

# A Review on Anti-bacterial Activity of Arka Thaila Against *Staphylococcus aureus*: A Comprehensive Analysis

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## ABSTRACT

A common component of the body's microbiota, *Staphylococcus aureus* is a Gram-positive spherically shaped bacterium that belongs to the *Bacillota* and is frequently found in the upper respiratory tract and on the skin. The traditional remedy was produced as an *Arka Thaila* using *Swarasa* (juice) of *Arka Patra* (leaves of *Calotropis procera*), *Kalka* (paste) of *Haridrā* (*Curcuma longa*) and *Sharshapa Thaila* (mustard oil). The objective of this review was to investigate the effectiveness of this herbal oil from the text *Shārangadara Samhitā* work to treat against *Staphylococcus aureus* bacterium. Information about bacteria and *Arka Thaila* was gleaned from *Ayurvedic* scriptures, contemporary texts and earlier research studies. Subsequently a comprehensive survey of the literature was conducted for these three ingredients in the selected oil, which was then scrutinized for their *Pancha Padārtha* and pharmacological qualities against *Staphylococcus aureus*. *Ayurvedic Pancha Padārtha* analysis has revealed that selected herbal formula is efficacious against *Staphylococcus aureus*. While majority of studies have demonstrated the anti-bacterial effects of herbal formula, reviewed articles have also highlighted additional qualities that aid in lowering the growth of bacterial. Based on the literature review and *Pancha Padārtha* analysis, selected herbal formula proves to be valuable in the management of *Staphylococcus aureus* bacterium.

**Keywords:** Anti-bacterial activity, *Arka Patra*, *Arka Thaila*, *Haridrā*, *Staphylococcus aureus*

## INTRODUCTION

*Staphylococcus aureus* is a typical sphere, though one side may be slightly flattened when the cells are grouped in the irregular grape-like cluster that gives the organism its generic name. It is a permanent resident of the nasal passages of 20% of the population and an additional 60% carry it there occasionally [1]. *Streptococci* are not mobile however, when observed in a hanging drop, they may show pronounced brownian motion. They are gram positive and non-sporogenous. But the middle of the clusters may include a few gram-positive organisms.

*Staphylococcus* bacteria, which are forms of germs frequently found on the skin or in the nose of even healthy humans, are what cause *Staphylococcus* infections. Most of the time, these bacteria are either completely unproblematic or result in very mild skin conditions. However, if the bacteria spread further into the body, *Staphylococcus* infections can become fatal. *Staphylococcus* infections can result in disease from a direct infection or from the bacteria producing toxins. Cellulitis, boils, impetigo, food poisoning, boils and toxic shock syndrome are a few examples of illnesses that *Staphylococcus* can cause [1].

Nearly 50 000 people worldwide die prematurely due to infectious diseases every day [1]. Mortality and

morbidity from diarrhea continue to be important issues in many developing nations, particularly among youngsters. The most frequent infections are those caused by a range of bacteria, including pathogenic *Escherichia coli*, *Salmonella spp.*, and *Staphylococcus aureus*. Drug resistance to human pathogenic microorganisms has recently been widely reported worldwide. As a result of widespread antibiotic misuse, bacteria have developed resistance. In addition to this issue, antibiotics can occasionally have negative effects on the host, such as hypersensitivity, immune suppression, and allergic reactions. Due to this, treating infectious diseases has become increasingly clinically challenging.

As a result, new antimicrobial medications are required for the treatment of infectious disorders. One strategy is to examine the potential antibacterial capabilities of regional medicinal herbs. According to WHO, plant materials continue to be a valuable resource in the fight against major diseases around the world [1]. The antibacterial effectiveness of *Arka Thaila* against the *Staphylococcus aureus* laboratory specimen, however, has not been scientifically verified. Therefore, the current investigation will be carried out to assess the antibacterial activity of *Arka Thaila*.

