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**MECHANISM OF ACTION AND DENTAL IMPLICATIONS OF SUDANTHA  
EXTRACT**

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**ABSTRACT**

Sudantha extract (SUD) has gained immense popularity among the researchers in the field of dental medicine. It has shown to exhibit antibacterial, antioxidant, antifungal, antiplasmodial and anti-inflammatory effects. Various components of this extract function by inhibiting major bacterial virulence factors, suppression of gtf genes and inhibition of expression of pro-inflammatory cytokines and IL-8. SUD containing herbal toothpaste has been found beneficial in improving oral hygiene; reducing gingival inflammation, bleeding, plaque accumulation etc. However, more evidence and clinical trials are required to validate their use amongst the human population.

**Keywords:** Sudantha extract, dental uses, herbal medicine, oral hygiene, gingivitis, anti-bacterial, anti-inflammatory effect

## INTRODUCTION:

The potential of ayurvedic medicines can never be understated. Since many years, traditional medicine has been gaining fame due to various factors such as adaptability to different cultures, availability and affordability [1]. Infact, they have been employed for use in new oral health regimes and for treatment of various diseases. Various randomized controlled studies and clinical trials have emphasized and documented the potential of herbal medicines as an anti-inflammatory, antibacterial and an antifungal agent [1-3]. Numerous plant extracts or a combination of herbs have been formulated for conservation of oral hygiene along with treatment of various oral diseases [3].

One such plant extract that has gained immense popularity among the researchers is Sudantha (SUD). Antibacterial, antioxidant, antifungal, anti-plasmodial and, anti-

inflammatory effects of these herbs have come into lime light [3]. Sri Lanka has already incorporated this extract into a toothpaste named as Sudantha [2, 4]. The results of an online survey conducted in the USA suggested that approximately 35% of the 26,157 participants used herbal medicines [5]. This article provides evidence-based conclusions from clinical studies on the efficacy of Sudantha extract. It also highlights proposed mechanism of action of various components of this herb along with dental applications.

### Botanical details:

Sudantha is a commercially available toothpaste. Its active ingredient, Sudantha extract (SUD) is a crude dark proprietary mixture composed of 9 herbs. Following **Table 1** enlists the ingredients of the same: [2, 4].

**Table 1: Ingredients of Sudantha extract (SUD)**

Plant	Scientific name
Heartwood of cutch tree	<i>Acacia chundra</i> Willd.
Malabar nut leaf	<i>Adhatoda vasica</i> Nees.
Spanish cherry bark	<i>Mimus opselengi</i> L.
Black pepper	<i>Piper nigrum</i> L.
Pongam oil tree root	<i>Pongamia pinnata</i> (L.) Piere
Aleppo oak galls	<i>Quercus infectoria</i> Olivier.
Clove	<i>Syzygium aromaticum</i> L.
Myrobalan fruit	<i>Terminalia liachebula</i> Retz.
Ginger	<i>Zingiber officinale</i> Roscoe

### Mechanism of Action:

Phytochemicals are plant-derived chemicals that are biologically active and are useful for preventing diseases or for plant protection.

These have anti-inflammatory, anti-bacterial, anti-cariogenic and astringent properties. Sudantha extract is composed of nine herbs. All the ingredients are believed to possess

some mechanism of action. They either play a role individually or in combination with another herb. Following is the list of probable

actions that have been reported for various herbs of Sudantha extract (**Table 2**) [1].

**Table 2: Mechanism of Action**

Herb (Component of Sudantha extract)	Action
<i>Pongamia pinnata</i> , <i>Zingiber officinale</i> Roscoe	Anti-inflammatory action
<i>Quercus infectoria</i> Oliv., <i>Terminalia chebula – aralu</i> <i>Syzygium aromaticum</i> (Clove)	Antibacterial activity
Leaf extracts of <i>Adhatoda vasica</i> Nees., <i>Mimusops elengi</i> L ('Munnamal')	Growth inhibition of <i>P. gingivalis</i> and <i>P. intermedia</i> Improves gingival inflammation

### **Inhibition of major bacterial virulence factors:**

Microbes inhabit every part of the human body, including the oral cavity. Resident flora comprises of organisms that form a part of the body's normal microbial community. They do not cause harm and have beneficiary effect on the host. They prevent colonization of pathogens and also stimulate the host's immune system. On the other hand, transient flora inhabits the body surface or mucous membrane temporarily and does not produce disease since the resident flora remains unharmed. Transient flora may colonize and produce diseases on disruption of resident flora. (TB CHP 7, PG121-123) It is necessary to maintain the natural microbiome in order to achieve homeostasis. These microbes do not harm the human body in good immune state. However, on attenuation of immunity, they may cause endogenous diseases. Hence, it is mandatory to preserve the normal microbial community of the human body at the same

time maintain our immune system at its best. Also, the use of antimicrobial agents leads to development of resistance in bacteria that were previously susceptible to antimicrobial agents. (TB CHP 3.5, PG61) [6]. Therefore, there is a shift of focus from elimination of pathogenic bacteria to targeting their virulence factors. This decreases the innate complications associated with antimicrobials such as unbiased action towards all bacteria, development of resistance and super infections. Biofilms, toxins, enzymes, quorum sensing and other bacterial virulence factors have successfully been antagonized by various natural compounds isolated from plants [4].

