

# Astaxanthin: The Key to a New You

by [Michael Ash](#) / Thursday, 29 August 2019 / Published in [Reviews](#)  
Reading Time: 9 minutes

## *The Microalgae-Sourced Carotenoid That Delivers Broad Spectrum Antiaging Benefits*

Pronounced “as-ta-ZAN-thin,” this word can be a mouthful at first. Even more of a mouthful is astaxanthin’s primary natural source, *Haematococcus pluvialis*, the microalgae that produces it as a protective antioxidant in response to light or other environmental stressors. Bright red in colour, this antioxidant bioaccumulates in organisms that eat it, and it is responsible for the pink to reddish hue of krill, shrimp, salmon, and even flamingos.

Astaxanthin is a potent antioxidant, with studies showing it provides significantly greater antioxidant protection than the carotenoids beta carotene, lycopene, and lutein as well as alpha-tocopherol, and thus it is considered one of the best agents for protecting cellular membranes.[\[1\]](#)[\[2\]](#)[\[3\]](#) Natural astaxanthin has been shown to be 20 times more potent than synthetic astaxanthin in eliminating free radicals.[\[4\]](#) Astaxanthin is not produced by mammals, so it must be obtained from the diet.[\[5\]](#)

Wild sockeye salmon is the best dietary source of astaxanthin, providing approximately 1 mg per ounce of flesh.[\[6\]](#) Much of the astaxanthin used in the fish-farming industry is produced by synthetic processes or yeast, which also affects the stereoisomers of astaxanthin found in these products—so much that it has been considered for use as a marker in evaluation of salmon source. Wild salmon primarily feed on krill and copepods, and thus contain primarily the 3S,3’S isomer (the main form produced by *H. pluvialis*), modest amounts of the 3R,3’R isomer (the main form produced by yeast), and very little of the 3R,3’S isomer (the main form found in synthetic astaxanthin)[\[7\]](#)[\[8\]](#)[\[9\]](#)—giving further reason to make the more natural choice.

As astaxanthin is a fat-soluble carotenoid, absorption and retention of supplemental astaxanthin is much higher (the area under the curve being more than double) if taken immediately after meals rather than away from food.[\[10\]](#) Despite being a carotenoid, in mammals astaxanthin does not have any provitamin A activity.[\[11\]](#) Studies have shown supplementation of astaxanthin to be incredibly safe, with no significant side effects—although, like other carotenoids, it has the potential to affect the colour of the skin if taken at high doses for prolonged periods.<sup>6</sup> That being said, such an effect has only been observed in animals, and doses of up to 100 mg as a single event and 40 mg daily for four weeks in humans were well tolerated with no skin changes or other adverse events reported.[\[12\]](#)[\[13\]](#) Because astaxanthin takes time to accumulate in the regions of the body where its benefits have been seen, clinical studies look at supplementation for a period of at least four weeks before re-evaluation of parameters.

Substantial clinical and preclinical research exists (a simple PubMed search for “astaxanthin” filtered by “humans” shows 365 publications, with approximately 50 being clinical trials) on the health benefits of this potent membrane-protective antioxidant, which also easily passes through the blood–brain and blood–retinal barrier.[\[14\]](#)[\[15\]](#) Numerous studies have shown astaxanthin supplementation may be beneficial for many of the processes and organs in the body that are challenged with aging: the brain, eyes, and skin.[\[16\]](#) Energy levels, mood,

## **Protection Against Age-Related Challenges**

With increasing age, we also experience the slowly declining function of many organs and systems, much attributable to oxidative damage and inflammation. Cellular senescence, the reduced ability for cells to grow and proliferate, typifies the aging process and is promoted by oxidative stress and other factors.[\[20\]](#) Therefore, it is not surprising that astaxanthin, with its ability to reduce oxidative damage,[\[21\]](#) promote healthy levels of inflammation,[\[22\]](#) and detoxify the body from environmental factors that trigger a pro-inflammatory and oxidative state,[\[23\]](#)[\[24\]](#) has been shown to help reduce changes we often see with aging.

## **Brain Health and Function.**

Numerous studies point toward inflammation and oxidative stress as contributors to age-related cognitive decline and dementia.<sup>[25].<sup>[26]</sup></sup> As a fat-soluble nutrient with an affinity for fatty tissues like the brain,<sup>[27]</sup> astaxanthin is an antioxidant of choice for cognitive health and neuroprotection.

