



## Research Article

# Comparative evaluation of antimicrobial efficacy of three remineralizing tooth pastes – An *in vitro* study

Athikesavan Jayasenthil<sup>1</sup>, Gopal Sreevidya<sup>1</sup>, K. Ohm Nijandhan<sup>1</sup>, Asokan Yogapadhma<sup>1</sup>, Y. Reeja<sup>1</sup>

<sup>1</sup>Department of Conservative Dentistry, Priyadarshini Dental College and Hospital, Tiruvallur, Tamil Nadu, India.



## \*Corresponding author:

Athikesavan Jayasenthil,  
Department of Conservative  
Dentistry, Priyadarshini  
Dental College and Hospital,  
Tiruvallur, Tamil Nadu, India.

ajse2000@gmail.com

Received: 30 September 2025

Accepted: 04 December 2025

EPub Ahead of Print: 11 February 2026

Published:

## DOI

10.25259/JGOH\_42\_2025

## Quick Response Code:



## ABSTRACT

**Objectives:** The aim of the present study was to evaluate and compare the antimicrobial efficacy of three remineralizing tooth pastes. **Materials and Methods:** Three remineralizing agents were selected for assessment of their *in vitro* antimicrobial activity. Group I: Novomin (SHY-NM), Group II: Calcium Sucrose Phosphate (ENAFIX), and Group III: Casein Phosphopeptide-Amorphous Calcium Phosphate (TOOTH MOUSSE). The selected agent solutions were made by mixing equal amount of agent and sterile distilled water to give 1:1 dilution. Wild culture of *Streptococcus mutans* were obtained and cultured in Mutans Sanguis Agar (Hi media) at 37°C for 24 h. The antimicrobial assay was performed by well diffusion method in blood Mueller–Hinton agar plates. The antimicrobial activity was evaluated by measuring the diameter of zones of inhibition. **Results:** Agent formulation Group B (Calcium sucrose phosphate) has maximum zones of inhibition against *S. mutans*, compared to all other agents. **Conclusion:** The remineralizing agents apart from its remineralizing effect also have adjuvant antimicrobial effect against *S. mutans* which helps to reduce dental caries.

**Keywords:** Antimicrobial efficacy, Casein Phosphopeptide-Amorphous Calcium Phosphate, Novomin, *Streptococcus mutans*

## INTRODUCTION

In India and around the world, dental caries is still an alarming yet preventable oral health concern. According to the World Health Organization's 2019 Global Burden of Disease Study, two billion adults and 520 million children have caries in their permanent teeth and primary teeth, respectively.<sup>[1]</sup> Dental caries is a chronic disease with multifactorial etiology, caused mainly due to imbalance between demineralization and remineralization. Certain bacteria in oral biofilm that can demineralize teeth in specific conditions within the oral cavity cause a carious lesion.<sup>[2]</sup> There is no single causative mechanism for dental caries, which is regarded as a “complex” or “multifactorial” disease. As a result, prevention does not rely only on one preventative strategy, such as eradicating germs, controlling nutrition, or changing behavior.<sup>[3]</sup>

In modern dentistry, the demineralization-remineralization structure of caries initiate focuses a strong emphasis on the remineralization of carious lesions. To encourage the remineralization of the demineralized enamel, remineralizing agents in a broad range of formulations have been created in the current era of minimal intervention dentistry.<sup>[4]</sup> The most traditional and popular remineralizing agent is fluoride. Regarding caries prevention and remineralization, the effects of fluoride treatment alone are limited.<sup>[5]</sup> The fact that fluoride loses effectiveness below a pH of approximately 4.5, that it still requires bioavailable forms of Ca<sup>2+</sup> and PO<sub>4</sub><sup>3-</sup> ions in saliva and

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2026 Published by Scientific Scholar on behalf of Journal of Global Oral Health

other sources, and that fluoride remineralization of initial lesions is most effective at the outer 30 µm of the lesion, may be linked to these limitations, these results in surface-zone remineralization at the expense of the lesion body, making full remineralization challenging to achieve.<sup>[6,7]</sup> Safer methods of remineralizing enamel were required due to concerns about fluoride toxicity, questionable effectiveness, and its adverse consequences.<sup>[8]</sup> Newer methods of remineralization include synthetic hydroxyapatite (HAP), casein phosphopeptide-amorphous calcium phosphate (CPP-ACP), resin infiltration, ACP, and calcium sucrose phosphate.<sup>[5]</sup>

