Red Foods for Clinical Success: The Therapeutic Power of Red Phytonutrients

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Disclosure

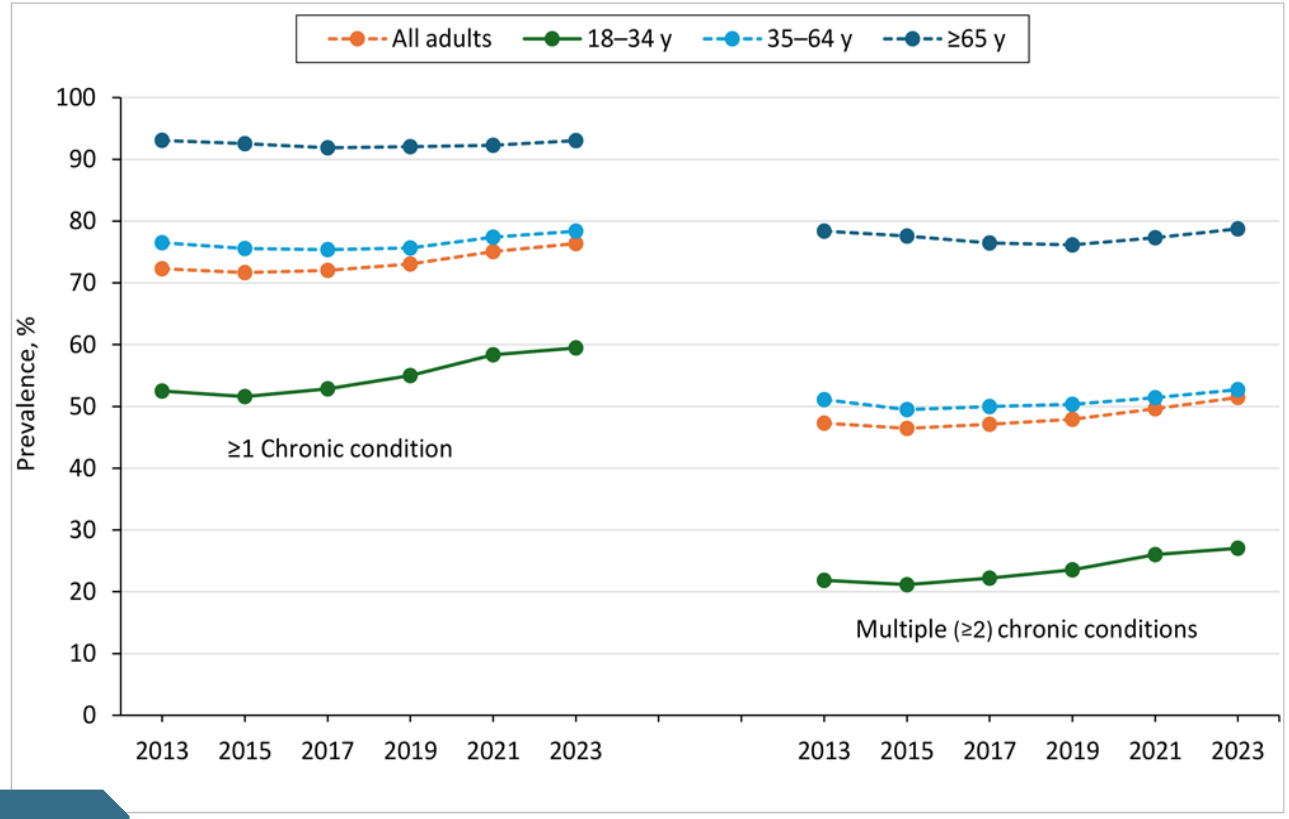
Sarah Clarke DC, IFMCP currently serves as the chiropractic liaison for Standard Process and is a clinical educator for the company.

Learning Objectives

- Discover how red phytonutrients promote health and the mechanisms through which they exert their effects.
- Understand the clinical implications of adding phytonutrients to a patient's diet through whole foods, whole food supplements, and isolated extracts.
- Learn how to leverage red phytonutrient-rich foods in clinical practice.

Reality of Chronic Health Epidemic in U.S.

- In 2023, 76.4% of US adults had at least 1 chronic condition
- 51.4% had multiple chronic conditions



Common conditions are obesity, high cholesterol and high blood pressure

Watson, K. et al. (2025). Prev Chronic Dis, 22

Role of Standard American Diet

Phytonutrient Poor

Highly processed SAD tends to be:

- High in refined sugars → high glycemic load
- Inflammatory
- Devoid of key nutrients

Diet can increase chronic disease risk

- High glycemic load worsens insulin sensitivity over time
- Increases oxidative stress
- Gut dysbiosis perpetuates chronic inflammation

Prevalence of the phytonutrient gap

- 78% of individuals worldwide do not consume recommended amount of phytonutrients
- 8/10 Americans have a gap in their phytonutrient intake
- 90% of Americans do not consume enough red phytonutrients

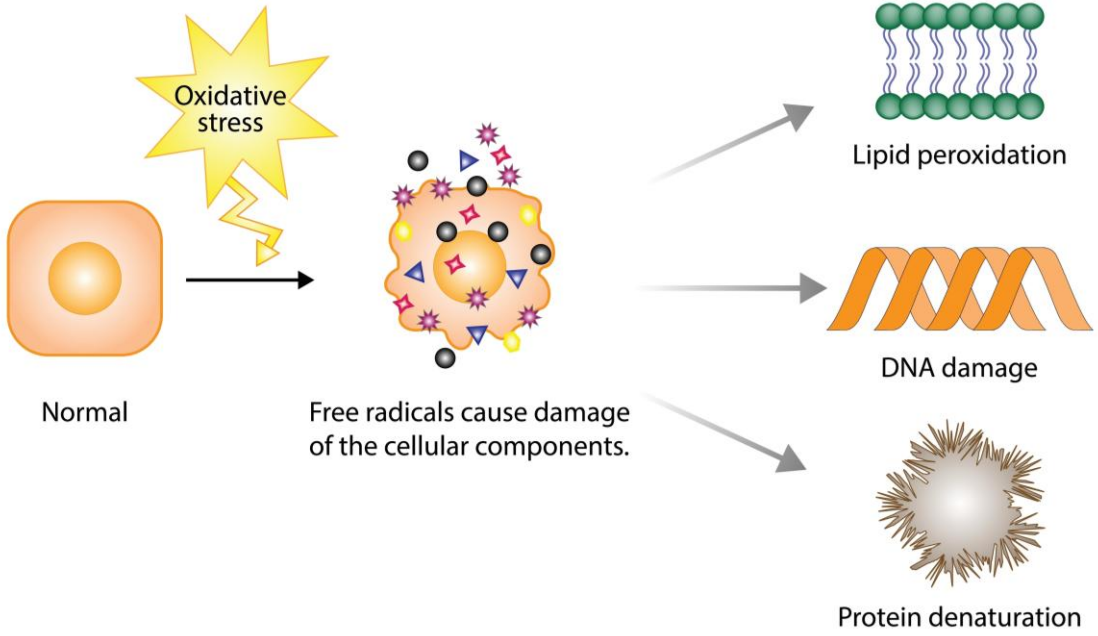
Dangers of the phytonutrient gap

- Lack of crucial antioxidant and anti-inflammatory compounds in the diet
- Higher consumption of fruits and vegetables lowers risk of all-cause mortality
- Red phytonutrients modulate oxidative stress and support healthy metabolism and cardiovascular health

