

Nutrition in Ocular Disease Beyond Carotenoids Comprehensive Antioxidant Approach

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PSS Eyecare
Saturday, September 6, 2025



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Disclosures- Greg Caldwell, OD, FAAO

All relevant relationships have been mitigated

- Lectured for: Alcon, B&L, Dompé, Lenz
- Disclosure: Receive speaker honorariums
- Advisory Board: Dompé, Tarsus
- Disclosure: Receive participant honorariums
- I have no direct financial or proprietary interest in any companies, products or services mentioned in this presentation
 - Disclosure: Non-salaried financial affiliation with Pharmanex
- Healthcare Registries – Chairman of Advisory Council for Diabetes and AMD
- The content of this activity was prepared independently by me - Dr. Caldwell
- The content and format of this course is presented without commercial bias and does not claim superiority of any commercial product or service
- Optometric Education Consultants – Scottsdale, AZ, Pittsburgh, PA, Sarasota, FL, Barcelona, Spain, Orlando, FL, Mackinac Island, MI, Quebec City, Canada, and Nashville, TN- Owner



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Macronutrients versus Micronutrients

Macronutrients

- Energy and tissue support
- Needed in **larger amounts** for energy and bodily functions
- Proteins, fats, and carbohydrates
- Provide the **energy** required for ocular tissues to function, repair, and recover

Micronutrients

- Regulation and protection
- Needed in **smaller amounts**, but essential for health and ocular health
- Vitamins, minerals, polyphenols, flavonoids, and carotenoids
- Regenerative, anti-inflammatory, and healing

Key Differences

- **Macronutrients** = energy + building blocks
- **Micronutrients** = regulators and protectors for optimal body function

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- Not to
- Chance
- Char
- Patients
- Alter
- Rec
- Patients
- Science
- It's bey

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Metabolically Healthy?

- You eat yourself into metabolic dysfunction and insulin resistance
 - ★ High blood pressure, high glucose/insulin, high triglycerides, low HDL, and obesity
- Metabolically brittle or broke:
 - ★ Vagus nerve damage, gut microbiome disruption, muscle tissue is pathologic oo not optimized – full of fat and infiltrates
- Increased risk of heart attack, stroke, cancer, fatty liver, Alzheimer/dementia (Type 3 DM)

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Ocular Disease and Nutrition

- The body/eye is meant to heal, wants to heal, can heal itself
- Treat the person not the disease
- Assist the patient to get to a healing state
- Muscle is the best endocrine gland not fat
- Looking to return systems, organs (eye), and the body back to homeostasis
 - ★ Optimize first – micronutrients, macronutrients (nutrition), hormones, and lifestyle

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Wouldn't Be Cool

- ~To know if you have low grade inflammation in your body?
- ~Know if your supplements are absorbing
- ~Lower your risk for chronic diseases
- ~Know your antioxidant status

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Chronic and Low-Grade Inflammation

Science has proven that chronic, low-grade inflammation can turn into a silent killer that contributes to cardiovascular disease, cancer, type 2 diabetes, diabetic retinopathy, cataracts, macular degeneration, and many other conditions



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Chronic and Low-Grade Inflammation

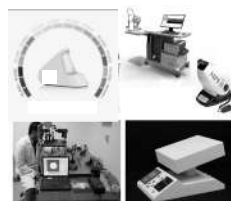
Like cancers and other slow-burn diseases, identifying these conditions early can make the difference between full recovery or a dramatically reduced quality of life or even death (vision loss or blindness)



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Wouldn't it be great if we could measure low grade chronic inflammation in YOUR body!

Measurement of Macular Pigment



- HPLC
- Psychophysical
 - Heterochromatic flicker photometry (HFP)
 - Minimum motion photometry
- Image Based
 - Autofluorescence attenuation
 - Reflectometry
 - Resonance Raman spectroscopy (skin and eye)

High Performance Liquid Chromatography



Credit to: An Evening with Dr. Paul Bernstein

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"Let me run something by you"



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Key Tenants of
**Aging,
Performance
and Vitality**

- Oxidative Stress / Inflammation
- Hormonal Balance
- Stress Hormones
- Glucose / Insulin Regulation
- **GUT integrity and microbiome diversity**
- Immune Balance
- Environmental Exposure/Burden
- Individuality

