

NATURAL ASTAXANTHIN

THE SUPPLEMENT YOU CAN FEEL



BOB CAPELLI

TECHNICALLY REVIEWED BY LIXIN DING, PHD

Including excerpts from renowned health and nutrition experts
Dr. Joseph Mercola, Mike Adams "The Health Ranger,"
Suzy Cohen RPh, Susan Smith Jones, PhD, and more

NATURAL ASTAXANTHIN

“The Supplement You Can Feel”

By Bob Capelli

Technically Reviewed by Lixin Ding, PhD

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*Natural Astaxanthin State-of-the-Art Farm
with glass-tube photobioreactors*

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The publisher of this book, Algae Health Sciences, Inc. (AlgaeHealth), a division of BGG, is a producer of Natural Astaxanthin from *Haematococcus microalgae*. This book is intended as an educational tool offered by AlgaeHealth to further industry and professional knowledge on Natural Astaxanthin and the medical research on its health benefits.

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Dedication

This book is dedicated to my family (many of whom helped in different ways to produce this book) and to my coworkers at AlgaeHealth and BGG who provided inspiration and support. Most of all, to my wife Berta for her love and friendship for 30 years.

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Introduction

By Suzy Cohen, RPh,

*"America's Most Trusted Pharmacist," best-selling author,
syndicated columnist and media personality*

What a funny, hard-to-pronounce word — “Astaxanthin.” Yet, regardless of how hard it is to say, I suggest you learn how to say it and go to your local health food or vitamin store and buy a bottle [as-ta-zán-thin]. This is certainly one of the most exciting supplements to hit the nutrition industry ever, and as you’ll find out in this book, researchers are discovering more promising qualities of Natural Astaxanthin every year.

Natural Astaxanthin is a powerful anti-inflammatory and can neutralize free radicals which are tied to cancer, infection, diabetes, heart disease and Alzheimer’s. I think it’s one of the simplest, most affordable antioxidants you can take for better health. It’s hundreds of times more powerful than CoQ10, Vitamin C and Vitamin E. I take it myself every day.

Part of the wonder of life is seeing your loved ones and enjoying the starlight, beautiful sunsets and incredible landscapes! So protecting your precious eyesight ranks high up on my recommendations for people. Clinical studies done on Natural Astaxanthin show that it improves blood flow to eye muscles, helping to improve accommodation and relieve eye strain. You have to think of Astaxanthin like you do beta-carotene, since every one’s heard of that. I think Astaxanthin dwarfs beta-carotene in terms of its ability to nourish the delicate tissue of the eye and protect eyesight. Medical research trials support the role of Natural Astaxanthin in preventing macular degeneration, the number one cause for blindness. It is one of my favorite dietary supplements because it is a natural energizer and there’s no jolt! It’s also a powerful immune enhancer, it helps lower blood pressure, reduce arthritic aches and pain, and it goes a long way in protecting the cardiovascular system. Plus, you can’t find a better supplement to work from the inside out to help protect and actually beautify your skin.

I’ve known Bob Capelli for over ten years now. I knew him before he wrote the world’s first book on Astaxanthin back in 2006. Bob has dedicated the last sixteen years of his career to studying, educating, writing about and promoting Natural Astaxanthin because he really believes in this miracle extract from algae.

He's passionate about Astaxanthin, and he has a knack for taking difficult scientific concepts in this book and making them so everyone can understand. I think you'll enjoy reading this book; but more importantly, I'm sure you'll come away with information that can help you live a longer, healthier life.

One last, very important point: When considering which brand of Astaxanthin to purchase, make sure you buy a brand that is "Natural" Astaxanthin extracted from algae. This is essential now because a large vitamin ingredient manufacturer launched a synthetic version of Astaxanthin a few years ago that is nothing at all like the natural version. They call it "Nature Identical" but that's far from the truth—Natural and Synthetic Astaxanthin are two completely different molecules. For example, Natural Astaxanthin has been shown to be at least twenty times stronger as an antioxidant than Synthetic Astaxanthin. And even more troubling, Synthetic Astaxanthin has never been tested in human clinical trials for health benefits or even for safety. Trust me—stay away from Synthetic Astaxanthin and make sure you're getting the "real deal." The best way to do this is to do like I do and make sure the brand you're buying comes from a member of the Natural Algae Astaxanthin Association (NAXA), a trade group that monitors quality and tests different brands to make sure they're natural. Some brands that use Astaxanthin from a NAXA member actually feature the NAXA seal; look for it on the label, or at the very least check with your brand and make sure they're sourcing their raw material from a NAXA member.

-- Suzy Cohen, RPh, "America's Most Trusted Pharmacist"



1

“The Supplement You Can Feel”

Q: What protects algae cells so incredibly well that they can live for over 40 years without food or water and in extreme weather conditions?

Q: What makes salmon pink and gives them the strength and energy to swim up raging rivers for weeks on end?

Q: What is the ultimate anti-aging nutrient and the athlete’s secret weapon?

A: Natural Astaxanthin!

In my twenties, I spent four years traveling and working in developing countries. In many of these developing countries in the 1980’s, Western-style medicine wasn’t used much; instead, people looked to herbs and natural healing for both preventive

and therapeutic benefits. I developed a huge admiration for preventive medicine at that time, and used herbal remedies when I had health issues during my travels. In fact, this natural healing concept (which was pretty new to me at the time) had such an impact on me that, upon returning to the USA, I sought out a job in the natural supplement industry.

I was working in the natural supplement industry for over ten years before I heard about Astaxanthin. I heard about this “super-carotenoid” (whose name I couldn’t even pronounce) that was supposed to be the world’s strongest antioxidant. (Carotenoids are a family of molecules that give many vegetables and animals their color.) I had been using nutritional supplements for about fifteen years at that point, since before I started working in the supplement industry.

Having read quite a bit about the importance of antioxidants, I decided that it made sense to try the world’s strongest when I heard about Astaxanthin. I wanted to give myself the extra antioxidant protection I knew was so important to be healthy in our modern world. For my first decade in the supplement industry, I was taking a variety of herbs, vitamins and minerals, and I was a relatively healthy person. In a normal year, I would get two or three colds, and once every few years I would get a bad case of the flu. I had no major illnesses, but I did have some muscle and joint issues that were starting to affect my ability to play sports.

The first thing I noticed after about a month of use was Astaxanthin’s muscle and joint pain benefits. This was the year before the first clinical study had been done showing that Astaxanthin reduces pain and works as an anti-inflammatory. I love to play basketball, and have been playing about two times a week for decades. Before trying Astaxanthin, when I was in my late thirties and early forties, I was starting to get very sore and stiff in the mornings after basketball. I would wake up the day after basketball and I would be so stiff when I got out of bed that my wife used to make fun of me—she said that I walked like the Frankenstein monster! It was a combination of joint issues in my knees and overall muscle soreness. I was not happy at all about this common consequence of aging, and could see the writing on the wall that I probably only had a couple years left playing basketball.

SURPRISE! I was amazed that, after about a month using Natural Astaxanthin, I had no more soreness or achy joints after playing basketball. It’s now sixteen years later, I’m 57 years old, and I still jump out of bed the morning after basketball like a



Astaxanthin can help stretch your active years

20 year old. (If only it could help my jump shot...but sadly, there are some things even Astaxanthin can't improve.)

The second benefit I found from using Astaxanthin took much longer to recognize. A few months after I started using Natural Astaxanthin, I began to reduce my use of other supplements. I still take a superfood called Spirulina every day, and I take a few other nutraceuticals specifically for their cardiovascular benefits. But after my early days working in the supplement industry when I was experimenting with many supplements, I ultimately narrowed it down to a few clinically validated products that I consider my personal

staples. What I realized after a few years of my new supplement regimen is that I hadn't gotten a cold or flu since I started using Astaxanthin. It is now 2017 and I still haven't come down with a cold or flu or missed a day of work since the year 2000! There is no doubt in my mind that Astaxanthin is boosting my immunity—how else could you explain going from two or three colds a year down to zero?

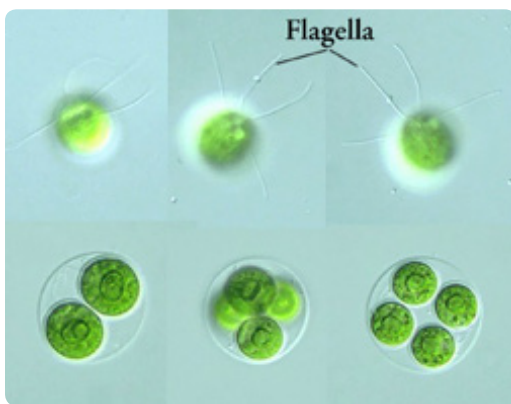
You may think, “He's not impartial—he works for a company that produces Astaxanthin.” This is true, and I can't fault anyone who thinks that way. But when you read what prominent doctors, professors and pharmacists say about Natural Astaxanthin, see the results from consumer surveys and review the huge quantity of medical research studies, you also may want to take Astaxanthin every day to keep yourself healthy.

The Most Protective Molecule in Nature

It's hard to believe that any substance is so protective that it can keep an organism alive for 40 years without food or water, and under conditions of freezing cold, blistering heat and intense ultraviolet light exposure. But believe it: This is the level of protection that Natural Astaxanthin brings to *Haematococcus pluvialis* (another tongue-twisting word like "Astaxanthin") microalgae cells. When *Haematococcus* cells are healthy, well-fed, have plenty of water and are in favorable climactic conditions, they are green and they use flagella to swim around. To put it simply, they're healthy and happy. But stop feeding them, take them out of their normal aqueous environment, put them in intense ultraviolet light and extreme temperatures (or do all three of these things at once), and the algae cells stop swimming and go dormant to save energy. But this "hibernation" isn't enough to keep them alive under these conditions. Any living organism, be it plant or animal, needs food and water to survive. When you take away these essential needs, it's only a matter of time before an organism will die.

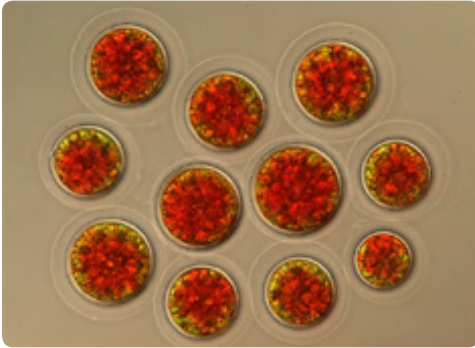
But these algae are different because they have the ability to generate Astaxanthin. They do this as a survival mechanism to withstand this extreme environmental stress. They hyper-accumulate huge amounts of Astaxanthin and turn red in a period of just about one week under highly stressful conditions. The Astaxanthin works like a protective force field to fend off starvation, dehydration, intense UV exposure and extreme temperatures. And amazing as it may sound, simply give the algae some nutrients, put them back in water and in a favorable climate, and what do you think happens? They turn green again and start happily swimming around!

Astaxanthin has been well documented in clinical research to distribute itself throughout the



Haematococcus pluvialis is a green alga in its normal, healthy state and uses its flagella to swim through the water.

entire body. It gets into muscles and the skin. It can cross the blood-brain barrier and the blood-retinal barrier to enter the brain and eyes. It gets into the heart, the liver,



When subjected to extreme stress, the algae cells hyper-accumulate Astaxanthin as a protective force field. Astaxanthin is so protective that the algae can live for over 40 years without food or water and in extreme weather conditions!

the kidneys and other organs. And what it's doing on a cellular level in our bodies is the same thing it does for the algae cells—providing its incredible protective properties to keep the cells healthy and alive. As the evidence in the rest of this book will indicate, it's the best nutrient you can take if you're over 40 to keep you feeling young and healthy. But it's not just for people getting on in years—it's also a wonderful supplement for athletes and active people of all ages and works as “preventive medicine” for everyone.

Learn from the Salmon and the World's Greatest Athletic Feat

In Chapter 2 you'll learn what renowned doctors, professors and pharmacists say about Astaxanthin, and in Chapter 3 you'll learn about the mountains of medical research in support of Astaxanthin's efficacy. But it's not just the scientific experts you can learn from—you can also learn from a fish.

Q: What animal performs (by far) the greatest athletic feat in nature?

A: The Salmon!

In my first two books on Astaxanthin, I put the photo below into human perspective so readers can get an idea of what salmon go through.

To put the essence of this photo and the salmon's athletic feat into human terms—imagine a six foot tall man swimming against 30 foot waves for a week straight and reaching his destination which is 100 miles away.



***Undoubtedly the Greatest Athletic Feat in Nature:
Salmon swim up raging rivers for up to seven days!***

In the plant world, *Haematococcus* algae have the highest concentration of Astaxanthin. But in the animal world, it's salmon that have the highest concentration. Within the salmon's bodies, the Astaxanthin accumulates in their muscles where the phenomenal onslaught of oxidation generated by nature's greatest athletic feat occurs. These salmon are different from human athletes: They'll keep swimming for a week straight regardless of the volume of water shooting down on them. Even humans competing in the most extreme endurance sports like

ultra-marathons will have significant time to sleep and rest each day during multi-day events. But the salmon keep at it for up to seven straight days. Measured gram per gram of body weight, they generate the highest quantity of free radicals by far in the animal kingdom.

But not to worry—the salmon have so much Astaxanthin in their muscles that they handle the free radical deluge in stride and happily spawn once they reach their birthing place upriver. Just as Astaxanthin provides extraordinary protection to the algae cells as described above, Astaxanthin also provides extraordinary protection to the salmon's muscle tissue cells. We're starting to see a pattern: Whether it's algae cells or salmon muscle tissue cells, Astaxanthin is an incredibly protective molecule. And as you'll read in Chapter 3, Astaxanthin provides humans with extraordinary protection to cells in our bodies as well.

I don't want to suggest that you run out to the store, buy a bottle of Natural Astaxanthin and then try to swim from New York to Paris. But there is certainly sufficient evidence, both from scientific studies and testimonials, that taking 4mg to 12mg of Natural Astaxanthin per day will provide greater strength and endurance.

Why Do I Call Astaxanthin “The Supplement You Can Feel?”

The answer is really quite simple: Roughly 80% of the people who take Natural Astaxanthin feel it or see it working in their bodies within a few months. This 80% figure has been borne out in clinical research as well as consumer surveys. Having been in the supplement industry for close to 30 years now, I can assure you that there aren't a lot of supplements that you can feel working. In fact, about 95% of supplements are taken on faith—people think that they're doing something

beneficial for their health so they take them. And getting people to continue taking these “can’t feel ‘em” supplements for the long haul is an ongoing battle for supplement brands. Even if they’re effective supplements helping to ward off disease, a large swath of consumers simply won’t stick with them if they can’t feel or see the results for themselves.

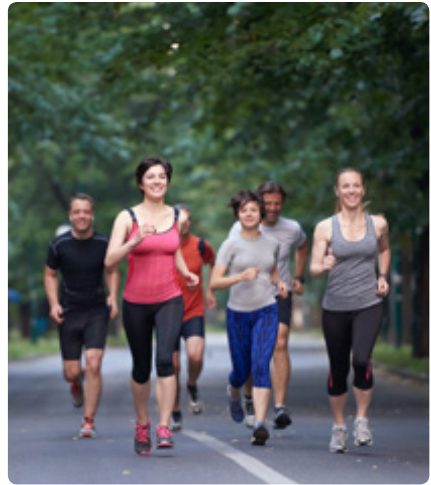
But Astaxanthin is different. When people take this product, after about a month or so they start seeing and feeling the benefits for themselves. Benefits that people have found from Natural Astaxanthin include:

- Better workouts, increased strength and quicker recovery from exercise
- Slower heart rate when doing endurance exercise
- Improved immunity and fewer colds and flu
- Improved skin quality and appearance
- Reduced sunburn
- More energy
- Less eye fatigue, dryness and soreness when spending long hours on the computer
- Improved vision and better brain function
- Better performance in sports
- Less joint, tendon and muscle pain and better flexibility
- Feeling and looking younger during the aging process
- And believe it or not, even improved male fertility when trying to have a baby

How many other supplements can bring even one of these “feelable” benefits to consumers? Natural Astaxanthin is the champ when it comes to “feelability.” Once people start taking Astaxanthin, many will become spokespeople and start telling their friends and family about it. They’ll tell their moms and dads how their aches and pains have diminished. They’ll tell their brothers and sisters how much more energetic they feel and how their workouts are much better. They’ll tell their friends how they’re able to read better without their glasses. And they’ll tell their coworkers how they’re not getting colds like they used to.

I’m not saying that Astaxanthin works overnight. This is a natural product and the effects I mentioned above (all of which are clinically validated) take time to manifest. Some consumers will feel it start to work in two weeks or less, but the majority of people won’t feel significant benefits for four to six weeks. And less frequently, it may take over two months before it really starts to kick in.

In addition to these noticeable effects, Natural Astaxanthin’s extreme antioxidant activity and its broad-spectrum anti-inflammatory properties also yield several other clinically validated benefits that people don’t necessarily “feel.” For example, there are demonstrated benefits for cardiovascular health. And you can’t “feel” Astaxanthin protecting you on a cellular level, but it’s one of the most important aspects of an anti-aging supplement. It’s easy to see why Natural Astaxanthin is a must-take supplement for anyone approaching middle age (another appropriate name for it is “The Ultimate Anti-Aging Nutrient”). But people in their 20’s and 30’s may seek a different set of benefits from daily Astaxanthin use—improved energy, recovery from exercise, strength, being able to stay in the sun longer without getting burnt — all sorts of things that young adults crave. Basically, there’s no other supplement on the market that can help so many different people in so many diverse ways.



*Astaxanthin has a variety of
benefits for people of all ages*

Why Don't 100% of People “Feel” Astaxanthin Working?

Approximately 20% of the people who take Astaxanthin don’t feel or see any results. This is most likely due to different people’s bodies having a different capacity to absorb carotenoids. Astaxanthin is a carotenoid, the family of molecules that

includes other health-giving nutrients like lutein, lycopene, zeaxanthin and the most famous carotenoid, beta-carotene. When absorption of carotenoids is studied in humans, researchers find a huge disparity in people's ability to assimilate them. The range is massive—from about 5% to over 90% absorption level. So what is probably happening when people take Astaxanthin for a few months and don't feel any benefits is that they are most likely in the very low absorption range. Their bodies may only be absorbing 5% of the Astaxanthin they're taking, so even if they're taking 12mg per day (which is generally the upper level recommended by most brands), they aren't feeling the effects because so little is getting into their bloodstream. Meanwhile, a person whose body is absorbing at the upper end of the range is getting practically all the Astaxanthin they consume into their bloodstream where it can work its magic. This person could take as little as 2mg – 4mg per day and really feel it working. Fortunately, about 80% of people find great results in the normal dosage range of 4mg – 12mg per day, and without any dangerous side effects or contraindications.



*Natural Astaxanthin:
A Safe & Natural Anti-Inflammatory*

Let's put this in perspective and compare this safe and natural supplement to over-the-counter (OTC) and prescription drugs. Consider the aches and pains we all commonly experience. Most people will run to a pharmacy and grab an OTC pain remedy for day-to-day aches and pains. For more serious painful conditions,

many will see a doctor and get a prescription for an anti-inflammatory, or perhaps an opioid or steroid medication. With regard to effectiveness, it appears that Astaxanthin isn't very different from anti-inflammatory products you find in a drug store—most of those don't work for 100% of the people 100% of the time either. There are two key differences between Natural Astaxanthin and OTC and

prescription anti-inflammatory drugs:

- Natural Astaxanthin takes much longer to work than anti-inflammatory drugs.
- However, Natural Astaxanthin is completely safe and natural with no documented side effects or contraindications, while all of the drugs have potential side effects (some of which are serious or even life-threatening).

Consumer Surveys Validate the 80/20 Rule

As I've mentioned above, about 80% of consumers feel or see Astaxanthin working in their bodies within two months of use. And unfortunately, about 20% of consumers don't feel or see any difference. We'll talk extensively about the clinical evidence supporting the 80/20 rule in Chapter 3. But in addition to many human clinical trials, two consumer surveys have validated the 80/20 rule for Natural Astaxanthin's ability to combat painful inflammatory conditions. In fact, one of these consumer surveys asked users to compare Natural Astaxanthin's anti-inflammatory effects to prescription and OTC anti-inflammatories and found that Natural Astaxanthin has similar results to these non-natural drugs.

A survey of people with joint, muscle or tendon pain found that:

- 84% had positive results from using Natural Astaxanthin
- 83% experienced less pain
- 60% had increased mobility
- When asked how Natural Astaxanthin's effects compared to other anti-inflammatories found in the drug store:
 - 75% said that Natural Astaxanthin works the same as or better than over-the-counter pain medications such as aspirin, Tylenol®, Alleve® or Motrin®
 - 64% said that Natural Astaxanthin works the same as or better than prescription anti-inflammatories such as Celebrex® or Vioxx® (Capelli et al., 2008).

Another consumer survey of 247 Natural Astaxanthin users stated “over 80% of those reporting back pain and symptoms from osteoarthritis or rheumatoid arthritis reported an improvement from Astaxanthin supplementation. Astaxanthin supplementation was also reported to improve symptoms of asthma and enlarged prostate. All of these conditions have an inflammation component which is closely tied to oxidative damage” (Guerin et al., 2002).

To summarize, it appears from these consumer surveys that Natural Astaxanthin works about as well as prescription and OTC anti-inflammatories. It does, however, take considerably longer to work. But as I pointed out above, a critical distinction is that Natural Astaxanthin has never been shown to have any side effects or contraindications—it’s completely safe and natural—while OTC pain pills and prescription anti-inflammatories all have side effects, some of which can end up killing you. So the crucial decision is left up to the consumer: Do you want fast results that may end up seriously hurting you, or would you rather wait about a month for the same results and be safe and healthy?

Author’s Recommendation

- ➔ **Month #1:** Take 24mg per day of Natural Astaxanthin for 30 days to let it accumulate in your body quickly.
- ➔ **Months #2 and #3:** Take 12mg per day to see and feel the full results you’re going to get.
- ➔ **Month #4 Onward:** Feel free to experiment with dosages anywhere from 4mg to 24mg per day. Let your body be your guide: If you feel results are diminishing, get your dose back up to higher levels.
- ➔ **Always:** Take Astaxanthin with a meal with some fat content. (Carotenoids taken with fat are absorbed much better.)

What is Astaxanthin?

I called my first book on Astaxanthin (published in 2007) “Natural Astaxanthin: King of the Carotenoids.” The problem is that most people don’t know what a carotenoid is. And yet, chances are you eat a few almost every day.

Carotenoids are pigments. Carotenoids are what give many of the foods we eat their beautiful colors. You already know that salmon are pink because of the carotenoid this book is about, Astaxanthin. If you had a salad recently, you almost definitely ate some carotenoids. Tomatoes are red because of a carotenoid called “lycopene.” Carrots contain the most famous carotenoid, beta-carotene (which makes them orange). Corn is yellow because of the carotenoid zeaxanthin. Along with its closely related carotenoid cousin lutein (which is also a yellow carotenoid), zeaxanthin is found in many green vegetables such as spinach, kale, broccoli, lettuce and peas. (The color of the yellow carotenoids is overpowered by the high levels of green chlorophyll in these vegetables; so even though the vegetables contain yellow carotenoids they look green to the human eye.)

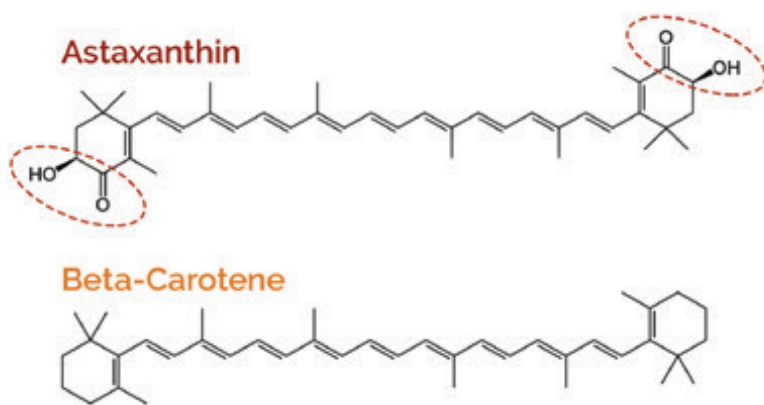


Carotenoids are among the healthiest ingredients in a healthy diet and can be found in a variety of vegetables and seafood.

Over 700 carotenoids have been identified, although most people have only heard of a few. Carotenoids provide essential benefits in plants: They absorb sunlight which they convert into biological energy, while at the same time protecting the plants from oxidants (generated by UV exposure and from other sources). Carotenoids are generally effective antioxidants in animals as well, and can neutralize free radicals and singlet oxygen in the body, with Astaxanthin having by far the

highest antioxidant activity. In fact, certain carotenoids are essential nutrients for different animal species as they are for plants. The most relevant example of this is beta-carotene which is necessary for humans as it is converted by the body to the essential nutrient Vitamin A. However, it's important to remember that there is a huge difference in the safety of Vitamin A compared to beta-carotene. In high doses, Vitamin A can be toxic; on the other hand, beta-carotene has no toxicity potential as the body simply converts as much beta-carotene as it needs into Vitamin A.

Carotenoids are broken down into two groups: “Carotenes” and “Xanthophylls” (pronounced ZAN-tho-fils). The carotene group is more widely known because of its most famous member, beta-carotene. Another well-known carotene is lycopene, which is also commonly sold as a nutritional supplement. The other group of carotenoids, xanthophylls, is much more biochemically active in our bodies than carotenes. Astaxanthin is a xanthophyll, as are lutein and zeaxanthin. The crucial difference between the two groups is that xanthophylls contain oxygen atoms while carotenes contain only carbon and hydrogen atoms. The positive energy of its electrons makes Astaxanthin more active in our bodies than its closely-related family members lutein and zeaxanthin, and makes it far more active than carotenes like beta-carotene and lycopene. (And while lutein and zeaxanthin have become famous for eye health and lycopene for prostate health, Astaxanthin—due to its superior antioxidant and anti-inflammatory activity—will most likely outperform these other carotenoids in eyes and prostate glands as well.)



The Astaxanthin molecule's unique structure makes it more biologically active than other carotenoids.

Astaxanthin can be found in different places around the world in both plants and animals. Besides salmon, any reddish or pink-colored seafood contains Astaxanthin (and, in fact, these animals are red because of their Astaxanthin content). This includes shellfish like crab, lobster and shrimp as well as the salmon I mentioned above and also some other fish species like trout and red sea bream. And while humans and other animals at the top end of the food chain eat these fish and shellfish, Astaxanthin is present on all levels of the ocean’s food chain: At the bottom in phytoplankton and algae, then in small sea animals such as krill. It can also be found in certain species of bacteria and fungi. It is present in diverse climates around the globe including arctic regions, where it is found in some algae species that can form a red haze on snow. By far, the highest concentration of Astaxanthin in nature is found in *Haematococcus pluvialis* microalgae, which is the source for the vast majority of Astaxanthin supplements on the market today.



Haematococcus pluvialis microalgae is the primary source of Astaxanthin for the supplement industry. The algae hyper-accumulate Astaxanthin as a survival mechanism when subjected to environmental stress, turning the algae cultures from green to red in the period of about a week. [State-of-the-art Astaxanthin farm growing Haematococcus algae in 100% glass tubes to prevent contamination.]

Where Can You Find Astaxanthin to Consume?

The very best food source with Astaxanthin in substantial quantities is wild salmon. I stress “wild” for a super-important reason: If you get farmed salmon there’s about a 99% chance you’ll be ingesting Synthetic Astaxanthin which is made from petrochemicals and is vastly inferior as an antioxidant and for health benefits. In fact, Synthetic Astaxanthin may not even be safe. (More about this huge issue later.) Unfortunately, the other seafood sources of Astaxanthin such as crab, shrimp and lobster do not contain sufficient quantities of Astaxanthin to serve as a reasonable source—so if you want to get your Astaxanthin from food, you’re really stuck with only wild salmon.

Source of Astaxanthin	Astaxanthin concentration (parts per million)
Salmonids	~ 13
Plankton	~ 60
Krill	~ 120
Arctic shrimp (<i>P. borealis</i>)	~ 1,200
Mutated <i>Phaffia</i> yeast	~ 10,000
<i>Haematococcus pluvialis</i>	~ 40,000

Salmon has the most Astaxanthin of any commonly eaten food, yet it only has a tiny fraction of the amount in Haematococcus microalgae. The only organism that gets close is genetically mutated Phaffia yeast, yet that still only has 1/4 of the Astaxanthin content of Haematococcus.

But even with salmon, you’d have to eat a whole lot to get the equivalent of a normal 4mg – 12mg Astaxanthin capsule each day. The species of salmon with the highest concentration of Astaxanthin is sockeye salmon which is found in abundance in Alaska. Even if you eat exclusively sockeye, you’d have to eat 100 – 300 gm per day (about 4 – 12 ounces). Since practically no one eats this much salmon (except maybe an Alaskan bear during a salmon run), I recommend a daily Astaxanthin supplement. You can find Astaxanthin in some cutting-edge multivitamins and in many different supplement formulas that address different health concerns

or performance enhancement goals for athletes. However, many of these formulas (especially multivitamins) contain very small quantities of Astaxanthin.

So the best way to take your Astaxanthin every day is to take what is known in the supplement industry as a “stand-alone.” This is a capsule or tablet that contains Astaxanthin as the sole (or at the very least, the main) active ingredient. These stand-alone products are available in many countries around the world in retail stores and are also widely available online. (The only better way to take your Astaxanthin may be a supplement formula targeted at a specific health condition provided that the Astaxanthin content is sufficient for the health condition that’s being targeted.)

It’s interesting that Astaxanthin’s appeal in different countries is focused on different specific health benefits (probably due to differing emphases in early media coverage). This is how condition-specific usage has developed in some of the countries where Natural Astaxanthin supplements are being consumed:

Condition-Specific Astaxanthin Use by Country (the majority of Astaxanthin products sold address these conditions):

Italy: Cardiovascular Health

Japan: Skin Health and Athletes

USA: Athletes, Eye Health and Joint Health

Scandinavia: Antioxidant, Cardiovascular Health and Athletes

France: Eye Health

Russia: Anti-Aging

China: Immunity, Anti-Aging and Joint Health

Chile: Antioxidant and Energy

Korea: Eye Health and Brain Health

Croatia: Male Fertility

Fun Stuff with Astaxanthin

When I give educational lectures about Astaxanthin, I sometimes like to show people right before their eyes how antioxidants work with a simple demonstration

using apples and lemon juice. I'll show photos of this demonstration in Chapter 3, but I wanted to refer readers to two compelling YouTube videos using Natural Astaxanthin. Marco Narducci, MD, is a medical doctor who loves Astaxanthin and shows readers why. In his first demonstration, he shows how incredibly powerful Astaxanthin is as an antioxidant by comparing a single drop of Astaxanthin to 1200mg of Green Tea and also to 1200mg of Vitamin C. He takes apple slices and puts them into water solutions with these three nutrients, stressing what a small amount of Astaxanthin is used compared to huge amounts of the other antioxidants. After waiting 20 minutes, Dr. Narducci shows how this tiny amount of Astaxanthin protects the apple from oxidation much better than the massive amounts of Vitamin C and Green Tea. The video is only five minutes long and very interesting to watch. It can be accessed by typing "Narducci apple" on YouTube or at this address: <https://www.youtube.com/watch?v=wBowCs3l9KY>



A single drop of Astaxanthin is far superior to 1200mg of either Vitamin C or Green Tea as an antioxidant.

The other YouTube video Dr. Narducci did was even more amazing. In this demonstration, he used an egg from a chicken fed Astaxanthin and compared it to a normal egg you can buy in a supermarket.

