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**Research Article**

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# *Antibacterial Activity of Taxifolin Isolated from Acacia Catechu Leaf Extract– An in Vitro Study*

**Thanish Ahamed S.[1], Lakshmi T.[2]**

*[1] Graduate Student, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai-600077, India*
*[2] Professor, Department of Pharmacology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, 162, Poonamallee High Road, Chennai-600077, India*

## ABSTRACT

*Background : An anti-microbial is an agent which causes the death or hinders the growth of microorganisms such as bacteria and fungi. Acacia catechu that is also commonly called Mimosa catechu, is a deciduous, thorny tree which grows up to be 15 m (50 ft) high. In folk medicine, Acacia catechu is applied as a treatment of many illnesses and specially for mother and child healthcare. The main constituent of Acacia catechu is Taxifolin which contains antifungal, antiviral, antibacterial, anti-inflammatory and anti-oxidant property. Aim : The study aimed at evaluating the anti-microbial activity of taxifolin isolated from Acacia catechu leaf extract against Streptococcus mutans and Lactobacillus acidophilus, which may help in development of health products without artificial chemical agent.*

**Key words:** *Antimicrobial, Herbal, Antibacterial, Acacia, S. Mutans, L. Acidophilu.*

## INTRODUCTION

Medicinal plants have been used for centuries as a remedy for various human diseases [1] through having antibacterial, antifungal or antioxidant activities [2]. Due to the fact that bacteria have been increasingly developed resistance to the currently available antibiotics, the need to find new antibacterial agents has been raised [3, 4]. Anti-microbial activity of certain plants has a significant effect on various microorganisms.

An antimicrobial can be defined as an agent that causes the death of microorganisms or hinders their growth with the least damage to the host cells [5]. Anti-microbial agents play a major role in maintaining good health. The management of infections like pneumonia, tuberculosis, malaria, and AIDS has been threatened by antimicrobial resistance. So, it is important to develop stronger antimicrobial agents which are achieved by various anti-microbial agents. One such antimicrobial agent is taxifolin which is isolated from many trees such as Acacia catechu, conifers like the Siberian larch, Larix sibirica in Russia, and Chinese yew [6].

Acacia catechu commonly known as catechu is a medicinal plant used for varied purposes [7]. The bark of this plant is powerful antioxidant [8], astringent, anti-inflammatory, anti-bacterial and antifungal in nature [9]. Sore throats and diarrhoea, have been treated by the extract of this plant, and also in cases of high blood pressure, dysentery, colitis, gastric problems, bronchial asthma, cough, leucorrhoea and leprosy, it is considered to be useful [10, 11]. It has also been used as mouthwash for mouth, gum, sore throat, gingivitis, dental and oral infections. The current study has been done to evaluate the anti-microbial activity of taxifolin isolated from Acacia catechu against Streptococcus mutans and Lactobacillus acidophilus

Taxifolin is a flavanonol, a type of flavonoid. They are isolated from many trees. One of those tree is Acacia catechu [12]. Taxifolin is an anti-cancer drug. By inhibiting the fatty acid synthase in cancer cells, they are able to prevent

the growth and spread of cancer cells. The property of taxifolin to activate fibril formation and improve the stabilization of fibrillar forms of collagen can be implemented in medicine.

Streptococcus mutans and Lactobacillus acidophilus are the most important microbes present in the oral cavity. They are one of the major reasons for the dental caries. They are gram positive bacteria [13, 14]. The lactobacilli and streptococci which are generally named the lactic acid bacteria are the most important genera of the group of bacteria, so it is not surprising that microbial species within these genera have been proposed as specific agents of the acid production that is primary to the dental caries process [15].

The study has been conducted to evaluate the anti-microbial activity of taxifolin extracted from Acacia catechu against Streptococcus mutans and Lactobacillus acidophilus

**Drugs**

Taxifolin was purchased from Sigma-Aldrich, India.

Acacia catechu – obtained from green chemical herbal extracts and formulation, Bengaluru.

**Test microorganism**

Streptococcus mutans - ATCC 25175 Lactobacillus acidophilus - ATCC 4356 from Himedia, Mumbai.

## MATERIALS AND METHODS

**Antibacterial activity**

To screen their susceptibility, active cultures were prepared by transferring loop full of cells from stock cultures to test Mueller Hilton Broth containing tubes, and then, were incubated at 37˚C for 24 hours [16, 17].

**Disc diffusion method**

Onto the plates containing sterile Mueller Hinton Agar, 0.1mL of the bacterial culture was swabbed uniformly. Different concentrations of the sample were loaded a day before on 5 mm sterile discs. These discs were placed on the bacteria inoculated plates. The plates were incubated at 37˚C for 24 hours. After incubation period, the diameter of inhibition zones which was formed around the discs was measured in millimeter. The study was performed in duplicates for all the samples.

