
T.cruzi	Trypanosoma cruzi
GSH	Glutathione
SOD	Superoxide dismutase
GPx	Glutathione peroxidase
GR	Glutathione reductase
C.elegans	Caenorhabditis elegans
WHO	World Health Organisation
AR	Aldose Reductase
HAT	Hydrogen atom transfer
DNA	DeoxyRibonucleic Acid
SET	Single electron transfer
GAC	Gallic Acid Equivalent

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TABLE

Table 1: Comparing the Symptoms of *Kann Kasam* And Cataract

KANN KASAM	CATARACT
Kann peelai,Kann sivapu,Neer vadithal	Ocular defect, Redness, Lacrimation
Kann yerichal	Eye irritation
Karu vizhi kalangal	Corneal irritation
Maalai neerathil kann pugaichal	Night Blindness
Imai ganam	Heaviness of eyelid
Kann iruttal	Darkness of vision
Kann koosal	Glare [intolerance of bright light]
Vizhi kuthal	Pricking pain of eyes
Paarvai pugaichal	White central opacity -impair vision

Table 2: Comparing the symptoms of *Padalam* and Keratitis

PADALAM	KERATITIS
Kann sivathal	Redness of eyes
Sathai valarchi	Ptergiyum
Paarvai maraivu	Blurred vision due to corneal haze
Neer vadiyum,peelai kattum	Purulent corneal ulcer
Paaravi pugaichal	Impaired vision
Vellai padarnthu vali undagum	White opacity
Kann ganathal	Stromaloedema
Kezhimai thadithal	Swelling of lower eyelids

Table 3: Comparing the symptoms of *Pillam* and Trachoma

PILLAM	TRACHOMA
Imai thadippu	Eyelid swelling
Thurmaamisa valarchi	Hyperplasia
Vizhi uruthal	Foreign body sensation in eyes
Kann neer vadithal	Lacrimation
Imai sathai valarchi	Pannus
Imai kaduppu	Irritation
Mel imaikul sathai valarnthu uruthal	Ocular discomfort

Table 4: Selected five siddha herbal and herbo – mineral formulation for the treatment of eye diseases

S. No	Name of the formulation	Main ingredients	Adjuvant	Uses in Siddha
1	*CHANDRAPRAKASAM*	*Piper nigrum* *Coscinium fenestratum* *Terminalia chebula* *Embelia ribes*	Water Honey Mother's milk	*Thimiram* *Padalam* *Sukkiran*
2	*SURIYAGANDHI KAYIRU*	*Alternathera sessilis* *Macrotyloma uniflorum* *Tamarindus indica* Pearl	Lemon juice	*Pillam* *Padalam* *Kan kasam* *Kan pugaichal* *Kan neerpaichal*
3	*NEELAKANDA MATHIRAI*	*Cupric sulfate* *Phyllanthus niruri* *Amaranthus campestris* *Aloe arborescens*	Lemon juice	*Anippoo* *Kundham* *Padalam* *Pillam*

4	*ANJANAATHI MATHIRAI*	*Lead Sulphide* *Terminalia chebula* *Terminalia bellirica* *Pongamia pinnata*	Mother's milk	*Pitha kasam* *Kann pugaichal* *Vizhi ganam* *Pellai kattuthal* *Kan neer vadithal* *Pterygium*
5	*THAMBIRATHI MATHIRAI*	*Copper* *Glycyrrhiza glabra* *Costus speciosus* *Piper longum*	Water	*Kan Mulaigal* *Naatpatta poo* *Imai noigal*

Table 5: Therapeutic properties of *Chandra Prakasam*

S. No	Tamil Name/ Botanical Name/ Family	Parts Used	Phyto Chemicals / Chemicals	Actions	Uses In Siddha	Reference
1	*Milagu* *Piper longum* Piperaceae	Seed	Piperine Carotenoids Alkaloids Terpenes Capsaicinoids Phenols	Analgesic Antiperiodic Antivatha Antiapoptotic Antibacterial Resolvant Antioxidant	Hysteria Gonorrhea Cholera Paralysis Headache Bacterial infection Sinus Anemia	[25] [21]

2	*Maramanjal* *Coscinium fenestratum* Menispermaceae	Bark	Berberine Saponin Sitosterols Alkaloids Phenols Flavonoids Sesquiterpenes Coumarin	Ophthalmic Antiseptic Antitumor Antihelminthic Febrifuge Antioxidant Antihepatotoxic Anticancer	Tastelessness Eye disorders Piles Fever Antidote for snake poison Wound dressing Ulcers	[19]
3.	*Korai kilangu* *Cyperus rotandus* Cyperaceae	Rhizome	Essential oils Terpenoids Flavonoids Sesquiterpenes Ascorbic acid Valencene Polyphenols	Anti proliferative Anti lipidemic Anti-convulsant Astringent Demulcent Vermifuge Diuretic Diaphoretic	Pyresis Inflammation Bowel disorders Diarrhea Stomach disorders	[18]

4.	*Kadukkai Thol* *Terminalia chebula* Combretaceae	Fruit	Chebulic acid Gallic acid 1,6 di –o-galloyl D- glucose Flavonoids Sterols Tannin Triterpenoids	Immuno modulatory Radioprotective Antiaging Antimicrobial Retinoprotective Cytoprotective Liver stimulant Cardioprotective	Eye diseases-ophthalmia Constipation Jaundice Appetite Haemorrhoids	[4] [13]
5	*Vepammottu* *Azadirachta indica* Meliaceae	Bud	Azadirachtin Nimbolide Nimbin Carotene Quercetin Polyphenols Vitamin C	Antioxidant Antitumor Antimicrobial Immunomodulant Antipyretic Antifungal Antiapoptotic	Arthritis Exfoliant Fungal infection Detoxification Increase immunity	[1] [30] [3]

6	*Vaaividangam* *Embelia ribes* Myrsinaceae	Seed	Embelin, Embellinol Embelliol Phenolic acids Quinones Essential oils(vilangin) Alkaloids (christembine) Tannin	Antihelmentic Antitumor Wound healing Antihyperglycemic Radioprotective Antimitotic Antifungal Stimulant Carminative Stomachic	Epilepsy Insomnia Rhinitis CVS Disorders Cough Diarrhea Metabolic disorders	[27]

Table 6: Therapeutic properties of *Suriyagandhi Kayiru*

S. No	**Tamil Name/Botanical Name/Chemical Name/ Family**	**Parts Used**	**Phytochemical/ Chemicals**	**Actions**	**Uses in Siddha**	**Reference**
1	*Ponangaani* *Alternathea sessilis* Amaranthaceae	Leaf	Beta carotene Alpha-spinasterol Stigmasterol Campesterol	Antioxidant Wound healing Antiulcer Antifungal Alterative Refrigerant Febrifuge Cholagogue Hypoglycemic	*Kann kaasam* *Kann pugaichal* *Karuvizhi noi* Eye coolant	[31] [32] [38]

2	*Karungollu* *Macrotyloma uniflorum* Fabaceae	Seed	Inositol N-hexa decanoic acid Ethyl alpha- d - glucopyranoside Linoleic acid Vitamin C Stigmasterol	Astringent Antiinflammatory Analgesic Antioxidant Wound healing Antioxidant antilithiatic Antihelmenthic	Eye Disorders *Nalir suram* Kidney stones Bronchitis Leucoderma Piles Heart disease	[23] [29]
3	*Puli ilai* Leaf of *Tamarindus indica* Caesalpiniaceae	Leaf	Limonene Benzyl benzoate Tartaric acid Cardiac glycosides Vitamin C,B3 Vintexin Peroxidase Lupeol Flavonoids	Antiinflammatory Antioxidant Antibacterial Antifungal stimulant	Redness of eyes Eye disease Anemia Gangrene Wound healing Parasite infections Cell cytotoxicity	[20]

