

Myths and misconceptions – dealing with the epidemic of dry mouth syndrome



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There is just so much to know!



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12 Dry Mouth, The Malevolent Symptom

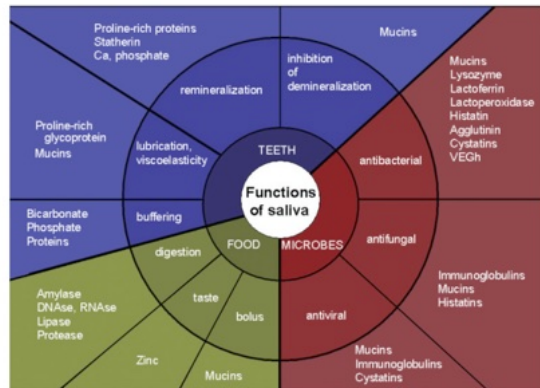


Figure 1.2.2. Overview of the relationship between the various functions of saliva and the salivary constituents involved. A number of salivary proteins participate in more than one function.

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.

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myths and misconceptions

What is the perfect dry mouth product?

What's the goal?

mouth feel hydration antimicrobial
lubrication balance pH electrolyte balance
mucosal protection prebiotic
remineralization salivary stimulation

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Older people, medications,
Sjögren's, radiation therapy



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Dry mouth is not that common



- ▶ 30% population
- ▶ more women
- ▶ 10% early 30s
- ▶ over age 50

Thomson WM, Lawrence HP, Broadbent JM, Poulton R. The impact of xerostomia on oral-health-related quality of life among younger adults. Health Qual Life Outcomes. 2006 Nov 8;4:96.
Anil S, Vellappally S, Hashem M, Preethanath RS, Patil S, Samaranyake LP. Xerostomia in geriatric patients: a burgeoning global concern. J Invest Clin Dent. 2014 Sep 1.

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My patient complains about a dry mouth ...but there is plenty of saliva



- ▶ **xerostomia** - subjective term
- ▶ perceived lack of moisture
- ▶ changes in composition

- ▶ 99% of saliva is water
- ▶ 1% is what makes saliva.....saliva

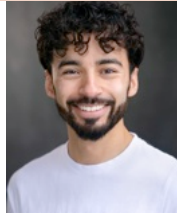
Sreebny LM, Vissink A. Dry mouth. The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.
Lussi A, Schlueter N, Rakhmatullina E, Ganss C. Dental erosion—an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45.

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Kids and young adults- not at risk for dry mouth issues



- ▶ soccer player
- ▶ frequent sinus headaches
- ▶ older dog - sheds a lot
- ▶ grandparents - heavy smokers
- ▶ snores while sleeping



- ▶ avid tennis player
- ▶ asthma inhaler - PRN
- ▶ 3 cups coffee before noon
- ▶ stand up comedian - open mic night
- ▶ drinks kumbacha daily

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Dry mouth? Just sip water all day long



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What is the perfect dry mouth product?

What's the goal?

mouth feel hydration antimicrobial

lubrication balance pH electrolyte balance

mucosal protection prebiotic

remineralization salivary stimulation

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risk factors



Challenges

- ▶ life style
- ▶ medically complex
- ▶ self care
- ▶ compliance
- ▶ immune systems
- ▶ chronic health issues

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- disruptive breathing
- dry climates / AC / heat
- OSA - CPAP therapy
- salivary gland pathology
- hormone imbalances
- laxative / diuretic abuse
- medications - over 700
- anxiety - overwhelmed
- cognitive impairment
- radiation treatment
- chronic renal failure
- autoimmune disorders
- eating disorders
- HIV - hepatitis C
- THC products
- alcohol
- sodium intake
- tobacco / vaping
- nursing / pregnancy
- exercise
- dehydration
- cancer therapy
- coughing / COPD
- mouth breathing

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- ▶ feel dry when eating?
- ▶ sip liquids to swallow dry food?
- ▶ amount of saliva seem reduced?

Dry mouth (Xerostomia): Diagnosis, Causes, Complications and Treatment. Dental Professional Version. Delta Dental. 2011

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- ▶ night time
- ▶ wake up dry

- ▶ dry during the daytime

- ▶ tongue burn?
- ▶ difficulty swallowing?

- ▶ problems tasting?
- ▶ sensitive to acidic, salty or spicy foods?