An essential component in *Ayurvedic* formulations is *Snēha Kalpanā*. In the *Madhyama Khanda*, *Acharya Sārangadhara* provided a thorough description of *Snēha Kalpanā*. Both *Taila* and *Ghrita* (ghee) *Kalpanā* are part of it. The comprehensive manufacture of therapeutic oils used to treat a variety of ailments is described in depth in *Thaila Kalpanā*. One such formulation is stated in *Shārangadhara Samhitā Madhyama Khanda* [2]. It is called *Arka Taila*.

In Sri Lankan traditional medicine, a substance known as *Arka Thaila* is utilized for exterior applications. There are 3 ingredients in it. According to the Sri Lanka Ayurveda Pharmacopeia, they include *Arka* (*Calotropis procera*), *Haridrā* (*Curcuma longa*), and Mustard oil (*Brasica campestris*), which can be used to treat skin conditions like *Pāma* (eczema), *Kachchu* (scabies), *Vicharchika* (itchy nodular swelling) and many others [3].

The current study is based on *Ayurvedic* medicinal oil that is used against *Staphylococcus aureus* and written over *Shārangadhara Samhitā*. The study critically analyzed the pharmacological activities of the ingredients in selected oil in the management of *Staphylococcus aureus*.

## AIMS & OBJECTIVES

The study was created to determine the anti-bacterial activity of the ingredients in selected oil in the management of *Staphylococcus aureus* bacteria.

## RESEARCH METHODOLOGY

This research utilized a comprehensive methodology to assess the efficacy of the chosen *Ayurvedic* herbal oil for the management of *Staphylococcus aureus*. This methodology comprised two primary components. Firstly, a systematic literature review was conducted to collect data from both traditional *Ayurvedic* texts and contemporary medical literature.

### Comprehensive Literature Review

In-depth examination of authentic *Ayurvedic* classics, including *Susruta Samhitā*, *Sārangadhara Samhitā* and the Ayurveda Pharmacopoeia, to establish the historical context and traditional understanding of *Thaila* and *Staphylococcus aureus* an extensive review of contemporary medical literature. A comprehensive literature search was carried out from March 2023 to September 2023, including encompassing textbooks, research articles, and official medical websites, to gain insights into current perspectives on frontal sinusitis.

## Investigation of Herbal Components

Detailed study of the specific herbal components, *Swarasa* (juice) of *Arka Patra* (leaves of *Caltropics procera*), *Kalka* (paste) of *Haridrā* (*Curcuma longa*) and mustard oil constituting the *Ayurvedic* herbal oil was done. A thorough examination of the pharmacological properties of these ingredients, with a particular emphasis on their proven anti-bacterial effects based on laboratory tests were done.

## Limitations

We acknowledge certain limitations in our methodology,

The availability and interpretation of data from traditional *Ayurvedic* sources may vary, potentially affecting the comprehensiveness of our historical analysis. In the review of contemporary medical literature, we recognize the possibility of publication bias, where studies with positive results may be more likely to be published, potentially influencing our findings. Interpretations of *Ayurvedic* texts can vary among scholars and practitioners, which may introduce subjectivity into our analysis.

## REVIEW OF FORMULA

An herbal Formula chosen from an authentic text *Shārangadara Samhitā* has three ingredients (Table 1)

**Table I :Review of Selected Herbs**

<b>Ingredients</b>	Caltropics procera	Curcuma longa	Mustard oil
<b>Family</b>	Apocynaceae	Zingiberaceae	Cruciferae
<b>Sanskrit name</b>	Arka	Haridrā	Sarshapa
<b>Part used</b>	Root, Flower, Leaves and Latex	Rhizome	Seeds and leaves

### Caltropics procera ( Arka)

A spreading shrub or medium-sized tree, *Caltropics procera* grows to a height of 2.5 to 6 meters. It possesses a secondary root system with woody lateral roots and a deep taproot that is 3–4m deep, which may quickly grow adventitious shoots when the plant is wounded. A fissured corky bark is seen on the bent stem. The word *procera*, which means in Latin, refers to the gray-green leaves, which are 15–30cm long and 2.5–10cm wide and have a succulent and waxy appearance. Chemicals contain are Cardenolide, citronellol, proceragenin, benzoylnessolone, multiflavenol, uzarigenin, and terpenol ester. Parts used are Root, Flower, Leaves and Latex

The antibacterial activity of chloroform and methanol extracts of *Caltropics procera* leaves in the forest region of Ghaziabad was discovered by Bhaman, 2009. While extracts obtained from *Caltropics procera* leaves were tested for potential in vitro antibacterial activity using the paper disc method, the chloroform extraction of the leaves showed superior antimicrobial activity [4].

