

# Effect of *Mangifera Indica* (Mango) on Dental Caries: A Systematic Review

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**ABSTRACT:** The present study aimed to evaluate the effect of *Mangifera indica* (mango) on dental caries. The entire plant, including the leaves, fruit, roots, and flowers, has various therapeutic characteristics used for centuries to cure various illnesses. This systematic review aimed to identify an inexpensive, simple, and effective method of preventing and controlling dental caries. The search was performed among the studies written in English, the database of abstracts concentrating on the effects of *Mangifera indica* (Mango) on dental caries detected in Pubmed, Scopus, Google Scholar, and Central. In total, we find 37 articles. The relevant English language articles published up to August 2022 were collected, screened, and reviewed. Search words contained “*Mangifera indica*” and “dental caries” or “*Streptococcus mutans*” or “tooth demineralization.” For our systematic review analysis, we included 3 randomized controlled trial studies studying a total of 130 people, of whom 110 were children aged 8 to 14 and 20 were adults aged 20 to 25. These experiments all employed mouthwash containing an extract from *Mangifera indica*. In conclusion, it has been proven in 2 separate studies that saliva’s PH will increase significantly. In addition, a reduction of *S. mutans* has been observed in another research. Overall, it was concluded that mango extract mouthwash is highly effective in decreasing the bacteria that can cause dental caries. however, we firmly believe that conduction of more detailed in vivo studies regarding *Mangifera indica* implications in dental caries treatment is essentially needed for further confirmation.

**KEYWORDS:** Mango, *Mangifera indica*, dental caries, *Streptococcus mutans*, tooth demineralization

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## Introduction

With the advancement of knowledge in various fields, preventive measures are more important than ever, and oral health is no exception. Dental caries is one of the most prevalent,<sup>1,2</sup> affecting almost all adults. Despite being relatively preventable, the disease primarily affects those in poor socioeconomic categories, and during the past 30 years, its prevalence has not decreased appreciably.<sup>3</sup>

It is a common chronic infection caused by *Streptococcus mutans*, which are cariogenic bacteria that adhere to teeth and produce acid by metabolizing carbohydrates, gradually demineralizing tooth structure.<sup>3</sup>

Dental caries is multifactorial, with nutritional, salivary, and microbiological variables contributing.<sup>2</sup> In addition, treating dental caries that have already developed is so expensive that it may not be a viable option, especially for those with tight budgets.<sup>4</sup>

As a result, preventive methods have been developed that specifically address these causative factors.<sup>2</sup> Using fluoride in

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various forms and expert care, is a technique proven effective in preventing dental caries.<sup>4</sup>

Antibacterial medications are the basis of therapy as bacteria are thought to cause caries, but these medications are expensive and have adverse side effects.<sup>2</sup> Namely, chlorhexidine use may have several unfavorable effects, including changed taste perception, tooth discoloration, and the emergence of bacteria with bacterial resistance, making it impossible to use it over an extended period.<sup>4</sup> Considering these challenges nowadays, scientists emphasize on the role of natural products more.

Herbs are an outstanding material to substitute nanosilver as both antibiotic and antiviral agent. The use of nanosilver implicates an ROS-mediated pathway that might result in oxidative stress-related cancer, cytotoxicity, and heart diseases. Oxidative stress further leads to increased ROS production and also delays the cellular processes involved in wound healing. Accordingly, existing antibiotic medications can be superseded with biomaterials including herbal medicine with high antimicrobial, antiviral, and antioxidant activity.<sup>5,6</sup>

*Mangifera Indica* (Mango) is a popular tropical fruit in the world<sup>7</sup> and contains substances such as phenol constituents, triterpenes, flavonoids, phytosterols, and polyphenols.<sup>2</sup>

The entire plant, including the leaves, fruit, roots, and flowers, has various therapeutic characteristics used for centuries to cure various illnesses.<sup>7</sup>

Additionally, surveys have shown that antimicrobial compounds can be found in mangoes.<sup>2</sup>

This is the first time a systematic review has been written on this subject, and we will probe into the effect of *Mangifera Indica* mouthwash.

### *Mangifera Indica: From origin to medical applications*

Mango (*Mangifera indica*) fruit is a member of the Anacardiaceae family and, in the Sapindales order, also is vegetated in different parts of the world, especially in tropical regions.<sup>8</sup> Mango fruit is a well-known source of vitamins and health-developing substances and phytochemicals. Also, mango fruit contains energy and phenolic compounds essential to health.<sup>9</sup> Each part of the mango is valuable and contains necessary nutrients, but the leading products from *Mangifera indica* are peels and seeds, which are 35-60% of the whole weight of the mango.<sup>10</sup> Unripe mango has dry and cold and also astringent creation. A ripe mango has hot and dry creation, which can be helpful or lenient. Also, ripe mango can develop the activity of the heart, brain, and gastrointestinal apparatus. Mango is efficient in progressing sexual vigor, feeding hair, also strengthening gingiva.