The Dangers of Reactive Oxygen Species

Increases chronic disease risk

- Damages cellular membranes
- Creates lipid peroxidation
- Protein damage



*"The doctor of the future will give no medicine but will interest his patients in the care of the human frame, **in diet**, and in the cause and prevention of disease."*

-Thomas Edison, 1903

Power of the Phytochemical Rainbow

Anti-inflammatory

Antioxidant-rich

Provides cardiometabolic support

Neuroprotective benefits

The value of red phytonutrients

Anthocyanins, Carotenoids, Betalains

- Protect against oxidative stress, neuroinflammation, vascular and endothelial damage
- Potent antioxidant and anti-inflammatory effects
- Support vascular and cardiometabolic health

3 categories of red phytonutrients

Today's focus:

- **Anthocyanins**: Pelargonidin, Cyanidin, Peonidin
- **Carotenoids**: Lycopene and Astaxanthin
- **Betalains:** Betanin

Anthocyanins

Benefits of Anthocyanins

Potent pigments

- Responsible for red, blue, and purple pigments
- Powerful anti-inflammatory properties
- Neutralize free radicals and protein DNA, lipids, and proteins from oxidative damage
- Offer cardiovascular, cardiometabolic, and neuroprotective benefits

Anthocyanins

Pelargonidin

- Strawberries
- Radishes

Cyanidin

- Cherries
- Red raspberries
- Red cabbage
- Purple corn

Peonidin

- Grapes
- Purple carrots


Pelargonidin

Attenuates postprandial insulin response

2.5 servings of strawberries

- Consumed daily for 12 weeks improved overall cardiometabolic profile in adults with prediabetes
- Lowered serum insulin, fasting glucose, total cholesterol
- Reduced body weight and IL-6

Strawberries Improve Insulin Resistance and Related Cardiometabolic Markers in Adults with Prediabetes: A Randomized Controlled Crossover Trial

Improved glycemic control with strawberry supplementation

Improves HbA1c in type 2 diabetes

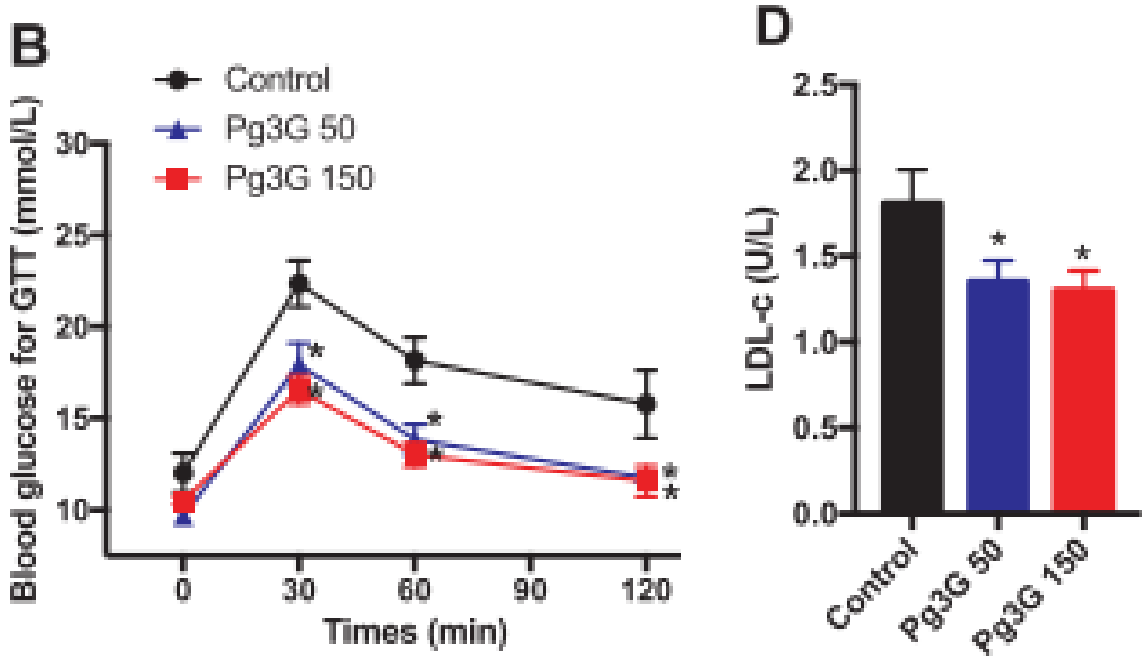
- Freeze dried strawberry beverage equivalent to 2.5 cups of strawberries
- Lowered inflammation (CRP) and lipid peroxidation (MDA)
- Reduced HbA1c (-5.7%) and increased total antioxidant status

Moazen, S. et al. Effects of freeze-dried strawberry supplementation on metabolic biomarkers of atherosclerosis in subjects with type 2 diabetes:*Annals of Nutrition & Metabolism* 2013;63(3):256-264

Pelargonidin-3-*O*-glucoside (Pg3G) from wild raspberry

Prevented hyperglycemia

- Altered genetic expression: upregulated 308 genes and downregulated 269 genes
- Improved glucose metabolism and lipid profiles
- Attenuated hepatic dysfunction

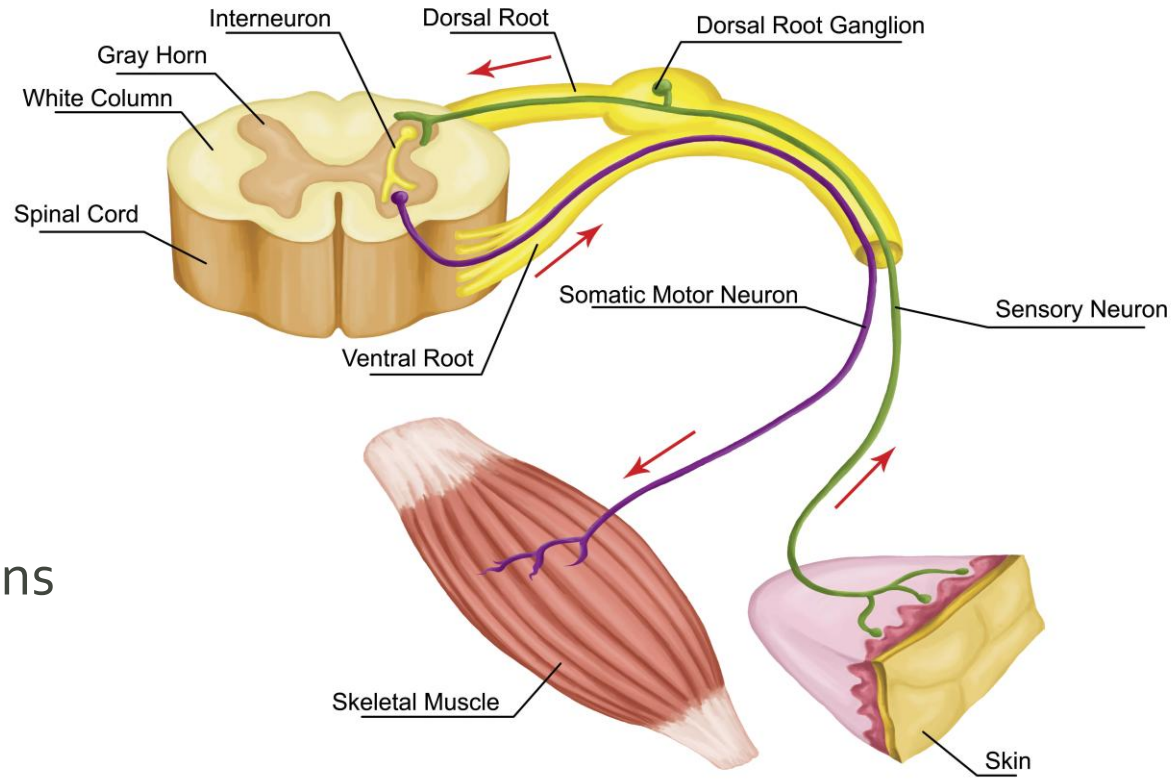


Su, H. et al. Transcriptome profiling reveals the antihyperglycemic mechanism of pelargonidin-3-O-glucoside extracted from wild raspberry. *Journal of Functional Foods* 2020;64:103641.

