

PVM/MA Copolymer Enhances Antimicrobial Efficacy and Delivery of 4-Isopropyl-3-Methylphenol in a Model Toothpaste

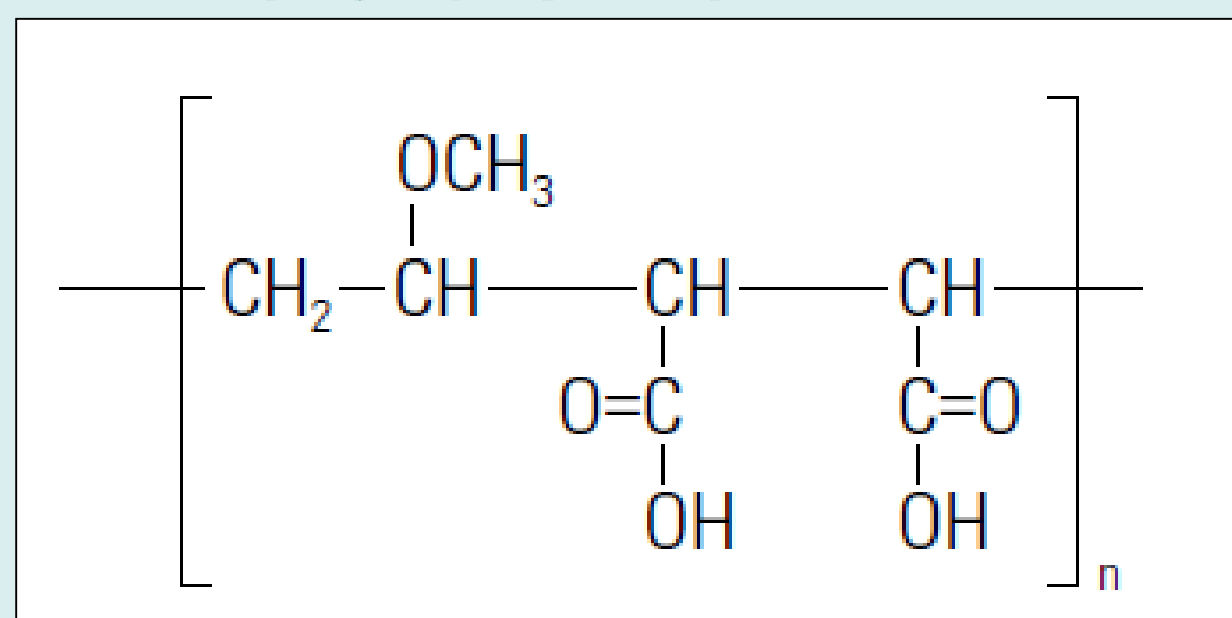


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The purpose of this study was to evaluate the effect of PVM/MA copolymer (Gantrez™ S-97 polymer) on the in-vitro antimicrobial efficacy and delivery of 4-isopropyl-3-methylphenol (IPMP) from a model toothpaste using HAP discs. Results showed that Gantrez™ S-97 polymer improved formulation antimicrobial efficacy and increased the retention of IPMP over the non-polymer control. These effects were seen immediately after rinsing the treated HAP discs and after a 1-hour challenge in artificial saliva. These results indicate that Gantrez™ S-97 polymer is potentially a useful functional excipient to help improve the anti-plaque efficacy of IPMP containing toothpastes.

