

PRYSM IO

Scientific Research & Clinical Validation

RESEARCH OVERVIEW	
100+ Peer-Reviewed Studies	20+ Years of Research
21M+ Scans Performed	10M+ People Scanned Globally

Raman Measurement of Carotenoids in Living Tissues

A validated method for determining meaningful aspects of human health

Based on official Pharmanex documentation (March 2025)

Introduction

Over 100 full-length peer-reviewed articles validate the use of Raman spectroscopy for the measurement of carotenoids in living tissues. Additional abstracts presented at scientific symposiums further confirm the validity of this method.

The Pharmanex BioPhotonic Scanner uses resonant Raman light to detect concentrations of carotenoids in intact human skin as an indicator of nutritional intake and in vivo antioxidant status.

Featured in: *Krause's Food, Nutrition and Diet Therapy* (12th Ed.) and a complete chapter in *Carotenoids and Retinoids: Molecular Aspects and Health Issues* edited by Dr. Lester Packer.

PRYSM IO Validation Studies

1. Clinical Validation Study (2026)

Riggs M, Knaggs H, Lephart ED, Gibb T, Draelos ZD. Validation of a New Non-invasive Personalized RS-Skin Carotenoid Scanner (Prysm iO) versus the BioPhotonic Scanner S3. Food & Nutrition Journal, 11: 334.

Institutions: NSE Products Inc., Brigham Young University, Dermatology Consulting Services

Participants: 97 adults | IRB Approved (Allendale, Oct 2025)

Result: $R^2 = 0.7659$ (Prysm iO) vs $R^2 = 0.7789$ (S3) — equivalent accuracy

Conclusion: "Prysm iO was equivalent to the established BioPhotonic Scanner S3 to estimate carotenoid levels in humans."

2. Nu Skin Randomized Controlled Trial (2025)

Study Type: Randomized, double-blind, placebo-controlled | 46 healthy adults | 12 weeks

Results:

- 43-46% increase in skin carotenoid levels
- 71% reported higher energy | 75% improved health | 82% stronger immune support

3. Ongoing University Research

- Stanford Medicine — Dr. Anne Chang
- Jiao Tong University (China) — Dr. Cai
- Yonsei University (South Korea) — Dr. Hanjoe Kim

Studies by Pharmanex Scientists (9 Studies)

Full-length studies co-authored by in-house Pharmanex scientists using the BioPhotonic Scanner:

1. Lopresti AL, et al. (2024). Effects of a Nutraceutical Supplement on Cognition, Stress, Eye Health, and Skin Satisfaction. *Nutrients*, 16(11):1770. [[PMC11174377](#)]
2. Shelly NH, et al. (2021). A Nutritional Supplement Blend Improves Skin Attributes. *JOJ Dermatol & Cosmet*, 4(2): 555633.
3. Wood SM, et al. (2017). Protective effects on UV radiation-induced skin damage. *J Cosmet Dermatol*, 16(4):491-499.
4. Spitale RC, et al. (2012). Differential effects of dietary supplements on metabolomic profile. *Genome Med*, 4(2):14. [[PMC3392760](#)]
5. Zidichouski JA, et al. (2009). Clinical validation of a noninvasive Raman spectroscopic method. *J Am Coll Nutr*, 28(6):687-93. [[PMID:20516269](#)]
6. Bergeson SD, et al. (2008). Resonance Raman measurements using light-emitting diodes. *J Biomed Opt*, 13(4):044026.
7. Li CL, et al. (2006). New functions of carotenoids and clinical assessments. *Shanghai J Preventive Med*, 6:261-264.
8. Li CL, et al. (2006). Human Skin Carotenoids in 88,611 subjects. *Chinese J Clinical Pharmacy*, 15(2):124-125.
9. Smidt CR, Burke DS. (2004). Nutritional Significance and Measurement of Carotenoids. *Current Topics in Nutraceutical Research*, 2(2):79-91.