Mango contains polyphenols, so it has anti-inflammatory, anti-bacterial, anti-tumor, anti-oxidant, and anti-diabetic activity.<sup>11</sup> The antioxidant function of methanolic extractives of

mango leaves has been studied in different articles. Also, ethyl acetate and butanol have antioxidant activity.<sup>12</sup> Ethanol extraction from mango leaves can reduce TNF- $\alpha$  and IL-1 $\beta$ , so it has an anti-inflammatory effect.<sup>12,13</sup> Sumant et al evaluated the efficacy of mango leaf as an oral hygiene aid and obtained interesting findings. Higher soft deposit scores were reported in group that used mango leaf. Caries experience in this group using mango leaf was similar to the group that used tooth brush. Mangiferin a compound present in mango leaves had significant antibacterial property against certain strains of Pneumococci, Streptococci, Staphylococci, and Lactobacillus acidophilus.<sup>14,15</sup> The analgesic function of stem-bark light extraction of mango has been reported.<sup>16</sup> Also, in another study,<sup>17</sup> it has been reported that methanol extraction from mango has an analgesic result. The immunomodulatory activity of ethanolic extraction of mango has been studied because it can prohibit duplication of T-cells and inhibit the transcription of NF- $\kappa$ B factor.<sup>18,19</sup> A study showed that mango has an anti-tumoral effect by targeting PI3K/AKT in breast cancer.<sup>19</sup> Also, it has been demonstrated that ethanolic extraction of mango induces the process of apoptosis by expressing proteins related to apoptosis, like Bid and Bax, and Caspases.<sup>20</sup> A study exhibited that the ethanolic extraction of mango decreases the blood glucose level in diabetic rats. After curing with the extraction of mango, a remarkable reduction in fructosamine also glycated hemoglobin (index of diabetes) was observed.<sup>21</sup> A study evaluated the antifungal properties of ethanolic extraction of mango versus 3 different species of fungus.<sup>17</sup>

Mangoes are an excellent source of vitamin C (ascorbic acid), which is crucial for the well-functioning of the immune system and for proper plant-based iron absorption, strong bones, and heart health. Despite its seemingly high sugar level, the mango fruit provides adequate amounts of dietary fiber and carbohydrates, both necessary to help proper digestion and energy production, increasing satiety and reducing food cravings between meals.<sup>22</sup> Additionally, reasonable amounts of copper and folate in mangoes also contribute to maintaining vascular and nervous health and red blood cell production. In contrast, vitamins A (from carotenoids), B6 (pyridoxine), and E (alpha-tocopherol) support eye health, brain function, adrenal health, immunity, and cell metabolism. The nutritional value of mangoes is rounded by less significant levels of many other compounds, including minerals such as potassium, manganese, and magnesium, as well as vitamins of the B-group and vitamin K.<sup>21</sup> Table 1 summarizes the studies concerning effects of mango in dental care (Figure 1).

### *Mango leaves*

We usually tend to put more importance on mangoes fruit rather than its leaves. Owing to this fact, we usually miss the health benefit of this part of plants. Being shiny with a sharp

**Table 1.** The results of in vitro/in vivo studies on the effects of *Mangifera indica* on oral health.

AUTHOR	YEAR	TYPE OF STUDY	MANGIFERA INDICA PARTS	FORM OF MANGIFERA INDICA USAGE	ROLE IN ORAL CARE
Anand et al. <sup>1</sup>	2014	In vitro	Mango leaves	Mouth rinse, ethanol extracts	Antimicrobial, anticytotoxic effects
Bbosa et al. <sup>2</sup>	2007	In vitro	Mango leaves	Powder, solution with dimethylsulphoxide	Antibacterial activity
Eziama et al. <sup>3</sup>	2022	In vitro	Mango stem	ethanol and water solutions	toothache
Kamath et al. <sup>4</sup>	1973	In vitro	Mango leaves	toothpaste	Antibacterial activity
Dandekar et al. <sup>5</sup>	2020	RCT-in vitro	Mango twig	mouthrinse	Antibacterial activity
Sahni et al. <sup>6</sup>	2016	In vitro	Mango sticks	Powder, solution	Antibacterial activity
Pandey a et al. <sup>7</sup>	2020	RCT	extracts	mouthrinse	Anti plaque, antigingivitis
Cardenas et al. <sup>8</sup>	2020	In vitro	Mango leaves	mouthrinse	Antibacterial activity
Ravi et al. <sup>9</sup>	2017	In vitro	Mango twig	Powder, solution	Antibacterial activity
Peter et al. <sup>10</sup>	2022	In vitro	Mango leaves	Non-alcoholic extract	Antibacterial activity
Shafiei et al. <sup>11</sup>	2020	In vitro	Mango leaves	Powder, solution	Antibacterial activity
Bodiba et al. <sup>12</sup>	2017	In vitro	Mango leaves	Powder, solution	Antibacterial activity

<sup>1</sup>Anand G, Ravinathan M, Ravishankar Basaviah, 2 and A. Veena Shetty. (2015). vitro antimicrobial and cytotoxic effects of Anacardium occidentale and Mangifera indica in oral care J Pharm Bioallied Sci Jan-Mar. 7(1):69-74.

