The erosion explosion....
effects of a modern day witch’s brew

Anne N. Guignon, RDH, MPH, CSP

Copyright 2007

Learning outcomes

Understand beverage components and changing consumption patterns.

Recognize how pH and titratable acidity contribute to erosion.

Learn how beverages are marketed to children and adolescents

www.wonderhowto.com/how-to-explore-atomic-structure-tooth-160130/

What is erosion?

Bioceramics masterpieces

Erosion

- progressive loss of hard tissue
- **chemical loss - not bacterial**
- most important factor - hypersensitivity
- erosive lesions – generally sensitivity

Erosion - a multifactorial condition

Erosion vs. caries

- surface-softening lesion
- non-bacterial - extrinsic and intrinsic acids
- complicated by attrition and abrasion
- remineralization difficult
- prevalence - increases with age

How does erosion happen?
Biofilm attachment

How does erosion happen?

Acid erosion

Erosion - surface softening
- citric acid pH 2.3
- 6 X 5 min/day
- 10 days
- stored in salt solution

Salivary pH - impact on tooth structure

Critical pH
- critical pH - is a dynamic number
- dependent - salivary calcium and phosphorus
- average resting salivary pH 6.4 – 7

When do teeth melt???
- root structure - pH 6
- enamel - between pH 5 and 5.5
- fluorapatite - pH 4.5

Stimulated saliva
- quality improves - proteins
- increased bicarbonate
- neutralizes acids
- bicarbonate reserves are limited

Proteins - secondary path - neutralization

Mount GJ and Hume WJ. Preservation and restoration of tooth structure: knowledge, tools and software. 2nd Edition. 2005
Stookey GK. The effect of saliva on dental caries. JADA 2008 May; 139;11S-17S.
Testing oral pH

Sensitivity

Dentinal hypersensitivity
- common
- transient pain
- short, sharp sensations
- exogenous stimuli

Stimulus
- thermal stimulus (cold) 75%
- tactile stimulus 25%
- osmotic stimulus (sweet) 16%
- air blast ?%

Dentinal hypersensitivity

Structural differences between sensitive and non-sensitive

<table>
<thead>
<tr>
<th></th>
<th>Non-Sensitive</th>
<th>Sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of open tubules</td>
<td>x</td>
<td>8 x</td>
</tr>
<tr>
<td>Diameter of tubules</td>
<td>0.43</td>
<td>0.83</td>
</tr>
<tr>
<td>Fluid Flow (Poiseuille’s law)</td>
<td>y</td>
<td>16 y</td>
</tr>
</tbody>
</table>


Dental hypersensitivity

- exposed dentin via loss of enamel or periodontal tissues
- open dentin tubules - patent to the pulp – loss of smear layer

Continued tubule exposure
- poor plaque control
- excess oral acids
- cervical decay
- toothbrush abrasion
- tartar control toothpaste

Hidden hypersensitivity

Non-verbal cues and clues
- apprehension
- negativity
- unwilling to schedule
- broken appointments
- arriving late

Non-sensitve
- Sensitive

Jacobsen PL, Bruce G. Clinical dentinal hypersensitivity: Understanding the cause and choosing a treatment. J Contemp Dent Pract 2001;Winter; (2)1:1-8

Verbal and non-verbal
- women/younger - more anxious
- tense bodies
- foot on the floor
- “I’d rather be anywhere but here”
- patient expectations
- previous dental experiences

Listen to patients......
- acknowledge their concern
- not that many hypochondriacs
- believe in their discomfort
- partner in the diagnosis

Rule out other conditions
- occlusal trauma
- cracked tooth syndrome
- caries – new and recurrent
- pulpal pathology
- gingival sensitivity
- layered sensitivities

A golden opportunity
- what is really bothering them
- discomfort triggers – temperature, air, galvanic, acidity
- feeling – sharp, dull, profound, achy, electric
- alternative procedure?

