



**PSC RESEARCH INSTITUTE INC**  
**RDA (RELATIVE DENTIN ABRASION) STUDY OF WHITE BIRCH™ CHARCOAL TOOTHPASTE**

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Determining the Abrasiveness of White Birch™ Charcoal Toothpaste

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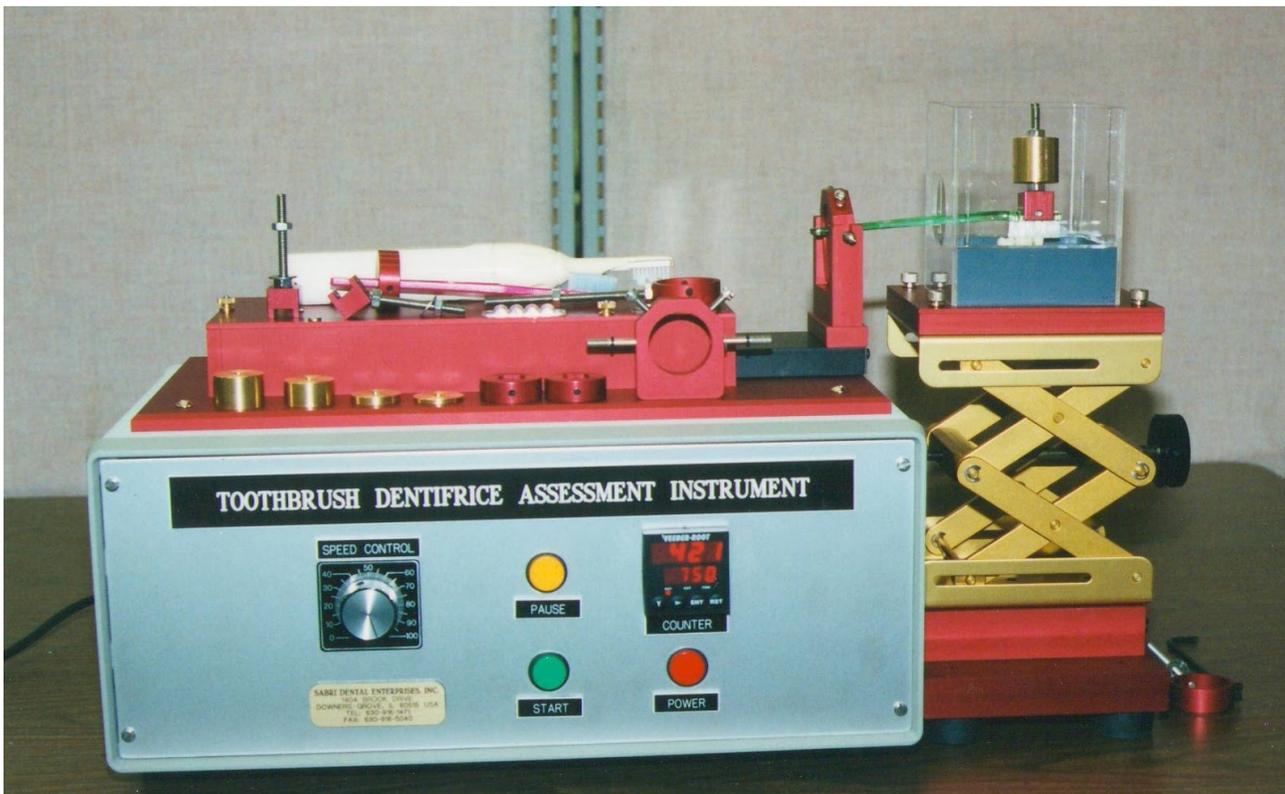
**METHOD FOR RELATIVE DENTIN ABRASION (RDA) STUDY:**

We used bovine specimens (n = 10) as well as synthetic apatite specimens for standardization underwent a neutron bombardment at the Atomic Institute of Australia. The exposure to a neutron flow of 1.7 neutrons/cm<sup>2</sup>-s converts 31P of hydroxyapatite within the specimens to radioactive 32P. After irradiation at a maximum temperature of 55°C and reshipment in special containers to a B-laboratory, the root specimens were embedded in methyl methacrylate using a custom Teflon mold and a positioning caliper to ensure a surface positioning 1 mm above the surface of the embedding material. To prevent root dentin dehydration, the molds were kept under water during polymerization. The specimens were then stored in water until handled further.