4	*Sangilai* Leaf of *Azima tetracantha* Salvadoraceae	Leaf	methanol P- coumaric acid Ferulic acid Flavonoids Phenols Carotenoids	Antioxidant Astringent Anti-inflammatory Antivenom Antiproliferative Stimulant Antiperiodic Expectorant	Rheumatism Dropsy Dyspepsia Smallpox Asthma Anemia	[15]
5	*Muthu* Pearl	Mineral	Calcium carbonate (conchiolin)	Antioxidant Anti haemolysis Antiepileptic Promoting bone growth and generation Proliferation of endothelial cells Anti haemolysis	Nebula disorder Redness of eyes Skin pigmentation CNS Disorders Sores	[26]
6	*Pavazham* Coral	Mineral	Calcium carbonate (Aragonite, Calcite) Terpenoids Steroids N_2 containing compounds	Neuroprotective Anticancer AntiInflammatory Antioxidant analgesic	Eye opacity Dizziness Dryness of mouth Migraine Convulsions Kapha diseases Lifestyle disorders	[24]

7	*Thurusu* Copper sulfate	Mineral	Cupric sulfate	Antiseptic Astringent Nutritive Emetic Fungicide Ascorbic acid metabolism	Eyes disease Trachoma Athlete foot Fungal infection in between the toes Cellular immune defense Redness of eyes	[11]

FIGURES

Figure 1: Figure representing the Most Common Eye Diseases

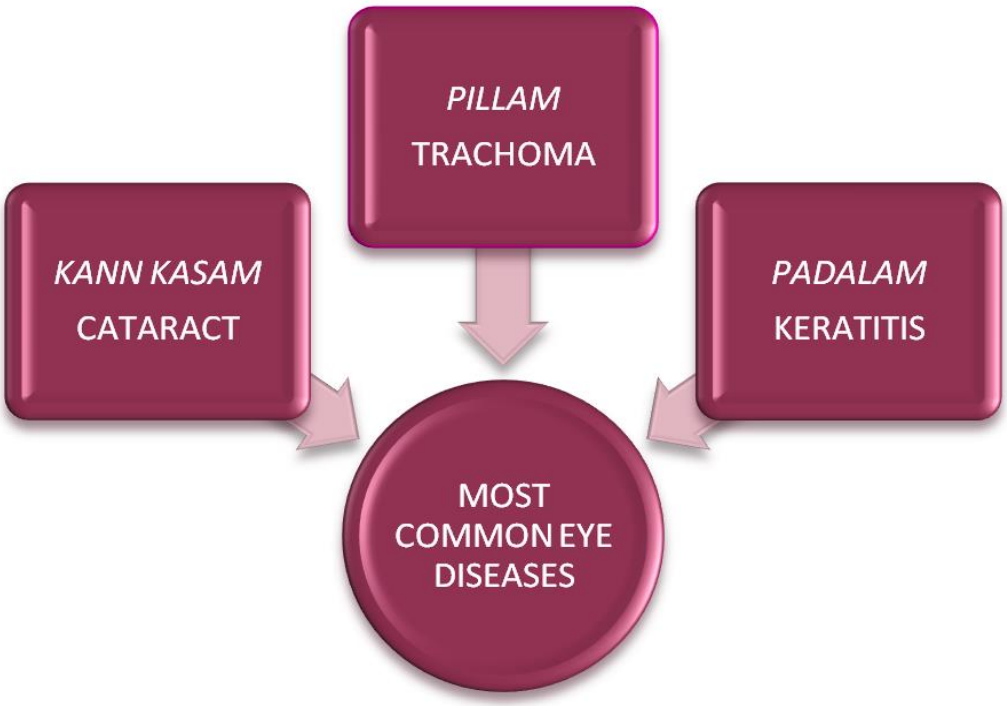


Figure 2: Figure representing the Siddha Herbal and Herbo- Mineral Formulation for Eye Diseases

