
Pacific Dental Conference
Welcome to the 2025 PDC
The PDC acknowledges that the conference is situated on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations.

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Pacific Dental Conference
March 6-8
2025
Vancouver Convention Centre – West and East Buildings
Session Review
Please complete your review after this presentation

2


Pacific Dental Conference
Welcome!
Let's make this session enjoyable for all.
Remember to...
Session Review
Please complete your review after this presentation
Held seats will be released 10 minutes prior to the start
Silence Phones
SHHH...

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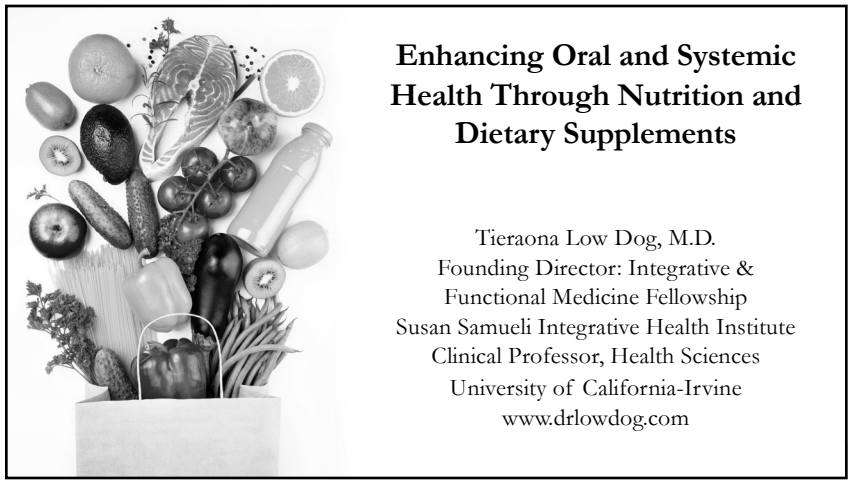
Enhancing Oral and Systemic Health Through Nutrition and Dietary Supplements
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Susan Samueli Integrative Health Institute
Clinical Professor, Health Sciences
University of California-Irvine
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Outline of Talk

- Nutrition and micronutrients significantly impact our health
  - Oral health plays a vital role in systemic health
  - Drivers of oral and systemic inflammation
  - Role of food and supplements in inflammation
  - The microbiome's role in overall health
  - Micronutrients for gum, gut, and mucosal health

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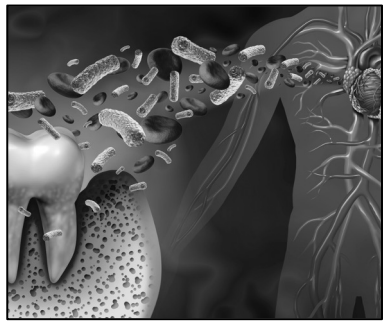
Periodontitis

- Chronic, **multi-bacterial infection** that elicits **low-grade systemic inflammation** through the release of pro-inflammatory cytokines, as well as **local invasion and long-distance translocation of periodontal pathogens.**
- **It can induce or exacerbate** other **chronic systemic inflammatory diseases**, such as **atherosclerosis and diabetes,** and can lead to **adverse pregnancy** outcomes.



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Oral and Systemic Health

- **1891:** Oral microbiologist Willoughby D. Miller suggests that oral infections can affect other body parts and are related to **systemic diseases.**
- **1912:** Frank Billings **speculated that tooth infection may cause rheumatoid arthritis, nephritis, endocarditis, and other diseases.**
- **Unchecked, this low-grade inflammation can *disrupt the body's overall health or worsen existing systemic diseases.* This underscores the crucial role of maintaining good oral health in *preserving overall health.***

Miller WD. The human mouth is a focus of infection. *Lancet* 1891; 138, 340–342

Billings F. Chronic focal infections and their etiologic relations to arthritis and nephritis. *Arch. Intern. Med* 1912; IX, 484–498 (1912).

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Leaky Gums

- **Increased permeability** of oral tissues **is *linked to systemic inflammation.***
- Causes **include poor dental hygiene, high glycemic-load diet, chronic stress, and microbiome imbalance.**
- The oral microbiome:
  - Maintains a **healthy balance of bacteria.**
  - Influenced by **prebiotic foods (fibers) and probiotics (yogurt), etc.**
  - **Oral dysbiosis** can lead to **gum disease, cavities, and systemic issues.**

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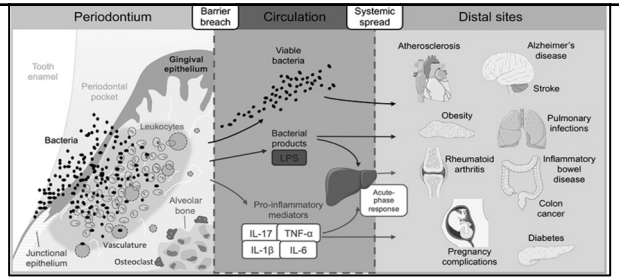

- **Severe periodontitis affects 743 million people worldwide.**
- **Bacteria enter the bloodstream** and can **translocate** to extraoral tissue, such as the lung, heart, gut, placenta, brain, and joints. It can **alter the gut microbiome, disrupt the intestinal barrier, and trigger a systemic inflammatory response.**

From: Konkel JE, et al. Distal Consequences of Oral Inflammation *Front. Immunol* 2019; https://doi.org/10.3389/fimmu.2019.01403

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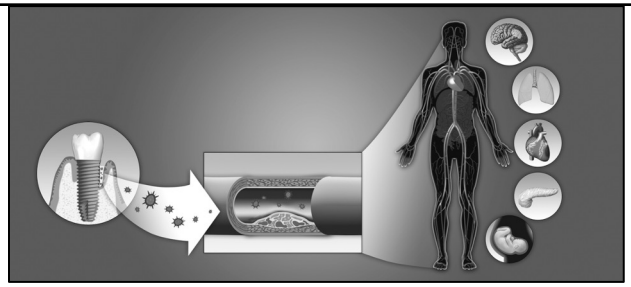

Clinical and experimental studies highlight the **strong association** between **periodontitis** and systemic disease, in particular **cardiovascular disease, diabetes, lung diseases, and complications of pregnancy. Oral health is a crucial part of holistic wellness.**

Isola G. The Impact of Diet, Nutrition, and Nutraceuticals on Oral and Periodontal Health. *Nutrients.* 2020 Sep 6;12(9):2724.

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Inflammation and Disease

- **Meta-inflammation**, driven by low-grade systemic inflammation, directly contributes to ***insulin resistance, metabolic syndrome, and T2DM***, which makes weight gain easier and weight loss more difficult.
- Diseases **related to chronic inflammation = 50% of global deaths.**
- In the US, **BMI ≥ 30** is significantly associated with **periodontal disease** among people **aged 30 to 44 (P <0.001).**[1] Studies show similar results in other global populations.[2]

1. Liu L, Xia LY, Gao YJ, Dong XH, Gong RG, Xu J. Association between Obesity and periodontitis in US Adults: NHANES 2011-2014. *Obes Facts.* 2023 Nov 7. doi: 10.1159/000534751.

2. Kim CM, et al. Obesity and periodontitis: A systematic review and updated meta-analysis. *Front Endocrinol* (Lausanne). 2022 Oct 24;13:999455.

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Dental Plaque

- **Organized biofilm** of microorganisms attached to the **tooth surface or other microorganisms**, allowing survival and resistance to host defenses.
- As **biofilm matures, dysbiosis occurs**, shifting from **Gram+ to Gram- anaerobic species**, biofilm forms under the gingival surface.
- **Sugar metabolism by biofilm produces organic acids, lowering pH** and **demineralizing the tooth surface.** Frequent sugar consumption induces dysbiosis of the supragingival microbiota, promoting the development of carious lesions.

Bui FQ, et al. Association between periodontal pathogens and systemic disease. *Biomedical Journal* 2019; 42(1):27-35

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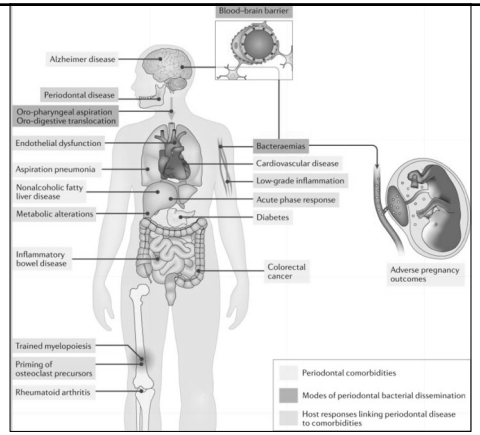

From: Hajishengallis G, Chavakis T. Local and systemic mechanisms linking periodontal disease and inflammatory comorbidities. *Nat Rev Immunol.* 2021 Jul;21(7):426-440.