Pelargonidin improves recovery and modulates neuropathic pain

Following spinal cord injury

- Enhanced motor performance
- Restored MMP2 activity and decreased MMP9 activity
- Increased number of motor neurons in ventral horn of spinal cord following pelargonidin treatment



Kooshki, L. et al. Pelargonidin improves functional recovery and attenuates neuropathic pain following spinal cord injury in rats. *Frontiers in Pharmacology* 2025;16:1547187.


Cyanidin

Anti-inflammatory effects of cyanidin

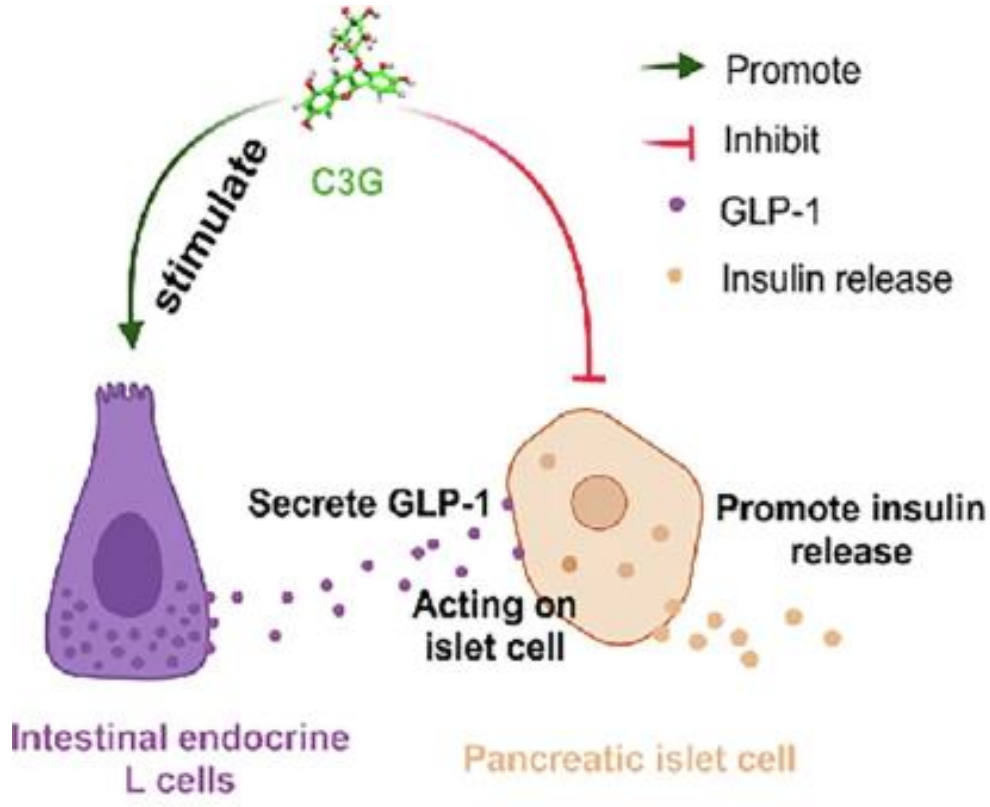
Potent antioxidant

- Inhibits NF-KB
- Shifts polarization from M1 phenotype to anti-inflammatory M2 phenotype
- Increases antioxidant enzymes
- Activates Nrf2/AMPK signaling pathway

Metabolic impact of cyanidin-3-o-glucoside (C3G)

Improves insulin sensitivity

- Cyanidin-3-O-glucoside (C3G) increased insulin levels by stimulating GLP-1 release from STC-1 cells
- Upregulates GLUT-1 and GLUT-4 expression
- Reduces lipid accumulation, improves obesity
- Stimulates mitochondrial biogenesis, boosts brown adipose tissue

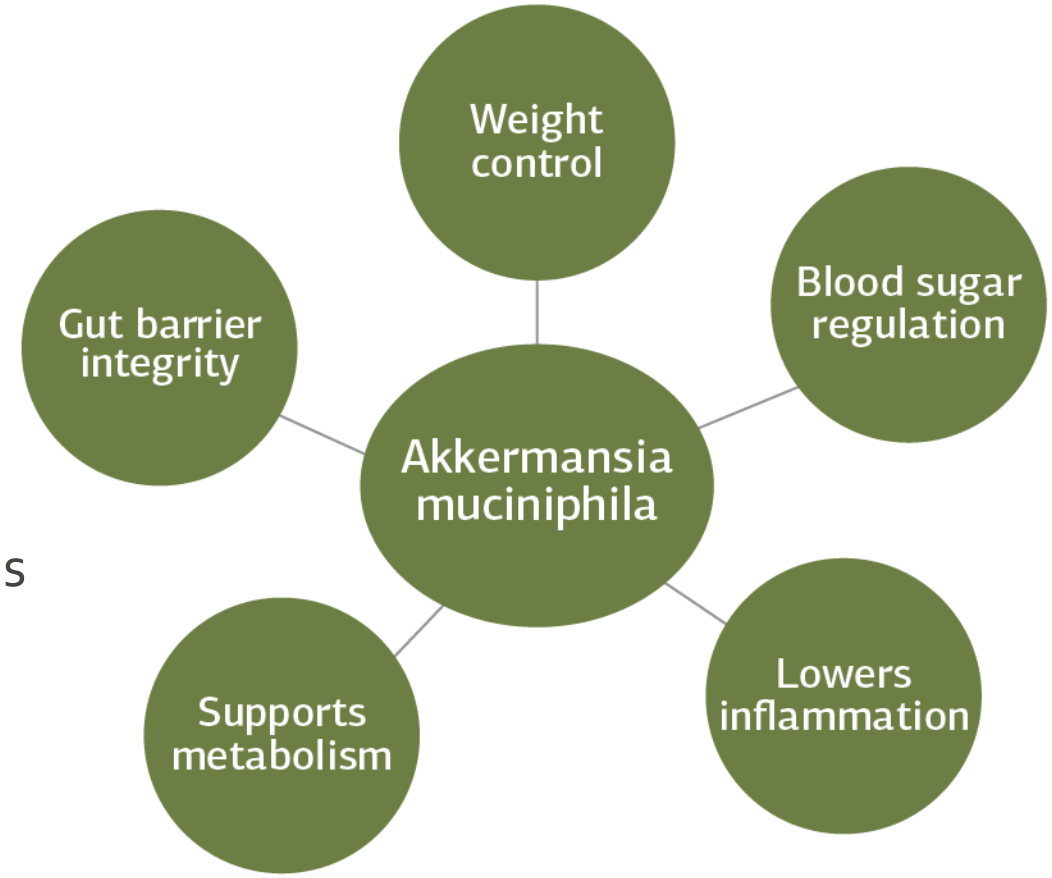


Ye, X. et al. Cyanidin-3-O-glucoside enhances GLP-1 secretion via PPARβ/δ-β-catenin-TCF-4 pathway in type 2 diabetes mellitus. *Science of Food* 2025;9:81.