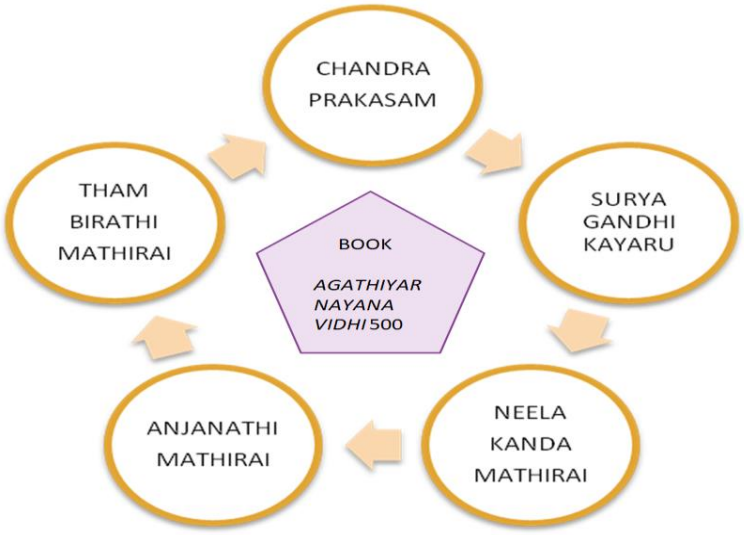


Figure 3: Important Pharmacological Actions for the treatment of Eye Diseases

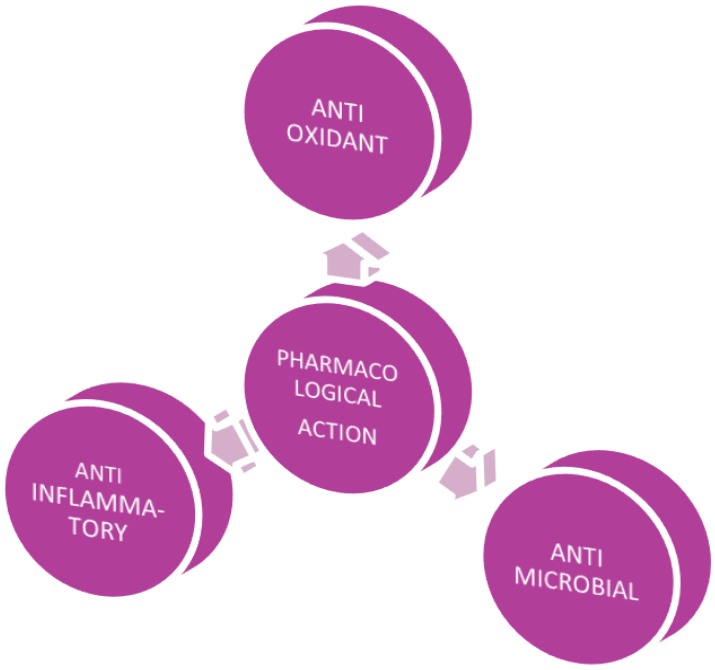


Figure 4: Figure representing the Phytochemicals having Antioxidant Action

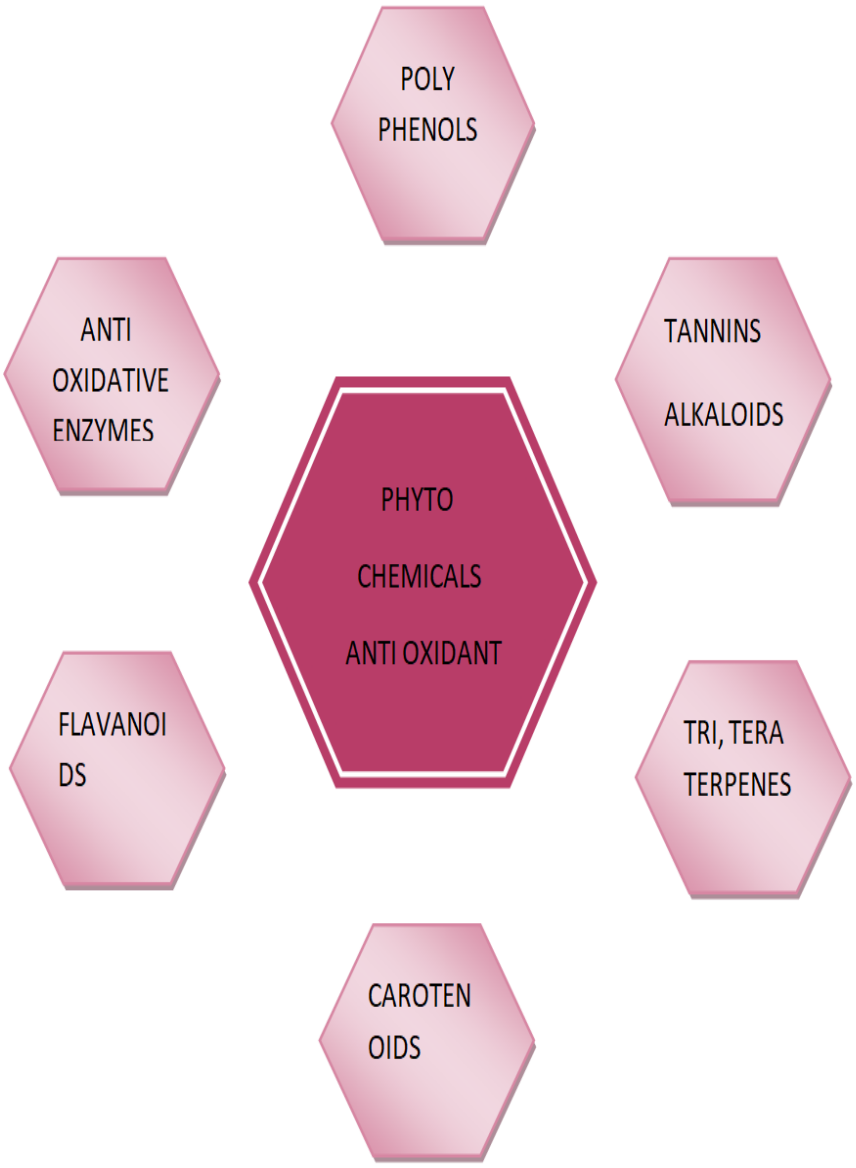
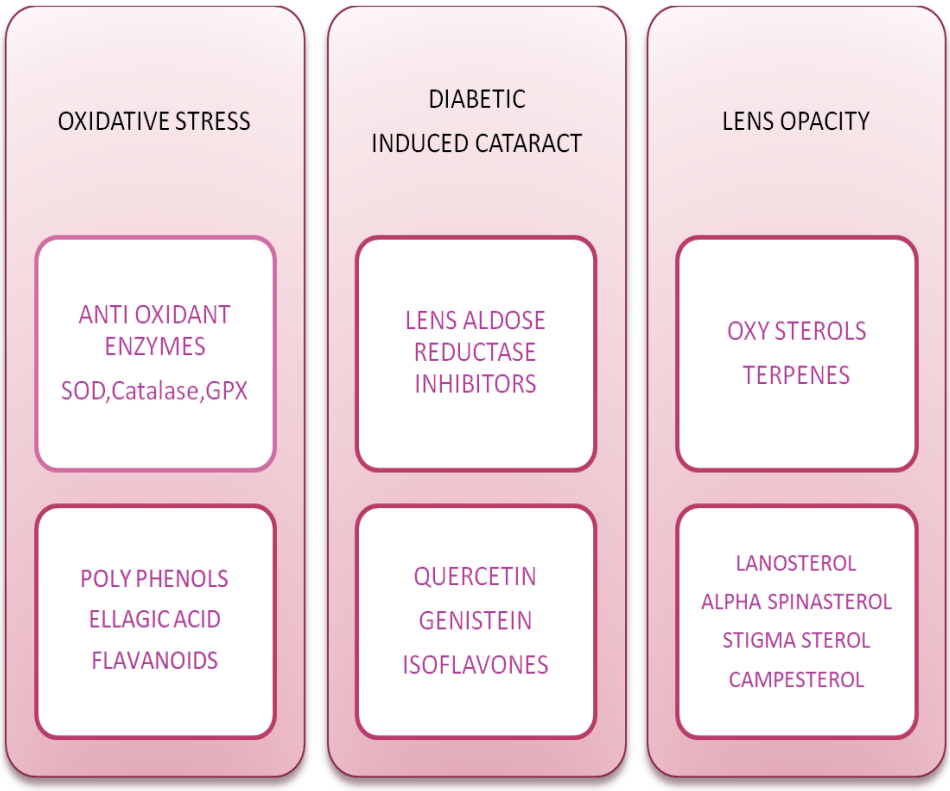


Figure 5: Figure representing the Mechanism of eye diseases and its required Phytochemicals



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Chemical Profiling of *Kalingathi Kadugu,* A Herbomineral Siddha Formulation Through Gas Chromatography-Mass Spectrometry (GC-MS) Analysis

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ABSTRACT

Kalingathi Kadugu **(KK)** is a herbomineral Siddha formulation with its reference from the classical Siddha text ***"Agathiyar vallathi 600"***. Among the nine indications, ***Karupai Kaluthuputru*** **(Cervical cancer)** has been specially mentioned in the text. Cervical Carcinoma, the fourth most common cancerous disease diagnosed in women worldwide, is caused by several factors such as human papillomavirus (HPV) etc. Compared to other treatment methods, chemotherapy is the principal and most feasible method. The higher dosage accompanies many post-treatment clinical consequences along with side effects. Nowadays discovering molecules from classical traditional systems of medicine such as Siddha become imperative as the system has many promising formulations like kalingathi kadugu for cancer therapy.

The study intends to analyze the presence of the active compounds within the formulation KK obtained from the classical Siddha literature *"Agathiyar vallathi 600"*.

KK was prepared from the Classical Siddha literature *"Agathiyar vallathi 600"* as per SOP. The raw drugs were authenticated by the Chief consultant of Walter Siddha Research Centre, Tirunelveli and GC-MS analysis was performed in SAIF- IIT Madras as per standard guidelines. GC-MS analysis was performed for KK. GC-MS screening of the drug KK unveiled the presence of multiple compounds such as Lanosterol, 9,19-cyclolanostan-3-ol,24 methylene-(3β), Tetradecane etc., exhibiting diverse reported biological activities including potentially beneficial anti-tumor activity against tested carcinoma cells, therefore it deserves furthermore clinical research in the prospective.

Keywords: *Agathiyar vallathi* 600, Anti-angiogenesis, Cervical cancer, *Kalingathi kadugu*.

INTRODUCTION

In the current scenario, lifestyle changes may lead to the development of carcinoma in the cervix. Despite many technological developments, Cancer has emerged as a prevalent and significant health concern, leading to substantial human suffering and mortality. According to WHO, Cervical carcinoma stands as the sixth most frequently diagnosed cancer in women and 99% of cervical cancer is due to human papillomavirus (HPV) which is easily spread through skin-to-skin contact (WHO, 2024). In 2020, globally 604000 new cases of cervical cancer were diagnosed, among these 342000 deaths occurred. The curable rate is high if cervical cancer is diagnosed early.

While chemotherapy remains the primary and viable treatment approach for cancer compared to other therapeutic modalities the higher dose of this chemotherapy treatment accompanies many post-treatment clinical consequences along with side effects. While numerous drugs have been identified as cancer chemotherapeutic agents, no single compound has been reported to have null toxicity. Cisplatin, the standard treatment for cervical cancer, is associated with post-treatment toxicity. Nowadays discovering molecules from classical traditional systems of medicine such as Siddha, Ayurveda, etc., has emerged in cancer drug discovery research. Natural compounds serve as an invaluable resource for the development of potent therapeutics. In the current scenario, the leading structure for new drug discoveries is from the natural resources that have Biologically derived substances with high structural diversity. The natural components in the drugs show high effectiveness by focusing on targeting structures of utmost importance. (Faruck, 2016).