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Periodontal Disease and Alzheimer's Disease

A meta-analysis of 13 studies:

- **Eight reported Alzheimer's disease** (AD; 291,114 participants)
- **Eight reported mild cognitive impairment** (MCI, 4,805 participants)

- The risk of AD and MCI in patients with periodontal disease (PD) was **significantly higher for AD** (OR=1.78) **and MCI** (OR=1.60) and **especially in those with severe PD** for **AD** (OR=4.89, or almost 5 x more likely) and for **MCI** (OR=2.32).

Hu X, et al. Periodontal disease and the risk of Alzheimer's disease and mild cognitive impairment: a systematic review and meta-analysis. *Psychogeriatrics.* 2021 Sep;21(5):813-825

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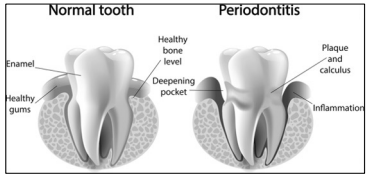
Diet and Periodontitis

- **Diet is a modifiable factor for systemic inflammation**, which plays a vital role in periodontitis.
- The research underscores a robust association between **proinflammatory dietary** patterns and the development of **periodontitis.**
- Both **micro-** and **macronutrients** modulate inflammatory cascades, influencing **inflammatory status.**[2]



Lieske B, et al. *Nutrients.* 2023 Jul 21;15(14):3235
Littlemore, B., et al. *BDJ Team* 2021; 8: 55–65

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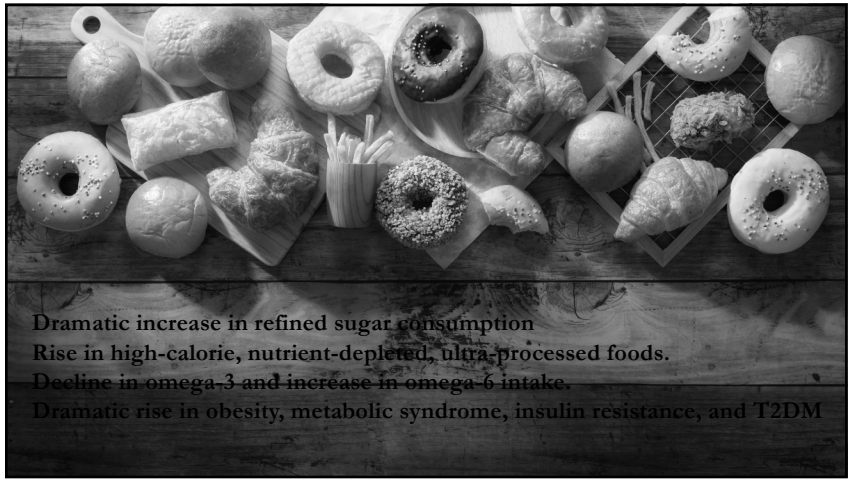

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By **1750** CE, those in Britain **consumed ~4 pounds of sugar per year.**
By **1850** CE, closer to **25 pounds per person per year.**
By **1950** CE, average consumption in the US was **~120 pounds per year.**
Today, the average sugar consumption of US adults is ~152 pounds per year.

DiNicolantonio JJ, et al. *Prog Cardiovasc Dis* 2016; 464-72

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Sugar and Dental Caries

- Excessive sugar consumption is the **leading cause of dental caries.** Sucrose is more cariogenic than fructose/glucose.
- **American Academy of Pediatrics:**
  - **No added sugars** to children **< 2 years**
  - No more **than 25 grams (6 tsp) of sugar** or added sugars **two years and older**
- **American Heart Association:**
  - **Women limit added sugar** intake to **6 tsp/d**
  - **Men limit to 9 tsp/d** (37.5 g)
- We consume roughly *triple this amount of sugar*

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What About Sugar Substitutes?

- Despite GRAS status, sugar substitutes **can negatively affect** gut microbiota.
- **Sucralose disrupts the diversity** of gut microbiota, **increasing bacterial pro-inflammatory genes.**
- In animal/human studies**, xylitol and erythritol** increase platelet **aggregation**.
- NIH-funded research: those with the **highest erythritol** levels (top 25%) **twice as likely to have CV events** over three years of follow-up as the bottom 25%.

Witkowski, M, *et al. Nature Medicine* 2023 https://doi.org/10.1038/s41591-023-02223-9

Witkowski M, et al. *Eur Heart J.* 2024 Jul 12;45(27):2439-2452

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Ultra-Processed Foods

- UPF are "**snacks, drinks, ready meals,** and other products created **mostly or entirely** from substances extracted from foods or derived from food constituents with ***little if any intact* food**."[1]
- From *animals or plants* - **harms the microbiome and drives inflammation**.[2]
- US: **57% of total calories** for adults and **67% for children** come from UPF. Observational studies show an association between UPF and **cancer, heart disease, obesity, depression, and other chronic health problems.**

1. Willett W, et al. *Lancet* 2019 February 2; 393, (10170): 447-492. 2. Srour B, et al. *Lancet Gastroenterol Hepatol* 2022 Dec;7(12):1128-1140
3. Juul F, et al. *Am J Clin Nutr* 2022; 115(1):211-221. 4. Wang L, et al. *JAMA* 2021; 326(6):519-530

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Anti-Inflammatory Dietary Patterns

- **Mediterranean and DASH diets** are associated with reduced inflammatory markers, **periodontopathogenic bacteria**[1,] and **better oral outcomes**.[2]
- **Both diets have high consumption of plant-based foods** (fruits, vegetables, legumes, nuts, whole grain products) and **dietary fiber and *limited consumption*** of sweets and **highly processed foods, including processed red meats.**

1.Laiola M et al. A Mediterranean Diet Intervention Reduces the Levels of Salivary Periodontopathogenic Bacteria in Overweight and Obese Subjects. *Appl. Environ. Microbiol.* 2020;86:e00777-20
2.Altun E, et al. Association between Dietary Patterns and Periodontitis-A Cross-Sectional Study. *Nutrients.* 2021;13:4167.

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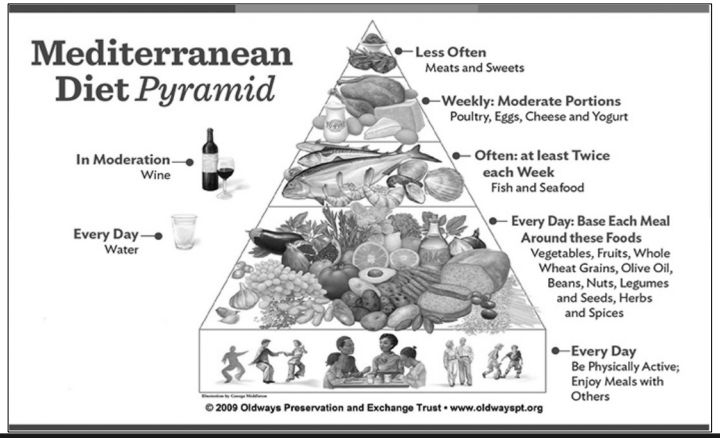

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Inflammatory Effects of Select Foods

Most ***anti***-inflammatory foods:

- Fatty fish (salmon, sardines, trout)
- Nuts, Berries
- Ginger and Turmeric
- Leafy green vegetables
- Broccoli
- Green tea, coffee
- Tomatoes
- Extra virgin olive oil
- Dark chocolate
- Fiber

Most ***pro***-inflammatory foods:

- Processed red meats
- Charred meats
- Sugar-sweetened beverages
- Refined grains
- Deep fried foods
- Foods high in saturated fat
- Highly refined carbohydrates
- Trans fats
- High sodium foods
- Alcohol (moderate consumption okay)

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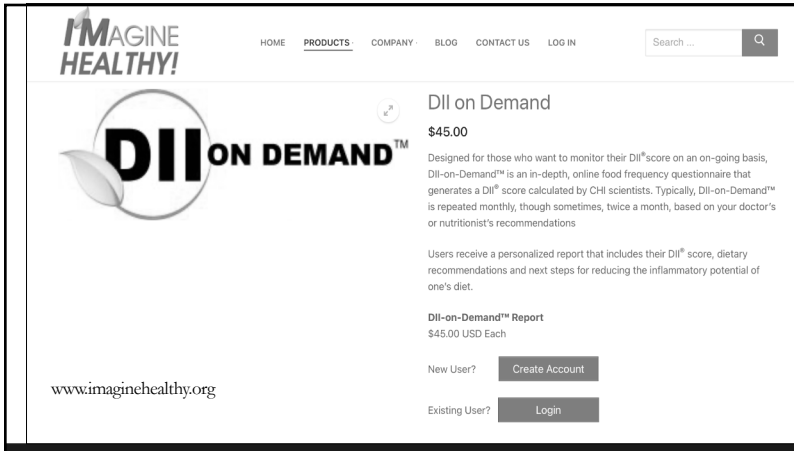

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Diet and Periodontal Diseases.