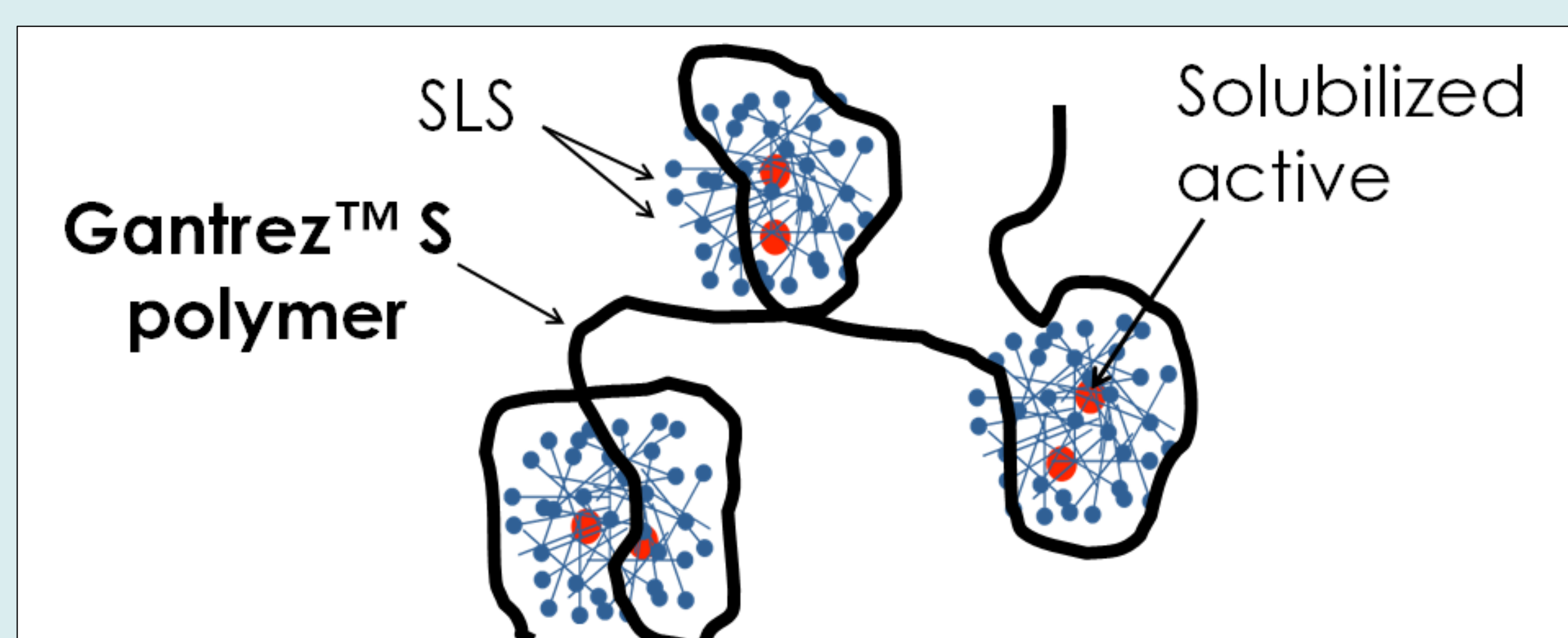
Introduction



Copolymers of methyl vinyl ether and maleic acid (PVM/MA copolymer, Gantrez™ S polymers) are well known to improve the delivery of poorly water soluble active ingredients such as triclosan and botanical oils from toothpaste¹.

PVM/MA copolymers (Gantrez™ S polymers) adhere to oral mucosal surfaces for many hours and, by associating with the solubilized active, help retain it in the mouth for improved delivery. The proposed structure of Gantrez™ S polymer association with sodium lauryl sulfate and insoluble actives is shown in stylized form in Figure 1.

Figure 1. Proposed structure of Gantrez S polymer interaction with SLS-solubilized active.



o-Cymen-5-ol, also known as 4-isopropyl-3-methylphenol (IPMP), is an antimicrobial ingredient used in toothpaste for the reduction of plaque². It is an isomer of thymol and unlike thymol, is tasteless, with much lower water solubility. Because of IPMP's extremely low water solubility, it is a good candidate to be studied with Gantrez S-97 polymer for delivery in toothpaste.

The objective of this study was to evaluate the effect of PVM/MA copolymer (Gantrez™ S-97 polymer) on the antimicrobial efficacy and chemical retention of IPMP on HAP discs treated with an IPMP containing model toothpaste formulation.

Methods

Abrasive-free Model
Toothpaste Formula
(pH 6.5)

Ingredient	% (w/w)
PVM/MA copolymer (Gantrez™ S-97 polymer)	2.00
IPMP	0.100
Glycerin	19.5
Sorbitol 70% Solution	20.0
Propylene Glycol	0.500
Sodium Fluoride	0.243
Sodium Lauryl Sulfate	2.00
Peppermint oil	0.250
Water	55.41

Methods

Treatment of Hydroxyapatite Discs

- Sintered, pellicle coated HAP discs were treated with toothpaste liquid phase for 30 minutes at 37°C, removed from the toothpaste and vortex rinsed 2 times in fresh portions of de-ionized water.
- The rinsed discs were further challenged by vigorously shaking in artificial saliva for one hour and vortex rinsed one time.

Agar Diffusion Assay

- *Streptococcus mutans* was sub-cultured twice in Todd-Hewitt Yeast Extract (THYE) broth, inoculated into THYE agar (cell density of 10⁶ cfu/ml) and poured into Petri dishes. Treated HAP discs were placed on top of the agar (one disc per plate), left overnight in a refrigerator (to allow actives to diffuse into the agar) and then incubated for 48 hours at 37°C and 5% CO₂.
- The growth inhibition zones were measured using a caliper.