<sup>2</sup>Bbosa G, Kyegombe D, Ogwal-Okeng J, Bukenya-Ziraba R, Odyek O, Waako P. Antibacterial activity of Mangifera indica (L.). African Journal of Ecology. 2007;45:13-16.

<sup>3</sup>Afam-Ezeaku CE, Obiekwe IC, Oledibe OJ, et al. The efficacy of extracts from mango (Mangifera indica) stem in the treatment of toothache. Asian Journal of Advances in Research. 2022:15-26.

<sup>4</sup>Apeksha S, Charishma K. Development of herbal toothpaste containing mango leaves extract. Studies. 2021;1:3.

<sup>5</sup>Dandekar NV, Winnier JJ. Assessment and evaluation of the effect of neem and mango mouthrinses on S. mutans count in vitro and in children. Journal of Herbal Medicine. 2021;29:100469.

<sup>6</sup>Sahni A, Chandak MG, Shrivastava S, Chandak R. An in vitro comparative evaluation of effect of Mangifera indica (Mango), Azadirachta indica (Neem) and Acacia nilotica (Babool) on Streptococcus mutans. Journal of Advanced Medical and Dental Sciences Research. 2016;4(1):1.

<sup>7</sup>Pandey A, Pandey B. Anti plaque and antigingivitis efficacy of neem, mango, triphala, and chlorhexidine mouth wash among school children: A double blind randomized control trial. Journal of Advanced Medical and Dental Sciences Research. 2020;8(9)

<sup>8</sup>Cardenas V, Mendoza R, Chiong L, Del Aguila E, Alvarez-Temoche D, Mayta-Tovalino F. Comparison of the antibacterial activity of the ethanol extract versus hydroalcoholic extract of the leaves of Mangifera indica L. (Mango) in different concentrations: An in vitro study. J Contemp Dent Pract. 2020;21:202-206.

<sup>9</sup>Banavar Ravi S, Nirupad S, Chippagiri P, Pandurangappa R. Antibacterial effects of natural herbal extracts on streptococcus mutans: can they be potential additives in dentifrices? International journal of dentistry. 2017;2017

<sup>10</sup>Peter J, Kumar RK, Vijai S, Augustin M, Anaswara M, Ajaykumar A. Comparative evaluation of the antimicrobial activity of various concentrations of nonalcoholic extracts of crude coconut shell oil, orange peel, and mango leaf with that of xylitol on Streptococcus mutans and Candida albicans: An in vitro study. International Journal of Preventive and Clinical Dental Research. 2022;9(2):37.

<sup>11</sup>Shafiei Z, Rahim ZHA, Philip K, Thurairajah N, Yaacob H. Potential effects of Psidium sp., Mangifera sp., Mentha sp. and its mixture (PEM) in reducing bacterial populations in biofilms, adherence and acid production of S. sanguinis and S. mutans. Archives of oral biology. 2020;109:104554.

<sup>12</sup>Bodiba DC, Prasad P, Srivastava A, Crampton B, Lall NS. Antibacterial activity of Azadirachta indica, Pongamia pinnata, Psidium guajava, and Mangifera indica and their mechanism of action against Streptococcus mutans. Pharmacognosy magazine. 2018;14(53):76.

tip as well as being fleshy, are the main characteristics of mango leaves. Mango leaves can be used as a powder or an extraction prepared by boiling the leaves in water. The leaves are a rich source of anti-oxidant. In addition to their medical properties, they are used in South East Asia cuisine. Mango leaves are full of vitamins C, B, and A. Besides, many flavonoids and phenol that act as anti-oxidants can be found in these leaves cough.<sup>23</sup>

### Regulates diabetes

Because tannins and anthocyanins exist in the leaves of mango in the first place, they can be used in treating diabetes. Moreover, it also alleviates diabetic angiopathy and diabetic retinopathy. The tender leaves of this plant contain taraxerol 3-beta and

ethyl acetate extract, stimulating the synthesis of glycogen. To treat diabetes, these leaves are either in powdered form or in an infusion by soaking the leaves in water for a night; this water can be drunk after removing the leaves. In addition, hyperglycemia can be treated with the help of these healing leaves.

### Lowers blood pressure and risk of hypertension

Apart from all said above, because of their hypotensive properties, they can come to play in alleviating lower blood pressure. On the other hand, the blood vessels can be strengthened with the help of these leaves. Also, the problem of varicose veins can be treated by them. If consumed as a tea, they improve hypertension.

