WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Anti-Bacterial Effect of Mangosteen Pericarp Extract Against Streptococcal Species: A Systematic Review

Caroline Saju[1], Sathiyapriya.S[2], Suganya.P[3], Sindhu.R[2], Dinesh Dhamodhar[4], Prabu.D[5], Rajmohan.M[4],Bharathwaj.V.V[2], M.R.Prashanthy[3]

[1]Undergraduate student, SRM dental college, Ramapuram, Chennai, India
[2]Senior Lecturer, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India
[3]Postgraduate student, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India
[4]Reader, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India
[5]Professor and Head of the Department, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India
*Corresponding Author:
Prabu.D
Master of Dental Surgery, Professor and Head of the Department
Department of Public Health Dentistry
SRM Dental college, Ramapuram, Chennai-600089, Tamilnadu, India
Email- researchphdsrm@gmail.com

ABSTRACT:

Background: Herbal medicine has gained significant importance in dentistry due to its minimal adverse effects on the oral tissue and its ability to overcome antibiotic resistance and is as effective as the current anti-cariogenic agents. The pericarp of G. mangostana is a good source of xanthone substances that have antioxidant, antitumor, antiallergic, anti-inflammatory, anti-bacterial, and antiviral activities.

Aim: To assess the effect of mangosteen pericarp extract against streptococcal species

Materials and Methods: A literature search was performed using PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Science direct, Wiley online library, Lilacs, Google Scholar and Ovid medicine using mesh terms-mangosteen and streptococcus. The search yielded 337 articles which were independently assessed amongst, 5 were included in the review. PRISMA guidelines were followed while reporting this review. Fourin-vitro studies were included for the review process.

Results: Mangosteen peel extract effectively inhibits the growth of S. mutans.

Conclusion: The antimicrobial activity of mangosteen pericarp extract can be effective against S. mutans and various other microorganisms, thus reducing plaque formation, which prevents dental caries

Keywords: Mangosteen, Streptococcus, Pericarp, Dental caries

INTRODUCTION

Oral health is the main indicator of overall health, well-being and quality of life. It includes a range of diseases and conditions like dental caries, periodontal disease, tooth loss, oral cancer, oral manifestations of HIV infection, dental trauma, and congenital disabilities such as cleft lip and palate. Lip and oral cavity cancers are a few of the 15 most common cancers worldwide, with nearly 180,000 deaths each year. Most oral diseases and conditions share modifiable risk factors with the leading non-communicable diseases such as CVS and respiratory diseases, diabetes and cancer. The risk factors are tobacco use, alcohol consumption and unhealthy diets high in free sugars, which are increasing worldwide. Scientific evidence shows a significant association between intake of free sugars and dental caries. Undernutrition, coupled with a high intake of sugars, may exacerbate dental caries. A positive correlationexists between high consumption of sugars with major oral public health problems such as dental caries and lifestyle disorders such as diabetes and obesity[1].

Dental caries is caused by a breakdown of the tooth enamel due to bacteria on the surface of the teeth that break down foods and produce acid that destroys tooth enamel resulting in demineralisation. Dental caries is the most common infectious diseases globally, involving high-cost treatment expenditure [2]. As the treatment is expensive, prevention is a major goal in caries control programs.

Streptococcus mutans is recognised as one of the key etiologic agents that causes dental caries initiation. Two major virulence attributes of the organisms are their capabilities for sucrose-dependent adhesion and glycolytic acid production at low pH values, which leads to enamel demineralisation. The cariogenic organisms such as Streptococcus sanguis, Streptococcus salivarius, Streptococcus mitis, Streptococcus oralis and Lactobacillus acidophilus plays a essential role in the etiology of dental caries. The growth of these organisms would profoundly affect the initiation and progression of the disease[3].

Herbal medicine has gained significant importance in dentistry due to its minimal adverse effects on the oral tissue and its ability to overcome antibiotic resistance and is as effective as the current anti-cariogenic medication[4]. World Health Organisation (WHO) proposed all medicinal herbs have to go through various scientific studies to establish the potential for their therapeutic use. Plants are a potential source of new bioactive compounds to combat dental caries. They produce a wide variety of secondary metabolites, many of which have been found in vitro to have antimicrobial properties against oral pathogens[5-9].