Numerous formulations were present in the Siddha system of medicine for cancer treatment. Our group primarily focuses on discovering natural product-derived medications for the treatment of cancer from the Siddha system of medicine. In this study, we explored the anticancer activity of KK formulation from the classical *"Agathiyar vallathi 600"* literature. In this formulation, the major ingredient is *Citrullus colocynthis* (*kalingathi*). *Citrullus colocynthis* seems a potential anticancer herbal medicine via various efficient compounds and is reported to trigger apoptosis in colorectal cancer cells also. (Abdulridha et al., 2020; Mohammed Al-Zharani et al., 2022). Therefore to find out the compounds responsible for anticancer properties and active principles we have performed GC-MS analysis in the formulation KK.

MATERIALS AND METHODS

(a)Preparation:

KK has been prepared as per the Siddha text "***Agathiyar Vallathi 600"*** (Uthamarayan et al., 1980). after following proper purification methods for its ingredients as per the Siddha textbook *"**Saraku Suthi Seimuraikal"*** (Anaivaari Ananthan, 2008). as shown in figure 1. The raw drugs were authenticated by the Chief consultant of Walter Siddha Research Centre, Tirunelveli.

(b) Gas chromatography- Mass spectrometry (GC-MS) Standard operating procedures:

Gas chromatography-mass spectrometry (GC-MS) is a diagnostic tool utilized for detecting the presence of active compounds in the formulations. **The acquisition method** of GC- MS of scan type is followed and the methods are mentioned in figure 2.

RESULT

GC–MS profile of the KK extract:

The formulation KK showed greater efficacy in cytotoxic activity against cervical cancer cell lines with all the advantages of micro-particle size. Consequently, the extracted portion underwent methylation to enhance volatility, and both fractions were subsequently analyzed using GC/MS.

The compounds recognized in the KK extract are presented in Table 1. The compounds identified as hits within the herbal formula are Lanosterol (63.24%), 9,19-cyclolanostan-3-ol,24

methylene -(3β) (60.97%), 3,3-Diethoxy-1-propanol, propyl ether (50.26%), Dodecane (28.49%), Tetradecane (27.72%), W-18(20.61%), methyl-3,3-dimethyl cyclopropane-1, trans-2-dicarboxylate (19.66%), 2-propanol,1 (1-methylethoxy) (12.24%) and Butanoic acid,2-ethyl-3 hydroxy-ethyl esteror 3-BH (6.75%) as shown in figure 3.

DISCUSSION

Secondary metabolites derived from plants often play a crucial role in treating a spectrum of conditions (Eng Soon Teoh, 2015). Gas chromatography-mass spectrometry (GC-MS) is an analytical method that integrates gas chromatography with mass spectrometry for the identification and quantification of organic substances in classical drug formulations. GC–MS analysis of KK unveiled the existence of multiple bioactive compounds, including Lanosterol(63.24%), 9,19-cyclolanostan-3-ol,24 methylene -(3β)(60.97%), 3,3-Diethoxy-1-propanol, propyl ether (50.26%), Dodecane(28.49%), Tetradecane(27.72%), W-18(20.61%),methyl-3,3-dimethyl cyclopropane-1,trans-2-dicarboxylate (19.66%), 2-propanol,1 (1-methylethoxy) (12.24%) and Butanoic acid,2-ethyl-3 hydroxy-ethyl ester(6.75%) with several known biological activities as shown in figure 5,6,7.

The GC-MS analysis of herbomineral formulation KK has three major hits namely Lanosterol (63.24%), 9,19-cyclolanostan-3-ol,24 methylene -(3β) (60.97%) and 3,3-Diethoxy-1-propanol, propyl ether (50.26%) as shown in figure 4.

(a) Lanosterol:

Lanosterol has a score of 743 in KK and has Anti-angiogenesis, Antitumor and Antiviral activities (Nourhan Hisham Shady et al., 2021). as shown in figure 6.

Claudia Stäubert Et al Found the potential of lanosterol in controlling function in maintaining cholesterol homeostasis which may be critical for **drug-resistant leukaemia cancer cells** and observed cancer drug resistance. Further, they revealed the novel connection between drug resistance and increased flux of lanosterol (Claudia Stäubert et al., 2016).

Lanosterol synthase (LSS), a crucial rate-limiting enzyme in cholesterol biosynthesis, may have a notable impact on oxidative stress. Antioxidants play a vital role in mitigating the toxic effects of free radicals in various diseases, including cancer. (Hui Hua et al. 2019).

Pengjuan Ma found that LSS protection plays an antifibrotic role in maintaining lens transparency. They also suggested that regulating lanosterol and sterol biosynthesis could be promising plans for averting and treating fibrotic cataracts (Pengjuan Ma et al., 2023).

Further, it was found that 3β-Hydroxylanosta-8,24-dien-21-al which is a lanosterol-type triterpene can inhibit tumour promotion and reduce the percentage of mice bearing papillomas (medchemexpress).

(b) 9, 19-cyclolanostan-3-ol,24 methylene -(3β):

9,19-cyclolanostan-3-ol,24 methylene -(3β) or 24-methylene cycloartenol (24-MCA) is derived mainly from Euphorbia species that have Anti-tumor and Anti-inflammatory activities (24-methylene cycloartenol, PUBCHEM). In our analysis, this compound is present in 60.97%

The two phytosterols 24-methylene cycloartenol (24-MCA) and cycloartenol (CA), found in Ficus krishnae exert antidiabetic activity by promoting an increase in the population of beta cells and restoring pancreatic beta cells to their natural insulin secretion function. (Ajikumaran Nair Sadasivan Nair et al., 2020**;** medchemexpress)

The use of 24-methylene-9,19-cyclolanostan -3-ol in drugs, food or drink improves pancreatic functions (Tanaka Miyuki, 2006).

(c) 3,3-Diethoxy-1-propanol, propyl ether:

3,3-Diethoxy-1-propanol, propyl ether present in 50.26% has anti-tumour, antimicrobial, excellent humectant, low toxicity, antioxidant, anti-inflammatory and anti-ulcer properties (Lan-Xiang Liu et al., 2015; Nastaran Hashemzadeh et al., 2022; Dinesh Shantilal Patel et al., 2017).

Further, the compound Butanoic acid,2-ethyl-3 hydroxy-ethyl ester shows anti-tumour activity through various mechanisms viz., promotion of TCA cycle, promotion of protein synthesis, reduction in inflammation & enhancement of antioxidant capacity, improvement of metabolic homeostasis and attenuation of proteolysis as shown in figure 10. Other compounds present in the formulation KK such as Butanoic acid,2-ethyl-3 hydroxy-ethyl ester (Ethyl-3 hydroxybutyrate), 2-propanol, and 1(1-methyl ethoxy) show antitumor activity and apoptosis action (Kurita-Ochiai et al., 2008; Siqi Feng et al., 2019). The secondary metabolites namely Tetradecane present in the formulation show antimicrobial activity (Zeinab Nasr, 2022). whereas Butanoic acid,2-ethyl-3 hydroxy-ethyl ester shows anti-cachexia activity (Zhou Y et al., 2023). Studies documented that these compounds induce programmed cell death in various cancer cells, indicating their potential as anticancer agents as shown in Figure 9. Many chemotherapeutic drugs including cisplatin, doxorubicin, fluorouracil, and vincristine exert their anticancer effects by inducing apoptosis in tumor cells, making them valuable for

oncology therapy (Gavamukulya et al., 2014; Milner et al., 2002). Further characterization and assessment are needed for the tentatively identified compounds to elucidate the structures present in formulation KK.

Similarly, the presence of a secondary metabolite, Dodecane, in the fungal extract, at a concentration of 28.49%, exhibited significant anti-tumor activity, particularly against HPV18+ human cervical cancer HeLa cells. This activity was confirmed through GC-MS analysis, highlighting its promising potential in cancer treatment. (Kumari et al., 2018; Serban Moldoveanu, 2019).

This assay shows that KK formulation is a source of anti-tumor and antioxidants that might impede the advancement of various conditions induced by free radicals, and proliferation such as cancers. However, the constituents that are accountable for the antioxidative capacity are also present in the formulation KK. The correlation between the chemical structures of the identified compounds and their known pharmacological activities indicates a prevalence of anti-inflammatory, antioxidant, and anticancer properties among the compounds.