There is already a company supplying eggs from chickens fed Astaxanthin in Sweden. They market their eggs with the name (translated into English) of "Golden Yolk." This is because the eggs of chickens fed Astaxanthin come out with a much



A normal egg from a chicken that was not fed Astaxanthin has a weak yolk which breaks when gently handled.

deeper, richer yolk color. Their egg carton educates consumers about Astaxanthin being the world’s strongest antioxidant. They price their eggs about 15% higher than standard eggs, yet because of the superior yolk color and education about Astaxanthin’s antioxidant protection, they’ve been able to carve out a nice market share—about 20% of the Swedish egg market the last I heard.

Dr. Narducci goes a step further in showing Astaxanthin’s positive effect in eggs. His theory is that, if Astaxanthin can protect cell membranes (as it does in algae, salmon and human cells) and make them more resilient, it should be able to make an egg yolk stronger. He cracks the Astaxanthin-fed chicken egg and starts tossing it around in his hands and dropping it in a bowl, and amazingly, the egg yolk remains intact. But with the standard egg from a chicken that was not fed Astaxanthin, the yolk breaks on the very first toss. Amazingly, he actually picks up the Astaxanthin egg between two fingers and it doesn’t break—this is one strong yolk! You can access



Astaxanthin creates the “Super Yolk.” Similar to how Astaxanthin protects a chicken egg yolk, it can protect our cells’ membranes.

this video by typing in “Narducci egg” on YouTube or at this address: <https://www.youtube.com/watch?v=Zc-4dgwGSC8>

Interesting Facts about Astaxanthin's Growing Popularity

Very few people outside of research circles had heard about Astaxanthin until the last ten years or so. That's been changing quickly recently, mostly because the prominent doctors, university professors and opinion leaders you'll read about in the next chapter have been appearing in the media and educating about what an incredibly healthful nutrient Astaxanthin is. Since Astaxanthin is so beneficial and is “The Supplement You Can Feel,” I expect it to become a household word in the future. There's a good chance that one day soon, more people will take Natural Astaxanthin than currently take glucosamine, CoQ10, collagen and lutein combined (since Astaxanthin almost certainly works for joints, hearts, skin and eyes better than these current category leaders due to its superior antioxidant and anti-inflammatory abilities).

We're already starting to see trends showing explosive growth for Natural Astaxanthin. Here are some interesting facts about how Astaxanthin is quickly emerging on the global supplement scene:

- Costco Warehouse Clubs (the world's second largest retailer) keeps 4 foot x 4 foot Astaxanthin floor displays up all the time in some of their stores (where they first introduced Astaxanthin over ten years ago).
- GNC (the world's largest chain of nutritional supplement stores with over 6000 locations in USA, plus stores in over 40 other countries) puts Astaxanthin in their two top-selling products, their “Women's Ultra Mega” and “Mega Men” multivitamins.
- In Norway, 10% of adults take Astaxanthin every day.
- A direct-selling company marketing mostly in China, Russia

and Eastern Europe produces 30 million Natural Astaxanthin capsules at a time.

- A huge home-shopping brand in Germany ranks Astaxanthin as their #1 best-selling product.
- Famous doctors (such as Dr. Mercola and Dr. Perricone) who market their own brands of nutritional supplements carry Astaxanthin in their product range.
- Some not-so-famous doctors have completely changed their lives because of Astaxanthin (which you’ll read about in the next chapter).
- The first two books I wrote on Astaxanthin in 2007 and 2012 have been translated into 11 languages.



Natural Astaxanthin display at a Costco store (the world's second largest retailer). Astaxanthin sells so well at some Costco locations that they keep this floor display up full time!

2 **Don't Believe Me!** **Listen to What Famous Doctors, Researchers, Pharmacists and Opinion Leaders Say About Astaxanthin**

I'm not a doctor, and I'm not a scientist. I'm simply a person who has gotten two "feelable" health benefits from Natural Astaxanthin and decided to dedicate my career to researching this wonderful substance and educating people about its benefits. Because I'm not a credentialed expert, I rigidly follow a protocol when discussing Astaxanthin and other supplements I've written about in the past: Unless there is strong clinical evidence, I never say that a supplement "works." I always insist that there are at least two solid human clinical studies for a particular health benefit before drawing conclusions about potential effectiveness. In fact, even if there is solid clinical evidence with at least two clinical trials for a particular health benefit, I still recommend that people consult their physician before embarking on a supplement regimen.

In Chapter 3, I will review in detail the voluminous research that has been conducted demonstrating Astaxanthin's various health benefits. This research review will be the "meat" of this book, and should be of special interest to health care professionals and people in the supplement industry. However, not everyone will have equal interest in this research, and may prefer some of their "meat" partially predigested. To make this book more reader-friendly, I will include a summary of the major findings concerning each health benefit in the beginning of Chapter 3. That way, readers who don't wish to get into too much detail on every health benefit can review the summary and then choose which health benefits they wish to study more closely.

The present chapter provides another basis for readers' evaluation: the conclusions of well-known, highly-respected health experts and educators who have



Research scientists and doctors around the world are discovering more about Astaxanthin's health benefits every year.

espoused themselves of the benefits of Natural Astaxanthin in the media. Rather than give a long list of testimonials from consumers as I did in the first two books I wrote on Astaxanthin, I thought it would be more meaningful to readers to hear what qualified experts say about it in their own words. Many of these experts have built their reputations over the years by providing the public with reli-

able, evidence-driven information on how to improve their health and quality of life. This diverse group has credentials and experience that surpass any I've seen quoted in any book on supplements over the last 25 years. Remarkably, they've written approximately 200 books between them! The list of experts includes, among others, the most widely-followed doctor on the Internet, the host of the most popular health-based show on American TV, two "New York Times" best-selling authors who are both MDs, the most well-known pediatrician in America, the most famous dermatologist and the most well-known pharmacist (who I'm proud to say also wrote the introduction to this book). These are individuals who deservedly have earned the public's trust and respect over many years, so what they say should help laypeople as well as professionals evaluate the potential benefits of Astaxanthin for themselves.

In addition to the credentialed experts, I'll also include a sampling of the universities, medical schools and governmental agencies from around the world that have conducted research on Astaxanthin showing potential health benefits. And I'll even tell about some Hollywood types—a pop music icon, an Academy Award-winning actress and a supermodel—who all take Natural Astaxanthin for its skin health and "Beauty from Within" benefits.

As you'll soon see, most of these prominent experts and opinion leaders that I reference in this chapter, like me, tried Astaxanthin and experienced the magic of "The Supplement You Can Feel" for themselves.

Dr. Joseph Mercola, Renowned Internet Health Expert

Dr. Joseph Mercola is almost certainly the most followed physician in the entire world on the Internet. If you do a Google search for ten cutting-edge supplements, Dr. Mercola's vast library of health information will probably be within the top few Google listings for most of them. He literally has thousands of web pages of information on health-related issues. In addition, he has an "opted-in" e-newsletter that goes out to millions and millions of consumers and people in the medical field and supplement industry. Dr. Mercola is a true powerhouse in the world of health information.



*Dr. Joseph Mercola interviews Bob Capelli about Astaxanthin
(available on www.mercola.com).*

I've been educating about Astaxanthin for over 15 years already, and have done hundreds of radio and TV shows and public presentations on my favorite topic. I'm so comfortable talking about Astaxanthin that I rarely get nervous regardless of where I appear. Yet I must admit that I was nervous back in 2011 when Dr. Mercola interviewed me about Astaxanthin for an educational video. Dr. Mercola's colleagues at www.mercola.com told me that the video would get about 200,000

views in the first few days after he sent it out in his newsletter, and I'll be darned if they weren't spot-on correct. (You can view the video by going to www.mercola.com and typing in "Capelli" or at this address: <http://articles.mercola.com/sites/articles/archive/2011/10/29/bob-capelli-on-astaxanthin.aspx>)

Like most of the other experts you'll read about in this chapter, Dr. Mercola takes Natural Astaxanthin every day and really believes in Astaxanthin as a health-giving nutrient.

"Astaxanthin is in a League of Its Own"

by Dr. Joseph Mercola

Astaxanthin is produced only by the microalgae *Haematococcus pluvialis* when its water supply dries up, forcing it to protect itself from ultraviolet radiation. It's the algae's survival mechanism—Astaxanthin serves as a "force field" to protect the algae from lack of nutrition and/or intense sunlight. There are only two main sources of Astaxanthin: the microalgae that produce it, and the sea creatures that consume the algae (such as salmon, shellfish, and krill).

Astaxanthin is now thought to be the most powerful antioxidant found in nature.

Astaxanthin not only provides the color to salmon but is also the reason salmon have the strength and endurance to swim up rivers and waterfalls for days on end. Their diets are high in this pigment, which concentrates in their muscles and makes them one of the "kings of endurance" of the animal kingdom.

Astaxanthin leaps and bounds more effective than beta-carotene, lycopene and lutein, other members of its chemical family. It exhibits exceptionally effective free radical scavenging activity and protects your cells, organs and body tissues from oxidative damage.

Astaxanthin's unique "antioxidative artillery" provides for an impressive array of health benefits, including improving cardiovascular health, stabilizing blood sugar, boosting your immune system, improving

Dr. Joseph Mercola (cont.)

endurance and athletic performance, improving fertility—and even protecting you from sunburn.

What Makes Astaxanthin Special?

There are many properties that make this carotenoid unique. Here are the main differences:

- Astaxanthin is by far the most powerful carotenoid antioxidant when it comes to free radical scavenging: Astaxanthin is 65 times more powerful than Vitamin C, 54 times more powerful than beta-carotene and 14 times more powerful than Vitamin E.
- Astaxanthin is far more effective than other carotenoids at “singlet oxygen quenching,” which is a particular type of oxidation. The damaging effects of sunlight and various organic materials are caused by this less-stable form of oxygen. Astaxanthin is *550 times more powerful than Vitamin E* and 11 times more powerful than beta-carotene at neutralizing singlet oxygen.
- Astaxanthin crosses the blood-brain barrier AND the blood-retinal barrier (beta carotene and lycopene do not), which brings antioxidant and anti-inflammatory protection to your eyes, brain and central nervous system and reduces your risk for cataracts, macular degeneration, blindness, dementia and Alzheimer's disease.
- Astaxanthin is soluble in lipids, so it easily incorporates into cell membranes and protects them from oxidative damage.
- It's a potent UVB absorber and reduces DNA damage.
- It's a very potent natural anti-inflammatory.



Dr. Joseph Mercola, the Internet's leading health educator.

Dr. Joseph Mercola (cont.)

And How About Some More Great News?

There have been no adverse reactions found for people taking Astaxanthin; that is right, there is no toxicity. The only known side effect if you consumed too much is that you would turn pink for a while (Mercola, 2011).

Dr. Oz, Star of the Most-Watched Health TV Show in America

Dr. Oz is to television doctors what Dr. Mercola is to Internet doctors—the most followed expert in his medium. He’s had the top-rated medical show in the USA for several years, and has become a trusted health advisor to millions in the USA and around the world. If you were to put Dr. Mercola together with Dr. Oz, that’s when things could get really crazy.

That’s exactly what happened in January 2011 when Dr. Oz invited Dr. Mercola on his show to talk about any nutrient he wanted. The one Dr. Mercola chose was Astaxanthin. The segment lasted about five minutes and they ran it three different times throughout 2011. This was the same year that Dr. Mercola began sending out e-newsletters and doing educational videos about Astaxanthin for his millions of followers. Between Dr. Mercola’s appearance on the Oz show and his educational blitz, the worldwide supply of Natural Astaxanthin sold out in 2011 and remained sold out until 2014! This was very unfortunate because many consumers who wanted to try the product had a hard time finding it—store shelves were wiped out, brands were forced to discontinue Astaxanthin for lack of supply, and retailers had no choice but to eliminate shelf space when new product didn’t arrive for months at a time.

The segment on the Oz show featured a huge backdrop saying “The #1 Supplement You’ve Never Heard of that You Should Be Taking.” Dr. Mercola talked about all the reasons why consumers should take Astaxanthin as a preventive and potentially therapeutic nutrient, and consumers were “off to the races” to buy a bottle for themselves.



When Dr. Mercola went on the Dr. Oz show and called Astaxanthin “The #1 Supplement You’ve Never Heard of that You Should Be Taking,” it took three years for worldwide supply to catch up with demand!

Dr. Nicholas Perricone, World’s Most Famous Dermatologist

“New York Times” best-selling author and dermatologist Nicholas Perricone, MD, had a series of best-selling books about looking and feeling better. He attained the #1 top position on the coveted “New York Times” Best Sellers list with his book “The Perricone Promise: Look Younger, Live Longer in Three Easy Steps.” He had written about Astaxanthin before, but in this best-seller he took it to a new level. He devoted three entire pages to a single nutrient— Natural Astaxanthin.

In one of his other best sellers, “The Perricone Weight-Loss Diet,” he refers to Astaxanthin as a “Superstar Supplement” and says that “it provides wrinkle reduction by internal supplementation and reduces hyperpigmentation (better known as age spots).” He attributes Astaxanthin’s outstanding skin health properties to its

unique role in protecting the cell membrane (Perricone, 2006). Fortunately, Dr. Perricone is very astute about the differences between Natural Astaxanthin and its distant cousin, Synthetic Astaxanthin (which is produced from petrochemicals) and cautions against eating farm-raised salmon which invariably contain the inferior synthetic variety (Perricone, 2005). (I'll discuss this crucial topic in detail later.)



*The World's Most Famous Dermatologist
loves Astaxanthin's effects on skin*

Oprah (need I say more?)

No credentials or even last name required here: Oprah Winfrey is one of the most famous people in the world, period. Just as Dr. Oz and Dr. Mercola teamed up to make Astaxanthin sales explode in 2011, Oprah and Dr. Perricone teamed up a few times to talk about Astaxanthin's role as an internal beauty supplement back when her TV show was still running regularly. On one of his appearances on her show, Dr. Perricone glowingly told Oprah that Astaxanthin is a "wonderful anti-inflammatory and antioxidant that gives you that beautiful, healthy glow."

Dr. William Sears, World's Best-Known Pediatrician

Over the last several years, I've had the great pleasure to become close friends with the renowned pediatrician, William Sears, MD (or "Dr. Bill" as his patients call him). Dr. Bill wrote a series of books on parenting, children and families that have

become classics. Over the last decade, Dr. Bill has branched out into writing books about more adult-oriented health themes. At last count he's written close to 50 books. He's been featured as a health and parenting expert on over 100 television shows including "Oprah," "Dr. Phil," "20/20," "Good Morning America," "CNN," the "Today Show" and "The Doctors." Dr. Bill was featured in a "Time Magazine" cover story in 2012 with six full pages about his vast work and parenting philosophy. But one of the best things about Dr. Bill is that, in spite of his fame, he's about the nicest, most down-to-earth person you'll ever meet!



"Working" in Hawaii with Dr. Bill Sears

With the possible exception of my mother (age 93), I don't know anyone who has aged as gracefully and healthfully as Dr. Bill. He and his brilliant and beautiful wife Martha love to come to the Big Island of Hawaii (where my wife and I live) where we often invite them to dinner at our home. On one visit, we decided to take them sightseeing down into Waipio Valley, perhaps the lushest, most beautiful place in all the Hawaiian Islands. This valley is accessed by driving down one of the steepest paved roads in the world with an elevation drop of about 1,000 feet. After

driving through some back roads (and even right through rivers) in the valley and spending time at the black sand beach, we started heading out. But Dr. Bill didn't want to drive out—he insisted on jogging out—1,000 feet straight up the side of a mountain that only four-wheel drive cars are able to successfully climb. And the truly amazing thing is: Dr. Bill was over 70 years “young” when he did this! So when he talks about healthy aging, everyone should pay close attention.

Dr. Bill has a voracious intellectual appetite, particularly for matters concerning health and wellness. I had the honor of introducing him to Astaxanthin several years ago, and since then, he's written his own excellent book on this wonderful nutrient. In Dr. Bill's Astaxanthin book, you'll find succinct, understandable advice about this “Supernutrient” as he calls it. He has an uncanny knack for being able to take the most complex subject matter and turn it into something everyone can understand (probably from his years of talking to children and some upset parents in his pediatric practice). Here are some gems from his Astaxanthin book:

Dr. William Sears

- An unfair quirk of aging is that as we get older, most of us continue to produce just as many oxidants, but our bodies decrease their production of antioxidants. When oxidants equal antioxidants, you tend to remain healthy. When oxidants outweigh antioxidants, you are out of balance, and wear and tear can accumulate, leading to accelerated aging.
- The AAA Effect of Aging: When we *Age*, our bodies produce less *Antioxidants*, so we need more *Astaxanthin*.
- What makes Astaxanthin such a special cell-membrane protector? It enjoys a double biochemical property: It is both lipophilic, meaning it loves fatty tissue, and hydrophilic, meaning it loves water. This enables it to work in tissue that contains both fat and water—the structure of the cell.
- Every age suffers inflammation. Every age needs more inflammation protection. Young children have a young immune system which is why they get sick so often. Teens work their bodies hard during sports and suffer overuse injuries. Pregnant mothers really overwork their bodies. Young

Dr. William Sears (cont.)

adults, a relative healthy period in life, should be in the “prevent mode” mindset, and seniors suffer ailments from tissues wearing out.

- With the immune system, we emphasize “balance” rather than “boosting,” since you want the body’s immune system to react according to the body’s needs. If the immune system underreacts, germs take over and you get sick. If it overreacts, the immune system gets its signals mixed up and attacks the body’s own tissue. Astaxanthin can help the immune system in a few ways.
- Here’s a medical lesson as true for the brain as it is for the eyes: Maintaining health is easier than repairing health, and Astaxanthin helps maintain eye health.
- The Two A’s are a perfect fit: Simply put, heavily worked tissues produce excess oxidants and inflammation. Astaxanthin is a powerful antioxidant and anti-inflammatory. Athletes and Astaxanthin are buddies.
- Aquaculture (basically farming in water) experiments to make farmed fish healthier reveal that farmed Atlantic salmon grow better and survive longer when fed Natural Astaxanthin. As the level of Natural Astaxanthin in the tissue of baby salmon increased, their survival rates increased from 17% to a whopping 87% (Sears, 2015).

Mike Adams “The Health Ranger”

Long before Dr. Mercola found out about Astaxanthin, Mike Adams (known popularly as “The Health Ranger”) was a daily consumer and a big fan. While Mike is not a physician, he has a lot in common with Dr. Mercola in that they both have large followings on their e-newsletters and lots of content on their websites. (Mike’s site is www.naturalnews.com.) About 15 years ago, Mike came out to visit Hawaii because he is a fan of Spirulina, another great supplement from microalgae.

He came to tour the microalgae farm where I worked at the time where we were also producing Astaxanthin. So Mike and I had a long talk about Spirulina and Astaxanthin, but it wasn't until Mike read my first book on Astaxanthin in 2008 and started taking it for himself that he became a true believer and began writing about it in his newsletters. In fact, Mike caused the first major increase in demand for Astaxanthin three years before Dr. Mercola's appearance on the Dr. Oz show.

I asked Mike if I could simply reprint a long excerpt from his very first newsletter about Astaxanthin in this book since, in this debut piece, Mike's enthusiasm for this "Supernutrient" is striking. Here's what he had to say about Astaxanthin:

Astaxanthin: The Little-Known Miracle Nutrient for Inflammation, Anti-Aging, Athletic Endurance and More

by Mike Adams "The Health Ranger"

Every once in a very great while, I discover a natural medicine so astonishing that I feel compelled to share it with you. The verb "discover" is actually not to my credit, by the way; Mother Nature created this natural medicine eons ago, and it's been present in trace amounts in aquatic ecosystems for over a billion years. In this article, I'm going to reveal the name of this natural medicine, what health benefits it provides to us, and how to get some right now. But first, before revealing the name, I want to share some of the numerous health benefits with you so you get the full picture of just how significant this substance can be in enhancing your



***Mike Adams "The Health Ranger,"
one of the earliest famous fans
of Natural Astaxanthin.***

Mike Adams (cont.)

health. As always, I have absolutely no financial ties to this product, and I earn nothing if you choose to purchase it. I do, however, buy and consume this product myself on a regular basis, as you'll see below.

Did you ever notice how the drug companies get excited when they find a drug that just slightly alters the risk of a single disease? I remember hearing all the hype about a particular cancer drug made by Big Pharma. It was called a “miracle” drug that needed to be fast-tracked so it could start saving lives. When I looked at the research, however, it only turned out to prevent cancer in one woman out of two hundred (a 0.5% reduction in the risk of breast cancer). Gee, that's not much to get excited about. And yet they called it a “miracle” drug! Well imagine if there were a natural substance that operated at many different biochemical levels at once, providing all the following health benefits (yes, from a single source!):

- Protects the brain from dementia and Alzheimer's
- Greatly reduces inflammation and joint pain
- Reduces oxidative damage to your DNA by 40% (even at low doses)
- Greatly increases endurance, muscle recovery and workout performance
- Reduces blood sugar level in diabetics and prediabetics
- Improves fertility while decreasing the rate of stillborn births
- Promotes cardiovascular health, reduces C-Reactive Protein (CRP)
- Reduces or eliminates carpal tunnel syndrome
- Boosts immune function and helps the body resist infections
- Protects the stomach from ulcers and invasive bacteria
- Protects the kidneys from damage due to high blood sugar
- Greatly improves sperm quality, motility, and sperm count
- Prevents asthma by normalizing histamine levels
- Protects the body from highly oxidative foods like fried foods

In addition, I've found that this natural medicine:

- Greatly protects eye health, reduces cataracts and prevents UV damage to the eyes
- Makes skin look younger and functions as a natural internal

Mike Adams (cont.)

sunscreen that prevents DNA damage and sunburn

- Protects the body from the dangerous oxidizing effects of Vioxx and COX-2 inhibitors, meaning that it can actually reduce the harmful side effects and deaths caused by other anti-inflammatory pharmaceuticals

Now, if all that is really true—and I'll show you in a minute that it is true—that would make this one of the most miraculous medicines ever discovered by modern science, wouldn't it? For any one substance to prevent and treat so many different diseases—and to protect the human body in so many different ways—is nothing short of truly miraculous. So why isn't this nutrient front-page news?

The answer, of course, is **because it can't be patented.** This natural substance (which I will reveal below) is created by microalgae, so it's not something that was invented by a drug company scientist for patenting purposes. And the sad fact of the matter is that *drug companies aren't interested in medicines that can't be patented, no matter how helpful or miraculous they may really be.*

And yes, all the health benefits I've described for this supplement are, indeed, quite true. And they're backed by clinical trials and research papers that are fascinating in what they contain, and yet have never been picked up by the mainstream media. In other words, **this nutrient may be the most powerful natural medicine you've never heard about!**

It's possible, of course, that you have heard about it. Especially if you've been reading NaturalNews for some time (I've mentioned it on this website before). But until recently, I never fully understood the health



Drug companies value patentable products over effective products.

Mike Adams (*cont.*)

benefits of taking *larger doses* of the nutrient.

Previously, I was only taking 2mg to 4mg per day. But for a while now, I've been taking 16mg per day (400% more than before), and I've discovered something truly astounding: **The health benefits of this natural medicine keep increasing as the dose increases** (to a limit, of course). I've found that 16mg a day is the ideal dosage for me to experience maximum benefits from this supplement...benefits that include outstanding athletic performance, a significant reduction in muscle soreness and joint pain, radical improvements in resistance to UV sun exposure, stabilized blood sugar and many more.

So what is this mystery nutrient? It's Astaxanthin, a deep red-colored phytonutrient synthesized by microalgae called *Haematococcus*. It's grown in fresh water using sophisticated techniques that encourage the algae to grow its own powerful medicines that protect it from oxidation, UV radiation and other environmental stresses. When harvested from the algae and concentrated into a liquid, Astaxanthin becomes *the most powerful antioxidant known in the natural world*, demonstrating 550 times the antioxidant power of Vitamin E, for example.

Now why is antioxidant power important? Think about it: Much of what goes on during the aging of the human body is due to *oxidation*. Every time you breathe, you're inhaling some oxygen, right? That oxygen reacts with your cells to create energy, but the byproduct of that energy is the creation of free radicals. These cause DNA damage, nerve cell damage, accelerated aging of internal organs and more.

The way to stop those free radicals is with antioxidants, which bind to them, neutralizing their damaging effects. Astaxanthin, it turns out, is so good at halting free radicals that it seems to confer **miracle-class health benefits** to the human body...benefits that might be described as "anti-aging" or "reversing disease" (Adams, 2008).

Dr. Michael Murray, Prolific Naturopathic Leader

Dr. Michael Murray has been educating and writing about natural healing and supplements for decades. With more than 30 books and over six million copies in print, Dr. Murray is recognized as an authority on natural medicine.

NAXA (Natural Algae Astaxanthin Association) is an organization of highly-respected producers of Natural Astaxanthin which was formed to educate the public about



Natural Astaxanthin and its benefits. Dr. Murray serves as an educator for NAXA, and the excerpt you'll read below is from a book that Dr. Murray wrote for this association. In the book, he is crystal clear that consumers should always purchase Astaxanthin products that contain NAXA members' Astaxanthin to ensure that they're getting an authentic product and will get the results they expect.

Dr. Murray did a particularly good job in his book of explaining why the size of the Astaxanthin molecule is so important:

Dr. Michael Murray

Astaxanthin is known as the “King of Carotenoids.” It is given this title because of its unique benefits and action in promoting health and protecting against cellular damage, especially in the brain and vascular system.

In regards to general antioxidant effects in protecting cells, Astaxanthin is more than 50 times more powerful than beta-carotene. There is also another big advantage that relates to its size and how it fits into cell membranes—it is considerably larger/longer than other popular carotenoids. Its size and physical form allow it to be incorporated into cell membranes where it is able to span the entire thickness of the cell membrane. This allows Astaxanthin to not only protect the inner and outer cell membrane from oxidative damage, but also to stabilize the cell membranes. No other carotenoid can produce this effect and that explains why the health benefits of Astaxanthin are considerably greater than other carotenoids (Murray, 2016).

Dr. Jason Theodosakis, “New York Times” Best-Selling Author

Jason Theodosakis, MD, MS, MPH, FACPM (or “Dr. Theo” as he’s commonly called) is a college professor, practicing physician, author and expert on joint health, having written the “New York Times” #1 bestseller “The Arthritis Cure.” Dr. Theo wrote an excellent introduction for Dr. Bill Sears’ book on Astaxanthin. He is particularly impressed by the small amount of Astaxanthin necessary to attain results. (As little as 4mg per day can have far-reaching beneficial effects in multiple body systems.)



*Joint health expert Dr. Jason Theodosakis
espouses the benefits of Astaxanthin*

Dr. Jason Theodosakis

When I first heard about Astaxanthin (“asta – ‘zan – thin”), the scientific research was in its infancy. Since then I have been surprised at the rate at which new discoveries associated with this impressive ingredient have been made. The potency of Astaxanthin, which can be achieved with only 4 – 12 milligrams, sharply contrasts with that of other natural ingredients, especially in the herbal world, where several grams are required to achieve positive research outcomes.

The effectiveness and favorable dosing open up a whole world of opportunities for Astaxanthin. Not only can it be used alone, but it can also be used in combination with other ingredients to support the health of the brain, joints, eyes, heart, immune system, and it even has cosmetic applications (Theodosakis, 2015).

Doctors Who Have Changed Their Lives Because of Astaxanthin

I personally know two medical doctors who changed their lives after learning about Astaxanthin and trying it for themselves. Dr. Robert Corish came to a large trade show for natural supplements in 2007 and I gave him a copy of my first book on Astaxanthin which had just been released. He literally read the book overnight. He then began taking Astaxanthin himself and, more importantly, immersed himself in the medical research on Astaxanthin. I hired Dr. Corish as our Medical Director at my former employer and was extremely impressed with how knowledgeable about Astaxanthin he became in a very short period of time.

Dr. Corish literally changed his life because of Astaxanthin. He has been involved professionally with Astaxanthin ever since 2007, now serving as Medical Director for a different producer of Natural Astaxanthin. If you ever get a chance to see one of his seminars on Astaxanthin, you'll find him one of the most knowledgeable and entertaining speakers you've ever seen. Dr. Corish now has his own book about Astaxanthin, and the introduction does a great job summing up our current health care system and how Astaxanthin can help:

Dr. Robert Corish

Why would a medical doctor, with a successful practice, leave his day job to write a book about a dietary nutritional supplement?

Allow me to explain: As a physician I am seeing younger and sicker patients, on more medications, coming to the operating room every day. More than I have seen in my twenty-year career in medicine. Something is desperately wrong!

Our medical system is broken, it is depleted, and it is heading in the wrong direction. We are no longer practicing health-care; we are practicing "sick-care" to the point where the medical system has become sick itself.

But all is not lost. In 2007 I was invited to the largest natural food and supplements exhibition in Anaheim, California known as Expo West, and it was there that I first heard about a natural antioxidant called Astaxanthin...

Dr. Robert Corish (cont.)

...Natural Astaxanthin is the strongest antioxidant I have ever come across. When it is taken regularly it can and will change the face of health care. It helps **prevent** diseases rather than treat them. Research and positive clinical data continue to pour out new information on Astaxanthin's health benefits. The human clinical trials only reconfirm what we already knew from animal studies: This antioxidant has incredibly wide reaching health effects.

Today, my new passion and practice is stopping illness before it happens and preventing unnecessary and painful surgeries. The key is Natural Astaxanthin (Corish, 2015).



It's all about prevention!

And Dr. Corish isn't the only medical doctor who changed his life due to Astaxanthin. When I first started working with Astaxanthin professionally in 2002, an MD from Honolulu, Hawaii [name withheld at his request] came up to me at a conference and told me that Astaxanthin had completely changed his life. He suffered from extreme susceptibility to sunburn (which was especially problematic since he lives in sunny Hawaii). After taking Natural Astaxanthin for a few months, he found he could go out in the sun for four or five hours at midday without burning due to Astaxanthin's sun protective qualities. This was a huge change from his pre-Astaxanthin days when he would get badly burned within an hour.

So what do you think this successful MD did? He started his own brand of Astaxanthin and began educating people on its health benefits!

Another Naturopath's Book on Astaxanthin

Although not nearly as well-known or prolific as the Naturopath Dr. Michael Murray I quoted above, a new Naturopath author is emerging on the scene and has written

a book on Astaxanthin. Her name is Dr. Jennifer Matthews and she did a good job in her book discussing Astaxanthin's superior antioxidative properties:

Dr. Jennifer Matthews

Due to the fact that Astaxanthin has a massive surplus of free electrons, its antioxidant capacity will last a lot longer. Once it has donated the electrons to neutralize free radicals, it will eliminate the excess energy as heat.

It can handle multiple free radicals at any given time—most antioxidants can only handle one free radical at a time, but Astaxanthin can handle up to 19 free radicals at once.

It positions itself across the entire cell membrane, which is unlike any other carotenoid:

- A portion will attach to the exterior of the cell (offers protection from free radicals outside of the cell).
- A portion will attach to the interior (offers protection inside where there are free radicals being generated).
- A portion crosses the entire lipid layer (to protect against lipid peroxidation) (Matthews, 2017).