Sudamro (2016), published a study titled “The Chemical study of Caltropics” on the most gram-positive and dangerous bacteria relieved by the chlorhexidine solution’s antibacterial properties and its concentration of *procera* latex from Caltropics. Chlororhexidine has a bacteriostatic effect at lower doses against most gram-positive bacteria (for example, at 1 L/ml), many gram-negative bacteria (for example, at 2 to 2.5 L/ml), and bacterial spores. A bacterial impact and activity against yeasts can be anticipated at chlorhexidine concentrations of 20 micrometer/ml or higher. With different supplements, the actual killing time and effective concentration against the most common members of *Burkholderia cepacia* and *S. aureus* vary from 0.0004 to 0.4% [5].

According to Chuekhar(2015), the *Arka Patra Swarasa* was effective for *Karnashūla* (ear ache) management, with a focus on diffuse otitis media. The *Samhitā* refers to *Ayurvedic* literature on otalgia. According to contemporary otology, *Karnashūla* is a distinct disease. A study on diffuse otitis media, *Karnashūla Yōga* (medicine), which is referenced in *Sārangadara Uttarakanda*, and *Yōgarathnakara* has been attempted. As *Arka Patra* is *Vēdana Stāpana*, *Shōtahara* and *Vrunahara*, ripe *Arkapatra* extract (*Swarasa*) is used to make *Uttarakanda*<sup>[6]</sup>.

They employed a medication for the control group that contained lignocaine, ofloxacin, and beclomethasone at concentrations of 3%, 3%, 1%, and 2%, respectively. In the trial group, 86.57% of the patient experienced relief, while in the control group, 90% did. Patients experienced improvement from all symptoms and signs. This analysis revealed that patients in the control group had 3.33% more belief, which is statistically insignificant, indicating that there was no significant treatment difference between the two groups<sup>[7]</sup>.

Additionally, Chritiana and Lilian (2019), came to the conclusion that a comparison of the phytochemicals and antibacterial activity of the leaf extracts of *Caltrop procera*, *Momoidoia charantia*, and *Allium ascalonicum* was made<sup>[8]</sup>.

### **Curcuma longa (Haridrā)**

A blooming plant belonging to the ginger family (*Zingiberaceae*), *Curcuma longa*. Bright yellow spice and color are produced from its rhizomes, or underground stems. An erect perennial herb growing to a height of about 1 m. Old leaf roots encircle the thick rhizome, which is the underground stem. Rhizomes are the only reproductive organ of turmeric. Large, rectangular, up to 1 m long leaves with a pale green underside and a dark green top surface. Each pseudo-stem or leafy branch has 8–12 leaves. Flowers are yellow and white and are carried on a 10-15 cm long spike-like stalk. Flowers do not produce viable seed and are sterile, Small, oval seed and brown. Chemicals (6%) contain volatile oils that range in color from pale yellow to orange-yellow and are made up of a variety of monoterpenes and sesquiterpenes, such as Zingiberene, Curcumene, and Turmerone. Part use is rhizome.

The study “Biochemistry, Safety, Pharmacological Activities and Clinical Application of Turmeric, A Mechanistic Review” by Muhammad (2014) looked examined turmeric oil’s phytochemical components in various solvent systems. Utilizing turmeric leaf essential oil greatly reduces the generation of aflatoxins B1 and G1 as well as fungus growth. Although curcuma is an extremely potent substance, its low water solubility limits its use. The Nano Curcumin’s antibacterial activity involved fully rupturing the cell wall, which resulted in cell death<sup>[9]</sup>.