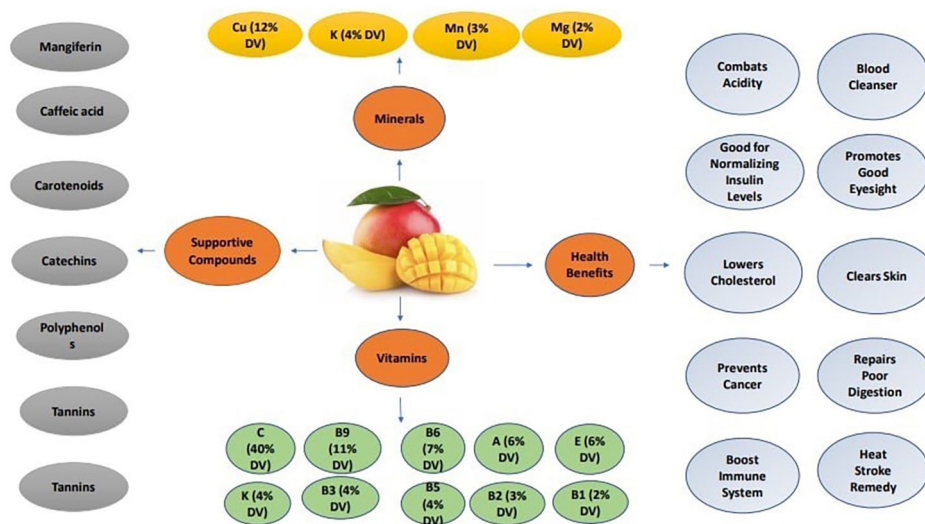


Figure 1. Mango fruit components and properties.

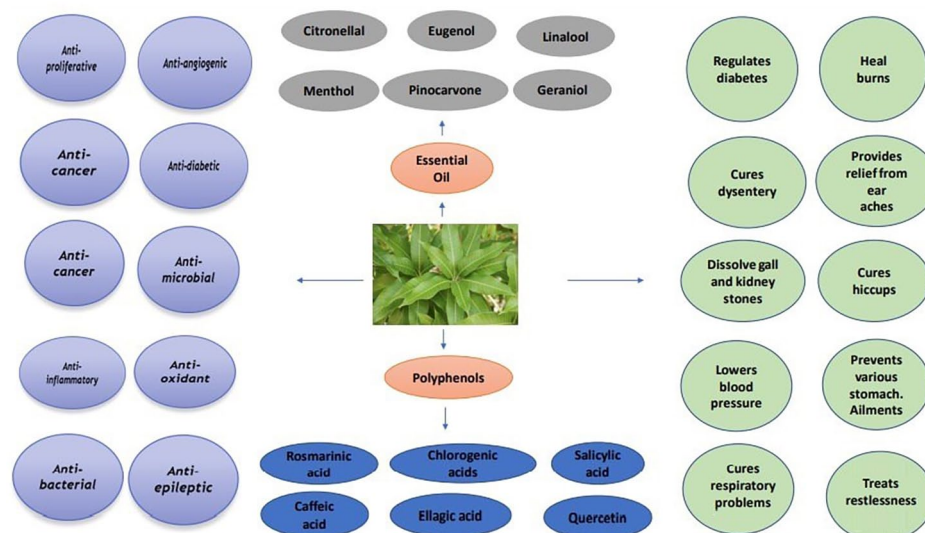


Figure 2. Mango leaves component and properties.

### *Dissolve gall and kidney stones*

Mango leaves dried in the shade, grinding into fine powder alleviates kidney stones and dissolves gall. This powder mixed with water should be rested overnight; drinking it daily dissolve kidney stone.

### *Treats restlessness*

Unfortunately, many young people suffer from anxiety which brings about restlessness. Restlessness is not only taking a toll on the person suffering from it, but it can also be unpleasant for those in their surroundings. Mango leaves are recommended as an effective home remedy for restlessness. Water relieves restlessness if 2 to 3 cups of mango leave tea are added to the bath top.

### *Cures respiratory diseases*

leaves of mango are effective for all types of respiratory diseases. It is especially effective for patients suffering from colds, asthma, and bronchitis. Respiratory diseases create many problems, so different proceedings must be done to eradicate them. Boil leaves of mango, then add honey to it. Drinking this compound is effective for curing cough<sup>23</sup>(Figure 2).