Erosion – Intrinsic factors

Regurgitation
- reflux
- bulimia
- chemotherapy
- pregnancy
- alcoholism
- peptic ulcers
- gastritis
- drug side effects

OTC supplements
- medications
- chewable vitamin C
- cough drops
- fizzy liquid medications
- gummy bear supplements

Redheads
- high anxiety
- fear of pain
- avoid dental care
- more sensitive to cold
- subcutaneous lidocaine significantly less effective

Intrinsic and extrinsic factors

Erosion – complicating medical conditions
GERD – gastric esophageal reflux
- 7% adults - daily episodes
- 36% monthly
- children also experience GERD

Anorexia
- 47% - binge/purge subcategory
- refuse to maintain normal weight

Bulimia
- typically normal weight
- self induced vomiting after eating

Eating disorders – behaviors and findings
- vomiting - palatal surfaces - maxillary teeth
- eroded surfaces - smooth/glossy
- erosion – 2+ years of self-induced vomiting
- active lesions - smooth/unstained
- inactive lesions - stain over time


Eating disorders – Common behaviors and findings

- erosion – 2+ years - self-induced vomiting
- excessive - acidic beverages and fresh fruits
- antidepressants - cause dry mouth
- binge/purge – high carbohydrate intake
- anorexia - often poor oral hygiene


Eating disorders/Excessive exercise/Suicide risk

- bulimia
- over-exercise/suicide relationship
- 1/3 dx bulimics attempt suicide
- over-exercise predicts pain insensitivity
- pain insensitivity predicts ACS (acquired capability for suicide)


Erosion from GERD

Loss of occlusal anatomy

Rising amalgams


Erosion from GERD

Loss of occlusal anatomy

Rising amalgams


Erosion – Extrinsic factors

- diet
  - drinks, fruits, candies, pickled foods
- environmental
  - occupational (acid vapors from industrial electrolytic processes / wine tasting)
  - recreational (swimming pools)*


Erosion – Dietary intake

- acidic foods – pickles, vinegar, citrus
- carbonated beverages
- sports and energy drinks
- flavored waters
- wine – particularly dry varieties
- beer


Erosion – Dietary intake

- high carbohydrate foods
- fruit juices
- fruits, especially citrus
- sour candies and powders
- breath mints
- sugar free candies containing citric acid
- Erika Feltham’s paper erikafeltham@mac.com


The many looks of erosion

Loss of surface gloss and thin enamel

Loss of occlusal anatomy and rising sealant


The many looks of erosion

Early erosion

Advanced occlusal erosion


Erosion of Dental Enamel among Competitive Swimmers – Virginia

http://www.cdc.gov/mmwr/preview/mmwrhtml/00000109.htm

The science behind erosion – pH and titratable acidity


Erosion of Dental Enamel among Competitive Swimmers – Virginia

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http://www.cdc.gov/mmwr/preview/mmwrhtml/00000109.htm
Soda Pop!

1950s - 6.5 oz bottle

Today........ 12 oz can is standard 20 oz bottle common

- Missouri Dental Association
- Brochure revised 2006
- 573-634-3436
- www.modental.org

Are you sure you want to drink another soda?!

Erosive potential of four soft drinks

Study drinks
- Red Bull
- Classic coke
- Diet coke
- Gatorade

Measured
- pH
- Titratible acidity
- Listed all ingredients found in the beverage

Chemical erosion via soft drinks

- decay-free human molars
- imbedded in acrylic
- enamel exposed
- half surface – nail polish coating
- remaining surface - exposed to beverage

Chemical erosion via soft drinks

- beverage changed daily
- 14 days = 14 years drinking exposure
- microscopic and SEM evaluations

Post immersion photos - 20x magnification

Classic Coke

Diet Coke

Gatorade

Red Bull

Control - Tap water

Note-Chalky, dull enamel

2004 Landmark study

Dissolution of enamel in soft drinks


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Red Bull

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Dissolution of enamel in soft drinks

Total acid content of beverages

- **pH-initial acidity**: measures hydrogen ion concentration
- **TA-titratable acidity**: measures total acid molecules / erosive potential
  - higher TA = longer time to neutral, safe pH value / salivary clearance

What's different about these non-carbonated drinks?