The Guttiferae group comprises a large family of medicinal plants, many of which are also known for their edible fruits. Garcinia mangostana, also known as Mangosteen, is cultivated for consumption in southeast Asian nations, including Thailand, Sri Lanka, the Philippines, and Vietnam[10]. Mangosteen is regarded as a queen of fruits or a superfruit since it is endowed with properties potentially beneficial to an individual's overall health. Their use formed an integral part of South Asian medical systems[11]. Mangosteen plant's leaves and bark have been used in oral care in some African countries, as chew sticks and an astringent. It is used in the treatment of aphthous ulcers and halitosis[12]. The usage of ayurvedic and siddha based medicine in India is especially huge among the urban and rural population for its antiseptic, anti-inflammatory, analgesic, antiparasitic, antipyretic, anticarcinogenic effects [13].The pericarp of mangosteen is endowed with a higher percentage of bioactive agents such as xanthones which includes compounds like α-mangostin, β-mangostin, γ-mangostin, garcinone B, garcinone E and mangostin one[14]. Experimental studies have demonstrated that the pericarp of G. mangostana is a good source of xanthone substances that have antioxidant, antitumor, antiallergic, anti-inflammatory, anti-bacterial, and antiviral activities[15-17].

The property of mangosteen as an anti-bacterial agent against streptococcal species is not very clear in the existing literature; hence, this review aims to understand the effect of mangosteen pericarp extract against streptococcal species. Hence this study aims to assess the effectiveness of mangosteen pericarp extract against streptococcal species.

MATERIALS AND METHODS

STUDY DESIGN

A systematic review of in vitro studies done using mangosteen pericarp extract.

ELIGIBILITY CRITERIA

Inclusion Criteria:

- Studies published in English
- Articles on mangosteen pericarp extract
- Articles on streptococcal species
- In-vitro studies
- Full-text articles
- Publication over the years

Exclusion Criteria:

- Articles published in other languages
- Articles not related to the topic
- Review and literature-based articles
- Articles on other properties of mangosteen
- Studies other than in-vitro
- Relevant articles without full text

SEARCH STRATEGY

The following databases were used to find published articles on in-vitro studies based on the anti-bacterial property of mangosteen against cariogenic bacteria- streptococcus species: PubMed, Science Direct, Cochrane, Wiley online library, Google Scholar and Lilacs. Each database was searched to obtain the articles using specific Mesh representations. The mesh term used was ‘mangosteen’, ‘streptococcus’, ‘pericarp’ AND ‘Dental caries’.

SEARCH ENGINE

- Pubmed
- Science Direct
- Cochrane
- Wiley Online Library
- Google Scholar
- Lilacs
- Ovid medicine

RESULTS

The search yielded 337 articles which were independently assessed amongst, 6 were included in the review. The table below shows the articles that were identified, duplicates removed, screened, excluded, assessed for eligibility and included in this systematic review.

Figure 1: Flow diagram showing the number of studies identified, screened, assessed for eligibility, excluded and included in the systematic review