Cyanidin and the gut connection

Gut microbiome impact

- Cyanidin promotes growth of Bifidobacteria and Akkermansia muciniphila
- Enhances mucosal integrity and reduces gut inflammation
- Inhibits the expression of pro-inflammatory TNF-alpha and IL-1B



Anti-carcinogenic effects of cyanidin

Cyanidin-3-o-glucoside

- Impaired tumor growth
- Increased tumor apoptosis
- Reduced inflammatory cytokines (IL-1B, TNF-a, C-reactive protein, IL-6)

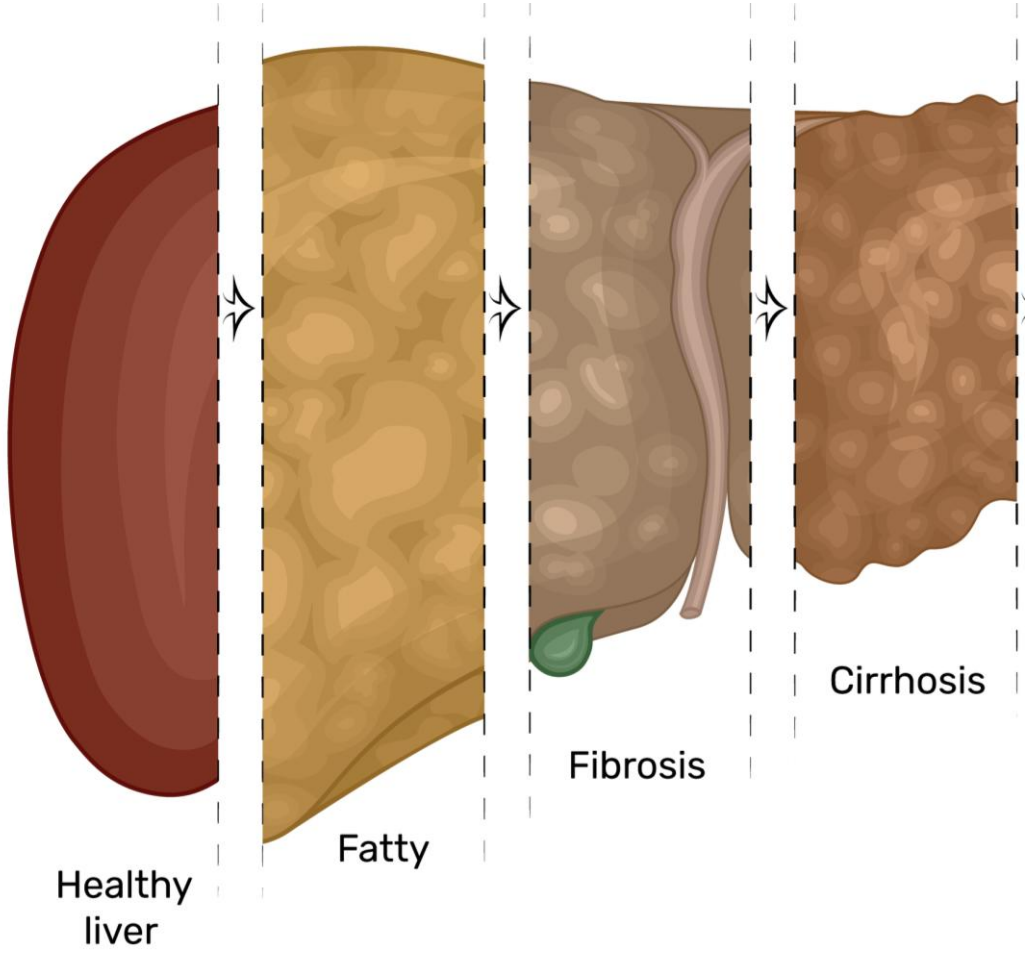
Wu, C.F. et al. The anticancer effects of cyanidin-3-O-glucoside combined with 5-fluorouracil on lung large-cell carcinoma in nude mice. *Biomedicine & Pharmacotherapy* 2022;151:113128.

Peonidin

Peodinin's effect on NAFLD

Peonidin-3-o-glucoside

- Reduced lipid accumulation
- Lowered oxidative stress markers
- Increased glutathione levels and enhanced SOD, GPx, and CAT
- Restored mitochondrial membrane potential



Hao, R. et al. Peonidin-3-O-glucoside ameliorates nonalcoholic fatty liver disease by regulating mitochondrial and lysosome functions to reduce oxidative stress and inflammation. *Nutrients* 2023;15(2):372.

Peodinin's neuroprotective benefits

Peonidin-3-o-glucoside

- Interferes with fibrillation of alpha synuclein protein
- Aggregations form Lewy bodies, seen in Parkinson's disease

The Anthocyanidin Peonidin Interferes with an Early Step in the Fibrillation Pathway of α−Synuclein and Modulates It toward Amorphous Aggregates

Pomegranates's potent anthocyanins

Cyanidin, pelargonidin, peonidin

- In vitro studies showed modulation of NF-KB, Cox-3, and anti-inflammatory effects in breast cancer cells
- Anti-proliferative effect and induced apoptosis in colon cancer cells

Rauf, A. The Role of Pom.Modulating Signaling Pathways. Food Sci Nutri (2025) 13(2).

Carotenoids: Lycopene & Astaxanthin

Lycopene: A key carotenoid

Lycopene

- Carotenoids are abundant dietary antioxidants in plasma and tissues
- Found in tomatoes, watermelon, pink grapefruit, guava
- More bioavailable in cooked products – the heat-induced isomerization moves from all-trans to a cis conformation

Lycopene's neuroprotective benefits

Lowers risk for neurodegenerative diseases

- Free radical quencher: 2x of beta-carotene, 10x more than a-tocopherol
- Protects against oxidative stress
- Downregulated MDA and 8-OHdG – key marker of oxidative stress