Third-Party Studies Using BioPhotonic Scanner (32 Studies)

Independent research groups conducted these studies:

10. Nolan JM, et al. (2022). Supplementation Has Positive Effect on Alzheimer's Disease. J Alzheimers Dis. [PMID:36093704]
11. Jilcott Pitts SB, et al. (2022). Meta-analysis: RRS skin carotenoids and plasma carotenoids. Nutr Rev, 80(2):230-241. [PMC8754254]
12. Toh DWK, et al. (2021). Skin carotenoid status and plasma carotenoids in Singaporean adults. Br J Nutr, 126(9):1398-1407.
13. Wengreen HJ, et al. (2021). FIT Game's Efficacy in Increasing Fruit and Vegetable Consumption. Nutrients, 13(8):2646. [PMC8399486]
14. Seguin-Fowler RA, et al. (2021). Fruit and Vegetable Intake Associated with Skin Carotenoids in Children. Nutrients, 13(3):980. [PMC8003042]
15. Horowitz M, et al. (2020). Preschooler nutrition education on carotenoid levels. Public Health Nutr, 23(13):2336-2344.
16. Green-Gomez M, et al. (2020). Impact of Formulation on Lutein, Zeaxanthin Bioavailability. Antioxidants, 9(8):767. [PMC7463514]
17. Jontony N, et al. (2020). Diet Quality, Carotenoid Status in NCAA Division I Athletes. Am J Health Behav, 44(4):432-443. [PMC7685237]
18. Tarshish E, et al. (2020). Effect of Oral Lycopene on Skin Ageing. Clinical Pharmacology & Biopharmaceutics, 9(2):195.
19. Morgan EH, et al. (2019). Serum carotenoids strongly associated with dermal carotenoids. Int J Behav Nutr Phys Act, 16(1):104. [PMC6852957]
20. Smith E, et al. (2019). Access With Education Improves Fruit and Vegetable Intake. J Nutr Educ Behav.
21. Whiteside-Mansell L, et al. (2019). Evaluation of WISE nutrition intervention. J Hunger Environ Nutr. [PMC7597824]
22. Li DG, et al. (2017). Dermal carotenoid inversely related to anxiety in breast cancer patients. J Investig Med.
23. Wengreen HJ, et al. (2017). Social norms messaging regarding skin carotenoid concentrations. Appetite, 116:39-44.
24. Nix E, Wengreen HJ. (2017). Social approval bias in self-reported fruit and vegetable intake. Appetite, 116:552-558.
25. Joyner D, et al. (2017). The FIT Game III. Games Health J, 6(2):111-118. [PMC5397199]
26. Spees CK, et al. (2016). Garden-Based Lifestyle Intervention for Cancer Survivors. Cancer Control, 23(3):302-10. [PMC5097863]
27. Morrill BA, et al. (2016). Randomized Controlled Trial of the Food Dudes Program. J Acad Nutr Diet, 116(4):618-29.
28. Janse VAN Rensburg A, et al. (2016). Validity and Reliability of Field RRS. J Nutr Sci Vitaminol, 62(5):317-321.
29. Perrone A, et al. (2016). Dermal Carotenoids in Breast Cancer Patients. Oxidative Med Cell Longevity. [PMC4861805]