*S. mutans* is a prime bacteria present in the oral cavity. It is also a major cause for dental caries. It secretes glucosyltransferases (gtfs) and soluble and insoluble exopolysaccharides. These along with other compounds form biofilm matrix which provide nourishment and protection against the action of salivary

enzymes, antimicrobial agents, mouthwashes, toothpastes and antibiotics administered systemically. A study unveiled that Sudantha extract was able to inhibit the development of *S. mutans* biofilm and disrupt its pre-formed biofilms [4].

### **Suppression of gtf genes:**

Expression of gtf gene results in synthesis of glucan polysaccharides in *S. mutans*. This is beneficial in biofilm formation of the bacteria. Plants produce polyphenols such as flavonoids, tannins and phenolic acid which act as a defensive agent against invading pathogens. Studies have shown that polyphenols suppress the gtf genes thereby inhibiting the synthesis of glucan polysaccharides. This has proven to be efficient in opposition to the biofilms produced by periodontal pathogens such as *Porphyromonas gingivalis* and *Enterococcus faecalis* [4].

### **Inhibition of expression of pro-inflammatory cytokines and IL-8:**

Inflammatory mediators such as histamine, prostaglandins, cytokines (TNF, IL-1, IL-6), chemokines etc. play an active role in initiating and regulating inflammatory reactions in the human body. They perform functions such as vasodilation, chemotaxis, leukocyte activation, promotion of tissue remodeling and formation of blood vessels

etc. [7]. Gingival keratinocytes present in humans express IL-8 in response to oral bacteria and pro-inflammatory cytokines IL-1 $\beta$  and TNF- $\alpha$ . The secretion of IL-8 in gingival epithelial tissues is regulated during the occurrence of periodontitis and gingivitis, which makes it an essential component for the maintenance of oral health. SUD inhibits expression of IL-8 that is agonized with bacterial products (F. nucleatum cell wall extracts or live F. nucleatum) and host inflammatory mediators (IL-1 $\beta$  and TNF- $\alpha$ ) in a dose-dependent manner [2].

The extract produced by cell wall of F. nucleatum induces expression of IL-8 in gingival keratinocytes. This extract is in turn suppressed by SUD without affecting cell viability. SUD also suppresses IL-1 $\beta$  and TNF- $\alpha$  host mediator induced IL-8 expression by gingival keratinocytes.

### **Dental uses:**

Periodontal diseases have been the most common cause of tooth loss among adults all over the world. World Health Organization (WHO) has estimated that periodontal diseases will affect around 19% of the global adult population showcasing higher than 1 billion cases worldwide [8]. The prevalence of periodontal diseases was around 18.82% globally in 2019. Poor oral hygiene and the use of tobacco contribute as a major

behavioural risk factor for periodontal disease [8]. Hence, there is a pressing need to implement various preventive and treatment strategies in order to reduce the burden of periodontal disease among the adult population.

Periodontitis, also known as inflammation of the periodontium which forms the supporting structure of the tooth is manifested as pain, discomfort, and cosmetic problems. If untreated, it eventually leads to gingival swelling, pocket formation, bleeding on probing the gingival sulcus, bone loss, loss of attachment, increased tooth mobility and tooth loss [9]. This reduces the quality of life and has severe consequences. The key-concept behind treatment of periodontal diseases is patient education, infection control and reduction of risk factors. Different components of *Sudantha* extract have been found beneficial for treatment of periodontal diseases. *Syzygium aromaticum* (Clove), a component of SUD has inhibitory effect on *P. gingivalis* and *P. intermedia* [1].

The inflammatory reaction in the tissues surrounding the teeth occurs as a result of release of proinflammatory mediators (e.g., Prostaglandin, tumor necrosis factor- $\alpha$ , etc.) These are released in response to the accumulation of plaque and calculus due to the action of microorganisms. Infection

control in periodontal treatment involves procedures such as supragingival and subgingival scaling and root planning. They facilitate the down-regulation of inflammation, thereby reducing the destructive effect of inflammatory mediators on the gingiva and periodontium [9]. Thus, aim of the treatment is to enhance the defense mechanism of the host thereby moderating the inflammatory response. Using the same approach, plant derived polyphenols has shown to inhibit certain important components of the inflammatory cascade, such as MAP kinases and nuclear transcription factors [2]. One suggested mechanism of action of SUD demonstrating its clinical efficacy may be due to its ability to mediate IL-8 secretion by host or bacteria, thereby reducing the migration of neutrophil [2].

SUD containing herbal toothpaste has been examined in two separate randomized double-blind placebo-controlled clinical trials. A notable amount of improvement was seen in the gingival health as there was reduction of signs of gingivitis. These results were seen as early as 4 weeks of its use compared to the placebo group [1]. A follow-up clinical trial confirmed these therapeutic benefits of SUD for patients with gingivitis [3].

To summarize, these randomized clinical studies provide robust evidence of the

effective antiplaque and anti-gingivitis effects of this herbal extract for both the maintenance of health and treatment of disease [2].

### CONCLUSION:

The therapeutic potential of Ayurvedic medicinal preparations have slowly come into limelight via various clinical trials. However, the data pertaining to the same is insufficient. Hence, thorough clinical trials, scientific evidence and experimentation are required to expand their use in the market among the human population.

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