

# 2054: Efficacy of an Experimental Dentifrice in a Demin-/Remineralization Caries Model

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## Introduction

The overall efficacy of fluoride dentifrices in the prevention of dental caries is well established, with fluoride bioavailability being one of the most important parameters.

The aim of the present study was to determine the efficacy of an experimental dentifrice to:

- promote enamel fluoride uptake (EFU)
- promote lesion remineralisation (REM)
- diminish subsequent demineralisation (DEM)

using an established in-vitro caries cycling model<sup>1</sup>, and to compare the results with marketed dentifrices.

## Methods

### Specimen Preparation

Enamel specimens (3 mm in diameter) were removed from extracted human teeth and mounted in rods. The specimens were ground and polished using standardised methods (n=27).

### Initial Decalcification

Artificial lesions were formed in the enamel specimens by a 48h immersion in a solution of 0.1M lactic acid and 0.2% (w/v) Carbopol C907 which was 50% saturated with hydroxyapatite and adjusted to pH 5.0. All specimens had Vickers' surface hardness between 25 and 45 (average lesion depth was estimated to be approximately 70µm).

### Remineralizing Solution

Pooled human saliva was used as the sole remineralization medium in all treatment regimens. Fresh, pooled human saliva was used each day (changed during the acid challenge period).

### Treatment Slurries

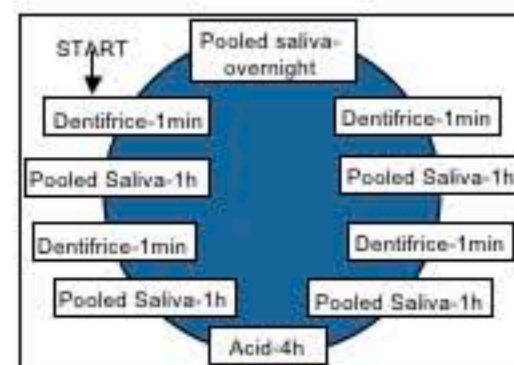
During the treatment period, the specimens were immersed in dentifrice slurries. The slurries were prepared by adding 5g of dentifrice to 10g of the fresh pooled saliva. A fresh slurry was prepared just prior to each treatment.

### Treatment Products - Dentifrices

- NaF0** 0ppm fluoride dose-response control; silica abrasive
- NaF250** 250ppm fluoride dose-response control, silica abrasive, sodium fluoride
- MFP1** 1100ppm fluoride as sodium monofluorophosphate (MFP); calcium carbonate abrasive (commercial product)
- MFP2** 1100ppm fluoride as sodium monofluorophosphate (MFP); dicalcium phosphate abrasive (commercial product)
- NaF1100** 1100ppm fluoride as sodium fluoride, silica abrasive (commercial product)
- EXP** Experimental formulation; silica abrasive, 1100ppm fluoride as sodium fluoride

### Treatment Regimen

The daily cyclic treatment regimen was repeated for 20 days as followed:  
\*On the first day, the first dentifrice treatment was not given; the test began with one hour in pooled saliva to permit pellicle development prior to any treatments. After the treatments, the specimens were rinsed with running deionized water and then placed back into the pooled saliva.



### Fluoride Analysis (EFU)

At the end of the 20-day treatment regimen, the fluoride content of each enamel specimen was determined using the microdrill technique to a depth of 100µm.

### Remineralisation Measurements (REM)

Following fluoride analysis all samples were measured again for surface microhardness. As all treatment groups were balanced for initial lesion hardness, surface microhardness measurements after the 20 day cycling period reflect the ability of the analyte to enhance remineralisation.

### Determination of Enamel Resistance to Demineralisation (DEM-2h; DEM-16h)

Resistance of treated enamel to a subsequent acid challenge was determined by placing the treated specimens into the lesion formation solution (with no remineralisation phase) for one 2-hour and one 16-hour period of simulated plaque acid challenge (SPAC). Following each acid challenge, the surface hardness of the specimens was measured. The difference between the hardness following each subsequent demineralisation and the hardness after the 20 day cycling period would reflect the degree of resistance to demineralisation provided by each dentifrice.

### Statistical analysis

The mean and standard error (SEM) were calculated for each group and each measurement point. A one-way ANOVA at the 95% confidence interval was employed in this study to determine differences between treatment groups.