Dry mouth (Xerostomia): Diagnosis, Causes, Complications and Treatment. Dental Professional Version. Delta Dental. 2011

© 2011 Delta Dental of the United States



- ▶ dry eyes
- ▶ eyes feel sandy
- ▶ recurring decay problems
- ▶ chew gum/candy for relief

Dry mouth (Xerostomia): Diagnosis, Causes, Complications and Treatment. Dental Professional Version. Delta Dental. 2011



prevalence

clinical presentation

Multiple terms



Dry mouth syndrome

- ▶ hypo-salivation
- ▶ xerostomia

Villa A, Wolff A, Aframian D, Vissink A, Ekström J, Proctor G, McGowan R, Narayana N, Aliko A, Sia YW, Joshi RK, Jensen SB, Kerr AR, Dawes C, Pedersen AM. World Workshop on Oral Medicine VI: a systematic review of medication-induced salivary gland dysfunction: prevalence, diagnosis, and treatment. Clin Oral Investig. 2015 Sep;19(7):1563-80. doi: 10.1007/s00784-015-1488-2.

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.



Hyposalivation



Clinical diagnosis

- ▶ decreased salivary flow
- ▶ insufficient in saliva

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.

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



Insufficient flow



- subtle changes
- 50% decrease - noticeable
- pH decreases
- increased demineralization

Takahashi N, Nyvad B. Caries ecology revisited: Microbial dynamics and the caries process. Caries Res. 2008;42(5):409-18.

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology, Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012.
Graham I, Mount WH. (2005). Preservation and restoration of tooth structure. 2nd Edition, Queensland, Australia: Knowledge Books and Software.

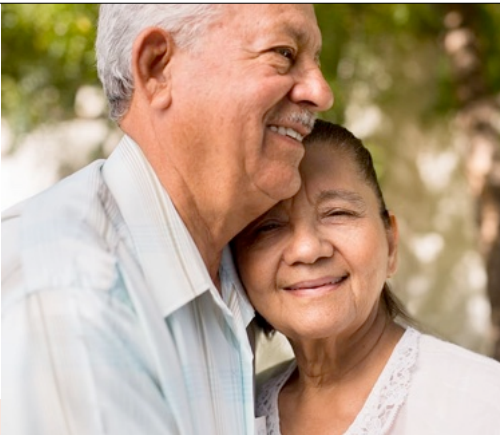


Visual observations



- red, glossy, parched
- pebbled tongue
- cracking in commissures
- chapped lips
- thick, foamy, ropy saliva

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide • Wiley, Blackwell. May 2010.



- problems talking
- tissue discomfort
- compromised nutrition
- sleep disturbances
- self esteem
- quality of life



Clinical complaints



- sore mucosa
- burning sensation
- stickiness
- halitosis
- metallic taste

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.



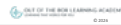


Additional complaints

- ▶ difficulty talking
- ▶ taste alterations
- ▶ problems chewing
- ▶ mint or cinnamon sensitivity
- ▶ difficulty swallowing
- ▶ dentinal hypersensitivity
- ▶ dry/sore throat

Sreebny LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley, Blackwell. May 2010.

Lussi A, Schuster N, Rakhmatullina E, Ganss C. Dental erosion—an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45.



Insufficient saliva



- increased acidogenic microbes
- aciduric microbes thrive
- decreased buffering capacity
- sticky plaque biofilm

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology. Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012

Graham I, Mount WH. (2005). Preservation and restoration of tooth structure. 2nd Edition. Queensland, Australia: Knowledge Books and Software.



saliva

the basics

Protection – functional



- ▶ dilution
- ▶ lubrication
- ▶ cleansing
- ▶ increase pH

de Almeida PDV, Grégio AMT, Machado MÂN, de Lima AAS, Azevedo LR. Saliva composition and functions: A comprehensive review. J Contemp Dent Pract 2008 March; (9)3:072-080.

Hara AT, Zeno DT. The caries environment: saliva, pellicle, diet, and hard tissue ultrastructure. Dent Clin North Am. 2010 Jul;54(3):455-67.

