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### “ANTIMICROBIAL ACTIVITIES OF ACACIA CATECHU (KHADIRA) WITH RESPECT TO ORAL DISEASE - A REVIEW”

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#### **ABSTRACT:**

Oral health touches every aspect of our lives but is often taken for granted. Our mouth is a window into the health of our body. It can show signs of nutritional deficiencies or general infection. Systemic diseases, those that affect the entire body, may first become apparent because of mouth lesions or other oral problems. Ayurvedic medicines can treat various infectious and chronic conditions. Various researchers have revealed that all kinds of *Churna*, oils, *Ghee*, *Lepa*, chewing sticks etc. described in ancient Ayurvedic literature have medicinal and anti-cariogenic properties on oral health. Use of safe, quality products and practices should be ensured based on available evidence if traditional medicine is to be acknowledged as part of primary health care. *Khadira*, is amongst those potent and important drugs mentioned in Ayurveda classics for oral hygiene. In recent time, many studies had revealed antimicrobial activities of different extracts of various parts of this plant working potentially in adverse situations and on specific infections. Such research works should be enlightened to the knowledge of mankind. Thus, in present study, above mentioned ayurvedic medicinal plant with emphasis on its antimicrobial activities is reviewed.

**Keywords:** Acacia catechu, Dental caries, Antimicrobial activity, oral hygiene

## INTRODUCTION:

Oral health is multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex.<sup>1</sup> Dental caries and periodontal diseases are among the most important global oral health problems, although other conditions like infections, oral and pharyngeal cancers and oral tissue lesions are also of significant concern. Worldwide, oral diseases affect 3.9 billion people, Prevalence of oral disease in India is very high.<sup>2</sup> Oral diseases may also impact on social and psychological aspect of life, consequently leading to social isolation.

Ayurveda has holistic approach towards health as well as disease of an individual. The principle of ayurvedic treatment is to keep an individual healthy and to treat diseased one.<sup>3</sup> Currently; Ayurveda is widely practiced in the Hindustan peninsula (India and the neighboring countries) and in recent years, has attracted much attention in economically developed countries such as those in Europe and in the United States and Japan. There are approximately 1250 Indian medicinal plants that are used in formulating beneficial measures according to Ayurvedic or another ethnicity.<sup>4</sup> The

exploration of botanicals used in traditional medicine, may lead to the development of novel preventive or therapeutic strategies for oral health. As most of the oral diseases are due to bacterial infections and it has been well-documented that medicinal plants confer considerable anti-bacterial activity against various microorganisms including bacteria's responsible for dental caries. Considering the vast potentiality of above mentioned ayurvedic medicinal drug for antimicrobial activities and in order to bring this knowledge forward for medical science and mankind, the present study is based on the review of this medicinal plant. In present paper, a brief description of Acacia catechu (*Khadira*) is presented and the work carried out by researchers using different extracts of this medicinal plant evaluating their pharmacology, phytochemistry and antimicrobial potency with respect to oral diseases has been reviewed.

## AIM AND OBJECTIVES:

The aim of the current study is to shed light on the phytochemistry and antimicrobial activities of the ayurvedic herbs- Acacia catechu (*Khadira*) in different extracts with the objective of compiling and putting forward its use in oral health for the knowledge for researchers and medical science.

## MATERIALS AND METHODS:

Literature search – Review Literature regarding the pharmacology of the Ayurvedic herbs is done from classics of Ayurveda and from various textbooks. The studies carried out to prove the antimicrobial potencies of the herbs have been taken from various research articles and papers published online and through medical magazines. All Compiled matter is reorganized and critically analyzed for the discussion and attempt has been made to draw some fruitful conclusions.

### Agar disk diffusion method.

It is the official method used in many clinical microbiology laboratories for routine antimicrobial susceptibility testing. In this well-known procedure, agar plates are inoculated with a standardized inoculum of the test microorganism. Then, filter paper discs (about 6mm in diameter), containing the test compound at a desired concentration, are placed on the agar surface. The petri dishes are incubated under suitable conditions. Generally, antimicrobial agent diffuses into the agar and inhibits germination and growth of the test microorganism and then the diameter of inhibition growth zones is measured.

## OBSERVATIONS AND RESULT:

Seven oral diseases and conditions account for most of the oral disease burden. They include dental caries (tooth decay),

periodontal (gum) diseases, oral cancers, oral manifestations of HIV, Oro-dental trauma, cleft lip and palate, and Noma. Almost all diseases and conditions are either largely preventable or can be treated in their early stages.<sup>5</sup> Out of which here we have discussed about infective pathologies including dental caries and periodontal disease.