30. Aguilar SS, et al. (2015). Skin Carotenoid Response to High-Carotenoid Juice in Children. *J Acad Nutr Diet*, 115(11):1771-8.
31. Norton MC, et al. (2015). The Gray Matters randomized trial for brain health. *Alzheimer's & Dementia*, 1(1):53-62.
32. Holt EW, et al. (2014). Low skin carotenoid associated with metabolic syndrome. *Nutr Res*.
33. Aguilar SS, et al. (2014). Skin carotenoids: biomarker of fruit and vegetable intake in children. *J Acad Nutr Diet*, 114(8):1174-80.
34. Jones BA, et al. (2014). Gamification of dietary decision-making in elementary-school. *PLoS One*, 9(4):e93872. [\[PMC3981730\]](#)
35. Wengreen HJ, et al. (2013). Food Dudes Program pilot study. *J Nutr Educ Behav*, 45(1):54-9.
36. Ramírez-Vélez R, et al. (2012). Non-invasive assessment of β -carotene in Colombian adults. *Endocrinol Nutr*.
37. Rerksuppaphol S, et al. (2012). Carotenoid intake and asthma prevalence in Thai children. *Pediatr Rep*, 4(1):e12. [\[PMC3357611\]](#)
38. Richer SP, et al. (2011). Zeaxanthin and Visual Function Study. *Optometry*, 82(11):667-680.
39. Lima XT, Kimball AB. (2011). Skin carotenoid levels in psoriasis patients. *J Eur Acad Dermatol Venereol*, 25(8):945-9.
40. Harpenau LA, et al. (2011). Nutritional supplementation on periodontal parameters. *J Calif Dent Assoc*, 39(5):309-318.
41. Rerksuppaphol S, et al. (2006). Fruit and vegetable intake on skin carotenoid by Raman. *J Med Assoc Thai*, 89(8):1206-12.

Independent Raman Device Studies (45 Studies)

Research groups designed their own Raman spectrometers, further confirming validity:

44. Ahn S, et al. (2024). Skin carotenoid status for estimating dietary intakes. *Nutrition*, 119:112304.
45. Ahn S, et al. (2023). Validation of RRS-measured skin carotenoid in Korean adults. *Br J Nutr*, 130(11):1993-2001.
46. Addo EK, et al. (2023). Prenatal Carotenoid Supplementation: L-ZIP Trial. *J Nutr*, 153(8):2205-2215. [[PMC10447612](#)]
47. Jahns L, et al. (2019). Skin carotenoid status as biomarker vs multiple 24h recalls. *Nutr J*, 18(1):78. [[PMC6873686](#)]
48. Conrady CD, et al. (2017). Correlations Between Macular, Skin, and Serum Carotenoids. *Invest Ophthalmol Vis Sci*, 58(9):3616-3627. [[PMC5520678](#)]
49. Beccarelli LM, et al. (2017). Using Skin Carotenoids to Assess Dietary Changes. *J Nutr Educ Behav*, 49(1):73-78.
50. Nguyen LM, et al. (2015). Plasma and skin carotenoids in elementary school children. *Arch Biochem Biophys*.
51. Jahns L, et al. (2014). Skin and plasma carotenoid response to high vegetable diet. *Am J Clin Nutr*, 100(3):930-7.
52. Darvin ME, et al. (2014). Sun exposure on cutaneous collagen and carotenoids. *J Biophotonics*.
53. Ermakov IV, et al. (2013). Carotenoid antioxidants in human bone. *J Biomed Opt*, 18(11):117006.
54. Ermakov IV, et al. (2013). Skin carotenoid measurements in newborns and infants. *J Biophotonics*, 6(10):793-802.
55. Henriksen BS, et al. (2013). Maternal carotenoid status and newborn macular pigment. *Invest Ophthalmol Vis Sci*, 54(8):5568-78. [[PMC3747792](#)]
56. Mayne ST, et al. (2013). RRS evaluation of skin carotenoids as biomarker. *Arch Biochem Biophys*. [[PMC3818359](#)]
57. Bernstein PS, et al. (2013). Macular pigment imaging in infants and children. *Invest Ophthalmol Vis Sci*, 54(6):4034-40. [[PMC3680006](#)]
58. Chan GM, et al. (2013). RRS and preterm infant carotenoid status. *J Pediatr Gastroenterol Nutr*, 56(5):556-9. [[PMC4115129](#)]
59. Scarmo S, et al. (2013). Single vs multiple measures of skin carotenoids. *Br J Nutr*, 110(5):911-7. [[PMC3696054](#)]
60. Darvin ME, et al. (2012). Comparison of two methods for noninvasive carotenoid determination. *J Biophotonics*.
61. Fluhr JW, et al. (2012). Tissue-tolerable plasma influences antioxidant profile. *Exp Dermatol*, 21(2):130-4.
62. Scarmo S, et al. (2012). Skin carotenoid as biomarker in preschool children. *Eur J Clin Nutr*, 66(5):555-60. [[PMC3380427](#)]