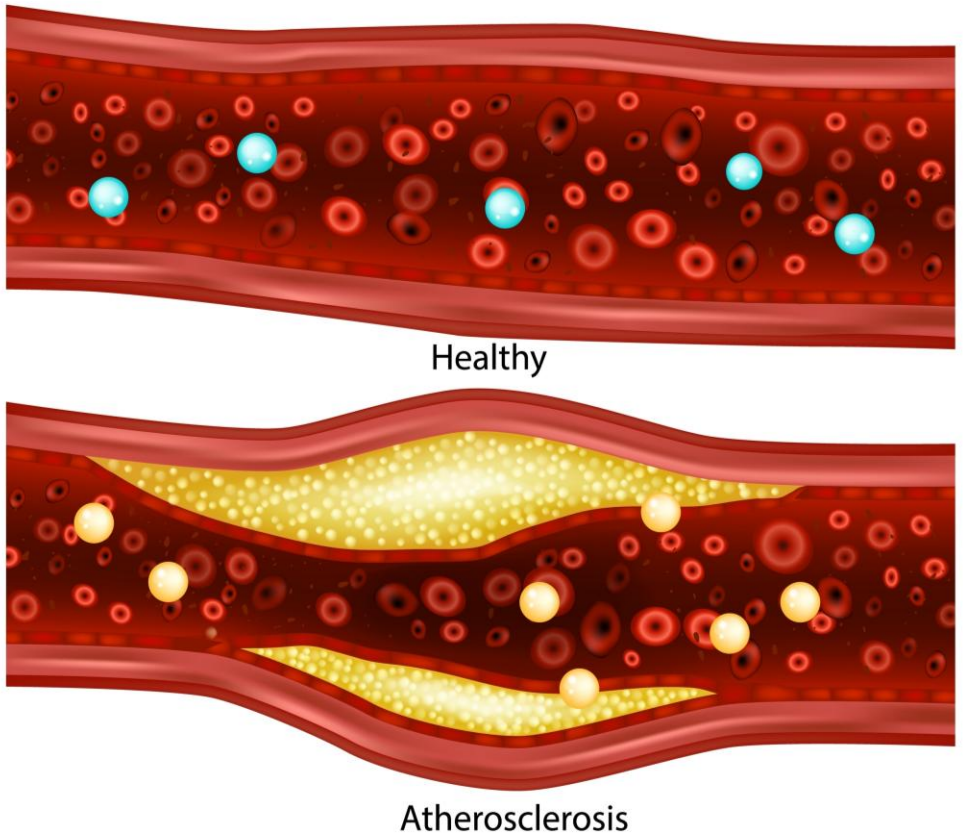
Ou, S. et al. Lycopene protects neuroblastoma cells against oxidative damage via depression of ER stress. *Journal of Food Science* 2020;85(10):3552-3561.

Vascular benefits of lycopene

Lowers cholesterol

- Inhibits HMG-CoA reductase
- Study found 25 mg per day, 10% reduction in LDL
- Performed similarly to statins

25 mg=1 cup of tomato sauce or 6-8 tomatoes

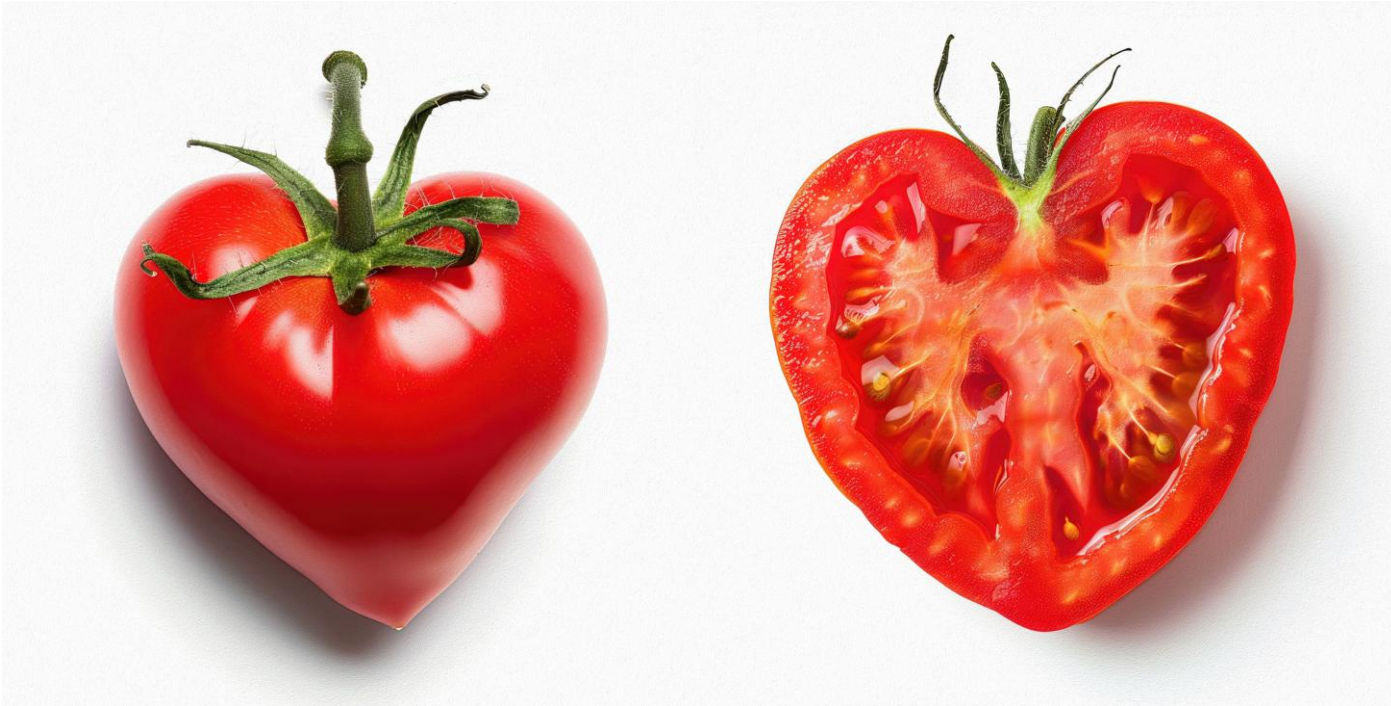


Ried, K. & Fakler, P. Protective effect of lycopene on serum cholesterol and blood pressure: meta-analyses of intervention trials. *Maturitas* 2011;68(4):299-310.

Lycopene

Protective against atherosclerosis and CVD

- Reduces oxidation of cholesterols (blocks HMG CoA Reductase)
- Increases HDL levels
- Lowers BP
- Improves CRP, IL-6 levels



Lycopene

Prostate Cancer

- Low lycopene was associated with higher levels of oxidation of lipids and proteins
- Serum and tissue lycopene levels were inversely related to prostate cancer
- > 10 servings per week of tomatoes, tomato sauce, tomato juice and pizza consumption were associated with lowered risk of prostate cancer

Zu, K. et al. Dietary lycopene, angiogenesis, and prostate cancer: a prospective study in the prostate-specific antigen era. *Journal of the Nat.Ca. Institute* 2014;106(2):430.