The research behind astaxanthin as a nutrient that supports brain health is well summarised in a 2017 review published in the journal *GeroScience*:

“Evidence suggests that astaxanthin may be a useful compound in delaying or ameliorating cognitive impairment associated with normal aging or alleviating the pathophysiology of various neurodegenerative diseases.”<sup>14</sup>

Astaxanthin helps protect the brain against numerous insults, including aluminum<sup>23</sup> (a central nervous system toxin linked with the development of Alzheimer’s disease),<sup>[28]</sup> tobacco smoke,<sup>24</sup> chemotherapy drugs,<sup>[29].<sup>[30]</sup></sup> and other toxic substances.<sup>[31].<sup>[32]</sup></sup> It induces proliferation of neural progenitor cells and promotes neurogenesis and neuroplasticity,<sup>14.<sup>[33]</sup></sup> each of which decline with increasing age. Astaxanthin increases levels of brain-derived neurotrophic factor (BDNF),<sup>[34]</sup> a growth factor that is important not only for nerve growth in the brain and periphery but also cardiovascular health.<sup>[35]</sup>

Multiple randomised, double-blind, placebo-controlled trials (RDBPCTs) have assessed the impact of astaxanthin on cognitive function. At a dosage of 12 mg/day, scores for the CogHealth test battery (a standardised test that assesses multiple domains of cognitive function), as well as maze learning rate, improved in individuals 45 to 64 years of age with complaints of age-related forgetfulness.<sup>[36]</sup> In another study of 45-to-64-year-olds (without cognitive complaints), at a dose of 8 mg/day, word recall was significantly improved in individuals under the age of 55 in the astaxanthin group compared to placebo.<sup>[37]</sup>

An additional RDBPCT found that the combination of 12 mg of astaxanthin with a low dose (20 mg) of tocotrienols significantly reduced perceived mental and physical fatigue, improving number of errors, clarity of thinking, concentration, motivation, and mood compared to placebo (tocotrienols only) in healthy subjects undergoing mental and physical challenge tests.<sup>[38]</sup> Finally, a RDBPCT assessed the impact of astaxanthin supplementation, at a dose of 6 or 12 mg/day, on levels of erythrocyte phospholipid hydroperoxides (PLOOH) (a phospholipid oxidation product possibly associated with neurodegenerative disease<sup>[39]</sup>), finding that, at both doses, this parameter significantly improved compared to placebo.<sup>[40]</sup>

## **Vision.**

Many age-related ocular health conditions are a result of ultraviolet (UV) exposure, which causes oxidative damage to the cornea, lens, and retina of the eye.<sup>[41].<sup>[42]</sup></sup> Because of its accumulation in the eye,<sup>[43]</sup> and protection it offers against ocular UV damage,<sup>[44]</sup> the impact of astaxanthin on visual health has been studied in a variety of settings.

Animal studies have shown astaxanthin helps protect against photokeratitis,<sup>[45]</sup> cataract formation,<sup>[46]</sup> and retinal damage associated with increased intraocular pressure.<sup>[47]</sup> In humans, RDBPCTs have shown that astaxanthin, at a dosage of 6 mg/day, significantly improves visual accommodation and reduces symptoms of eye fatigue,(another indicator of eye health).<sup>[50]</sup> At a dosage of 12 mg/day, far visual acuity and choroidal blood flow were also observed to significantly improve.<sup>[51].<sup>[52]</sup></sup>

## **Skin.**

Astaxanthin can also improve the health of the skin, another organ challenged by aging, as it protects against age-related changes, promotes wound healing, and helps mitigate inflammation and cellular damage due to UV light exposure.<sup>[53].<sup>[54]</sup></sup> In animal studies, astaxanthin has been shown to reduce UV-induced inflammation

and apoptosis,<sup>44</sup> [55] as well as increase the amount of collagen and growth factors, [56] [57] which can enhance wound healing and improve age-related changes.