Non-polar compounds such as Lanosterol,9,19-cyclolanostan-3-ol,24 methylene -(3β), etc. have a cytotoxic effect that is soluble in the lipid bilayer, so they can easily cross the cell membrane (Nicole Peiris, chem. libretexts). There may be certain restrictions within this study. First, no investigation was carried out for incursion, displacement and colonization of the cells when treated with KK formulation. It's crucial because the majority of cancer-related fatalities are ascribed to metastasis. The second restriction is the scarcity of toxicological investigation of KK formulation using in vivo animal studies.

The result of GC-MS verified the existence of selective compounds that were noted to stimulate programmed cell death. Therefore, it can be deduced that the anticancer potential, especially for cervical cancer, observed in the KK could be credited to the existence of these compounds.

CONCLUSION

To conclude, the data unveiled that KK formulation has secondary metabolites namely Lanosterol(63.24%), 9,19-cyclolanostan-3-ol,24 methylene -(3β)(60.97%), 3,3-Diethoxy-1-propanol, propyl ether (50.26%), Dodecane(28.49%), Tetradecane(27.72%), W-18(20.61%),methyl-3,3-dimethyl cyclopropane-1,trans-2-dicarboxylate (19.66%), 2-propanol,1 (1-methylethoxy) (12.24%) and Butanoic acid,2-ethyl-3 hydroxy-ethyl ester(6.75%). Further the top three hits namely Lanosterol, 9,19-cyclolanostan-3-ol,24

methylene -(3β) and 3,3-Diethoxy-1-propanol, propyl ether were derived from GC-MS analysis showed Antitumor activity especially cervical cancer via apoptosis and anti-angiogenesis as shown in table 2 and figure 8,9. This may be a promising formulation since the KK formulation contains natural Compounds effective even in apoptosis-resistant cells.

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CONFLICT OF INTEREST

The authors have declared that no competing interests exist.

DECLARATION OF COMPETING INTERESTS

The authors affirm that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ABBREVIATIONS

1.	**HPV**	Human papilloma virus
2.	**KK**	*Kalingathi kadugu*
3.	**GC-MS**	Gas chromatography-mass spectrometry
4.	**WHO**	World Health Organization
5.	**IC50**	Half-maximal inhibitory concentration
6.	**CAS**	Chemical Abstracts Service
7.	**LSS**	Lanosterol Synthase
8.	**TCA**	Tricarboxylic Acid Cycle
9.	**3HB**	Ethyl-3 hydroxybutyrate

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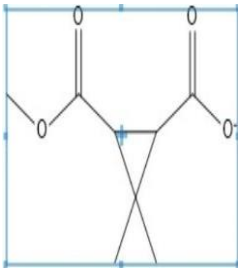
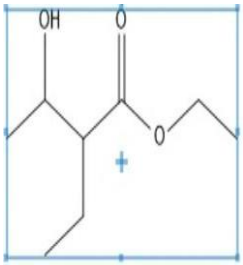
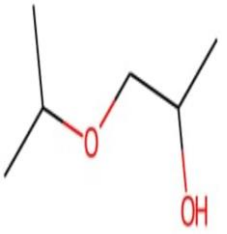
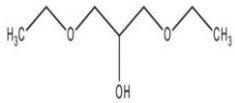
TABLES

Table 1: Phytoconstituents identified in the *Kalingathi Kadugu* extract via gas chromatography-mass spectrometry.

S. NO.	Retention time	Compound name	Molecular formula& molecular weight	Chemical structure	Score	Probability (%)	CAS#
1	3.999	(-)-methyl-3,3-dimethyl cyclopropane-1,trans-2-dicarboxylate	C8H11O4 Molecular weight: 171.17g/mol (chemdraw)		672	19.66	98628

2	4.216	Butanoic acid,2-ethyl-3 hydroxy-ethyl ester	C8H16O3 Molecular weight: 160.21g/mol(chemdraw)		625	6.75	45719
3	4.842	2-propanol,1 (1-methylethoxy)	C6H14O2 Molecular weight: 118.17g/mol (chemeo - high quality chemical properties)		648	12.24	18333
4	5.810	3,3-Diethoxy-1-propanol, propyl ether	C10H22O3 (pubchem) Molecular weight: 190.28g/mol (Atman Chemicals)		746	50.26	83574
5	7.898	Dodecane	C12H26 Molecular weight:170.34g/mol (Dodecane, 2021)		883	28.49	26119
6	12.709	Tetradecane	C14H30 Molecular weight: 198.39g/mol (Tetradecane, 2021)		857	27.72	26185

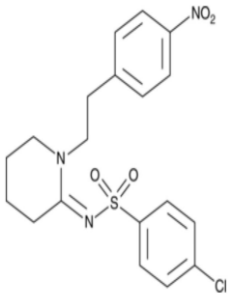
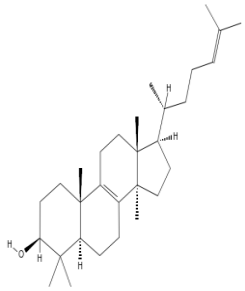
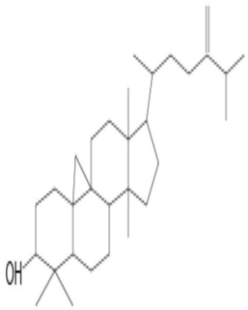
7	43.287	W-18	C19H20CIN3O4S Molecular weight: 421.90g/mol. (cayman chemical)		552	20.61	207754
8	47.533	Lanosterol	C30H50O (NIST chemistry webbook) Molecular weight: 426.71g/mol (lanosterol,2021)		743	63.24	262184
9	49.806	9,19-Cyclolanostan-3-ol, 24-methylene-3β	C31H52O (spectrabase) Molecular weight: 440.74g/mol		711	60.97	22724

Table 2: Significance of compounds present in Kalingathi kadugu

S.NO.	Compound name	Significance
1	Lanosterol	Anti-angiogenesis, Anti-tumor and Antiviral activity
2	9,19-cyclolanostan-3-ol,24 methylene -(3β)	Anti-tumor and Anti-inflammatory activity
3	3,3-Diethoxy-1-propanol, propyl ether	Anti-tumor activity

FIGURES

Figure.1: Ingredients of *Kalingathi kadugu* namely *Piper longum*. Sodium chloridum impura, magnetite, *Croton tiglium*, cinnabar (mercuric sulphide), *Euphorbia nivulia*, asafoetida, *Citrullus colocynthis* and *dry* ginger *(Zingiber officinale)*

Tune File:	atune	**Ion Source:**	EI	**Source Temperature:**	230 °C
Quad Temperature:	150 °C	**Fixed Electron Energy:**	70 eV	**Acquisition Type:**	Scan
Stop Time:	53.5 min	**Solvent Delay:**	3 min	**Trace Ion Detection:**	Off
Gain Factor:	1	**EM Saver:**	Off	**EM Saver Limit:**	N/A

