

# Astaxanthin:

**A**staxanthin, a pinkish-reddish carotenoid derived from the microalgae *Haematococcus pluvialis* and found in foods such as salmon, trout, shrimp and lobster<sup>1,2</sup>, has generated a great deal of excitement due to the ongoing plethora of published research validating a significant number of health benefits. Structurally similar to beta-carotene<sup>3</sup>, astaxanthin has tremendous antioxidant activity. In fact, research<sup>4</sup> has demonstrated that the antioxidant activity of astaxanthin is approximately 10 times stronger than other carotenoids tested (e.g., zeaxanthin, lutein, tunaxanthin, canthaxanthin, beta-carotene) and 100 times greater than those of vitamin E (alpha-tocopherol). This resulted in one researcher stating "astaxanthin has the properties of a 'super vitamin E.'"<sup>5</sup> Other research has also demonstrated superior antioxidant activity of astaxanthin over carotenoids and vitamin E.<sup>6</sup>

It is astaxanthin's marked antioxidant activity that seems to be the primary source of its health promoting properties. These properties include improvements in cardiovascular health, diabetic nephropathy, muscle endurance, eye fatigue, *H. pylori*/dyspepsia, skin, fat metabolism, stress and immune function.

## Cardiovascular Health

In Japan, the International Research Center for Traditional Medicine investigated the effects of astaxanthin in hypertensive (i.e., high blood pressure) rats. They found that, after 14 days, astaxanthin provided significant reduction in the arterial blood pressure. After five weeks, astaxanthin significantly reduced blood pressure in stroke-prone rats. The researchers suggested that astaxanthin can exert beneficial effects in protection against hypertension and stroke, and in improving memory in vascular dementia. The mechanism of action appears to be a relaxation of blood vessels mediated by nitric oxide.<sup>7-9</sup> Likewise, in a human study, 6 mg astaxanthin daily for 10 days resulted in an increase in circulation.<sup>10</sup>

In a placebo-controlled, 12-week human study<sup>11</sup>, subjects with high fasting triglyceride levels (120-200 mg/dl)

receiving various daily doses of astaxanthin. The results were that 12 and 18 mg/day doses significantly reduced triglyceride, and 6 and 12 mg doses significantly increased HDL-cholesterol. Serum adiponectin (a hormone associated with less body fat) was increased by 12 and 18 mg/day astaxanthin. In addition, a double-blind, placebo-controlled, human study<sup>12</sup> found that 4 mg/day astaxanthin reduced lipid peroxidation, which may also promote healthy cardiovascular function.

## Diabetic Nephropathy

Diabetic nephropathy is kidney disease or damage that occurs in diabetes. In a 12-week study<sup>13</sup>, type 2 diabetic mice received astaxanthin, while a control group of diabetic mice did not. The results were that the astaxanthin-treated group showed a lower level of blood glucose compared with the non-treated group. Also, the antioxidative activity of astaxanthin reduced the oxidative stress on the kidneys and prevented kidney cell damage.<sup>14</sup> The researchers concluded that astaxanthin might be a novel approach for the prevention of diabetes nephropathy. Additional research suggests that another mechanism of action may be that astaxanthin helps modulate genes involved in protecting kidney cells.<sup>15</sup>

## Muscle Endurance

In a double-blind, placebo-controlled study<sup>16</sup>, 40 male students received

# An Extraordinary Antioxidant

BY GENE BRUNO, MS, MHS

astaxanthin or placebo daily in conjunction with a meal. Standardized exercise tests were carried out before starting the dietary supplementation, and after three and six months of dietary supplementation with the capsules. The results were a statistically significant ( $P=0.047$ ) increase in strength/endurance of the astaxanthin group over the placebo group. For example, the astaxanthin group was able to do 61.74 knee-bends, while the placebo group did 21.78 knee bends.

In another human study<sup>17</sup>, 16 adult males running 1,200 meters received 6 mg/day astaxanthin or placebo for four weeks. The results were that serum lactic acid concentration at two minutes after running in the astaxanthin group was significantly lower than that of the control group. Based on these findings, researchers suggested that supplementation of astaxanthin is effective for improvement of muscle fatigue, and may lead to sports performance benefits. The effects of 12 mg/day astaxanthin for six weeks with aerobic exercise (walking) were examined using healthy adult women in a randomized double-blind, placebo-controlled study.<sup>18</sup> The results were that astaxanthin supplementation contributed to reduction of

body fat and suppressed the increase in blood lactic acid level after exercise.