- multiple organic acids
- added sucrose and glucose
- TA off the charts! Requires more titration

What a brew!

- **sodium citrate**
- gum arabic
- erythorbic acid (preserves freshness)
- calcium disodium EDTA (protects flavor)
- brominated vegetable oil
- yellow 5

What's different about these non-carbonated drinks?

- **citric acid**: binds (chelates) calcium - higher pH
- net effect – accelerates calcium loss
- maintains pH below 5.5, causing erosion

More news on acidity

<table>
<thead>
<tr>
<th>pH</th>
<th>TA</th>
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<tbody>
<tr>
<td>LOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbonated water</td>
<td>5.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Lager</td>
<td>4.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Beer</td>
<td>3.9</td>
<td>0.6</td>
</tr>
<tr>
<td>MEDIUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cola</td>
<td>2.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Carbonated orange</td>
<td>2.9</td>
<td>2.0</td>
</tr>
<tr>
<td>White wine</td>
<td>2.5</td>
<td>2.2</td>
</tr>
<tr>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple juice</td>
<td>3.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Grapefruit juice</td>
<td>3.2</td>
<td>9.3</td>
</tr>
</tbody>
</table>

The scoop..... powdered drinks

- Bottled water - pH 6.3
- Propel Fit Powder 'vitamins' - raspberry lemonade flavor - pH 3.2
- Kool-Aid Singles - cherry flavor - pH 2.8
- Country Time Lemonade 'On the Go' - pH 2.5
- Crystal Light 'On the Go' - raspberry ice flavor - pH 2.6

Soda, juice and other drinks......

- commercial tea bag flavors - black, green, citrus, fruity, floral
- measured - pH, titratable acidity and fluoride in teas
- human molar samples soaked for 25 hours - tea refreshed every 5 hours
- teeth sectioned - lesion depths measured

Tea - brewed teas

- tea - brewed teas
  - commercial tea bag flavors - black, green, citrus, fruity, floral
  - measured - pH, titratable acidity and fluoride in teas
  - human molar samples soaked for 25 hours - tea refreshed every 5 hours
  - teeth sectioned - lesion depths measured

Propel....now vitamin and calcium enhanced

- Vitamin B 5
- Vitamin B 6
- Vitamin B 3
- sucrose syrup
- Vitamin B 12
- flavors
- Vitamin D
- citric acid
- sodium citrate
- One 8 oz contains: 10 Calories
- Splenda (sucrose) - 35 mg of sodium
- ascorbate potassium - 3 g of carbohydrates
- calcium disodium EDTA - 2 g of sugar

Red Bull – 250x SEM


David Bartle, BDS, PhD – Acids, sensitivity and teeth: A practical approach to management of erosion and tooth wear. ADA Meeting – October 17, 2008 – San Antonio, TX.


Tea - brewed teas

- citrus and fruity teas - greatest lesion depths
- pH inversely associated with depth
- titratable acidity positively associated with depth


Tea - ready to drink

- low pH values - all below 4.03
- high titratable acidity values
- acidulants added - typically citric acid


Smoothies

- kiwi, apple and lime most erosion depth
- cranberry, blueberry, cherry, strawberry and banana - reduced surface micro hardness
- smoothie with yoghurt - no change in surface hardness
- recommend - consume during meals


Adding calcium to juices

- calcium containing beverages
- lower enamel demineralization/wear
- beverages - calcium supplement reduces demineralization


Digestive aids / trends

- apple cider vinegar
- Kombucha tea fermented
- 2 tsp twice daily
- sweeten with honey
- pH 2.8 – 3.0

24 oz warm water
- juice of 1 lemon
- pH approx. 2.4

“But drinking lemon-water does not expose the mouth for excessive amounts of time to high citric acid levels in the mouth, thereby causing no harm to the enamel. In fact, it improves plaque-stained teeth and just breath.”