Ahmed (2005) study, “A Review on Antibacterial, Antiviral, and Antifungal Activity of Curcumin on Aqueous Extract of *C. Longa* Rhizome,” showed that curcumin was effective against *S. epidermis*, *S. aureus*, *Klesibellae*, and *Pneumoniae* at MIC values of 4 to 16 g/L and MBC values of 16 g/L to 32 g/L. According to a study using a methanol extract of turmeric, the MIC values for *S. aureus* and *Bacillus subtilis* were 16 g/mL and 128 g/mL, respectively. Curcumin has been modified to be employed as an anti-microbial activity medication for more mechanistic works<sup>[10]</sup>.

The anti-inflammatory activity of curcumin has recently been shown in acute and chronic models of inflammation in rats and mice<sup>[11]</sup>. Curcumin administration was found to be as effective as cortisone or phenyl butazone in rats with Freud’s adjuvant-induced arthritis, but only in chronic inflammation<sup>[12]</sup>.

In order to reduce inflammation and irritation brought on by inflammatory skin conditions and allergies, curcumin is frequently applied to animal skin (Mukhopadhyay, 1982). Compared to vitamin E, curcumin is a stronger antioxidant. Curcumin’s detoxifying and wound-healing abilities have also drawn significant interest<sup>[13]</sup>.

All tree curcuminoids derived from *C. longa* were shown by Litrakul *et al.*, (2004) using Rt-PCR to block the expression of the multidrug resistance-1 (MDR-1) gene. By using the pour plate method, fraction II of the oil extract from the turmeric oleores demonstrated antibacterial activity against *Bacillus cereus*, *Bacillus coagulans*, *Bacillus subtilis*, *Staphylococcus aureus*, *E. coli*, and *Pseudomonas aeruginosa* [14].

The major bioactive component of the turmeric herb is thought to be curcumin 95%, a powerful antioxidant with anti-inflammatory, anti-platelet, anti-inflammatory, cholesterol-lowering, antibacterial, and antifungal activities. It includes curcuminoids, which prevent cancer at its early stages as well as during its progression [15].

*Staphylococcus albus* and *Staphylococcus aureus* growth was inhibited by *C. longa* oil at concentrations up to 1 to 5000 when it was tested against cultures of those three bacteria.

### Mustard oil (*Sharshapa Thaila*)

Since the beginning of time, humanity has employed mustard for culinary, religious, and cultural purposes. The *Ayurvedic* classical text extensively evaluates and documents the medicinal benefits of mustard, which has a significant role in Indian tradition. In Ayurveda, mustard, or *Sharshapa*, has been utilized as a food and a medication [16].

Different mustard kinds can be distinguished from one another based on their color. *Sarshapa* and *Rājika* are the two varieties of mustard that *Susrutha Samhitā* identifies. The four varieties of mustard that are currently known as brown mustard (*Brassica campestris*), black mustard (*Brassica nigra*), and Indian mustard (*Brassica juncea*), also known as Indian mustard, may correspond to one another according to these classifications. Indian mustard is a botanical source of one of the mustards mentioned in *Ayurvedic* texts.

Chemicals contain are Di-(9-octadecenoyl)-glycerol, 9, 12-octadecenoyl chloride, Hexa deca dicanic acid, 1, 2- ethanediyl ester. Parts used are Seeds and leaves. According to Tambekar (2011), mustard oil is a potent antifungal, anti-parasitic, anti-bacterial disinfecting and anti-microbial oil that help to heal minor skin issues like cuts, athlete's foot, ringworm, insect bites, small lacerations, abrasions, and more. It also protects the skin from infections [17].

The study, "Chemical composition and Antibacterial Activity in Cold Press Oil of Fennel, Anise, White and Black Mustard Seed," by Cagari *et al.*, (2017), explored the antibacterial activity against several bacteria. These were decided. From a farmed region, seeds of the *F. vulgare*, *P. anisum*, *S. alba*, and *B. nigra* species were collected. The oil was extracted using a screw press, and the volatile oil and fatty acid components were assessed by GCMC. Total phenol, total flavonoid, and anti-oxidant activities were also determined using the DPPH and FRAP method. The MIC test was used to examine the antibacterial effects of the produced oils against eight different kinds of bacteria. The examined bacteria did not exhibit any microbial activity in response to the plant oils. When compared to synthetic antioxidants, white and black mustard oils had significant antibacterial and antioxidant activities [18].