Eight irradiated root samples were allocated to each of the 2 test groups and the respective standard ISO abrasion material. The relative dentine abrasion of the 15 toothpastes was then determined after brushing the specimens using a sandwich technique, previously described by Imfeld (2010)♦. The abrasivity of the dentifrices was calculated based on the ratio relative to a reference abrasive (standard slurry). To determine the reference abrasivity, specimens were first brushed with a standard slurry, then with a slurry of the test dentifrice and then again with standard slurry. For each brushing sequence, Oral B manual toothbrushes were moved for 25 min over the roots in 30 mm excursions at a rate of 60 cycles/minute at 2.5 N. Specimens were positioned in an automated 8-place cross-brushing machine, enabling simultaneous testing of seven testing slurries and one standard slurry (V-8 Cross Brushing Machine, Sabri Enterprises Inc., Downers Grove, IL, USA). Each chamber was filled with 65 g of the respective testing slurry or the standard slurry. The experimental slurries contained the respective toothpaste mixed

with saliva substitute, bi-distilled water and sodium bicarbonate. After each brushing sequence, samples of the slurry were removed for analysis.

**FIGURE 1: PSC Research Toothbrush and Toothpaste Abrasion Testing Instrument:** A single toothbrush versatile dentifrice assessment instrument has been designed to evaluate brushing efficacy of manual and electrically powered toothbrushes currently being marketed in a laboratory simulated operational test protocols. Test can be performed on the stained human, bovine teeth or any desired material shaped flat or convex specimens which are placed in the trough in wet or dry conditions. Brushing speed and brushing test cycles are programmed and set in the front control panel of the instrument. Brushing pressure on the manual brushes is applied directly on the head by the weight holder and on electrical powered brushes by round collar weights ranging from 50-200 grams.



Prior to the next brushing sequence, the chamber was cleaned with ionized water. For analysis, three 0.5 g samples were taken from each slurry after each brushing sequence to measure the  $^{32}\text{P}$  radiation activity over 24 h (Phosphor-Imager<sup>®</sup>, Molecular Dynamics, Sunnyvale, CA, USA). The measured  $^{32}\text{P}$  activity in counts per minute (cpm) was converted into decays per minute (dpm)/mg by comparison with the results of a  $^{32}\text{P}$  standard (Amersham Pharmacia Biotech, Vienna, Austria). The data obtained from the two brushing sequences with standard slurry served as a reference and were averaged and normalized to the value 100. The relative dentin abrasion of the test dentifrices (processed in between standard slurry runs) was expressed as a percentage of this standard value.

Ranking for the RDA values:

- RDA-1: Very low abrasion, RDA <20
- RDA-2: Low abrasion, RDA 20–40
- RDA-3: Moderate abrasion, RDA 41–61
- RDA-4: Strong abrasion, RDA 61–80
- RDA-5: Very strong abrasion, RDA >80 (not recommended to be safe for daily use)

\* From the following source: <http://www.promenadedentalva.com/docs/toothpaste-abrasion-chart.pdf>

## RESULTS:

TOOTHPASTE	DECLARED RDA*	MEASURED RDA (MEAN ± STDEV)
White Birch™ Charcoal TP	unknown	45 ± 8
Colgate Optic White TP	100	108 ± 11

## DISCUSSION:

None of the tested dentifrices were graded as having very low abrasion (RDA-1). However, the White Birch™ Charcoal Toothpaste demonstrated only Moderate Abrasion (RDA-3), while the market leading toothpaste with peroxide was very strongly abrasive, both according to their own declared findings and also according to our finds (RDA-5; RDA = 100). The control market leader should therefore be categorized as a mostly whitening dentifrice for stain removal and is not recommended for use on a daily basis. However, the experimental dentifrice, White Birch™ Charcoal Toothpaste should be considered a safe every day toothpaste according to its low RDA value.

