



# Clinical Uses and Scope of *Spilanthes acmella* in Dentistry: A Narrative Review

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## Abstract

*Spilanthes acmella*, also identified as Akarkara (Toothache plant), is a crucial herb with immense applications both in the medical as well as dental field. Its biologically active component, *Spilanthol*, is believed to be responsible for an array of wields like anti-toothache, analgesic, anti-pyretic, anti-inflammatory, anti-diuretic anti-oxidant, immune-modulatory, anti-microbial, and anti-cancer agent, etc. Recent advances in the use of this plant include food, cosmetic industry, treatment of periodontal diseases and oral ulcers, toothpaste, as an intracanal medicament, and aphrodisiac. The scope of herbal remedies for treatment is expected to rise in near future. However, more experimental studies are required to ascertain this plant's quality, efficacy, potency, etc. The scope of the current review is to discuss various uses of *Spilanthes* in dentistry.

**Keywords:** Dentistry, Herbal Topical, Local Anesthetic Agent, *Spilanthes acmella*, *Spilanthes oleraracea*, Toothache Plant

## 1. Introduction

*Spilanthes acmella*, a popular plant of the family Asteraceae and kingdom Plantae has been of extensive therapeutic use for treating ailments for a very long time<sup>1</sup>. The taxonomical hierarchy is shown in Table 1. It has been estimated by World Health Organization (WHO) that in some countries of Asia and Africa, as much as 80% of them prefer using herbal medicine for primary healthcare<sup>2</sup>. Herbal medicines are some of the most common ancient remedies used by various cultures for treatment of injuries and illnesses. *Spilanthes acmella* is also referred to as 'Jambu', 'Toothache plant', 'Akarkara', 'Jotang', etc<sup>1</sup>. Its therapeutic value is enlightened by the presence of chemical constituents such as "*spilanthol*" and "*acmellonate*"<sup>3,4</sup>. Owing to its name, this plant reduces toothache, treats infection of the gums and throat, and can also induce saliva secretion. All the parts of this herbaceous plant viz. flowers, leaves, roots, stems, and aerial parts have

widely been used in healthcare. Specifically, its leaves and flower heads have an analgesic, astringent, and digestive properties<sup>1,3</sup>. The herb is also an anti-bacterial, anti-fungal, anti-helminthic, immune-modulatory, lithotriptic, sialagogue<sup>1,3</sup>. On conduction of lab and animal studies, it was found that the plant possesses vasorelaxant, antioxidant, antipyretic, and local anesthetic property because of the presence of the chemical spilanthol<sup>5</sup>. Herbal medicines offer dynamic pharmacological potential and are of immense therapeutic value. This has led to a surge in its demand with increasing cognizance in the global market. There is anticipation for the broad use of herbal remedies in the near future. However, a major obstacle that remains is their standardization, quality assurance, safety, and efficacy. These obstacles are key focus areas to be worked upon and efforts have already been initialized in achieving this goal<sup>4</sup>. The main purpose of this review article is to summarize botanical details, distribution, and a broad range of medicinal and dental uses of *S. acmella*.

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**Table 1.** Scientific classification

Kingdom	Plantae
Subkingdom	Tracheobionta
Phylum	Tracheophyta
Division	Magnoliophyta
Super division	Spermatophyte
Class	Magnoliopsida
Sub Class	Asteridae
Order	Asterales
Family	Asteraceae
Subfamily	Mimosoideae
Genus	<i>Spilanthes</i>
Species	<i>acmella</i>

## 2. Botanical Details and Distribution

*Spilanthes*, a vital medicinal plant comprising of 60 species widely dispersed in the tropical and subtropical regions of the world including Africa, America, Borneo, India, Malaya, North America, and Sri Lanka. When it comes to India, its distribution is confined to Chhattisgarh, Jharkhand, and South India<sup>6,7</sup>. It is indigenous to Brazil and is an annual herb with growth up to 40-60cm. It grows in damp areas with a low germination rate. The plant consists of gumdrop-shaped flowers which are yellow/red and the leaves are 2.5 to 5 cm in length which are arranged opposite to one another<sup>6</sup>. It has no discrete odor as such, but on consumption, an interesting savor develops slowly which is pleasant and salty to a strong, tickling burning pungency retaining an anesthetized sensation in the oral cavity<sup>8</sup>. On cooking, the pungency is lost making it a favorable green leafy vegetable. On touch, one would feel a tingling sensation and numbness<sup>2</sup>.