Suzy Cohen, RPh, "America's Most Trusted Pharmacist"

I'm also happy to say that I'm good friends with Suzy Cohen and her hilarious husband Sam, some of the most enjoyable people you could ever hope to meet. Suzy Cohen has been a pharmacist for over 25 years and is frequently referred to as "America's Most Trusted Pharmacist." In fact, she may well be the world's most famous pharmacist at this point. She is the author



*Suzy Cohen, Bob Capelli and Sam Cohen
overlooking pristine Waipio Valley in Hawaii*

of the nationally syndicated column “Dear Pharmacist” and best-selling books including “The 24-Hour Pharmacist,” “Drug Muggers” and “Diabetes Without Drugs.” Suzy spent many years as a full-time pharmacist before she began sharing the vast knowledge and experience she had acquired in her studies and behind the counter through her writings and media appearances. As a pharmacist rather than a physician, Suzy looks at health issues from a slightly different perspective. In addition to all of her various writings, she has also appeared on hundreds of TV and radio programs as a health expert, including eight appearances on the Dr. Oz show. I asked Suzy to write the Introduction for this book, but I also asked her to write her personal testimonial about Astaxanthin so people can see first-hand how “The Supplement You Can Feel” works for her:

Suzy Cohen, RPh

I take Natural Astaxanthin every day. Why do I do this? I can answer this in one word: “Insurance.” I hit 50 recently and I want to take a powerful antioxidant and a safe and natural anti-inflammatory to help keep me healthy. Scientists have found out that most of the diseases that kill us are in one way or another caused by excessive oxidation in our bodies and by long-term, low grade “silent inflammation.” So by taking a single capsule every day that is super-potent in scavenging oxidants and has been clinically validated to lower the key marker for silent inflammation CRP (C-reactive protein), I’m “insuring” my body against all of the maladies associated with these silent killers. And on top of that, clinical research has shown that Natural Astaxanthin can help with lots of other health concerns associated with aging: It can help protect our brains and our eyesight, keep our joints and tendons flexible and pain-free, and I can’t deny that I love the fact that it helps keep my skin looking young, healthy and wrinkle-free. If you’re going to take one supplement to help see you through the aging process, do like I do: Make it Natural Astaxanthin!”



***Suzy Cohen, RPh, “America’s
Most Trusted Pharmacist”***

Susan Smith Jones, PhD, Prolific Author and Media Personality

I've referenced many prominent MDs, a few Naturopaths and "America's Most Trusted Pharmacist" in the pages above. Now let's turn to another hugely important group of experts: PhDs and university professors. We'll start with two of my favorites who, in addition to being extremely well-respected in their fields, are also personal friends.

For a woman with three of America's most ordinary names, Susan Smith Jones, MS, PhD, has certainly made extraordinary contributions to the field of holistic health. With 30 years at the University of California Los Angeles teaching students, staff and faculty how to be healthy and fit, Susan has established herself as one of the world's foremost experts on diet and nutrition, high-level wellness, natural remedies, balanced living and human potential. She is the author of 27 books (including "Walking on Air," "The Joy Factor," "The Curative Kitchen & Lifestyle," "Healthy, Happy & Radiant...at Any Age," "Living on the Lighter Side," "Recipes for Health Bliss" and "Invest in Yourself with Exercise"). She's written over 2,000 magazine articles on these topics, and has been a guest on more than 2,500 radio and TV shows worldwide. Selected as one of "10 Healthy American Fitness Leaders by the President's Council on Physical Fitness & Sports," Susan teaches that the body is designed to be self-repairing, self-renewing and self-sustaining, and that the power to live a radiantly healthy life is within everyone's grasp. On a personal level, I can honestly say that Susan is one of the most positive-thinking people I've had the pleasure of meeting. (Susan's website is www.SusanSmithJones.com.)

Astaxanthin: My Daily Companion

by Dr. Susan Smith Jones

Whenever I talk about Natural Astaxanthin, a super-antioxidant supplement, I practically blush with excitement. Astaxanthin, a red-colored superfood of nature, gives marine life like salmon and shrimp its signature pinkish-reddish color and is a powerhouse of antioxidant support for the

Dr. Susan Smith Jones (cont.)

human body. Science has proven it to be an exceptionally safe and effective supplement for joint health, skin health, eye health, brain health, exercise stamina and immune function.

I have been taking Astaxanthin for over 12 years and have benefitted with glowing skin, effervescent energy and a pain-free lifestyle. Thanks to this reddish wonder, I'm indeed "blushing" with radiant health!

Before I discovered Astaxanthin, I had a host of recurring health problems including low energy, skin that was dry and prone to sun damage and joints that ached for hours after workouts. After just 90 days of supplementation, I began to see improvement in my stamina, sun sensitivity and joint inflammation—results which have been so consistent over time that I was literally able to throw out 10 other bottles of supplements on my kitchen counter and trade them in for just this one antioxidant superstar.

"Antioxidant" is a buzzword in the health and nutrition industry, one that is often not well understood. I like to think of antioxidants as powerful "mops" that clean up free radicals in our bodies. Free radicals are toxic, unstable molecules that can inflict damage on our cells, leading to premature aging and disease states. No doubt you're familiar with foods high in antioxidants like spinach and other dark green vegetables, sweet potatoes, beans, berries, papaya, dark-colored grapes, mangos, walnuts, pecans, artichoke hearts, cloves, pomegranates, tomatoes and other



Susan Smith Jones, PhD, Motivational Speaker, Author, Holistic Health Educator and Media Personality

Dr. Susan Smith Jones (cont.)

colorful superfoods. But Astaxanthin blows all of them out of the water!

A red plant pigment, Astaxanthin comes from the same carotenoid family as beta-carotene, lycopene and lutein. The International Carotenoid Society found that Astaxanthin is 6,000 times stronger than Vitamin C, 500 times stronger than Vitamin E, and 2,000 times stronger than resveratrol and quercetin. It is also 300 times stronger than Co-Q10, 550 times stronger than green tea catechins, and 11 times stronger than beta-carotene. How is that for some powerful healing?

Not only is it among the most potent of nature's antioxidants, but Astaxanthin is also one of the most versatile. It can handle multiple types of free radicals and do so simultaneously (in some cases, up to 19 free radicals at once). Think of it as a "super mop" that can handle every type of "cleaning" situation, so you don't need a dozen different tools to get the job done. This is in contrast to antioxidants like Vitamins C and E, which can only take on specific types of free radicals, become exhausted after handling one free radical, and can actually end up "switching teams" to become pro-oxidants. Natural Astaxanthin, on the other hand, never becomes a free radical. No wonder it is considered the "King of Antioxidants"! What does this mean for your body?

As it turns out, a great deal.

To understand what Astaxanthin can do for humans, consider what it does for marine life. Microalgae known as *H. pluvialis* produce Astaxanthin in response to stressors such as excessive sunlight, changes in the water pH or lack of nutrients. The Astaxanthin shields the algae from crisis and absorbs free radicals to protect it from injury. The protection is so comprehensive, in fact, that these algae can survive over 40 years without food or water during times of drought! The marine animals that feed off the algae—including krill, shrimp, trout, salmon and even flamingos—benefit from Astaxanthin as well. Actually, it is thought that Astaxanthin is what gives wild salmon the energy to swim upstream to spawn.

Taken as a dietary supplement, Astaxanthin can provide humans an energy boost too, leading to increased strength and decreased recovery

Dr. Susan Smith Jones (cont.)

time from exercise. Astaxanthin protects algae and salmon eggs from the harsh UV rays of the sun; it does the same for human skin. Regular supplementation with Astaxanthin can actually make you less sunburn-prone, improve skin moisture and reduce wrinkles. Research has also shown that Astaxanthin can block inflammatory Cox-2 enzymes, thereby promoting joint health. I can vouch for all of these benefits through personal experience!

Additionally, as I've seen in my private holistic health practice, Astaxanthin supports immune function, cardiovascular health and brain health. It crosses the blood-brain and blood-retinal barriers, helping to guard against cataracts in the eye and safeguarding the brain and central nervous system. Astaxanthin has also been shown to reduce the amount of hydroperoxides in red blood cells (elevated amounts are associated with Alzheimer's disease).

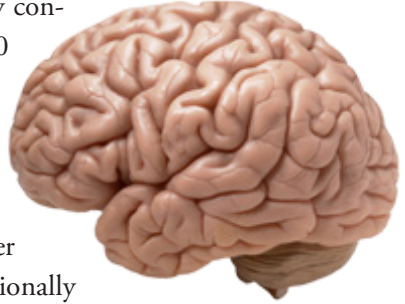
There are many dietary sources of Astaxanthin, including foods like red trout, crab and lobster. Wild sockeye salmon has the highest concentration of Astaxanthin of any protein source; however, you'd have to eat one pound of salmon to get the amount contained in one 4mg softgel capsule of Natural Astaxanthin.

I personally take at least 12mg to 16mg of Natural Astaxanthin daily. As a preventative for overall health, 4mg to 8mg is sufficient, but if (like me) you have more specific health concerns or lead an exceptionally active lifestyle, 12mg to 16mg offers maximum benefit. In over 300 scientific studies, Natural Astaxanthin (not synthetically produced Astaxanthin from petrochemicals, which has many potential safety concerns) has proven safe for human consumption with no side effects (aside from a rosy glow to the skin when taken in high doses of 50+ mg).

In sum, Astaxanthin is nature's best antioxidant delivered in its purest, most potent form. You'd be hard-pressed to find a product that delivered a greater free-radical punch or had such uncompromising purity. With a boost from this red-pigmented antioxidant, you might just feel like everything's coming up roses!

Paula Bickford, PhD, Prominent Brain Health Researcher

Dr. Paula Bickford is the main reason blueberry consumption increased by 3X or 4X over the last 20 years. Early in her career as a university professor, Dr. Bickford did extensive research on blueberries' cognitive health benefits. This led to a great deal of media coverage on blueberries which, in turn, led to a huge increase in consumption. Over the years, Dr. Bickford has become an internationally acclaimed expert in the field of aging, specifically with regards to brain health as we age. She has served as the President of the American Aging Association as well as the American Society for Neural Therapy and Repair.



Dr. Paula Bickford is beginning to uncover potential benefits for Astaxanthin in the fight against Parkinson's disease

After investing a huge amount of her time into studying the cognitive benefits of blueberries, Dr. Bickford turned her attention to “Supernutrients” like Spirulina and Natural Astaxanthin a few years ago. Her initial research on Astaxanthin, based on a mouse model of Parkinson's disease, showed very promising results (Grimmig, et al, 2017). (More about this in Chapter 3.)

Hundreds of Other University Professors & Researchers

Dr. Jones and Dr. Bickford aren't the only PhDs who love Astaxanthin. There are literally hundreds more around the world who have researched “The Supplement You Can Feel” or taken Astaxanthin themselves and felt its benefits. You'll read about some of them in Chapter 3 as we discuss the abundance of medical research. But there are a few who deserve special recognition for their notable contributions:

- You could say that Debasis Bagchi, PhD pretty much wrote the book on antioxidant research. He has about 300 publications including several books and hundreds of peer-reviewed studies. Astoundingly, Dr. Bagchi's work has been cited by his colleagues over 12,000 times! He has personally developed protocols for antioxidant surveys, and the work he performed on Astaxanthin at Creighton University was groundbreaking: While previous antioxidant research had typically analyzed Astaxanthin's effects on singlet oxygen, Dr. Bagchi discovered that Natural Astaxanthin is 14X to 65X stronger than all other antioxidants he tested it against in free radical elimination. This wasn't particularly earth-shattering for common antioxidants such as beta-carotene and Vitamin E that Natural Astaxanthin had already soundly beaten in the singlet oxygen comparisons. What was groundbreaking was that he and Dr. Gerald Cysewski (who together developed the protocol for this study) had the foresight to pit Natural Astaxanthin against Synthetic Astaxanthin and Pycnogenol® (Pycnogenol is a branded supplement that claims strong antioxidant activity) and found that Natural Astaxanthin is respectively 21X and 18X more effective at quenching free radicals than these two molecules (Capelli et al., 2013). This really puts things into perspective when considering that Synthetic Astaxanthin is being marketed as "Nature Identical" and Pycnogenol® is being marketed as a super-antioxidant.

- Within carotenoid research circles, Dr. Boon Chew is very well known. He's been researching carotenoids' potential health benefits for over 25 years as a Professor at Washington State University. He has published over 100 research studies, written chapters in books, and won many awards. (I'll reference his outstanding work on Astaxanthin heavily in the Immunity section of Chapter 3.) He did a series of experiments in



***Boon Chew, PhD, renowned
carotenoid researcher,
Washington State University***

several mammal species which culminated in a landmark human clinical trial that demonstrated many potential benefits for Natural Astaxanthin including reduction of DNA damage by 40%, an increase in several immune system markers and a decrease in C-reactive protein (the key marker for systemic inflammation) (Chew and Park, 2006).

- In the early 1990s, long before Dr. Chew began his research on Astaxanthin, a pioneer in this field working at the University of Minnesota's School of Medicine first uncovered Astaxanthin's potential to help modulate the immune system. Dr. Harumi Jyonouchi, a medical doctor as well as a university professor, oversaw a series of pre-clinical trials throughout the early 1990s which showed great promise for Astaxanthin's role in improving immune system function. It was upon this body of research that Professor Chew based his later experiments.
- Over 40 years before Dr. Jyonouchi began her research on Astaxanthin, two undisputed groundbreakers were beginning the world's first medical research on Astaxanthin. Doctoral candidates Rene Grangaud and Renee Massonet were working with what would now be considered primitive equipment in Algeria in the late 1940s. (Both of their doctoral theses based on this research were accepted at the University of Lyon in France.) Working with rodents, they were the first to discover that Astaxanthin reaches the eyes with its ability to cross the blood-retinal barrier and that its exceptional antioxidant and anti-inflammatory activities have various potential therapeutic and preventive benefits for eye health (Grangaud, 1951 and Massonet, 1958). (Sadly, their research was "lost" to the scientific community until recently, allowing an ophthalmologist professor from University of Illinois, Dr. Mark Tso, to receive a patent in this very same area of research in 1994.)

Universities, Medical Schools and Governments from Around the World

Researchers from universities around the world have studied Astaxanthin and added to the critical mass of research showing its health benefits. Probably the most impressive of all is Harvard University (which is usually ranked the top university in the world in most surveys). Harvard Medical School did one of the most fascinating studies of all on Astaxanthin: They showed that the prescription anti-inflammatory drug Vioxx® (which was taken off the market for causing heart attacks) could have been rendered completely safe and not caused any heart attacks if they had added a little Astaxanthin to it (Mason et al., 2006). (I'll discuss this study in more detail in Chapter 3.) Also toward the top of the “most impressive list” is Cornell University College of Veterinary Medicine (considered the first or second best veterinary university in the world). They did a pre-clinical study showing potential for Astaxanthin in cancerous cells from dogs (Wakshalg et al., 2010).



Harvard is the top-rated university in the world in most surveys. Their medical school did a groundbreaking study on Astaxanthin related to its ability to eliminate the pro-oxidant effects of the prescription drug Vioxx®.



Cornell University College of Veterinary Medicine is generally regarded as one of the top two vet schools in the world. A study done there in dogs uncovered Astaxanthin's potential with cancer cells.

These are two great examples of top universities that have studied Astaxanthin, and while listing all the different universities, medical schools and governmental agencies that have published studies would take a whole chapter for itself, I'll give just a sampling below to help readers understand just how widespread the research is:

Some of the Universities, Medical Schools and Governmental Agencies that Have Published Positive Research on Astaxanthin

- **USA Medical Schools:** Harvard University; University of Michigan; Georgetown University; University of Minnesota; University of Pittsburgh; Tufts University; Medical College of Wisconsin; University of Hawaii.
- **USA Universities:** Cornell University College of Veterinary Medicine; Massachusetts College of Pharmacy and Health Sciences; Washington State University; University of Connecticut; University of Memphis.
- **European Medical Schools:** Catholic University in Italy; Copenhagen University in Denmark; Faculte de Medecine de Rennes in France; Ghent University in Belgium; Kaunas University in Lithuania.
- **European Universities:** Royal Veterinary and Agricultural University in Denmark; University of Bologna in Italy; Stockholm University, Linkoping University and University of Lund in Sweden; University of Lyon and University of Lille Nord in France; University of Stirling in UK; University of Basque Country in Spain; University of Debrecen Faculty of Pharmacy in Hungary; University College in Ireland; Universitat Karlsruhe in Germany.
- **Japanese Medical Schools:** Hokkaido University Graduate School of Medicine; Nippon Medical School; Kochi Medical School; Keio University of Medicine; Tsurumi University School of Dental Medicine.
- **Japanese Universities:** Tokyo University of Pharmacy and Life Science; Kyoto University; Nagoya University; Gifu Pharmaceutical University; International Research Center for Traditional Medicine.
- **Chinese Medical Schools:** Chinese Academy of Medical Science; Binzhou Medical University; China Academy of Chinese Medical Science.
- **Chinese Universities:** Nantong University; Renmin University; Chinese Academy of Science.
- **Korean Universities:** Seoul National University; Kangwon

National University; Korea University; Dong-Eui University.

- **Taiwan Universities:** Providence University; Hungkuang University; Taipei Medical University School of Pharmacy.
- **Brazil Universities:** Federal Universities in the states of 1) Sao Paulo; 2) Rio Grande do Sul; 3) Pernambuco; and 4) Santa Maria; Cruzeiro do Sul University.
- **Other Universities and Medical Schools Around the World:** University of Queensland School of Medicine in Australia; University of Madras in India; Hong Kong Polytechnic University; University of Tabriz Faculty of Veterinary Medicine in Iran; Akdeniz University Medical School and Hacettepe University School of Medicine in Turkey.
- **Government-Sponsored Research:** In addition to tons of university-sponsored research, many countries have sponsored studies on Astaxanthin as well. Some examples of this government-sponsored research includes:
 - National Institute of Health in USA
 - Department of Veterans Affairs in USA
 - National Institute on Drug Abuse in USA
 - National Food Research Institute in Japan
 - National Institute of Agronomy Research in France
 - National Institute of Nutrition and Seafood Research in Norway
 - National Institute of Pharmaceutical Education and Research in India
 - Central Food Technological Research Institute in India

A Different Category of Opinion Leader: Celebrities Who Love Astaxanthin's "Beauty from Within" Benefits

Up to now, this chapter has reviewed the opinions of health experts and educators who are prominent in the media and other credentialed experts. But as shown by

the popularity of celebrity endorsements and magazine articles on the subject, many people are also interested in the beauty secrets of glamorous stars. Guess which anti-aging “beauty pill” is preferred by three celebrities below (a major Hollywood actress, a supermodel and one of the most famous pop icons of all time)?



Astaxanthin Goes Hollywood!

An Academy Award-winning actress, a Supermodel and a Pop Star all look to Astaxanthin for its skin health and “Beauty-from-Within” properties.

- **Academy Award Winning Actress Gwyneth Paltrow and Supermodel Heidi Klum** appeared in an article in England’s second largest circulation newspaper “The Daily Mail” a few years back. The article was titled “Extended Life Pill: ‘Miracle Supplement’ Promises to Fight the Signs of Aging.” The article reported that these Hollywood stars were both using Natural Astaxanthin to help keep their skin healthy and looking young. The article listed many different skin benefits for Astaxanthin, mentioning that it:
 - Fights wrinkles
 - Improves skin elasticity
 - Reduces visible signs of UV-aging within four to six weeks of use
 - Maintains a youthful appearance
 - Reverses premature signs of aging. [Please Note: These skin benefits are pretty much word-for-word from clinical research I’ll reference in Chapter 3, so it’s not just “Hollywood Hype” that’s driving this article: It’s based on science!]
- **Madonna** is another one of the few people (like Oprah) who can go by a single name and be recognized around the world. She is the consummate Pop Icon, and just like Gwyneth and Heidi, she

recognizes that Natural Astaxanthin is effective in keeping her skin looking young and healthy. An article came out about Madonna in “Allure Magazine” a while back that quoted the prominent dermatologist Dr. Perricone that I mentioned above.

Madonna's Fishy Fountain of Youth

By Jessica Matlin

Contrary to rumors that she's gone under the knife, Madonna's youthful appearance is due to something a lot fishier: Salmon. While only her personal chef knows for sure, to many in the anti-aging industry, it's obvious why she'd be stocking up on salmon, and why we should, too:

“Wild salmon is an outstanding source of Natural Astaxanthin, a unique and multi-talented antioxidant,” says Nicholas Perricone, MD, author of “Ageless Face, Ageless Mind” and one of salmon's biggest cheerleaders. “It's a superstar in the realm of anti-aging foods. Astaxanthin is shown to improve skin elasticity and reduce the appearance of fine lines,” he says. It also helps “endurance and recovery following vigorous exercise”—key for Madonna, who spends hours each day working out.

Now before you dig in, make sure the salmon you're eating is wild, since only wild salmon is rich in Astaxanthin (Matlin, 2009).

In conclusion, the list of prominent doctors, researchers, pharmacists and opinion leaders who extoll the benefits of Astaxanthin is impressive (perhaps only exceeded by the list of universities and medical schools around the world that have found positive research results on Astaxanthin). And to be perfectly honest, Astaxanthin is still in its early years—there is so much more to understand about how this “supernutrient” can help us live healthier, longer lives. Now that I've reviewed what distinguished leaders in their fields have written about Astaxanthin, I'll turn my attention in the next chapter to the medical research to date on Astaxanthin's ten clinically validated health benefits.

3

“The Healthy Ten”

The Ten Clinically Validated Health Benefits of Natural Astaxanthin

As I mentioned in Chapter 2, I’ve developed a personal rule when discussing the health benefits of supplements during my career: Unless there are two human clinical trials demonstrating efficacy for a supplement for a particular health benefit, I won’t refer to the benefit as being “clinically validated.” I have cited a single study for a specific health benefit in my writings and presentations over the years; however, because it’s only a single study, I don’t feel that it warrants extensive attention and I certainly don’t claim the result of the study as a “clinically validated health benefit.” The volume of research has to be built up with two or more clinical trials before I start to feel comfortable that there is a potential health benefit in that area.

And I have an iron-clad rule when it comes to pre-clinical research such as animal models and in-vitro surveys: to put it in plain English—they don’t count. They absolutely lend additional support when there are already two human clinical trials for a particular health benefit; but even if there are dozens of studies in a single area (such as in the case with Astaxanthin and cancer prevention with over 40 pre-clinical trials, mostly in rodents), my position is that we can’t make any inference that a similar effect will be found in humans. Why? Because, put simply, humans and rats are not the same species and a supplement may not affect both equally.

Fortunately, there has been a mountain of human clinical research on Natural Astaxanthin. The trials have been across a diverse array of ten different potential health benefits as you’ll discover in this chapter. And in a way, this is both a huge advantage for producers of Astaxanthin as well as a detriment:

- ➔ **Advantage:** What company producing and marketing a supplement wouldn't want to have strong human research for ten different health benefits?
- ➔ **Detriment:** Unfortunately, to some skeptics, since the diversity of health benefits is so great, Astaxanthin can begin to appear as a “snake oil” or “cure-all” and some consumers may start to question the validity of the health claims.

The areas of research for some of the health benefits are considerably deeper than others. You'll find a comprehensive list in the next section that details exactly how many human clinical studies and supporting pre-clinical trials there are for each of “The Healthy Ten.” Even the areas with the least human research have at least three or four positive clinical trials, and in every case there are many supporting pre-clinical trials to add a little additional credibility for the skeptics in the crowd. In fact, the area of research with the fewest number of studies (Astaxanthin's positive effect on Male Fertility) still has 3 human clinical trials and 11 supporting pre-clinical trials. And the area with the most research, Anti-Aging and Cellular Health, has a whopping 42 clinical trials and 214 supporting pre-clinical trials. With this mass of medical research, I'm very confident when I talk about “The Healthy Ten” as well-established potential health benefits of Natural Astaxanthin.



*How many supplements
have ten clinically validated
health benefits? (None
that I can think of.)*

I'll begin this chapter with a summary of research for “The Healthy Ten.” Then I'll move through each health benefit one by one starting with the two foundational properties that enable Natural Astaxanthin to positively affect the other eight areas: its exceptional strength and unique qualitative properties as an antioxidant, and its safe and natural anti-inflammatory activity. Astaxanthin's other health benefits for athletes, eyes and brains, cardiovascular health, immunity, joint and tendon support, skin health, male fertility and of course, its anti-aging potential, all emanate from

the antioxidant and anti-inflammatory building blocks. I'll focus mostly on the human studies, but in some cases I'll reference some pre-clinical trials which I feel are important to support this review. Finally, in each section I'll very briefly summarize several other pre-clinical trials which I feel will be of interest to some readers (particularly the scientists).

“The Healthy Ten” Research Summary

I've kept a compilation of medical research on Astaxanthin for many years. It contains the abstracts (summaries) of all the published research showing its potential health benefits. Once or twice each year I update it with the recently published research. This document is now over 600 pages long! (Available at: www.algaehealthsciences.com)

Sometimes in life, you need someone far removed from your own day to day work life to open your eyes to see things in a different way. The following Research Summary is the result of such an encounter that happened earlier this year. I had been sending out this 600+ page “War and Peace of Abstracts” to everyone in the industry that had interest in Astaxanthin. Some people (mainly scientists at supplement brands) love receiving such a complete list of research. It's separated into chapters that deal with the various health benefits, and the human clinical studies that matter most are always listed first in each section.

But it wasn't until the Buyer at one of the world's largest retailers of supplements honestly told me “You think I'm actually going to read a 600-page list of research?” that I decided that a precise summary was necessary. (Once completed, she was the first person I sent it to, with profuse thanks for her candor and inspiration.) I've found since then that even the scientists who genuinely love the 600-page document often prefer looking at the summary first to get an idea of the volume of research for each health benefit. So I'm happy to say that this learning experience turned out positive for all involved.



BIGGER isn't always better!

“The Healthy Ten”

Ten Clinically-Validated Benefits of Natural Astaxanthin*



Brain Health

- 4 Human Clinical Studies
- 50 Supporting Pre-Clinical Trials

Eye Health

- 14 Human Clinical Studies
- 24 Supporting Pre-Clinical Trials

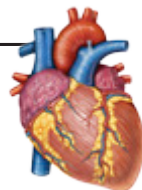


Skin Health & UV Protection

- 7 Human Clinical Studies
- 27 Supporting Pre-Clinical Trials

Cardiovascular Support

- 6 Human Clinical Studies
- 40 Supporting Pre-Clinical Trials

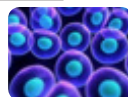


Immune System Modulation

- 4 Human Clinical Studies
- 26 Supporting Pre-Clinical Trials

Anti-Aging & Cellular Health

- 42 Human Clinical Studies
- 214 Supporting Pre-Clinical Trials



Male Fertility

- 3 Human Clinical Studies
- 11 Supporting Pre-Clinical Trials

Athletic Performance & Energy Levels

- 12 Human Clinical Studies
- 27 Supporting Pre-Clinical Trials

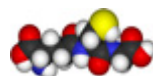


Joint, Tendon and Muscle Support

- 9 Human Clinical Studies
- 51 Supporting Pre-Clinical Trials

World's Strongest & Highest Quality Natural Antioxidant

- 10 Human Clinical Studies
- 87 Supporting Pre-Clinical Trials



World's Strongest & Highest Quality Natural Antioxidant

Clinical Trial Results

- Reduces various oxidative stress markers
- Prevents oxidative damage
- Prevents peroxidation of blood lipids including LDL cholesterol
- Prevents depletion of non-enzymatic antioxidant defense
- Dosage range 2mg to 4mg per day



In-Vitro Research Results

- Multiple times stronger than all other antioxidants tested in various head-to-head antioxidant experiments regardless of testing method
 - Generally at least 10X stronger than all other carotenoids
 - 800X stronger than CoQ10
 - 550X stronger than Vitamin E
 - 6000X stronger than Vitamin C
 - 18X stronger than Pycnogenol®
- 20X to 90X stronger than Synthetic Astaxanthin as an antioxidant in three separate tests from two peer-reviewed studies



Anti-Inflammatory and Joint & Muscle Health

Clinical Trial Results

- Decreases C-Reactive Protein (CRP) levels (key marker for systemic or “silent” inflammation)
- Prevents muscle damage and inflammation in athletes
- Reduces pain in rheumatoid arthritis sufferers
- Decreases pain rate and pain duration in carpal tunnel syndrome sufferers
- Improves grip strength by 93% in sufferers of tendonitis (tennis elbow) with reduced pain and improved mobility
- Reduces joint and muscle pain in heavily-training athletes
- Dosage range 4mg to 12mg per day



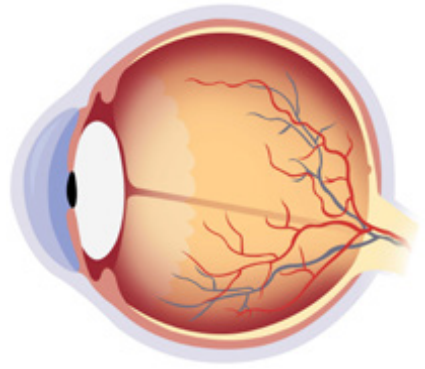
In-Vitro Research Results

- Astaxanthin has been shown to support 8 different inflammatory response markers without side effects or contraindications
 - Tumor Necrosis Factor-A
 - Prostaglandin E-2
 - Interleukin 1-B
 - Interleukin 6
 - Nitric Oxide
 - Nuclear Factor Kappa-B
 - Cox 1 Enzyme
 - Cox 2 Enzyme

Eye Health

Clinical Trial Results

- Dose-dependently improves visual acuity (the ability to see fine detail)
- Improves depth perception
- Improves eye fatigue
- Also can prevent eye fatigue
- Increases retinal capillary blood flow
- Increases blood flow velocity to the eyes
- Prevents eye strain
- Improves eye accommodation (adjustment of the lens that allows it to focus)
- Reduces blurred vision
- Reduces eye soreness
- Prevents eye dryness
- Prevents diplopia (double vision)
- Dosage range 4mg to 8mg per day



Brain Health

Clinical Trial Results

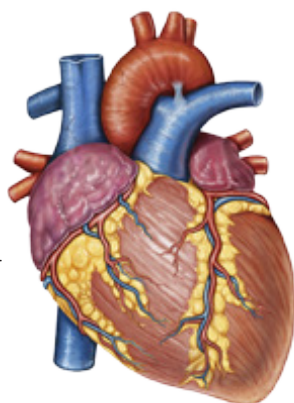
- Prevents age-related decline in cognitive function
- Improves psychomotor function in elderly subjects
- Improves marker for dementia in middle-aged and senior subjects and may contribute to the prevention of dementia from aging
- Improves cognitive function in healthy middle-aged and elderly subjects
- Decreases mental fatigue and confusion
- Improves erythrocyte antioxidant status to help transport oxygen to the brain
- Dosage range 6mg to 12mg per day



Cardiovascular Support

Clinical Trial Results

- Improves blood lipid parameters in patients with mild hyperlipidemia
- Dose-dependently inhibits LDL cholesterol oxidation
- May contribute to the prevention of atherosclerosis
- Improves blood flow rate
- Decreases heart rate of athletes when doing endurance training
- Dosage range 4mg to 18mg per day



Key In-Vitro Study Result

- Completely negates the pro-oxidant effects of Vioxx (prescription anti-inflammatory that caused heart attacks in some consumers due to it becoming a pro-oxidant)

Skin Health and Beauty-from-Within

Clinical Trial Results



- Reduces fine lines and wrinkles
- Increases skin moisture levels
- Improves skin elasticity
- Prevents skin sagging
- Reduces visible signs of UV-aging within four to six weeks of use
- Prevents photo-aging of skin
- Prevents UV damage
- Improves skin conditions in all layers of the skin (corneocyte layer, epidermis, basal layer and dermis)
- Dosage range 4mg to 6mg per day

Athletic Performance and Energy Levels

Clinical Trial Results

- Improves power output by 15% and reduces racing time by 5% in competitive cyclists
- Promotes recovery from exercise
- Prevents muscle fatigue
- Improves endurance
- Increases strength in healthy subjects
- Increases grip strength in sufferers of tennis elbow by 93%
- Decreases lactic acid levels
- Decreases respiratory parameters during exercise



- Helps prevent muscle damage and inflammation in elite soccer players
- May be effective in preventing exercise-induced free radical production
- Improves oxidative status in athletes
- Prevents joint and muscle soreness after exercise
- Decreases heart rate in athletes doing endurance training
- Dosage range 4mg to 12mg per day

Immune System Modulation

Clinical Trial Results



- Improves a variety of immunity markers in subjects at only 2mg per day in eight weeks
 - Increases the total number of antibody-producing B-cells
 - Amplifies natural killer cell cytotoxic activity
 - Leads to increased number of T-cells
 - Stimulates white blood cell counts
 - Significantly increases delay-type hypersensitivity response
 - Dramatically reduces DNA damage
- Raises immunoglobulin levels in healthy athletes
- Suppresses lymphocyte activation in patients with allergic rhinitis and pollen-related asthma
- Leads to therapeutic improvement in patients suffering from auto-immune disease
- Dosage range 2mg to 4mg per day

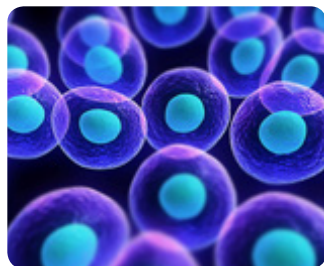
Fertility and Sperm Improvement

Clinical Trial Results

- Improves sperm functioning
- Increases sperm linear velocity
- Improves sperm quality
- Increases sperm motility
- Decreases reactive oxygen species in sperm
- May be used to decrease male idiopathic infertility
- Improves conception rate in infertile men
- Also improves sperm functioning and motility in normal men without any fertility issues
- Dosage 16mg per day



Anti-Aging and Cellular Health



Clinical Trial Results

- Skin Health and Beauty-from-Within
- Eye & Brain Health
- Joint, Tendon & Muscle Health
- Cardiovascular Protection
- Immune System Modulation
- Strength, Endurance and Energy Levels
- Dosage range 4mg to 12mg per day

In-Vitro Research Results

- Mitochondria protection
- Prevention of damage to DNA
- Profound inhibition of oxidation
- Safe & natural anti-inflammatory activity

Major Areas of Pre-Clinical Research



- | | |
|---|------------|
| • Cancer Prevention and Tumor Reduction | 46 studies |
| • Support for Diabetes | 25 studies |
| • Liver & Kidney Health | 23 studies |
| • Gastrointestinal Health | 13 studies |
| • Respiratory Health | 4 studies |



The World's Strongest and Highest Quality Natural Antioxidant

For many years, we've heard products being touted as strong antioxidants: supplements in particular, but also many food and beverage items, and even ingredients used in cosmetics put out claims of having antioxidant activity. As a result, consumers have become somewhat numb to companies hyping their products' antioxidant status over the last few decades.