Astaxanthin

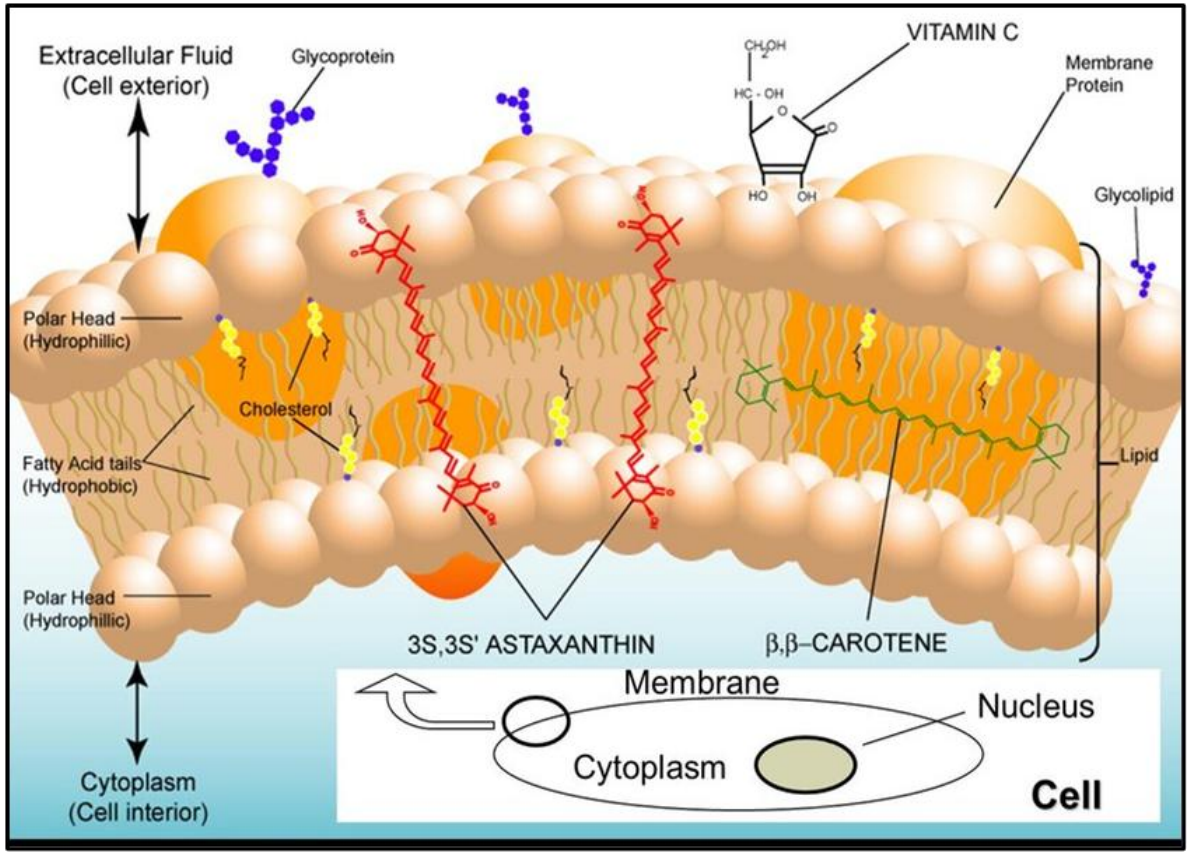
Key benefits

- Carotenoid found in marine animals like salmon, shrimp, lobster
- Gives tissue its red-orange color
- Antioxidant and anti-inflammatory properties

Astaxanthin

Cell membrane antioxidant

- 1,000x more potent than vitamin E
- 40x more effective than B-carotene
- Protects the lipid bilayer



Yamashita, E. Astaxanthin as a medical food, functional foods in health and disease 3, 254-258, 2013.

Astaxanthin

Strength endurance

4 mg/day Astaxanthin

Sourced from AstaReal® whole algal biomass

Duration: 6 months

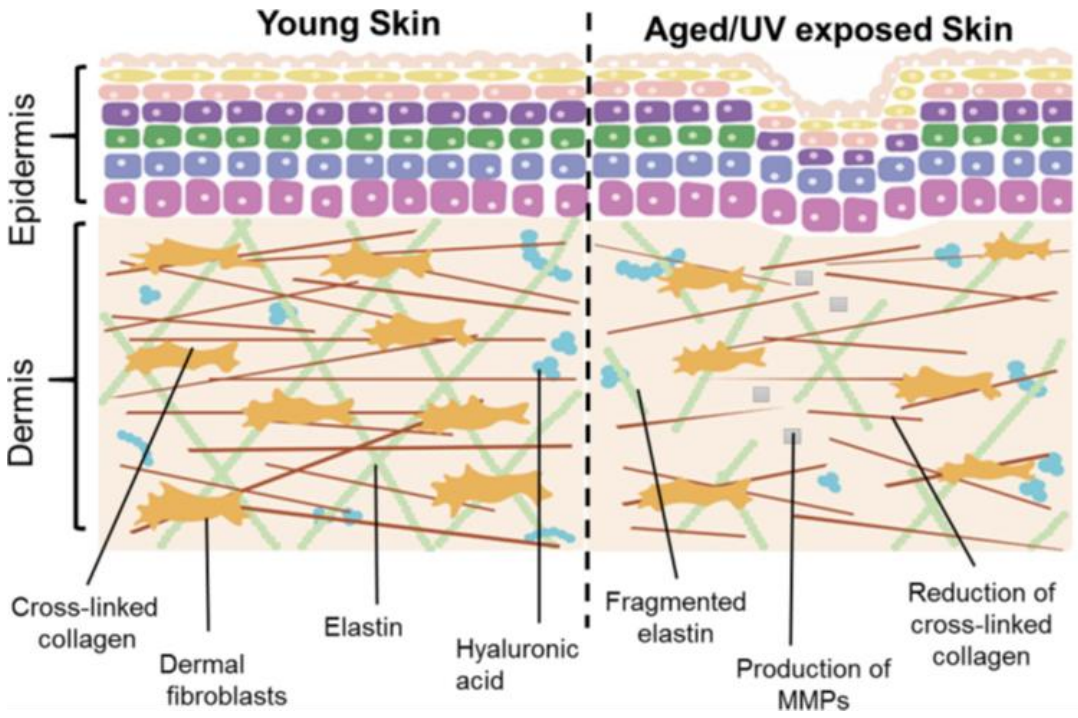
Knee-bending (squat) repetitions increased 3× more in AX group

Malmsten CL, Lignell Å, editors. Dietary Supplementation with Astaxanthin-Rich Algal Meal Improves Strength Endurance – A Double-Blind Placebo Controlled Study on Male Students –2009.

Astaxanthin skin benefits

Improvements were seen in:

- Skin wrinkles
- Elasticity
- Skin texture
- Reduction in age spot size



ATX benefits

Reduction of:
Skin dryness
Skin spots size
Erythema
Corneocyte debris
Microbe presence
MPPs gene expression

Improvement of:
Skin elasticity
Lipid droplet size
Skin moisture
Skin texture

Tominaga, K. et al. (2012). Acta Biochim Pol, 59, 43–47.

Support for healthy individuals

Protects against oxidative stress

- Healthy female college students
- Significant decrease in DNA damage - 8-OHdG
- Lowered inflammation - C-reactive protein
- Enhanced immune response – NK cell activity

Astaxanthin decreased oxidative stress and inflammation and enhanced immune response in humans