## 3. Other Names

*Spilanthes acmella* is also called 'Akarkara', 'Bian di hong', 'Buzz buttons', 'Dung getang', 'Electric daisy', 'Jambu', 'Jocong', 'Jotang', 'Paracress', 'Schezuan buttons', 'Tian wen cao', 'Toothache plant' and 'Xiao tong chui'. The Table 2 enlists local names of this plant used in different countries.

## 4. Bioactive Compounds

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

**Table 2.** Local names

Local names	Region
'Mandal Poo Chedi'	Tamil Nadu, India <sup>2</sup>
'Akarkara'	India <sup>1</sup>
'Jhummosak'	Bangladesh <sup>2</sup>
'Jotang', 'Jocong' and 'Dung getang'	Indonesia <sup>1</sup>
'San lu cao', 'Xiao tong chui', 'Tian wen cao' 'Bian di hong'	China <sup>1</sup>

or for plant protection. One such phytochemical present in *S. acmella* is "*Spilanthol*". Chemically, it is N-isobutyl amide and is capable of stimulating salivation. It also gives the plant a pungent taste and is believed to generate anesthetic and astringent effects<sup>9,10</sup>. The leaves contain alkaloids, amino acids, carbohydrates, carotenoids,  $\alpha$ -carotene and  $\beta$ -carotene, essential oils, pro-vitamin A, steroids, sesquiterpenes, and tannins. It is used as immunomodulators, adaptogenic, tonic, diuretic, lithotriptic, antiscorbutic, digestive, sialagogic, and antibacterial. It is also used as a constituent in making toothpaste for toothache<sup>11,12</sup>.

## 5. Medicinal Uses

**Anti-inflammatory, Anti-pyretic, and Analgesic Action:** Prostaglandins (PG) play an important role as mediators of inflammation. Prostaglandins (PG), prostacyclin (PG I<sub>2</sub>), and thromboxane A<sub>2</sub> (TXA<sub>2</sub>) are produced from arachidonic acid by the enzyme cyclo-oxygenase (COX). Inhibition of COX production results in anti-inflammatory action<sup>13</sup>. A study conducted by Hernandez *et al.* in 2009 demonstrated that spilanthol, which is an active component of the plant *S. acmella* inhibits the COX enzyme thus producing an anti-inflammatory response<sup>2,14,15</sup>.

Fever is produced during infection or tissue injury through the generation of pyrogen, Interleukins (ILs), Tumor Necrosis Factor  $\alpha$  (TNF $\alpha$ ), and interferons which induces Prostaglandins (PG) production in the hypothalamus thereby raising its temperature set point<sup>13</sup>. A review conducted in 2020 explained the anti-inflammatory, anti-oxidant, and painkiller effects of *Acmella* via molecular mechanisms that included transcription factors and pro-inflammatory mediators. This plant has shown promising results for pain management in chronic degenerative diseases<sup>16</sup>. Flavonoids obtained by flower and aerial aqueous extracts of this plant are believed to be responsible for its antipyretic

**Table 3.** Extracts of various parts of plant and antimicrobial effect

S. acmella plant extract	Microbes
Ethyl and Methanol (MeOH) extracts	<i>Klebsiella pneumonia</i> <sup>21</sup>
Chloroform (CHCl <sub>3</sub> ) extracts	<i>Streptococcus pyogens</i> <sup>22</sup>
Hexane and CHCl <sub>3</sub> extracts	<i>Saccharomyces cerevisiae</i> <sup>22</sup>
EtOAc and CHCl <sub>3</sub> extracts	<i>Corynebacterium diphtheria</i> <sup>22</sup>

activity<sup>2,17,18</sup>. Prostaglandins (PGs) induce hyperalgesia by affecting the transducing property of free nerve endings<sup>13</sup>. The mechanism of analgesic action is possibly through the inhibition of PGs by spilanthol-containing extract or by flavonoids in the plant extract<sup>2,19,20</sup>.