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology. Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012





Additional functions

- speech
- nutrition
- social interaction
- kissing
- licking
- excretion

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology. Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012

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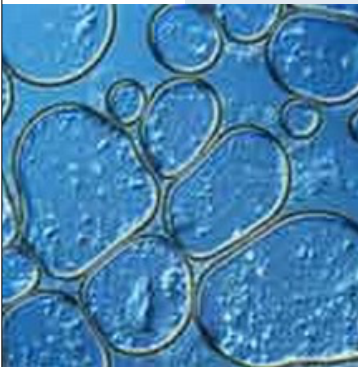
Digestion



- chewing
- bolus
- swallowing
- enzymes
- taste

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Protection – biochemical



- buffering - neutralizes pH
- remineralization
- anti-microbial / antioxidant
- healing

de Almeida PDV, Grégio AMT, Machado MÂN, de Lima AAS, Azevedo LR. Saliva composition and functions: A comprehensive review. J Contemp Dent Pract 2008 March; (9)3:072-080.
Hara AT. Zero DT. The caries environment: saliva, pellicle, diet, and hard tissue ultrastructure. Dent Clin North Am. 2010 Jul;54(3):455-67.
Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology. Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012
astoundingminds.blogspot.com/2012/04/boiling-point-of-human-saliva.html

© 2012

Tasting food



- saliva initiates taste
- poor taste - anorexia
- adequate nutrition
 - supports muscle mass
 - immune system

Nordén J, Grönberg AM, et al. Nutrition impact symptoms and body composition in patients with COPD. Eur J Clin Nutr. 2015 Feb;69(2):256-61.
Ekstrom J, Khosravani N, et al. Saliva and its control of secretions. Dysphagia, Medical Radiology. Diagnostic Imaging. Ed. Ekberg O. Springer-Verlag Berlin Heidelberg 2012.

© 2012



Salivary protein functions

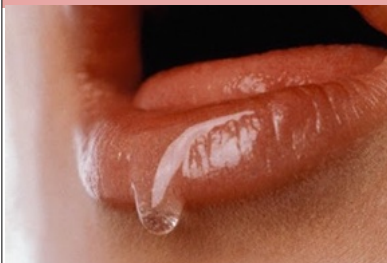
- antibacterial / antioxidant
- antifungal
- antiviral
- buffering
- tasting
- tissue coating
- wound healing
- remineralization
- digestion
- lubrication

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testing saliva

pH / buffering

Healthy salivary pH



- resting - pH 6.8 - 7.2
- favors homeostasis
- supports remineralization
- suppresses pathogens

Sreedhry LM, Vissink A. Dry mouth, The malevolent symptom: A clinical guide. Wiley Blackwell, May 2010.

Lussi A, Schlueter N, Rahmatullina E, Ganss C. Dental erosion—an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45.

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Critical pH

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

Mount GJ and Hume WJ. Preservation and restoration of tooth structure. Knowledge books and software. 2nd Edition, 2005

Dawes C. What is the critical pH and why does tooth dissolve in acid? J Can Dent Assoc 2003; 69(11):722-4

Stooley GK. The effect of saliva on dental caries. JADA 2008 May; 139:115-175.

Lussi A1, Schlueter N, et al. Dental erosion—an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45 Suppl 1:2-12.

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When do teeth melt???

- root structure - pH 6
- enamel - between pH 5 and 5.5
- fluorapatite - pH 4.5

Mount GJ and Hume WJ. Preservation and restoration of tooth structure. Knowledge books and software. 2nd Edition. 2005
Stooley GK. The effect of saliva on dental caries. JADA 2008 May; 139:115-175.
Lussi A1, Schlueter N, et al. Dental erosion—an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45 Suppl 1:2-12.

Blame Shame Frustration



Drill Fill Bill

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Problem saliva?

Identifying risks

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Baseline data

- snapshot in time
- data can change

first thing in the morning

pH testing

- wet strip with saliva
- match to grid on bottle
- take a “saliva selfie”

later in the day

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Healthy - daily flow rate



0.5 to 1.5 liters

- resting - 0.25 to 0.4 ml /min
- stimulated - 1 - 3 ml / min
- **establish a baseline!**

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology: Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012

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Flow rate - visual inspection



- retract lower lip
- dry with gauze

- 1 min - drops on mucosa
- sufficient flow
- pooling in floor of mouth

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology: Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012

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Tasting food



- chew wax - 5 min
- spit in cup
 - normal - 1 to 3ml
 - low - 0.7 to 1 ml
 - very low - < 0.7 ml

Saliva and the Control of Its Secretion. Ekberg (ed.), Dysphagia, Medical Radiology: Diagnostic Imaging, Springer-Verlag Berlin Heidelberg 2012

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What is the perfect dry mouth product?