1. Tooth decay – also known as dental caries or cavities, is a breakdown of teeth due to acids made by bacteria. The cavities may be a number of different colours from yellow to black. Symptoms may include pain and difficulty with eating. Complications may include inflammation of the tissue around the tooth, tooth loss, and infection or abscess formation. The cause of cavities is acid from bacteria dissolving the hard tissues of the teeth (enamel, dentin and cementum). The acid is produced by the bacteria when they break down food debris or sugar on the tooth surface. Simple sugars in food are these bacteria's primary energy source and thus a diet high in simple sugar is a risk factor. If mineral breakdown is greater than buildup from sources such as saliva, caries results. Risk factors include conditions that result in less saliva such as: diabetes

mellitus, Sjogren's syndrome and some medications. Medications that decrease saliva production include antihistamines and antidepressants. Caries is also associated with poverty, poor cleaning of the mouth, and receding gums resulting in exposure of the roots of the teeth.<sup>6</sup>

According to Ayurveda such disease is caused due to vitiation of *Kapha* and *Rakta Dosh* as described in *Sushrut Samhita NidanSthan* in *Dantagat Vyadhi*.<sup>7</sup>

2. Periodontal (gum) disease – also known as gum disease, is a set of inflammatory conditions affecting the tissues surrounding the teeth. In its early stage, called gingivitis, the gums become swollen, red and may bleed. In its more serious form, called periodontitis, the gums can pull away from the tooth, bone can be lost, and the teeth may loosen or fall out. Bad breath may also occur. Periodontal disease is generally due to bacteria in the mouth infecting the tissue around the teeth. Risk factors include smoking, diabetes, HIV/AIDS, family history and certain medications.<sup>8</sup>

This can be compared with *Dantmoolgat Vyadhi* mentioned in Ayurveda. The

mainly affecting *Dhatus* are *Rakta* and *Mansa* due to vitiation of *Tridosha*.<sup>9</sup>

### Acacia catechu (*Khadira*)

Acacia catechu also known as *Khadira* in Ayurveda is very important economical plant for medicine use. It contains many biologically active constituents like catechin, epicatechin, kaempferol, dihydrokaempferol, quercetin, dihydroquercetin, catechutannic acid, tannins etc.<sup>10</sup> Catechin present in Acacia catechu possess significant antioxidant and antimicrobial effect.<sup>11</sup> Epicatechin improves the blood flow which has potential for healing of wound and cardiac health.<sup>10</sup>

### Plant Description<sup>12</sup>

It is a medium sized, thorny deciduous tree grows up to 13 meters in height. Leaves are bipinnately compound, leaflets 30-50 paired, main rachis pubescent, with large conspicuous gland near the middle of the rachis. Flowers are pale yellow, sessile, found in axillary spikes. Fruits show flat brown pods, with triangular beak at the apex, shiny, narrowed at base. There are 3-10 seeds per pod. The gummy extract of the wood is called *Katha* or *cutch*. (Table 1)

Table 1: **Botanical classification of *Khadira***

<b>Kingdom:</b>	Plantae Plants
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<b>Sub kingdom</b>	Tracheobionta - Vascular plants
<b>Spermatophyte</b>	Seed plants
<b>Division</b>	Magnoliophyta - Flowering plants
<b>Class</b>	Magnoliopsida - Dicotyledons
<b>Subclass</b>	Rosidae
<b>Order</b>	Fabales
<b>Family</b>	Fabaceae - Pea family
<b>Genus</b>	Acacia Mill. - Acacia
<b>Species</b>	Acacia catechu (L. f.) Willd

*Khadir* is said to the *Datya* in its properties. The components in it works on many infectious agents such as bacteria, fungus, viruses. The antibacterial activity of the acetone bark extract of *Acacia catechu* wild, is an indication of its broad-spectrum antibacterial potential which may be helpful in eradicating *E. faecalis* for the management of Root canal failure that occurs frequently during Endodontic procedure and on other organisms too.<sup>14</sup>

**Table 2**

Results of antimicrobial screening of aqueous and organic plant extracts determined by agar diffusion method

Plant type	Extraction type	Zone of inhibition (in mm diameter)					
		S. aureus	B. subtilis	E. coli	S. typhi	P. aeruginosa	C. albicans
Acacia	Metanol	20 ± 0.24	18 ± 0.22	19 ± 0.22	20 ± 0.20	18 ± 0.20	20 ± 0.20

### Ayurvedic Properties of *Khadira*<sup>13</sup>

**Rasa (taste):** *Tikta, Kasaya*

**Guna (property):** *Laghu, Ruksha*

**Virya (potency):** *Shita*

**Vipaka (post digestive taste):** *Katu*

**Karma:** *Kaphapittahara, Raktasodhaka, Kushtaghna, Medohara, Krmighna, Dantya.*

Plant type	Extraction type	Zone of inhibition (in mm diameter)					
		<i>S. aureus</i>	<i>B. subtilis</i>	<i>E. coli</i>	<i>S. typhi</i>	<i>P. aeruginosa</i>	<i>C. albicans</i>
catechu	Hexane	11 ± 0 .14	11 ± 0 .14	11 ± 0 .15	10 ± 0 .15	10 ± 0 14	12 ± 0 .16
	Acetone	10 ± 0 .12	12 ± 0 .16	11 ± 0 .14	10 ± 0 .14	10 ± 0 12	11 ± 0 .14
	Aqueous	10 ± 0 .16	11 ± 0 .14	10 ± 0 .16	10 ± 0 .14	10 ± 0 14	N D
Positive control	Tetracycline	24 ± 0 .26	22 ± 0 .24	20 ± 0 .24	22 ± 0 .20	20 ± 0 20	22 ± 0 .24