Credit to: James LaValle, RPh, CCN

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Nutrition

- ⌚ Don't consume too many or too few calories
- ⌚ Eat sufficient protein and essential fats
- ⌚ Obtain the vitamins and minerals you need – Micronutrients
- ⌚ Avoid pathogens like E Coli
- ⌚ Avoid toxins like mercury and lead
- ⌚ Beyond this we know relatively little with complete certainty

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[illegible]

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Free Radicals and Antioxidants

Antioxidant **Free radical** **Healthy cell**

How antioxidants reduce free radicals

ANTIOXIDANT **FREE RADICAL**

Chemically: reaction: unpaired electron + electron donation: stable electron pair is formed, free radical is neutralized

HEALTHY
STABLE
MOLECULE

UNPAIRED
UNSTABLE
MOLECULE

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Oxidative Stress

- Small percentage of oxygen is not completely reduced
- Accumulation of free radicals
- Oxidative damage
- Oxidative stress
- Considered the starting of several diseases
- Responsible for epigenetic alterations
- Mitochondria – vulnerable

Not going to make this apple new again

- Prevention is the one of the best medicines

The diagram illustrates the process of oxidative stress. At the top, three apples are shown: a whole, healthy apple; a partially oxidized apple; and a completely oxidized, brown apple. Below this, a cell is shown in three stages: a healthy cell, a cell with oxidative stress, and a cell with oxidative damage. The cell with oxidative stress shows a large, dark, irregular shape representing a free radical. The cell with oxidative damage shows a fragmented, brown cell. The diagram also includes a circular diagram showing the cycle of oxidative stress, with labels for 'Oxidative Stress', 'Free Radicals', 'Cell Damage', and 'Cell Death'.

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Endogenous and Exogenous Free Radical Formation

$$\begin{aligned} &O_2 \xrightarrow{e^- + 2H^+} O_2 \cdot H \xrightarrow{-2H^+} H_2O_2 \xrightarrow{e^- + 2H^+} OH \cdot \xrightarrow{-2H^+} H_2O \\ &O_2 \xrightarrow{e^- + 2H^+} O_2 \cdot H \xrightarrow{-2H^+} H_2O_2 \xrightarrow{e^- + 2H^+} OH \cdot \xrightarrow{-2H^+} H_2O \end{aligned}$$

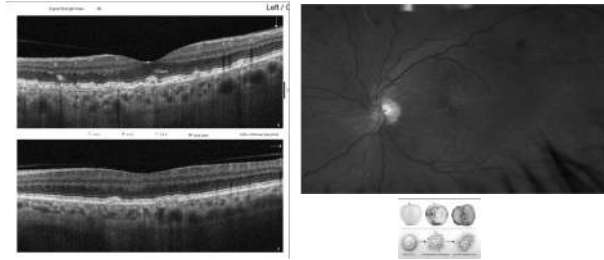
Aerobic respiration

radiation $e^- + 2H^+ \xrightarrow{H_2O} OH \cdot \xrightarrow{-2H^+} H_2O_2 \xrightarrow{e^- + 2H^+} O_2 \cdot H \xrightarrow{-2H^+} O_2$

irradiation

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Oxidative Stress with Your OCT



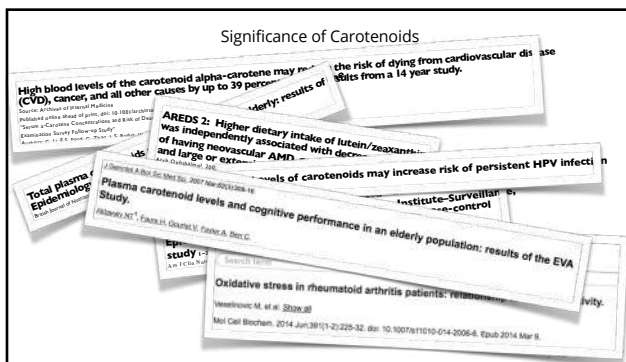
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Carotenoids