If an antioxidant is powerful but it can't reach the brain and eyes, how beneficial is it? If an antioxidant gets into the brain but can't protect the fat-soluble part of cells, how effective will it be in protecting our body's command center which is comprised of approximately 60% fat? On the other hand, if an antioxidant can reach the brain and eyes, and it can protect the fat-soluble part of cells, how much good can it do if it isn't particularly potent in eliminating damaging free radicals?

There is no doubt that it's very important to consume a strong antioxidant to help combat the increased levels of oxidation that occur in our bodies in modern life; however, it's equally important to ensure the quality and efficacy of the antioxidant you consume.

Since the 1940s, scientists have known that Astaxanthin is a powerful antioxidant. Since the 1990s, a multitude of head-to-head antioxidant studies have shown that Astaxanthin is consistently the strongest natural antioxidant yet discovered. Its antioxidant activity in eliminating free radicals and quenching harmful singlet oxygen is usually at least ten times stronger and often hundreds or even thousands of times stronger than other antioxidants.

But where Astaxanthin truly shines is in its qualitative properties. Astaxanthin has six distinguishing factors that make it the world's highest quality antioxidant, allowing it to far surpass all the other contenders:

The first three qualitative advantages involve functional advantages over other antioxidants:

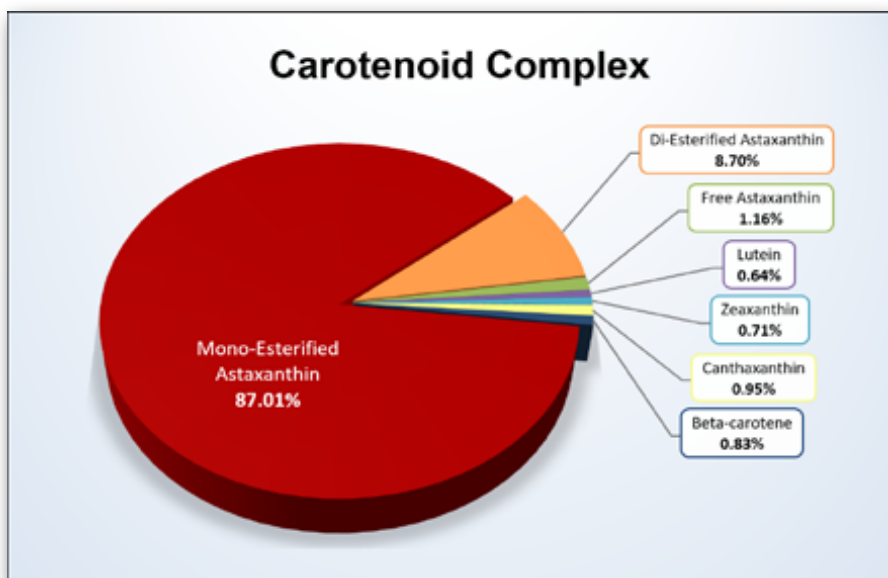
- Astaxanthin can protect the entire cell. Its long molecular structure allows it to span the cell membrane and protect both the water-soluble and fat-soluble areas inside our cells, plus it protects the cell membrane from the onslaught of free radicals hitting cells from outside.
- Astaxanthin remains active as an antioxidant longer and can handle many free radicals at the same time (as compared to most other antioxidants which can only neutralize one free radical and then become exhausted).
- Unlike many otherwise good antioxidants, Astaxanthin never turns into a Pro-Oxidant and starts causing additional oxidative damage in our bodies.

The last three qualitative advantages relate to where Astaxanthin goes in the human body: *Everywhere!*

- Astaxanthin can cross the blood-brain and blood-retinal barriers to bring its antioxidant and anti-inflammatory protection to these vital organs (our brains and eyes).
- Of particular interest to athletes and active people, Astaxanthin can bond with muscle tissue to greatly reduce the tremendous additional quantity of free radicals generated by physical exertion.
- Lastly, Astaxanthin accumulates in the skin to protect and beautify our bodies' largest organ.

While some other antioxidants may share one or two of these properties, I'm not aware of any other antioxidant that possesses all six of these substantial qualitative properties. Combined with its superior antioxidant strength and its other cell-protective benefits such as broad-spectrum anti-inflammatory activity, prevention of DNA damage and support for the cell's mitochondria, these qualitative differences have led many scientists and doctors to recommend Natural

Astaxanthin as the #1 choice for a preventive dietary supplement. In fact, the only possible concern in using Astaxanthin singly as a supplemental antioxidant is the fact that antioxidants tend to work better in synergy with other antioxidants in our diets. But nature has taken care of even this: Astaxanthin occurs in nature as a “carotenoid complex” of antioxidants in the algae in which it accumulates. When you take a Natural Astaxanthin capsule, you’re not getting just Astaxanthin; you’re also getting supporting carotenoids lutein, zeaxanthin, beta-carotene and canthaxanthin which help the Astaxanthin work even better in your body. Actually, you could call algae-based Astaxanthin the “One-Stop Carotenoid Cocktail.”



Natural Astaxanthin from algae provides a synergistic “Carotenoid Cocktail” which is far more efficacious than a single antioxidant molecule

Why Do We Need to Take Antioxidant Supplements?

Most of what we do in our daily life causes oxidation in our bodies. Believe it or not, breathing and digestion cause increases in free radicals, as does the normal

functioning of our immune system. And when we exert ourselves, huge quantities of singlet oxygen and other harmful free radicals are produced. As a matter of fact, a hard-training athlete's free radical production can be ten times higher than a sedentary person's. There are many other sources of oxidation that we're subjected to, and as I'll elaborate on below, more and more free radicals are being generated in our bodies in today's world than our grandparents were subject to.

To understand the oxidative process better, think of your body like a car. Our bodies burn oxygen like a car burns fuel, and the billions of biochemical reactions happening in our bodies, in turn, generate trillions of "exhaust particles" (free radicals including singlet oxygen, a particularly nasty type of free radical that causes a great deal of damage to our cells). The famous antioxidant researcher Lester Packer estimates that each of our cells is attacked by oxidants an average of 10,000X every day! Since our bodies are composed of trillions of cells, it's mind-boggling how many oxidative assaults our bodies take in a given day.

Another common analogy for oxidation is also related to cars: Oxidation is similar to the rusting of a car's body. Once it starts, it generally tends to accelerate quickly until there are holes in the body of the car. Taking antioxidants is like putting a fresh coat of paint on the car—if done in time, the new paint will prevent rusting for several years. Likewise, if sufficient antioxidants are consumed, they can prevent oxidation from starting to deteriorate our bodies, can delay the aging process, and can help ward off many diseases associated with an oxidative imbalance.



A rusty car is like a cell that didn't have sufficient antioxidant protection.



A car protected by a fresh coat of paint is like a cell that has been protected by Natural Astaxanthin.

Free radicals are toxic. They're unstable molecules running around our bodies stealing electrons from healthy molecules. This causes an energy imbalance in our cells. Free radicals cause damage to our cells, especially to the hardest working cells such as those in the brain and eyes. Within the cell, they target critical components such as the energy-producing mitochondria and the DNA. Damage to both of these critical cell components can cause serious health issues. In the case of DNA damage, it can lead to the development of a cancerous cell line. The variety and severity of diseases associated with cell oxidation and systemic inflammation is staggering. The list starts with the biggest killers worldwide—heart disease, stroke and cancer—and runs the gamut to diabetes, asthma, neurological disorders, eye disorders, auto-immune diseases, pulmonary diseases and many more. *An absolute key to good health and a long life is stopping free radical damage and systemic inflammation before they start!*

The human body is designed to accommodate normal free radical production in two different ways. First of all, we naturally produce antioxidants such as superoxide dismutase. This is part of nature's balancing act: Our bodies naturally produce free radicals, but at the same time, our bodies naturally produce antioxidants to eliminate the free radicals before they can do harm. The second way our bodies combat oxidation is through assimilating antioxidants from our diets and dispersing them throughout our bodies. When we eat an orange, for example, we are ingesting antioxidants like Vitamin C and citrus bioflavonoids. And when we eat colorful vegetables, we are often ingesting powerful antioxidants from the same carotenoid family as Astaxanthin. So between self-production of antioxidants produced by our bodies and antioxidants ingested through our diets, you might assume that we are pretty well protected from the oxidation that occurs in the course of daily life.

But you would be wrong. There are two serious problems that have surfaced in modern life that have rendered nature's antioxidant balance out-of-whack. First of all, the proliferation of packaged foods, modern farming techniques and long-range transportation of produce have led to severe decreases in antioxidants and other fragile phytonutrients in the food we consume. Commercial, non-organic farming depletes the soil of nutrients, resulting in fewer antioxidants, enzymes and nutrients in our diets. Frankly, a fruit or vegetable that is raised on a commercial farm with pesticides and herbicides, then chemically treated to control ripening and maintain appearance, then transported a few thousand miles from where it

was grown and put in a store's produce section simply isn't going to be chock-full of antioxidants by the time the consumer eats it. Secondly, our world has changed dramatically since our grandparents were young, resulting in unprecedented levels of oxidation occurring in our bodies. There are many new causes of free radicals in modern life.

Causes of Additional Oxidation in Modern Life

- Air and water pollution
- Chemicals in consumer items that we use on a daily basis
- Preservatives, pesticides and additives in our food supply
- Increased levels of stress in modern life
- Increased UV exposure due to the diminishing ozone layer
- Radiation
- Tobacco smoking and other non-natural habits
- Some new prescription medicines

All of these lead to oxidation levels in our bodies that self-produced and dietary antioxidants simply cannot handle (Harman, 1981; Esterbauer et al., 1992; Ames and Shigenaga, 1992; Ames et al., 1993). Some results of all of this increased oxidation in modern life are higher levels of cancer and heart disease and the numerous other diseases associated with oxidation.

We have arrived at an oxidation imbalance in today's world that calls for not only eating a healthy diet full of fruits and vegetables (preferably locally-grown, organic fruits and vegetables), but also supplementing our diet with a strong, effective antioxidant for maximum protection. And as you'll see as you read the rest of this chapter, as an antioxidant, Natural Astaxanthin has no equal. I recommend taking at least 4mg per day of Natural Astaxanthin as a preventive health measure to ward off oxidative imbalance and the various disease states it can cause, and to help ensure a long, healthy life.

Lastly, in addition to the new causes of oxidation in today's world, there is another fact that is of great concern to the world's aging population: As we move

into middle age and beyond, our bodies begin to produce fewer antioxidants. Just as our immune systems weaken and our organs start to function at a reduced level as a normal part of the aging process, our bodies also stop producing the same level of antioxidants. So supplementing with an effective, powerful antioxidant like Astaxanthin becomes even more critical for people once they've passed 35 or 40 years of age.

Fortunately, it appears that antioxidants can actually slow the aging process. A fascinating mouse study was done at the University of Washington. The researchers genetically engineered mice to load an antioxidant into the mitochondria of their cells. This single change resulted in the treatment group living 20% longer on average than the control group! They had fewer heart attacks too. "In short, they were biologically younger. It's the best proof yet that antioxidants can slow aging" (Carper, 2005).

Witness the Power of Antioxidants in Front of Your Very Own Eyes

There's a famous experiment that anyone can easily do at home to see the effect that antioxidants have in preventing oxidation right before your own eyes. I showed a variation on this in Chapter 1 using Astaxanthin (however, Dr. Narducci's YouTube experiment can't be done at home because it involves a special water-dispersible form of Astaxanthin that is sold to manufacturers but not consumers). You can get a very good idea of the power of antioxidants with only three tools: An apple, a lemon and a knife.

1. Cut both the apple and the lemon in half.
2. Squeeze lemon juice (a natural antioxidant) on only one half of the apple.

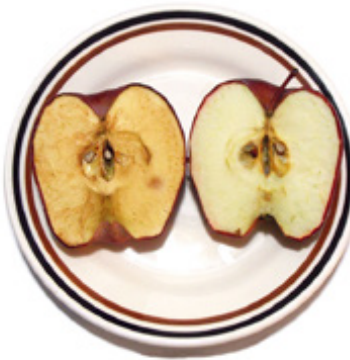
3. Don't do anything to the other half of the apple.
4. Let both halves of the apple sit side-by-side for a few hours (preferably in a hot area in direct light to amplify the level of oxidation happening to the apples).
5. Compare the two apple halves visually every 20 to 30 minutes.
6. You'll see before your own eyes how oxidation is rotting the unprotected apple half (without lemon juice) while the protected apple half (with lemon juice) looks fresh and unspoiled.



0 MINUTES



30 MINUTES



60 MINUTES



120 MINUTES

The apple half on the right is protected by antioxidants in lemon juice.

What's happening here is that the antioxidants in the lemon juice (Vitamin C and citrus bioflavonoids) are protecting one of the apple halves from oxidation and thus preventing it from rotting. This is the same thing going on in all of the cells in our bodies on a continual basis. As the renowned antioxidant research Lester Packer pointed out, each cell is taking about 10,000 oxidative “hits” every day. In the absence of sufficient antioxidants to protect our cells, they're essentially starting to rot by becoming damaged—their powerhouse mitochondria stop functioning properly; their DNA goes bad and may start a cancerous cell line; and their membranes start getting weak like the egg yolk Dr. Narducci showed in his other YouTube video. The cells are basically rotting due to oxidation.

Now think about this: If a little Vitamin C and citrus bioflavonoids can protect an apple from rotting, how much more protection can the cells in our bodies get from Astaxanthin which has been shown to be up to 6000X stronger as an antioxidant than Vitamin C in singlet oxygen elimination?

Unmatched Antioxidant Power

Astaxanthin is the strongest natural antioxidant that science has found to date. I stress *natural* because there are some synthetic antioxidants that would probably have similar free-radical quenching activity to Astaxanthin. One that comes to mind is ethoxyquin, a synthetic preservative antioxidant used in animal feeds. But as with most synthetically-produced substances, there is a serious downside to ethoxyquin. According to a study done at Nagoya City University Medical School in Japan, ethoxyquin leads to stomach hyperplasia and cytotoxicity. It has also been implicated as a source of cancer of the kidneys and bladder, and can increase the incidence of stomach tumors (Hirose et al., 1986). So while this synthetic antioxidant is legally permitted in the USA in feeds designed for pets and farm animals, I wouldn't recommend giving it to any animal (let alone humans) due to its potential for serious side effects.

Later in this section, I'll describe a few of the head-to-head experiments on antioxidant strength pitting Astaxanthin against several other antioxidants. In every one, Astaxanthin has consistently come out as the very strongest of all natural

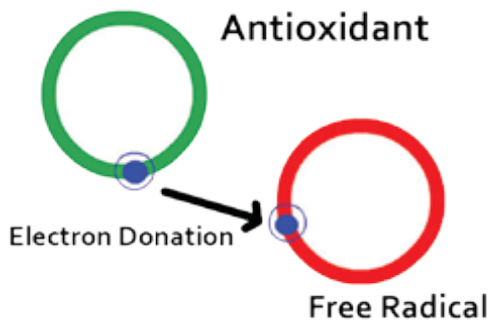
antioxidants regardless of the type of test. For example, whether examining free radical elimination or singlet oxygen quenching, Astaxanthin's power as an antioxidant proves to be far beyond that of all other antioxidants. Even though many of the antioxidants Astaxanthin has been tested against are closely related molecules in the carotenoid family, Astaxanthin usually comes out superior to all the other carotenoids by at least a power of ten.

I've asked people to guess how much stronger Astaxanthin is than other supplements that are touted as being "powerful antioxidants" when I've done educational presentations. Pycnogenol® is a supplement that claims to be very strong as an antioxidant. So are CoQ10, alpha lipoic acid and green tea catechins. And everyone's heard of Vitamin C being referred to as an antioxidant—in fact, it was Nobel Laureate Linus Pauling's favorite antioxidant back when he was studying oxidation.

When I ask people how much stronger they think Astaxanthin is than these other supplements (which, by the way, are all very good products), they usually guess anywhere from 25% stronger to 2X or 3X stronger. But they're way off with these guesses. As you'll see later in this chapter, Astaxanthin ranges from 18X stronger than Pycnogenol® in scavenging free radicals to as much as 6000X stronger than Vitamin C in eliminating singlet oxygen! A little Astaxanthin certainly goes a long way toward protecting your health from the destructive force of free radicals.

Supplement	How many times weaker than Astaxanthin	How many mg to equal 4mg of Astaxanthin	Suggested Retail Price
Astaxanthin			\$0.33
Alpha Lipoic Acid	75X weaker	300 mg	\$0.51
Green Tea Catechins	550X weaker	2200 mg	\$5.23
CoQ10	800X weaker	3200 mg	\$21.30
Vitamin C	6000X weaker	24,000 mg	\$7.19

And when you consider how much money you save by taking Astaxanthin as an antioxidant over these other products, it's an absolute win-win from an economic/health perspective. The chart on Page 75 is based on the undiscounted retail price of leading brands of each supplement and their head-to-head antioxidant strength in eliminating harmful singlet oxygen, as measured against Astaxanthin. You'll notice that the only supplement that comes close to the price of Astaxanthin is alpha lipoic acid, and it's still over 50% more expensive. The others range from 16X more expensive (green tea catechins) to a whopping 65X more expensive (CoQ10).



*Antioxidants neutralize free radicals
by donating an electron.*

In light of the data above and considering other factors such as Astaxanthin's superior qualitative properties, there should be little question about which is the best antioxidant to take. And when you add in the convenience of taking one small 4mg softgel of Astaxanthin versus 3200mg of CoQ10 or 24,000mg of Vitamin C to get the same protection against singlet oxygen, it becomes an absolute no-brainer. (By the way, Linus Pauling actually took about half this amount—12,000mg of Vitamin C per day—but even at that mega-dose, he was still only protecting his cells against singlet oxygen half as much as if he had taken a 4mg Astaxanthin softgel. And since Vitamin C doesn't reach all the places in our bodies that Astaxanthin does and doesn't protect the fat-soluble parts of cells, his mega-dose of Vitamin C wasn't coming close to the protection that 4mg of Astaxanthin gives.)

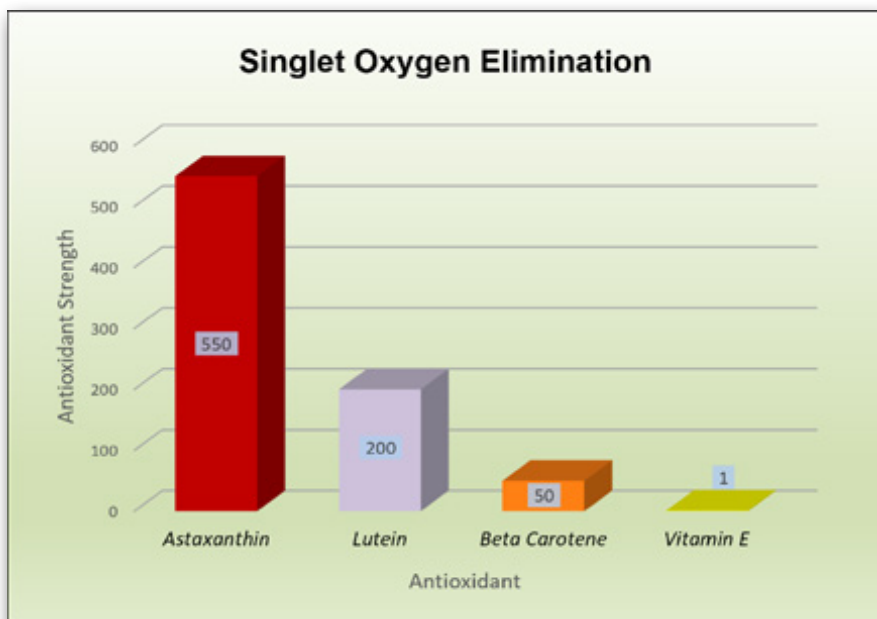
Historically, as far back as the 1940s, scientists had discovered the antioxidant abilities of carotenoids and had isolated Astaxanthin as being extremely potent. Research in France in 1946 found that Astaxanthin and beta-carotene were both powerful antioxidants, with Astaxanthin being the stronger of the two (Herisset, 1946). By the 1990s, Astaxanthin's powerful antioxidant activity had become widely accepted. A paper published in Japan in 1991 set the stage for the flurry of research that would follow.

**Antioxidant Researcher Calls Astaxanthin a
“Super Vitamin E” – 10X Stronger than Other
Carotenoids and 100X Stronger than Vitamin E**

“Astaxanthin, one of the dominant carotenoids in marine animals, showed both a strong quenching effect against singlet oxygen and a strong scavenging effect against free radicals. These effects are considered to be defense mechanisms in the animals for attacking these active oxygen species. The activities of Astaxanthin are approximately 10 times stronger than those of other carotenoids that were tested, namely zeaxanthin, lutein, tunaxanthin, canthaxanthin and beta-carotene, and 100 times greater than a-tocopherol. Astaxanthin also showed strong activity as an inhibitor of lipid peroxidation mediated by these active forms of oxygen. From these results, Astaxanthin has the properties of a ‘Super Vitamin E’” (Miki et al., 1991).

Dr. Miki must have been extremely impressed to call Astaxanthin a “Super Vitamin E.” During that period in the early 1990s, Vitamin E was considered by many to be the most beneficial nutrient for both topical application and internal consumption. However, in finding that Astaxanthin was 10X stronger as an antioxidant than its carotenoid cousins and 100X stronger than Vitamin E, he must have felt that it deserved such a venerable title.

Many other experiments have been done since Dr. Miki’s, all with the same results—Astaxanthin remains the most powerful natural antioxidant found to date. The next study we’ll examine was also done in the 1990s and also in Japan. This study focused on singlet oxygen quenching. It pitted Astaxanthin against several other antioxidants including carotenoids such as lutein and beta carotene, and it also tested Astaxanthin against Vitamin E. The results were heavily favored toward Astaxanthin; lutein got within the same realm as Astaxanthin in this particular test, but beta carotene and particularly Vitamin E were found to be far weaker than Astaxanthin.



Singlet Oxygen Elimination (Shimidzu, Goto & Miki, 1996)

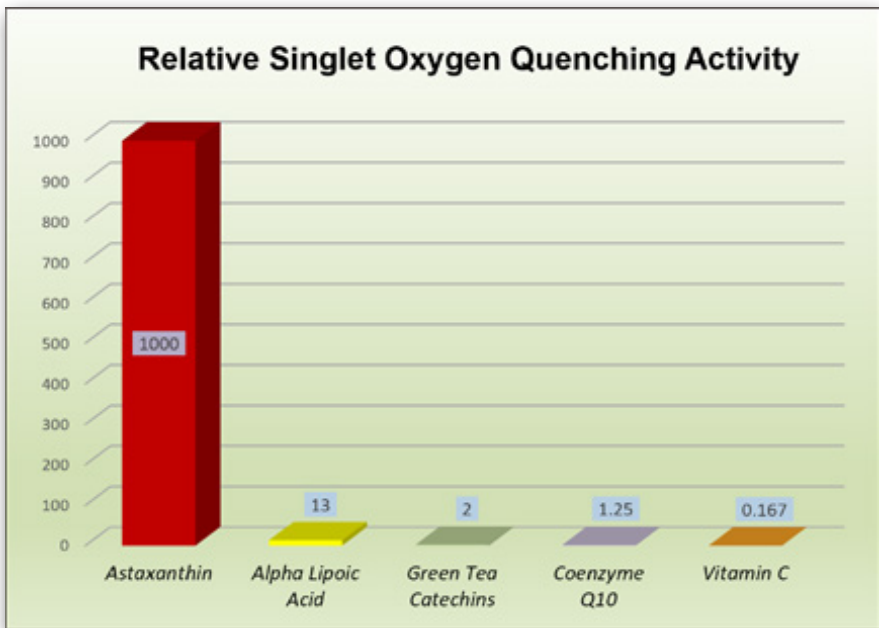
In singlet oxygen elimination, results of this study found Astaxanthin to be:

- ✓ 550X stronger than Vitamin E
- ✓ 11X stronger than beta-carotene
- ✓ 2.75X stronger than lutein

After this study was published, because the results were so striking, a few pioneering companies began producing Natural Astaxanthin commercially. As we mentioned earlier, Vitamin E was widely regarded as one of the very best supplements to consume and by far the most popular topical antioxidant in the 1990s. Of course, when an antioxidant was shown in a published study to be 550X stronger than the preferred antioxidant of that time, it really turned heads.

One of the authors of this study was Dr. Miki, the original researcher who did the often-quoted study from 1991 showing Astaxanthin to be phenomenally

stronger than other antioxidants and calling it a “Super Vitamin E.” As a great fan of Astaxanthin, Dr. Miki participated in another study of Astaxanthin’s strength against singlet oxygen many years later in 2007. This time he and his colleagues pitted Astaxanthin against a completely different set of antioxidants: Coenzyme Q10, green tea catechins, alpha lipoic acid and Vitamin C. The main difference between this study and Dr. Miki’s earlier work is that the results were even more dramatically slanted in Astaxanthin’s favor.



Singlet Oxygen Quenching (Nishida, Yamashita & Miki, 2007)

Results from this study showed that Astaxanthin is:

- ✓ 6000X more potent than Vitamin C
- ✓ 800X more potent than CoQ10
- ✓ 550X more potent than Green Tea Catechins
- ✓ 75X more potent than Alpha Lipoic Acid

Many people consider CoQ10 and Vitamin C excellent antioxidants. Yet when tested against Astaxanthin for their ability to eliminate singlet oxygen, Astaxanthin wasn't just superior—it left them in the dust.

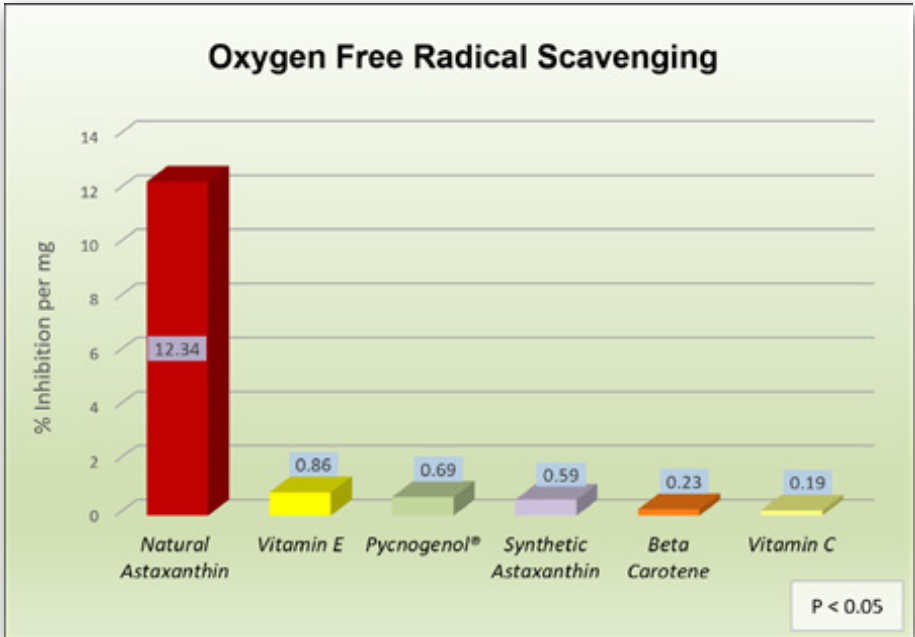
As you can see from the chart on Page 79, none of the other antioxidants had anything even remotely close to Astaxanthin's capacity to eliminate harmful singlet oxygen. The best of the four was alpha lipoic acid, yet Astaxanthin was still 75X more potent.

Another particularly interesting comparative study was done at Creighton University by a leading antioxidant and nutritional supplement researcher, Debasis Bagchi, PhD. Dr. Bagchi is highly respected in his field with almost 300 publications (including several books and hundreds of peer-reviewed studies) and has been cited by his colleagues over 12,000 times! He has also designed protocols for antioxidant surveys that are used by many researchers around the world.

When comparing antioxidants, it's very important to analyze them head to head and to test them in different experiments. A single test of, for example, Astaxanthin versus Vitamin E as a singlet oxygen eliminator is not a comprehensive view of the two different molecules' antioxidant capacity. Singlet oxygen are without a doubt one of the most harmful free radicals to our cells over time, but they are just one of many different types of oxidants that wreak havoc in our bodies. The Astaxanthin research in the 1990s focused primarily on its role as a singlet oxygen eliminator, so Dr. Bagchi decided to look at Astaxanthin from a different angle. In a very well-designed experiment, he tested Astaxanthin head to head against other well-known antioxidants by measuring their ability to scavenge various free radicals.

When this research was originally done in 2001, Dr. Bagchi and his co-author Dr. Gerald Cysewski had great foresight and decided to test both Natural Astaxanthin and Synthetic Astaxanthin even though Synthetic Astaxanthin was not available at the time as a human nutritional supplement. They pitted the natural and synthetic versions of Astaxanthin against Vitamin E, Vitamin C, beta-carotene and the trademarked supplement Pycnogenol® (which has claimed to be an extremely powerful antioxidant in its marketing literature). Although they used a completely different way to measure antioxidant strength from the earlier Miki studies, and included two previously untested molecules—Synthetic Astaxanthin

and Pycnogenol®—Natural Astaxanthin again came out the undisputed champion with antioxidant strength ranging from 14X greater than Vitamin E to 65X greater than Vitamin C.