### *Nanoparticle extracts and their dentistry implication*

Recently silver compounds and nanoparticles have been investigated for their extensive area of research in dental applications such as dental restorative material, endodontic retro fill cement, dental implants, and caries inhibitory solutions Glass



**Table 2.** The search strategy of Pubmed, Google scholar, Scopus, Central.

SEARCH ENGINE	SEARCH STRATEGY	ADDITIONAL FILTERS
Pubmed 5 articles	((Magno[Title/Abstract]) OR (Mangifera indica[Title/Abstract])) AND ((Dental caries[Title/Abstract]) OR (Streptococcus mutans[Title/Abstract]) OR (Tooth demineralization[Title/Abstract]))	English, August, 2022
Google scholar 14 articles	mangifera indica "tooth demineralization" OR "dental caries" OR "streptococcus mutans" Mango "tooth demineralization" OR "dental caries" OR "streptococcus mutans"	English, August, 2022
Scopus 16 articles	(TITLE-ABS-KEY (magno) OR TITLE-ABS-KEY (mangifera AND indica) AND TITLE-ABS-KEY (dental AND caries) OR TITLE-ABS-KEY (tooth AND demineralization) OR TITLE-ABS-KEY (streptococcus AND mutans))	English, August, 2022
Central 2 articles	#1: Mango in Title Abstract Keyword AND dental caries in Title Abstract Keyword #2: Mango in Title Abstract Keyword AND tooth demineralization in Title Abstract Keyword #3: Mango in Title Abstract Keyword AND streptococcus mutans in Title Abstract Keyword #4: Mangifera indica in Title Abstract Keyword AND "Streptococcus mutans" #5: Mangifera indica in Title Abstract Keyword AND Dental caries in Title Abstract Keyword #6: Mangifera indica in Title Abstract Keyword AND tooth demineralization in Title Abstract Keyword	English, August, 2022

ionomer cement (GIC) is known for its adhesiveness and biocompatibility; therefore, it is used as a restorative material in dentistry

Low wear resistance and fracture toughness are the prominent drawbacks that result in restoration failure and lead to the expansion of bacterial proliferation. These failures can even lead to ancillary caries and tooth fractures.<sup>24</sup>

## Methods

### *Guideline and OSF registration*

In the present study, 2 independent reviewers analyzed the article following the guidelines of PRISMA, in the lack of a formerly published review method.<sup>25</sup> To certify the transparency also the repeatability of this article which is a systematic review, a method titled "Effect of Mangifera indica (Mango) on dental caries: a systematic review" was recorded with the OSF enrollment (Registration DOI 10.17605/OSF.IO/4C9TX). The search Strategy is included in Table 2.

### *Study selection and searching*

In the first step, each reviewer looked for the articles released and published in peer-reviewed journals written in English up to March 2019. Searches in different databases were conducted from December 2nd, 2018, to July 19th, 2019. At first, each reviewer noted the articles in a database of abstracts concentrating on the effects of Mangifera indica (Mango) on dental caries detected in Pubmed, Scopus, Google Scholar, and Central. Searched words contained "Mangifera indica" [MeSH] and "dental caries" [MeSH Terms] or "tooth demineralization" [MeSH], or "Streptococcus mutans" [MeSH]. Table 2 abridges the data of the search strategy used in this article.

### *Inclusion and exclusion criteria*

After the primary article search, the abstracts of the gathered articles were evaluated. Eventually, an independent complete study review was carried out for all the studies. The article was excluded if the study's main goals did not match one of the 2 main objectives of our systematic review. Review articles, as well as in vitro and in vivo studies, were excluded. We included human studies investigating the impact of Mangifera indica extracts on dental caries.