Nutrient(s)	Type of Study	Methodology	Follow-Up Period	Clinical Outcomes	Subclinical Outcomes	Author(s) and Year
Mediterranean diet	RCT	42 patients with gingivitis were divided into 2 groups. Test group had to adhere to Mediterranean diet (DM) for 6 weeks and control group did not have to change their diet. Gingival parameters were assessed at baseline, week 2 (beginning of the MD intervention), and week 8.	8 weeks	Test group showed better results in gingival inflammatory parameters (GI, BOP) after treatment. No differences in dental bacterial plaque scores between test and control groups.	Test group achieved weight loss and waist compliance after treatment.	Bartha et al., 2021 [13]
Low in carbohydrates, rich in omega-3 fatty acids, vitamins C and D, antioxidants, and fiber	Pilot RCT	15 patients with gingivitis were divided into 2 groups. The test group was started on a diet low in carbohydrates, high in omega-3 fatty acids, and rich in vitamins C and D, antioxidants, and fiber for 4 weeks. Periodontal parameters were measured after 1 and 2 weeks, followed by a 2-week transition period, and then measured weekly for 4 weeks.	4 weeks	Test group showed significant improvement in GI, BOP, PI, PPD, and CAL parameters.	N/A	J. P. Woelber et al., 2016 [14]
Low in carbohydrates, rich in omega-3 fatty acids, vitamins C and D, antioxidants, and fiber	RCT	54 patients with gingivitis were divided into 2 groups. The test group was started on a diet low in carbohydrates, high in omega-3 fatty acids, and rich in vitamins C and D, antioxidants, and fiber for 4 weeks. Periodontal parameters were measured once a week for 4 weeks, followed by a 2-week transition period, and then measured weekly for 4 weeks.	4 weeks	Test group showed significant improvement in BOP and GI.	N/A	Sava Sunari Rajaram et al., 2021 [15]

PPD= probing pocket depth
CAL =clinical attachment loss
BoP =bleeding on probing

Table From: Papathanasiou E, et al. Anti-Inflammatory Benefits of Food Ingredients in Periodontal Diseases. *Pathogens.* 2023 Mar 27;12(4):520.

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High-fiber and low-fat diet	Pilot Study	47 volunteers were included in the study. Subjects received a high-fiber, low-fat test meal 3x/day for 8 weeks, followed by a regular diet for 24 weeks. Periodontal parameters were evaluated at the beginning and end of treatment.	8 weeks	The high-fiber, low-fat diet effectively improved PPD, CAL, and BoP in patients after treatment.	After treatment, there was improvement in metabolic profiles (body weight, HbA1c, and high-sensitivity C-reactive protein levels).	Keiko Kondo et al., 2014 [16]
Nordic diet	Cohort	2187 healthy Finns eating a Nordic diet were divided into two age groups and then into two oral hygiene groups (good and poor oral hygiene). Periodontal parameters were used as outcome variables. Dietary data were collected using a validated food frequency questionnaire.	6 weeks	Nordic diet provides evidence that it is associated with less gingival bleeding and reduced PPD in patients with poor oral hygiene.	N/A	Jauhiainen L et al., 2016 [17]
Nitrate	RCT	44 patients with gingivitis were divided into 2 groups. Test group received 100 mL of a lettuce juice drink (200 mg of nitrate) to be consumed daily for 14 days, and the control group received placebo. Periodontal parameters of salivary nitrate were evaluated before and after treatment.	2 weeks	Test group showed better results in GI on day 14.	Test group showed higher levels of salivary nitrate.	Jockel-Schneider Y et al., 2016 [18]
Nitrate	RCT	37 patients with gingivitis and reduced periodontium were divided into 2 groups. Test group received lettuce juice (200 mg of nitrate) daily for 14 days and test group received placebo. Microbial samples, salt collection, and assessment of gingival inflammation were analyzed before and after treatment.	2 weeks	Test group showed reduction in gingival inflammation after treatment.	Test group showed compositional changes within the subgingival microbiome after treatment.	Yvonne Jockel-Schneider et al., 2020 [19]

Table From: Papathanasiou E, et al. Anti-Inflammatory Benefits of Food Ingredients in Periodontal Diseases. *Pathogens.* 2023 Mar 27;12(4):520.

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Fiber and Oral Health: Systematic Review

- **5 RCT, one sequential feeding trial**; fiber-rich diet for 4-8 weeks
- Fiber-rich dietary intervention significantly reduced:
  - **Clinical Attachment Loss/**Level by 0.48 mm/tooth ($p < 0.001$)
  - **Bleeding On Probing** by 27.57% sites/tooth ($p = 0.02$)
  - **Periodontal Inflamed Surface Area** by 173.88 mm² ($p = 0.003$),
  - **Plaque Index** by 0.02 ($p = 0.04$)
  - **Gingival Index** by 0.41 ($p= 0.002$).
  - **Probing Depth** -0.17 mm/tooth ($p = 0.09$ ***non-significant***)

Swarnamali H, et al. Role of Dietary Fibre in Managing Periodontal Diseases-A Systematic Review and Meta-Analysis of Human Intervention Studies. *Nutrients.* 2023 Sep 18;15(18):4034.

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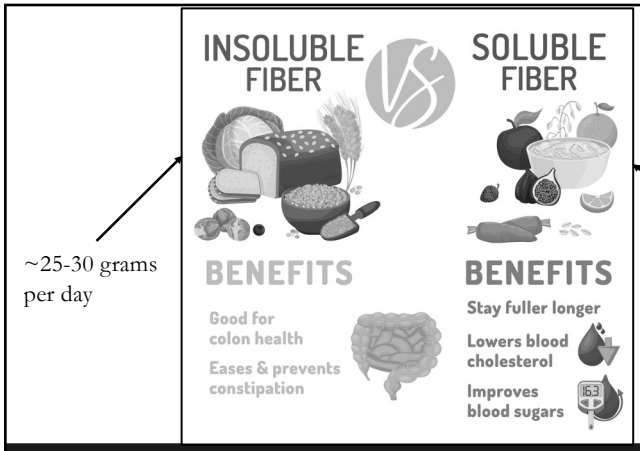

~25-30 grams per day

All soluble fibers are prebiotics.

~8 grams per day

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Fresh & Dried Fruits	Serving	Soluble Fiber (g)	Insoluble Fiber (g)	Total Fiber (g)
Apple with skin	1 medium	4.2	1.5	5.7
Apricots, dried	4 medium	1.8	1.7	3.5
Banana	1 medium	2.1	0.7	2.8
Blackberries	½ cup	3.1	0.7	3.8
Figs, dried	3 medium	3.0	2.3	5.3
Grapefruit	½ of large	2.4	0.7	3.1
Kiwi	1 large	2.4	0.8	3.2
Orange	1 medium	2.1	1.3	3.4
Pear	1 medium	0.8	3.2	4.0
Plums	2 medium	1.2	1.0	2.2
Prunes	4 medium	1.3	1.8	3.1
Raspberries	½ cup	0.9	2.3	3.2
Strawberries	1 cup	1.8	2.6	4.4
Nuts, Seeds & Beans				
Almonds, raw	1 ounce	0.7	3.5	4.2
Black beans, cooked	½ cup	3.8	3.1	6.9
Flaxseeds	2 tbsp.	2.7	2.1	4.8
Garbanzo beans, cooked	½ cup	1.2	2.8	4.0
Kidney beans, cooked	½ cup	2.9	2.9	5.8
Lentils, cooked	½ cup	2.8	3.8	6.6
Peanuts, dry roasted	1 ounce	1.1	1.2	2.3
Pinto beans, cooked	½ cup	5.5	1.9	7.4
Psyllium seeds	2 tbsp.	7.1	0.9	8.0
Sesame seeds	¼ cup	0.7	2.6	3.3
Split peas, cooked	½ cup	1.1	2.4	3.5
Sunflower seeds	¼ cup	1.1	1.9	3.0
Walnuts	1 ounce	0.6	2.5	3.1

