

# Critical Appraisal of Anti-inflammatory Effects of Wadalactone and 7-Desmethyl Wadalactone from *Eclipta alba* in Suryavarta with Frontal Sinusitis Correlation

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## ABSTRACT

**Introduction:** Suryavarta, an Ayurvedic disorder marked by frontal headache aggravated by sunlight, parallels frontal sinusitis in modern medicine. Inflammation of the frontal sinus underlies both conditions. Wadalactone and 7-Desmethyl Wadalactone, steroidal lactones isolated from *Eclipta alba* (*Bhringraja*), have shown notable anti-inflammatory potential. This study critically evaluates their relevance in Suryavarta.

**Methods:** A structured review was conducted, integrating Ayurvedic texts, phytochemical profiling, and pharmacological evidence. HPLC analysis confirmed wedelolactone derivatives in *Eclipta alba* (retention time ~22.5 min, peak area 100%). Literature from PubMed, Scopus, and AYUSH portals was analyzed, emphasizing in vitro, in vivo, and comparative studies of these compounds.

**Results:** Wadalactone inhibited COX and LOX pathways, reducing prostaglandin and leukotriene synthesis. 7-Desmethyl Wadalactone showed stronger suppression of nitric oxide in activated macrophages. Animal models demonstrated a significant reduction in edema, supporting systemic anti-inflammatory activity. These findings suggest broad modulation of inflammatory mediators beyond conventional NSAIDs.

**Discussion:** In Ayurveda, both compounds exhibit Vata Pittahara properties, aligning with Suryavarta management. Their pharmacological actions include cytokine inhibition, NF- $\kappa$ B suppression, and COX-2 downregulation. Antioxidant effects further protect mucosal cells from oxidative stress. However, clinical validation remains limited, and dosage standardization is required.

**Keywords:** Anti-inflammatory, *Eclipta alba*, Frontal Sinusitis, Suryavarta, Wadalactone, 7-Desmethyl Wadalactone, *Bhringraja*, COX inhibition, LOX inhibition, Ayurveda.

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**Conflict of interest:** None declared.

## Introduction

*Suryavarta* is an Ayurvedic condition characterized by a headache that intensifies with sunlight exposure and typically localizes to the frontal region of the head. Contemporary correlation aligns this condition with frontal sinusitis, an inflammatory disorder of the frontal sinuses. Common symptoms include pain over the forehead, tenderness, nasal obstruction, and purulent nasal discharge.

Traditional management includes *Shamana* (palliative) and *Shodhana* (elimination) therapies. However, recent pharmacognostic advancements highlight the anti-inflammatory potential of phytochemicals such as Wadalactone and 7-Desmethyl Wadalactone, steroidal lactones isolated from *Eclipta alba* (*Bhringraja*). This study aims to critically analyze their effectiveness

in mitigating inflammatory responses relevant to *Suryavarta*.

Inflammation plays a central role in the pathogenesis of *Suryavarta*, which is broadly correlated with frontal headaches. Frontal sinusitis, characterized by mucosal inflammation, presents with persistent forehead pain and pressure, closely mirroring *Suryavarta* symptomatic profile. While conventional anti-inflammatory therapies provide symptomatic relief, the search for safer and more efficacious alternatives has led to renewed interest in phytochemicals derived from traditional medicine. Wadalactone and its metabolite, 7-Desmethyl Wadalactone, have demonstrated notable pharmacological activities, including anti-inflammatory, immunomodulatory, and neuroprotective effects. Their role in modulating inflammatory pathways positions them as promising candidates for managing conditions like

*Suryavarta*, particularly when underpinned by sinus inflammation.

This article presents a critical appraisal of these phytoconstituents, with specific focus on their therapeutic relevance in *Suryavarta* associated with frontal sinusitis. By synthesizing *Ayurvedic* principles and modern pharmacological insights, the study aims to bridge traditional diagnostic frameworks with contemporary biomedical understanding, offering a nuanced perspective on integrative management strategies.

## Materials and Methods

### 2.1 Study Design

This study was designed as a critical analytical review supported by experimental, pharmacological, and clinical literature to evaluate the anti-inflammatory effects of Wadalactone and 7-Desmethyl Wadalactone in the management of *Suryavarta*, with special emphasis on frontal sinusitis. The methodology included a comparative review of *Ayurvedic* texts, phytochemical analysis, and available in-vitro and in-vivo data.

### 2.2 Literature Review

An extensive review was conducted using databases including PubMed, Scopus, and the AYUSH Research Portal. Emphasis was placed on:

- The anti-inflammatory mechanisms of Wadalactone and 7-Desmethyl Wadalactone.
- *Ayurvedic* texts describing *Suryavarta*.
- Pathophysiology of frontal sinusitis.