Kombucha tea fermented
- fermented - tea + sugar + yeast + bacteria
- contains vinegar
- pH 2.8 – 3.2

And it’s not just soft drinks!

<table>
<thead>
<tr>
<th>Fruits</th>
<th>pH</th>
<th>Other Beverages</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>2.6</td>
<td>Cranberry sauce</td>
<td>2.3</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>2.6</td>
<td>Fruit juices</td>
<td>3.6</td>
</tr>
<tr>
<td>Blackberries</td>
<td>2.3</td>
<td>Bubblegum</td>
<td>3.0</td>
</tr>
<tr>
<td>Cherries</td>
<td>2.6</td>
<td>Birth</td>
<td>3.6</td>
</tr>
<tr>
<td>Grapes</td>
<td>3.4</td>
<td>Marzipan</td>
<td>3.9</td>
</tr>
<tr>
<td>Cranberries</td>
<td>1.9</td>
<td>Mirin</td>
<td>3.8</td>
</tr>
<tr>
<td>Lemoons/Blood</td>
<td>1.8</td>
<td>Pickles</td>
<td>3.5</td>
</tr>
<tr>
<td>Oranges</td>
<td>2.8</td>
<td>Salat</td>
<td>3.0</td>
</tr>
<tr>
<td>Peaches</td>
<td>1.3</td>
<td>Raspberry</td>
<td>2.8</td>
</tr>
<tr>
<td>Fruits</td>
<td>1.4</td>
<td>Sweater</td>
<td>3.5</td>
</tr>
<tr>
<td>Pineapples</td>
<td>1.4</td>
<td>Ice cream</td>
<td>4.1</td>
</tr>
<tr>
<td>Peaches</td>
<td>2.6</td>
<td>Tangerine</td>
<td>3.7</td>
</tr>
<tr>
<td>Blackberries</td>
<td>2.5</td>
<td>Hamburger</td>
<td>3.5</td>
</tr>
<tr>
<td>Strawberries</td>
<td>1.0</td>
<td>Yogurt</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Mouth rinses!!!

- pH levels 3.5 to 5


Bottled water!!!

- pH levels of 5-5.5 are common


Legacy drinks……

- sip on sweet drinks
- require no chewing / preparation
- high carb nutritional supplements


Lussi A, Schlueter N, Rakhmatullina E, Ganss C. Dental erosion – an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45.
USA – average annual consumption

- one-quarter of all drinks consumed
- 450 brands
- 2,500,000 vending machines in the USA

Soft drinks USA – average annual

- average American - 100 gal/year
- three bath tubs full!
- teen boys - 160 gal/year

The beverage of choice – kids and teens

consumption doubled in the last ten years

teenage boys
3+ cans daily
10% - 7+ cans a day

teenage girls
2 cans daily
10% drink more than 5+ cans a day

Beverage consumption
Fast Facts........

1977 - 2001 - children age 6 - 11

increased decreased

- 137% soda consumption - 39% milk consumption
- 54% fruit juice
- 69% fruit drink
sugar sweetened beverages - 11% total calories

consumption.... fast facts

- super sized drinks
- frequent snacking
- sipping, swishing, swilling
- holding liquid in the mouth
- baby bottles and sippy cups

Flavored waters....fitness waters

Energy and sports drinks......
composition and consumption
Non-carbonated energy drinks - What’s different?

- Hip names - RockStar, Hype, Tiger, Monster
- Branded as dietary supplements
- Marketed to students, athletes, seniors
- Coca-Cola Classic - 35 mg of caffeine
- Monster Energy Drink - 120 mg of caffeine

Contents and rebranding

- Caffeine
- 80–300 mg per 16-oz
- Herbs
- Guarana (high in caffeine)
- Taurine
- Ginseng
- Ginkgo biloba
- Various ingredients

Rebranding as a beverage

- Yes injury or death reports to FDA
- Purchased with food stamps
- Must list ingredients