Betalains

Betalains

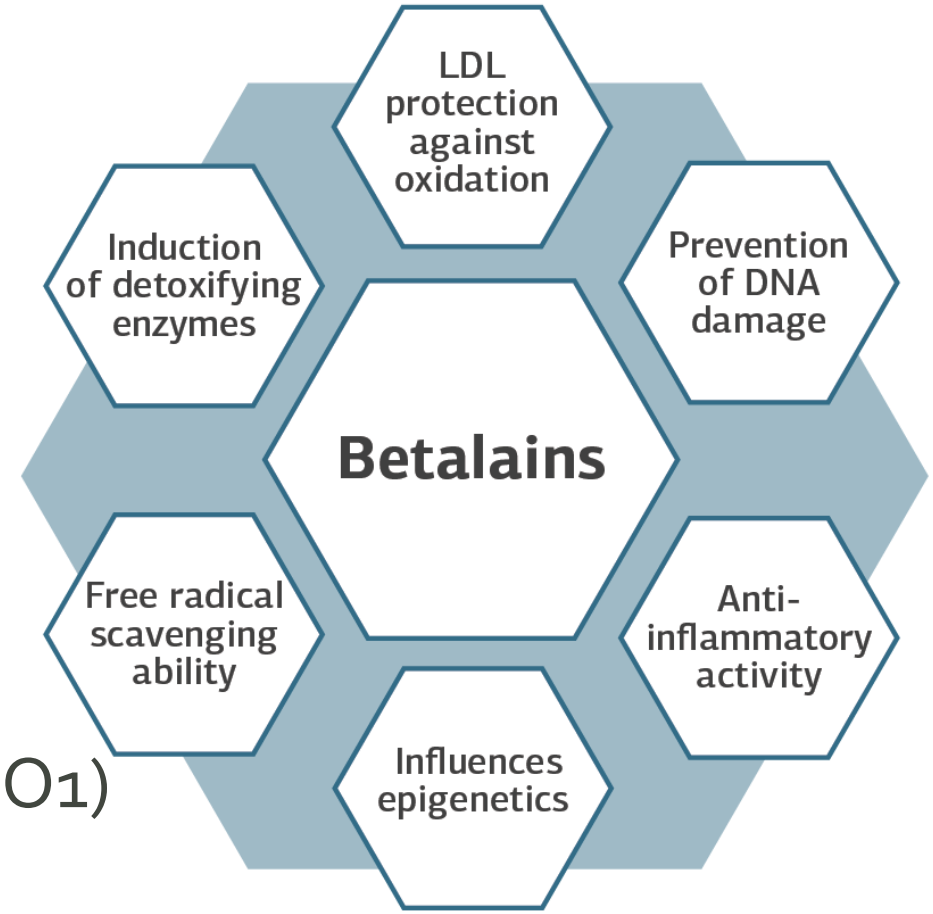
Pigments with benefits

- Nitrogen containing pigments found in beets, swiss chard, dragon fruit, mountain spinach, prickly pear
- Betacyanins are red-purple pigments
- Betanins are the red-violet pigments found in beets, swiss chard, mountain spinach

Major impacts of betanin

Influences multiple body systems

- Activates Nrf2
- Lower Nf-Kb and Cox-2
- Upregulates phase II detoxification (GST, NQO1)
- Supports insulin sensitivity in liver
- Lowers LDL



Red Beetroot

Postmenopausal mobility

Training 3x a week for 8 weeks

½ glass of beetroot juice 2-3 hours before each workout

- 40-meter increase in the six-minute walk test
- Heart rate recovery, decreasing by 10 beats per minute after the walk test

Randomized Controlled Trial

› Am J Physiol Regul Integr Comp Physiol. 2024 Dec 1;327(6):R534-R542.
doi: 10.1152/ajpregu.00150.2024. Epub 2024 Sep 9.

Preworkout dietary nitrate magnifies training-induced benefits to physical function in late postmenopausal women: a randomized pilot study

Stephen J Carter [1 2], Tyler H Blechschmid [1], Marissa N Baranauskas [3], Emily B Long [1], Allison H Gruber [1], John S Raglin [1], Kenneth Lim [4], Andrew R Coggan [5 6]

Betanin improved glycemic control

Supported glucose homeostasis

- Improved insulin sensitivity in rats with diabetes
- Enhanced lipid profile, liver enzymes, and glucose tolerance
- Upregulated AMPK and SIRT1
- Downregulated the NF-kB signaling pathway

The anti-diabetic effects of betanin in streptozotocin-induced diabetic rats through modulating AMPK/SIRT1/NF-κB signaling pathway

Vascular impact of betanin in red beetroot

Circulatory effects

- Supports nitric oxide production and vasodilation
- Reduces arterial stiffness
- Supports bile flow

Improves oxygen efficiency

Lowers oxygen cost during submaximal exercise.

Enhances performance adaptation

Supports greater endurance gains than nitrate salts.

Accelerates muscle recovery

Reduces soreness and preserves strength post-exercise.

Betalains and cardiovascular biomarkers

Supports cardiovascular health

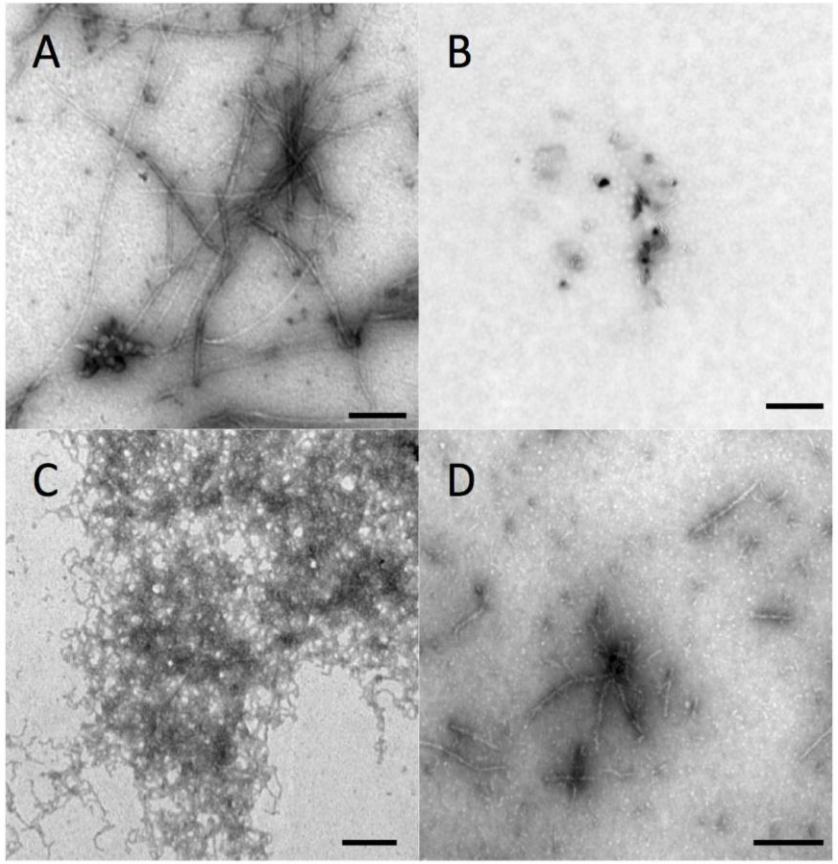
- Decreased homocysteine
- Lowered TG, TC, LDL
- Reduced glucose concentration
- Improved systolic BP

Effects of betalains on atherogenic risk factors in patients with atherosclerotic cardiovascular disease

Neuroprotective nature of betalains

Positive effects on neurodegeneration

- Improved learning and memory in rats with AD after 25-50 mg/kg of betanin for 9 days
- Reduced risk of ischemic brain injuries
- Found to reduce aggregation of beta amyloid proteins



Imamura, T. et al. Red-beet betalain pigments inhibit amyloid-β aggregation and toxicity in amyloid-β expressing *Caenorhabditis elegans*. *Scientific Reports* 2019;9:12932.

Summary of the impact of betalains

Influences multiple body systems

Support Lipids & Glucose: Lower LDL, triglycerides, BMI, and post-meal glucose in clinical studies.

Boost Antioxidant Defenses: Activate Nrf2 and upregulates detox enzymes.

Reduce Inflammation: Inhibit NF-κB and pro-inflammatory markers.