What's the goal?

mouth feel	hydration	antimicrobial
lubrication	balance pH	electrolyte balance
	mucosal protection	prebiotic
remineralization	salivary stimulation	

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More things to know.....

readily available?

what will they use?

can afford?

lifestyle compatible?

Know the details.....

ease of use

Rx or OTC

product pH

Rinses

Lozenges

Disks

Sprays

Gels

Pastes

discontinued

pH levels of common dry mouth products

Rinses		Lozenges + Disks		Sprays	
TheraBreath ¹	9.2	XyliMelts ⁸	8.04	CT2X Spray ⁶	9.1
Perio Sciences AO Rinse ²	7.75	Salese ¹	8.2-8.52	All Day Spray ⁹	7
MightyFlow ³	7.37	Cavity pHghter Mints ⁵	7	Spry Rain Spray ⁶	6.98
Smart Mouth ⁷	7.11	IceChips ³	7	MightyFlow Organic Spray ¹	6.43
Closys ²	7.1	MightyFlow ³	6.44	Biotene Moisturizing Spray ⁴	6.11
GUM Hydral Rinse ¹⁰	7	Act Dry Mouth ¹	6.31	Moisyn Spray ³	6
Plaque HD Extreme Dry Mouth ¹	7	Smart Mouth ¹	6.15	3M Xerostomia Spray ⁴	6
Biotene Dry Mouth ¹	6.72	RiteKid Lozenges ⁵	5.2	Xylimist Spray ³	6
Act Total Care Anticavity ³	6.51	CVS Lozenges ⁵	5.28	MedActive Spray ³	5.92
Thayers ⁴	6.3	TheraBreath ¹	5.82	Stoppers 4 US Spray ²	4
MedActive SnF2 Base ¹	6.18	Act Lozenges ⁵	5.72	Lubricity ³	4
Hydri ³	6	Hylamint ¹	4.84	Mouth Kote Spray ⁴	3.02
Oasis Mouth Rinse ⁴	6	Hager Pharma ³	4.44	Gels and Pastes	
Moisyn Rinse ³	6	OraMoist Patch ¹	3.54	XylGel ⁸	7.4
Smart Mouth Dry Mouth ¹	6	Thayer's Sugar-Free ¹	3.17	GC Dry Mouth Gel ¹	7
MedActive SnF2 Rinse Complete ¹	5.4	Cotton Mouth ⁵	3.1	Orajel ¹	7.11
Biotene PBF Oral Moisturizing ¹	5.39	MedActive ¹	2.43-2.73	GUM Hydral Gel ¹⁰	6.8
OraCare Rinse ²	4.8	DenTek ¹	2.9	Biotene Oral Balance Gel ¹	6.6
		Luden's Pectin ¹	2.93		

Taste and see.....why not?

- flavors
- textures
- foaming
- SLS / fluoride



salivary stimulation

Salivary stimulation Acidic recommendations - pH?



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- candies
- lozenges
- lollipops
- sprays
- pastes
- rinses
- gels
- granulated

Garcia-Godoy F, Hicks MJ. Maintaining the integrity of the enamel surface: the role of dental buffers, saliva and preventive agents in enamel... mineralization and remineralization. J Am Dent Assoc. 2008 May;139 Suppl:292-305.

An Rx option

- Salagen - pilocarpine
- Evoxac - cevimeline

pleasanthillsapothecary.com

- one or two licks
- topical application
- store in container

PHOTO BY THE BORN LAB/SHUTTERSTOCK
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lubrication

mouth feel

hydration and mucosal protection

Homeopathic approaches



Ibrahim SS, Abou-Bakr A, Ghalwash DM, Hussein RR. Effectiveness of thyme honey in the management of xerostomia in geriatric patients with end-stage renal disease: a randomized controlled clinical trial with a biochemical assessment. *Eur J Med Res.* 2023 Oct 7;28(1):406. doi: 10.1186/s40001-023-01351-9.