Energy drinks - overdose

2005 to 2009
- 10X increase U.S. ER visits
- Related to energy drink intake

2007
- Caffeine overdoses (5448)
- 46% in persons under age 19

Energy shots

- Specialized, concentrated
- Smaller, 50ml bottles
- Same total - caffeine, vitamins, functional ingredients
- Marketed - low calorie, "instant energy", one swallow
- 5x more caffeine than an 8oz cola

Energy drinks risks

- Heart palpitations
- Increases blood pressure
- Nausea, stomach upsets
- Headaches
- Psychiatric disturbances
- Sleep disturbances
- Tooth erosion
- Weight gain
- Fatigue

Energy drinks - Teens

- Widespread consumption - 30% daily use
- Strongly associated - alcohol, cigarette, and illicit drugs
- Users - heightened risk for substance abuse
- Users - more physiologic and behavioral adverse effects

Energy drinks - Adults

- 31.3% - 1 drink past 7 days
- 11.5% - 3X+ per week
- Age 18-24 10X more likely to consume than those age 40+
- Non-Hispanic blacks & Hispanics
- Male
- Live in South or West
- Current smokers
- Unmarried
- Higher family income
- Younger adults
- Engaged in leisure-time physical activity
- More satisfied with their social activities/relationships

Energy drinks - Troops

- Monster - top seller - military PX
- 44 deployed troops - one daily
- 13.9% three +/day - slept less than 4 hours a day
- Three a day - increase in sleep problems / stress / illness / daytime sleepiness during guard duty or briefings

Energy-sports drinks - Adults

- 2010 National Health Interview Survey
- 31.3% - 1 drink past 7 days
- 11.5% - 3X+ per week
- Age 18-24 10X more likely to consume than those age 40+

Groundwater pH and titratable acidity values

- Titratable acidity (milliequivalents per liter) values
- pH values
- Shorter titratable acidity values

pH and titratable acidity values

<table>
<thead>
<tr>
<th>Beverages</th>
<th>Initial pH</th>
<th>Titratable acidity (amount of NaOH)</th>
<th>Titratable acidity (amount of NaOH)</th>
<th>Shorter titratable acidity values</th>
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</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>3.46</td>
<td>5.4 mL</td>
<td>6.8 mL</td>
<td></td>
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<tr>
<td>Limo</td>
<td>3.49</td>
<td>2.7 mL</td>
<td>5.7 mL</td>
<td></td>
</tr>
<tr>
<td>Party</td>
<td>3.15</td>
<td>2 mL</td>
<td>5.5 mL</td>
<td></td>
</tr>
<tr>
<td>Fizzy</td>
<td>3.78</td>
<td>4.4 mL</td>
<td>7.5 mL</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>3.90</td>
<td>4.5 mL</td>
<td>6.1 mL</td>
<td></td>
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<tr>
<td>Juice</td>
<td>1.05</td>
<td>0 mL</td>
<td>3.9 mL</td>
<td></td>
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<tr>
<td>Green tea</td>
<td>6.15</td>
<td>0 mL</td>
<td>0.1 mL</td>
<td></td>
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<tr>
<td>Latte</td>
<td>4.19</td>
<td>0.1 mL</td>
<td>0.3 mL</td>
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<tr>
<td>Black tea</td>
<td>4.89</td>
<td>0.2 mL</td>
<td>0.5 mL</td>
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<tr>
<td>Vodka</td>
<td>7.29</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Agua</td>
<td>7.34</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Water</td>
<td>7.69</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

References:
- McLellan TM, Lieberman HR. Do energy drinks contain active components other than caffeine? Nutr Rev. 2012 Dec;70(12):730-44.