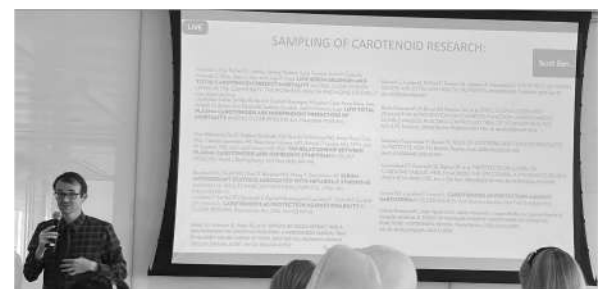
- ~ Organic pigments produced by plants, algae, and bacteria
- ~ Cannot be synthesized by the human body
 - * Hydrophobic compounds
 - Important for the phospholipid bilayer
- ~ 600 in nature – 50 human food chain – 15-20 human blood stream
- ~ Macular carotenoids (L and Z) = highest concentration found in the human body
 - * Diet derived
 - * Henle fibers – between the inner and outer plexiform layers
 - * Sequester or absorb blue light

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Significance of Carotenoids



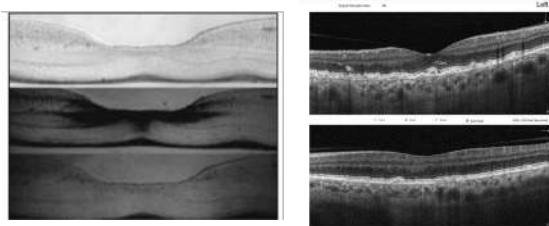
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Evidence Informed Risk Adjusted Medicine

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Macular Pigment Foveal Pigment?



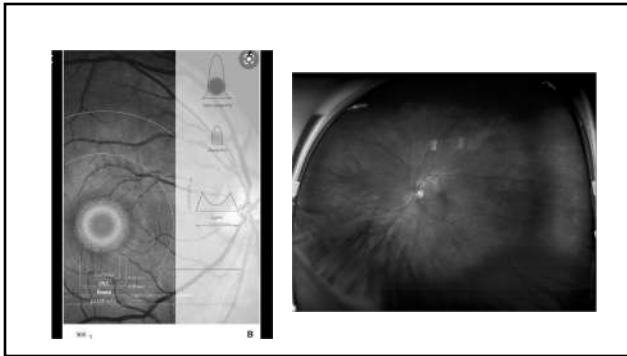
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Macular Pigment Foveal Pigment?

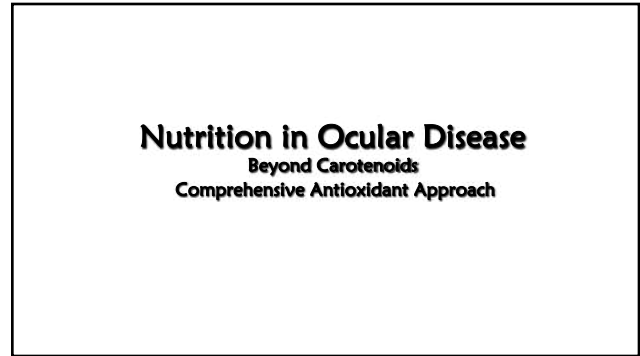
Imaging lutein and zeaxanthin in the human retina with
confocal resonance Raman microscopy