**Anti-microbial Action:** Various extracts from the plant *S. acmella* exhibited anti-microbial activity against *Klebsiella pneumoniae*, *Streptococcus pyogens*, *Saccharomyces cerevisiae*, and *Corynebacterium diphtheria*<sup>2,21,22</sup>. A study conducted in 2013 by Noor Jahan *et al.* showed that the ethanolic extract of *S. acmella* exhibited antimicrobial activity against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogens*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Salmonella typhi*<sup>23</sup>. The Table 3 categorizes a few plant extracts of *S. acmella* and microbes that they are effective against:

**Biomedical Uses:** A thorough literature review performed by Prachayasittikul *et al.* in 2013 concluded that *S. acmella* is used to treat fungal skin infections, such as ringworm, nail infections, and athletes' foot by the Indian tribe<sup>2</sup>. It was also used in the treatment of stuttering in children and leukorrhoea in females. Gout, a painful form of arthritis can be treated by this entire plant<sup>6</sup>. The diuretic activity of flowers of *S. acmella* was found to be similar to that of furosemide with a quick onset and longer time of action. Conditions such as headache, fever, cough, flu, throat complaints, stomatitis, rabies, and tuberculosis are treated traditionally with the leaf and flower extracts of this plant. The plant has also proven to be effective in preventing scurvy and helps with digestion. Gastrointestinal tract disturbances can be treated by chewing the its roots. Addressed as 'Jhummosak' in Chittagong hill tracts of Bangladesh, the entire plant paste is utilized as a "poisonous sting". The plant has successfully extended its use in aesthetic care and cosmetic. It serves as a mayorelaxant in various anti-

wrinkle cream formulations<sup>3</sup>. This results in smoother skin due to the reduction of facial wrinkles.

## 6. Clinical Applications in Dentistry

**Toothache:** Odontalgia or toothache is a condition characterized by pain in the tooth originating from dental or non-dental causes. Pulpitis, erupting wisdom teeth, periodontal inflammation, and dry socket account for the dental causes. The non-dental causes comprise referred pain of angina pectoris, trigeminal neuralgia, etc. Pulpitis, also defined as inflammation of the pulp tissue of the tooth, is the most common pathology among various populations<sup>24</sup>. Traditionally, *Spilanthes acmella* was used by people to obtain relief from toothache. They used to chew the pungent flower heads to numb the tooth pain<sup>6</sup>.

**Local Anesthetic Activity:** Local anesthesia is defined as "a temporary loss of sensation in a circumscribed area of the body caused by depression of excitation in nerve endings or inhibition of the conduction process in peripheral nerves"<sup>25</sup>. Alkyl amides present in *S. acmella* may be responsible for local anesthetic action<sup>2,26</sup>. Ethanolic extract from the *Acmella* flowers produced antinociceptive and anesthetic effects in adult male mice<sup>27</sup>. The plant extracts are used as an analgesic oral gel without any identified side effects described in the literature<sup>28</sup>. The local anesthetic activity of aqueous extract of *Spilanthes acmella* in experimental animal model was also evaluated by Chakraborty *et al*<sup>29</sup>.

**Topical Anesthesia:** The importance of topical anesthesia can never be understated. Dentistry involves several procedures covered under local anesthesia. Till date, the fear of pain from injection has deferred the children as well as adults from taking dental treatment. The advent of *Acmella* plant extract in topical anesthesia has successfully proven to be of potential use in order to provide a less fearful and more calming dental experience to the patients. This was backed up by a study that had aimed to develop and evaluate a muco-adhesive film containing *Acmella* plant extract for its use as a topical anesthesia on oral mucosa. The most favourable formulation that was developed showed a considerable degree of anesthetic effect similar to routinely used topical anesthetic agents<sup>30</sup>. This proposed its potentiality as a substitute to the topical anesthetics presently found in the market. Mohite *et al.* compared the use of herbal topical preparation prepared from flower buds of *Spilanthes*

*acmella* against conventional 2% lignocaine for reducing needle prick pain during intraoral injections in children<sup>31</sup>. Andrade *et al.* Compared the use of *Acmella* extract with that of 20% benzocaine for reducing intraoral needle prick pain during buccal mucosa<sup>32</sup>. Blanco *et al.* evaluated mucoadhesive film containing 10% and 20% extract of *Spilanthes acmella* and reported good anesthetic efficacy in animal studies (Tail-flick test)<sup>33</sup>.