Mohsin AHB, Reddy SV, Kumar MP, Samee S. Aloe vera for Dry Mouth Denture Patients - Palliative Therapy. *J Clin Diagn Res.* 2017 Jun;11(6):2C20-2C23. doi: 10.7860/JCDR/2017/25084.10036.

hopkinsmedicine.org/health/conditions-and-diseases/dry-mouth-remedies-14-to-try

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Multiaction formulation - attract and retain moisture



- chitosan - biocompatible polysaccharide
- arginine
- pH 7
- antimicrobial

- moistens / lubricates
- reduces pain
- speeds healing

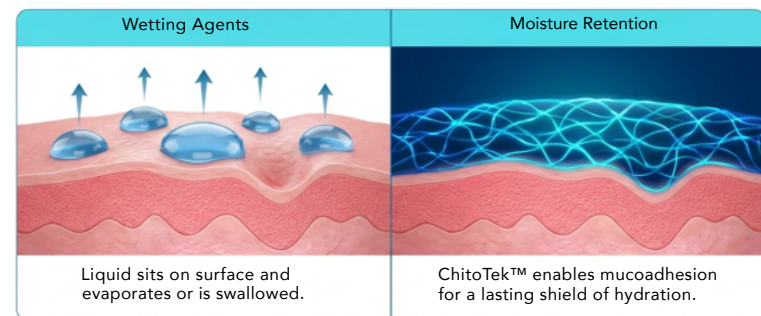
contraindication -
shellfish allergies

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Hydration - moisture retention

ChitoTek™ - complete coverage / longer lasting

Result: A rich, hydrated environment that is pH balanced and safe for enamel.



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remineralization

balancing electrolytes



- high caries risk
- white spot lesions
- dry mouth
- dentinal hypersensitivity

- no fluoride or xylitol
- Gel - FDA cleared medical device
- trays - keep gel in direct contact
- PerioProtect tray advantage - eliminate dilution



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Product creation

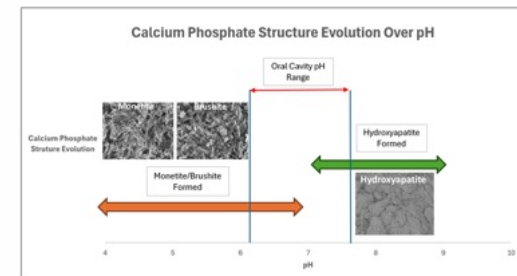


- salts - calcium, potassium, phosphate
- pH buffer
- thickening agent
- wintergreen flavoring

- patented homogenous precipitation - creates hydroxyapatite precursors and hydroxyapatite
- plus bioavailable calcium and phosphate ions

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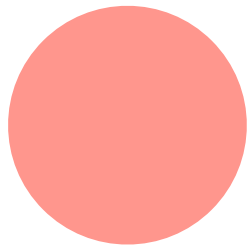
ReminGel - effective over a wide pH range



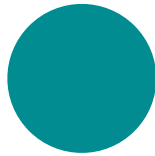
- hydroxyapatite precursors - monetite and brushite
- calcium & phosphate ions
- hydroxyapatite

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Size and shape matter



dental tubules
0.5-1.7 microns



hydroxyapatite precursors
0.2 microns

Hydroxyapatite
▸ flake shaped
▸ range of sizes



phosphate ion
0.000302 microns



calcium ion
0.00000099 microns

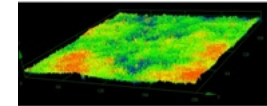
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White spot lesion treatment

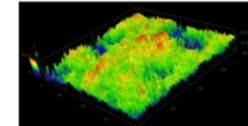


ReminGel -15 min daily
using PerioProtect trays

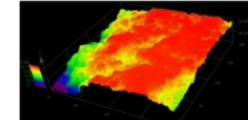
Control



Demin (7 Days with 0.5M Citric Acid)



ReminGel (11 Treatments)



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create/sustain a healthy microbiome

antimicrobials / antioxidants / probiotics



Antioxidants - Polyphenols

- adhere to mucosal surfaces
- retained there for long periods
- may function as a "slow release devices"
- capable of affecting the redox status

Ginsburg I, Kohen R, Shalish M, Varon D, Shai E, Koren E. The oxidant-scavenging abilities in the oral cavity may be regulated by a collaboration among antioxidants in saliva, microorganisms, blood cells and polyphenols: a chemiluminescence-based study. *PLoS One*. 2013 May 2;8(5):e63062.