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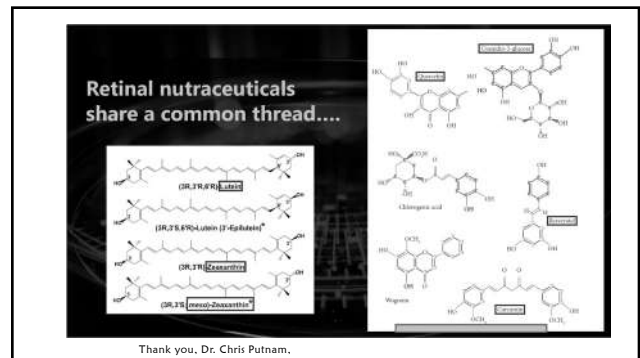
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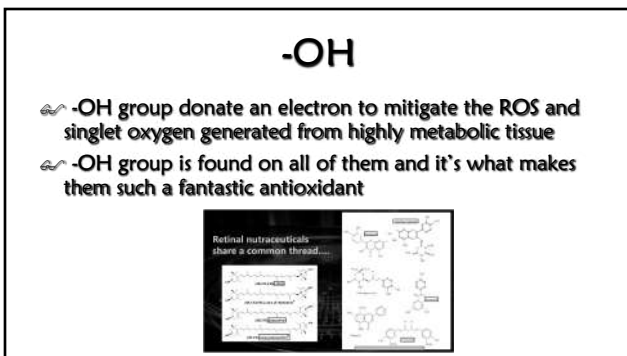
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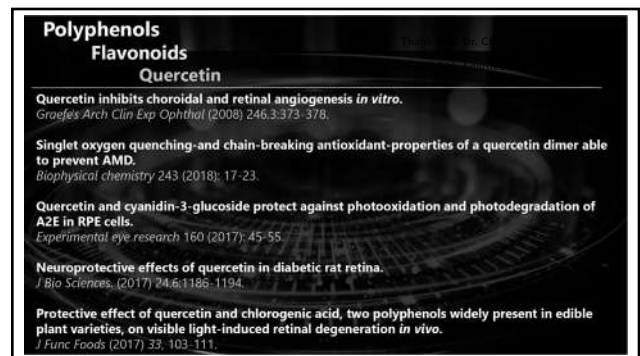
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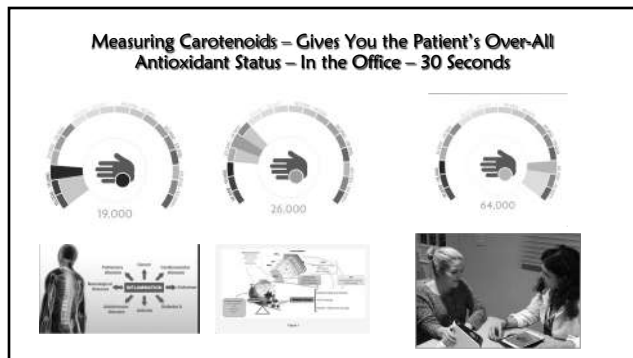
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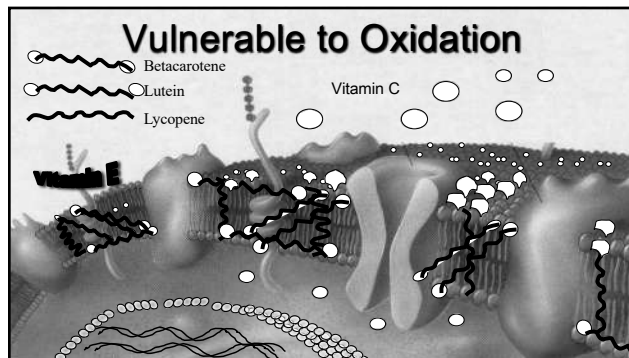
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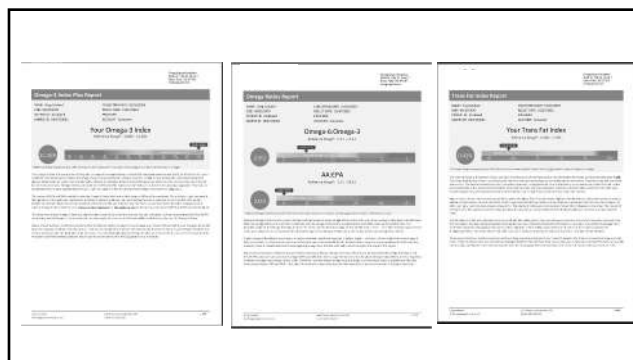
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Comprehensive Antioxidant Support

- Cell membrane support
- Immune system support
- Support to the oxidative stress to the extracellular matrix
- Support to cell signaling

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Patients Are Expecting

- Early detection
- Wellness
- Prevention

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Early Detection and Allopathic Treatments

Rabin Cone Contrast Test
ERG and VEP

Evidence Informed Risk Adjusted Medicine

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Comprehensive versus Isolate



Ocular Nutrition

Is it really any different than systemic nutrition?

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Acute vs Chronic

- Corneal abrasion
- Marginal ulcer
- CL overwear
- Hordeolum
- HSV Keratitis
- Anterior Chamber Iritis
- Randomized Clinical Trials
 - Heterogenous input and arrive at a homogenous result
 - Evidence based medicine -- we apply those average findings to everyone, that is an individual
- Everyone is not average
- The longest clinical trials are 5-10 years
- Thyroid Eye Disease
- Diabetes
 - Metabolic diseases
- Cardiovascular disease
- Rheumatoid Arthritis
- Macular degeneration
 - Geographic atrophy
 - Wet AMD

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Chronic

- Not acute or binary
 - Complex processes
- Short term fixes don't work
- More of strategy
- Assessment of risk
- We try to take complex processes and try to make them binary
- Chronic or Focus of Prevention
- Shift from evidence based to Evidence Informed Risk Adjusted Medicine
- Glaucoma
- Thyroid Eye Disease
- Diabetes
 - Metabolic diseases
- Cardiovascular disease
- Hypertension
- Rheumatoid Arthritis
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Comprehensive Antioxidant Support

- Cell membrane support
- Immune system support
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Key Tenants of Aging, Performance and Vitality

- Oxidative Stress / Inflammation
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Credit to: James LaValle, RPh, CCN

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If You Are Low in Carotenoids – What Does It Mean?