Plant type	Extraction type	Zone of inhibition (in mm diameter)					
		<i>S. aureus</i>	<i>B. subtilis</i>	<i>E. coli</i>	<i>S. typhi</i>	<i>P. aeruginosa</i>	<i>C. albicans</i>
Negative control	DM SO	N A	N A	N A	N A	NA	N A
	Control						

Zone of inhibition (in mm diameter) including the diameter of well (6 mm) in agar well diffusion assay

Assay was performed in triplicate and results are the mean of three values. In each well, the sample size was 100 µl.  
Tetracycline: 1 U strength

Microorganisms: *S.aureus*, *Staphylococcus aureus*; *B. subtilis*, *Bacillus subtilis*; *E. coli*, *Escherichia coli*; *S. typhi*, *Salmonella typhi*; *P. aeruginosa*, *Pseudomonas aeruginosa*; *C. albicans*, *Candida albicans*

ND Not detected, NA no activity

**Table 3**

Results of minimum inhibitory concentration (MIC) of methanol extract of test plant

Plant type	Extract type	Minimum inhibitory concentration (µg/ml)					
		S. aureus	B. subtilis	E. coli	S. typhi	P. aeruginosa	C. albicans
Acacia catechu	Methanol	1,000	1,000	1,500	700	2,000	1,500
Positive control	Brot + TO	G	G	G	G	G	G
Negative control	Brot + CE	N	N	N	N	NG	NG

Plant type	Extract type	Minimum inhibitory concentration (µg/ml)					
		S. aureus	B. subtilis	E. coli	S. typhi	P. aeruginosa	C. albicans
Control							

TO Test organisms, CE crude extract, G growth, NG no growth

Microorganisms: S.

*aureus*, *Staphylococcus aureus*; *B. subtilis*, *Bacillus subtilis*; *E. coli*, *Escherichia coli*; *S. typhi*, *Salmonella typhi*; *P. aeruginosa*, *Pseudomonas aeruginosa*; *C. albicans*, *Candida albicans*

**DISCUSSION:**

*Khadira* contains *Tikta-KashayaRasa*(bitter and astringent taste).<sup>15</sup>

These two *Rasa* by the virtue of their pharmacological properties like *Soshana* (absorption), *Vishaghnatva* (anti poisonous), *KanduPrashamana* (reduce itching sensation), *Tvakmamsa*,

*Sthirakarana* (nourishment and strengthening of skin and muscle) and

*Pidana*, *Ropana* (wound healing),

*Kledaupashosana* (dry of exudation)

causes therapeutic action of reducing

oedema, detoxification, restoration, antihistaminic action and contraction, healing, clearing of derbies. All these pharmacological properties as a whole are able to exert an anti-inflammatory action on the affected areas of skin, mucosal and muscle layer of buccal region which is beneficial to cure dental caries, gum infections, complication of buccal mucosa. The principal pharmacological action of *Khadira* is *Kusthaghna* (destroy any kind of skin ailments) which originated from ‘*Saptadravyasangraha*’ i.e., accumulation and vitiation of *Tridoshaja* and four dhatus to create the disease.<sup>16</sup> buccal cavity consists of all these ailments. In the disease condition of buccal cavity *Khadira* is used as important medicine to get rid of it. In infective pathology of dental caries or periodontal disease *Khadira* completely inhibits the pathway of pathogenesis of infection by creating an unfavourable condition in *DoshaDushyaSammurchana* (destroy the causative pathological factors). *Khadira* is most potent drug to cure all types of such infections.

#### CONCLUSION:

Based on the above discussion it can be concluded that Based on the above discussion it may be concluded that nature is the best combinatorial chemist and possibly has answers to all diseases.

Natural products and compounds discovered from medicinal plants (and their analogues thereof) have provided numerous clinically useful drugs. In spite of the various challenges encountered in the medicinal plant-based drug discovery, natural products isolated from plants will still remain an essential component in the search for new medicines. The results have established the antimicrobial as well as antifungal activities of extracts (aqueous and alcoholic) *Acacia catechu* (*Khadira*). This indicates that the phytoconstituents present in the mentioned plant have considerable potential to inhibit microorganisms and diseases caused by fungi as well as the diseases resulting from bacteria in oral disease. So, the natural phytochemicals derived from *Acacia catechu* (*Khadira*) could be regarded as promising alternative to synthetic antifungals and antimicrobials in oral care for further safe use.

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