**Dentifrice:** Various kinds of toothpaste and mouth rinses contain *Spilanthal*. It provides a refreshing minty flavor, increases salivation, and improves appetite. It also dispenses a pain-relieving effect while brushing for people who are suffering from toothache<sup>6</sup>. Sapro *et al.* based on their study reported that *spilanthes* root extract has better antimicrobial properties compared to conventional dentifrice<sup>34</sup>.

**Dry Mouth (Xerostomia):** *Spilanthal* has shown to induce salivary secretion. *Spilanthal*, responsible for the pungent taste of this plant is considered a potent stimulant and a sialogogue (a herb that promotes an increased salivary flow)<sup>24</sup>. A study reports use of tooth picks infused with *spilanthal* for opioid-induced dry mouth<sup>30</sup>.

**Periodontitis:** Periodontitis is “an inflammatory disease of the supporting tissues (gums and bone) of the teeth caused by specific microorganisms resulting in progressive destruction of the periodontal ligament and alveolar bone with increased gingival recession”. It manifests as the accumulation of supragingival and subgingival plaque and calculus, gingival swelling, bleeding on probing with an instrument, increased tooth mobility, tooth loss, etc<sup>36</sup>. Periodontal disease is a foremost public health concern throughout the globe as it is the most common culprit for missing teeth in adults. It accompanies pain, discomfort, and cosmetic problems. Hence, it has become necessary to develop ways to prevent, minimize, control, and treat dental diseases. 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. It has been studied that *Spilanthes acmella* can help eliminate inflammation and infection of the periodontal tissues<sup>37,38</sup>. The inflammation significantly decreases on chewing the flower heads and roots of the *S. acmella* plant due to anti-inflammatory action of its active component, *Spilanthal*<sup>2,39</sup>.

**Recurrent Aphthous Stomatitis (RAS):** It is “a non-traumatic condition of the oral cavity that presents as

persistently recurrent multiple painful ulcers which are small, round, or ovoid with circumscribed margins, having yellowish-gray floors, and are surrounded by erythematous haloes<sup>740</sup>. Predisposing factors constitute stress and anxiety, hormonal imbalance, genetic, immunologic, and systemic conditions such as Crohn’s disease, Reiter’s disease, etc. Patients experience a burning sensation 2-48 hrs before the appearance of these ulcers. The treatment is palliative and hence focuses on providing symptomatic relief by alleviating pain and accelerating the healing process<sup>41</sup>. It has been witnessed that extracts obtained from leaves of the *Spilanthes acmella* plant provide substantial pain relief and speed up wound healing in the case of RAS<sup>2,42</sup>.

**Intracanal Medicament:** Intracanal medicaments are used to secondarily disinfect the pulp space during endodontic treatment and render the canal free of microbes. The gold standard intracanal medicament used since the 1920s is calcium hydroxide. However, certain microbes such as *Enterococcus faecalis* and *Candida albicans* have been a trouble-maker for dentists for a very long time. In certain clinical conditions, these microbes remain resistant to the action of intracanal medicaments, thus being accounted for endodontic treatment failures<sup>43</sup>. An experimental study to evaluate the efficacy of *Spilanthes acmella* flower extract as an intracanal medicament with Calcium hydroxide and 2% chlorhexidine gel was conducted by Anamika *et al.* This study concluded that *Spilanthes acmella* extract had significant anti-bacterial and anti-fungal properties. This potentiated its utility as an intracanal medicament<sup>44,45</sup>.

**Cancer Therapeutics:** A study conducted in India in 2019 concluded that *Spilanthes acmella* is a promising source of therapeutic agent in the prevention of cancer development and DNA damage<sup>46</sup>. Another experimental study stated that this plant may have significant potential in promoting dental and hard tissue regeneration<sup>47</sup>.

## 7. Conclusion

*Spilanthes acmella* has a broad range of uses in medicine as well as in dentistry. In dentistry, it has numerous uses such as topical anesthesia, reducing periodontal inflammation, as an intracanal medicament and further used has to be explored. Although this plant has proven to be beneficial with a wide array of applicability, its scope in stem cell research and functioning at the molecular level is still in the preliminary stage. More studies and



experiments should be carried out to explore the same. Most of the studies whose findings have been summarized in this review were conducted on animal models.

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