Measurement of Macular Pigment

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 - Heterochromatic flicker photometry (HFP)
 - Minimum motion photometry
- Image Based
 - Autofluorescence attenuation
 - Reflectometry
 - Resonance Raman spectroscopy (skin and eye)

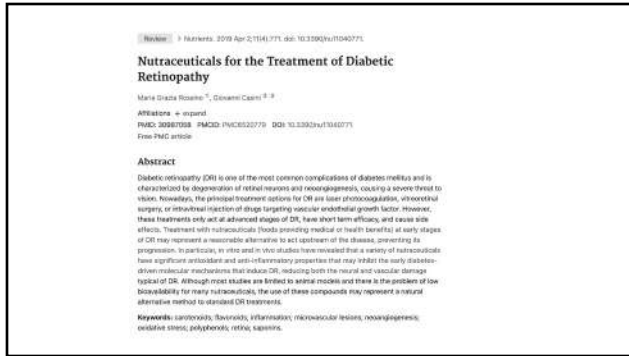
High Performance Liquid Chromatography

Life Meter

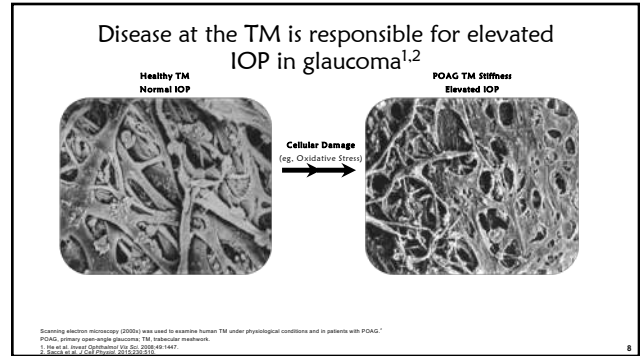
Credit to: An Evening with Dr. Paul Bernstein

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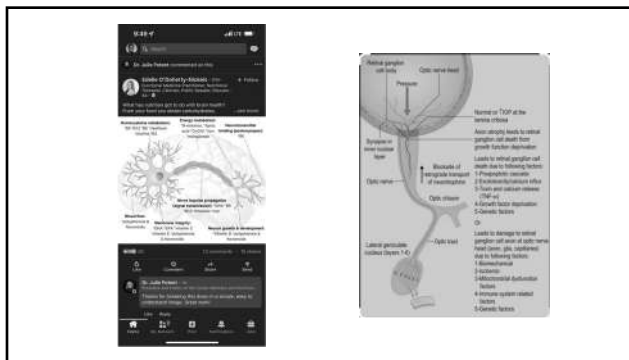




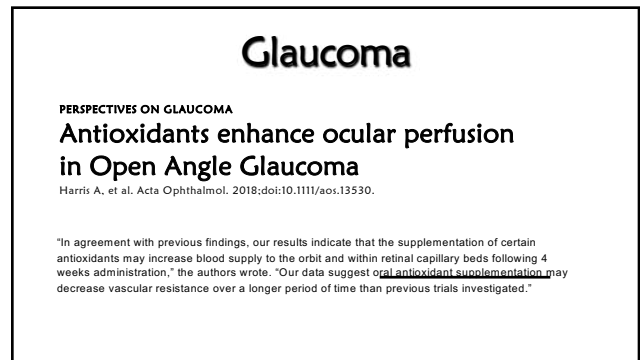
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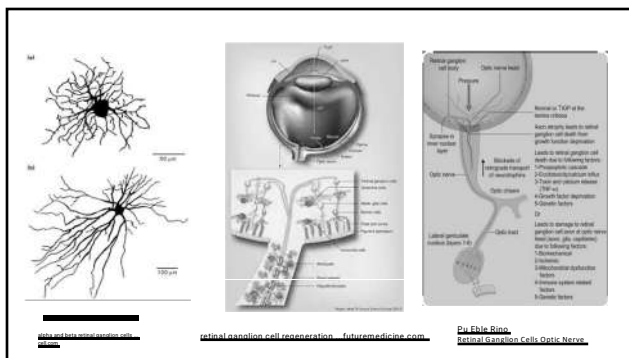
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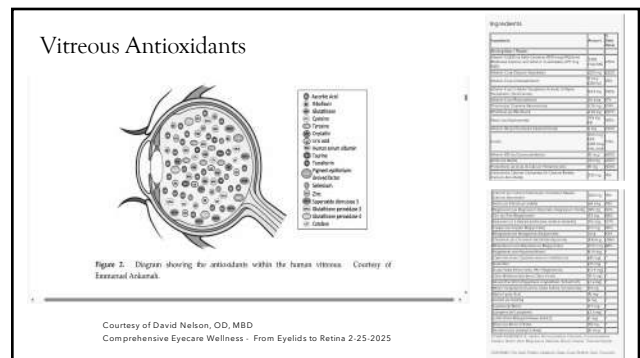
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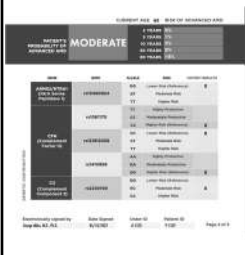
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MODERATE

