

**Systematic Review****Sophora flavescens in Dentistry: A Systematic Review**

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ABSTRACT

Sophora flavescens is an evergreen shrubby plant that is widely distributed in Asia, especially in China. The roots of the plant have been used in traditional Chinese medicine for treating inflammation, burns, and infections. Studies have proved the medicinal properties of different types of alkaloids and flavonoids, which are extracted from the roots through various procedures. Recent research has shown positive effects of these extracts against many diseases like different kinds of tumours, allergies, diabetes, hepatitis, dental caries, and various kinds of infections, owing to their anti-microbial and analgesic properties. In the case of dental diseases like dental caries and periodontitis extracts such as *Sophora flavanone G* and *oxymatrine* have shown positive indicators.

INTRODUCTION

Sophora flavescens is a shrubby evergreen medicinal plant that belongs to the family *Leguminosae* [1]. *S. flavescens* has been used in many East Asian and some of European countries since historic times. It has been used in treating many medical conditions like eczema, jaundice, fever, inflammatory disorders, dysentery, ulcers, oliguria, and burns [2]. This article reviews the uses of *S. flavescens*, especially in dentistry. Forty-six articles have been studied from PubMed and Google scholar. These research articles show that the extracts from the roots of *S. flavescens* have diverse effects such as analgesic [1], anti-inflammatory [3], antitumor [4], anti-asthmatic [5], antiviral [6], anti-bacterial [7] and antioxidant [8]. The main active compounds alkaloids and flavonoids are extracted from the roots of the plant [9], known as kushen in China [1]. Research has been done on the potential use of antimicrobial effects of *S. flavescens* in treating dental diseases. According to one study *Streptococcus mutans*

(*S. mutans*) associated with dental caries, has shown susceptibility to extracts from *S. flavescens* [10].

Chemical Composition

S. flavescens plant has many uses but there is a need to do more advanced studies in order to access the safety and clinical value of its extracts and pure compounds and to identify their mechanism of action [2]. The main pharmacological components of the plant are alkaloids and flavonoids mainly found in its roots [11]. The mechanism of action of these components is still not clear. The alkaloids extracted from *S. flavescens* are of four types (matrine, anagrine, lupine, and broom alkali type) [12]. Studies have shown that the main effects of the plant are mainly due to its matrine type alkaloids [11]. Six flavonoids have been isolated from the roots [9]. The main flavonoids that have been extracted include kushenol I, sophora flavanone G, kurarinone, maackiain, and trifolirhizin [13]. Fifteen recognized and some new alkaloids have also been isolated

from *S. flavescens*[14].

Methods for Isolation of Compounds: Active components in *sophora flavescens* can be extracted by methods such as ultrasonic-assisted extraction [15], supercritical extraction by CO₂ fluid [16], mechanochemical promoted extraction technology (MPET) [17], gas chromatography [18], microwave-assisted aqueous two-phase extraction for alkaloids [19], and oxymatine [20], subcritical water extraction [21], and heat reflux extraction [22]. High antioxidant activity has been shown by the flavonoids that have been prepared by mechanochemical promoted extraction technology as compared to other methods [17]. Other methods include liquid chromatography or capillary electrophoresis which can be used for the separation of matrine type of alkaloids [18].

Uses as Medicine: *S. flavescens* has a broad spectrum of biological potency. That has been deemed to be of substantial value in both conventional and modern medicine. *S. flavescens* possess wide-ranging anti-tumor, anti-microbial, anti-pyretic, anti-nociceptive, anti-cancer, anti-infection, and anti-inflammatory pharmacological abilities [2].

1. Anti-Tumor Activity: It has anti-cancer effect and can inhibit the proliferation of cancerous cells. It can halt the progression of cell cycle, induce programmed cell death, and prevent metastasis of cancerous cells. It also has the ability to reverse the resistance to anticancer medication and lowers the harmful effects of anticancer drugs [23]. Research has shown that extracts of *S. flavescens* as potential treatment options for different types of cancers such as breast cancer [24], cervical cancer [25], colorectal cancer [26], leukemia's [27], osteosarcoma [28], and liver cancer [29].

2. Ameliorates Ulcerative Colitis: *S. flavescens* provides good efficacy and possesses great potential in the treatment of Ulcerative Colitis. It acts as an anti-inflammatory agent and eliminates inflammation from the gut [30].

3. Combats Diabetes: *S. flavescens* is advantageous for metabolic disorders in the body. It activates alpha and gamma peroxisome proliferator-activated receptors. So, it is helpful for diabetes treatment [30]. It helps in the removal of excess glucose through the kidneys by a reduction in the activity of sodium-glucose linked transporter and treat diabetes [31]. It helps with glucose levels after eating starchy foods by acting as an inhibitor of a-glucosidase and b amylase enzymes [32]. It has the ability to dispose of orally taken glucose, cause a reduction in body weight, increase serum high-density lipoprotein cholesterol, glucose levels of the blood, and other blood lipid indicators [33].