In numerous human studies, oral supplementation of astaxanthin at a dose of between 2 to 12 mg/day (most often 6 mg/day) has been shown to reduce various parameters related to wrinkles, increasing skin elasticity and moisture content.<sup>44</sup> In one of the larger RDBPCTs, the impact of dosage was also investigated, finding that 12 mg was more effective than 6 mg in reducing inflammation; however, both doses significantly reduced wrinkle parameters and improved moisture content. [58] In an open-label pilot trial, supplementation of astaxanthin at 6 mg/day was also shown to improve age spot size and skin texture. [59]

Although there is no denying the governance of Father Time, at least we have tools like astaxanthin to help us maintain our youthful capabilities, appearance, and vigour and improve our healthspan (*the period of one's life that one is healthy, or, at least, free of serious disease* [60]).

## References

- [1] O'Connor I, O'Brien N. Modulation of UVA light-induced oxidative stress by beta-carotene, lutein and astaxanthin in cultured fibroblasts. *J Dermatol Sci*. 1998 Mar;16(3):226-30.
- [2] Kurashige M, et al. Inhibition of oxidative injury of biological membranes by astaxanthin. *Physiol Chem Phys Med NMR*. 1990;22(1):27-38.
- [3] Rodrigues E, et al. Scavenging capacity of marine carotenoids against reactive oxygen and nitrogen species in a membrane-mimicking system. *Mar Drugs*. 2012 Aug;10(8):1784-98.
- [4] Capelli B, et al. Synthetic astaxanthin is significantly inferior to algal-based astaxanthin as an antioxidant and may not be suitable as a human nutraceutical supplement. *Nutrafoods*. 2013 Dec 1;12(4):145-52.
- [5] Guerin M, et al. Haematococcus astaxanthin: applications for human health and nutrition. *Trends Biotechnol*. 2003 May;21(5):210-6.
- [6] Ambati RR, et al. Astaxanthin: sources, extraction, stability, biological activities and its commercial applications—a review. *Mar Drugs*. 2014 Jan 7;12(1):128-52.
- [7] Renstrøm B, et al. Optical purity of (3S, 3'S)-astaxanthin from *Haematococcus pluvialis*. *Phytochemistry*. 1981 Jan 1;20(11):2561-4.
- [8] Megdal PA, et al. A simplified method to distinguish farmed (*Salmo salar*) from wild salmon: fatty acid ratios versus astaxanthin chiral isomers. *Lipids*. 2009 Jun;44(6):569-76.
- [9] Bjerkeng B. Chromatographic analysis of synthesized astaxanthin—a handy tool for the ecologist and the forensic chemist? *The Progressive Fish-Culturist*. 1997 Apr;59(2):129-40.
- [10] Okada Y, et al. Bioavailability of astaxanthin in *Haematococcus* algal extract: the effects of timing of diet and smoking habits. *Biosci Biotechnol Biochem*. 2009 Sep;73(9):1928-32.
- [11] Jyonouchi H, et al. Astaxanthin, a carotenoid without vitamin A activity, augments antibody responses in cultures including T-helper cell clones and suboptimal doses of antigen. *J Nutr*. 1995 Oct;125(10):2483-92.
- [12] Østerlie M, et al. Plasma appearance and distribution of astaxanthin E/Z and R/S isomers in plasma lipoproteins of men after single dose administration of astaxanthin. *J Nutr Biochem*. 2000 Oct;11(10):482-90.
- [13] Andersen LP, et al. Gastric inflammatory markers and interleukins in patients with functional dyspepsia treated with astaxanthin. *FEMS Immunol Med Microbiol*. 2007 Jul;50(2):244-8.