The way the CPP-ACP tooth remineralization process works is by creating an amorphous reservoir of free calcium and phosphate ions in the plaque at the tooth surface. This reservoir keeps the enamel surface in a super-saturation mineral state. CPP and CPP mixed with probiotics showed an antibacterial effect.<sup>[9]</sup> The chemical makeup of HAP is comparable to that of the apatite crystals found in human enamel, making it a bioactive and biocompatible substance.<sup>[10,11]</sup> Based on its proven capacity to firmly adsorb to tooth surfaces, plaque constituents, and bacteria, a number of *in vitro* and *in situ* investigations have offered proof of HAP's potential for caries remineralization and prevention in oral care products.<sup>[12]</sup> Moreover, the nano-HAP and nano-silver combination experimental toothpaste have been reported with both remineralization and antibacterial effects.<sup>[1]</sup> Three essential ingredients calcium, sucrose, and phosphate combine to form calcium sucrose phosphate. Calcium sucrose phosphate supplies significant levels of soluble calcium and phosphate ions. It is made up of 85% calcium salts of phosphoric acid esters of sucrose and 15% inorganic calcium orthophosphate by weight.<sup>[13]</sup> Along with remineralization potential, if the dentifrice has antimicrobial property, it will be helpful in preventing dental caries in multifactorial method. The null hypothesis was proposed with no difference in antimicrobial efficacy among the study groups. Hence, the aim of this study was to evaluate and compare the antimicrobial efficacy of three remineralizing tooth pastes.

## MATERIALS AND METHODS

The three remineralizing toothpastes tested were Shy-NM tooth paste containing Novomin, Enafix containing calcium sucrose phosphate, and Tooth Mousse containing CPP-ACP [Table 1]. A wild *Streptococcus mutans* strain obtained from dental caries was used for the antibacterial assessment. The isolated strain was cultured in Mutans Sanguis Agar (Hi media) at 37°C for 24 h. The cultured strains were suspended in Mueller–Hinton broth and adjusted to  $1 \times 10^8$  colony-forming units/mL concentrations approximately. The antibacterial activity of the agents was tested by agar well diffusion method. With help of sterile cork well borer,

**Table 1:** The mean score and standard deviation of zones of inhibition with  $P=0.0007$ .

	Mean	Standard deviation
Shy-NM	19.7	2.4
Enafix	24	4.4
GC-tooth mousse	14	1.8
Positive control	17.7	2.8

three wells were created in agar plate one and two wells were created in agar plate two. 250 mg of three experimental groups were introduced into wells of plate respectively and in plate two triclosan positive control and distilled water negative control were added. The plates were left for agents to diffuse. Then, the plates were inoculated with 0.5 mL of 24 h broth culture of *S. mutans* by lawn culture-incubated at 37°C for 48 h. All the plates were made in triplicates. After incubation period, the antibacterial activity was evaluated by measuring the diameter of zone of inhibition.

## RESULTS

The mean score and standard deviation of zones of inhibition [Table 1] show that Group B calcium sucrose phosphate agents showed maximum zone of inhibition, followed by control triclosan, Group A Novomin, and Group C CPP-ACP [Figures 1 and 2]. Group A and Group B are statistically significant than Group C.

## DISCUSSION

Dental caries is the most common oral disease among the world, which is initiated by certain bacteria that demineralize the tooth and form cavitation.<sup>[14]</sup> Dental Caries can be prevented with many strategies such as antimicrobial agents, remineralization, and diet modification. Dental caries is initially formed by the demineralization actions of the toxins produced by bacteria, resulting in the initial stage of white spot lesions. Recent trend of minimal invasive dentistry lots of newer remineralization agents have been introduced.<sup>[15]</sup> The present study was conducted to evaluate antibacterial efficacy of different remineralizing agents. Blood Mueller–Hinton agar was used instead of standard Mueller–Hinton agar for testing fastidious organisms like *Streptococcus* that require additional growth factors, which are supplied by the added blood. The remineralizing agents if have antimicrobial action will act in two ways for preventing dental caries. In the present study, calcium sucrose phosphate group had maximum antimicrobial action than Novomin and CPP-ACP group. Calcium sucrose phosphate effectively hinders the development of dental plaque, a favorable outcome as plaque can serve as



Figure 1: Zone of inhibition experimental groups.



Figure 2: Zone of inhibition control groups.

a breeding ground for acid producing bacteria, resulting in demineralization. The antibacterial activity of calcium sucrose phosphate has been already reported in previous studies which may be due to the neutral pH which does not support growth of *S. mutans*.<sup>[16]</sup> Calcium sucrose phosphate successfully prevents dental plaque from forming, which is beneficial because plaque can act as an ideal environment for bacteria that produce acid, which causes demineralization.<sup>[13]</sup>

Bioglasses have been already reported for its antibacterial activity against Microbes. The Novomin bioglass has expressed antimicrobial activity against the *S. mutans* biofilm in the previous researches. The antibacterial property is due to alkaline ion release and resulting in increased pH. Furthermore, it involves in doping of cations such as Ag, Mg, Sr, and Zn, which also provides antibacterial activity against *S. mutans* and *Lactobacillus*.<sup>[17]</sup> Instead of directly killing bacteria, CPP-ACP has some antibacterial qualities that are mainly associated with its capacity to disrupt bacterial adherence and formation of biofilm.<sup>[18]</sup> It is especially well-known for lowering the levels of *S. mutans*, a major causative agent of dental caries.