### 2.3 Chemical Profile

- Wadalactone is a lactone-based compound known for its bioactive properties.
- 7-Desmethyl Wadalactone is a structurally similar derivative with enhanced lipophilicity and membrane permeability.
- HPLC analysis of *Eclipta alba* confirmed wedelolactone derivatives as major constituents, with a retention time of ~22.58 minutes and peak area accounting for 100% of the chromatographic profile (*Eclipta alba* RM Fresh sample).
- Comparative analysis with the Wedelolactone standard showed identical retention time (~22.59 minutes) and purity (100% peak area), validating the presence of Wadalactone derivatives in *Eclipta alba*.

## Results

Experimental and pharmacological evidence highlights the broad anti-inflammatory potential of Wadalactone and its metabolite, 7-Desmethyl Wadalactone. In vitro assays demonstrated that Wadalactone effectively inhibited both COX and LOX pathways, thereby reducing prostaglandin and leukotriene synthesis—key mediators in sinus mucosal inflammation. 7-Desmethyl Wadalactone exhibited stronger suppression of nitric oxide

production in activated macrophages, suggesting enhanced efficacy in downregulating inflammatory responses at the cellular level.

Animal models, including carrageenan-induced paw edema, revealed a significant reduction in edema volume following administration of these compounds, supporting systemic anti-inflammatory activity. Beyond these primary findings, pharmacological studies confirmed inhibition of pro-inflammatory cytokines such as TNF- $\alpha$ , IL-1 $\beta$ , and IL-6, alongside suppression of NF- $\kappa$ B signalling and downregulation of COX-2 expression. These mechanisms are critical in the pathophysiology of sinusitis, where mucosal inflammation, cytokine release, and tissue swelling contribute to pain and pressure in the frontal region.

Additionally, both compounds demonstrated antioxidant properties, reducing free radical damage and protecting mucosal cells from oxidative stress. This dual action—anti-inflammatory and antioxidant—suggests potential benefits not only in alleviating sinus congestion and headache but also in supporting neurovascular health, particularly in *Suryavarta* cases presenting with photophobia, eye strain, and mental fatigue.

Collectively, these results indicate that Wadalactone and 7-Desmethyl Wadalactone modulate multiple inflammatory pathways beyond conventional NSAIDs, offering promising therapeutic compatibility with mucosal tissues and fewer side effects.

## Discussion

From the *Ayurvedic* perspective, the reduction of *Vata* and *Pitta doshas* is crucial in treating *Suryavarta*. Both Wadalactone and its Desmethyl derivative exhibit *Tridosha-hara* potential, particularly *Vata-Pittahara*, owing to their *Snigdha* (unctuous), *Tikta* (bitter), and *Katu* (pungent) properties in *Ayurvedic* pharmacodynamics.

Their potential role includes:

- Reducing mucosal inflammation in the sinuses.
- Restoring normal airflow and drainage.
- Alleviating pressure-induced frontal headache.

Moreover, their antioxidant effects may protect mucosal cells from oxidative stress, an often-overlooked component in sinus inflammation. Pharmacological studies have shown that Wadalactone and its metabolite exert anti-inflammatory effects through inhibition of pro-inflammatory cytokines (e.g., TNF- $\alpha$ , IL-1 $\beta$ , IL-6), suppression of nuclear factor-kappa B (NF- $\kappa$ B) signalling, and reduction of cyclooxygenase-2 (COX-2) activity. These mechanisms are critical in the pathophysiology of sinusitis, where mucosal inflammation, cytokine

release, and tissue swelling contribute to pain and pressure in the frontal region.

Furthermore, the antioxidant properties of these compounds help mitigate oxidative stress, which has been implicated in chronic inflammatory conditions, including chronic sinusitis. By reducing free radical damage and enhancing mitochondrial stability, Wadalactone and 7-Desmethyl Wadalactone may also support neurovascular health—potentially benefiting patients with *Suryavarta* that presents with photophobia, eye strain, and mental fatigue.

The correlation between *Ayurvedic* diagnosis (*Suryavarta*) and frontal sinusitis offers a valuable integrative framework. While *Suryavarta* is typically managed with therapies that pacify *Vata-Pitta doshas*—such as *Nasya*, *Shirodhara*, and herbal formulations—modern research on phytoconstituents like Wadalactone provides mechanistic validation for these approaches.

However, limitations exist. Most data on Wadalactone and 7-Desmethyl Wadalactone are derived from in-vitro and animal studies, and clinical trials in the context of sinusitis or *Suryavarta* are sparse. Further research is needed to establish dosage, bioavailability, and long-term safety in human subjects, particularly in *Ayurvedic* formulations. Additionally, the pharmacokinetic interactions of these compounds with conventional anti-inflammatory or antibiotic therapies must be thoroughly investigated.