Free Radical Elimination (Capelli, Bagchi & Cysewski, 2013)

The results showed that, in free radical scavenging, Natural Astaxanthin is:

- ✓ 14X stronger than Vitamin E
- ✓ 18X stronger than Pycnogenol®
- ✓ 21X stronger than Synthetic Astaxanthin
- ✓ 54X stronger than Beta-Carotene
- ✓ 65X stronger than Vitamin C

As in the three earlier studies I described above, Dr. Bagchi's experimental protocol tested singlet oxygen elimination. This is important in any analysis of antioxidant capacity because singlet oxygen are extremely damaging to our cells. But this study also included analyses of several other free radicals including the superoxide ion, peroxy radicals, peroxynitrite and hydroxyl radicals, making it much more diverse in its scope. This university-based research led by one of the world's leading experts in the antioxidant field did three very important things:

- ✓ It proved the consistency of Astaxanthin's superior antioxidant strength regardless of how it is analyzed.
- ✓ It proved quantitatively that Astaxanthin is much stronger than other antioxidants that were claiming to be extremely powerful at that time such as Pycnogenol®.
- ✓ It showed how vastly different Natural Astaxanthin is from Synthetic Astaxanthin.

We see by the relationship between Astaxanthin and Vitamin E in the studies cited above how important it is to use more than one method of measuring antioxidant strength. In the singlet oxygen experiments in the 1990s, Astaxanthin was proven to be 550X stronger than Vitamin E. Yet, when Dr. Bagchi tested the two as free radical scavengers in 2001, Astaxanthin was shown to be 14X stronger. While a factor of 14X is still quite impressive, it is a far cry from 550X. So the question arises as to which number is accurate? The answer is that both of these numbers are accurate: Astaxanthin is 14X better than Vitamin E in eliminating free radicals generally and 550X better than Vitamin E in eliminating singlet oxygen specifically. Because of the different measures, it's impossible to specify an exact number when comparing the two in "antioxidant strength," but if I had to, Dr. Miki's original estimate of 100X back in 1991 would probably be just about right. (Which may be why Dr. Miki simplified things and started calling Astaxanthin a "Super Vitamin E.")

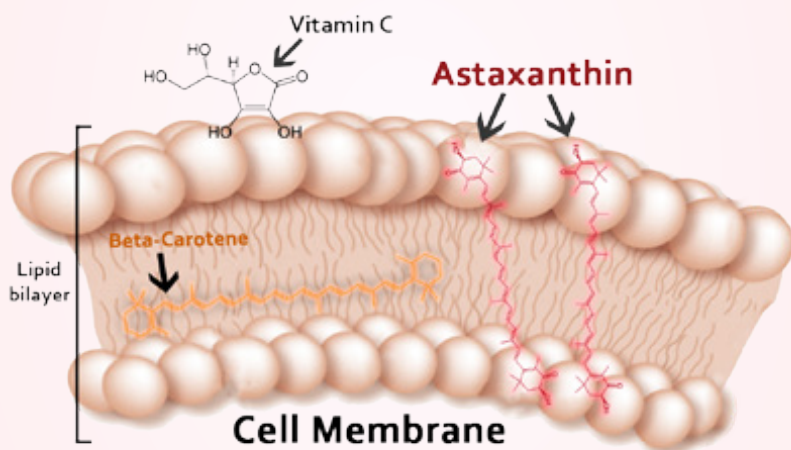
Strength Isn't Everything: The World's Highest Quality Antioxidant

Though strength certainly matters, *Quality* is more important than strength when evaluating an antioxidant. Frankly, if all antioxidants were equal in their qualitative properties but had different strengths, you could simply compensate for one antioxidant being weaker than another by taking more of the weaker one. For example, if they were exactly the same qualitatively, you could take 6000X more Vitamin C than Astaxanthin to get the same level of protection against singlet oxygen. (And as Linus Pauling protected his cells by taking 12,000mg of Vitamin C each day, you could take 2mg of Astaxanthin to get the same preventive dose.) But as you'll see below, even by mega-dosing on Vitamin C or other antioxidants, you still wouldn't come close to Astaxanthin's ability to protect your cells, your muscle tissue, your skin, your brain, your eyes or your other vital organs.

I don't make the claim lightly that Astaxanthin is "The World's Highest Quality Antioxidant." If it was superior to other antioxidants in only a single way I wouldn't call it that. Remarkably, there are six distinct ways we can see Astaxanthin's superior qualitative antioxidant properties which, taken together, set it apart from other antioxidants in terms of health value and efficacy. Each of these on its own is extremely impressive, and while hard to pick the most important or least, below I list these qualitative differences in the order of their relative importance in my opinion:

- 1. Spans the cell membrane to protect the entire cell.** I've mentioned this already, but it's so important that I'll elaborate on it here: a general rule of antioxidants is that lipid-soluble antioxidants protect the lipid (fat) soluble part of our cells, and water-soluble antioxidants protect the water-soluble part of our cells. So when we ingest Vitamin C (which is water-soluble), its antioxidant properties are useful in some parts of our cells, and when we ingest Vitamin E (which is oil-soluble), its antioxidant properties are useful in the remaining part of our cells. The length and shape of the Astaxanthin molecule allow it to span the cell membrane

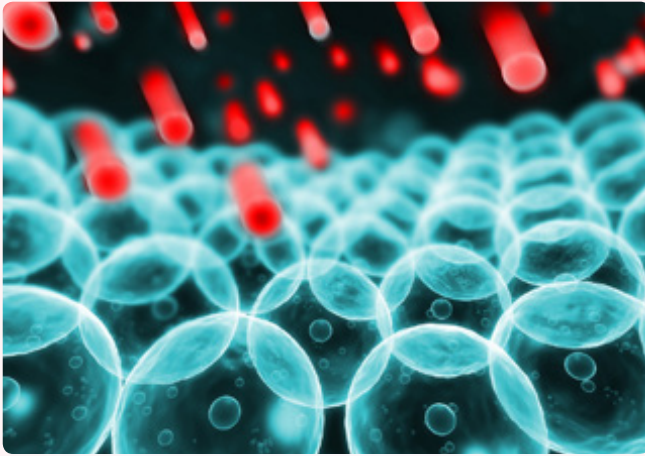
and have one end of the molecule in the lipid-soluble part of the cell and the other end of the molecule in the water-soluble part of the cell. This gives Astaxanthin the distinctive characteristic of being able to protect the entire cell. And Astaxanthin has been found capable of traveling throughout the entire body, into the bloodstream, muscle tissue, skin, as well as various critical organs so it can protect all the cells in our entire body! This double feature of (1) being able to get throughout the body and (2) being able to protect the entire cell makes Astaxanthin a super-effective antioxidant and anti-inflammatory. It's the fundamental reason why Astaxanthin's health benefits are so diverse and why it can positively affect so many different parts of our bodies.



Astaxanthin's long molecular structure allows it to span the cell membrane, thereby protecting every part of the cell including both the fat- and water-soluble parts. Meanwhile, Vitamin C only protects the water-soluble part of the cell and beta-carotene and Vitamin E only protect the fat soluble part.

- 2. Remains active as an antioxidant longer and can handle many free radicals at the same time.** Some of our health experts pointed this out in Chapter 2: A normal antioxidant can only work on

one free radical at a time, and then becomes exhausted (which can lead to the topic we'll discuss next: Pro-Oxidation). Astaxanthin is believed to neutralize between 13 and 19 free radicals simultaneously. Simply put, it lasts longer, works harder and is more effective than other antioxidants. And, as we saw in Dr. Bagchi's landmark study, it has the ability to neutralize various types of free radicals, such as the extremely damaging singlet oxygen molecule as well as the superoxide ion, peroxynitrate and peroxy radicals.

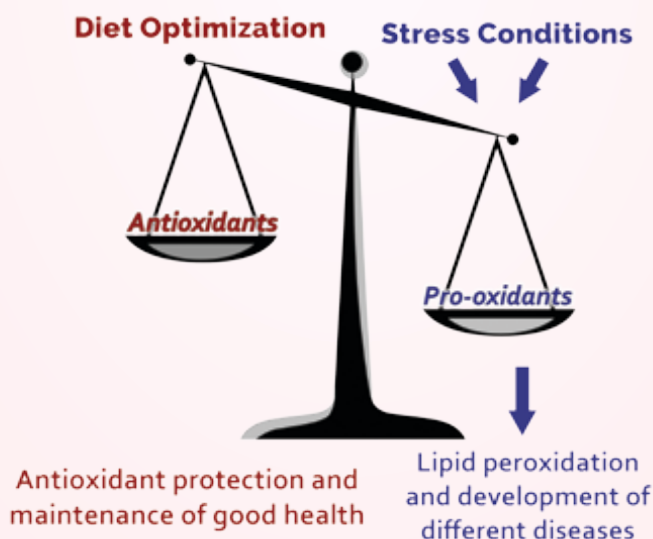


Astaxanthin is capable of handling several free radicals simultaneously.

- 3. Never a Pro-Oxidant.** Many very good antioxidants can, under certain conditions, turn into oxidants and start harming our cells. They get exhausted and end up switching teams, causing oxidation rather than neutralizing it. This is what happened in the famous “Finnish Smokers Study” on beta-carotene (published in the prestigious “New England Journal of Medicine” in 1994). This study tested consumption of synthetic beta-carotene, which (like Synthetic Astaxanthin) is completely different from the natural form. Heavy smokers (who were smoking on average three packs of cigarettes each day) were supplemented with synthetic beta-carotene and found after time to have a slightly higher

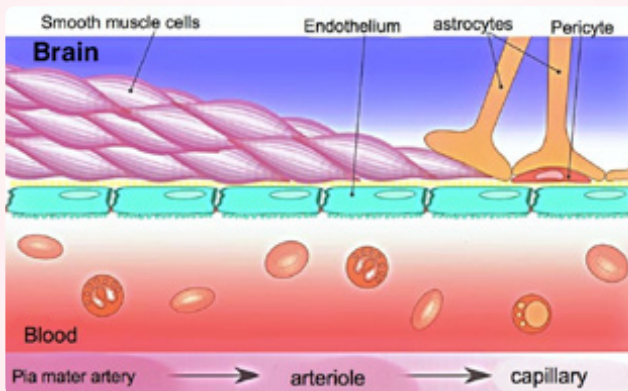
(although statistically insignificant) incidence of cancer. This was surprising to all involved since dozens of epidemiological and pre-clinical studies had previously shown that natural beta-carotene has cancer-preventive properties (Moorhead et al., 2005). What was happening was that the beta-carotene was turning into a pro-oxidant in the smokers' bodies because smoking depleted their Vitamin C levels. In the absence of Vitamin C, the beta-carotene molecules had no supporting antioxidants to pass off the supercharged free radicals caused by smoking, so the beta-carotene molecules "changed teams" and became oxidants. This caused additional cellular damage, which, in turn increased the incidence of cancer (Heinonen and Albanes, 1994). "Without Vitamin C, beta-carotene can catch the destructive energy of a free radical and itself become a damaging molecule. In this situation, beta-carotene has entered a 'pro-oxidant' state. If Vitamin C is available, this pro-oxidant state will quickly be converted back to an antioxidant state without damage to cells" (Malila et al., 2006).

Antioxidant/Pro-Oxidant Balance in the Cell



Many other excellent antioxidants besides beta-carotene can become pro-oxidants under certain conditions. For example, well-known vitamin antioxidants such as Vitamins C and E, zinc, and even carotenoid antioxidants such as lycopene and zeaxanthin can all become pro-oxidants (Martin et al., 1999). This pro-oxidant state can have life-threatening consequences. Not only may it increase cancer risk, but as we'll see later in this chapter it can contribute to heart attack risk as well. While there are many other disease states that pro-oxidation may cause, these two examples of initiating the #1 and #2 leading causes of death alone is enough to make me want to take an antioxidant supplement that can never become a pro-oxidant. Fortunately, it has been documented that Astaxanthin can never become a pro-oxidant and cause damage to our cells (Beutner et al., 2000).

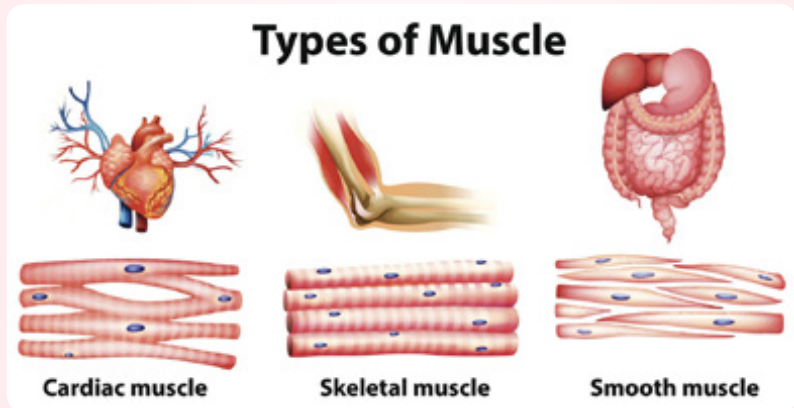
4. **Crosses the blood-brain barrier and blood-retinal barrier.** A lot of very good antioxidants cannot help protect our eyes and brains. Even carotenoid antioxidants that are closely related to Astaxanthin such as beta-carotene and lycopene cannot get through these



Crossing the blood-brain and blood-retinal barriers is essential to provide antioxidant and anti-inflammatory protection to the brain and eyes.

barriers that are present to protect the brain and eyes from foreign matter and contaminants. Fortunately, Astaxanthin can get through the blood-brain barrier to protect our brains. When it reaches our brains, it can then travel through the blood-retinal barrier to help protect our eyes. Some of the earliest research on Astaxanthin back in the 1940s and 1950s showed Astaxanthin's ability to get into the brains and eyes of rats (Grangaud, 1951; Massonet, 1958). Meanwhile, many human clinical studies have been completed over the last several years to confirm Astaxanthin's diverse health benefits for the eyes and brain. And once present in the eyes and brain, it is not only Astaxanthin's antioxidant activity that is working prophylactically, but also its broad spectrum anti-inflammatory properties. This one-two punch against oxidation and inflammation is exactly what brains and eyes need to stay healthy and function well.

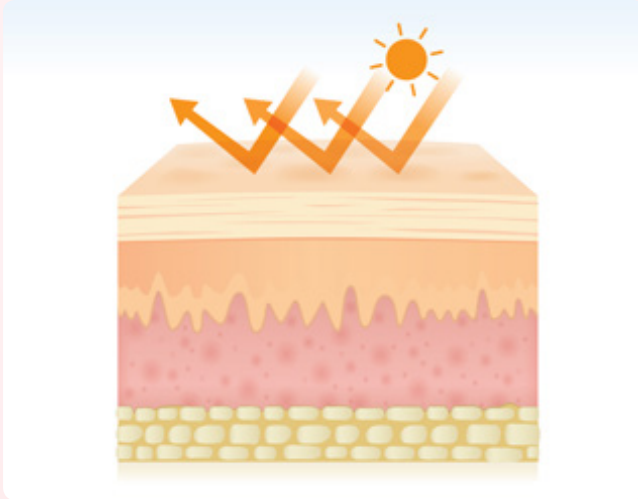
- 5. Bonds with muscle tissue.** As you already know, Astaxanthin can get throughout the entire body and into all the critical organs. It can also bond with muscle tissue to protect muscles from increased levels of oxidation caused by physical exertion. It reduces inflammation in the muscles and keeps them functioning smoothly.



Astaxanthin can bond with muscle tissue to combat oxidation and inflammation in our muscles.

Some important results from this qualitative property of Astaxanthin are increased endurance, faster recovery from training and improved performance for athletes.

- 6. Accumulates in the skin.** In the same way that Astaxanthin gets into our muscle tissues, it also gets into the skin where it accumulates over time. This leads to some amazing results that I'll discuss in detail later such as its "Beauty-from-Within" and skin health properties. Many other antioxidants don't reach the skin at all, thereby yielding no benefit to our body's largest organ.



Astaxanthin's ability to accumulate in the skin is key to its preventive effect against photo-aging.

With these six important and documented advantages over more commonplace antioxidants, I feel that it's perfectly warranted to call Astaxanthin the "World's Highest Quality Antioxidant." Coupled with its other cellular-defending properties such as broad-spectrum anti-inflammatory activity and protection of DNA and the cells' mitochondria, it becomes crystal clear that Astaxanthin is the consummate preventive health supplement.

Astaxanthin's Antioxidant Activity Is Backed by 10 Clinical Trials and 87 Pre-Clinical Studies

There are ten different human clinical trials that clearly and specifically demonstrate Astaxanthin's antioxidant activity. To be honest, I could easily stretch to a lot more than ten clinical trials in this section since antioxidant activity is one of the two basic building blocks from which all of Astaxanthin's other health benefits emanate. In fact, antioxidation is mentioned in dozens of the studies done on Astaxanthin. But in the interest of brevity, I'll stick to these ten as proof of Astaxanthin's antioxidant efficacy:

- ➔ Soccer is the world's sport—the most popular competitive sport in most countries around the globe. A series of studies in Europe focused on the effects of Astaxanthin supplementation on young elite soccer players. The most recent study was randomized and placebo-controlled. It spanned 90 days of supplementation at a dosage of 4mg per day. By testing the plasma of the athletes, the researchers found that those who took Astaxanthin showed reduction in inflammation, improvement in muscle recuperation and better immune system function. The scientists determined that Astaxanthin “attenuates muscle damage, thus preventing inflammation induced by rigorous physical training.” They concluded that this was because Astaxanthin “protects the cell membranes against free radicals generated during heavy exercise, thus preserving the functionality of muscle cells” (Baralic et al., 2015).



Intense exercise creates a correspondingly intense onslaught of free radicals.

- ➔ The same group of researchers who did this study had done two preliminary human clinical trials before embarking on their landmark study. The

first of these preliminary studies tested whether Astaxanthin can reduce free radical production after intense two-hour long exercise. The treatment group took 4mg per day of Astaxanthin for 90 days. As expected, the results showed antioxidant benefits for Astaxanthin. The conclusion stated, “Supplementation with Astaxanthin could prevent exercise-induced free radical production and depletion of non-enzymatic antioxidant defense in young soccer players” (Djordjevic et al., 2012). The other study further validated the results of the first preliminary trial: Astaxanthin supplementation again led to improvement in oxidative status in young soccer players (Baralic et al., 2013). The implications of this series of studies are indeed very promising for athletes and active people whose bodies generate huge amounts of free radicals when working, training and competing.

- ➔ A very different clinical trial looked at the effects of Natural Astaxanthin on smokers’ oxidative status. This study was done on 78 people who smoked over 20 cigarettes per day. They were separated into four groups: A placebo group of 39 people along with three treatment groups who received different daily dosages of Astaxanthin (5mg per day, 20mg per day and 40mg per day) over the course of three weeks. Three different oxidative stress biomarkers as well as total antioxidant capacity were tested at the beginning of the study and after each full week of supplementation. The results were positive for each of the four markers tested at every dosage level. The conclusion stated, “The results suggest that Astaxanthin supplementation might prevent oxidative damage in smokers by suppressing lipid peroxidation



Astaxanthin reduces oxidation caused by smoking.

and stimulating the activity of the antioxidant system” (Kim et al., 2011). This study is an excellent complement to the series of studies on soccer

players I cited above—we see that Astaxanthin can help not only healthy, active people with oxidation issues, but it may also benefit smokers by decreasing their susceptibility to the oxidative ravages of tobacco.

- ➔ There have been several human clinical trials showing potential cardiovascular health benefits from Natural Astaxanthin supplementation, presumably due to its antioxidant activity. One of these was done in Scandinavia on healthy, non-smoking men. This randomized, double-blind study took young men aged 19 – 33 and gave them either 8mg of Natural Astaxanthin per day or placebo for three months. The object of this experiment was to see if Astaxanthin has an effect on lipid peroxidation. The Astaxanthin group experienced significantly reduced 12- and 15-hydroxy fatty acids while the placebo group had no changes. “Supplementation with Astaxanthin may decrease in-vivo oxidation of fatty acids in men,” concluded the researchers (Karppi et al., 2007).



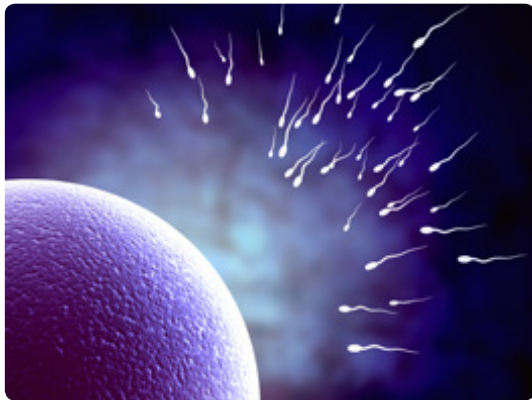
A key health concern from excess oxidation: Cardiovascular health.

- ➔ An earlier study from Japan found related results. These researchers first tested Astaxanthin's effects on the oxidation of LDL cholesterol in-vitro, and found that it dose-dependently prolongs LDL oxidation lag time. Then they performed a clinical trial in healthy volunteers. They tested four different dosages of 1.8mg per day, 3.6mg per day, 14.4mg per day and 21.6mg per day over the course of two weeks. The oxidation lag time of LDL increased at all doses. Surprisingly, the best result was found at 14.4mg per day rather than the upper dosage of 21.6mg per day. The authors concluded that Astaxanthin inhibits LDL oxidation, and that it may contribute to the prevention of atherosclerosis (Iwamoto et al., 2000).

➔ In a study done in Korea, overweight and obese subjects were given placebo or Astaxanthin for a 12-week period. This double-blind, randomized study found that Astaxanthin supplementation resulted in decreased LDL cholesterol and apolipoprotein B. Total antioxidant capacity increased, while two oxidative markers (malondialdehyde and isoprostane) decreased significantly (Choi et al., 2011a). The same group of researchers published another study the same year, also on overweight and obese subjects. This study lasted only three weeks, and measured only oxidative stress markers. They tested two different dosages of 5mg per day and 20mg per day and found that all four oxidative stress markers tested improved significantly at both dosages over the course of the three-week supplementation (Choi et al., 2011b).

➔ Oxidation also adversely affects fertility in men by damaging sperm. A very interesting clinical trial was based on 30 couples who could not conceive a child. The women in these couples had no demonstrable cause of infertility, while the men were diagnosed as having poor sperm quality. This was also a double-blind, random-

ized trial. The men in the treatment group received 16mg per day of Natural Astaxanthin over a three-month period. Amazingly, over half of the couples got pregnant after just three months of Astaxanthin supplementation for the infertile men! Measurement of reactive



*Too much oxidation will prevent
sperm from reaching the egg.*

oxygen species as well as the hormone Inhibin B decreased significantly in the treatment group, while sperm linear velocity increased (Comhaire et al., 2005).

➔ Now we'll look at a very different condition than most people think of when they consider the damage that oxidation causes in our bodies. This study examined patients suffering from an autoimmune disease called Sjögren's syndrome. This affliction has the very unpleasant effect of decreasing salivary secretions and causing sufferers to experience dry mouths. This study done at Tsurumi University (a dental school in Japan) showed that Astaxanthin appeared to increase salivary output in both of the human subject groups (patients with Sjögren's syndrome as well as normal subjects), while the level of an oxidative stress marker, hexanoyl-lysine was reduced after supplementation with Astaxanthin. The researchers concluded "These results suggest that Astaxanthin might act as a reactive oxygen species scavenger, providing benefits to Sjögren's syndrome patients with impaired salivary secretion" (Yamada et al., 2010).

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

- Natural Astaxanthin is superior to Synthetic Astaxanthin in prolonging the life of investigational worms by reducing reactive oxygen species more effectively (Liu et al., 2016).
- Natural Astaxanthin's intracellular antioxidant activity is approximately 90X stronger than Synthetic Astaxanthin's (Regnier et al., 2015).
- Astaxanthin from *H. pluvialis* microalgae is superior to Synthetic Astaxanthin as an antioxidant and shows stronger protective properties in the livers of rats (Rao et al., 2013).
- Astaxanthin is more effective than other carotenoids as a neuroprotectant in rats due to its superior reactive oxygen species scavenging activities (Chang et al., 2013).
- Astaxanthin is a more effective antioxidant than other carotenoids due to its higher electron transfer activity (Han et al., 2009).

- Astaxanthin is more stable than zeaxanthin, canthaxanthin and beta-carotene during lipid peroxidation (Jorgensen and Skibsted, 1993).
- Astaxanthin is a potent antioxidant in a membrane model, much more so than beta-carotene (Palozza and Krinsky, 1992).
- Astaxanthin is a more effective antioxidant than beta-carotene through its stabilization of trapped radicals (Terao, 1989).



In conclusion, Astaxanthin is the strongest natural antioxidant. There have been scores of studies demonstrating Astaxanthin's enormous antioxidant potential. These studies run the gamut from in-vitro to comparative antioxidant studies to pre-clinical animal trials to double-blind, placebo-controlled human clinical trials. Even against closely related molecules in the same family of carotenoids, Astaxanthin consistently tests many times higher in singlet oxygen elimination and overall free radical scavenging (usually by at least a factor of 10X). Coupled with its six qualitative advantages as an antioxidant, it becomes clear that Natural Astaxanthin is the perfect choice as a preventive supplement, particularly for anyone over 40 years of age.



Do You Want a Fast-Acting Anti-Inflammatory That Can Kill You, or a Slow-Working One That Is Safe & Natural?

The answer to this question seems very obvious to me, yet most people suffering from painful conditions run down to the local pharmacy or their doctor's office and start taking anti-inflammatory drugs that have dangerous side effects—some that can even kill you!

People with chronic pain will do just about anything to get rid of it. Sufferers of nagging pain from arthritis or other conditions yearn to return to a pain-free state. There are many health issues associated with pain that are considered “chronic” because they last for a long time—months, even years. And in some tragic cases, people will pass decades with the same painful condition without finding a cure. Those of us fortunate to be pain-free probably can't fathom what it's like to be in a state of chronic pain. But what most pharmacists and doctors have to offer for chronic pain doesn't amount to a cure but rather a Band-Aid to treat the symptoms, often with side effects that are worse than the condition being treated.

Good Inflammation Versus Bad Inflammation

The inflammatory response is a natural part of our bodies' healing process. It is a part of our immune system that our bodies employ to help repair damaged tissue and also to fight infection. When our bodies sense that something is wrong, for example, when a virus infiltrates and begins to attack us, our inflammatory response springs into action and begins to fight off the offender. We can actually see the result of our inflammatory response working before our eyes when we break a bone—the swelling and redness in the skin around the bone is caused by the inflammatory response. It is a natural and necessary part of our lives and a key part of the

healing process. We need inflammation for our very survival. This is what I call “good inflammation.” However, there is an evil twin to this good and necessary inflammation that I’ll talk about at length later in this chapter called systemic or chronic inflammation (also commonly called “silent inflammation”). Silent inflammation is a long-lasting, low level of inflammation that is slowly destroying our organs and reducing functionality of our bodily systems. This “bad inflammation” is a silent killer and, along with oxidation, a root cause of most diseases.

Common Treatments for Chronic Pain

Since time immemorial, doctors and healers have been called on to help people combat pain. A great variety of folk remedies and traditional techniques were employed in past civilizations and, in fact, are still used extensively in many places today. In Western medicine, the normal treatments for pain come in pill form or in topical ointments or creams. Topical treatments have very limited benefits, while internal pain pills generally have much stronger effects.

The most commonly used pain medications are Non-Steroidal Anti-Inflammatory Drugs (NSAIDs). These are pretty effective for getting rid of pain quickly, but they have dangerous side effects. According to the “American Journal of Medicine” they cause about 16,500 deaths and over 100,000 hospitalizations in the USA each year (Singh, 1998). The prestigious “New England Journal of Medicine” said back in the heyday of the AIDS epidemic that NSAIDs killed about as many people as AIDS (Wolf et al., 1999). Many people



Chronic pain affects millions and millions of people around the world.

seeking a natural remedy for pain have turned to glucosamine and chondroitin; however, in a large scale study where subjects were given the full recommended doses of both glucosamine and chondroitin together, as well as individually, they fared no better than subjects who were given a placebo (Clegg et al., 2006). It's obvious that we need something different: something safe and natural that will work but won't kill you.

There are four categories of drugs that are the most common pain medications currently used:

- Over-the-counter anti-inflammatories and other OTC pain medications
- Prescription anti-inflammatories
- Steroids
- Opioids

And as most people are already aware, each of these classes of medication comes with corresponding side-effects that can be worse than the condition they're treating. Let's look at each of these classes of drugs and their corresponding side effects.

➔ **Over-the-Counter Pain Medications** include a long list of familiar names that fill the pain section in your neighborhood pharmacy. Most of these fall into the class of drugs known as Non-Steroidal Anti-Inflammatory Drugs or NSAIDs. Among the best known NSAIDs are:

- Aspirin (sold under many brand names including Bayer®, Anacin® and Bufferin®)
- Ibuprofen (sold under brand names such as Advil® and Motrin®)
- Naproxen (sold under brand names such as Aleve® and Anaprox®)

The list of over-the-counter NSAIDs is much longer than this, though many have fallen out of favor as more effective



NSAIDs are effective, but come with consequences.

products have gained in popularity and taken over shelf space. An example of one of these is magnesium salicylate, which was marketed under many different names, the most recognized perhaps being Doan's Pills®.

One well-known OTC pain remedy that is not an NSAID is Tylenol® (chemical name acetaminophen). Tylenol and generic acetaminophen are from another class of drug called “analgesics” which work differently from NSAIDs. Tylenol at best has only a slight effect on inflammation. In fact, its exact mechanism of action for reducing pain is not known (Botting, 2016).

Side Effects. The list of side effects from NSAIDs and other over-the-counter pain remedies is long. The minor side effects such as vomiting, nausea, headaches and dizziness can result from a single dose. However, in treating chronic pain over the long term, the side effects become much more serious. Aspirin is mostly associated with gastrointestinal issues such as ulcers and bleeding of the stomach or intestines. The other over-the-counter NSAIDs are associated with even more severe side effects than aspirin. As with aspirin, these anti-inflammatories can induce ulcers and stomach bleeding. But in addition, their long-term use has also been associated with liver and kidney damage. They also can increase blood pressure in some cases.

➔ **Prescription Anti-Inflammatories** include Vioxx® (which was taken off the market due to its serious side effects) and Celebrex® (which is currently still on the market, albeit with a long list of precautionary warnings and disclaimers). Both drugs are strong anti-inflammatories used for arthritis and other painful conditions. These drugs are powerful inhibitors of cyclooxygenase-2 (Cox-2), which is an enzyme in our bodies that contributes to inflammation and pain. However, Cox-2 is only one of several different inflammatory markers in our bodies. What happens when a patient uses a strong Cox-2 inhibitor like Vioxx or Celebrex is that the drug drastically reduces this enzyme in the body while not significantly affecting other inflammatory markers. This may alleviate the pain, but it throws our systems completely out-of-whack and causes oxidation to occur. The patient feels less pain, but the constant use of these drugs increases free radicals in the body which, in turn, can cause much more serious problems.

Read the Fine Print!

I went on a common website for information on prescription pharmaceuticals and found the list below as potential side effects of Celebrex (Drugs.com, 2017). Why would anyone want to take this drug if they read all the fine print? (Ironically, some of the side effects listed for Celebrex, an anti-inflammatory drug used to reduce pain, are “Joint or muscle pain” and “Inflammation”!)