## Results

The EFU and VHN data for all treatments and measurement points are shown in Table 1, and also in Figures 1 to 3 for better clarity.

Table 1. Summary of EFU, REM and DEM data. Significant differences are indicated by different letters (p < 0.05).

Dentifrice	EFU (ppmF)	dVHN from baseline		
		REM	DEM-2h	DEM-16h
NaF0	324 <sup>f</sup>	-0.1 <sup>d</sup>	-4.9 <sup>d</sup>	-7.4 <sup>d</sup>
NaF250	1503 <sup>cd</sup>	12.9 <sup>c</sup>	7.1 <sup>c</sup>	8.6 <sup>c</sup>
MFP1	1185 <sup>dc</sup>	13.5 <sup>c</sup>	6.7 <sup>c</sup>	7.0 <sup>c</sup>
MFP2	1025 <sup>c</sup>	12.1 <sup>c</sup>	7.8 <sup>c</sup>	7.5 <sup>c</sup>
NaF1100	3966 <sup>b</sup>	40.4 <sup>b</sup>	25.6 <sup>b</sup>	24.2 <sup>b</sup>
EXP	5086 <sup>a</sup>	45.7 <sup>a</sup>	32.5 <sup>a</sup>	28.7 <sup>a</sup>

The EFU data as a function of dentifrice treatment measured after the 20 day cycling period are shown in Figure 1.

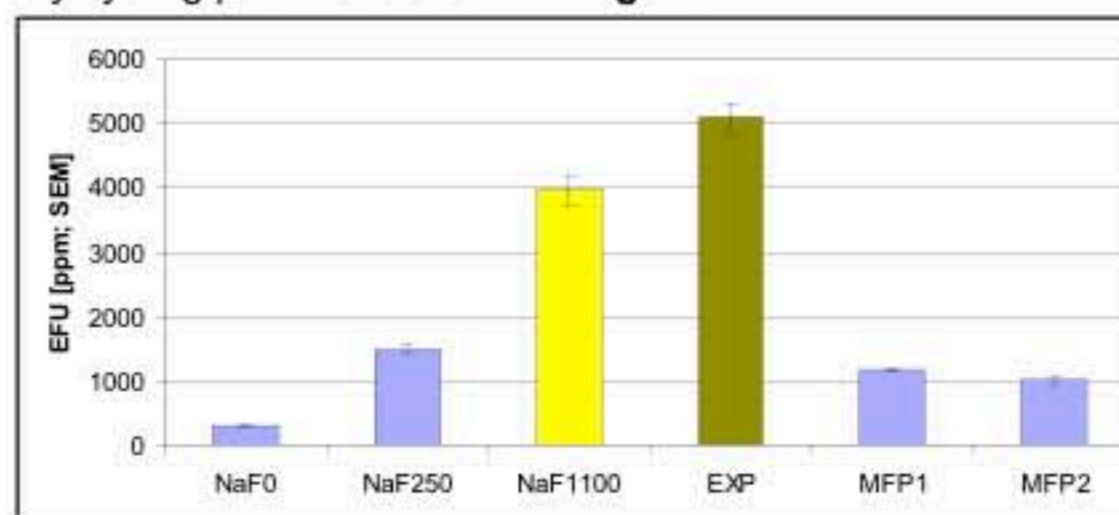


Figure 1. Enamel fluoride uptake (EFU) of enamel samples post-cycling as a function of dentifrice treatment.

The REM data as a function of dentifrice treatment measured after the 20 day cycling period are shown in Figure 2.