Figure 2: Acquisition method of GC-MS analysis

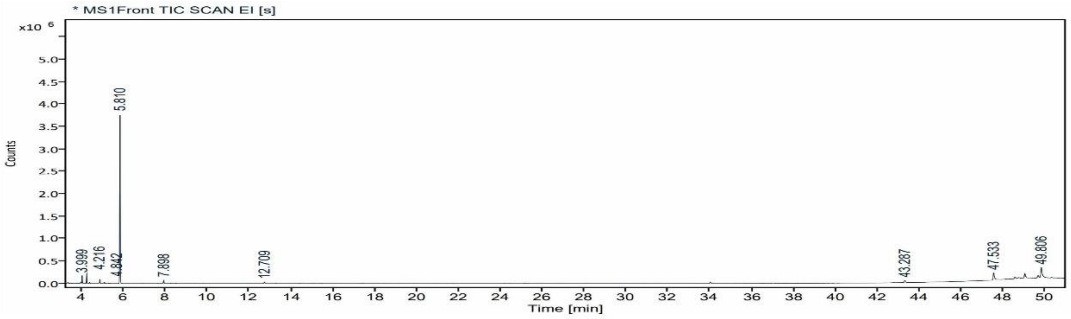


Figure 3: Chromatogram of KK extract using Gas Chromatography-Mass Spectrometry

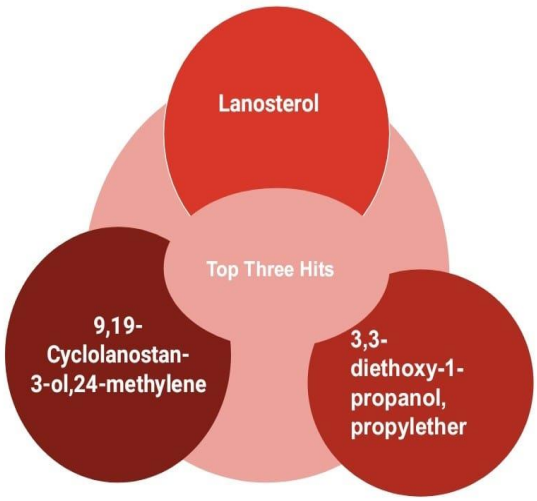


Figure 4: Represents the top three compounds with Antitumor activity

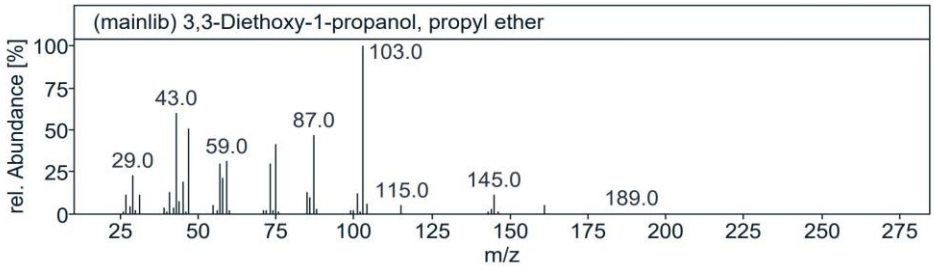


Figure 5: Graph representing retention time of 3,3-Diethoxy-1-propanol, propyl ether

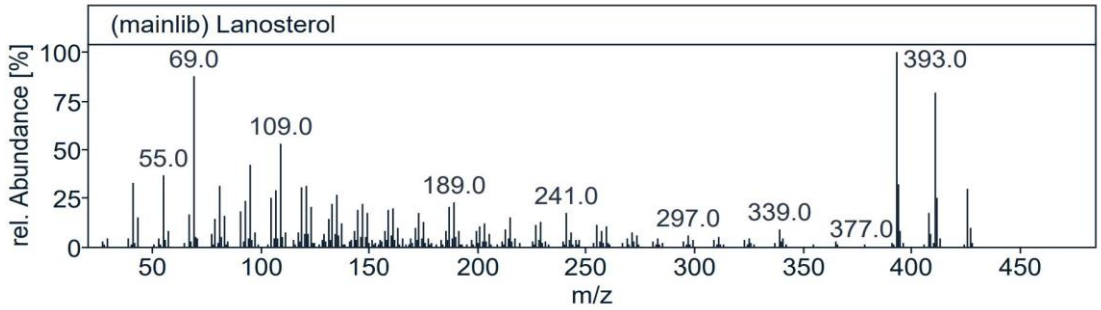


Figure 6: Graph representing retention time of Lanosterol

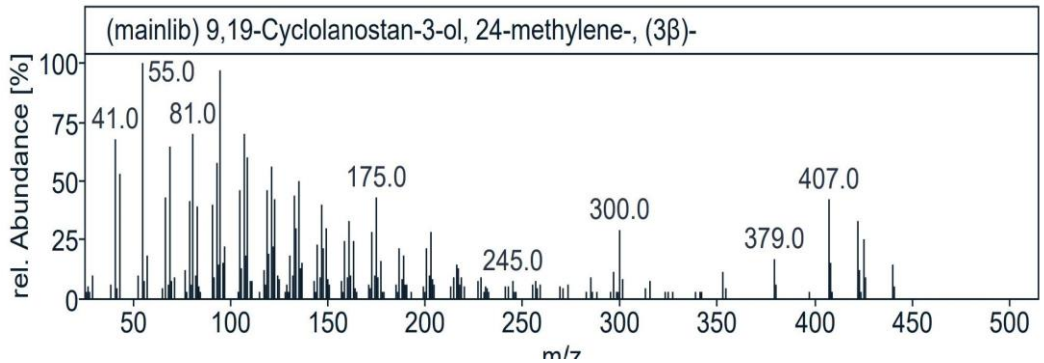


Figure 7: Graph representing retention time of 9,19-Cyclolanostan-3-ol,24-methylene-(3β

