

2559 Stain Removal and Abrasivity of Various Commercial Dentifrices *in Vitro*

Dental Products Testing, Indianapolis, IN, USA,

Health Science Research Center, Indiana University-Purdue University, Fort Wayne, IN, USA

Introduction:

In recent years, dentifrice companies have emphasized stain-removal properties in their marketing, adding various terms such as “cleaning” or “whitening” to product tradenames, while also citing product gentleness and polishing ability.

Objective:

To examine the relationship between stain-removal effectiveness and abrasivity of representative commercial dentifrices that have a variety of compositions and are marketed for cleaning, whitening, and/or polishing capabilities.

Methods:

- 26 commercial dentifrices, purchased through retail outlets or online, were tested against American Dental Association (ADA) calcium pyrophosphate reference standard (1:5 with 0.5% CMC in glycerin-water).
- ADA reference standard assigned value of 100 for calculating ratio to test material.

Pellicle Cleaning Ratio (PCR) (Stookey *et al.*, *J Dent Res* 61:1028, 1982)

- Squares (4 mm x 4 mm) cut with diamond disk and mounted with labial enamel exposed in clear orthodontic repair resin.
- Bovine specimens stained using coffee, tea and chromogenic bacteria broth.
- Baseline and final diffuse reflectance absorbance readings of tooth specimens in triplicate with Minolta CM-503i spectrophotometer equipped with targeting mask.
- Specimens (n=16) balanced across groups to provide statistically equivalent baseline L*a*b* values.
- Treatments on V-8 cross-brushing machine using dentifrice slurries (5:8 ratio with water) and ADA nylon-bristle toothbrushes at 150 gm pressure for 800 strokes.
- Equation: $PCR = \text{Dentifrice sample } \Delta E \div \text{ADA reference sample } \Delta E \times 100$.

Relative Dentin Abrasion (RDA) (Hefferren, *J Dent Res* 55:563, 1976)

- Dentin specimens (n=8) placed in neutron flux under controlled ADA conditions.
- Specimens mounted in dental acrylic blocks to fit in V-8 cross-brushing machine.
- Specimens preconditioned for 1500 strokes with ADA reference standard.
- Treatments on V-8 cross-brushing machine using dentifrice slurries (5:8 ratio with water) and ADA nylon-bristle toothbrushes at 150 gm pressure for 1500 strokes.
- 1ml slurry aliquots added to 4.5 ml scintillation cocktail, mixed and immediately placed in scintillation counter and counts per minute (cpm) determined.
- Equation: $RDA = \text{cpm of test sample} \div \text{net cpm of reference standard} \times 100$.

Cleaning Efficiency Index (CEI) (Schemehorn *et al.*, *J Dent Res* 71:559, 1992)

- Equation: $CEI = RDA + (PCR - 50) \div RDA$

Results:

All dentifrices removed extrinsic stain and produced some dentin abrasion, but scores ranged widely (from 25 to 138 for PCR and from 36 to 269 for RDA). The majority contained hydrated silicas, and those with high PCR scores often, but not always, had higher RDA values. Products containing other abrasives (e.g. dicalcium phosphate, sodium bicarbonate, and calcium carbonate) generally had lower RDA values and usually lower PCR values. There were exceptions (e.g. refined kaolin) that had high PCR values and low RDA values. The Cleaning Efficiency Index indicated that other ingredients (e.g. peroxide) also affected stain removal.