Amount Per Serving (1 Capsule) % Daily Value

Vitamin A (as Retinyl Palmitate)	10,000 IU	200%
Vitamin C (as Ascorbic Acid)	500 mg	100%
Vitamin E (as d-Alpha Tocopheryl Succinate)	400 IU	800%
Zinc (as Zinc Gluconate)	25 mg	500%
Copper (as Cupric Gluconate)	2 mg	100%
Selenium (as Selenium Enzyme)	70 mcg	100%
Lutein (from Marigold Flower Extract)	10 mg	100%
Zeaxanthin (from Marigold Flower Extract)	2 mg	100%

Raise Your Hand

Would you recommend AREDS 2 or a supplement high dose Zinc?

A. Yes
B. No

(Note: The text on the right side of the slide discusses the efficacy of AREDS 2 in slowing the progression of macular degeneration, particularly in the 'MODERATE' category.)

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"Low" Dose Zinc (Not No Zinc)

Amount Per Serving	% Daily Value
Vitamin C (Ascorbic Acid)	500 mg 100%
Vitamin E (d-Alpha Tocopheryl Succinate)	400 IU 800%
Zinc (Zinc Gluconate)	25 mg 500%
Copper (Copper Gluconate)	2 mg 100%
Selenium (Selenium Enzyme)	70 mcg 100%
Lutein (from Marigold Flower Extract)	10 mg 100%
Zeaxanthin (from Marigold Flower Extract)	2 mg 100%

Other Ingredients: Gelatin, Microcrystalline Cellulose, Stearic Acid, Silicon Dioxide, Magnesium Stearate.



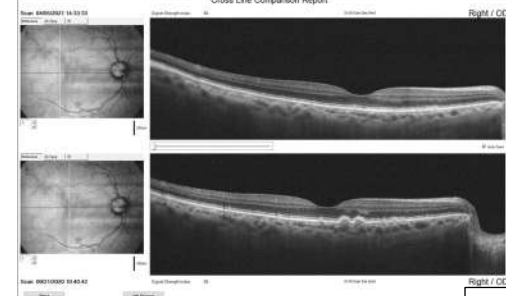
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Zinc is Essential for Immune Function, Excessive Zinc Intake Can Paradoxically Suppress the Immune System

- Imbalance of Immune Cells:** Zinc is critical for the normal function of various immune cells, including neutrophils, macrophages, and lymphocytes. Excessive zinc can cause an imbalance in these cells, particularly by suppressing T-cell function, which is essential for adaptive immunity.
- Interference with Other Essential Minerals:** High doses of zinc can interfere with the absorption and balance of other essential minerals, notably copper and iron. Copper, in particular, is crucial for certain immune responses, and a deficiency can impair neutrophil and macrophage function, weakening the body's ability to fight infections.
- Oxidative Stress:** Excessive zinc may contribute to oxidative stress by affecting the body's antioxidant systems. Although zinc generally has antioxidant properties, at high doses it can disrupt the balance of reactive oxygen species (ROS) and antioxidants, leading to cellular damage that can impact immune cells.
- Downregulation of Immune Signaling Pathways:** Zinc excess may downregulate certain immune signaling pathways, such as those involving cytokines and chemokines, which are necessary for inflammation and immune cell recruitment. This suppression can limit the body's ability to mount an effective immune response.