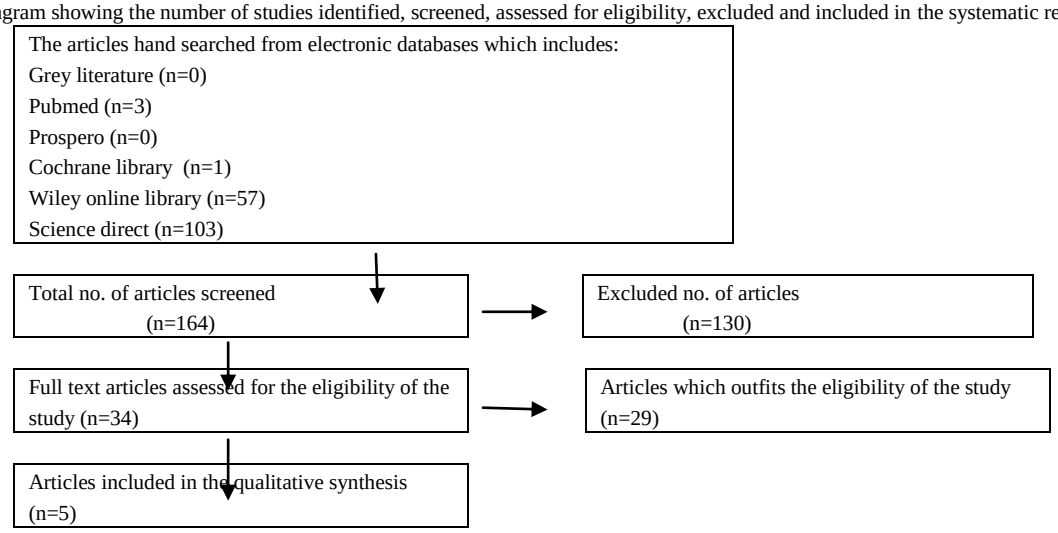

Table 1: Search Database and Characteristics Of Excluded Articles.

Search Database and Keywords			
Database	Keyword	Results	Relevant Articles
PubMed	'mangosteen AND 'streptococcus'	9	9
Science Direct	'mangosteen AND 'streptococcus'	99	54
Cochrane	'mangosteen AND 'streptococcus'	0	0
Wiley Online Library	'mangosteen AND 'streptococcus'	37	21
Google Scholar	'mangosteen AND 'streptococcus'	192	13
Lilacs	'mangosteen AND 'streptococcus'	0	0
Ovid Medicine	'mangosteen AND 'streptococcus'	0	0
Total	-	337	

Characteristics Of Excluded Articles		
SL.no	Reason for exclusion	No: of articles excluded
1	Articles not related to the topic	42
2	Articles in other languages	2
3	Review and literature-based articles	13
4	Articles on other properties of mangosteen extract	25
5	Studies other than in-vitro	5
6	Relevant article without full text	3

Table 2: Characteristics Of Intervention And Outcome Data As Reported In The In-VitroStudies Included.

AUTHOR NAME	YEAR	AIM	PREPARATION USED	TOOL OF ASSESSMENT	RESULT
Nguyen et al.[18]	2011	This study aims to assess the antimicrobial action of α-mangostin against oral streptococci.	1. S. mutans UA159, S. rattus FA-1 and S. salivarius ATCC 134 grown in static cultures in BHI containing 1% (m/v) glucose (55.6 mmol L–1). 2. Tryptone-yeast extract supplemented with 0.1% glucose and 1% arginine (47.5 mmol L–1). 3. Tryptone-yeast extract medium supplemented with 25 mmol L–1 glucose and 50 mmol L–1 L-malate. 4.Ethanolic extracts of G. mangostana.	1. Glycolysis assay 2. Alkali-producing systems 3.Enzyme assays 4. Isolation of F1-ATPase 5. Measurement of Oxygen Uptake. 6. Killing assays	The results showed that α-mangostin is a multi-target inhibitor of S. mutans and may be useful as an anticaries agent.
Nguyen et al.[19]	2014	The aim of the study was to analyse whetherα-Mangostin Disrupts the Development of Streptococcus mutans Biofilms and Facilitates Its Mechanical Removal.	1. Biofilm of S.mutansUA159 (ATCC 700610) was formed on saliva-coated hydroxyapatite (sHA) surfaces (12.7 mm in diameter, 1 mm in thickness. 2. Ethanolic extracts of G. mangostana.	1. Biofilm formation inhibition.	The results show that α-MG can disrupt the development and structural integrity of S. mutans biofilms, at least in part via inhibition of key enzymatic systems associated with exopolysaccharide synthesis and acidogenicity