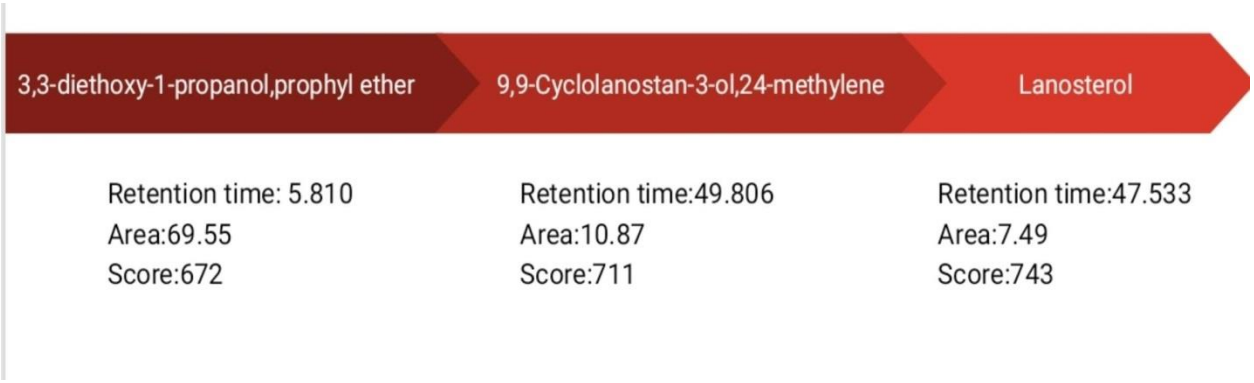


Figure 8: Top three Hits obtained from GCMS analysis

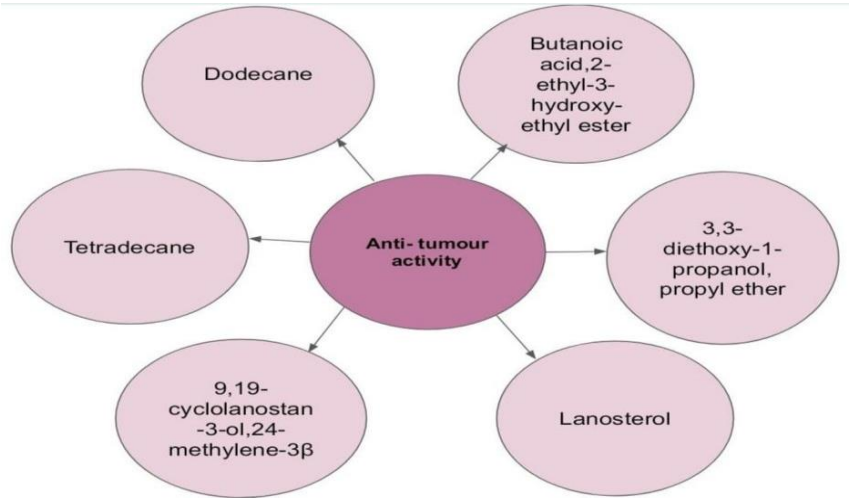


Figure 9: Compounds having anti-tumour activity obtained from GC-MS analysis

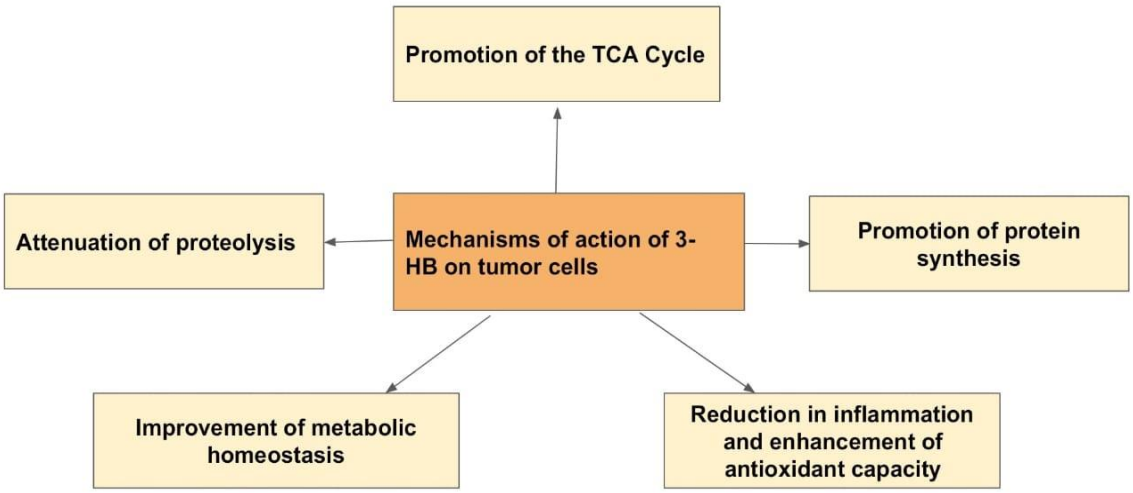


Figure 10: The mechanism of action of 3-HB (Butanoic acid,2-ethyl-3 hydroxy-ethyl ester) on tumour cells.

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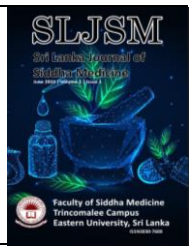

The Siddha Moongazing Techniques in Ophthalmic Care - A Literature Review

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ABSTRACT

The visual impairment and eye diseases pose significant public health challenges worldwide, affecting approximately 2.2 billion people over the age of 50. In Sri Lanka, the prevalence of blindness and visual impairment is estimated to be around 1.9% and 8.8%, respectively. The Siddha system of medicine offers various preventive measures for eye health, including moon gazing therapy, which is mentioned in classical Siddha texts. However, scientific validation of its efficacy remains limited. This study aims to explore the effectiveness of different moon gazing techniques for ophthalmic care. Siddha literature was collected from classical texts such as Agathiyar Nayana Vidhi 500 and Pararasasekara Nayana Rogam, while relevant research articles were sourced from reputable databases, including Scopus, Medline, PubMed, and Medlar. The findings reveal that moon gazing techniques in Siddha medicine include direct observation of the moon (with or without Palagani), water application to the eyes, and eye massage. These techniques, as described in relevant Siddha texts, may have the potential to mitigate the onset of eye diseases. Scientifically validating these traditional practices could establish them as cost-effective and sustainable therapeutic options for ophthalmic care in the future.

Keywords: Nayana Rogam, Ophthalmic, Palagani, Moon gazing, Visual impairment

INTRODUCTION

The human eye is a complex organ with intricate structures, including the cornea, iris, lens, and retina. Its primary function is to perceive light and transmit visual information to the brain, a process that is crucial for daily functioning and overall quality of life (Selvam et al., 2017). In Siddha medicine, the eyes are regarded as vital for maintaining overall well-being, as they are believed to be the "windows to the soul" and play a significant role in sensory perception. The Siddha tradition emphasizes the importance of balancing the five elements within the body to achieve optimal health, with the eyes closely linked to these elements (Thulasidasan, 2015). The core principle of Siddha medicine is based on *Tridosha*, and when it comes to eye health, the Fire element (*Teyu*) plays a crucial role, with vision being maintained by the *Alochaka Pitham* (Shanmugavelu, 2003).

On a global scale, visual impairment and eye diseases present significant public health challenges. According to the World Health Organization (WHO), an estimated 2.2 billion people aged 50 and older worldwide are affected by vision impairment or blindness, with uncorrected refractive errors being the most common cause. Age-related eye diseases such as macular degeneration and diabetic retinopathy are also on the rise, primarily due to aging populations and lifestyle factors. Among individuals with distant vision impairment, 36% suffer from refractive errors, while 17% experience vision impairment due to cataracts (WHO, World Report on Vision, 2023). In Sri Lanka, as in many other countries, visual impairment is a pressing concern. A study by the Sri Lanka College of Ophthalmologists indicates that the prevalence of blindness and visual impairment in Sri Lanka is approximately 1.9% and 8.8%, respectively. Cataracts are the leading cause of blindness in the country, followed by refractive errors and glaucoma (Herath, 2022).

According to *Agatthiar Nayana Vidhi 500*, the sclera refers to the white part of the eye, while the iris and pupil form the black part. A healthy eye should possess a pure, crystal-like sclera devoid of any reddish tint, and a dark black pupil within the black part. It is also believed that the eye reflects the face of a person standing before it. The dimensions of the eye are typically two inches in length, half an inch in breadth, and one inch in depth, with the black part occupying one-third of the eye and the pupil covering one-seventh of the black part. Various diseases afflict the eye, with classifications including diseases of the lens and pupil 27, diseases of the black part of the eye 10, diseases of the white part of the eye 13, diseases of binding unions 9, diseases of the upper and lower eyelids 24, and diseases of the eyeball 13. Abnormalities in the three humours *Vatham, Pitham*, and *Kapam* can affect the eyes and lead to eye diseases. The *Agatthiar Nayana Vidhi* 500 also categorizes 96 eye diseases according to the vitiated humours: vitiated *Vatham* 45, vitiated *Pitham* 31, and vitiated *Kapam* 20 (Thandayuthapani, 1976).

Siddha medicine identifies various factors contributing to eye diseases, with common causes including carrying heavy weights on the head, prolonged exposure to sunlight, neglecting precautions after oil or head baths, using unclean water for bath, excessive consumption of narcotics, frequent sexual activity, external injuries, and allowing flies to enter the ears. Additionally, specific causes include leaving oil residue in the hair after bathing, walking barefoot on hot surfaces, prolonged focus on objects, excessive anger, and infections during pregnancy (Uthamarayan, 1967).

The Siddha Text books of *Agatthiar Nayana Vidhi* 500 and *Pararasasekara Nayana Vithi* mention preventive care measures for eye diseases in their stanzas, including the practice of *Anjanam* once every three days, brushing teeth with medical plants sticks of *Aal* (*Ficus benghalensis*), *Erukku* (*Calotropis gigantia*), *Vel* (*Acacia leucophloea*), *Maruthu* (*Terminalia arjuna*) and *Poola* (*Phyllanthus reticulatus*). Additionally, applying cow's ghee to the sole of feet before bedtime and covering them with *Thavidu* (Rice husk) is recommended for alleviating eye pain and burning sensations. After waking up, one should wash the feet, dry them, and apply *Santhanam* (Sandal paste) to the sole of feet. The practice of moon gazing is also mentioned as a beneficial therapy for eye health (Sivashamugaraja, 2018; Thandayuthapani, 1976).

While traditional practices like moon gazing therapy have been passed down through generations in Siddha medicine, there is limited scientific research specifically validating its efficacy for ophthalmic health. However, some studies have explored the potential benefits of light therapy, including exposure to natural light sources like the moon, for various health conditions. While more research is needed to directly assess the effects of moon gazing therapy on eye diseases, preliminary evidence suggests that light therapy may have therapeutic potential for certain conditions (Levi, et al., 1997).

Objectives:

General Objective:

This study aims to explore the effectiveness of moon gazing therapy in Siddha for Ophthalmic Care.