Side Effects of Celebrex:

Cough; fever; skin rash; sneezing; sore throat; swelling of the face, fingers, feet, or lower legs; abnormal growth in the breast; arm, back, or jaw pain; bloody or black, tarry stools; blurred vision; burning feeling in the chest or stomach; burning or stinging of the skin; burning, tingling, numbness, or pain in the hands, arms, feet, or legs; chest pain or discomfort; chest tightness or heaviness; chills; confusion; congestion in the chest; cramps; diarrhea; dry mouth; earache; fast or irregular heartbeat; heartburn; heavy bleeding; heavy non-menstrual vaginal bleeding; high blood pressure; increased hunger; increased thirst; increased urination; loss of appetite; loss of consciousness; muscle aches and pains; nausea; nerve pain; painful blisters on the trunk of body; painful cold sores or blisters on the lips, nose, eyes, or genitals; pale skin; redness or swelling in the ear; sensation of pins and needles; soreness or redness around the fingernails and toenails; stabbing pain; stiff neck; stomach ache; stomach pain (severe); sweating; tenderness in the stomach area; troubled breathing with exertion; unexplained weight loss; unusual bleeding or bruising; unusual tiredness or weakness; unusual weight gain; vomiting of blood or material that looks like coffee grounds; weakness; wheezing; back pain; gas; headache; heartburn; inability to sleep; pain or burning in the throat; stuffy or runny nose; anxiety; bleeding after defecation; bloody or cloudy urine; breast pain; bone deformity; buzzing or ringing noise in the ears; change in sense of taste; constipation; decrease in height; decreased appetite; depression; difficult, burning, or painful urination; difficulty with moving or walking; difficulty with swallowing; excessive muscle tone, muscle tension, or tightness; excessive tearing; feeling of pressure; hair loss; hives; hoarseness; increased sweating; infection; inflammation; itching, lumps, numbness, pain, rash, redness, scarring, soreness, stinging, swelling, tenderness, tingling, ulceration, or warmth at site; itching of the vagina or genital area; joint or muscle pain or stiffness; large, flat, blue, or purplish patches in the skin; loss of energy or weakness; loss of hearing; muscle pain increased; muscle stiffness; nervousness; numbness or tingling in the fingers or toes; pain during sexual intercourse; pain in the back, ribs, arms, or legs; pounding heartbeat; puffiness or swelling of the eyelids or around the eyes, face, lips, or tongue; redness or swelling in the arms or legs; sensitivity of the skin to sunlight; severe sunburn; sleepiness; straining while passing stool; sudden sweating and feelings of warmth; swelling or inflammation of the mouth; tenderness; thick, white vaginal discharge with no odor or with a mild odor; thinning of the hair; trouble with swallowing; troubled breathing; uncomfortable swelling around anus; unexplained weight loss; voice changes; warmth on the skin; weakness or heaviness of the legs.

Symptoms of Overdose:

Continuing thirst; dizziness; drowsiness; headache, severe or continuing; shortness of breath; sudden decrease in the amount of urine; troubled breathing; weight gain.

The website goes on to list six additional pages of side effects in another section named “For Healthcare Professionals.”

Side Effects. Vioxx was taken off the market because it caused many users to suffer heart attacks and strokes. This is one possible result of increased oxidation due to pro-oxidants (substances that increase the prevalence of free radicals) that I discussed in the last section on Astaxanthin’s

antioxidant qualities. Merck, the pharmaceutical company that marketed Vioxx, spent approximately \$5 billion on settling lawsuits from people who had suffered heart attacks due to this drug. Meanwhile, Celebrex remains on the market but carries extensive warnings. Basically they're telling the consumer "Take this drug and it can help with your pain, but it may ultimately kill you."

I'm going to digress slightly here to describe a fascinating study that was done at the prestigious Harvard Medical School on the negative effects of Vioxx. This is the study that illuminated Vioxx's pro-oxidant effects. Specifically, the study pointed out that the dangerous cardiovascular effects of Vioxx emanate from its action of increasing the susceptibility of LDL and cellular membrane lipids to oxidation. This, in turn, contributes to plaque instability and thrombus formation (the formation of arterial blood clots). Why is this happening? Vioxx becomes a pro-oxidant which results in an increased number of free radicals attacking the cellular membranes and LDL cholesterol, thus causing cardiovascular disease.

The researchers in this study tested to see what effect Astaxanthin would have on Vioxx. They most likely chose Astaxanthin because of the many studies showing how potent it is as an antioxidant, as well as

Astaxanthin Is Safe. It Is *Not* a Strong Cox-2 Inhibitor.

There's no need to worry that Astaxanthin has the same strong Cox-2 inhibition of Vioxx or Celebrex and will thus throw your whole system out-of-whack. It is a Cox-2 inhibitor, but an extremely gentle one. (And at the same time, it's mildly inhibiting seven other inflammatory markers, thus maintaining balance.) Brunswick Laboratories (a well-respected independent laboratory) analyzed Celebrex against Natural Astaxanthin and found that Celebrex was over 300X stronger in Cox-2 inhibition than Natural Astaxanthin (Capelli and Cysewski, 2014). As a renowned professor at UCLA's School of Medicine, Dr. Greg Cole, put it: "While anti-inflammatory drugs usually block a single target molecule and reduce its activity dramatically, natural anti-inflammatories gently tweak a broader range of inflammatory compounds. You'll get greater safety and efficacy reducing five inflammatory mediators by 30% than by reducing one by 100%" (Cole, 2005).



Adding Astaxanthin to Vioxx pills could have prevented many unnecessary deaths.

the fact that Astaxanthin never turns into a pro-oxidant (Shimidzu et al., 1996; Martin et al., 1999; Beutner et al., 2000; Nishida et al., 2007; Capelli et al., 2013). The researchers concluded, “Remarkably, Astaxanthin was able to completely inhibit the adverse effects of Vioxx on lipid peroxidation... We have now demonstrated a pharmacological approach to block the pro-oxidant effect of Vioxx using a high lipophilic chain-breaking antioxidant, Astaxanthin” (Mason et al., 2006). So basically, if the manufacturer, Merck, had only known about Astaxanthin’s

excellent antioxidant effects before beginning to sell Vioxx, they could have added Astaxanthin to Vioxx and prevented the death of many innocent people.

➔ **Steroids** are synthetically produced pain-reducing medications designed to resemble cortisol. (Cortisol is a hormone that is naturally produced by the human body.) Steroids can be administered orally, trans-dermally or by injection. They work by reducing inflammation. They also are known to limit immune activity.

Side Effects. The list of side effects from steroid use is extensive. Generally, the higher the dose and the longer the treatment, the greater the chance that some of these side effects will occur. They include less serious issues such as acne, bruising, insomnia, growth of body hair, nervousness,

It’s interesting to note that a commonly prescribed steroid called prednisolone was tested directly against Astaxanthin in rats to see how they compared in reducing inflammatory markers in the rats’ bloodstream. For all three markers tested, prednisolone and Astaxanthin performed fairly equally. In fact, at higher doses, Astaxanthin outperformed prednisolone in reducing key inflammatory markers Prostaglandin E-2 and Nitric Oxide (Ohgami et al., 2003; Lee et al., 2003). And as I’ll continue to stress throughout this chapter, unlike steroids and many other pain relievers, *Astaxanthin has no adverse side effects.*

water retention and swelling. More troubling, they can adversely affect the eyes, increase blood pressure, induce weight gain, decrease resistance to infection, weaken muscles and lead to osteoporosis. Additionally, use of steroids in diabetics can lead to a worsening of their condition.

➔ **Opioids** are drugs that I hesitate to include in our discussion here since they are generally not used for chronic pain (because they are highly addictive). Doctors usually prescribe them for intense pain only on a short-term basis to prevent patients from becoming addicted. Unfortunately, the overuse and misuse of opioids has led to epidemic levels of addiction over the last few decades. The other huge downside to opioid use is the potential for overdose. Patients who aren't getting the reduction in pain they seek may increase their dose, or may take opioids in conjunction with other drugs such as alcohol and wind up in a coma or dead from respiratory failure. While extremely effective in masking pain, this class of drugs is not a wise treatment for chronic pain due to these two major issues—addiction and overdose.

The Centers for Disease Control Warns Against Opioids

- In 2014, almost 2 million Americans abused or were dependent on prescription opioids.
- As many as 1 in 4 people who receive prescription opioids over a long term for non-cancer pain in primary care settings struggle with addiction.
- Every day in USA, over 1000 people are treated in emergency departments for misusing prescription opioids (CDC, 2017).

Clinical Research Reveals a Potential New Pain Treatment

There have been several human clinical trials showing that Astaxanthin reduces pain in joints, tendons and muscles both in groups of patients suffering from chronic conditions as well as in healthy young men doing intense exercise. The variety of studies is strong support for Natural Astaxanthin's far-ranging anti-inflammatory

effects. Whether the pain is in the joints, the tendons or the muscles, Astaxanthin is generally able to reduce it and make people feel better. But once again I must warn readers—don't expect it to work fast. You'll have to use Astaxanthin at least two weeks and more likely four to even eight weeks to get the desired results.

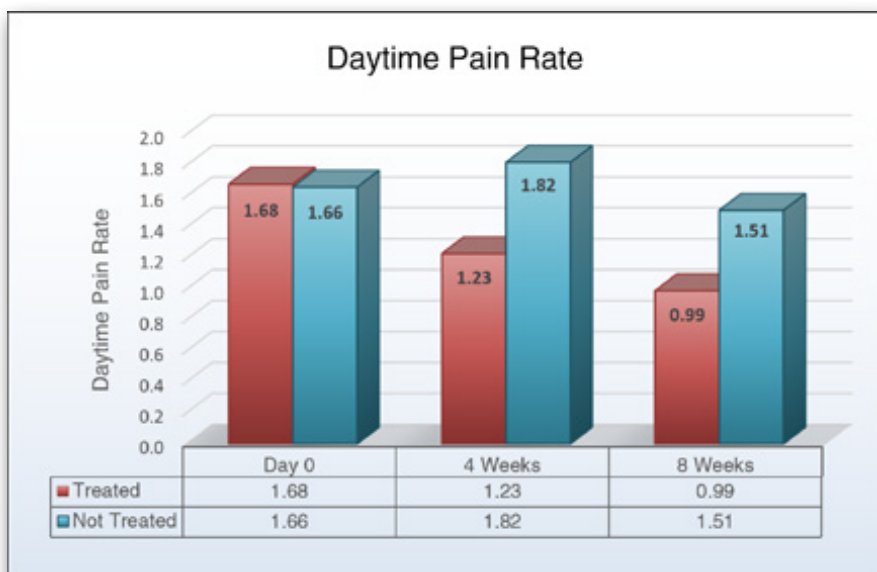
Readers should also remember the 80/20 rule I mentioned in Chapter 1: Roughly 20% of the people who take Astaxanthin for pain don't obtain their desired results. But keep in mind that this isn't very different from other anti-inflammatory products you find in a drug store—most of those don't work for 100% of the people 100% of the time either, and unlike Astaxanthin, they all have side effects.

Let's look at studies done on various painful conditions to see how Astaxanthin's diverse anti-inflammatory activities work when treating people afflicted with pain.

➔ **Rheumatoid Arthritis.** This is a chronic painful condition with no cure; it is very difficult to treat compared to osteoarthritis. For sufferers of rheumatoid arthritis, Astaxanthin was found to reduce pain levels and increase satisfaction with the ability to perform daily activities. In this double-blind, placebo-controlled study, people in the treatment group took 12mg per day of Natural Astaxanthin over the course of eight weeks. Results showed an improvement over time for both measures. During the first month, subjects found slight improvements on average. But by the end of eight weeks, the pain scores had dropped by 35% and the satisfaction scores improved by 40% in the group taking Astaxanthin (Nir and Spiller, 2002a).

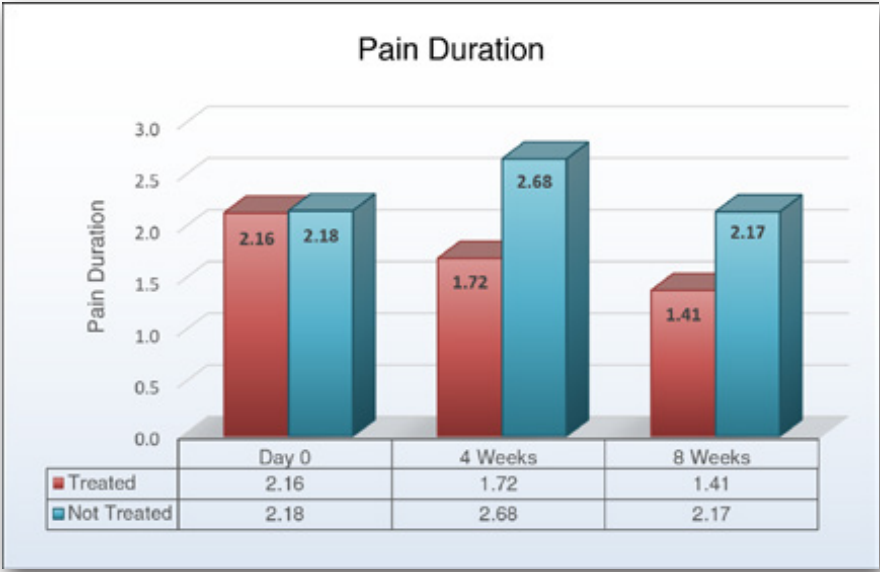
Over 80% of Arthritis Sufferers Improve with Astaxanthin!

A health questionnaire of 247 Astaxanthin users showed that “over 80% of those reporting back pain and symptoms from osteoarthritis or rheumatoid arthritis reported an improvement from Astaxanthin supplementation. Astaxanthin supplementation was also reported to improve symptoms of asthma and enlarged prostate. All of these conditions have an inflammation component which is closely tied to oxidative damage” (Guerin et al., 2002).



Astaxanthin had a great effect for people suffering from incurable rheumatoid arthritis.

➔ **Carpal Tunnel Syndrome.** Another disease with no cure, carpal tunnel syndrome (abbreviated as “CTS” and also known as “repetitive stress injury” in some countries) affects up to 2% of Americans at any given time. This is a debilitating tendon condition that causes pain in the wrists. Doctors can’t cure it, so they generally just recommend a splint or surgery. Patients suffering from CTS were randomly separated into two groups. One group took 12mg per day of Natural Astaxanthin and the other group took a placebo. As in the study on rheumatoid arthritis, this study also lasted eight weeks with a mid-term assessment of pain levels after four weeks. Mimicking the results found in the rheumatoid arthritis study, the CTS group taking Astaxanthin had good results after four weeks, but much more pronounced results after the full eight-week course of treatment. Subjective pain levels were measured as well as the duration of pain. After eight weeks, these dropped by 41% and 36% respectively. Some of the people taking Astaxanthin reported that they were able to make major changes in their lifestyle due to the positive effects they experienced (Nir and Spiller, 2002b).



Astaxanthin also helped sufferers of Carpal Tunnel Syndrome (known as “Repetitive Stress Injury” in some countries).

➔ **Muscle Inflammation and Recuperation in Elite Soccer Players.** The researchers carrying out this study looked at the effect of 90 days of Astaxanthin supplementation on young elite soccer players in Europe. This study was randomized and placebo-controlled with the treatment group supplementing with 4mg of Natural Astaxanthin per day. The total number of subjects was 40. Both blood and saliva samples were tested at the commencement of the study and again after 90 days. Various parameters that were tested showed favorable results in the Astaxanthin group including inflammation levels, immune system function and muscle recuperation. In addition, muscle damage from exercise decreased in the athletes supplementing with Astaxanthin.



Whether pain occurs in joints, tendons or muscles, Astaxanthin seems to help reduce it.

In their conclusion, the researchers hypothesized that the mechanism of action may be that Astaxanthin “protects the cell membranes against free radicals generated during heavy exercise, thus preserving the functionality of muscle cells” (Baralic et al., 2015). Once again, we see the link between oxidation and inflammation—where you find one, you generally will find the other. Fortunately, Natural Astaxanthin is both an antioxidant and an anti-inflammatory, so the oxidation/inflammation in the muscles created by heavy training is combated from both angles by a single supplement.

- ➔ **Increased Strength and Decreased Pain in Patients Suffering from Tendonitis.** Gene Spiller, PhD, the lead author of the rheumatoid arthritis and carpal tunnel syndrome studies described above, also studied the effects of Astaxanthin on people suffering from tennis elbow, a form of tendonitis that affects the arms. The repetitive motion of hitting tennis balls with a racket can manifest as tennis elbow, which causes a loss of grip strength in the hands and pain while gripping objects. Spiller and his colleagues randomly divided the tennis elbow sufferers into two different groups: One group took 12mg per day of Natural Astaxanthin for eight weeks, while the other group took a visually identical placebo. The results for people supplementing with Astaxanthin were impressive: on average, their grip strength increased by almost double in only eight weeks (93% to be exact), and there was also a decrease in their self-assessment of pain in their hands. Dr. Spiller concluded that Natural Astaxanthin may alleviate pain and increase mobility. “This improvement may greatly improve the standard of living for those who suffer from such joint disorders” (Spiller et al., 2006a).
- ➔ **Prevention of Joint Soreness After Exercise.** The first human clinical trial to test Astaxanthin’s effectiveness against pain and inflammation was performed at the University of Memphis back in 2001 under the supervision of Andrew Fry, PhD. This study looked at Natural Astaxanthin’s effect on 20 healthy young men who were performing strenuous exercise. It’s an important study to consider since it was done on perfectly healthy subjects, unlike most of the other studies reviewed above that were done

on patients suffering from conditions that cause chronic pain.

Dr. Fry used a relatively low dose of Astaxanthin—only 4mg per day. Additionally, this study ran for a relatively short period of time—only three weeks. Dr. Fry wanted to see if Astaxanthin could help prevent the soreness that usually occurs after intense exercise. The young men who participated in this study were training regularly with weights. The subjects used a resistance-training apparatus for strenuous knee exercises during the three-week treatment period. Half took 4mg of Natural Astaxanthin and half took a placebo every day.

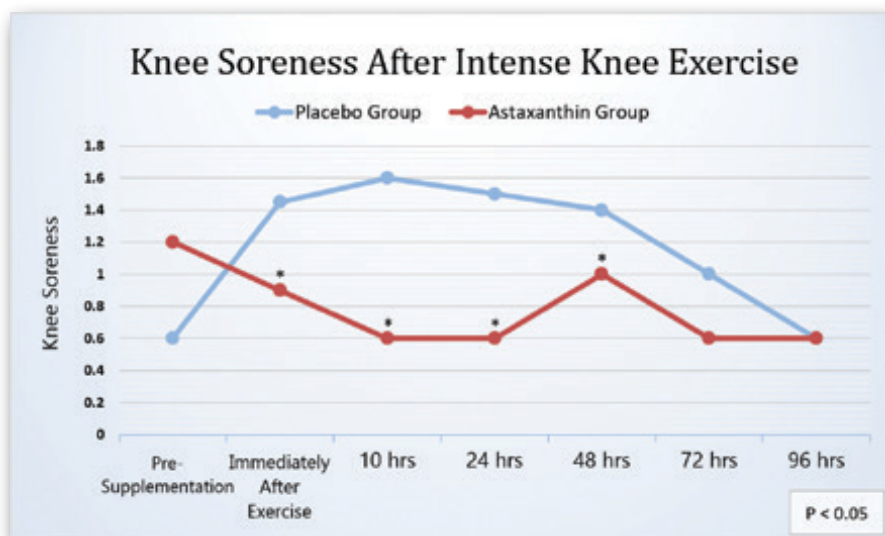


Strenuous physical exercise can lead to sore joints and muscles.

The young men taking placebo had significant joint pain in their knees immediately after the exercise. This pain was tested 10 hours after the heavy exercise, and then again at 24 hours and 48 hours after the exercise. Whether immediately afterward or at the various test times up to and including 48 hours afterward, the pain persisted for those who took placebo. But the young men who were taking 4mg of Astaxanthin every day showed no increase in knee soreness right after exercise. This reduced-pain state remained consistent at the first three test times of 10, 24 and 48 hours after exercise (Fry, 2001). This is a stunning result in particular when you consider that the dosage was the lowest level commonly recommended and that the study ran only for three weeks. In research on chronic painful conditions subsequent to Dr. Fry's study, dosage was generally 12mg per day and the studies ran for eight weeks. After four weeks there was an improvement in pain levels, but it became much more pronounced after eight weeks as the Astaxanthin accumulated throughout the body. However, in this University of Memphis study, the results were much quicker and

at a lower dose. The reason for this is not clear, but may have to do with the fact that these subjects did not start with painful conditions and were young and athletic.

Whatever the reason, it's notable that Natural Astaxanthin appears to reduce pain in people who suffer from chronic conditions, but also seems capable of preventing pain in healthy people who are exercising heavily. The implications are promising not only for the millions suffering from arthritis and tendonitis but also for athletes and regular people doing exercise or heavy work on a daily basis.



No increase in joint pain after exercise for subjects taking Astaxanthin while the placebo group suffered.

- ➔ **Prevention of Muscle Soreness After Exercise.** The clinical trial that Dr. Fry did at the University of Memphis was originally focused on another inflammation-related condition. In fact, the main goal Dr. Fry had with the study was to see if Natural Astaxanthin could help prevent the soreness in muscles that occurs after doing heavy exercise. This condition is called “delayed onset muscle soreness,” and it affects athletes, weight lifters, people doing hard physical work and, perhaps most notably, weekend warriors. Fortunately,

the results he found about Astaxanthin preventing joint soreness are much more important than his original goal. There is no doubt that joint pain caused by strenuous exercise is a much more serious condition than muscle soreness that occurs after strenuous exercise. Pretty much everyone has had sore muscles after a tough day in the garden or a long game of volleyball at the beach, and most people are aware that it's just a temporary condition that will go away in a couple days. But sore joints are a much more troubling issue that are of greater concern than normal muscle soreness.



Reducing joint and muscle soreness can help athletes get back to training faster.

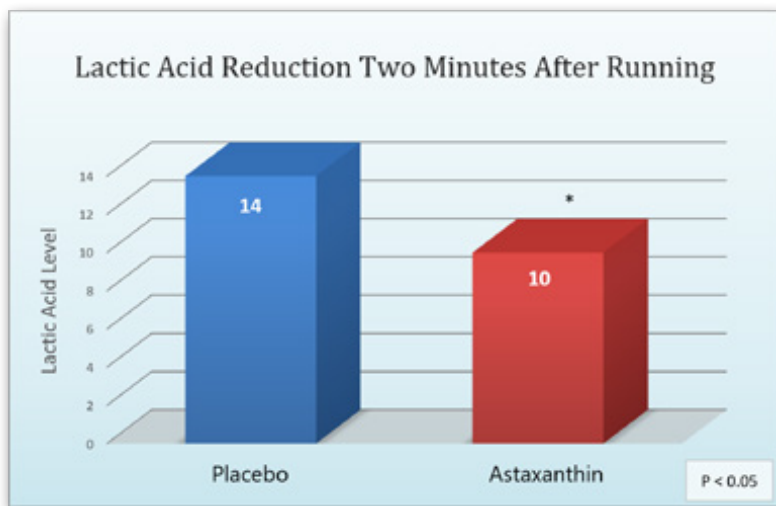
In any event, Dr. Fry did not immediately find a statistically significant result showing that Astaxanthin could prevent muscle soreness. But years later, Dr. Fry re-examined the data and found that in a subset of the subjects in this trial, Astaxanthin did have an excellent result in preventing muscle soreness after heavy exercise. The people that were positively affected were those whose muscles had high fiber content (Fry et al., 2004).

➔ **Reduced Muscle Soreness from Lactic Acid Buildup During Exercise.**

We saw in the study above that Natural Astaxanthin can help prevent muscle soreness in certain people doing heavy exercise. But how is this possible?

Lactic acid builds up during physical exertion and causes fatigue and burning in the muscles. A study from Japan had healthy adult men take 6mg of Astaxanthin or a placebo daily for four weeks. They had both the placebo and the Astaxanthin group run 1200 meters and tested their lactic acid levels before supplementation began. They repeated this after 30 days at the end of the study and found a statistically significant reduction in lactic acid buildup due to exercise in the men taking Astaxanthin. The difference was substantial—a 28.6% reduction in lactic acid on average

from taking 6mg of Natural Astaxanthin per day for a month (Sawaki et al., 2002). This is one more piece of evidence that Astaxanthin can prevent pain and soreness, in this case the burning pain due to heavy exercise. Plus, this study explains how this is possible—by Astaxanthin’s ability to reduce lactic acid levels.



Too much lactic acid can cause burning in the muscles after exercise.

Consumer Surveys Corroborate the Clinical Studies

While some scientists and doctors place little stock in surveys as they consider them unscientific, others consider them useful evidence when viewed in tandem with clinical research. In addition to all the human clinical trials I described above, as I pointed out in Chapter 1, two consumer surveys have validated Natural Astaxanthin’s ability to combat painful inflammatory conditions. Both of these surveys showed that about 80% of respondents found relief from pain with Natural Astaxanthin use. (Of particular interest is the survey that asked users to compare Natural Astaxanthin to prescription and OTC anti-inflammatories and found similar results.)

The Silent Killer: Systemic Inflammation



Mainstream media have recently publicized the ravaging effects of Silent Inflammation.

for most of the diseases that kill us. And fortunately, Astaxanthin shows excellent protection against both.

The longest-running clinical study on aging has produced proof of how silent inflammation ages our bodies. This study has shown that “having more than one disease, which doctors call ‘comorbidity,’ is a good indicator of how rapidly a person is aging, and it seems to be driven by chronic inflammation” (Oaklander, 2016). An eminent health crusader, Dr. Barry Sears, summed up the situation very graphically. Dr. Sears is the President of the Inflammation Research Foundation, so he is an expert on silent inflammation. Here is what he said:

Dr. Barry Sears

What if there was a condition that threatened to destroy the entire US healthcare system in a very short time? Every politician would be making speeches about it. There would be a mobilization of the entire medical establishment to combat it...Unfortunately, such a condition does exist and no one seems concerned about it. This condition is “silent inflammation”...

Dr. Barry Sears (cont.)

Silent inflammation is different from classical inflammation in that it is below the threshold of perceived pain. As a result, no action is taken to stop it, and it lingers for years, if not decades, causing insults on the heart, the immune system and the brain (Sears, 2005).

Unfortunately, Americans have the highest level of silent inflammation in the world, with estimates of up to 75% of American adults affected. Dr. Sears goes on to point out that there is no prescription medication for silent inflammation, but fortunately, there are anti-inflammatory diets and supplements that can be employed in the fight against this silent killer. According to the clinical research below, Natural Astaxanthin appears to be one such supplement, and a very effective one at that.

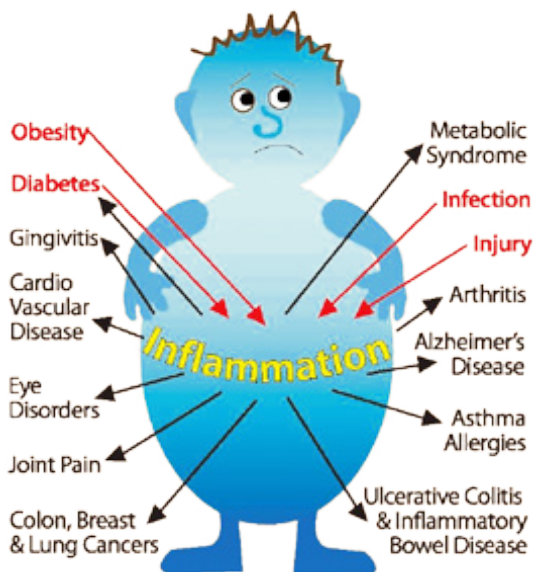
Astaxanthin Targets the Key Marker for Silent Inflammation

The marker used by doctors to measure how much silent inflammation is occurring in a person's body is called C-reactive protein (CRP). The scariest thing about silent inflammation is that it has no signs or symptoms—the only way to find out if you have high levels of silent inflammation is to get a blood test for CRP.

A panel of experts convened by the American Heart Association and the Centers for Disease Control and Prevention recommended CRP testing as a means of predicting heart disease risk. CRP tests are now becoming a routine part of adults' annual physical exams in many countries, just as cholesterol and blood lipid testing became standard procedure back in the 1980s. It's interesting to note that many scientists (including some from the world's most prestigious institutions like Harvard University) now consider CRP levels a more reliable indicator of impending heart disease than cholesterol and blood lipid levels (Perry, 2006).

A few different clinical trials have shown that Natural Astaxanthin may help reduce levels of CRP in humans. One such study, a randomized, double-blind,

placebo controlled clinical trial, was done to test Natural Astaxanthin's effect on CRP levels in healthy volunteers. The subjects took either 12mg per day of Natural Astaxanthin or a placebo for eight weeks. CRP levels were measured before and after the eight week supplementation period. The results were impressive—in only eight weeks people taking Astaxanthin reduced their CRP levels by over 20%. Meanwhile, people taking placebo saw a slight increase in their CRP levels (Spiller et al., 2006b).



A phenomenal array of diseases have been linked to silent inflammation.

A team of scientists from Washington State University (led by long-time carotenoid researcher Boon Chew, PhD) did a multi-faceted study on Natural Astaxanthin primarily to test its effect on the human immune response. They used young women in this randomized, double-blind and placebo-controlled study. In addition to measuring immune markers, they also measured DNA damage, oxidative stress levels and CRP. The results were positive on all markers tested. In fact, at both dosage levels of 2mg per day and 8mg per day of Natural Astaxanthin, they found a statistically significant decrease in CRP levels after eight weeks of supplementation as well as a reduction of approximately 40% in DNA damage (Park et al., 2010).

A final study I'll describe here showed that Astaxanthin can greatly reduce CRP levels in high-risk individuals. A company experimenting with Astaxanthin production back in 2006 publicized a human clinical trial on patients with elevated CRP levels that placed them in a high risk category for cardiovascular disease. The patients took Natural Astaxanthin or placebo for three months, after which their CRP levels were again measured. Nearly half of the people taking Astaxanthin fell out of the high risk category; meanwhile, none of those taking placebo did (Mera, 2006).

Astaxanthin's Multiple Mechanisms of Action

In contrast to common prescription anti-inflammatories (which work by intensely inhibiting the Cox-2 enzyme and thereby throwing your natural balance completely out-of-whack), Astaxanthin works as an anti-inflammatory through multiple pathways. The various mechanisms of action for Astaxanthin as an anti-inflammatory have been demonstrated in numerous studies. This research has consistently shown that Astaxanthin works on several different inflammatory markers, but that it works in a gentle, broad-spectrum manner. Impressively, Astaxanthin has been shown to gently and safely reduce eight different markers of substances that cause inflammation.

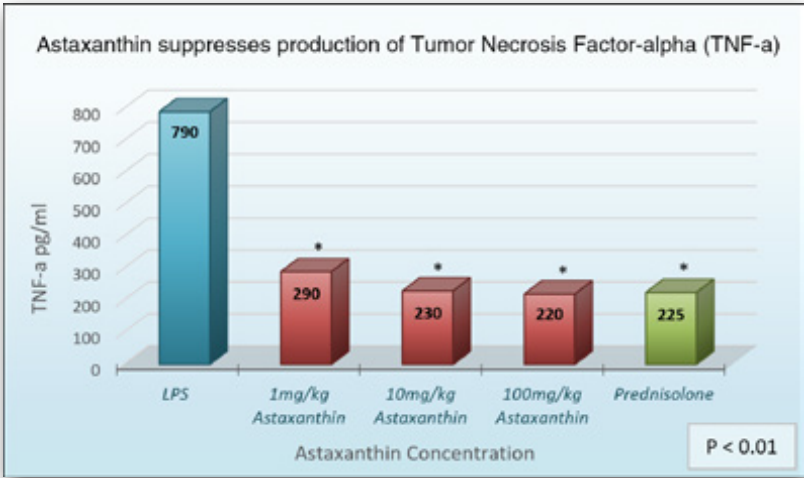
Back in 2003, scientists working concurrently but independently in Japan and Korea were honing in on Astaxanthin's broad-spectrum mechanisms of action for combatting inflammation. Although they were not corresponding or sharing information, and although they used very different paths to get there, both groups of researchers arrived at similar conclusions. This was only the start—other studies since then have further substantiated the early findings. Below is a summary of some of the most significant research on Astaxanthin's multiple mechanisms of action against inflammation.