### *Quality assessment*

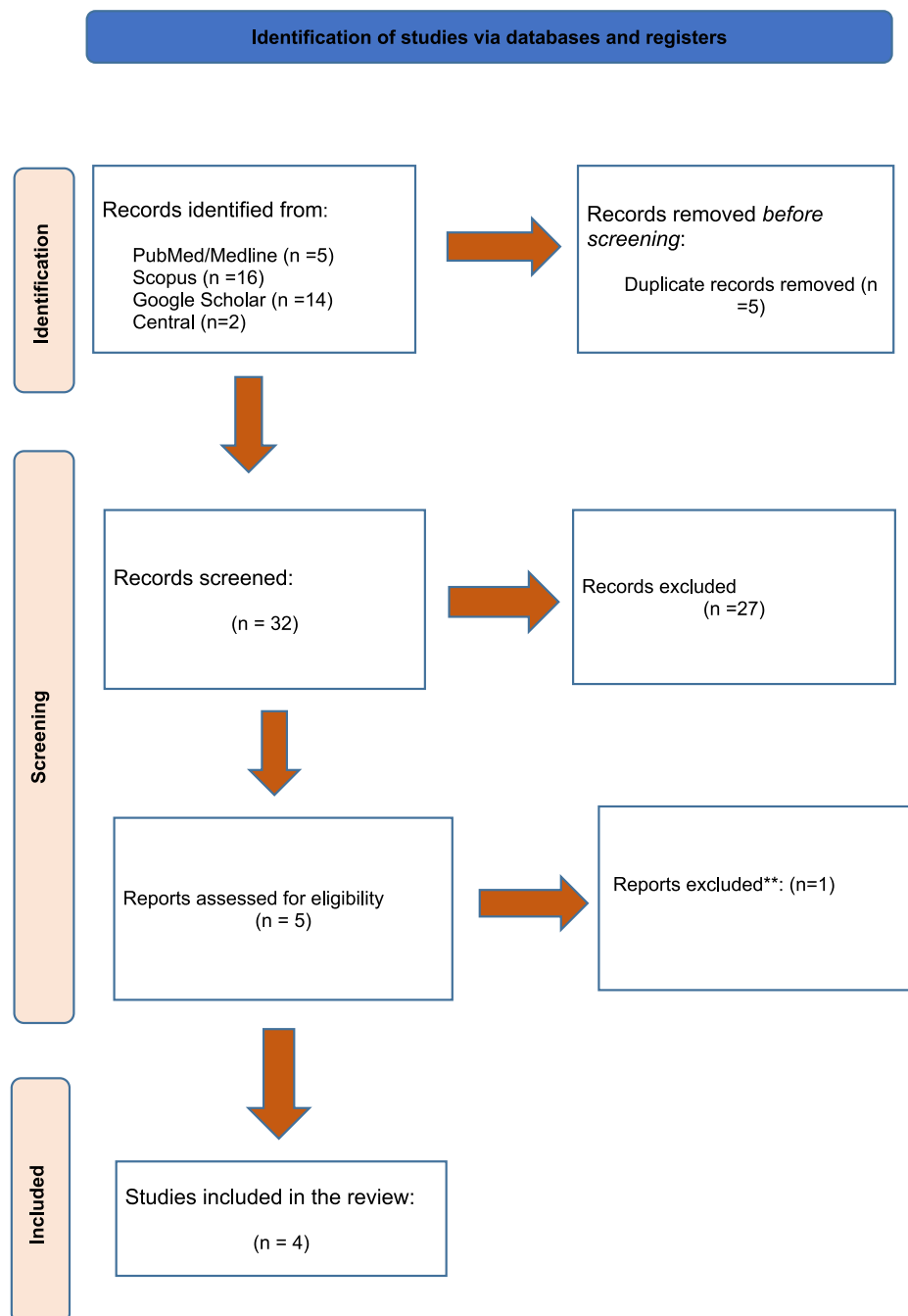
The publication bias was assessed by Cochrane's risk of bias tool for randomized controlled trials. (The results are summarized in Figure 4)

## Result

After searching PubMed/MedLine, Scopus, Google Scholar, and Central databases, 37 articles were identified. Five duplicates were removed, and 32 records were screened (Figure 3). After screening the Title/Abstracts, 27 records were excluded from our study, and 5 reports were assessed for eligibility. Then after screening for the full text of the studies, 2 reports were excluded, and finally, 3 studies were included in the review; all of these 3 articles were performed in India.<sup>1,2,25,26</sup> (Figure 4)

For our systematic review analysis, we included 3 randomized controlled trial studies investigating a total of 130 people, of whom 110 were children aged 8 to 14 and 20 were adults aged 20 to 25. All these experiments employed mouthwash containing an extract from Mangifera indica.

Duration of studies ranged from 5 days to 1 year, which was compared with control groups such as 10 ml of 0.12% CHX mouth rinse twice daily for 30 seconds<sup>26</sup> 15 ml of miswak for



**Figure 3.** The Prisma diagram of the study.

2 minutes,<sup>1,2</sup> and chlorhexidine mouthwash,<sup>1</sup> all three of which were conducted in India.

In conclusion, it has been proven in 2 separate studies<sup>1,2</sup> that saliva's PH will increase significantly. In addition, a reduction of *S. Mutans* has been observed in other research.<sup>1,2</sup> (Table 3 summarizes the data of the studies)

### Discussion

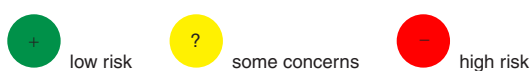
This systematic review of 130 people determined the effect of *Mangifera indica* on dental caries. Extract of *Mangifera indica* has a significant effect on raising the salivary PH and reducing

*Streptococcus mutans* count. Also, it can improve the control of dental plaque and gingival health.

A study showed that ethanolic, methanolic, and aqueous extracts of *Mangifera indica* inhibited the growth of all the pathogenic organisms tested. Higher antimicrobial activities were observed against *Staphylococcus aureus* in an ethanolic extract of the root, followed by *Streptococcus mutans*, *Candida albicans*, and *Escherichia coli*. In the methanolic extract, higher antimicrobial activities were observed against *Candida albicans*, followed by *Staphylococcus aureus* and *Escherichia coli*. While in the aqueous extract, the highest antimicrobial activity

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Nikita V. Dandekar et.al (2021)	●	●	●	●	●	●	●
Sham S. Bhat et.al (2017)	●	●	●	●	●	●	●
Garima Sharma et.al (2010)	●	●	●	●	●	●	