## RESULTS AND DISCUSSION

Table II *Pancha Padārtha* Analysis of Selected Herbal Formula

Botanical Name	Rasa	Guna	Veerya	Vipāka	Thridōsha Karma	Pharmacological activities	Chemical Compounds
Caltropics procerca	Katu, Tikta	Laghu	Ushna	Katu	Reducing Kapha and Vāta Dōsha	Anti-microbial, Anti-bacterial	ardenoids, caltropin, citronellol, glycosides, phenols, flavonoids

Curcuma longa	Tikta, Katu	Laghu, Rūksha	Ushna	Katu	Balance of Tridōsha	Anti-bacterial, Anti-viral, Anti-fungal, Anti-inflammatory, Anti-oxidant, Anti-platelet	Curcuminoids, potent antioxidant, cortisone, polyphenols, tannin, ascorbic acid
Brassica juncea	Katu, Tikta	Thikshana (sharp), Snigdha (thaila)	Ushna	Katu	Reducing Kapha and Vāta Dōsha, increasing Pitta	Anti-bacterial, Anti-fungal, Anti-parasitic	glycerol, octadecenoic chloride, AITC, linolenic acid

According to Table 2 the above collection of plants reveals many of the anti-bacterial effect source plants have same Ayurveda properties in their *Rasa*, *Guna*, *Veerya*, *Vipāka*, *Dōshagnata* and actions. *Rasa-Tikta* (bitter) and *Katu* (pungent) *Rasa* is more prominent, Then *Madura* (sweet) and *Kashāya* (astringent) *Rasa* are prominent. *Guna- Laghu* (light) *Guna* is more prominent after the *Rūksha* (dry) *Guna* is prominent. Then *Katu Vipāka* is most prominent Majority of plants showed *Ushna* (hot) *Veerya Karma* -most of these plants show reducing fever and *Shōtahara Karma*. After they mainly have *Vruna Rōpana*, *Kushtagna* and *Vēdanā Stāpana Karma* Chemical constituents are phenols, saponins, flavonoids, glycosides, tannin and terpenoids are more prominent. Most of these plants show wound healing, anti-inflammatory, antimicrobial & Anti-oxidant activities in modern research works. So it's very clear that *Pancha Padārtha* which are more effective in the anti-bacterial effect against *Staphylococcus aureus*. Further the ingredients of *Arka Thaila* possess equal percentage of antibacterial effect, anti-inflammatory effect and anti-oxidant activity. The above collection reveals many of these plants have same Ayurveda properties they are predominantly show *Katu*, *Tikta*, *Kashāya Rasa*, *Laghu Rūksha Guna*, *Ushna Veerya*, *Katu Vipāka* according to *Ayurvedic* concepts. These qualities are mainly created from fire and air element. Burning digestion tearing and Heating are the action of fire elements. Lightning, Roughing are actions of air elements. So it reveals the combination of fire and air elements is produced the quality of antibacterial activity. Which are excision (Removing), cutting (diving), scraping, digestive, cleaning, healing and drying. Also have proved researchers it contains flavonoids, phenols, saponins, tannin and alkaloids which are act as antibacterial activity, anti-inflammatory activity and antioxidant

## CONCLUSION

Based on evidence that revealed by this research, the selected formula mentioned in *Shārangadhara Samhitā* can be effectively used for antibacterial activity.

All the drugs used in the formulation of *Arka Thaila* have *Rasa Panchaka* like *Katu*, *Tikta Rasa*, *Ushna Veerya*, *Katu Vipāka* and *Thridōsha Karma*. Experimental studies (invitro) of individual drugs have proved to have antibacterial action. Thus, the formulation of *Arka Thaila* comprising of all these three drugs will have a synergistic action and may prove to be efficacious in disease caused by *Staphylococcus aureus*.

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