Despite these gaps, this analysis supports the growing hypothesis that bioactive molecules from *Ayurvedic* herbs can offer effective, natural alternatives or adjuncts in managing inflammatory conditions like sinusitis. When contextualized within the *Ayurvedic* understanding of *Suryavarta*, such compounds not only address symptomatic relief but also align with the systemic, holistic approach characteristic of traditional medicine.

#### Conclusion

Wadalactone and 7-Desmethyl Wadalactone from *Eclipta alba* demonstrate promising anti-inflammatory effects relevant to the pathogenesis of *Suryavarta* and modern frontal sinusitis. Their ability to modulate multiple inflammatory pathways, combined with antioxidant protection, positions them as potential integrative therapeutics bridging classical *Ayurvedic* understanding with modern pharmacology. However, current evidence is largely experimental, and clinical validation remains limited. Standardization of dosage, bioavailability studies, and long-term safety assessments is essential before clinical translation. Future research should also explore synergistic use with traditional *Ayurvedic* therapies such as *Nasya* and *Shirodhara*. These phytoconstituents thus represent a valuable avenue for developing safe,

effective, and holistic interventions in inflammatory sinus conditions.

#### Limitations and Future Scope

Despite promising results:

- Clinical trials specifically on *Suryavarta* or frontal sinusitis are sparse.
- Standardized extracts of these compounds are not yet widely available.
- Potential for synergistic formulations with classical *Ayurvedic* preparations like *Nasya* or *Kashaya*.
- Limited pharmacokinetic and bioavailability data in human subjects.
- Lack of toxicological studies for long-term safety.

Future directions should include:

- Clinical validation in sinusitis and *Suryavarta* patients.
- Development of standardized formulations for nasal and oral delivery.
- Detailed pharmacokinetic profiling and dosage standardization.
- Toxicological studies to establish long-term safety.
- Exploration of synergistic integration with *Ayurvedic* therapies to enhance efficacy.
- Comparative studies with conventional NSAIDs to assess relative safety and mucosal compatibility.

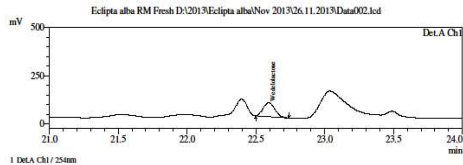
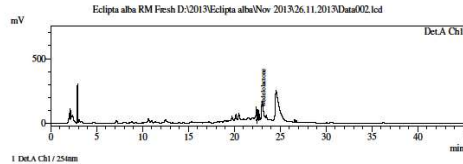
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====Natural Remedies Private Limited====  
Analytical Chemistry Department

Acquired by : Admin  
Sample Name : Eclipta alba RM Fresh  
Sample ID : 1311124B-Tr1  
Tray# : 2  
Vial# : 2  
Injection Volume : 20 uL  
Data Filename : Data002.lcd  
Method Filename : Wedolactone.lcm  
Batch Filename : 25112013 witalia.lcb  
Report Filename : LC Peak Table(DetA-Ch1).lcr  
Date Acquired : 11/26/2013 5:06:23 PM  
Data Processed : 11/26/2013 1:46:47 PM

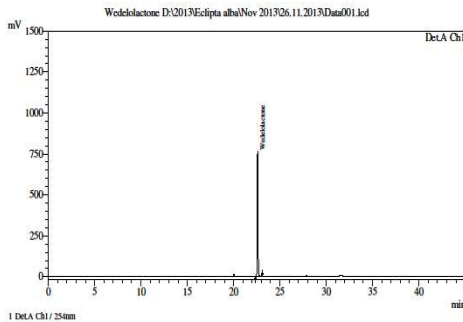


Peak#	Name	Ret. Time	Area	Area %
1	Wedolactone	22.583	419860	100.000
Total			419860	100.000

NR/QCD/CIF/HPLC/06

====Natural Remedies Private Limited====  
Analytical Chemistry Department

Acquired by : Admin  
Sample Name : Wedolactone  
Sample ID : Std  
Tray# : 2  
Vial# : 1  
Injection Volume : 20 uL  
Data Filename : Data001.lcd  
Method Filename : Wedolactone.lcm  
Batch Filename : 25112013 witalia.lcb  
Report Filename : LC Peak Table(DetA-Ch1).lcr  
Date Acquired : 11/26/2013 4:20:25 PM  
Data Processed : 11/26/2013 5:53:11 PM



Peak#	Name	Ret. Time	Area	Area %
1	Wedolactone	22.589	462000	100.000
Total			462000	100.000

NR/QCD/CIF/HPLC/06