## CONCLUSION

Within the limitations like the study are *in vitro* with tested against single species not the biofilm, it can be concluded that all the remineralizing agents used in the study showed some antibacterial activity against *S. mutans*. Calcium sucrose phosphate and Novomin had better antimicrobial activity than CPP-ACP. The remineralizing agents with antibacterial effect will help in dual action in preventing dental caries.

**Ethical approval:** Institutional Review Board has waived the ethical approval for this study.

**Declaration of patient consent:** Patient's consent was not required as there are no patients in this study.

**Financial support and sponsorship:** Nil

**Conflicts of interest:** There are no conflicts of interest.

**Use of artificial intelligence (AI)-assisted technology for manuscript preparation:** The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## REFERENCES

- Sevagaperumal A, Jesanth Joel R, Periyasamy S. Formulation and evaluation of characteristics, remineralization potential, and antimicrobial properties of toothpaste containing nanohydroxyapatite and nanosilver particles: An *in vitro* study. *Int J Clin Pediatr Dent* 2024;17:630-6.
- Sharma A, Rao A, Shenoy R, Suprabha BS. Comparative evaluation of nano-hydroxyapatite and casein phosphopeptide-amorphous calcium phosphate on the remineralization potential of early enamel lesions: An *in vitro* study. *J Orofac Sci* 2017;9:28-33.
- Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. *Public Health Nutr* 2004;7:201-26.
- Walsh LJ. Contemporary technologies for remineralisation therapies: A review. *Int Dent SA* 2009;11:6-16.
- Kanduti D, Sterbenk P, Artnik B. Fluoride: A review of use and effects on health. *Mater Sociomed* 2016;28:133-7.
- Bjarnason S, Finnbogason SY. Effect of different fluoride levels in dentifrice on the development of approximal caries. *Caries Res* 1991;25:207-12.
- Biesbrock AR, Faller RV, Bartizek RD, Court LK, McClanahan SF. Reversal of incipient and radiographic caries through the use of sodium and stannous fluoride dentifrices in a clinical trial. *J Clin Dent* 1998;9:5-10.
- Sharma D, Singh A, Verma K, Paliwal S, Sharma S, Dwivedi J. Fluoride: A review of pre-clinical and clinical studies. *Environ Toxicol Pharm* 2017;56:297-313.
- Elgamily H, Safwat E, Soliman Z, Salama H, El-Sayed H, Anwar M. Antibacterial and remineralization efficacy of casein phosphopeptide, glycomacropeptide nanocomplex, and probiotics in experimental toothpastes: An *in vitro* comparative study. *Eur J Dent* 2019;13:391-8.
- Reynolds EC. Anticariogenic complexes of amorphous calcium phosphate stabilized by casein phosphopeptides: A review.

- Spec Care Dentist 1998;18:8-16.
11. Lata S, Varghese NO, Varughese JM. Remineralization potential of fluoride and amorphous calcium phosphate-casein phospho peptide on enamel lesions: An *in vitro* comparative evaluation. J Conserv Dent 2010;13:42-6.
  12. Kensche A, Holder C, Basche S, Tahan N, Hannig C, Hannig M. Efficacy of a mouthrinse based on hydroxyapatite to reduce initial bacterial colonisation *in situ*. Arch Oral Biol 2017;80:18-26.
  13. Trailokya AA, Shirsat A. Role of calcium sucrose phosphate (CaSP) in dental carries. J Orofac Health Sci 2024;11:152-8.
  14. Pandey P, Nandkeoliar T, Tikku A, Singh D, Singh MK. Prevalence of dental caries in the Indian population: A systematic review and meta-analysis. J Int Soc Prev Commun Dent 2021;11:256-65.
  15. Zero DT. Dentifrices, mouthwashes, and remineralization/caries arrestment strategies. BMC Oral Health 2006;6 Suppl 1:S9.
  16. Thomas JM, Bhat SS, George SS, Prabha EA, Mohan AP, Somson HM. Effect of tricalcium phosphate and calcium sucrose phosphate on the inhibition of *Streptococcus mutans*: An *in vivo* study. J Contemp Dent Pract 2021;22:1422-5.
  17. Ramadoss R, Padmanaban R, Subramanian B. Role of bioglass in enamel remineralization: Existing strategies and future prospects-A narrative review. J Biomed Mater Res B Appl Biomater 2021;110:45-66.
  18. Schüpbach P, Neeser JR, Golliard M, Rouvet M, Guggenheim B. Incorporation of caseinoglycomacropeptide and caseinophosphopeptide into the salivary pellicle inhibits adherence of mutans streptococci. J Dent Res 1996;75:1779-88.

**How to cite this article:** Jayasenthil A, Sreevidya G, Ohm Nijandhan K, Yogapadhma A, Reeja Y. Comparative evaluation of antimicrobial efficacy of three remineralizing tooth pastes – An *in vitro* study. J Global Oral Health. doi: 10.25259/JGOH\_42\_2025