Janardhanan et al.[20]	2017	The study was aimed to assess the antibacterial efficacy of the crude chloroform extract of mangosteen pericarp against cariogenic bacteria.	1. Standard strains of the microorganisms S. oralis, MTCC 2696 S. mutans MTCC no. 890, Lactobacillus acidophilus MTCC no. 10307, S. salivarius ATCC no. 13419 and S. sanguis ATCC no. 10556 for the study were procured from MTCC and ATCC. 2.The crude extract of mangosteen pericarp.	1. Minimum Inhibitory Concentration. 2. Minimum Bactericidal Concentration.	The anti-bacterial bioassay showed the most activity for Streptococcus sanguis and Lactobacillus acidophilus, whereas it showed a medium and low activity in Streptococcus oralis, Streptococcus mutans and Streptococcus salivarius, respectively. The MBC and MIC values were least seen for Lactobacillus acidophilus (MIC 25 mg/ml, MBC 50 mg/ml) and Streptococcus oralis (MIC 50 mg/ml, MBC 100 mg/ml).
Widyarman et al.[21]	2019	This study aims to analyse mangosteen peelextractsability to inhibit S. mutans and P. gingivalis has biofilms growth in vitro.	1. Crude forms of Indonesian mangosteen peel extract G. mangostana L. 2. Standard strains of S. and P. gingivalis inoculated into BHI broth.	1. Biofilm formation inhibition	The results showed that mangosteen peel extract could inhibit the growth of S. mutans and P. gingivalis in biofilmscompared to the negative control ($P < 0.05$). Furthermore, the most effective concentration and incubation time for inhibiting biofilm growth was 100% in 6 hours for S. mutans and 100% in 24 hours for P. gingivalis.
Janardhanan et al.[22]	2021	The aim of this study the present study is to explore the role of α-mangostin on oral cariogenic organisms, the anticarcinogenic potential on oral cancer and cervical cancer cell lines grown in-vitro, expressed in oral cancer using molecular docking technique.	1. Standard strains ofmicroorganisms S. oralis, S. mutans, Lactobacillus acidophilus, S. salivarius and S. sanguisfor the study were procured from MTCC and ATCC. 2. The crude extract of mangosteen pericarp.	1. Minimum Inhibitory Concentration. 2. Minimum Bactericidal Concentration.	The results show that mangosteen is effective as an anti-cariogenic against Streptococcal species. The pericarp extract showed promising results as an anticancer agent by inducing apoptosis in both oral cancer and cervical cancer cell lines.

Table 3: Bias Assessment As Included In The Studies.

AUTHORNAME, YEAR	RANDOM SEQUENCE GENERATION	ALLOCATION CONCEALMENT	BLINDING OF OUTCOME	INCOMPLETE OUTCOME DATA	BLINDING OF PARTICIPANTS AND PERSONNEL	SELECTIVE REPORTING	OTHER BIAS
P.T.M. Nguyen et al., 2011	-	+	-	-	+	+	?
P.T.M. Nguyen et al., 2014	-	?	-	-	?	+	?
S. Janardhanan et al., 2017	-	+	-	-	+	?	?
A.S. Widyarman et al. 2019	-	?	-	-	+	?	?
S. Janardhanan et al., 2021	-	+	-	?	+	+	?

+= low risk of bias; -= high risk of bias;?= unclear of bias

DISCUSSION

Garcinia mangostana is a tropical fruit indigenous to India, Myanmar, Malaysia, Indonesia, the Philippines, Thailand, Kenya and South Africa. Mangosteen pericarp forms an inherent part of herbal medicine and is extensively used to treat various disorders of the stomach, such as dysentery. It is also used as an anti-inflammatory, anti-bacterial and antifungal agent[23]. The active ingredient present in mangosteen are the xanthones. All the xanthones of mangosteen, such as α-mangostin, β mangostin, γ-mangostin, garcinone B, garcinone E, along with mangostin-one contribute to its therapeutic properties[24].

P.T.M. Nguyen et al.focused on gaining a general view of the effects of α-mangostin on the physiology of S. mutans UA159. The picture obtained is one of α-mangostin antimicrobial action involving multiple targets but with the cell membrane as a locus for primary targets. The overall effects involve killing the organism at higher concentrations and bacteriostatic action at lower concentrations.