Specific Objectives:

- To identify the various moon gazing techniques described in classical Siddha texts.
- To analyze the therapeutic benefits of adjunctive practices such as *Palagani*, water application and eye massage in the context of eye care.
- To provide a scientific rationale for integrating traditional practices into modern ophthalmic care framework

MATERIALS AND METHODS

The siddha literary elements were collected from classical siddha texts, such as *Agatthiar Nayana Vidhi* 500 and *Pararasasekara Nayana Rogam.* Research papers were referenced from reputable platforms including Scopus, Medline, Pubmed, Medlar and others.

RESULTS AND DISCUSSION

Moon Gazing Techniques in Siddha Texts

Various Siddha schools of thought discuss eye diseases, but only limited evidence highlights the significance of moon gazing therapy for ophthalmic health. Among them, the texts *Pararasasekaram Nayana Rogam* and *Agasthi Nayana Vithi* 500 play a crucial role. However, there is a lack of scientific evidence to validate their effectiveness in preventing eye diseases. Siddha texts describe various techniques for moon gazing. Table 1 provides a summary of the moon gazing techniques mentioned in the relevant Siddha texts.

Stanzas Based on *Pararasasekaram Nayana Rogam*

1 “ கைவிரல் தன்னை கோர்த்துக் கவிந்து பல்கணிபோல் விட்டுத்
திவ்விய மதியந் தன்னைத் திகழவே நோக்க மற்றும்
வெய்யென வுண்டு நீயம் விரவிய கையி னீரைத்
துய்யுமா கண்ணி விட்டுத் துவக்கரப் பிசைந்திடாயே ”

2 “ உண்டுகைத் துளிபிழி முகத்து நீரெறி
கண்டிடு மதியமுங் கருது மஞ்சனம்
விண்டிட விரவிய தந்த சுத்திசெய்
அண்டுறு கண்ணினுக் கமுத யோகமே ”

Stanzas in *Agasthi Nayana Vithi* 500

3 “ கைவிரல் தன்னைக் கொண்டு கலந்து பலகணி போல் விட்டு
துய்யச் சந்திரனை மெள்ள தெளியவே நோக்கிப் பாரும்
வெய்யொளி உண்டு நீயும் விரவிய கண்ணில் நீரை
துய்யமாய் விட்டலம்பித் துவளாகப் பிசைந்திடாயே ”

4 “ உண்டுகை கழுவிப்பின்னே உறுமைய மூன்று துள்ளி
வண்டணி குழலால் வார்த்து வளமிகும் இமையை தேய்த்து
கொண்டொரு கடிகை நேரம் குணமிகுங் கதிரைப் பார்த்து
பண்டு போலிருக்கும் போது பரிவுகண் அமிர்தயோகம்

Table 1: Summary of Moon Gazing Techniques in Stanzas

Siddha Text	Moon Gazing Techniques in Stanza
1. Pararasasekaram Nayana Rogam	**Stanza 1:** Form a *Palagani* by shaping fingers into a window-like frame and gaze at the moon through it. Afterward, wash the eyes with water and gently massage them. **Stanza 2:** After dinner, Wash hands and face thoroughly, then gaze at the moon. This practice is considered as one of the "*Amirtha Yogam*" techniques in Siddha medicine and is believed to help prevent eye diseases.
2. Agasthiyar Nayana Vithi 500	**Stanza 3:** Use a *Palagani* by shaping fingers into a window-like frame to focus on the moon in the clear sky. After observing, wash eyes with clean water and gently massage them to improve vision. **Stanza 4:** After dinner, wash the hands thoroughly and place three drops of water into each eye using a *Kuzhal* (a small tube). Follow this with an eyebrow massage and gaze at the moon for one *Kadikai* (24 minutes). The practice is known as "*Amirtha Yogam*" and is believed to help prevent eye diseases.

Role of Palagani in Ophthalmic Care

Palagani is a technique that involves creating a window-like frame with the hands to view the moon. Research findings suggest that using this hand position can help focus attention on a specific object or scene, enhancing concentration and reducing distractions (Posner, 2007). Thus, it aids in maintaining focus on the moon without external interruptions. Furthermore, engaging in mindfulness practices such as using the window hand position, has been linked to reductions in stress and anxiety. By directing attention to the present moment and observing without judgment, individuals may experience increased relaxation and improved emotional

regulation (Hofmann, 2010). This technique encourages mindfulness by providing a tangible focal point for awareness. Mindfulness practices have been associated with several psychological benefits, including enhanced self-awareness, acceptance, and resilience. The physical act of forming the hand position can serve as a grounding technique, helping individuals reconnect with their bodies and the present moment. Grounding techniques are commonly used in trauma-informed therapies to promote a sense of safety and stability (Kabat-Zinn, 1982).

Impact of Water Application in Eye Wellness

Applying water to the eyes helps maintain hydration and lubrication of the ocular surface, which is essential for overall eye health and comfort (Lemp, 2007) . Water drops are commonly used to alleviate symptoms of dry eye syndrome by restoring moisture, reducing irritation, and relieving discomfort. Regular application of water drops has been shown to improve tear film stability, enhancing eye protection and reducing the risk of corneal damage. Additionally, water drops containing anti-inflammatory agents can help manage inflammation associated with conditions such as conjunctivitis and blepharitis (Baudouin, 2001; Goto, 2002).

Therapeutic Significance of Eye massage for Ophthalmic Health

Traditional eye massage with water has been practiced for centuries in various cultures and is believed to offer multiple benefits for eye health and the prevention of eye diseases. Eye massage techniques, such as gentle circular motions around the eyes, can improve blood circulation, which may help reduce eye strain and fatigue. Enhanced circulation also aids in delivering essential nutrients to the eyes. Prolonged screen time and excessive use of digital devices often lead to eye strain and discomfort. Traditional eye massage techniques, such as palming (covering closed eyes with warm hands), can provide relief by relaxing the eye muscles and reducing tension (Lee, 2016).

Siddha Varma Maruthuvam describes several *varma* points around the eye region, including *Puruva Varmam***,** *Nachathirak Kaalam***,** *Kaampothari Kaalam***,** and *Manthira Kaalam*. Applying gentle pressure to these points is believed to stimulate vision, regulate ophthalmic nerve function, and treat eye diseases by reducing excess heat and strengthening eye muscles (Shunmugom, 2016). Traditional eye massage techniques can also complement conventional treatments for conditions such as myopia, hyperopia, and astigmatism. Integrating these

methods into a holistic eye care regimen may provide additional benefits and support overall eye health (Saxena, 2015).

Scientific Basis for Moon Gazing

A review study discussed the effects of light exposure in regulating circadian rhythms and melatonin secretion, both of which play a crucial role in eye health and sleep-wake cycles (Levi, et al., 1997). While scientific evidence on the therapeutic benefits of moonlight and moon gazing is limited, some studies suggest potential advantages. Moonlight, particularly during full moon phases, creates a serene atmosphere that promotes relaxation and reduces stress. Gazing at the moon may help relax the eyes and alleviate eye strain caused by prolonged screen time or excessive focus on nearby objects. Exposure to natural light, including moonlight, has been associated with mood enhancement and may help alleviate symptoms of depression or anxiety in some individuals. Moon watching can also contribute to a sense of well-being and emotional balance. Additionally, it serves as a form of mindfulness practice, encouraging individuals to be present in the moment and cultivate awareness of their surroundings (Gidlow, 2016; Song, 2016).

CONCLUSION

The conclusion drawn is that moon gazing techniques in Siddha, comprising observation of the moon with or without *Palagani*, watering into eyes and eye massaging possess scientifically verifiable properties that can mitigate the onset of eye diseases. While deeply rooted in Siddha tradition, its principles find resonance with modern therapeutic practices. This traditional practice, may be both non-costly and sustainable, emerges as a viable therapeutic option for ophthalmic care for future practices. However, further studies are needed to elucidate the mechanisms and efficacy of moon gazing therapy for various eye diseases and conditions.

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