- [14] Grimmig B, et al. Neuroprotective mechanisms of astaxanthin: a potential therapeutic role in preserving cognitive function in age and neurodegeneration. *Geroscience*. 2017 Feb;39(1):19-32.
- [15] Naguib YM, et al. Antioxidant activities of astaxanthin and related carotenoids. *J Agric Food Chem*. 2000 Apr;48(4):1150-4.
- [16] Kidd P. Astaxanthin, cell membrane nutrient with diverse clinical benefits and anti-aging potential. *Altern Med Rev*. 2011 Dec;16(4):355-64.
- [17] Talbott S, et al. Astaxanthin Supplementation Reduces Depression and Fatigue in Healthy Subjects. *EC Nutrition*. 2019;14(3):239-46.
- [18] Comhaire FH, et al. Combined conventional/antioxidant “Astaxanthin” treatment for male infertility: a double blind, randomized trial. *Asian J Androl*. 2005 Sep;7(3):257-62.
- [19] Brown DR, et al. Astaxanthin in Exercise Metabolism, Performance and Recovery: A Review. *Front Nutr*. 2018 Jan 18;4:76.
- [20] Campisi J, et al. Cellular senescence: when bad things happen to good cells. *Nat Rev Mol Cell Biol*. 2007 Sep;8(9):729-40.
- [21] Choi HD, et al. Effects of astaxanthin on oxidative stress in overweight and obese adults. *Phytother Res*. 2011 Dec;25(12):1813-8.
- [22] Biswal S. Oxidative stress and astaxanthin: The novel supernutrient carotenoid. *Int J Health Allied Sci*. 2014 Jul 1;3(3):147.
- [23] Al-Amin MM, et al. Astaxanthin ameliorates aluminum chloride-induced spatial memory impairment and neuronal oxidative stress in mice. *Eur J Pharmacol*. 2016 Apr 15;777:60-9.
- [24] Yang X, et al. Astaxanthin attenuates environmental tobacco smoke-induced cognitive deficits: a critical role of p38 MAPK. *Mar Drugs*. 2019 Jan 3;17(1):24.
- [25] Padurariu M, et al. The oxidative stress hypothesis in Alzheimer’s disease. *Psychiatr Danub*. 2013 Dec;25(4):401-9.
- [26] Akiyama H, et al. Inflammation and Alzheimer’s disease. *Neurobiol Aging*. 2000 May-Jun;21(3):383-421.
- [27] Manabe Y, et al. Dietary astaxanthin can accumulate in the brain of rats. *Biosci Biotechnol Biochem*. 2018 Aug;82(8):1433-6.
- [28] Mirza A, et al. Aluminum in brain tissue in familial Alzheimer’s disease. *J Trace Elem Med Biol*. 2017 Mar;40:30-6.
- [29] El-Agamy SE, et al. Astaxanthin ameliorates doxorubicin-induced cognitive impairment (chemobrain) in experimental rat model: impact on oxidative, inflammatory, and apoptotic machineries. *Mol Neurobiol*. 2018 Jul;55(7):5727-40.
- [30] Findik H, et al. The protective effects of astaxanthin against cisplatin-induced retinal toxicity. *Cutan Ocul Toxicol*. 2019 Mar;38(1):59-65.
- [31] Liu X, et al. Astaxanthin inhibits reactive oxygen species-mediated cellular toxicity in dopaminergic SH-SY5Y cells via mitochondria-targeted protective mechanism. *Brain Res*. 2009;1254:18-27.