[Additional 26 skin studies from 2008-2012 in full reference document]

Macular Carotenoid Studies (17 Studies)

Raman resonance was first validated for detection of carotenoids in intact human retinas:

89. Addo EK, et al. (2024). Ocular Effects of Prenatal Carotenoid Supplementation: L-ZIP Trial Report 2. *Ophthalmol Sci*, 4(5):100537. [PMCID:11283155]
90. Bernstein PS, et al. (2012). Macular Pigment Imaging in AREDS2 Participants. *Invest Ophthalmol Vis Sci*, 53(10):6178-86. [PMCID:3444209]
91. Ward MS, et al. (2008). Macular and serum carotenoids in malabsorption syndromes. *J Ocul Biol Dis Infor*, 1(1):12-8. [PMCID:2600549]
92. Sharifzadeh M, et al. (2008). Resonance Raman imaging of macular pigment. *J Opt Soc Am*, 25(4):947-57. [PMCID:3079576]
93. Ermakov IV, et al. (2005). Simple Raman instrument for macular pigments. *Appl Spectrosc*, 59(7):861-7. [PMCID:3079574]
94. Neelam K, et al. (2005). Macular Pigment: Raman Spectroscopy vs Heterochromatic Flicker Photometry. *Invest Ophthalmol Vis Sci*, 46(3):1023-1032.
95. Ermakov I, et al. (2004). Macular pigment Raman detector for clinical applications. *J Biomed Opt*, 9(1):139-48. [PMCID:3086335]
96. Bernstein PS, et al. (2004). Resonance Raman measurement of macular carotenoids. *Arch Biochem Biophys*, 430(2):163-9.
97. Gellermann W, Bernstein PS. (2004). Noninvasive detection of macular pigments. *J Biomed Opt*, 9(1):75-85.
98. Zhao DY, et al. (2003). Macular carotenoids in retinal, choroidal, and macular dystrophies. *Arch Ophthalmol*, 121(7):967-72.
99. Gellermann W, et al. (2002). Raman imaging of human macular pigments. *Optics Letters*, 27(1):833-835.
100. Gellermann W, et al. (2002). In vivo resonant Raman measurement of macular carotenoid pigments. *J Opt Soc Am*, 19(6):1172-86.
101. Bernstein PS, et al. (2002). Macular carotenoids in normal subjects and AMD patients. *Ophthalmology*, 109(10):1780-7. [PMCID:3079575]
102. Bernstein PS, Gellermann W. (2002). Measurement of carotenoids in living primate eye. *Methods Mol Biol*, 196:321-9.
103. Bernstein PS. (2002). Macular carotenoids in age-related macular degeneration. *Pure Appl Chem*, 74(8):1419-1425.
104. Ermakov IG, et al. (2001). Resonant Raman detection of macular pigments. *Optics Letters*, 26(4):202-204.
105. Bernstein PS, et al. (1998). Raman detection of macular carotenoid pigments. *Invest Ophthalmol Vis Sci*, 39(11):2003-11.

Book Chapters & Textbook References

1. *Carotenoids and Retinoids: Molecular Aspects and Health Issues* — Gellermann W, et al. "Raman Detection of Carotenoids in Human Tissue." Ch. 6, 86-114. AOCS Press, 2005.

2. *Krause's Food, Nutrition and Diet Therapy* (12th Ed.) — Ch. 15, 427-428. Saunders, 2007. The most authoritative nutrition text for 50+ years worldwide.

Conference Abstracts

An additional 30 abstracts have been presented at scientific symposiums including FASEB, American Dietetic Association, American College of Sports Medicine, and Utah Academy of Nutrition and Dietetics conferences (2003-2020). Full list available in source document.

TOTAL: 135 CITATIONS

100+ full-length peer-reviewed articles | 30+ conference abstracts | 2 book chapters

Source: Official Pharmanex Scientific Documentation (Updated March 2025)