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Vegetables	Serving	Soluble fiber (g)	Insoluble fiber (g)	Total fiber (g)
Artichoke, cooked	1 medium	4.7	1.8	6.5
Asparagus, cooked	½ cup	1.7	1.1	2.8
Broccoli, raw	½ cup	1.3	1.4	2.7
Brussel Sprouts, cooked	1 cup	1.7	1.9	3.6
Carrot, raw	1 medium	1.1	1.5	2.6
Green peas, cooked	½ cup	3.2	1.2	4.4
Green beans, cooked	½ cup	0.8	1.2	2.0
Kale, cooked	1 cup	2.1	5.1	7.2
Lima beans, cooked	½ cup	2.1	2.2	4.3
Potato with skin	1 medium	2.4	2.4	4.8
Soybeans (edamame)	½ cup	2.7	2.2	4.9
Squash, summer, cooked	½ cup	1.3	1.2	2.5
Sweet potato, peeled	1 medium	2.7	2.2	4.9
Tomato with skin	1 medium	0.3	1.0	1.3
Zucchini, cooked	½ cup	1.4	1.2	2.6
Whole Grains				
Barley, cooked	½ cup	3.3	0.9	4.2
Brown rice, cooked	½ cup	1.3	0.1	1.4
Oat bran, cooked	¾ cup	2.2	1.8	4.0
Oatmeal, cooked	1 cup	2.4	1.6	4.0
Popcorn, air-popped	3 cups	3.2	0.4	3.6
Pumpernickel bread	1 slice	1.5	1.2	1.7
Rye bread	1 slice	1.9	0.8	2.7
Wheat bran	½ cup	11.3	1.0	12.3
Wheat germ	3 tbsp.	3.2	0.7	3.9
Wholegrain bread	1 slice	2.8	0.1	2.9
Whole wheat bread	1 slice	1.6	0.3	1.9
Wholegrain pasta	1 cup	4.1	2.2	6.3

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Dietary Protein

- **Essential for collagen production, a key structural component of gingival tissue, periodontal ligament, and alveolar bone.**
- **Supports the synthesis of antibodies, cytokines, and other immune molecules that protect against oral infections.**
- **Enough, but NOT too much!**

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Dietary Protein

- Saliva contains proteins that contribute to **antimicrobial activity, buffer acid, and protect teeth from demineralization.**
- Protein-rich diets ensure the **production of high-quality saliva, enhancing its protective functions.**
- **Arginine-**containing proteins **increase oral pH,** reducing the risk of **dental caries** (e.g., nuts, eggs, chicken, pumpkin seeds, soybeans, dairy, chickpeas)

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Dietary Protein and Oral Health

- **Elders are particularly at risk for low protein diet, which increases the risk of sarcopenia and poor bone health.**
- **Low protein intake** in **elders** is associated with **poor oral health, dental caries, enamel hypoplasia, and salivary gland atrophy**.

Jayasinghe TN, et al. *Nutrients.* 2022 Oct 25;14(21):4478.

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Protein Fast Facts

- Maximize the ability to **digest, absorb, and use protein** by distributing it **evenly throughout meals and snacks.**
- A high-protein snack within **one hour of exercise is best** - muscles are sensitive to nutrients they use to repair and grow.
- **Beans, peas, quinoa, and lentils are rich in protein, fiber, vitamins, and *minerals*.**
- Meat cuts with **round, chuck, or loin in the** name are usually lean.
- Beware of buying ground chicken or turkey unless the package says 100% ground turkey breast or chicken breast. ***The meat is likely ground with skin/fat.***
- **Eat low-mercury fatty fish 2 times per week.**

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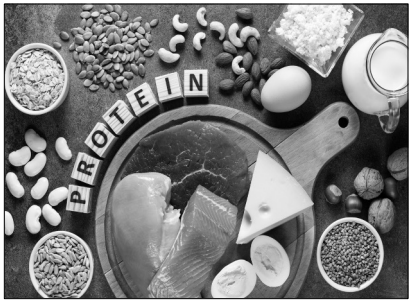
How Much Protein Do You Need?



- **~0.8 g/kg *ideal* body weight adults**
  - **(Multiply weight in lb. x 0.36)**
  - 150 pounds = 55 g/d
  - 180 pounds = 65 g/d
- **1.0–1.2 g/kg for those over age 60***
  - 150 pounds = 69–81 grams
  - 180 pounds = 81–98 grams
- **1.2–1.6 g/kg competitive athletes**

Caution with advanced kidney disease.

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Protein Choices

- Protein intake should be of **high biological value** and from **healthy dietary choices**: **legumes, nuts, eggs, fish, lean meats, dairy, etc.**






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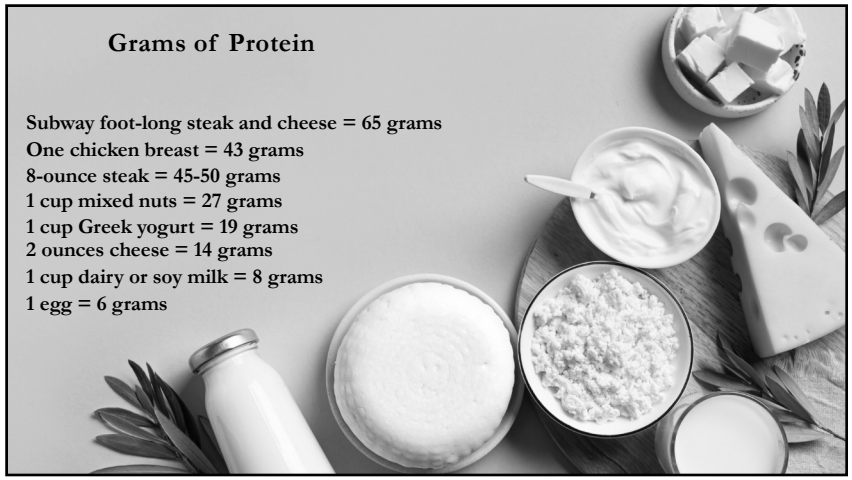
Grams of Protein

Subway foot-long steak and cheese = 65 grams
One chicken breast = 43 grams
8-ounce steak = 45-50 grams
1 cup mixed nuts = 27 grams
1 cup Greek yogurt = 19 grams
2 ounces cheese = 14 grams
1 cup dairy or soy milk = 8 grams
1 egg = 6 grams



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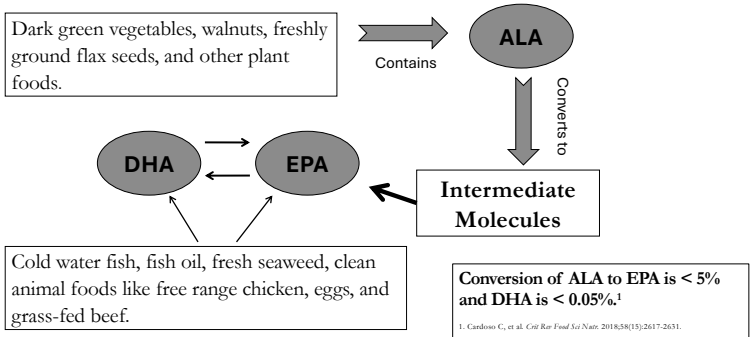
Omega 3 Fatty Acids from Plants and Animals



Conversion of ALA to EPA is < 5% and DHA is < 0.05%.[1]

1. Cardoso C, et al. *Crit Rev Food Sci Nutr.* 2018;58(15):2617-2631.

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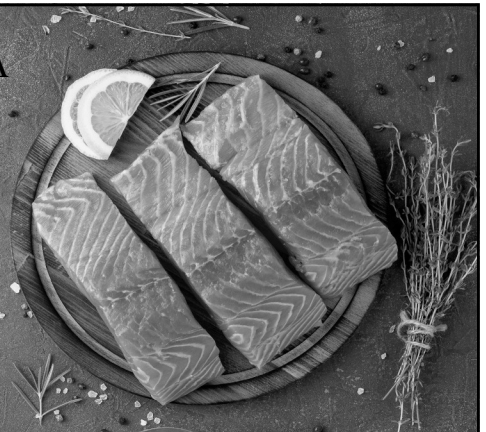
Benefits of EPA and DHA

- Modest reductions in blood pressure
- Reduces inflammation
- Supports cardiovascular health
- Lower triglycerides
- Maintains muscle mass
- Contribute to the maintenance of bone density.
- Improve calcium absorption and reduce urinary calcium loss.



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What is a serving? As a guide, use the palm of your hand.

Pregnancy and breastfeeding:
1 serving is 4 ounces

Eat 2 to 3 servings a week from the "Best Choices" list
(OR 1 serving from the "Good Choices" list).

Childhood:
On average, a serving is about:
1 ounce at age 1 to 3
2 ounces at age 4 to 7
3 ounces at age 8 to 10
4 ounces at age 11

Eat 2 servings a week from the "Best Choices" list.