## RESULTS

**Taxifolin –Antibacterial activity**

**Table 1.** Antibacterial activity of taxifolin against S. mutans and L. acidophilus

| Concentration (mg/ml) | Streptococcus mutans | | | Lactobacillus acidophilus | | |
|---|---|---|---|---|---|---|
| | Zone of inhibition (in mm) | | | Zone of inhibition (in mm) | | |
| | Plate 1 | Plate 2 | Average | Plate 1 | Plate 2 | Average |
| 1.5 | 18 | 16 | 17 | 7 | 7 | 7 |
| 2.0 | 19 | 17 | 18 | 7 | 8 | 7.5 |
| 2.5 | 22 | 24 | 23 | 13 | 16 | 14.5 |

**Control**

**Table 2.** Antibacterial activity of chlorhexidine

| Concentration (mg/ml) | Chlorhexidine | | |
|---|---|---|---|
| | Zone of inhibition (in mm) | | |
| | Plate 1 | Plate 2 | Average |
| 1.5 | 24 | 26 | 25 |
| 2.0 | 25 | 20 | 22.5 |
| 2.5 | 24 | 22 | 23 |

The antibacterial activity of the Taxifolin from Acacia catechu leaf was tested against S. mutans and L. acidophilus using the disc diffusion method. As shown in Table 1, three different concentrations of 1.5mg/ml ,2mg/ml ,2.5mg

/ml were used in this study. Taxifolin inhibits Streptococcus mutants significantly when compared to Lactobacillus acidophilus. Chlorhexidine is a gold standard drug for maintaining oral hygiene with its antibacterial effect. The Taxifolin showed moderate antibacterial efficacy against S. mutans & L. acidophilus when compared to the control chlorhexidine.

**DISCUSSION**

Taxifolin which is isolated from Acacia catechu has various medical properties. Various studies have been done to disclose the medical property of taxifolin. Taxifolin has been found as anti-cancer drug. The therapeutic promise of dihydroquercetin(taxifolin) in major inflammatory disease states such as cancer was recently reviewed by [18, 19]. Further studies have been done, and the results concluded that Taxifolin and possibly other flavonoids with a similar molecular structure may act as "enhancers" in combination with Andro to treat prostate cancer [20].

Taxifolin has been said to have a dose-dependent effect on inhibiting the ovarian cancer cells. It also has a strong correlation between the anti-proliferative effects of DHQ derivatives on murine skin fibroblasts and human breast cancer cells [21]. They have been used positively to treat patients infected with strains of methicillinresistant S. aureus (MRSA) [22]. They increase the efficacy of certain antibiotics such as ceftazidime and levofloxacin.

A study was done in 2011 by [23], and found that heartwood of Acacia catechu has anti-fungal activity. The obtained results demonstrated that the higher concentration of the extract showed good antifungal activity against all the fungal strains tested, and the lower concentration showed very weak or no activities.

Acacia catechu thus have various medical property [24]. Studies were done in 2010 to assess the antimicrobial activity of the Acacia catechu against organisms causing dental caries. Based on the results, Acacia catechu willd has been proven to be a potent antimicrobial agent against dental infections like dental caries being caused primarily by Streptococcus mutans which is similar to the current result.

Another study was done by [25] to evaluate the antibacterial activity of heartwood extract of Acacia catechu willd. The results demonstrated that the antibacterial activity of the extracts (Ethanolic and Aqueous) at different concentrations was determined by measuring the zone of inhibition. The ethanolic extract was more effective against Staphylococcus aureus with a zone of inhibition of 24 mm diameter (at conc200 g.) and was least effective against Pseudomonas aeruginosa and Bacillus subtilis with a zone of inhibition of 10mm (at conc. 200 g.) and 11mm (at conc. 200 g.) respectively.E. coli showed a zone of inhibition of 19mm diameter (at conc. 200 g.) and Klebsiella pnuemoniae showed inhibition zone of 16mm diameter (at conc. 200 g.) among the other studied bacterial species. It was concluded that the Acacia catechu willd heart wood extracts contain antibacterial activity

[26, 27] performed a study on the Antimicrobial property of Acacia species. The results concluded that A. nilotica (pods) and A. catechu (bark) were reported to be the most active against different bacterial and fungal strains. The mathanolic extract of A. nilotica (pods) showed the highest activity against E. coli, S. aureus and A. niger, whereas A. catechu exhibited its prominent activity against S. aureus and C. albicans. Although, the hexane extract of A. nilotica was also found the most active against S. typhi. In whole antimicrobial experiment, Acacia Jacquemonti was found to have the weakest or no activity.

The increasing evidence has supported that the plants of genus Acacia contain high amount of bioactive secondary compound, and therefore, are likely to be promising in drug discovery. The importance of secondary compounds in Acacia lie in a variety of their functions, that the most important among them include their being anticancer (triterpenoid and saponins), diuretic (glucosides), natriuretic (glucosides), important nutraceutical (polysaccaride and gum) anti-digestive disorder (saponins, tannins and flavanoids), anti-oxidant (polyphenols), antiplasmodial (treptamine, tannins, organic acids and saponins) [25, 28].

As the above discussion has elaborated, Acacia catechu is of a high medical value. One such property is anti-microbial activity. Various studies reported the anti-bacterial activity of the plant. They showed a great response against streptococcus mutants and lactobacillus acidophilus. These two organisms play a major role in the dental caries. The anti-bacterial activity of Acacia catechu is positivity higher against S. mutans than the later L. acidophilus. Acacia catechu showed less activity on these organisms when compared to chlorhexidine, but the former is a herbal drug with no side effects.

## CONCLUSION

Taxifolin isolated from Acacia catechu leaf was found to be effective as antibacterial against different bacterial pathogens, providing the scientific basis for its traditional application in Indian folk medicine against many Oro dental infections. Further studies should be done to find out the active compound responsible for antibacterial effects, and other necessary pharmacological studies are needed to be conducted to use it in modern drugs' developments.

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