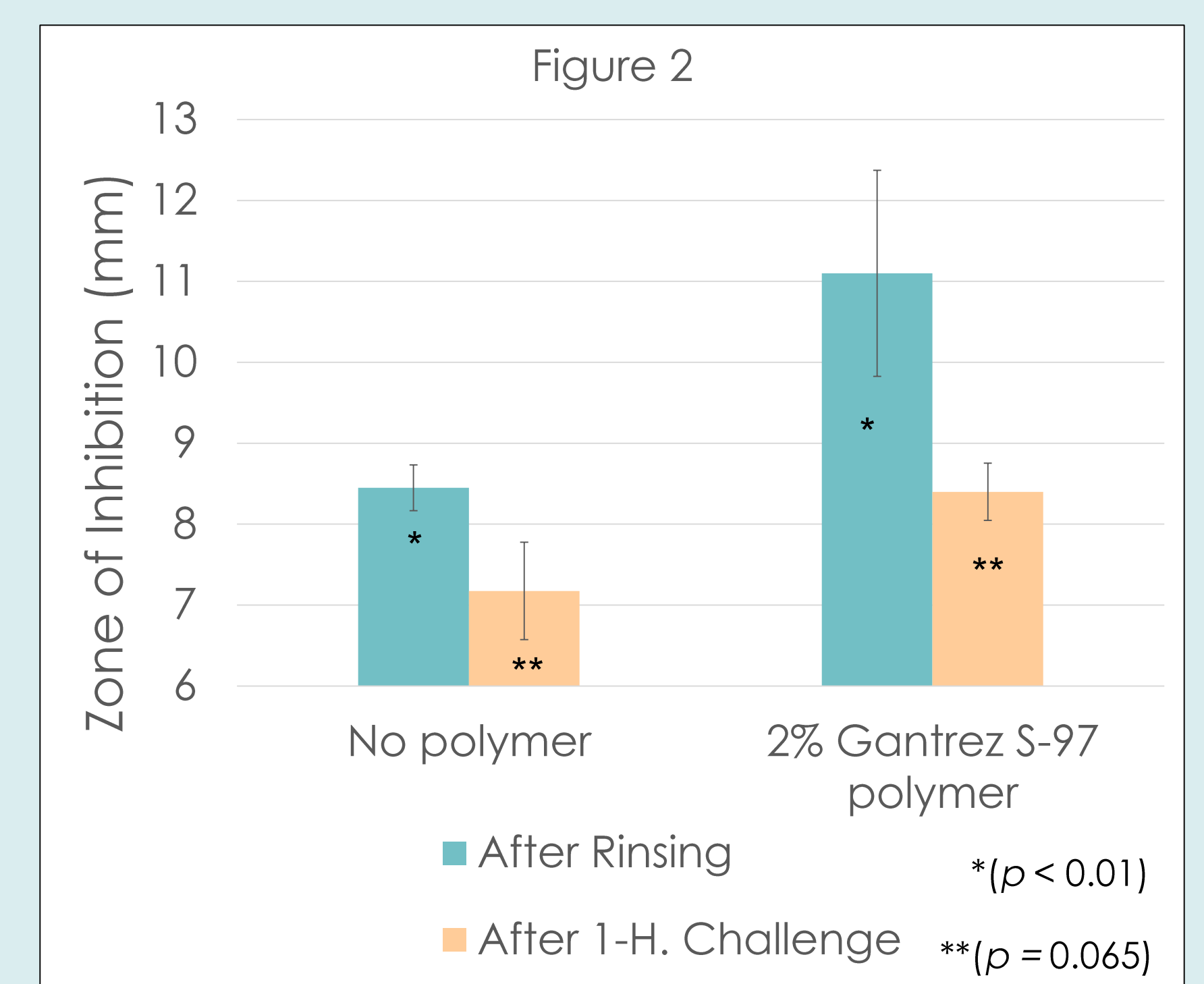
IPMP Assay

- IPMP was extracted from HAP discs with absolute ethanol and aliquots analyzed using reversed-phase HPLC with UV detection at 279 nm.