Erosion - lesion depths enamel versus dentin

✓ energy drinks - higher titratable acidity (TA)
✓ energy drinks - more significant enamel loss - 2x higher
✓ TA significant predictor of enamel dissolution
✓ weight loss greatest = high TA + low pH


Beverage viscosity

✓ Coca Cola, Sprite, orange juice
✓ regular drinks modified with hydropropyl cellulose
✓ bovine teeth exposed to 3ml drop for 10 min
✓ increase viscosity - reduce enamel erosion by 12.6-18.7%.
✓ erosive potential - dependent chemical properties and viscosity

Marketing trends

Marketing to children and teens

Industry growth analysis

U.S. LIQUID REFRESHMENT BEVERAGE MARKET CHANGE IN VOLUME BY SEGMENT 2009 - 2011

<table>
<thead>
<tr>
<th>Segment</th>
<th>2011/12</th>
<th>% Change</th>
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<tbody>
<tr>
<td>Energy Drinks</td>
<td>11.4%</td>
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<tr>
<td>mixer drinks</td>
<td>2.3%</td>
<td></td>
</tr>
<tr>
<td>Sweet Beverages</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>RTD Tea</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>Bottled Water</td>
<td>4.5%</td>
<td></td>
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<tr>
<td>Carbonated soft drinks</td>
<td>-1.7%</td>
<td></td>
</tr>
<tr>
<td>Value-added water</td>
<td>-1.7%</td>
<td></td>
</tr>
<tr>
<td>Packaged water</td>
<td>0.4%</td>
<td></td>
</tr>
<tr>
<td>TOTAL USD</td>
<td>0.5%</td>
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</tr>
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</table>

Sources: Beverage Marketing Corporation

They're on us

> Wellness is driving growth. The “quintessential wellness” brand image of V8...striking a chord with consumers.

> The core V8® line... household penetration of about 36 percent, rising 6 points in two years.

> A reflection of the loyalty this brand has engendered as a reliable “better-for-you beverage choice.”

> As the health and wellness trend took off, Campbell recognized how well the V8® Franchise was positioned to build category sales, and has worked hard to “migrate their positioning.”


http://www.retailwire.com


**2013 – Brand Market Share – Energy drinks**

Red Bull - $3.4 BILLION
Monster - $3.1 BILLION


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**Marketing – 2013**

Top Selling Energy Drink Mixes

<table>
<thead>
<tr>
<th>Brand</th>
<th>Year 2013 Sales</th>
<th>Year 2013 Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Bull</td>
<td>$3.4 BILLION</td>
<td>$3.4 BILLION</td>
</tr>
<tr>
<td>Monster</td>
<td>$3.1 BILLION</td>
<td>$3.1 BILLION</td>
</tr>
<tr>
<td>5th</td>
<td>M.O.Energy</td>
<td>58</td>
</tr>
<tr>
<td>6th</td>
<td>Crystal Light</td>
<td>39.5</td>
</tr>
<tr>
<td>7th</td>
<td>Private Label</td>
<td>36.7</td>
</tr>
<tr>
<td>8th</td>
<td>Propel Energy</td>
<td>23</td>
</tr>
<tr>
<td>9th</td>
<td>Zulu</td>
<td>12.5</td>
</tr>
<tr>
<td>10th</td>
<td>4C Energy Rush</td>
<td>11</td>
</tr>
<tr>
<td>11th</td>
<td>Goodrick</td>
<td>1.5</td>
</tr>
<tr>
<td>12th</td>
<td>Splash</td>
<td>.34</td>
</tr>
</tbody>
</table>

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**Effects on dental materials**

**Effects – dental materials**

- dental ceramics - surface roughness
- 168 hour (7 day) exposure
- citrate buffer solution, pineapple juice, green mango juice
- surface roughness evaluated - 24, 96, and 168 hours
- added - typically citric acid
- microhardness decreased significantly (p<.05)

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**Solutions**

**Improving the patient’s outcome**

- Individual clinical expertise
- Best external evidence
- Patient values & expectations

EBM

- non-fermentable sweeteners
- metabolic inhibitors - fluoride
- anti-adhesion - xylitol
- arginine products
- stimulate saliva
- raise pH

http://med.fsu.edu/index.cfm?/page=medicalinformatics.abt/tutorial

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**Effects – dental materials**