Mountain Spinach

Natural source of trivalent chromium

- Status declines with age
- Chromium depletes in extensive sweating
- Deficiency is linked to increased risk of metabolic and cardiovascular disorders
- Deficiency raises blood sugar and lipids
- Supplementation reversed these effects

Mountain spinach has been used in Mediterranean folk medicine to treat diabetes

Davies et al., *Metabolism*, 1997; 46(5):469–473
Cherrada N, et al. Antidiabetic medicinal plants from the Chenopodiaceae family. *Int J Food Prop*. 2024;27(1):194-213.

Mountain Spinach

Chromium and glycemic control

- Chromium activates insulin receptors and supports glucose uptake
- In diabetes models, chromium improved insulin sensitivity and cellular glucose handling

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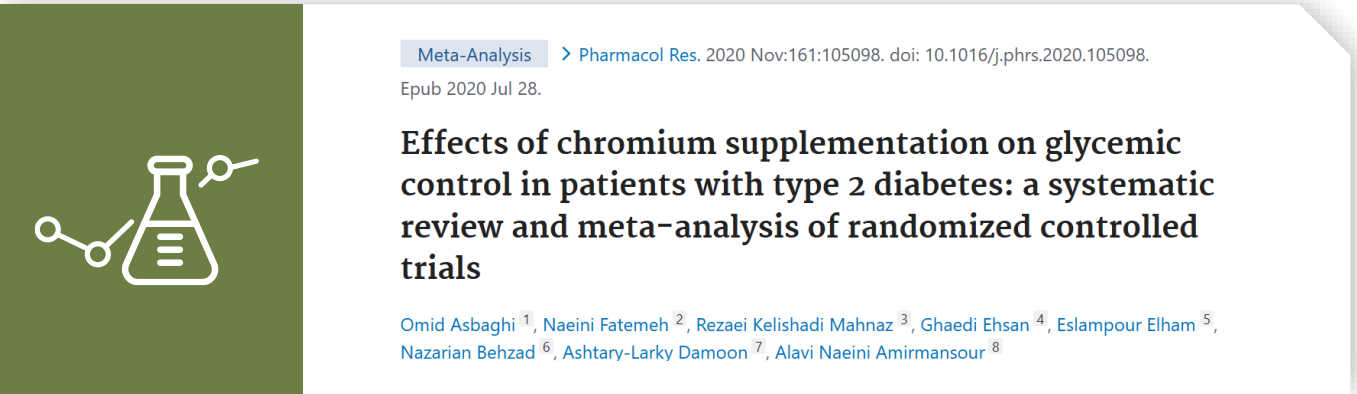
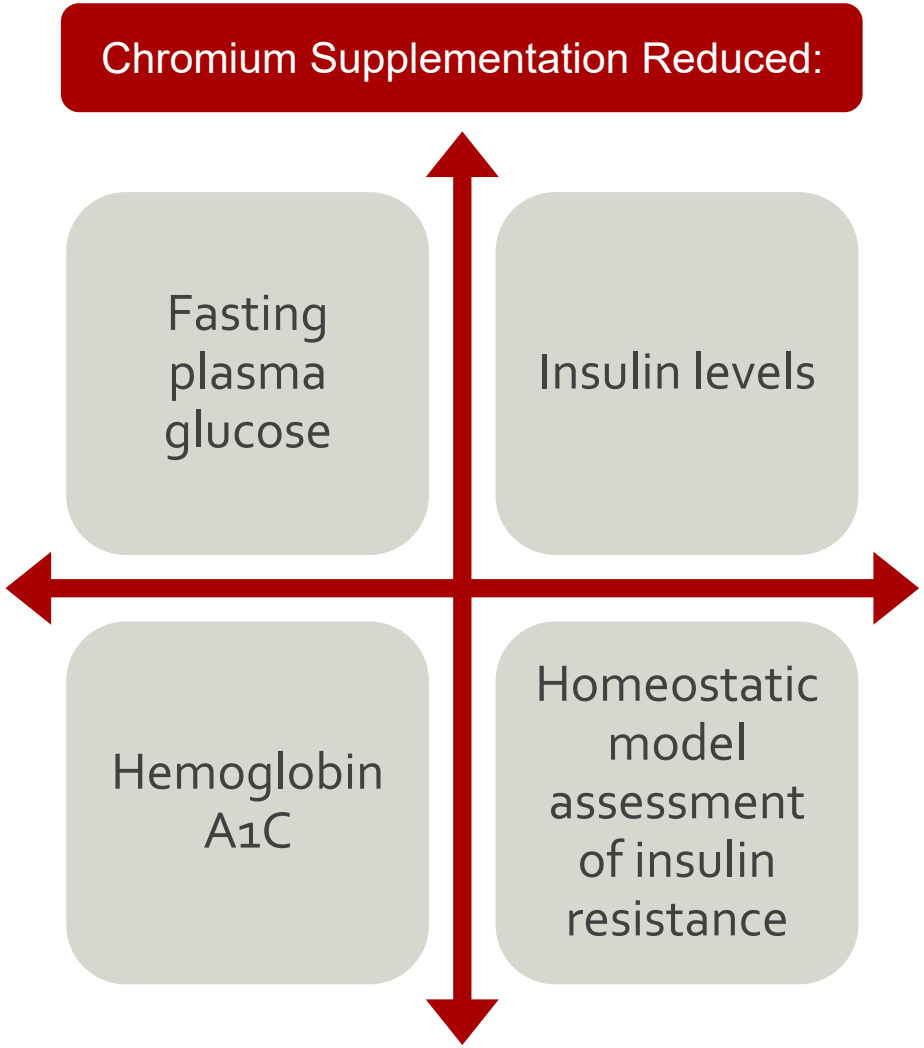


Meta-Analysis > Pharmacol Res. 2020 Nov:161:105098. doi: 10.1016/j.phrs.2020.105098. Epub 2020 Jul 28.

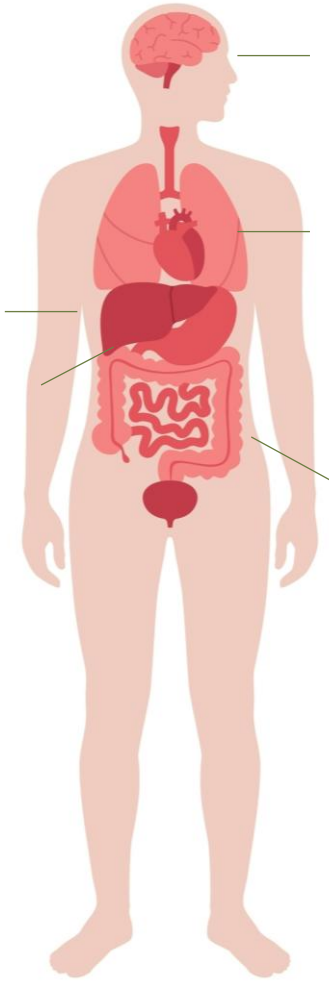
Effects of chromium supplementation on glycemic control in patients with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials

Omid Asbaghi [1], Naeini Fatemeh [2], Rezaei Kelishadi Mahnaz [3], Ghaedi Ehsan [4], Eslampour Elham [5], Nazarian Behzad [6], Ashtary-Larky Damoon [7], Alavi Naeini Amirmansour [8]



Rahimi K et al. Lancet. 2021;397(10285):1625–1636.

Red phytonutrients and their effects



Brain

Cardiovascular system

Liver

Pancreas

Gut microbiome

Inflammation and Oxidative Stress