♦ Imfeld T: Comparison of the mechanical effects of a toothbrush and standard abrasive on human and bovine dentine in vitro. J Clin Dent 12: 92–96 (2001)

RDA VALUE OF CURRENT COMMERCIAL TOOTHPASTES (AUGUST 2018)

Toothpaste	RDA Value	Toothpaste	RDA Value
Livionex	0	Rembrandt Plus	94
Toothbrush with plain water	4	Plus White	94
Plain baking soda	7	Oxyfresh with Fluoride	95
Arm & Hammer Tooth Powder	8	Crest Regular	95
Weleda Salt Toothpaste	15	Oxyfresh Powder	97
CariFree CTx4 Gel 1100/5000	18.5	Colgate Enamel Care Natural Whitening	100
CariFree CTx3 Gel	18.5	Colgate Optic White	100
Elmex Sensitive Plus	30	Natural White	101
Weleda Plant Tooth Gel	30	Mentadent	103
Pronamel	34	Arm & Hammer Sensation	103
Arm & Hammer Dental Care	35	Sensodyne Extra Whitening	104
Weleda Children's Tooth Gel	40	Colgate Platinum	106
Arm & Hammer Mentadent Advance Whitening	42	Arm & Hammer Advance White Extreme Whitening	106
Squiggle Enamel Saver	44	Crest Sensitivity Protection	107
Weleda Calendula Toothpaste	45	Topex ReNew	109
Weleda Pink Toothpaste with Ratanhia	45	Colgate Tartar Control with Baking Soda and Peroxide	109
Oxyfresh	45	Colgate Herbal	110
Arm & Hammer Dental Care Sensitive	48	Amway Glister	110
Tom's of Maine Sensitive	49	Aquafresh Whitening	113
Arm & Hammer Peroxicare Tartar Control	49	Arm & Hammer Advance White Gel	117
Crest with Scope	51	Arm & Hammer Sensation Tartar Control	117
Arm & Hammer Peroxicare Regular	52	Fluoridex Daily Defense	117
Healthy Teeth & Gums	52	Close Up with Baking Soda	120
Rembrandt Original	53	Crest Extra Whitening with Tartar Protection	120
Closys	53	Colgate Whitening	124
Arm & Hammer Dental Care PM Bold Mint	54	Crest Maximum Sensitivity	126
PerioSciences White Care	57	Crest Extra Whitening	130
Tom's of Maine Children's	57	Ultra Brite	133
Biotene Gel	60	Crest MultiCare Fresh Mint	139
Clinpro 5000	62	Crest Pro-Health	140
Supersmile	62	Crest Multicare Whitening	144
Rembrandt Mint	63	Colgate Baking Soda Whitening	145
Colgate Prevident 5000 Plus	65	Ultra Brite Advanced Whitening Formula	146
Colgate Enamel Care Advanced Whitening	65	Pepsodent	150
Crest with Scope Whitening	65	Crest Rejuvenating Effects	155
Colgate Regular	68	Colgate Tartar Control	165
Colgate Total	70	Colgate Luminous	175
Arm & Hammer Advance White Sensitive	70	Colgate 2-in-1 Tartar Control/White	200
Colgate 2-in-1 Fresh Mint	70	FDA Recommended Limit	200
Crest Rejuvenating Effects Liquid Gel	74	ADA Recommended Limit	250
Prevident 5000 Booster	75		
Sensodyne	79		
Aim	80	<b>The RDA table:</b>	
Biotene Paste with Fluoride	80	<b>0-70 = low abrasive</b>	
Colgate Sensitive Max Strength	83	<b>70-100 = medium abrasive</b>	
Aquafresh Sensitive	91	<b>100-150 = highly abrasive</b>	
Tom's of Maine Regular	93	<b>150-250 = regarded as harmful limit</b>	