- [32] Ye Q, et al. Astaxanthin protects against MPP(+)-induced oxidative stress in PC12 cells via the HO-1/NOX2 axis *BMC. Neurosci.* 2012;13:1471-2202.
- [33] Kim JH, et al. Astaxanthin improves stem cell potency via an increase in the proliferation of neural progenitor cells. *Int J Mol Sci.* 2010;11(12):5109-19.
- [34] Wu W, et al. Astaxanthin alleviates brain aging in rats by attenuating oxidative stress and increasing BDNF levels. *Food Funct.* 2014;5:158-66.
- [35] Kermani P, Hempstead B. BDNF Actions in the Cardiovascular System: Roles in Development, Adulthood and Response to Injury. *Front Physiol.* 2019 Apr 26;10:455.
- [36] Katagiri M, et al. Effects of astaxanthin-rich *Haematococcus pluvialis* extract on cognitive function: a randomised, double-blind, placebo-controlled study. *J Clin Biochem Nutr.* 2012;51:102-7.
- [37] Hayashi M, et al. Effect of astaxanthin-rich extract derived from *Paracoccus carotinifaciens* on cognitive function in middle-aged and older individuals. *J Clin Biochem Nutr.* 2018 Mar;62(2):195-205.
- [38] Hongo N, et al. Randomized controlled trial of the anti-fatigue effects of astaxanthin on mental and physical loads simulating daily life. *J Clin Ther Med.* 2016 Jul;32(7):277-91.
- [39] Yamashita S, et al. Alterations in the Levels of Amyloid- $\beta$ , Phospholipid Hydroperoxide, and Plasmalogen in the Blood of Patients with Alzheimer's Disease: Possible Interactions between Amyloid- $\beta$  and These Lipids. *J Alzheimers Dis.* 2016;50(2):527-37.
- [40] Nakagawa K, et al. Antioxidant effect of astaxanthin on phospholipid peroxidation in human erythrocytes. *Br J Nutr.* 2011;105:1563-71.
- [41] Lin JB, et al. A glimpse at the aging eye. *NPJ Aging Mech Dis.* 2016 Mar 10;2:16003.
- [42] Linetsky M, et al. UVA light-excited kynurenines oxidize ascorbate and modify lens proteins through the formation of advanced glycation end products: implications for human lens aging and cataract formation. *J Biol Chem.* 2014 Jun 13;289(24):17111-23.
- [43] Petri D, Lundebye AK. Tissue distribution of astaxanthin in rats following exposure to graded levels in the feed. *Comp Biochem Physiol C Toxicol Pharmacol.* 2007 Mar;145(2):202-9.
- [44] Yoshihisa Y, et al. Astaxanthin, a xanthophyll carotenoid, inhibits ultraviolet-induced apoptosis in keratinocytes. *Exp Dermatol.* 2014 Mar;23(3):178-83.
- [45] Harada F, et al. Protective effects of oral astaxanthin nanopowder against ultraviolet-induced photokeratitis in mice. *Oxid Med Cell Longev.* 2017;2017:1956104.
- [46] Ishikawa S, et al. Effect of astaxanthin on cataract formation induced by glucocorticoids in the chick embryo. *Curr Eye Res.* 2015 May;40(5):535-40.
- [47] Cort A, et al. Suppressive effect of astaxanthin on retinal injury induced by elevated intraocular pressure. *Regul Toxicol Pharmacol.* 2010 Oct;58(1):121-30.
- [48] Nagaki Y, et al. [The supplementation effect of astaxanthin on accommodation and asthenopia.] *J Clin Ther Med.* 2006;22(1):41-54.
- [49] Shiratori K, et al. The effects of astaxanthin on accommodation and asthenopia—efficacy identification study in healthy volunteers. *J Clin Ther Med.* 2005 Jun;21(6):637-50.

- [50] Nagaki Y, et al. [The effect of astaxanthin on retinal capillary blood flow in normal volunteers.] *J Clin Ther Med*. 2005;21(5):537-42.
- [51] Akira N, et al. Changes in visual function following peroral astaxanthin. *Jap J Clin Ophthalmol*. 2004;58(6):1051-4.
- [52] Saito M, et al. Astaxanthin increases choroidal blood flow velocity. *Graefes Arch Clin Exp Ophthalmol*. 2012 Feb;250(2):239-45.
- [53] Rao AR, et al. Effective inhibition of skin cancer, tyrosinase, and antioxidative properties by astaxanthin and astaxanthin esters from the green alga *Haematococcus pluvialis*. *J Agric Food Chem*. 2013 Apr 24;61(16):3842-51.
- [54] Davinelli S, et al. Astaxanthin in Skin Health, Repair, and Disease: A Comprehensive Review. *Nutrients*. 2018 Apr 22;10(4).
- [55] Imokawa G. The Xanthophyll Carotenoid Astaxanthin has Distinct Biological Effects to Prevent the Photoaging of the Skin Even by its Postirradiation Treatment. *Photochem Photobiol*. 2019 Mar;95(2):490-500.
- [56] Chou HY, et al. Enriched Astaxanthin Extract from *Haematococcus pluvialis* Augments Growth Factor Secretions to Increase Cell Proliferation and Induces MMP1 Degradation to Enhance Collagen Production in Human Dermal Fibroblasts. *Int J Mol Sci*. 2016 Jun 16;17(6).
- [57] Meehansan J, et al. Effect of astaxanthin on cutaneous wound healing. *Clin Cosmet Investig Dermatol*. 2017 Jul 13;10:259-65.
- [58] Tominaga K, et al. Protective effects of astaxanthin on skin deterioration. *J Clin Biochem Nutr*. 2017 Jul;61(1):33-9.
- [59] Tominaga K, et al. Cosmetic benefits of astaxanthin on humans subjects. *Acta Biochim Pol*. 2012;59(1):43-7.
- [60] Peterson T. Healthspan Is More Important Than Lifespan, So Why Don't More People Know About It? Institute for Public Health, Washington University in St. Louis. 2017 May 30.