Inflammatory markers gently reduced by Astaxanthin include:

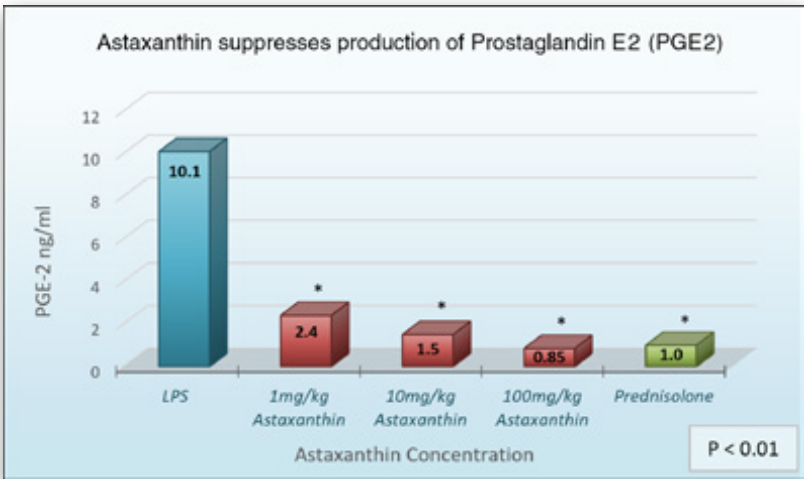
- ✓ Prostaglandin E2
- ✓ Interleukin 1b
- ✓ Interleukin 6
- ✓ Tumor Necrosis Factor alpha
- ✓ Nitric Oxide
- ✓ Nuclear Factor Kappa B
- ✓ Cox 1 enzyme
- ✓ Cox 2 enzyme (Lee et al., 2003; Ohgami et al., 2003; Choi et al., 2008; Kishimoto et al., 2010)

- **First Study Proving Broad-Spectrum Mechanisms of Action.** Researchers at Japan's Hokkaido Graduate School of Medicine were the first to demonstrate Astaxanthin's multiple mechanisms for controlling inflammation. They did their research in test tubes and also in rats, focusing on the rats' eyes. They found that Astaxanthin reduced three key causes of inflammation: Prostaglandin E2 (PGE2), nitric oxide (NO) and tumor necrosis factor alpha (TNF-a) (Ohgami et al., 2003).

Combined Results From Anti-Inflammatory Mechanism Research

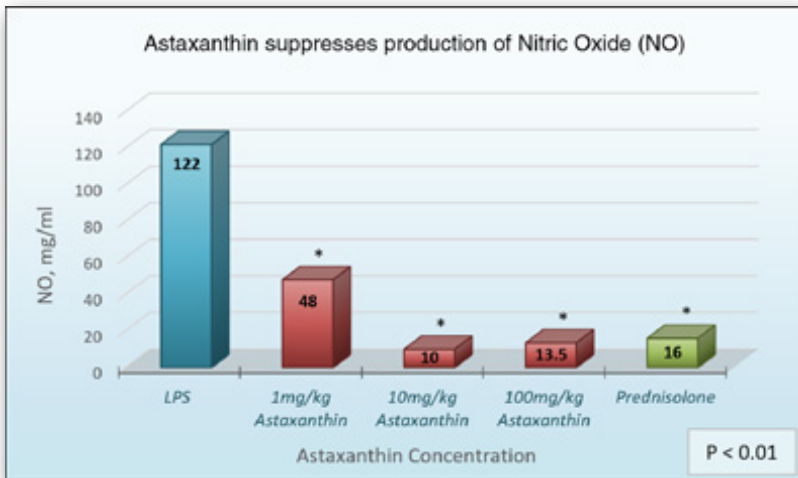


Tumer Necrosis Factor alpha

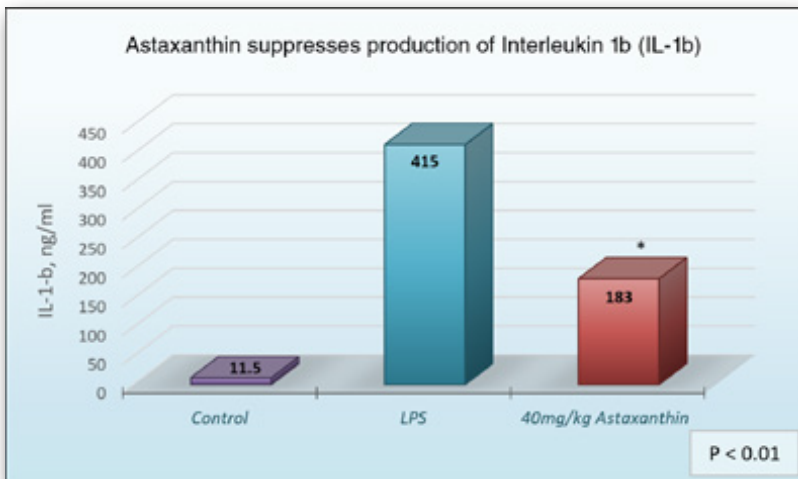


Prostaglandin E2

Measurement of the anti-inflammatory action of Astaxanthin in lipopolysaccharide (LPS) induced inflammation in rats, as measured by tumor necrosis factor-a and prostaglandin E2, and compared with the anti-inflammatory drug prednisolone (Ohgami et al., 2003).



Nitric Oxide



Interleukin 1b

The top graph shows the measurement of the anti-inflammatory action of Astaxanthin in lipopolysaccharide (LPS) induced inflammation in rats as measured by nitric oxide levels, and compared with the anti-inflammatory drug prednisolone (Ohgami et al., 2003). The bottom graph shows the measurement of anti-inflammatory action of Astaxanthin in LPS induced inflammation in mice as measured by interleukin 1b (Lee et al., 2003).

- **Second Study on the Mechanisms of Action.** Later the same year, Korean researchers working independently found similar results both in-vitro and ex-vivo. In harmony with the Ohgami results, they found that Astaxanthin suppresses the inflammatory mediators PGE2, NO and TNF-a. But they also demonstrated Astaxanthin's positive effects on three other inflammatory markers: Interleukin 1b, COX-2 enzyme and nuclear factor kappa B (Lee et al., 2003).
- **Further Validation.** Several years later, scientists from Korea University further validated the earlier results finding broad-spectrum anti-inflammatory activity (Choi et al., 2008).
- **Inhibition of Mast Cells.** Mast cells are the key initiators of inflammation. Research at Kyoto University showed that Astaxanthin had an inhibitory effect on rats' mast cells (Sakai et al., 2009).
- **"Remarkable" Results.** Japanese researchers referred to Astaxanthin's anti-inflammatory activity as "remarkable" and found a statistically significant reduction in six different inflammatory markers tested (Kishimoto et al., 2010).
- **Effective Against UV-Induced Inflammation.** Astaxanthin was found to be effective at protecting against UV-induced inflammation in a broad-spectrum manner. In fact, cell death that is frequently caused by UV exposure was significantly decreased in the Astaxanthin-treated cells (Yoshihisa et al., 2014).
- **Most Recent Findings.** An in-vitro experiment found again that Astaxanthin can reduce inflammatory markers interleukin 6 and TNF-a. This study also found an impact on nuclear factor kB/p65. The study concluded: "These results suggest that Astaxanthin could be useful for improving chronic inflammation such as that associated with oral lichen planus (a chronic inflammatory condition that affects mucous membranes in the mouth) (Miyachi et al., 2015).

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

- Astaxanthin provides neuroprotection by inhibiting inflammation in mice (Ying et al., 2015).
- Astaxanthin reduces inflammation and oxidation in the kidneys of mice (Qiu et al., 2015).
- Astaxanthin reduces pro-inflammatory cytokines and reactive oxygen species in mice (Li et al., 2015a).
- Astaxanthin exerts anti-inflammatory and antioxidant effects in mice with kidney injury (Liu et al., 2015).
- Astaxanthin decreases several inflammatory and oxidative markers in rats with systemic inflammation (Zhou et al., 2015).
- Astaxanthin protects against autoimmune hepatitis by reducing the release of inflammatory factors (Li et al., 2015b).
- Astaxanthin protects against diabetes-induced hepatic inflammation and oxidative stress in rats (Park et al., 2015).
- Astaxanthin inhibits the formation of pre-malignant colon lesions in mice by suppressing chronic inflammation and oxidative stress (Kochi et al., 2014).
- Astaxanthin reduces inflammation and liver stress in mice fed a high fructose/high fat diet (Bhuvaneswari et al., 2014).
- Astaxanthin protects cells from

A mouse study backed up the human trial showing that Astaxanthin can reduce lactic acid levels, thereby preventing sore, burning muscles after exercise. In this study they measured blood lactose levels in both the control and Astaxanthin groups. The mice fed Astaxanthin had lower lactic acid levels in their muscles, which resulted in their being able to swim significantly longer before exhaustion (Ikeuchi et al., 2006).

In a dog study preceding a similar study he later did in humans, renowned carotenoid researcher Boon Chew, PhD, from Washington State University found that Astaxanthin heightens the dogs' immune response and reduces DNA damage and inflammation (as measured by CRP levels) (Chew et al., 2011).

inflammation and oxidative stress caused by lipopolysaccharide-reducing O₂-production (Franceschi et al., 2014).

- Astaxanthin may prevent inflammation-associated colon cancer in rodents (Tanaka, 2012).
- Astaxanthin exhibits anti-inflammatory and anti-coagulatory effects in diabetic rats (Chan et al., 2012).
- Astaxanthin improves insulin sensitivity by reducing inflammation, oxidation and lipid accumulation in obese mice (Arunkumar et al., 2012).
- Astaxanthin reduces inflammatory cytokines induced by UVB exposure (Terazawa et al., 2012).
- Astaxanthin inhibits colitis and colon cancer formation in mice by modulation of inflammatory cytokines (Yasui et al., 2011).
- Astaxanthin protects against inflammation, oxidative stress and cell death in epithelial cells exposed to high levels of glucose (Kim et al., 2009).
- Astaxanthin's anti-inflammatory activity may prevent age-related macular degeneration in mice (Izumi-Nagai et al., 2008).
- Astaxanthin reduces inflammation in rats' eyes (Suzuki et al., 2006).
- In a comparative study on nitric oxide scavenging, researchers pitted

Decreases Inflammation by 50% in Mice

An early study in this area had mice run on a treadmill until exhausted. Mice that were supplemented with Astaxanthin had decreased inflammation in their muscles by 50%. In addition, the Astaxanthin mice had:

- Less DNA damage
- Less oxidative damage in their heart muscles
- Less oxidative damage in their calf muscles
- Reduced oxidation in their plasma
- Less peroxidation damage in their cell membranes

The study concluded: "Our data documented that Astaxanthin indeed is absorbed and transported into skeletal muscle and heart in mice, even though most carotenoids accumulate mainly in the liver and show relatively little distribution to other peripheral tissues, including skeletal muscle and heart. This unique pharmacokinetic characteristic of Astaxanthin makes it well suited to oxidative stress in calf and heart... Thus, Astaxanthin attenuates exercise-induced damage by directly scavenging reactive oxygen species and also by down-regulating the inflammatory response" (Aoi et al., 2003).

Astaxanthin against another commonly used natural anti-inflammatory, curcumin, and also tested a few curcumin derivatives as well. This in-vitro study found that curcumin and its related compounds were all less effective than Astaxanthin in scavenging nitric oxide radicals (Sumanont et al., 2004).

In conclusion, clinical research shows that Natural Astaxanthin reduces CRP, the key marker for systemic inflammation (which causes many diseases). Furthermore, several clinical trials show that it is capable of reducing joint, tendon and muscle soreness in a variety of painful conditions and also in healthy subjects doing strenuous exercise. Interestingly, two consumer surveys showed that Natural Astaxanthin works about as well as prescription and OTC anti-inflammatories. It does, however, take considerably longer to work. But the critical distinction is that Natural Astaxanthin has never been shown to have any side effects or contraindications—it's completely safe and natural—while OTC pain pills and prescription anti-inflammatories all have serious side effects, some that might end up killing you. So the crucial decision is left up to the consumer: Do you want fast results that may end up seriously hurting or killing you, or would you rather wait about a month for the same results and be safe and healthy?



The Eyes Have It! How Astaxanthin Can Enter the Eyes and Protect Them

“The Eyes Have It?” What’s that supposed to mean? Unlike many otherwise good antioxidants (including carotenoids in the same family as Astaxanthin such as beta-carotene and lycopene), Astaxanthin reaches the eyes. It first gets into the brain by crossing something called the “blood-brain barrier.” Then it marches onward and through another barrier called the “blood-retinal barrier.” These barriers are both protective screens in our heads designed to limit which molecules can reach these vital organs. Basically, they’re designed to keep the bad stuff out. The problem is, they can also keep a lot of good things out (including many otherwise competent antioxidants).

Other than some preliminary antioxidant experiments, research on Astaxanthin’s potential to help the eyes was where it all started.

Two young scientists working toward their doctorates way back in the 1940s were really on to something. And they were clearly ahead of their time. Before almost any scientist in the world had ever heard of “Astaxanthin,” Renee Massonet and Rene Grangaud had already discovered how protective Astaxanthin is for the eyes. The work they started in the 1940s using primitive equipment in Algeria was eventually published in the 1950s in France as their doctoral theses, earning them their PhDs and great respect from their peers.

Then something strange happened. The research community somehow forgot about Astaxanthin for eye health. In fact, the scientific community largely forgot about Astaxanthin as a nutrient for improving health for over 20 years. Amazingly, this early eye health research was so completely forgotten that in 1996, a professor and ophthalmologist at the University of Illinois, Mark Tso, MD, was able to get a patent on the use of Astaxanthin for eye and central nervous system diseases and damage! As anyone who’s familiar with patents knows, they’re supposed to be granted

based on a new, previously undiscovered invention. How could Dr. Tso get a patent on Astaxanthin for eye disease when Massonet and Grangaud had discovered its potential in this area over 40 years earlier? Basically, this shows how completely forgotten Astaxanthin had become.

The US patent that Dr. Tso was granted back in the 1990s (currently expired) was based on wide-ranging research in rodents for the use of Astaxanthin for eye and brain diseases. After demonstrating Astaxanthin's ability to cross the blood-brain and blood-retinal barriers, Dr. Tso went on to show, through an extensive series of experiments, a multitude of potential preventive and therapeutic benefits for Astaxanthin in the areas of eye and brain health. The benefits related to eyes include prevention or reduction of:

- ✓ Erosion of the macula (to prevent age-related macular degeneration)
- ✓ Glaucoma
- ✓ Inflammation of the retina, iris, uvea and sclera
- ✓ Cataracts
- ✓ Central retinal artery and venous thrombosis
- ✓ Cystic macular edema
- ✓ Injuries resulting from trauma
- ✓ Light-induced damage
- ✓ Photoreceptor cell damage
- ✓ Ganglion cell damage
- ✓ Neuronal damage
- ✓ Inflammatory damage (Tso and Lam, 1996)



Protection of the eyes was Astaxanthin's first researched health benefit.

Eye diseases are prevalent. Astaxanthin's potential to benefit so many different eye disorders makes it the supplement of choice for eye health. According to the National Institute of Health, over 10% of Americans are afflicted with a serious eye disorder, and it's a sad fact that this percentage is substantially higher in many developing countries. Based on US Census data from 2016, American eyes are hurting.

Affliction	Americans Afflicted	Percentage of total population
Cataract	24,409,978	7.5%
Diabetic Retinopathy	7,685,237	2.4%
Glaucoma	2,719,379	0.8%
Age-Related Macular Degeneration	2,069,403	0.6%
Total Afflicted	36,883,997	11.4%

(National Institute of Health, 2017)

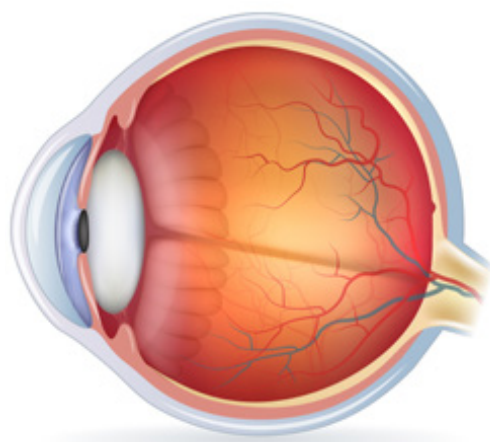
Though this is only a partial list of eye diseases, these are surprisingly large numbers for maladies of one specific organ. Taking age into consideration, eye diseases are affecting close to 25% of people past the age of 40. And even though glaucoma and age-related macular degeneration are less common (affecting less than 1% of the population), they are still grave concerns as they are leading causes of blindness.

The Most Versatile Nutrient for the Eyes

As anyone who is 50 or older knows, the eyes change with age. Many people who never required corrective lenses before find themselves in need of a pair of reading glasses in their mid-40s. And many serious issues such as age-related macular degeneration, cataracts and glaucoma become increasingly prevalent among older populations. In addition, the constant barrage of UV light to the eyes wears them down over time. This can manifest as ocular ischemia, which is a blockage of oxygen and nutrition to the eyes. All of these ocular maladies are linked to the evil twins—oxidation and inflammation. As is the case with the brain, the eyes have

a high concentration of fat, and fats in our bodies are particularly susceptible to oxidants. Eyes are affected over time by free radicals, which oxidize the fatty acids in the retina. This results in damage to the retinal cells (which is permanent). Antioxidants that reach the eyes can greatly help them maintain their health over time.

Several other nutrients have been claimed as the top supplement for eye health. Yet, as you'll discover as you read through this chapter and learn about the diversity of the research, Astaxanthin can provide eye protection like no other nutrient. This is due to two key characteristics that were explained previously: Astaxanthin is far and away the world's strongest and highest quality natural antioxidant, and Astaxanthin is also a broad-spectrum anti-inflammatory. And most of the health and functionality issues affecting the eyes are caused by—you guessed it—oxidation and inflammation.



Protection of the eyes from oxidation and inflammation is essential for their long-term health.

What we need as an ounce of prevention for our aging eyes and brains is a combination supplement: a strong antioxidant and broad spectrum anti-inflammatory that can get through the blood-brain barrier, and then through the blood-retinal barrier, to bring its protection to both the brain and eyes. Both the groundbreaking research from Algeria and the follow-up patent from the University of Illinois demonstrated Astaxanthin's ability to get into the eyes. And dozens of studies have confirmed Astaxanthin's potent antioxidant activity and its broad-spectrum anti-inflammatory properties. It seems that Astaxanthin is an ideal candidate to support eye health. And clinical research bears this out.

**In human clinical research, Astaxanthin
has demonstrated an ability to:**

- Improve visual acuity (the ability to see fine detail)
- Treat or prevent asthenopia (eye fatigue)
- Reduce blurred vision
- Increase accommodation amplitude (the adjustment in the lens that allows it to focus)
- Prevent eye strain
- Reduce eye soreness
- Prevent eye dryness
- Improve depth perception
- Prevent diplopia (double vision)
- Increase blood flow to the retina and to the vascular layer of the eye
- Increase blood flow velocity to the eyes

Eye Problems of the Modern Age

Many people around the world spend over three hours each day working or playing on a computer. This is problematic—according to the US National Institute for Occupational Safety and Health, a condition called “Computer Vision Syndrome” (CVS) affects about 90% of these people.

Symptoms of Computer Vision Syndrome

- | | |
|------------------|----------------------------------|
| • Eye fatigue | • Headaches |
| • Eye strain | • Neck pain |
| • Dry eyes | • Irritated eyes |
| • Blurred vision | • Vertigo or dizziness |
| • Double vision | • Difficulty refocusing the eyes |

(As listed in Wikipedia under “Computer Vision Syndrome”)

The eyes did not evolve to look at computer terminals and televisions. We focus differently when working on a computer—more intensely—which results in blinking far less. Normally, we blink about 15 times per minute. But when we're in front of a computer, this rate can decrease to as low as 3 or 4 times per minute. This is only one of the significant changes that happen to our eyes when we work on computers, and it can become more pronounced when we spend longer periods with our gazes fixed on screens. The increase worldwide in short-sightedness (myopia) can be directly attributed to increased time spent on visual display terminals.

Some remarkable research has surfaced over the last 15 years about how Astaxanthin can help our eyes in today's world. Two of the most interesting areas of this research are in conditions known as eye fatigue and eye accommodation.

- ➔ **Eye fatigue** (known medically as “Asthenopia”) can manifest as eye strain, blurring and diplopia (also called double vision—a disorder of vision in which two images of a single object are seen because of unequal action of the eye muscles).
- ➔ **Eye accommodation**, a critical function of the eyes, is the process by which the eye changes optical power to focus on a particular object as the viewing distance varies. The natural loss of accommodation as we age is called “presbyopia.”

An extensive series of human clinical trials have shown that Natural Astaxanthin has positive benefits for both of these conditions and their accompanying symptoms. All of these studies have been conducted in Japan, where researchers as well as nutritional supplement companies have embraced Astaxanthin to a much greater degree than in most other countries. These clinical trials, along with some others in related areas I'll review later, have established a critical mass of evidence indicating that Natural Astaxanthin is the most diverse nutrient yet discovered to support eye health.

Like most of the human research I'll cite in this book, the first clinical trial for eye health was a state-of-the-art investigation—randomized, double-blind and

placebo-controlled. After four weeks of supplementation with 5mg of Astaxanthin per day (extracted from *Haematococcus* algae meal) the authors reported that 46% fewer subjects suffered from eye strain compared to the placebo group. They also found that the Astaxanthin group showed higher accommodation amplitude (the adjustment in the lens of the eye that allows it to focus) when using visual display terminals (Nagaki et al., 2002).

Another study examined Natural Astaxanthin's effects on eye fatigue. This study tested two different dosage levels. Results showed positive effects at 4mg per day, but found a better result at 12mg per day (Nakamura et al., 2004). This study showed that the optimum dose was somewhere above 4mg per day, but could not determine the minimum effective dosage. (Much of the research since then has centered on 6mg per day as the optimum dose for eye health.)



Computer Vision Syndrome (CVS) affects about 90% of people using computers for over three hours per day. Fortunately, Mother Nature has provided Astaxanthin to help combat CVS.

This study established that at least 6mg per day is the optimal dose for eye fatigue and accommodation amplitude (Nitta et al., 2005).

A study the following year corroborated these results. This was a crossover study (a study in which individual subjects receive different treatments within the study) which concluded that taking 6mg of Natural Astaxanthin per day has the effects of reducing and preventing eye strain and accommodative dysfunction

Another group of researchers found similar results in their own human clinical study. This double-blind study was done to evaluate Astaxanthin's effect on eye fatigue as well as visual accommodation. Forty subjects were divided into placebo and treatment groups, with the treatment group receiving 6mg of Astaxanthin for four weeks. The results: three separate visual measures showed statistically significant benefits from Astaxanthin supplementation. This

(Iwasaki et al., 2006). This study was particularly interesting because it showed both a prophylactic as well as a therapeutic potential for Astaxanthin for eye conditions such as fatigue and accommodation. In other words, besides being able to *prevent* eye strain and fatigue and improve accommodation, Natural Astaxanthin also showed a capacity to *reverse* these conditions in people already afflicted.

Astaxanthin's preventive role was further documented in a clinical study done on subjects whose eyes were healthy, with no signs of fatigue or strain. Both the treatment and the placebo groups in this study were subjected to heavy visual stimuli to induce eye fatigue, and it was found that the treatment group recovered more quickly (Takahashi and Kajita, 2005). These last two studies show us that it's not just about treatment, but also prevention: Natural Astaxanthin can keep eye fatigue from occurring in healthy people and help the eyes to recover better from intense visual stimuli.

To summarize, our modern lifestyles of desk work, computer use and television viewing are particularly hard on the eyes. These practices lead to tired, sore eyes that don't focus well and may even reach a level of blurred or double vision. All of these conditions may be prevented or improved by supplementing with 6mg of Natural Astaxanthin each day.

In addition to its positive effects on eye fatigue, strain and accommodation, Astaxanthin has demonstrated other diverse benefits for eye health: Studies have shown that 6mg per day of Natural Astaxanthin supplementation for four weeks can reduce eye soreness, dryness and blurred vision (Shiratori et al., 2005; Nagaki et al., 2006).

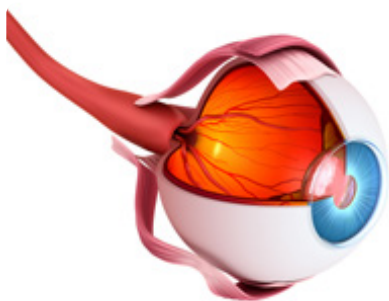
Diversity of Human Clinical Research

A very different kind of eye study was also done in Japan. This study employed a subject pool comprised of 20-year-old, healthy men. The subjects were randomly separated into a placebo group or a treatment group who were given 6mg of Natural Astaxanthin per day for four weeks. Statistically significant improvements were found in two different parameters—visual acuity (the ability to see fine detail) and depth perception. The difference in depth perception was particularly dramatic:

a 46% improvement in the group that took Natural Astaxanthin (Sawaki et al., 2002).

Improvement in visual acuity was found in an older group of subjects as well. This study took 49 healthy volunteers who were over the age of 40 and tested for improvements in visual function at 2mg, 4mg or 12mg per day as compared to placebo. At the end of a 28 day period, the groups taking the 4mg and 12mg doses were found to have statistically significant improvements in both visual acuity and accommodation time. No improvements were found in the placebo group or the 2mg per day group (Nakamura et al., 2004).

It is essential to have sufficient blood flow to the eyes and the retina to ensure they are healthy and functioning properly. A human clinical study examined the ability of Astaxanthin to improve retinal capillary blood flow. Eighteen subjects were given 6mg per day of Natural Astaxanthin and another 18 subjects were given a placebo. After four weeks the Astaxanthin group had improved retinal capillary blood flow as compared to the placebo group (Yasunori et al., 2005).



Astaxanthin helps ensure steady blood flow to the eyes to keep them healthy.



Want to be able to read that bottom line? Make sure you're taking Natural Astaxanthin every day!

Natural Astaxanthin affects not only the volume of blood flow to the retina but also the speed at which that flow occurs. In a double-blind study, healthy volunteers were randomly divided into a placebo group and a group that was given 12mg of Natural Astaxanthin per day for four weeks. The study examined Astaxanthin's effect on blood flow to the vascular layer of the eye. The speed of this blood flow increased significantly in subjects taking Astaxanthin (Saito et al., 2012).

For the Scientists

(A quick review of some excellent supporting pre-clinical studies)

Besides the rodent studies from the 1940s and 1950s and the University of Illinois research by Dr. Tso that I reviewed at the start of this section, a wide range of additional animal studies have demonstrated Astaxanthin's diverse effects for the eyes.

- Astaxanthin protects the vascular layer of the eye in mice and may be a potential therapy for age-related macular degeneration. In this unique study, it was found that Astaxanthin can reduce damage caused by abnormal growth of blood vessels in the eyes (a condition that can result in macular degeneration). The authors concluded that Astaxanthin may provide a therapeutic strategy for macular degeneration (Izumi-Nagai et al., 2008).
- Astaxanthin has been shown to reduce high blood pressure in the eyes. Rats with elevated pressure in the retina that were fed Astaxanthin were found to have three distinct benefits: reduced inflammation, reduced protein oxidation levels, and perhaps most significant of all, reduced cell death (Cort et al., 2010).
- Astaxanthin inhibits oxidative stress and may be developed as an antioxidant drug to treat diabetic retinopathy (Dong et al., 2013).
- Astaxanthin protects retinal cells against

Astaxanthin and Cataracts

Cataract research has been conducted with three very different animal species—two studies in rats and one each in salmon and chick embryos:

- Prevention of cataracts in rats was linked to Astaxanthin's strong antioxidant effect (Wu et al., 2002).
- In a similar study, Astaxanthin was successful in preventing the formation of cataracts in rats (Liao et al., 2009).
- Astaxanthin also protected against the formation of cataracts in chick embryos (Ishikawa et al., 2015).
- In a fascinating study done at Norway's National Institute of Nutrition and Seafood Research, Astaxanthin and Vitamins C & E prevented the formation of cataracts in salmon while pro-oxidants such as iron, copper and manganese increased the incidence of cataracts (Waagbo et al., 2003).

oxidative stress in mice and in-vitro (Nakajima et al., 2008).

- The first study proving Astaxanthin's broad-spectrum anti-inflammatory activity was done in rats' eyes. The researchers showed that Astaxanthin dose-dependently reduces three different inflammatory markers (Ohgami et al., 2003).
- Astaxanthin protects against eye inflammation in rats (Suzuki et al., 2006).
- Astaxanthin protects against ganglion cell death due to various stressors in rat retinal cells (Yamagishi and Aihara, 2014).
- Astaxanthin protects against light-induced retinal damage in mice (Otsuka et al., 2013).
- Mice treated with Astaxanthin eye-drops showed improvement in their resistance to UV-induced eye damage (Lennikov et al., 2012).

A study in pigs found that Astaxanthin performed better than glutathione (an antioxidant produced by the pig's own bodies) in protecting the lens from oxidative damage (Wu et al., 2006).

In conclusion, we've learned that:

1. Astaxanthin can get through the blood brain and blood retinal barriers.
2. Most diseases of the eye are caused by oxidation and inflammation.
3. Astaxanthin is a powerful antioxidant and a broad-spectrum anti-inflammatory.
4. Astaxanthin has demonstrated its effectiveness for eye health in multiple ways.

Taken together, these four points make a strong argument that Natural Astaxanthin is an excellent nutrient to protect our eyes. And the variety and depth of the human clinical research backs it up: Natural Astaxanthin has been shown to have beneficial effects in diverse areas such as eye fatigue, eye accommodation, visual acuity, depth perception and blood flow to the retina. Based on this, I hope readers understand why I consider Natural Astaxanthin the most versatile nutrient for the eyes and why I recommend daily supplementation with at least 6mg each day as a preventive and potentially therapeutic measure to maintain optimum eye health.

*“The
Healthy
Ten” #4*

Safeguarding the Command Center

The brain is the command center for everything that happens to us—it controls vital processes that transpire throughout the entire body. Keeping the brain healthy as we get older is critical to our well-being during the aging process. And as we’ve seen from the huge increase in the incidence of Alzheimer’s disease and other cognitive ailments over the last few decades, maintaining good brain function is emerging as a principal health issue of the 21st century.



Protecting our body’s most vital organ is imperative for good health.

As with other organs in our bodies, there are two primary enemies of the brain that can wear it down over time and decrease performance: inflammation and oxidation. Brain tissue is highly susceptible to oxidation because it’s mostly composed of fat—approximately 60%. (As my friend Dr. Bill Sears says, “We’re all really just a bunch of fatheads.”) In the absence of effective antioxidants, fatty tissue is essentially defenseless when exposed to free radicals.

Furthermore, the brain processes a phenomenal quantity of biochemical activities, which creates a steady flow of free radicals. Brain tissue is the hardest-working tissue in our bodies—amazingly, the brain uses 25% of the energy from the food we ingest although it only accounts for approximately 2% of our body weight (or in my case, maybe 1%).