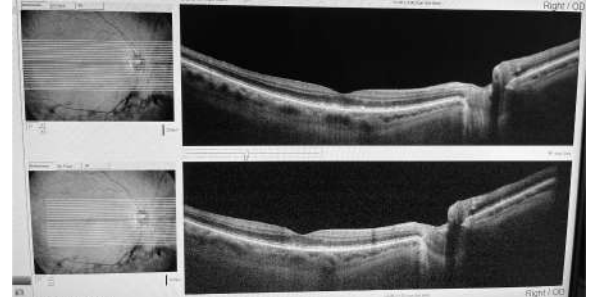
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Cross Line Comparison Report



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Raster Comparison Report



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LifePak and Optimum Omega - Pharmanex

Ingredients	Amount	% Daily Value
Vitamin A (as Retinyl Palmitate)	10,000 IU	200%
Vitamin C (as Ascorbic Acid)	500 mg	100%
Vitamin E (as d-Alpha Tocopheryl Succinate)	400 IU	800%
Zinc (as Zinc Gluconate)	25 mg	500%
Copper (as Cupric Gluconate)	2 mg	100%
Selenium (as Selenium Enzyme)	70 mcg	100%
Lutein (from Marigold Flower Extract)	10 mg	100%
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Selection Sourcing Specification Standardization Safety Studies

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"Comprehensive Antioxidant" Support AMD, Diabetes, Thyroid, Glaucoma, Prevention, Wellness, Living...



AMD – drusen
Once per day for "low" zinc

Evidence Informed Risk Adjusted Medicine

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53-year-old man


- Family history of AMD
 - Dad with 43 injections for AMD
- Pre-diabetic with borderline HbA1c
- Vision 20/20 OU
- DFE- retina clear
- OCT normal
- Passes dark adaptation

CONGRATULATIONS ON TAKING THE FIRST STEPS
TOWARDS OPTIMIZING YOUR SCS

Dear [Name],

Recently, on 12/15/2020, you met with me and I examined the path of your hand with the BioPhotonic Scanner. Your score returned a Bio-Carotenoid Score (BCS) of 20.00.

This score represents the current carotenoid level of your skin. The higher the score, the more carotenoids your body is retaining.



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"Comprehensive Antioxidant" Support AMD, Diabetes, Thyroid, Glaucoma, Prevention, Wellness, Living...



Evidence Informed Risk Adjusted Medicine

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LifePak - Pharmanex

Ingredients	Amount	Daily Dose
Ascorbic Acid (Vitamin C)	2000 mg	2000 mg
Alpha-Tocopherol (Vitamin E)	1000 IU	1000 IU
Beta-Carotene (Vitamin A)	15,000 IU	15,000 IU
Lutein	20 mg	20 mg
Zeaxanthin	10 mg	10 mg
Omega-3 Fatty Acids (EPA/DHA)	1000 mg	1000 mg
Coenzyme Q10	100 mg	100 mg
Selenium	200 mcg	200 mcg
Copper	2 mg	2 mg
Manganese	5 mg	5 mg
Zinc	50 mg	50 mg
Biotin	5 mg	5 mg
Vitamin B12	1000 mcg	1000 mcg
Vitamin K2	100 mcg	100 mcg
Vitamin D3	1000 IU	1000 IU
Vitamin B6	10 mg	10 mg
Vitamin B9	1000 mcg	1000 mcg
Vitamin B1	10 mg	10 mg
Vitamin B2	10 mg	10 mg
Vitamin B3	10 mg	10 mg
Vitamin B4	10 mg	10 mg
Vitamin B5	10 mg	10 mg
Vitamin B7	10 mg	10 mg
Vitamin B8	10 mg	10 mg
Vitamin B9	10 mg	10 mg
Vitamin B10	10 mg	10 mg
Vitamin B11	10 mg	10 mg
Vitamin B12	10 mg	10 mg
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Vitamin B14	10 mg	10 mg
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Vitamin B95	10 mg	10 mg
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Vitamin B97	10 mg	10 mg
Vitamin B98	10 mg	10 mg
Vitamin B99	10 mg	10 mg
Vitamin B100	10 mg	10 mg

Selection
Sourcing
Specification
Standardization
Safety
Studies

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53-year-old man

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Questions and Thank You!

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