Best Choices

Anchovy	Herring	Scallop
Atlantic croaker	Lobster, American and spiny	Shad
Atlantic mackerel	Mullet	Shrimp
Black sea bass	Oyster	Skate
Butterfish	Pacific chub mackerel	Smelt
Catfish	Perch, freshwater and ocean	Sole
Clam	Pickerel	Squid
Cod	Plaice	Tilapia
Crab	Pollock	Trout, freshwater
Crawfish	Salmon	Tuna, canned light (includes skipjack)
Flounder	Sardine	Whitefish
Haddock		Whiting
Hake		

Good Choices

Bluefish	Monkfish	Tilefish (Atlantic Ocean)
Buffalofish	Rockfish	Tuna, albacore/ white tuna, canned and fresh/frozen
Carp	Sablefish	Tuna, yellowfin
Chilean sea bass/ Patagonian toothfish	Sheepshead	Weakfish/seatrout
Grouper	Snapper	White croaker/ Pacific croaker
Halibut	Spanish mackerel	
Mahi mahi/dolphinfish	Striped bass (ocean)	

Choices to Avoid HIGHEST MERCURY LEVELS

King mackerel	Shark	Tilefish (Gulf of Mexico)
Marlin	Swordfish	Tuna, bigeye
Orange roughy		

What about fish caught by family or friends? Check for fish and shellfish advisories to tell you how often you can safely eat those fish. If there is no advisory, eat only one serving and no other fish that week. Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants.

www.FDA.gov/fishadvice
www.EPA.gov/fishadvice

U.S. FOOD & DRUG ADMINISTRATION · EPA United States Environmental Protection Agency

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Omega 3 Fatty Acids and Periodontitis

- **Meta-analysis 8 RCTs:** Significant overall reduction in **probing pocket depth of 0.42 mm and clinical attachment loss gain of 0.58 mm associated with the use of omega-3 fatty acids.**
- "In **individuals with periodontitis**, omega-3 fatty acid supplementation as an ***adjunct*** *to non-surgical periodontal treatment* can **provide additional benefits in CAL gain and PPD reduction,** compared with non-surgical periodontal treatment alone."

Castro Dos Santos NC, et al. Does the use of omega-3 fatty acids as an adjunct to non-surgical periodontal therapy provide additional benefits in the treatment of periodontitis? A systematic review and meta-analysis. *J Periodontal Res.* 2022 Jun;57(3):435-447."

Vienna Low Doz, M.D.

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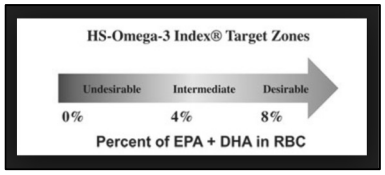
Omega 3 Index

- The **omega-3 index** is the amount of **EPA and DHA** in RBC membranes, expressed as a percentage of the total number of fatty acids in the membranes.
- Many studies have NOT used the omega-3 index **to determine if dosing was adequate**.
- Should we use omega-3 index in those those with periodontal disease? Chronic pain? Heart disease?



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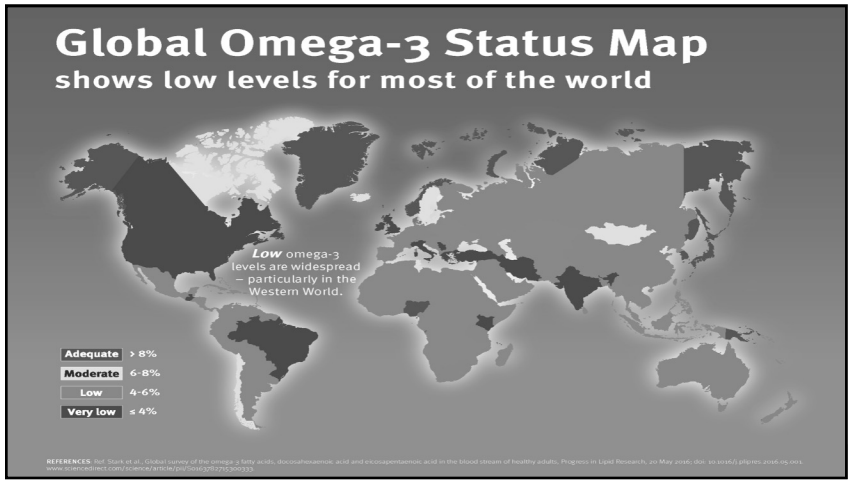

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Update on Omega 3 Index Status

- The **US (excluding Alaska), Canada, Germany, and Italy** have seen improvement and are now in the **"low category."**
- **Spain** has moved from the low to the **"moderate"** category.
- **South Korea, Japan, and Alaska's average Ω-3i were >8%.**
- **Total fish and shellfish intake:**
  - US 4.38 kg/capita/y
  - Germany 14.1 kg/capita/y
  - Japan (45.5 kg/capita/y)
  - South Korea 55.0 kg/capita/y

Schuchardt JP, et al. Red blood cell fatty acid patterns from 7 countries: Focus on the Omega-3 index. *Prostaglandins Leukot Essent Fatty Acids.* 2022 Apr;179:102418.

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The Omega-3 Index and Risk for Fatal CHD

Stanford University

Data from 10 prospective cohort studies including >24,000 subjects showed that an Omega-3 Index of 8% or greater was associated with the lowest risk for fatal CHD.

Total Mortality and the Omega-3 Index: Heart and Soul

UCSF University of California San Francisco

People with the highest Omega-3 Index levels lived longer than those with the lowest levels.

The Omega-3 Index, Brain Size a Cognitive Function: Framingham H Study

Participants in the Framingham Heart Study v lowest Omega-3 Indexes had smaller brain v and performed worse on mental function t

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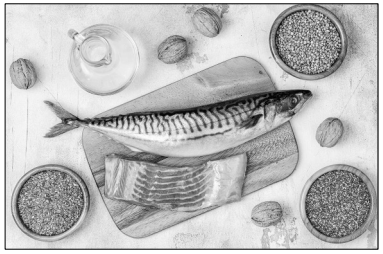
Omega 3 Supplement Forms

- The **lowest effective dose to raise Ω-3i: >1,000 mg/d DHA + EPA for 12 weeks.**[1]
- **Triglyceride and ethyl-ester forms more bioavailable and effective.**[1]
- **Microalgal oil supplementation increased Ω-3i levels in all studies.**[2]
- High-dose flaxseed or echium seed oil: **no change in Ω-3i.**[2]



1. Dempsey M, Rockwell MS, Wentz LM. The influence of dietary and supplemental omega-3 fatty acids on the omega-3 index: A scoping review. *Front Nutr.* 2023 Jan 19;10:1072653.
2. Lane KE, et al. Bioavailability and conversion of plant-based sources of omega-3 fatty acids - a scoping review to update supplementation options for vegetarians and vegans. *Crit Rev Food Sci Nutr.* 2022;62(18):4982-4997.

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Looking at Labels

Supplement Facts
Serving Size 2 Soft Gels

Amount Per Serving		% DV
Calories	20	
Total Fat	2 g	3%**
Saturated Fat	0.5 g	3%**
Cholesterol	10 mg	3%
Protein	<1 g	
Vitamin E (as d-alpha tocopherol)	13.4 mg	89%
Norwegian Fish Oil	2 g	†
Total Omega-3 Fatty Acids*	700 mg	†
EPA (Eicosapentaenoic Acid)*	360 mg	†
DHA (Docosahexaenoic Acid)*	240 mg	†

** Percent Daily Values are based on a 2,000 calorie diet.
† Daily Value (DV) not established.
Other Ingredients: Soft gel shell (beef gelatin, glycerin, water), natural flavors, natural mixed tocopherols. Contains fish (anchovy, sardine, mackerel).
*Reported as triglycerides.

Supplement facts

Serving Size: 2 Veggie Softgels

Servings Per Container: 30

	Amount Per Serving	%Daily Value
Calories	20	
Total Fat	2 g	3%**
Omega-3 Oil Concentrate (Elantria®)(from microalgae of Schizochytrium sp.), providing:	2000 mg	†
Total Omega-3 Fatty Acids *	1300 mg	†
EPA (Eicosapentaenoic Acid)*	800 mg	†
DHA (Docosahexaenoic Acid)*	400 mg	†

**Percent Daily Values are based on a 2,000 calorie diet.
†Daily Value not established.
*Reported as triglycerides.

Vegan form EPA/DHA 2:1

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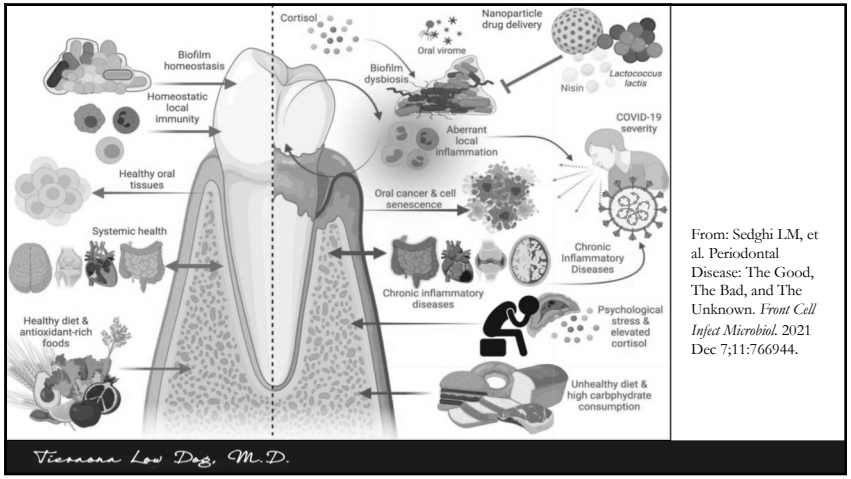

From: Sedghi LM, et al. Periodontal Disease: The Good, The Bad, and The Unknown. *Front Cell Infect Microbiol.* 2021 Dec 7;11:766944.