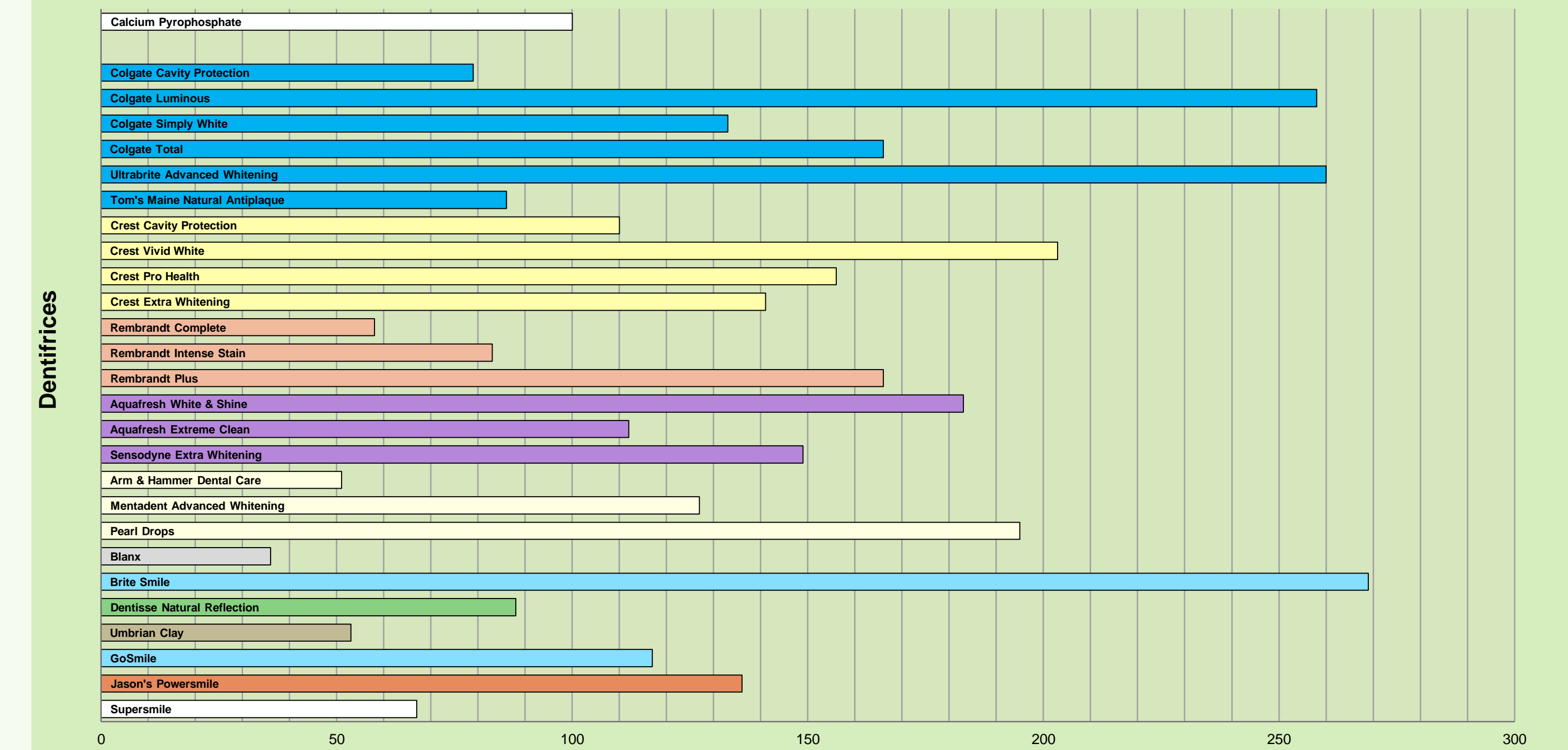
Dentifrice Information and CEI

Group	Dentifrice	Manufacturer	Abrasive	Other Relevant Ingredients	CEI
1	Colgate Cavity Protection	Colgate-Palmolive	Dicalcium phosphate	Tetrasodium pyrophosphate	1.01
2	Colgate Luminous	Colgate-Palmolive	Hydrated silica	Tetrasodium pyrophosphate, Titanium dioxide	1.28
3	Colgate Simply White	Colgate-Palmolive	Hydrated silica	Titanium dioxide, Hydrogen peroxide	1.16
4	Colgate Total	Colgate-Palmolive	Hydrated silica	Titanium dioxide	1.29
5	UltraBrite Advanced Whitening	Colgate-Palmolive	Hydrated silica, Alumina	Tetrasodium pyrophosphate, Titanium dioxide	1.34
6	Tom's of Maine Natural Antiplaque + Whitening Gel	Tom's of Maine	Hydrated silica		1.16
7	Crest Cavity Protection	Proctor & Gamble	Hydrated silica	Trisodium phosphate, sodium phosphate	1.15
8	Crest Vivid White	Proctor & Gamble	Hydrated silica	Sodium hexametaphosphate, Titanium dioxide	1.13
9	Crest Pro Health	Proctor & Gamble	Hydrated silica	Sodium hexametaphosphate, Trisodium phosphate, Titanium dioxide	1.42
10	Crest Extra Whitening	Proctor & Gamble	Hydrated silica, Sodium bicarbonate	Tetrasodium pyrophosphate, Sodium carbonate, Titanium dioxide	1.36
11	Rembrandt Complete	Johnson & Johnson	Dicalcium phosphate	Papain	1.53
12	Rembrandt Intense Stain	Johnson & Johnson	Hydrated silica, Dicalcium phosphate	Papain	1.58
13	Rembrandt Plus	Johnson & Johnson	Hydrated silica	Papain	1.35
14	Aquafresh White & Shine	GlaxoSmithKline	Hydrated silica	Disodium phosphate, Titanium dioxide	1.40
15	Aquafresh Extreme Clean	GlaxoSmithKline	Hydrated silica	Titanium dioxide	1.45
16	Sensodyne Extra Whitening	GlaxoSmithKline	Hydrated silica	Titanium dioxide	1.38
17	Arm & Hammer Dental Care	Church & Dwight	Sodium bicarbonate		0.86
18	Mentadent Advanced Whitening	Church & Dwight	Hydrated silica, Sodium bicarbonate	Hydrogen peroxide, Titanium dioxide	1.22
19	Pearl Drops	Church & Dwight	Sodium bicarbonate, Hydrated silica	Tetrasodium pyrophosphate, Titanium dioxide	1.30
20	BlanX	Guaber, UK	Silica	Titanium dioxide	0.31
21	Brite Smile	BriteSmile, Inc	Hydrated silica	Pentasodium triphosphate, Titanium dioxide	1.31
22	Dentisse Natural Reflection	Dentisse, Inc	Refined kaolin clay	Bentonite clay	1.78
23	Umbrian Clay	Fresh, Inc	Fullers earth	Sodium chloride	1.06
24	GoSmile AM	GoSmile, Inc	Hydrated silica	Titanium dioxide	1.41
25	Jason's Powersmile	Jason Natural Products	Calcium carbonate, Silica, Sodium bicarbonate		1.21
26	Supersmile	Robell Research, Inc	Dicalcium phosphate, Sodium bicarbonate, Calcium carbonate	Titanium dioxide, Calcium peroxide	1.36

Conclusions:

Stain-removal ability and abrasivity of dentifrices, especially those containing silicas, were highly variable, and the relationship between these two factors was not necessarily direct. With some exceptions, dentifrices marketed as “whitening” products generally were more abrasive than other products.

Radioactive Dentin Abrasion (RDA)



Pellicle Cleaning Ratio (PCR)