- GI cement, resin-modified GI cement, resin composite, amalgam
- citrate buffer solution, pineapple juice and green mango juice
- 37°C for 168 hours (7 days)
- GI cement highest roughness (p<.05) > by resin modified GI cement
- minor changes to other materials
- mango juice - greatest degradation
Remineralization strategies

- Tubule occlusion
  - Stannous fluoride
  - toothpaste, gel, rinse
  - High fluoride
  - varnish, gels
  - Precipitating salts
  - calcium phosphate, arginine bicarbonate
  - Restorative materials
  - adhesives, silicates, resins, hydroxyapatite
  - Laser
  - soft laser

Fluoride platforms

Professional

- Home

Varnish recommendations

- Varnish application
  - 2+ times a year
  - caries prevention
  - high risk populations

Application benefits
- less time
- less patient discomfort
- patient acceptance
- preschool / adolescents / geriatrics

Tricalcium phosphate

- Barrier breaks down
  - fluoride, calcium, phosphate - readily available
  - Creates fluorapatite

Theobromine

- theobromine - found in cacao (chocolate) plus minerals
- growth of larger hydroxyapatite crystals (4X larger)
- occlusion - 7 days
- FDA GRAS (generally regarded as safe) status
- does not contain fluoride

Increase in surface micro hardness – 7 days
**ACP – Amorphous calcium phosphate**
- releases calcium and phosphorus
- highly soluble compound - prolonged substantivity?
- building block of apatite

**CPP-ACP compounds**
- contains casein phosphopeptide (Recaldent)
- adheres to soft tissue, plaque, teeth
- calcium and phosphate – released during acid challenge
- contraindicated with milk allergy

**The magic of xylitol** [xylitol.org]
- interferes with Strep Mutans metabolism
- disrupts biofilm integrity
- promotes neutral pH
- stimulates salivary flow
- shifts equilibrium to enhance remineralization
- increases available calcium and phosphate

*Can be fatal to dogs and ferrets*
Avoid fructose for up to one hour after use

**Xylitol products**

**Arginine - mode of action**

<table>
<thead>
<tr>
<th>Urea</th>
<th>Arginine</th>
</tr>
</thead>
<tbody>
<tr>
<td>- few bacteria</td>
<td>- many bacteria</td>
</tr>
<tr>
<td>- saliva &amp; crevicular fluid</td>
<td>- low in saliva/abundant in peptides</td>
</tr>
<tr>
<td>- broken down by urea</td>
<td>- ADS - 3 enzyme system</td>
</tr>
<tr>
<td>- byproduct-ammonia</td>
<td>- byproduct - ammonia</td>
</tr>
</tbody>
</table>

**Arginine**
- surface negatively charged
- attracts arginine’s positive charge
- arginine and calcium carbonate
- CaCO₃ promotes precipitation into tubules
- Arginine - raises pH to 7

Brand new!!

Basic Bite Chew
- 20 calories
- 20% RDA calcium
- 2g of sugar alcohols
- 0 fats
- 5g carbohydrates
- Kosher
- Gluten-free

Supportive strategies - Slowing down erosion

Understanding labels
- "ose" words - sugar
- "ate words" - acid
- corn syrup
- ascorbic acid

July 27, 2015
New label proposal
FDA proposing to include a percent daily value for added sugars!

Slowing down erosion
- use a straw
- drink quickly
- beverages during meals
- add ice
- avoid snacks/drinks

Slowing down erosion
- brush before morning juices, etc.
- rinse with water - reduces titratable acidity, not pH
- soft bristle brushes / low abrasion paste
- brush after acidic intake
- xylitol gum, mints, lozenges or spray
- chew gum
- bicarbonates - rinse, paste or lozenge
Slowing down erosion


Erosion - a multifactorial condition

Summary - factors that affect erosion

✓ chemical - F level, pH, titratable acidity, calcium & phosphorus
✓ biological - saliva composition, flow, buffering capacity, pellicle formation and tooth composition
✓ behavioral - drinking habits, frequency, duration, timing of exposure


What do we owe our patients?

- current, in-depth health history
- assess total needs
- tell the truth
- provide all options

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Thank You!