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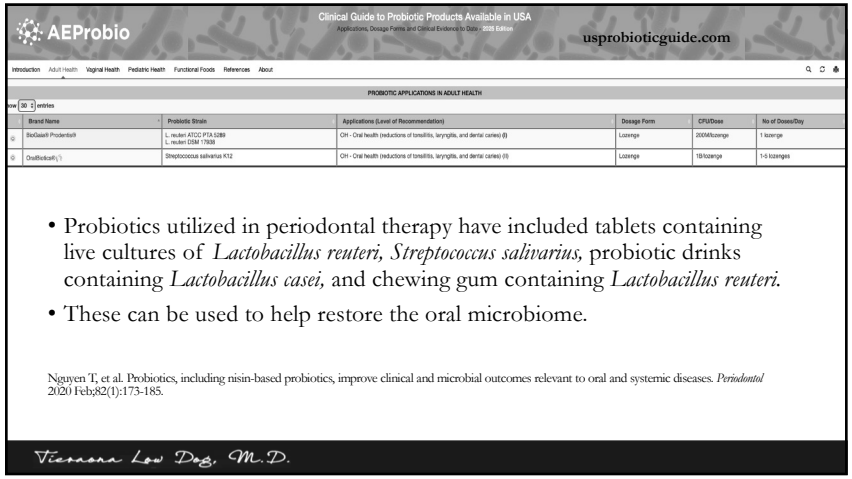

- Probiotics utilized in periodontal therapy have included tablets containing live cultures of *Lactobacillus reuteri, Streptococcus salivarius,* probiotic drinks containing *Lactobacillus casei,* and chewing gum containing *Lactobacillus reuteri.*
- These can be used to help restore the oral microbiome.

Nguyen T, et al. Probiotics, including nisin-based probiotics, improve clinical and microbial outcomes relevant to oral and systemic diseases. *Periodontol* 2020 Feb;82(1):173-185.

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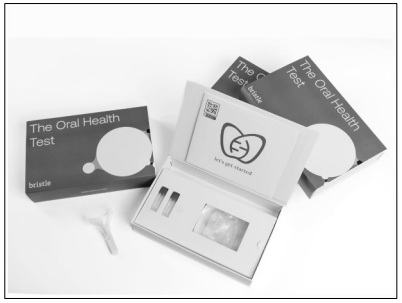
Oral Microbiome Testing



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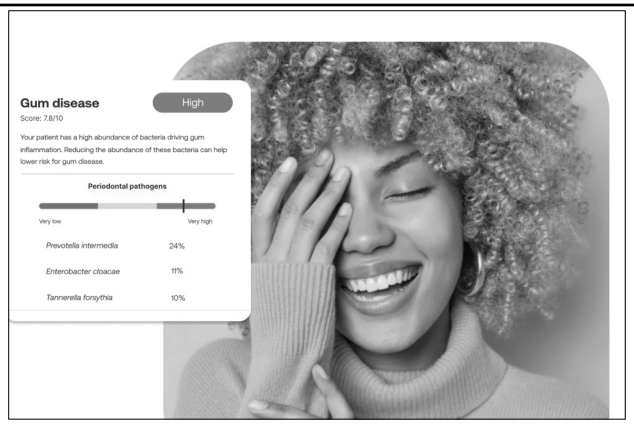

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Nisin

- **Nisin is an antimicrobial peptide** produced by *Lactococcus lactis.*
- It is active against both Gram(+) and Gram(-) bacteria, including *Streptococcus aureus, Listeria monocytogenes, Fusobacterium nucleatum, Porphyromonas gingivalis,* and *Treponema denticola.*
- ***L. lactis*** **can prevent oral biofilm formation and disrupt 24-h and 48-h pre-formed biofilms.**

Radaic A, et al. Modulation of pathogenic oral biofilms towards health with nisin probiotic. *J Oral Microbiol.* 2020 Aug 24;12(1):1809302.

Nguyen T, et al. Probiotics, including nisin-based probiotics, improve clinical and microbial outcomes relevant to oral and systemic diseases. *Periodontol* 2020 Feb;82(1):173-185.

The Enterosalivary Circuit

- **Dietary nitrate** (e.g., spinach, arugula, celery, beets) is absorbed into the **bloodstream from the stomach and small intestine.**
- **~25% is concentrated in the salivary glands** and secreted into the saliva.
- Bacteria in the oral cavity **reduce nitrate to nitrite**. The **saliva containing nitrite is swallowed. In the stomach's acidic environment, nitrite is reduced to nitric oxide.**
- Nitrite and NO are absorbed systemically, contributing to vasodilation, improved blood flow, lowered blood pressure, and immune defense.
- Studies show PPIs and antiseptic mouthwash blunt these effects.

Montenegro MF, et al. Blood Pressure-Lowering Effect of Orally Ingested Nitrite Is Abolished by a Proton Pump Inhibitor. *Hypertension.* 2017 Jan;*69*(1):23-31.

Nitrate and Oral Health

- The **nitrate-reducing bacteria *Rothia* and *Neisseria*** are consistently found at **higher levels in individuals free of oral disease** (vs. individuals with caries, periodontitis, and/or halitosis) and **increase when nitrate is consumed in clinical studies.**
- Preliminary in vitro and clinical evidence show that **bacteria normally associated with disease,** such as *Veillonella* (caries) and *Prevotella* (periodontal diseases and halitosis), **decrease in the presence of nitrate.**

Rosier BT, Takahashi N, Zaura E, et al. The Importance of Nitrate Reduction for Oral Health. *Journal of Dental Research.* 2022;101(8):887-897.

Saliva

- **Facilitates clearance** of dietary carbohydrates and microorganisms from the oral cavity.
- **Supplies bacteria with nutrients** through enzymatic breakdown of dietary starch, proteins, and salivary glycoproteins.
- **Antimicrobial activity through numerous proteins and peptides,** including mucins, lactoferrin, lysozyme, lactoperoxidase, and SIgA.
- Up to 10^8 microorganisms/ml of saliva have been found.
- **Salivary gland hypofunction causes dysbiosis and increases the risk of oral disease.**

Lynge Pedersen AM, Belstrøm D. The role of natural salivary defences in maintaining a healthy oral microbiota. *J Dent.* 2019 Jan;80 Suppl 1:S3-S12.

Ginger Mouthwash

- Several studies have **found ginger spray or mouthwash can be helpful in patients with xerostomia.**
- A study of 105 patients with diabetes and xerostomia randomized to one of the following groups: **ginger (25%) mouthwash, aloe vera mouthwash, or control with normal saline.**
- All the mouthwashes were used at 20 cc three times per day.

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		before intervention [n (%)]				after intervention [n (%)]				Com-parison
Symptom	**Response**	**Ginger**	**Aloe vera**	**control**	**P***	**Ginger**	**Aloe vera**	**control**	**P***	**P****
Experience of Mouth dryness during meals	yes	23(65.7)	18(51.4)	23(65.7)	0.368	2 (5.7)	4(11.4)	5(14.3)	0.491	<0.001
Difficulty in swallowing	yes	27(77.1)	20(57.1)	21 (60)	0.166	4(11.4)	3(8.6)	7(20)	0.343	<0.001
The need of Drinking fluids while swallowing dry food	yes	31(88.6)	35(100)	32(91.4)	0.120	12(34.3)	17(47.6)	27(77.1)	<0.001	<0.001
The feeling of decreased saliva in mouth	yes	33(94.3)	29(82.9)	33(94.3)	0.171	6(17.1)	12(34.3)	26(74.3)	<0.001	<0.001
Experience of Mouth dryness after waking up	yes	34(97.1)	30(85.7)	33(94.3)	0.233	8(22.9)	10(28.6)	25(71.4)	<0.001	<0.001
Waking up during night due to thirst	yes	28(80)	29(82.9)	23(65.7)	0.196	5(14.3)	14(40)	9(25.7)	<0.051	<0.001
Chewing gum or using chocolate to diminish dryness in mouth	yes	12(34.3)	10(28.6)	10(28.6)	0.955	3(8.6)	3(8.6)	9(25.7)	<0.061	<0.001
Difficulty in tasting foods	yes	12(34.3)	12(34.3)	16(45.7)	0.524	6(17.1)	5(14.3)	11(31.4)	0.168	<0.001
Burning sensation in mouth	yes	14(40)	10(28.6)	17(48.6)	0.228	6(17.1)	2(5.7)	11(31.4)	0.020	<0.001
Feeling dry mouth during travel	yes	34(97.1)	35(100)	35(100)	0.364	13(37.1)	25(71.4)	31(88.6)	<0.001	<0.001

From: Badooei F, et al. *Med Oral Patol Oral Cir Bucal.* 2021 Jun 20;26(4):e408–e413.

