

Anticaries Efficacy of Whitening Toothpastes

R.V. Faller*, S.L. Eversole, J.M. Best
Procter & Gamble Co., Cincinnati, OH, USA

ABSTRACT

Addition of new ingredients to clinically proven, fluoride toothpaste formulations often raise concerns that the new ingredient may adversely impact the anticaries efficacy of the base formulation. "Profile" tests are often used to gauge whether or not these new ingredients have introduced any deleterious effects on product efficacy. Several such studies have demonstrated "no effect" for the incorporation of anticalculus agents such as soluble pyrophosphate and zinc into fluoride toothpaste. One of the newest additives to be used in toothpaste is sodium tripolyphosphate (STPP), an anionic anticalculus ingredient that is claimed to enhance toothpastes ability to whiten teeth. The purpose of this study was to assess the anticaries efficacy of a new toothpaste containing sodium fluoride (NaF) and STPP relative to a conventional, clinically proven NaF dentifrice which contains 3.3% soluble pyrophosphate but no STPP. Products were evaluated using a well defined animal (rat) caries model (Francis, et. al., *Whitening, containing Arch Oral Biol* 1966;11:141). Test products included (a) Aquafresh® 1100ppm F (NaF) + STPP in a silica based abrasive; (b) original Crest which contains 1100ppm F® Tartar Control as NaF in a silica based abrasive and 3.3% soluble pyrophosphate (clinical benchmark); (c) 250ppm F (NaF)/silica; and (d) Placebo (0ppm F)/silica. Caries scores (hypomineralized areas: x HMA) were (a) 84.9; (b) 69.2; (c) 109.3; and (d) 126.7 which translate to a reduction in caries of 33%, 45% and 14%, respectively, for the three test products relative to placebo (0ppm F). A Duncan's Multiple Range Test (p=0.05) demonstrated (b) > (a) > (c) > (d). **These results suggest the addition of sodium tripolyphosphate (STPP), fluoride toothpaste might significantly reduce the anticaries efficacy of the toothpaste. Further studies are warranted to determine whether the observed effect is related to (1) an issue of fluoride incompatibility for this particular formulation or (2) an issue with STPP itself.**

INTRODUCTION

Since the introduction of tartar control toothpastes in the late 1980's, some researchers have expressed concern that the addition of pyrophosphate, a crystal growth inhibitor, could have a negative effect on enamel remineralization, and thus

anticaries efficacy. Caries clinical studies have since eliminated these concerns.

Compounds are often added to F toothpastes in order to provide additional, non-therapeutic benefits such as tartar control or flavor enhancement. "Profile" tests help gauge whether or not these compounds interfere with the therapeutic activity of the base formulation. Animal (rat caries) testing is one accepted method to verify the anticaries efficacy of these modified formulations. Any negative impact on anticaries efficacy resulting from the addition of new ingredients should be evident in calibrated, well-controlled, animal caries testing. Sodium Tripolyphosphate (STPP), an anionic anticalculus ingredient, is a toothpaste additive which is claimed to enhance a toothpaste's ability to whiten teeth. The impact of STPP on anticaries efficacy is assessed relative to a clinically proven F toothpaste containing pyrophosphate, an anticalculus agent with a history of safe use. Pyrophosphate has been demonstrated to have no deleterious impact on anticaries activity of F dentifrices.

OBJECTIVE

The objective of this study was to assess the anticaries efficacy of a new toothpaste containing sodium fluoride (NaF) and sodium tripolyphosphate (STPP) relative to a conventional, clinically proven NaF dentifrice which contains 3.3% soluble pyrophosphate but no STPP. The animal (rat) caries model (Francis, et. al., *Arch Oral Biol* 1966;11:141), a profile test method which has been validated with respect to fluoride dose response sensitivity, was used to evaluate this new formulation.

PROTOCOL

Harlan Sprague Dawley rats (22-23 days old) were allocated into test groups of 20 animals each and immediately placed on a high cariogenic diet #469 (63% granular sucrose, 32% non-fat dry milk, 2% liver powder, 3% cellulflour). Food and water (deionized) were administered *ad libitum*.

Dentifrices were applied with long-stem cotton-tipped swabs. The swab was dipped into a slurry of toothpaste diluted 1:1 (w/v) with deionized water. This dilution was mixed thoroughly for five minutes prior to treatment. The swab was brushed against the maxillary molars with a front-to-back stroke, repeated six times. On the mandible, the swab was dipped into the treatment slurry and then rotated toward the cheek, moving around the tongue to reach the mandible molars. Again, this included six rotations per mouth with a fresh quantity of toothpaste slurry. Treatment was applied twice daily for a total of ten treatment days (excluding Saturdays and Sundays).

At the end of the study, animals were sacrificed. The jaws were stained with 2% silver nitrate, then hemisected longitudinally for evaluation. Using 30X magnification, the first, second and third molars of each quadrant were graded. Thus, 12 teeth with 22 fissures and 24 smooth surfaces were graded per animal. Each fissure was divided by an imaginary line through the middle of its bottom, and then each side of the fissure assigned a severity grade. Since each quadrant was sectioned longitudinally, both halves of each quadrant were graded and the most severe grade recorded for each corresponding smooth surface or half-fissure. In all, there were 68 grades per animal. The method of scoring lesion severity was as follows:

- 0 - no stain in the enamel or dentin at site
- 1 - dark brown stain in enamel only
- 2 - dark brown stain in enamel extending to the dentin/enamel junction
- 3 - stain through the enamel and into the dentin

The 68 smooth-surface and half-fissure grades for each animal in the group were totaled. A mean severity score (x HMA) was then calculated. A percent reduction was determined by subtracting the test group score from the placebo control group score, dividing by the placebo group score, and converting to percent.

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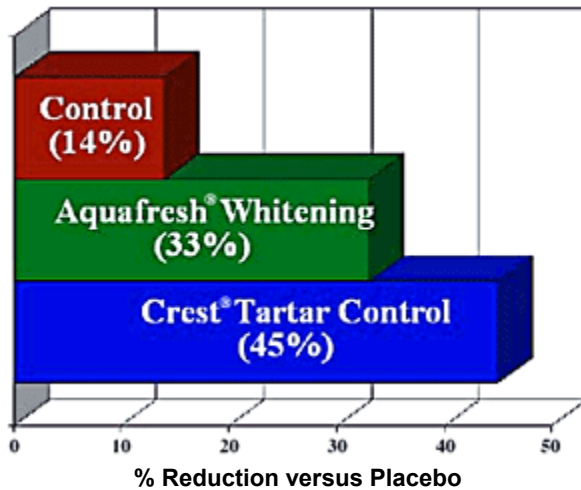
TEST PRODUCTS AND RESULTS

Dentifrice	F (ppm)	Abrasive	Anticalculus Ingredient
Aquafresh® Whitening	1100	silica	STPP
Crest® Tartar Control	1100	silica	pyrophosphate
Dose Response Control	250	silica	
Placebo	0	silica	

CONCLUSION

-The results of this study suggest that, under the conditions of this test, the addition of sodium tripolyphosphate (STPP), a whitening agent, to fluoride toothpaste significantly reduces the anticaries efficacy of the toothpaste.

-Further studies are planned to determine whether the results observed in this study are related to fluoride incompatibility for this particular formulation or an issue with STPP itself.



* All products were significantly different from one another at $p = 0.05$, Duncan's Multiple Range test.