4. Reduces Pain: It causes a reduction in pain

manifestations related with cancer such as leukopenia and nausea [34]. It also helps in the reduction of neuropathic pain [35].

5. Protection of the Vascular System: It has the potential to selectively restrain the activity of cyclic guanosine monophosphate and phosphodiesterase type 5. So, it can be used for impotence and overall inflammation of the vascular system [36]. It fights against atherosclerosis, a disorder in which the arteries become narrow leading to improper blood circulation and inflammation of the vascular system. It relaxes vascular smooth muscles which in turn helps with blood flow and blood pressure. It can improve heart failure by adjusting irregular rhythms caused by calcium in the heart [37]. It is also therapeutic for heart injury induced by septic shock.

6. Anti-Microbial Properties: *Sophora flavescens* has microbicidal activity against *Aggregatibacter*, *Escherichia coli*, *Fusobacterium nucleatum*, *Mycobacterium aurum*, *Porphyromonas gingivalis*, *Staphylococcus aureus*, *Streptococcus anginosus*, *Streptococcus mutans* [38]. It has antiviral properties against Cervical HPV, Coxsackie virus, HBV, Influenza A Virus, Zika virus, Dengue and Hepatitis C virus [39].

7. Skin Improvement and Wound Fixation: It helps in the healing of wounds by increasing levels of growth factors (mRNA), and by PGE₂ and IL-8 which are pro-inflammatory cytokines [40]. It may also help with dermatitis [41]. It is used to treat skin inflammation.

8. Enhances Liver Function: *S. flavescens* contain polysaccharides that save the liver from hepatitis B virus, hepatocellular carcinoma, and chronic hepatitis B. It also prevents liver failure and fibrosis of the liver [43].

9. Fights Asthma: It can suppress lung inflammation and asthmatic reactions (5). It can protect against lung nodules caused by mycobacteria. It reduces antibiotic-induced scarring in the lungs [43].

10. Antioxidant Effect: It can protect the body against reactive oxygen species and the end products of glycation reaction by activating the transcription factors and other downstream targets [44].

11. Anti-Allergic Effect: *S. flavescens* has anti-allergic compounds that hinder the rise in levels of receptors of histamine and gene expression of interleukin-4 and inhibit histamine release from mast cells [45].

12. Treatment of MRSA Infection: The extracts of *S. flavescens* are used either alone or in combination with other antibiotics to control and treat MRSA infections. *S. flavescens* extracts have shown potent bioactivity against methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) which causes lethal hospital infections, as well as against *S. mutans* [46].

Uses in Dentistry

1. Antibacterial Effect against Oral Bacteria: Infectious diseases are caused by pathogenic bacteria which become the most frequent cause of illness and death in human history. *S. flavescens* show high levels of antibacterial activity against oral bacteria. It has synergistic effects against *S. mutans*, *S. Sanguinis*, *S. sobrinus*, *S. gordonii*, and *Porphyromonas. gingivalis* [38]. Sophora flavanone G can increase the bactericidal effect of antibiotics when used in combination, studies show synergistic relation between *S. flavanone G* and ampicillin [47].

2. Prevention of Implant Loosening: It prevents implant loosening. It prohibits the formation of osteoclast and resorption of bone. Therefore, it acts as a curative agent to prevent the loosening of the prosthesis and for osteolytic disorders. It enhances the stability of implants and decreases bone resorption-related turnover [48].

3. Prevention of Dental Caries: The extracts of *S. flavescens* have the potential to prevent and manage dental caries due to their bactericidal potential. More research is required to access the safety of these compounds [10].

4. Treating Periodontitis: The extracts such as oxymatrine have shown the potential to relieve periodontitis in animal models [49]. Further research is required to access the safety and dosage of these extracts for potential use in humans.

5. Oral Hygiene Products Development: *S. flavanone G* an extract of *S. flavescens* can be used in dentifrices and gargle solutions due to its anti-microbial properties [50].

CONCLUSION

It is concluded that *S. flavescens* has vast benefits as a medicinal plant individually as well as in combination with other drugs to treat many illnesses but its use in dentistry needs more research to explore its potential. Antimicrobial effects of root extracts of *S. flavescens* have shown to be highly effective against oral pathogens especially *S. mutans*. The current studies lack systematic approach hence. Further research is required to explore their probable uses for treatment of oral pathologies and to access their safety for humans.

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