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Aloe Vera Gel

- **Antiseptic/anti-inflammatory gingivitis and periodontitis**
- Mouth rinse: **reduction in gingivitis and plaque** accumulation after use
- Anti-viral: **herpes simplex**
- Reduce **oral ulcer** pain
- Inhibits oral **candida**
- Managing. **oral lichen planus**

Scientific name (Family name)	Subjects	Outcomes	Reference
Aloe vera (L.) Burm.f. (Asphodelaceae)	120 volunteers with gingivitis aged 18–25 years old	Inhibition of gingivitis and plaque accumulation after oral rinse	Chandrahas et al. (2012)
	45 patients with plaque-induced gingivitis aged 18–65 years old	Reduction of gingival inflammation	Ajmera et al. (2013)
	345 healthy subjects	Reduction of gingival bleeding and plaque indices	Karim et al. (2014)
	76 intubated patients in intensive care unit aged 18-64 years old	Reduction of gingival index compared with chlorhexidine	Rezaei et al. (2016)
	390 healthy subjects	Reduction of gingival index compared with chlorhexidine	Vangipuram et al. (2016)

Sujatha G, et al. Aloe vera in dentistry. *J Clin Diagn Res* 2014; 8(10): ZI01–ZI02
Ali S, Wahbi W. The efficacy of aloe vera in management of oral lichen planus: a systematic review and meta-analysis. *Oral Dis.* 2017 Oct;23(7):913-918.

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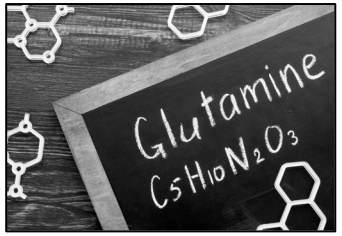
Glutamine as an Immunomodulatory Agent

- **Immune cells** depend on glutamine to **survive, proliferate, and function**. During catabolic/hypercatabolic circumstances, **demand for glutamine increases dramatically; low glutamine may severely impair immune function. (Pre-op, post-op, elite athletes, trauma)**
- A **systematic review** of eight studies (six RCTs) recommended **glutamine oral care to mitigate oral mucositis.**



Mahendran VJ, et al. Advances in the use of anti-inflammatory agents to manage chemotherapy-induced oral and gastrointestinal mucositis. *Curr Pharm Des.* 2018;24(14):1518–32.

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MSM Medical Science Monitor
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PUBLISHER: ISI

Med Sci Monit. 2024 Feb 22;30:e942585-1–e942585-10. doi: 10.12659/MSM.942585

Effectiveness of Glutamine Oral Care in Reducing Oral Mucositis and Improving Oral Health After Neurosurgery: A Randomized Controlled Trial with Microbiome Analysis

Yan Gao [1,D,E], Hong Yang [1,B], Xiaohong Zhang [1,C], Ying Ma [1,D,F], Ling Wang [1,A,E,✉]

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PMCID: PMC10898191 PMID: 38384124

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Glutamine and Oral Care

- In a double-blind study, 300 patients undergoing neurosurgery without pneumonia or oral infection were randomized into three groups:
  - The **control group** (n=100) received oral care with routine oral nursing methods with saline
  - The **experimental group** (n=100) received oral care with 5% glutamine.
  - The **saline chlorhexidine combo** (n=100) was positive control.
- Oral health complications, such as local debris, oral mucositis, halitosis rates, oral flora, and pneumonia incidence, were included in the analysis.

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Checklist of oral care procedures.

Number	Procedure	Status (√)
1	Patients were asked to sit fully upright or in an elevated side-lying position to prevent aspiration during mouth cleaning	
2	Take off the denture if there is one, spread the treatment towel under the jaw, and wet the mouth	
3	Rinse the teeth and mouth with saline 0.9% solution for 150–180s, and check the condition of the oral cavity	
4	Brush the teeth with a suction toothbrush (or soft toothbrush) with toothpaste for 180s, ensuring all four quadrants were cleaned	
5	Dip swab into a standard 0.9% saline oral rinse	
6	Clean the mouth with swab for 150–180s	
7	Clean the hard palate, tongue and the bottom of the tongue with swab for 150–180s	
8	Wipe the mouth and lips for 20–30s	
9	Inquire about the patient's feelings about the whole care process, and check the oral condition with the flashlight (whether it is clean, whether there are any residues left, whether there is bleeding, ulcer, etc.)	

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Results

Comparison of oral disorders.

Group	Case number	Local debris cases	Oral mucositis cases	Halitosis cases	Dryness cases
Control	100	38 (38.00)	52 (52.00)	46 (46.00)	24 (24.00)
Glutamine	100	14 (14.00)	23 (23.00)	23 (23.00)	18 (18.00)
Chlorhexidine	100	12 (12.00)	22 (22.00)	21 (21.00)	19 (19.00)
χ^2		24.95	26.54	18.38	1.28
P		<0.001	<0.001	<0.001	0.528

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Nutrient	Dietary Source(s)	Importance in Periodontal Heath	Reported Improvement in PD and CAL (Mean mm, SD)	References
Vitamin A	Cod liver oil, carrots, capsicum, liver, sweet potato, broccoli, leafy vegetables	Not clear. Research indicates insignificant improvement in periodontal health upon supplementation.	PD: 0.52 ± 0.03 CAL: n.d.	[33,65]
B-vitamins	B_1—Liver, oats, pork, potatoes, eggs B_2—Bananas, dairy, green beans B_3—Eggs, fish, meat, mushrooms, nuts B_5—Avocados, meat, broccoli B_6—Meat, vegetables, nuts, banana B_7—Raw egg, liver, leafy vegetables, peanuts B_9—Cereals, leafy vegetables B_{12}—Animal products	Supplementation may accelerate post-surgical healing.	PD: 1.57 ± 0.34 CAL: 0.41 ± 0.12	[56]

PD (Pocket depth), CAL (Clinical attachment level), n.d. (Not determined)

Vitamin C	Citrus fruits, vegetables, liver	Gingival bleeding and inflammation are hallmarks of scurvy. Supplementation may improve outcomes of periodontal therapy.	PD: 0.58 ± 0.14 CAL: n.d.	[66]
Vitamin D	Fish eggs, mushrooms, liver, milk	Deficiency may lead to delayed post-surgical healing. Local application may accelerate post-surgical healing/osseointegration	PD: 1.35 (SD n.d.) CAL: 1.4 (SD n.d.)	[34,56,57,67]
Vitamin E	poultry, meat, fish, nuts, seeds and cereals	Impaired gingival wound healing	PD: 0.39 ± 0.18 CAL: n.d.	[33,68,69,70]
Vitamin K	Green vegetables, egg yolk	Deficiency may lead to gingival bleeding. No known effects on periodontal therapy if supplementation used as an adjunct.	n.d.	[71,72,73]

From: Najeeb S, The Role of Nutrition in Periodontal Health: An Update. *Nutrients*. 2016 Aug 30;8(9):530.

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	VITAMIN D
Function	Promotes calcium absorption and maintains adequate serum calcium and phosphate concentrations. Involved in modulation of cell growth, neuromuscular, hormone, and immune function; and glucose metabolism. Involved in regulation of hundreds of genes.
Clinical Use	Bone pain, muscle weakness, osteomalacia, high risk for falls/fractures Prediabetes
Deficiency Signs	Musculoskeletal pain, muscle twitches, spasms, poor gait Poor immune function
Status Indicator	25(OH)D: IOM: sufficiency 20 ng/mL, severe deficiency <12 ng/mL Endocrine Society: sufficiency 30 ng/mL higher, deficiency <20 ng/mL
Typical Dosing	400 IU daily for infants less than one year, exclusively or partially breastfed 600 IU daily for those ages 1 to 70 years of age 800 IU daily for all adults up >70 years Tolerable upper limit: 4-8 years 3000 IU/d; those 9 years and older: 4000 IU/d Deficiency: 4000–5000 IU/d (100–125 µg) or 50,000 IU/wk for 2-3 months, recheck
Forms	D_2 (ergocalciferol) – from mushrooms D_3 (cholecalciferol) – from lanolin or lichen, superior form

Chauhan K, Shahrokhi M, Huecker MR. StatPearls Publishing; 2024 Jan. and Berger MM, et al. ESPEN micronutrient guideline. *Clin Nutr*. 2022 Jun;41(6):1357-1424.