## Eye Fatigue

Many people are experiencing eyestrain or eye fatigue as a result of frequent and ongoing use of computers at home and in the office.<sup>19</sup> There are a number of studies showing that astaxanthin can make a significant difference. In one study<sup>20</sup>, people with eyestrain given 6 mg/day of astaxanthin for two weeks were able to reduce and prevent further eyestrain caused by accommodative dysfunction (i.e., difficulty focusing at a book, computer screen, etc.). Another study<sup>21</sup> indicated that accommodation amplitude (i.e., the ability of the eye to focus) was improved in computer users after 5 mg daily astaxanthin supplementation for four weeks. Additional research found that computer users with eye fatigue experienced significant relief with 6 mg astaxanthin daily for four weeks.<sup>22</sup>

The effect of 6 mg/day astaxanthin or placebo on asthenopia (i.e., weakness or easy fatigue of the eye with eye pain, headache or dim vision) was also examined

in a double-blind study<sup>23</sup> for four weeks. The

results were that astaxanthin improved subjective symptoms of asthenopia, as well as ability to focus. Also, astaxanthin was confirmed to be completely safe. Another interesting study<sup>24</sup> evaluated the effect of 0 mg, 2 mg, 4 mg or 12 mg astaxanthin/day on visual function in 49 healthy volunteers over 40 years of age. After 28 days, visual acuity significantly improved in those receiving 4 mg or 12 mg. The time it took for the eye to focus also improved. Likewise, in a four-week, placebo-controlled study using 6 mg astaxanthin or placebo, visual acuity was examined in 18 healthy adult male volunteers. The results were that visual acuity significantly improved in the astaxanthin group compared to the control group.<sup>25</sup>

## H. pylori/Dyspepsia

*Helicobacter pylori* (*H. pylori*) are bacteria found in the stomach, and implicated in many patients with chronic gastritis, gastric ulcers, duodenal ulcers and stomach cancer.<sup>26</sup> In research on *H. pylori*-infected mice, treatment with

astaxanthin reduced gastric inflammation and bacterial load.<sup>27</sup> Another study<sup>28</sup> on *H. pylori*-infected mice found that treatment with astaxanthin and vitamin C showed significantly lower colonization of *H. pylori* and lower inflammation scores than those of untreated. In a four-week, prospective, randomized, double-blind, placebo-controlled study<sup>29</sup>, patients with functional dyspepsia were divided into three groups of 44 individuals each and treated with placebo, 16 mg or 40 mg astaxanthin. At the end of therapy, there was a significant reduction of reflux syndrome in the higher (40mg) dose compared to the other treatment groups (16 mg and placebo,  $p=0.04$ ).

## Skin

The cosmetic effects on human skin by 4 mg per day astaxanthin supplementation were demonstrated in a single-blind, placebo-controlled study<sup>30</sup> using 49 healthy, middle-aged American women. Based upon dermatologist's assessment and instrumental assessment at week six compares to baseline initial values, the results were more than a 50 percent reduction in fine lines and wrinkles, about a 50 percent improvement in the moisture content of skin and more than a 50 percent improvement in skin elasticity. In addition, self-assessment of patients indicated a reduction of skin roughness by more than 40 percent.

## Fat Metabolism

In a six-week, randomized, double-blind, placebo-controlled study<sup>31</sup>, 32 healthy women were divided into two groups and received 12 mg/day astaxanthin or a placebo. The subjects were instructed to take a walking exercise three times a week according to their own physical strength. The results were that the average body fat percentage was significantly decreased 3.8 percent in the astaxanthin-supplemented group compared with no significant difference between before and after supplementation in the placebo.

## Stress

An eight-week, open-label, non-controlled study<sup>32</sup> was conducted to evaluate the mental and physical effects of 12 mg/day astaxanthin in 35 healthy postmenopausal women, 21 with high oxidative stress burden. Subjects were assessed by means of an Anti-Aging Quality of Life Common Questionnaire, as well as laboratory tests before and

four and eight weeks after the start of the study. The results were that after eight weeks, significant improvement was observed in physical symptoms listed in the common questionnaire, including "tired eyes," "stiff shoulders," "constipation," "gray hair" and "cold skin," and in three mental symptoms, including "daily life is not enjoyable," "difficulty in falling asleep" and "a sense of tension." In addition, systolic and diastolic blood pressure significantly decreased. Results also show that astaxanthin may enhance antioxidant capacity.

## Immune Function

An eight-week, randomized, double-blind, placebo-controlled study<sup>33</sup> assessed the effects of astaxanthin (0, 2 or 8 mg/day) in modulating immune response, oxidative status and inflammation in young healthy adult female human subjects. The results were that astaxanthin decreased a DNA damage biomarker after four weeks, decreased C-reactive protein (an inflammation marker) after eight weeks. In subjects given 2 mg astaxanthin, there were increased markers of immune function, including an increase in natural killer cell cytotoxic activity, total T and B cell subpopulations, and leukocytes. Plasma IFN-gamma and IL-6 increased on in subjects given 8 mg astaxanthin.

## Conclusions

Extensive human and animal research has been conducted on the health-promoting benefits of astaxanthin. Since relatively small amounts of this nutraceutical are needed for efficacious effects, supplementation with astaxanthin may be a practical addition to individual programs for health and wellness. **VR**

A full list of references can be found online at [www.vitaminretailer.com](http://www.vitaminretailer.com).

Gene Bruno, MS, MHS, the dean of academics for Huntington College of Health Sciences, is a nutritionist, herbalist, writer and educator. For more than 30 years he has educated and trained natural product retailers and health care professionals, has researched and formulated natural products for dozens of dietary supplement companies, and has written articles on nutrition, herbal medicine, nutraceuticals and integrative health issues for trade, consumer magazines and peer-reviewed publications.