**Figure 4.** Risk of bias of the included studies.



was observed against *Staphylococcus aureus* and *Escherichia coli* simultaneously, then lower *Candida albicans*.<sup>27</sup>

The results of Ravi et al study indicate that the mango twigs possess an antibacterial effect, even at low concentrations, against the most cariogenic bacteria, *Streptococcus mutans*. It appears that it may be possible to combat *Streptococcus mutans* to increase the efficacy of oral hygiene practices by incorporating the mango and eucalyptus twig extracts into dentifrices. However, studies simulating in vivo situations more closely are required to get a clear understanding.<sup>28</sup>

These plant extracts are rich in phytonutrients such as flavonoids, tannins, saponins, glycosides, and alkaloids. These secondary metabolites exert antimicrobial activities through different mechanisms: tannins are polyphenolic compounds that bind to a protein-rich protein that interferes with protein synthesis and have been shown to have antimicrobial activities.<sup>29</sup>

In the randomized control trial by Sharma et al It was shown that *Mangifera indica* extract was efficient in raising the salivary PH. Also, it influenced the suppression and therapy of periodontitis and halitosis.<sup>2</sup> In an article by Bhat et al <sup>1</sup>the impact of chlorhexidine and *Mangifera indica* in plaque reposition, the health of gingiva, and the streptococcal count of *S. mutans* and *Staphylococcus aureus*; were compared. Since salivary numbers of *S. mutans* and lactobacilli are associated with dental caries activity,<sup>29</sup> this method is a trusty alternative to monitor the count of mentioned micro-organisms in dental plaque.<sup>30</sup> The results have shown progress in gingival health and decreased salivary microbial count and plaque accumulation after using 2% of *Mangifera indica* mouthwash for 5 days. Based on this study, chlorhexidine mouthwash was more effective than mouth rinse, which contains *M. indica* leaves. Chandu et al study demonstrated that *Mangifera indica* had an antibacterial function at superior concentrations. Also, it was most

efficient at a concentration of 50% .<sup>22</sup> in another study by Sharma et al that was conducted in a triple-blind randomized controlled plot they reported *Mangifera indica* effects on gingival health.<sup>31</sup>

In Dandekar and Winnier's study,<sup>26</sup> the efficacy of neem also mango twig extractions on the count of *S. mutans* were evaluated; the efficacy of mouth rinse containing mentioned extract on the count of *S. mutans* present in the saliva of kids. In this article, the powder of these extracts showed an 18.5 to 19 mm zone of inhibition. Since the inhibition zone diameter was more than 18mm, these extracts were counted as highly effective.<sup>32</sup>

In another study,<sup>26</sup> 8-13-year-old kids were included, and unstimulated saliva was gathered. The count of *S. mutans* present in the saliva was measured at baseline and 7 and 21 days after using neem, mango, and chlorhexidine mouthwash. Results showed a remarkable decrease in the count of *S. mutans* after using all 3 types of mouthwash, and they were equally efficient. It was shown that the twig of Mango had higher antimicrobial virtues than the leaves of Mango.<sup>33</sup>

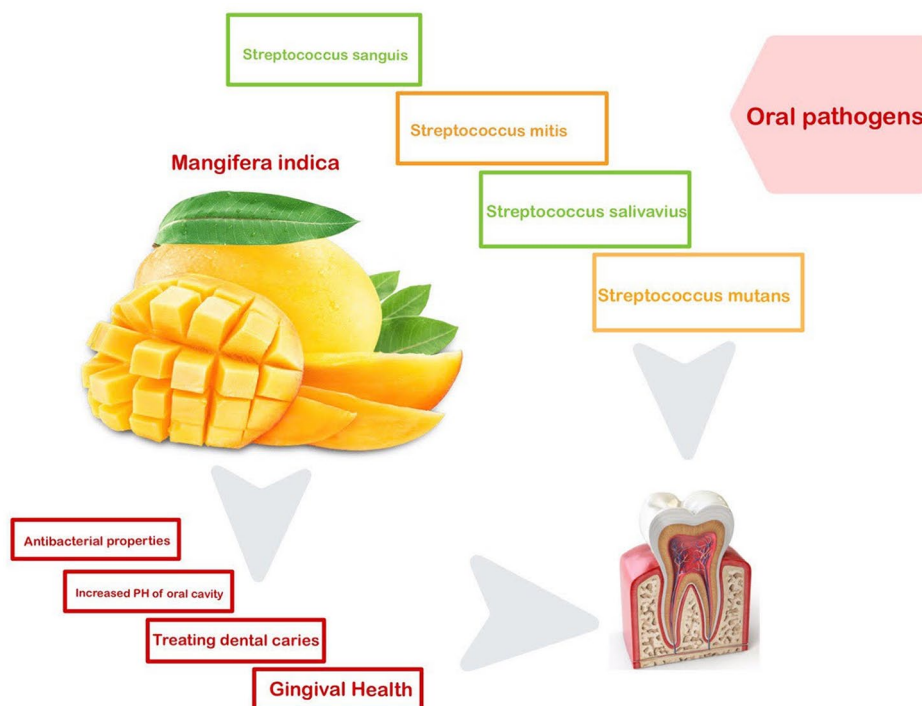
In the work, silver nanoparticles were synthesized by a novel green synthesis technique using new *Mangifera indica* (mango leaves) and characterized to assess the crystalline size, shape, crystalline imperfection and distortions, and dislocation density. The antibacterial activity of the synthesized silver nanoparticles against *Escherichia coli* and *Staphylococcus aureus* bacteria was evaluated at different concentrations, and the moderate antibacterial activity of the AgNPs was conveyed. Consequently, the study suggests dual simultaneous dentistry applications of the synthesized AgNPs.<sup>24</sup>