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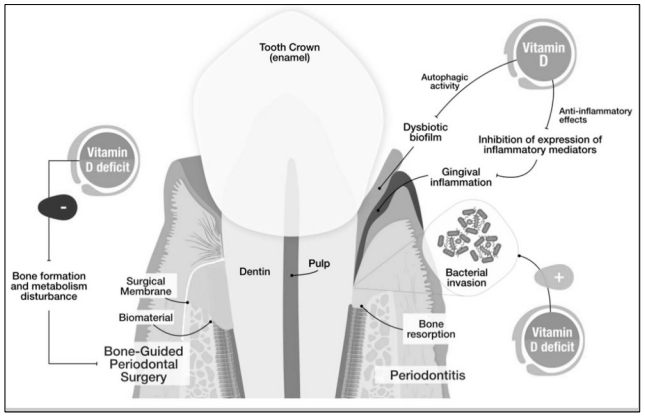

From: Botelho J, et al. Vitamin D Deficiency and Oral Health: A Comprehensive Review. *Nutrients*. 2020 May 19;12(5):1471.

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Vitamin D

- **Vitamin D levels ≤ 12ng/mL,** lower calcium and phosphate levels leading to **impaired bone mineralization and potential oral issues due to inadequate mineral deposition in teeth** increasing the risk of bone loss and dental caries.
- European consensus stated that **inadequate vitamin D impacts periodontal health and oral functions.**

<12 ng/mL (<30 nmol/L): Severe deficiency

12–20 ng/mL (30–50 nmol/L): Deficiency

20–30 ng/mL (50–75 nmol/L): Some consider it insufficient, while others consider it sufficient

>30 ng/mL(>75 nmol/L): Sufficiency

Chapple IL, et al. *J Clin Periodontol*. 2017 Mar;44 Suppl 18:S39-S51.

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Vitamin D Supplementation

Endocrine Society's new guidelines highlight the following groups:

- **1-18 years:** prevent nutritional **rickets** and potentially lower risk of RTI* (estimated weighted average **~ 1200 IU/d***)
- **Pregnancy**: potential to lower the risk of **preeclampsia, intra-uterine mortality, preterm birth, small for gestational age birth, and neonatal mortality (~2500 IU/d).**
- **Adults**: **high-risk prediabetes** to reduce **risk of progression** to diabetes.
- **75 years and older:** potential to **lower the risk of mortality**.

Endocrine Society Clinical Practice Guidelines. Vitamin D for the Prevention of Disease Guideline Resources. https://www.endocrine.org/clinical-practice-guidelines/vitamin-d-for-prevention-of-disease Accessed November 4, 2024

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Zinc

1. Uwitonze AM, et al. Zinc Adequacy Is Essential for the Maintenance of Optimal Oral Health. *Nutrients.* 2020 Mar 30;12(4):949.
2. Mozaffar B, et al. The Effectiveness of Zinc Supplementation in Taste Disorder Treatment: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *J Nutr Metab.* 2023 Mar 8;2023:6711071.

- Found in saliva, dental plaque, and dental hard tissues.
- Supplementation is beneficial in gingivitis, periodontitis, and halitosis, while deficiency is associated with poor oral and periodontal health.[1]
- Maintains periodontal health due to immunological effect on oral soft tissues.
- Systematic review: Supplementation is an effective treatment for taste disorders in patients with zinc deficiency or idiopathic taste disorders.[2]

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Zinc L-Carnosine

- Zinc provides anti-inflammatory and wound-healing benefits, while carnosine has cytoprotective effects. Together, they exert more substantial mucosal healing properties than zinc alone.
- It adheres to ulcerated and inflamed oral or gastric mucosa, protecting against further damage while promoting healing.[1]
- Evidence supports the safety and efficacy of maintaining, preventing, and treating the mucosal lining, particularly for oral mucositis (approved in Japan for treatment of gastric ulcers).[2]

1. Efthymakis K, Neri M. The role of Zinc L-Carnosine in preventing and treating gastrointestinal mucosal disease in humans: a review. *Clin Res Hepatol Gastroenterol.* 2022 Aug-Sep;46(7):101954
2. Hewlings S, Kalman D. A Review of Zinc-L-Carnosine and Its Positive Effects on Oral Mucositis, Taste Disorders, and Gastrointestinal Disorders. *Nutrients.* 2020 Feb 29;12(3):665.

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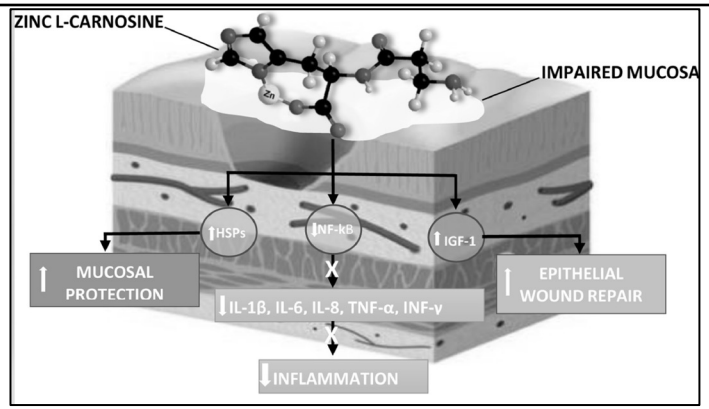

Efthymakis K, Neri M. The role of Zinc L-Carnosine in the prevention and treatment of gastrointestinal mucosal disease in humans: a review. *Clin Res Hepatol Gastroenterol.* 2022 Aug-Sep;46(7):101954.

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Dose and Safety Profile

- **Recommend Dose: 75–150 mg/d zinc L-carnosine (~16–30 mg elemental zinc).**
- **Duration: 8–12 weeks**, depending on the condition being treated.
- **Safety: Generally well-tolerated** with minimal adverse effects.
- **Toxicity: There is a low risk at the recommended dose**. Excessive *elemental* zinc intake (>40 mg/d) may cause copper deficiency.
- Side Effects:
- **Mild gastrointestinal discomfort (rare).**
- **Zinc-related nausea or metallic taste (occasionally reported).**

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Labels

- Recommend Dose: 75–150 mg/d zinc L-carnosine (~16–30 mg elemental zinc).
- Duration: usually 8–12 weeks, depending on the condition being treated.
- Safety: Generally well-tolerated with minimal adverse effects.
- Toxicity: Low risk at recommended dose. Excessive *elemental* zinc intake (>40 mg/day) may cause copper deficiency or immune dysregulation.
- Side Effects:
- Mild gastrointestinal discomfort (rare).
- Zinc-related nausea or metallic taste (occasionally reported).

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Supplement facts

Serving Size: 1 Capsule

Servings Per Container: 90

	Amount Per Serving	%Daily Value
Zinc (from Zinc-L-Carnosine)	12 mg	109%
Zinc-L-Carnosine	75 mg	†
L-Carnosine (from Zinc-L-Carnosine)	43 mg	†

†Daily Value not established.

Supplement Facts

Serving Size 1 Tablet
Servings Per Container 60

Amount Per Serving		% Daily Value
Zinc (from 75 mg zinc-carnosine)	17 mg	155%

Other Ingredients: Microcrystalline cellulose, stearic acid (vegetable), and silica.

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Resources

- Micronutrient Information
  - https://lpi.oregonstate.edu/mic
  - https://ods.od.nih.gov
  - https://www.who.int/health-topics/micronutrients#tab=tab_1
- Micronutrient Calculator
  - https://www.nal.usda.gov/human-nutrition-and-food-safety/dri-calculator
  - https://www.osteoporosis.foundation/educational-hub/topic/calcium-calculator
- Identifying Drug-Nutrient Interactions:
  - https://lpi.oregonstate.edu/mic/drug-nutrient-interactions
  - https://www.drugs.com/drug-interactions/multivitamin-vitamins.html
  - https://familydoctor.org/drug-nutrient-interactions-and-drug-supplement-interactions/
  - https://medlineplus.gov/druginformation.html
  - https://naturalmedicines.therapeuticresearch.com (paid subscription)

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