P.T.M. Nguyen et al. demonstrated that the phytochemical α-MG might show a potentially useful anti-virulence additive for the control and removal of cariogenic biofilms. Having shown here that α-MG exhibits noteworthy bioactivity against S. mutans biofilms, further understanding of this agent's molecular mechanisms of action and its effects on mixed-species cariogenic biofilm models is certainly necessary. Furthermore, cytotoxicity studies revealed that α-MG is non-toxic and is generally regarded as safe.

S. Janardhanan et al. demonstrated that the crude chloroform extract of mangosteen pericarp showed an effective zone of inhibition against Streptococcus mutans, Streptococcus salivarius, Streptococcus sanguis, Streptococcus oralis and Lactobacillus acidophilus. Thus, the mangosteen pericarp extract showed promising activity against dental pathogens.

A.S. Widyarman et al. concluded that Mangosteen peel extract effectively inhibits the growth of S. mutans and P. gingivalis in biofilms. This study demonstrates that the antibiofilm effect can be an alternative therapy in preventing caries and periodontal disease.

S. Janardhanan et al.concluded the mangosteen pericarp extract showed favourable activity against the cariogenic organism. However, further studies are recommended to delineate the mechanism of action of mangosteen pericarp extracts in in-vitro biofilm models and in-vivo studies to substantiate its role in preventing caries. The present study demonstrates that ethanolic crude mangosteen pericarp extract is cytotoxic and can induce apoptosis on oral and cervical cancer cells. However, further research into the molecular mechanism involved and on in vivo models will provide substantial evidence to the anticancer potential of mangosteen pericarp extract. Molecular docking studies in association with α-MG have shown that the most promising genes are CALM3 and HTT. These genes could pave the way for using mangosteen derivatives in targeted therapy against oral cancer. Since dysbiosis can lead to dental caries and oral cancer, it is commendable that mangosteen has inhibited the cancer cells and inhibited the streptococcal species group of microorganisms, which plays a role in dysbiosis in the oral cavity.

This Systematic review shows that mangosteen is effective as an anti-cariogenic against Streptococcal species. All the five included studies show that α-MG inhibits the growth of S. Mutans and is thus an effective anti-cariogenic agent.

CONCLUSION

The antimicrobial activity of mangosteen pericarp extract can be effective against S. mutans and various other microorganisms, thus reducing plaque formation, hence preventing dental caries.