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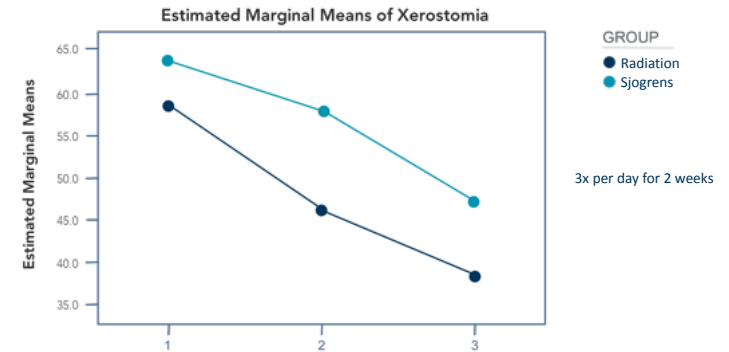
- ▶ antioxidants - phloretin (apples), ferulic acid (seeds and leaves)
- ▶ antibacterial essential oils - menthol, thymol
- ▶ additional oils - peppermint, sage, clove flower
- ▶ 10% xylitol

Thick gel

- ▶ more stable ingredients
- ▶ higher antioxidant concentration than rinse
- ▶ no SLS / artificial sweeteners

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AO ProVantage Gel - Dry mouth study



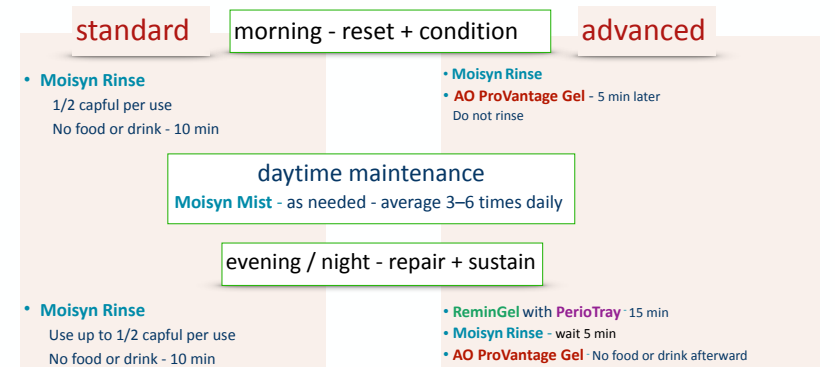
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pH balance

reducing erosion risks

neutralizing acids

Customized dry mouth strategy

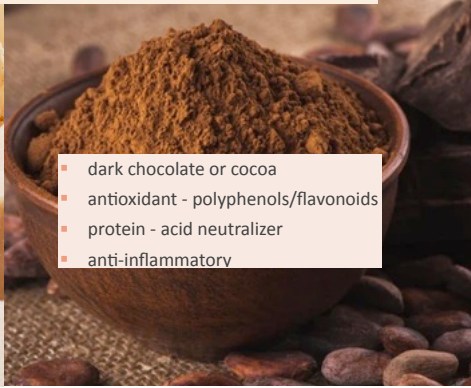


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Cheese and chocolate



- calcium and phosphorus
- antioxidant
- protein - acid neutralizer
- fermented cheese - probiotics



- dark chocolate or cocoa
- antioxidant - polyphenols/flavonoids
- protein - acid neutralizer
- anti-inflammatory

Raschler T, Yildiz U, Turgut P, Tork A, Chaitin T. Effect of consuming different dairy products on calcium, phosphorus and pH levels of human dental plaque: a comparative study. *Arch Paediatr Dent*. 2012 Jun;13(2):144-8.

Wang S, Kishner A, Lammert J, Pomeroy J, Johnson M, Wu Q. The effects of dairy products on plaque acidogenicity after a sugar challenge. *J Am Dent Assoc*. 2013 Jul;144(7):812-22.

Wu Q, Raschler T, Lammert J, Pomeroy J, Johnson M, Wu Q. Antioxidant, anti-inflammatory, and anti-inflammatory activities of long-term repeated cheese consumption. *Food Sci Technol*. 2014 Nov;35(11):1188-94. doi: 10.1016/j.foodsci.2014.08.018. Epub 2014 Nov 1.

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