Mangiferin is a phenolic composition with antimicrobial, anti-inflammatory, antioxidant, and antitumor characteristics, so *Mangifera indica* can be used for cleaning teeth. In addition, pleasant taste, as well as reasonable price, make it desirable.<sup>34</sup>

**Table 3.** A summary of the studies on the effect of *Mangifera indica* extracts on dental carries.

FIRST AUTHOR	COUNTRY	TYPE OF STUDY	FOLLOW UP DURATION	INTERVENTION	PARTICIPANTS	CONTROL GROUP	OUTCOME	REFERENCE
Garima Sharma, 2010	India	A double-blind cross-over study	1 wk	15 ml of extract for each participant for 2 min	Twenty students between 20_25years	15 ml of miswak for 2 min	A significant rise in PH was shown in both groups ( $P \leq .05$ ) About 65% of the subjects showed a reduction in Streptococcus mutans after rising with <i>Mangifera indica</i> extract.	Sharma et al <sup>2</sup>
Sham S Bhat et al, 2017	India	RCT	for 5 d	½ h after washing of mouth 10 ml of ethanolic extract of mango ( <i>Mangifera indica</i> ) leaf uses by mouthwash.	20 kids between the ages of 8 and 14, divided to two groups of 10 kids.	Chlorhexidine mouthwash	Both groups saw a substantial decrease in microbial count as well as improvements in plaque control and gingival health. However, the chlorhexidine group experienced a greater decrease in microbial count as well as greater improvements in plaque control and gingival health. Chlorhexidine showed higher difference in Streptococcus Count.	Bhat et al <sup>1</sup>
Dandekar, 2020	India	double-blind RCT	1 y	10ml of neem and mango twig extract mouth rinse twice daily for 30s	90 children (8-13y/O) divided into three groups of 30.	10ml of 0/12% CHX mouth rinse twice daily for 30s	a significant reduction was observed in salivary S. mutans count in all the three study groups after 21 d. ( $P < .001$ ) [However there was no statistically significant difference between the groups. ( $P = .167$ )]	Dandekar and Winnier <sup>26</sup>
Sharma R et al.	India	Triple- blind randomized controlled trial	3 mo	Mango mouthwash twice daily for 21 d (10ml)	97 children (12-15y/o) in three groups	10ml CHX mouth rinse twice daily for 21 d	Statistically significant reduction ( $P < .001$ ) in plaque index, gingival indices in all three groups.	Sharma et al <sup>31</sup>





**Figure 5.** Effect of *Mangifera indica* on oral health.

Its antibacterial activity is due to bitter gummy resins containing Tannin in *Mangifera indica*, which makes a layer on the enamel, and it has a protective role against caries (Figure 5).<sup>22</sup> Under using *Mangifera indica* mouthwash, acid formation by bacteria was reduced.<sup>1</sup> combination of other herbal compounds with *Mangifera indica* extract seems to impact the efficacy of materials used to intervene in oral care; further studies on this perspective are highly encouraged better to understand this plant's therapeutic potential in dentistry.

## Conclusion

Our systematic review showed that Mango extract effectively prevents dental caries by reducing *Streptococcus mutans* count and increasing salivary PH. No side effects were reported for *Mangifera indica* in the studies. Since chlorhexidine mouthwash has side effects like the metallic taste, changing perception of taste, and discoloration of the teeth, Mango extracts could be a suitable substitute. In addition, based on the findings of our analysis, *Mangifera indica* extracts have the potential to be a substitute for antibiotics that are misused widely, thus presenting lesser complications. Mango extracts are good candidates for preparing toothpaste and other drugs related to various oral diseases and care; however, we firmly believe that the conduction of more detailed in vivo studies regarding *Mangifera indica* implications in dental caries treatment is essentially needed for further confirmation. Use of a combination of herbs is also widespread in traditional medicine practice. Therefore, future research can focus on the characterization

of the active component and the effect of herb combinations for future therapeutic advancement and pharmaceutical product development in dental care orientation.

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