Results

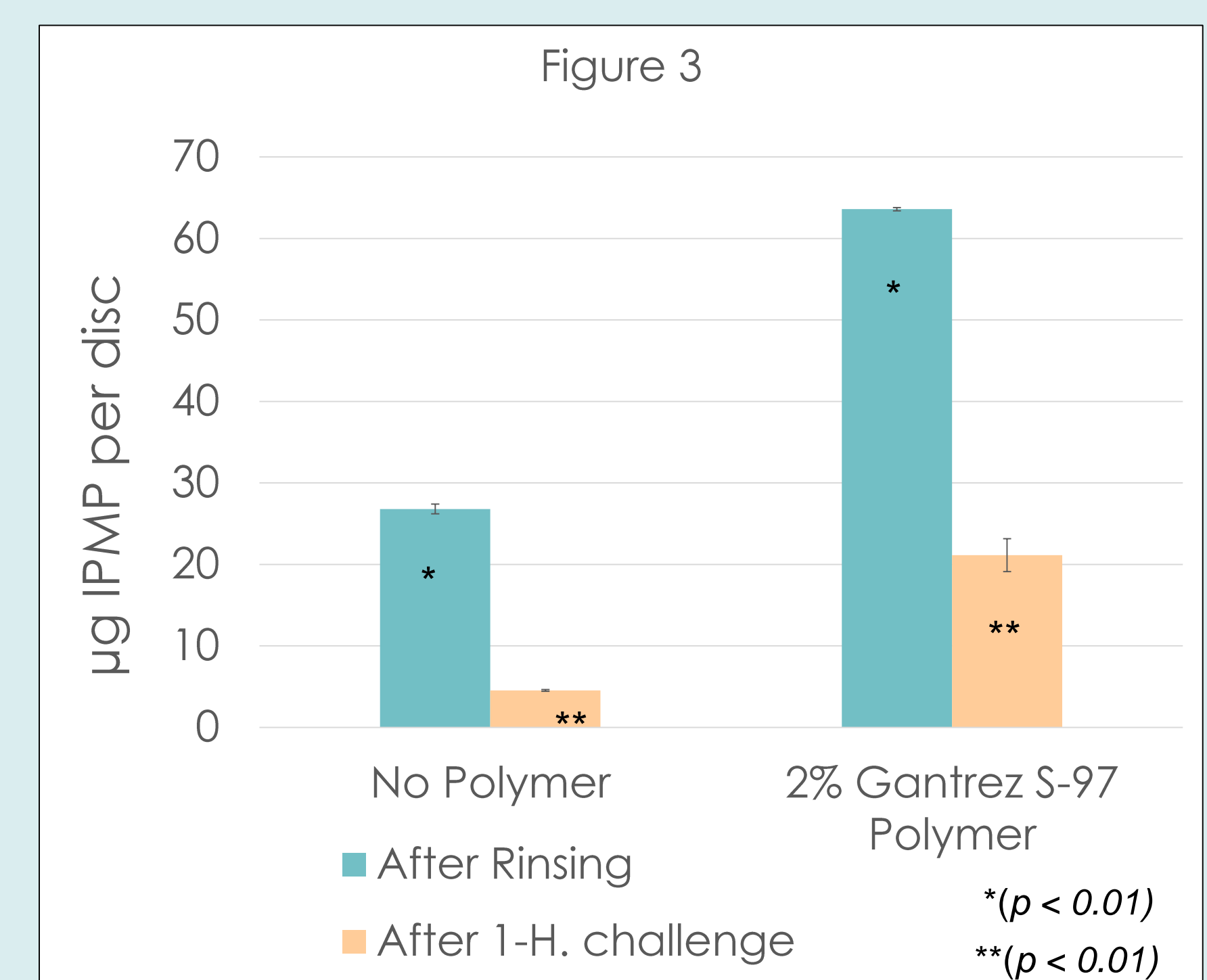
Agar Diffusion Assay

Figure 2. Effect of Gantrez™ S-97 polymer on the zone of inhibition around HAP discs treated with model toothpastes containing 0.1% IPMP (error bars represent ± 1 S.D).



Retention of IPMP

Figure 3. Effect of Gantrez™ S-97 polymer on the retention of IPMP extracted from HAP discs which were treated with model toothpastes containing 0.1% IPMP (error bars represent ± 1 S.D).



Conclusions

PVM/MA copolymer (Gantrez™ S-97 polymer) at 2% in a model toothpaste formula containing 0.1% IPMP significantly improves the retention of IPMP and the antimicrobial efficacy of treated/rinsed HAP discs compared to control without polymer.

References

1. Gafar A. et al; Applications of Polymers in Dentifrices and Mouthwashes; J. Clin. Dentistry; 13(4) 2002 pp 138-148
2. Yong-Duk Park et al; Int. J. of Clinical Preventive Dentistry, Vol. 6, No. 2, June 2010

This work was completed by the Ashland R&D Laboratories.
Ashland is the manufacturer of the Gantrez™ S-97 polymer tested herein.