REFERENCES

1. https://www.who.int/health-topics/oral-health#tab=tab_1 as accessed on 12th February,2022.
2. Quivey, R.G., Jr. Caries. Edited by R.J. Lamont, R.A. Burne, M.S. Lantz, and D.J. LeBlanc. ASM Press, Washington, D.C. 2006;233–252.
3. R Sivapathasundharam B, Raghu AR. Microbiology of dental caries. In: Sivapathasundharam B, Rajendran R Editors. Shafer's textbook of Oral Pathology. 6th Ed: Elsevier publications; 438–43.
4. Bhat N, Mitra R, Oza S, Mantu VK, Bishnoi S, Gohil M, et al. The antiplaque effect of herbal mouthwash in comparison to chlorhexidine in human gingival disease: A randomized placebo controlled clinical trial. J Complement Integr Med. 2014;11(2):129-37
5. Duarte, S., Gregoire, S., Singh, A.P., Vorsa, N., Schaich, K., Bowen, W.H., and Koo, H. 2006. Inhibitory effects of cranberry polyphenols on formation and acidogenicity of Streptococcus mutans biofilms. FEMS Microbiol. Lett. 257(1): 50–56.
6. He, J., Chen, L., Heber, D., Shi, W., and Lu, Q.Y. 2006. Antibacterial compounds from Glycyrrhizauralensis. J. Nat. Prod. 69(1): 121–124.
7. Gregoire, S., Singh, A.P., Vorsa, N., and Koo, H. 2007. Influence of cranberry phenolics on glucan synthesis by glucosyltransferases and Streptococcus mutans acidogenicity. J. Appl. Microbiol. 103(5): 1960–1968.
8. Furiga, A., Lonvaud-Funel, A., Dorignac, G., and Badet, C. 2008. In vitro anti-bacterial and anti-adherence effects of natural polyphenolic compounds on oral bacteria. J. Appl. Microbiol. 105(5): 1470– 1476.
9. Almeida, L.S., Murata, R.M., Yatsuda, R., Dos Santos, M.H., Nagem, T.J., Alencar, S.M., et al. 2008. Antimicrobial activity of Rheediabrasiliensis and 7-epiclusianone against Streptococcus mutans. Phytomedicine, 15(10): 886–891.
10. Ee, G.C., Daud, S., Izzaddin, S.A., and Rahmani, M. 2008. Garciniamangostana: a source of potential anti-cancer lead compounds against CEM-SS cell line. J. Asian Nat. Prod. Res. 10(5–6): 475–479.
11. Pedrasa-Chaverri J, Rodroguez NC, Arozco-Ibarra M, Perez-Rojas JM. Medicinal properties of mangosteen. Food ChemToxicol. 2008;46:3227-29
12. Sagar S. Role of natural toothbrushes in containing oral microbial flora-A review. Asian J Pharm Clin Res. 2015;8(4):29-33
13. Ibrahim MY, Hasim NM, Mariod AM, Mohan S, Abdulla MA , Abdelwahab SI, et al. α-Mangostin from Garciniamangostana Linn: An updated review of its pharmacological properties. Arab J Chem. 2014;4:123-29.
14. Shibata MA, Matoba Y, Tosa H, Iinuma M. Effects of mangosteen pericarp extracts against mammary cancer. AlternInteg Med. 2013;8(2):1-5.
15. Gopalakrishnan, G., Banumathi, B., and Suresh, G. 1997. Evaluation of the antifungal activity of natural xanthones from Garciniamangostana and their synthetic derivatives. J. Nat. Prod. 60(5): 519–524.
16. Ee, G.C., Daud, S., Taufiq-Yap, Y.H., Ismail, N.H., and Rahmani, M. 2006. Xanthones from Garciniamangostana (Guttiferae). Nat. Prod. Res. 20(12): 1067–1073.
17. Jung, H.A., Su, B.N., Keller, W.J., Mehta, R.G., and Kinghorn, A.D. 2006. Antioxidant xanthones from the pericarp of Garciniamangostana (Mangosteen). J. Agric. Food Chem. 54(6): 2077– 2082.
18. Nguyen PT, Marquis RE. Antimicrobial actions of α-mangostin against oral streptococci. Canadian Journal of Microbiology. 2011 Mar;57(3):217-225.
19. Nguyen PTM, Falsetta ML, Hwang G, Gonzalez-Begne M, Koo H (2014) α-Mangostin Disrupts the Development of Streptococcus mutans Biofilms and Facilitates Its Mechanical Removal. PLoS ONE 9(10): e111312.
20. Janardhanan S, Mahendra J, Girija AS, Mahendra L, Priyadharsini V. Antimicrobial Effects of *GarciniaMangostana* on Cariogenic Microorganisms. J Clin Diagn Res. 2017 Jan;11(1):ZC19-ZC22.
21. Widyarman AS, Lay SH, Wendhita IP, Tjakra EE, Murdono FI, Binartha CT. Indonesian mangosteen fruit (Garciniamangostana L.) peel extract inhibits Streptococcus mutans and Porphyromonasgingivalis in Biofilms In vitro. ContempClin Dent 2019;10:123-8.
22. Janardhanan S, Mahendra J, Mahendra L. AnticariogenicAndAnticarcinogenic Effects Of GarciniaMangostana Pericarp Extracts On Cariogenic Bacteria And On Cancer Cell Lines With Molecular Docking Study. Int. Journal of Pharmaceutical Research. 2021.
23. Jindarat, S. (2014). Xanthones from mangosteen (Garciniamangostana): multi-targeting pharmacological properties. Journal of the Medical Association of Thailand= Chotmaihetthangphaet, 97, S196
24. Shibata, M. A., Matoba, Y., Tosa, H., Iinuma, M. Effects of mangosteen pericarp extracts against mammary cancer. Alternative & Integrative Medicine, 2013;1-6.