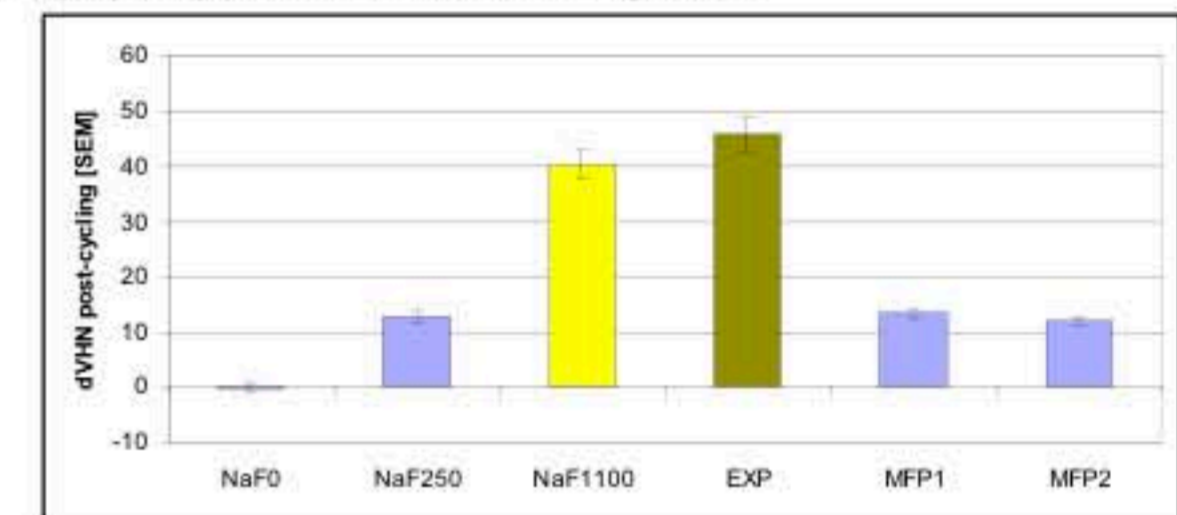


Figure 2. Carious enamel remineralisation (REM) of enamel samples post-cycling as a function of dentifrice treatment.

The DEM data (2h and 16h) as a function of dentifrice treatment and post-cycling demineralisation time are shown in Figure 3.

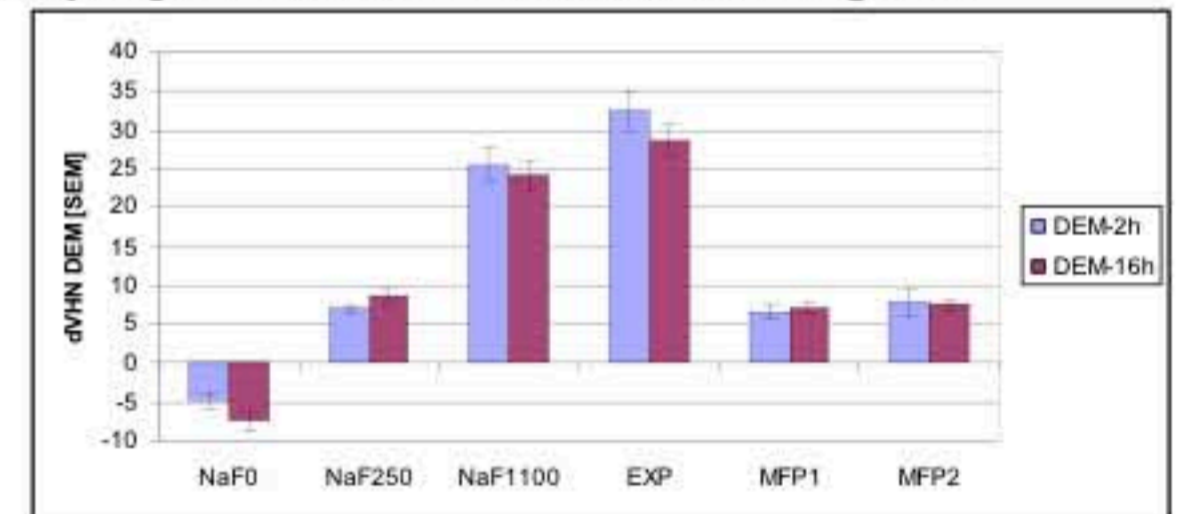


Figure 3. Determination of resistance to demineralisation of enamel samples post-cycling as a function of dentifrice treatment and post-cycling demineralisation time.

In summary, a good fluoride dose-response was established for EFU and REM. EXP delivered statistically significantly better EFU, REM & DEM than NaF1100, with both being superior to MFP1&2 which showed fluoride efficacy equivalent to NaF250 in this model.

## Conclusions

The experimental sodium fluoride/silica dentifrice delivered more fluoride into enamel, showed superior remineralisation and greater protection against demineralisation than the comparable, marketed sodium fluoride dentifrice. EXP and NaF1100 were also superior to MFP1&2 under the conditions of the study.

## References

1. White DJ: Reactivity of fluoride dentifrices with artificial caries. III. Quantitative aspects of acquired acid resistance (AAR): F uptake, retention, surface hardening and demineralization. J Clin Dent 3:6-14, 1991.