The blood-brain barrier can weaken as we get older, thus allowing more unwanted molecules to enter our brains. This can include neurotoxins that are harmful to brain cells. What we need as a preventive “brain tonic” as we age is a safe anti-inflammatory and a strong antioxidant, and both of these must be able to cross the blood-brain barrier. Ideally, this substance should also protect our brains

on a cellular level—by reducing DNA damage and protecting the mitochondria that power our cells. This would be the perfect protective combination for brain cells. As you already know, this is pretty much the description of Natural Astaxanthin. And there have been over 50 medical research studies in this area—in-vitro experiments, pre-clinical animal trials, as well as double-blind, placebo-controlled human clinical studies—that make a clear case for Astaxanthin as a superb brain health supplement.

Trends in Neurological Health

While modern medicine has lessened the impact of many life-threatening conditions, things are moving in the wrong direction when we consider the increase in neurological disorders in recent decades. Of particular concern is the devastating neurological condition known as Alzheimer's Disease.

Alzheimer's Association, 2017

- Alzheimer's is now the sixth leading cause of death in the USA, with over 5 million Americans currently affected.
- Since the year 2000, deaths from heart disease decreased by 14%, while deaths from Alzheimer's increased by 89% in the USA.
- One out of every three senior citizens dies from Alzheimer's or another form of dementia (Alzheimer's Association, 2017).

In an excellent journal article in “Public Health,” Colin Pritchard, a Professor of Psychiatric Social Work, analyzed recent death trends from neurological disorders in ten developed economies. He found a sharp increase in people less than 74 years of age suffering from dementia and neurological-related deaths, which was in direct contrast to significant reductions in deaths from other causes. The US led the way with an increase in neurological deaths of 66% in men and 92% in women from the year 1979 to the year 2010. Dr. Pritchard believes that environmental and societal changes are the root cause of what he refers to as an “epidemic.”

Pritchard et al., 2013

Considering the changes over the last 30 years—the explosion in electronic devices, rises in background non-ionizing radiation-PC's, microwaves, TV's, mobile phones, road and air transport up four-fold increasing background petrochemical pollution, chemical additives to food, etc., there is not one factor, rather the likely interaction between all these environmental triggers... While cancer deaths are down substantially, cancer incidence continues to rise; levels of asthma are unprecedented; the fall in male sperm count—the rise of auto-immune diseases—all point to lifestyle and environmental influences. These 'statistics' are about real people and real families, and we need to recognize that there is an “epidemic” that clearly is influenced by environmental and societal changes (Pritchard et al., 2013).

Does this sound familiar? In the discussion about increased levels of oxidation in the modern world, I pointed out this exact trend and the same root cause: There are unprecedented levels of oxidation in our bodies in today's world—far more than our grandparents ever experienced—due to our environment and changes in how we live. It's clear that we're at higher risk of oxidative- and inflammatory-related maladies in modern life, and from what Dr. Pritchard put forward, it's also clear that this is having a particularly strong effect on brain health.

The Clinical Trials

There are five clinical studies to date showing Astaxanthin's positive influence on brain health: The first three were done on age-related issues, while the last two are extremely promising for people of all ages.

Age-Related Decline in Cognitive and Psychomotor Functions. The first study involved elderly subjects with age-related forgetfulness. After first establishing safety at dosages ranging from 4mg per day up to 20mg per day in a general pool of healthy adult volunteers, the researchers focused on the older subjects who were experiencing forgetfulness due to their advanced age. These patients

were given a *Haematococcus pluvialis* algae extract equivalent to 12mg of pure Astaxanthin per day over the course of 12 weeks. Promising results were found related to Astaxanthin's neuroprotective activity. The researcher's conclusion was that "efficacy for age-related decline in cognitive and psychomotor function was suggested" (Sato, 2009).



Astaxanthin has been documented in three human clinical trials to help with brain health issues associated with aging.

Improvement in Marker of Dementia. The second study was a state-of-the-art research project: a randomized, double-blind and placebo-controlled clinical trial in human volunteers. This study tested a key marker for dementia: phospholipid hydroperoxides. "Phospholipid hydroperoxides accumulate abnormally in the erythrocytes of dementia patients, and dietary xanthophylls (polar carotenoids such as Astaxanthin) are hypothesized to prevent their accumulation."

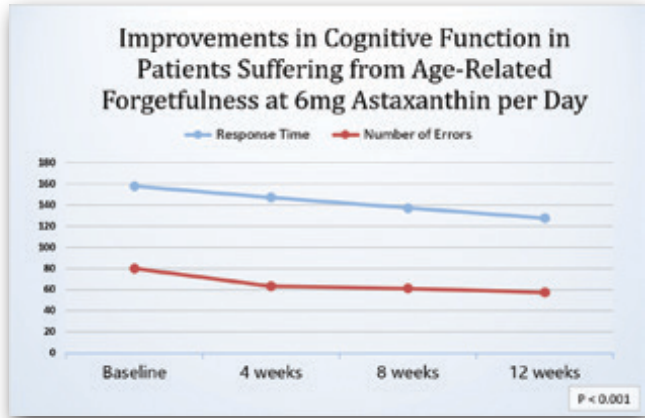
The researchers randomly separated 30 subjects into three groups: Group A was supplemented with 6mg per day of Astaxanthin; Group B was supplemented with 12mg per day of Astaxanthin; and Group C was given a placebo. The supplementation period lasted 12 weeks.

At the end of the trial, at either 6mg or 12mg daily Astaxanthin dosages, subjects were found to have decreased levels of phospholipid hydroperoxides in their erythrocytes and in their plasma. The study concluded: "These results suggest that Astaxanthin supplementation results in improved erythrocyte antioxidant status and decreased phospholipid hydroperoxide levels, which may contribute to the prevention of dementia" (Nakagawa et al., 2011).

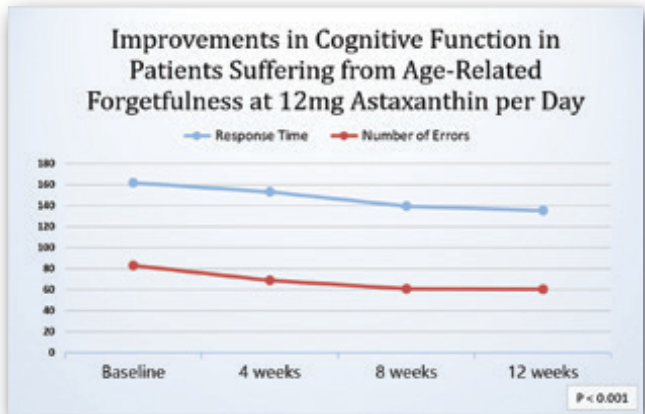
Improvement in Cognitive Function in Elderly Subjects. The subjects in this study were healthy people (who were either middle-aged or elderly) who complained of age-related forgetfulness. The number of subjects was impressive: A total of 96 people were randomly assigned to take either placebo, 6mg of Natural Astaxanthin per day, or 12mg of Natural Astaxanthin per day. The study duration was 12 weeks; however, tests were performed every four weeks during the study. The tests included blood work, urine screens as well as cognitive assessments such as the

Groton Maze Learning Test and CogHealth.

The 12mg dose appeared to work somewhat better than the 6mg dose. After 12 weeks, the CogHealth battery score improved in the 12mg group. Improvements were noted earlier in the Groton Maze Learning Test in both Astaxanthin groups (as compared to the placebo group). The authors concluded, “The results suggested that Astaxanthin-rich *Haematococcus pluvialis* extract improves cognitive function in healthy aged individuals” (Katagiri et al., 2012).



Astaxanthin led to steady improvement in cognitive function. Subjects who took Astaxanthin were able to perform cognitive tests faster and with fewer errors.



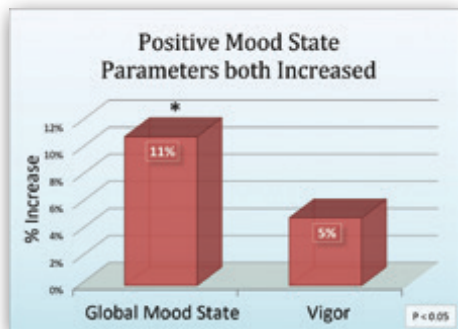
Both 6mg and 12mg doses resulted in significant improvements.

Improvement in Mental and Physical Fatigue. One of the leading complaints doctors hear nowadays is fatigue. Many people often feel tired, both mentally and physically. A recent study looked at how Natural Astaxanthin can affect both kinds of fatigue. This double-blind study was done over eight weeks with a total of 39 subjects. The treatment group received 12mg per day of Astaxanthin along with 20mg of tocotrienols (a component of natural Vitamin E), while the control group supplemented with only 20mg of tocotrienols. To measure mental fatigue, subjects

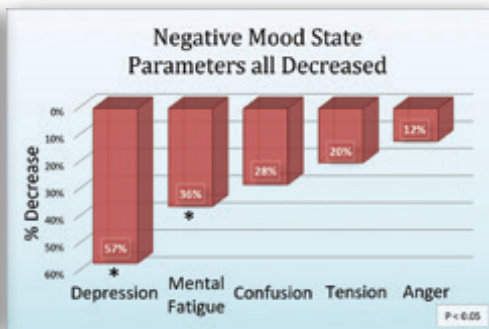
underwent a variety of timed calculations (known as the Uchida-Kraepelin test) which require a high level of concentration. The physical fatigue measurement used a bicycle ergometer. (The conditions for this study were designed to simulate the fatigue and stress faced in daily life.) The perceived symptoms of both mental and physical fatigue were significantly reduced in the Astaxanthin group (Hongo et al., 2016). While earlier research had shown potential for Astaxanthin to reduce physical fatigue, this was the first study to show a reduction in mental fatigue, indicating a promising brain health benefit for Astaxanthin consumers.

Improvement in Mood State in Healthy Runners. Astaxanthin's positive brain effects are not confined to cognitive functions—it may also improve mood. The participants in this study were amateur athletes (with an average age of 42) who were training for a half marathon race. The experimental group took 12mg per day of Astaxanthin over an eight-week period, while the control group took placebos. Half of the subjects were male and half were female. This study was done using AstaZine® Natural Astaxanthin and was sponsored by Algae Health Sciences.

As anyone who participates in sports knows, how you feel mentally is just about as important as how you feel physically. As you'll learn in a later section of this chapter, the physical benefits of Astaxanthin for athletes are already well-documented. The lead researcher of this study, Shawn Talbott, PhD, wanted to see if Astaxanthin could also help these amateur athletes improve their mental state. The results were striking—improvements in many different mood state parameters were found.



- ✓ *Global Mood State increased by 11%*
- ✓ *Vigor increased by 5%*



- ✓ *Depression decreased by 57%*
- ✓ *Mental Fatigue decreased by 36%*
- ✓ *Confusion decreased by 28%*
- ✓ *Tension decreased by 20%*
- ✓ *Anger decreased by 12%*

AstaZine® did remarkably well in improving the mood state of these runners. In particular, the decreases in depression by 57% and in mental fatigue by 36% were extremely impressive. This is the first study of its kind on Astaxanthin and a patent is now pending.

The potential ramifications of this research are considerable: In addition to the established improvements in physical parameters for athletes, Natural Astaxanthin may help athletes mentally as well. And although this study was done on one specific group (healthy runners), the results may very well extend to the general population as well (Talbot et al., 2017a).

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

Besides the five brain health studies in humans described above, there are almost 50 pre-clinical trials in animals and in-vitro that further substantiate the human research. There are far too many to cover in any degree of depth in this book, so I'll describe a few of the most relevant studies in some level of detail and then quickly summarize results from several others.

Protecting Brain Cells from Oxidation. Back in 2009, two researchers from Japan's Nagoya University hypothesized that since Astaxanthin is a powerful antioxidant that can cross the blood-brain barrier, it should protect neuronal cells against oxidation. They treated neuronal cells with two different oxidative agents and measured the results without Astaxanthin and again with a pre-treatment of Astaxanthin. Significant protection was found in the cells pre-treated with Astaxanthin. "The neuroprotective effect of Astaxanthin is suggested to be dependent upon its antioxidant potential and mitochondria protection; therefore, it is strongly suggested that treatment with Astaxanthin may be effective for oxidative stress-associated

neurodegeneration and a potential candidate for natural brain food” (Liu and Osawa, 2009).

Memory Improvement in Mice. The Chinese Academy of Sciences found excellent results for memory improvement in mice fed Astaxanthin. They fed mice Natural Astaxanthin for 30 days and tested them in a water maze with the goal of finding a safe place on an insulated platform. The mice were separated into four different groups: three with different dosage levels of Astaxanthin and one as a placebo control. The mice fed Astaxanthin at each dosage remembered the location of the safe platform, while the mice given the placebo were more likely to forget the original location. The summary stated: “These results indicate that *Haematococcus pluvialis* powder is associated with dose-dependent memory improvement and that a low dosage of algal powder is really good for improving memory” (Zhang et al., 2007). This study was done on strong, healthy mice as compared to aging or neurologically impaired animals. If this animal research turns out to be applicable to humans, the implications for scientists, doctors, professionals, students and just about everyone else is truly exciting. After all, who wouldn’t benefit from a better memory?

Parkinson’s Disease. At University of Pittsburgh’s School of Medicine, a group of scientists tested Astaxanthin’s therapeutic potential in a mouse model of Parkinson’s disease as well as in vitro. In both cases, positive results emerged. In vitro, Astaxanthin inhibited the production of intracellular reactive oxygen species and reduced cytotoxicity in human neuroblastoma cells. In the Parkinson’s mouse model, Astaxanthin protected against neuronal cell death. “These data indicate that Astaxanthin may provide a valuable therapeutic strategy for the treatment of progressive neurodegenerative diseases such as Parkinson’s disease” (Lee et al., 2011).

Alzheimer’s Disease. The potential for therapeutic benefits in the brain are not limited to Parkinson’s disease. Two studies found prospective benefits for Astaxanthin in the treatment of Alzheimer’s disease as well. In 2010, scientists at Hungkuang University in Taiwan found that Astaxanthin can protect neurons in several different ways, including suppressing approximately 75% of reactive oxygen species and inhibiting or completely eliminating different inflammatory markers. “Conclusively, Astaxanthin may have merit to be used as a potential neuron protectant and an anti-early-stage Alzheimer’s disease adjuvant therapy” (Chang et al., 2010). A different group of researchers also concluded that Astaxanthin may be useful for the treatment

of neurodegenerative diseases like Alzheimer's after showing a variety of positive effects such as resistance to brain cell death (Wen et al., 2015).

Brain Effects of Diabetes. Diabetes adversely affects many organs in the body including the brain. It causes inflammation and a condition that has been described as accelerated brain aging. Research on diabetic mice given Astaxanthin found beneficial effects on cognitive function. Mice fed Astaxanthin had significantly increased neuronal survival. In a water maze test, Astaxanthin helped the mice improve in three different measurable ways—by increasing the distance they swam, increasing the time spent in the target quadrant, and decreasing the latency to reach the goal. “Overall, the present study implied that Astaxanthin can improve cognition by protecting neurons against inflammation injury” (Zhou et al., 2015). Other studies by different research teams found related results in diabetic rats. The first study showed that Astaxanthin improved results in the water maze test, reduced blood glucose levels, reduced inflammation and oxidative stress levels and protected brain cells (Xu et al., 2015). The most recent study demonstrated that Astaxanthin reduces cognitive decline in rats with Type-2 diabetes (Li et al., 2016).



Both rats and rabbits were protected from early brain injury and showed less oxidative stress when ingesting Astaxanthin (Zhang et al., 2014).

- A study using a mouse model found potential for Astaxanthin to reduce depression-like symptoms and attributed this to its anti-inflammatory activity (Jiang et al., 2016).
- Astaxanthin was found to dose-dependently improve neurological metrics in mice subjected to traumatic brain injury (Zhang et al., 2016).
- Astaxanthin helps rats recover from early brain injury by inducing

antioxidant and detoxifying enzymes (Wu et al., 2014).

- Astaxanthin reduced brain cell death in rats fed a substance to induce brain damage (Wang et al., 2016).
- Astaxanthin protects brain cells from the damaging effects of alcohol and may be effective for preventing neurotoxicity associated with excessive alcohol consumption (Yan et al., 2016).
- A university study in Brazil showed that Astaxanthin dose-dependently reduced cortical spreading depression (an underlying cause of migraines) in rats subjected to chronic alcohol consumption (Abadie-Guedes et al., 2008).
- A study on a human neuroblastoma cell line showed that Astaxanthin can prevent cell death, leading to the researchers' hypothesis that it may be of use for treating diseases such as Parkinson's (Ikeda et al., 2008).
- Neuron loss due to epilepsy was reduced by Astaxanthin in the hippocampus of rats (Lu et al., 2015).
- Astaxanthin improved spatial memory and increased the genesis of neuron cells in mice (Yook et al., 2016).
- Researchers at the Federal University of Sao Paulo in Brazil noted that many neuronal dysfunctions and conditions such as anxiety and depression are related to different brain regions being subjected to oxidative stress. They found that Astaxanthin could restore normal oxidative conditions in plasma and positively affect the forebrains of rats (Mattei et al., 2011).

I mentioned Dr. Paula Bickford in Chapter 2. She is the professor who brought the health-giving properties of blueberries to the public eye based on her research. Dr. Bickford just released her first study on Astaxanthin: a mouse model of Parkinson's disease. Results showed a variety of benefits:

- Prevents neuron loss after exposure to a neurotoxin
- Reduces microglial response to a neurotoxin
- Increases the antioxidant glutathione
- May be acting as both an antioxidant and anti-inflammatory to combat neurotoxins
- Conclusion: "Astaxanthin is a promising therapeutic agent for the treatment of Parkinson's disease" (Grimmig et al., 2017)

- Scientists at the Gifu Pharmaceutical University in Japan found that Astaxanthin supplementation reduces anxious behavior in mice (Nishioka et al., 2011).
- Tested against other carotenoids for protection of rat neural cells, Astaxanthin came out the strongest. In analyzing the different metrics used, the researchers pointed out that Astaxanthin protected cells in four different ways and declared: “Our results conclusively show that Astaxanthin has merit as a potential neuron protectant” (Chang et al., 2013).
- Autism is a neurological condition that has been diagnosed with increasing frequency over the last few decades. A study in 2015 created a model of human autism in mice. After administering Astaxanthin to these mice, the authors concluded that “Astaxanthin improves the impaired behavior in an animal model of autism presumably by its antioxidant activity” (Al-Amin et al., 2015).

The United States’ National Institute on Drug Abuse conducted a study on rats with ischemic brain injury (caused by blocked blood flow to the brain). Results showed that Astaxanthin can reduce ischemia-related injury in brain tissue through the inhibition of oxidative stress, reduction of glutamate release, and antiapoptosis (prevention of cell death). The researchers concluded that Astaxanthin may be clinically useful for patients vulnerable or prone to ischemic events (Shen et al., 2009).

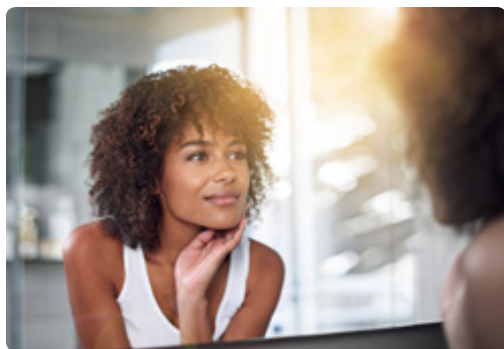
In conclusion, three human clinical studies have indicated that Astaxanthin has great potential for aging brains in areas including forgetfulness, age-related decline in cognitive function, psychomotor function and dementia. In addition, there is budding research showing that Astaxanthin may help improve mood state and reduce mental fatigue. Along with evidence from approximately 50 pre-clinical trials and considering Astaxanthin’s multi-pronged cellular protective properties, these human studies argue that people concerned with protecting their brains should strongly consider supplementing with at least 6mg and preferably 12mg of Natural Astaxanthin each day.



Beauty-from-Within and Skin Health

Who would think that swallowing a small capsule every day could make you more beautiful? Or that the same pill may help protect your skin's health and possibly even work as an internal sunscreen? We mentioned some famous people who use Astaxanthin to help their skin in Chapter 2: Actress Gwyneth Paltrow and super-model Heidi Klum both take Natural Astaxanthin capsules for their internal beauty effect. Pop icon Madonna eats Astaxanthin-rich wild salmon for her skin's health and appearance. Meanwhile, the world's most famous dermatologist, best-selling author Nicholas Perricone, MD, writes about Astaxanthin for skin health in his books and talked about it on the Oprah Winfrey show. What do all of these people know that most people don't?

I'm sure you're probably thinking, "How is it possible that you can take a small capsule internally and it can improve your skin's appearance from the inside out?" This seems unbelievable, particularly when we consider that for years, cosmetic marketers have aggressively promoted creams and lotions to improve skin health and appearance through topical application. The idea of an "Internal Beauty Pill" seems like something from an old Star Trek episode. (In fact, it was



*Improve your skin from the inside
out with Natural Astaxanthin.*

the subject of a Star Trek episode from 50 years ago.) Yet, as incredible as it may seem, Astaxanthin has already been documented to serve as an Internal Beauty Pill in human clinical research. Fortunately, many people are discovering the key to skin health starts from the inside.

How is Astaxanthin able to help skin from the inside out? Astaxanthin is an extremely potent

antioxidant as well as a safe and natural anti-inflammatory. When an Astaxanthin capsule is ingested, it has been documented to get throughout the entire body. Over the period of about one to two months of daily use, Astaxanthin concentrates in our blood, our muscles, in organs such as eyes, brains, hearts and livers, as well as in the body's largest single organ—the skin. As it concentrates in these organs, it protects them on a cellular level against oxidation, inflammation, and damage to DNA and to the cells' mitochondria. The outcome for skin: Natural Astaxanthin improves our skin's appearance by protecting skin cells against UV damage and aging, and by enhancing the cells' health status. Astaxanthin protects against photo-aging which occurs when UV light penetrates deep into the skin's dermis layer. This photo-aging causes wrinkles, age spots, inflammation (sunburn) and cellular damage. By preventing UV damage and photo-aging, Astaxanthin is helping improve the appearance and quality of the skin while, at the same time, preserving skin health.

Skin Health Benefits of Natural Astaxanthin

The potential benefits of Natural Astaxanthin for skin are multifold, as evidenced by a great variety of research. They can be separated into three distinct categories:

- ➔ **Internal Beauty Pill.** First of all, the daily internal consumption of 4mg of Natural Astaxanthin can improve the appearance and the quality of skin in four to six weeks.
- ➔ **Skin Health Defender.** Secondly, Astaxanthin has demonstrated potential not only to improve the appearance and quality of the skin, but to improve the health of the skin as well.
- ➔ **UV Protector.** The last benefit is actually closely related to the first two: After Astaxanthin has had time to accumulate in the skin, it has a protective effect against the ongoing ravages from ultraviolet light exposure.

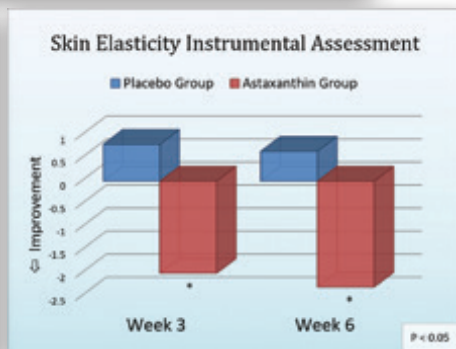
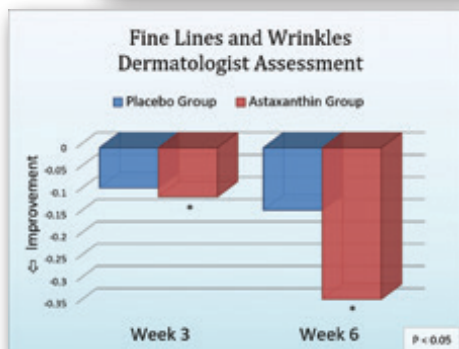
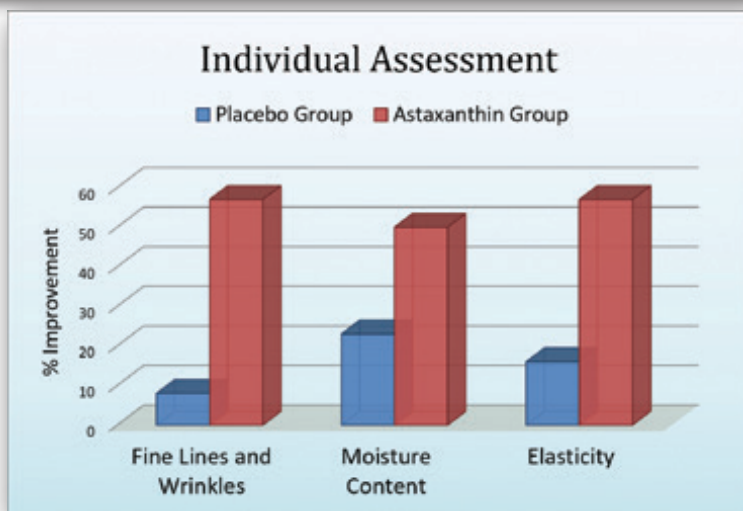
Internal Beauty Pill

A landmark clinical trial done in the USA in 2006 reported that Natural Astaxanthin has several different benefits for skin quality and beauty. In this study, 49 middle-aged women were divided into two matched groups based on several factors including their skin type, age and measurement of skin parameters such as moisture levels. The subjects in the treatment group took 4mg of Natural Astaxanthin per day and the other group took a similar-looking placebo. The study was conducted over six weeks. Skin parameters were measured at the beginning of the study, in the middle (after three weeks) and at the end of the study (after six weeks). One of the most impressive factors in this study is how varied and thorough the measures were:

- ✓ Skin surface was photographed before and after supplementation and the photos were published within the study.
- ✓ Fine lines and wrinkles were inspected by a dermatologist.
- ✓ Skin elasticity and skin dryness were also inspected by the dermatologist.
- ✓ Skin elasticity was measured using Dermalab® (an instrument used for skin analysis).
- ✓ Skin moisture content was measured using Dermal Phase Meter 9003™ (another skin analysis instrument).
- ✓ Subjects answered a Yes / No Questionnaire at the end of the study that assessed their subjective perception of:
 - Fine lines and wrinkles
 - Elasticity
 - Roughness
 - Dryness
 - Moisture content

On every one of these measures, the results showed an advantage for the Astaxanthin-treated group, leaving no doubt that Natural Astaxanthin supplementation had made these women's skin more beautiful and healthy.

- In the self-assessment questionnaire, over 50% of the subjects taking Natural Astaxanthin rated improvements in all areas.
- Dermatologist assessment found improvements in all three areas tested: fine lines and wrinkles, elasticity and dryness.
- Dermatological clinical instruments recorded improvements in both parameters tested: moisture content and elasticity.
- Before and after photos showed visible improvements in fine lines, wrinkles and elasticity.



Many different tests. Many different results. One conclusion: Natural Astaxanthin made these women's skin more beautiful and healthier.

This study found that as an internal beauty pill, Natural Astaxanthin fights wrinkles, improves skin elasticity, increases skin moisture levels and reduces visible signs of UV-aging within four to six weeks of use (Yamashita, 2006). Put simply, Natural Astaxanthin improves skin quality and helps maintain a youthful appearance.

Additional human clinical studies bear out these results. A group of researchers from Japan combined two separate human clinical trials into a single publication. In one study, they tested internal Natural Astaxanthin supplementation at 6mg per day in men, while in the other study they examined the effects of a combination internal/external Astaxanthin program in women. Both of these studies featured a variety of measurements using dermatological instruments.

The study with male subjects was randomized, double-blind and placebo-controlled, with 36 volunteers participating. The men in the treatment group took 6mg of Astaxanthin each day for six weeks. At the end of six weeks, several statistically significant results were noted.

- Reduced volume ratio of all wrinkles
- Reduced area ratio of all wrinkles
- Increased skin elasticity of crow's feet area
- Improved transepidermal water loss (this is the quantity of water that passes through the skin to the surrounding atmosphere)
- In addition, two parameters showed a tendency toward improvement:
 - Skin moisture levels of the cheeks increased
 - Sebum oil in the cheeks increased



In clinical trials, Natural Astaxanthin has been clinically validated to improve skin appearance and quality in both men and women.

The study with female subjects was an open-label study involving 30 healthy adult volunteers for eight weeks. The treatment regimen combined 6mg per day

oral supplementation and 2 ml per day topical application of a Natural Astaxanthin solution. Significant improvements were found on several measures.

- Deepest point of the deepest wrinkle decreased.
- Mean depth of the deepest wrinkle decreased.
- Maximum width of the deepest wrinkle decreased.
- Mean depth of all wrinkles decreased.
- Skin elasticity of crow's feet area improved.
- Visual age spots were reduced.
- Visual rough skin improved.
- Mean depth of skin texture decreased.
- Total area of corneocyte (the outermost part of the epidermis) increased.
- Additionally, in ten of the subjects who started with dry skin, a significant increase in skin moisture levels was found.

It's interesting to note that both the internal study and the combination internal/topical study yielded a variety of statistically significant results. The women's study lasted two weeks longer than the men's study and took the "inside/outside" approach, yielding stronger positive effects in a larger variety of beauty and skin health parameters. Because there were two major protocol differences between the men's and the women's studies (the additional two weeks and the topical application of Astaxanthin), we cannot be sure which caused the greater variety of positive results. Most likely, both of these factors helped. (We've already seen that oral Astaxanthin alone results in visual skin improvement, and we'll see later in this section that topical Astaxanthin alone also leads to skin improvement.) The researchers' final verdict: "In conclusion, these results suggest that Astaxanthin derived from *Haematococcus pluvialis* can improve skin condition in all layers such as the corneocyte layer, epidermis, basal layer and dermis" (Tominaga et al., 2012).

The Synergistic Effect of Astaxanthin

Four different human clinical trials have each shown that Astaxanthin can work in tandem with other natural ingredients to improve the beauty of the skin from the inside out. The first was a placebo-controlled study done in Japan. It combined Natural Astaxanthin with an excellent natural derivative of Vitamin E called “tocotrienols.” Astaxanthin was used at 2mg per day and tocotrienols at 40mg per day. The capsules were given to women aged 38 - 42 with dry skin. This study was conducted over only four weeks, yet excellent results were found in the treatment group including an increase in skin moisture levels, improved skin elasticity and a reduction in fine wrinkles and pimples (Yamashita, 2002).

Astaxanthin also worked in combination with collagen on 44 subjects who were fed 2mg per day of Astaxanthin and 3gm per day of collagen hydrolysate versus a group that received only placebo over the course of 12 weeks. Several different parameters showed statistically significant improvements.

- Elasticity of facial skin
- Hydration of facial skin
- Appearance of new collagen fibers
- Reduced inflammatory markers (Yoon et al., 2014)

A product was developed in Switzerland as an internal beauty formula featuring 5mg of Natural Astaxanthin in each capsule along with omega-3 fatty acids, marine proteins, natural tocopherols and plant flavonoids. When tested, the treatment group experienced continuous and significant improvement over the three-month course of the study. Before-and-after photos showed visible improvement in the skin's appearance and reduction of fine wrinkles. Additionally, an increase in dermis density of up to 78% was found in the treatment group (Beguín, 2005).

Lastly, a study done in Canada on a product containing Astaxanthin along with omega-3 fatty acids and marine glycosaminoglycans showed benefits for both skin hydration and skin elasticity (Thibodeau, 2004).

Skin Health Defender

All of the studies cited above contained skin health components. For example, skin moisture levels and skin elasticity are key components of skin health. So I've already covered some of the human clinical evidence that Natural Astaxanthin helps defend skin health. (There will be more human evidence in the UV and topical sections below.) But there are some very encouraging pre-clinical studies as well:

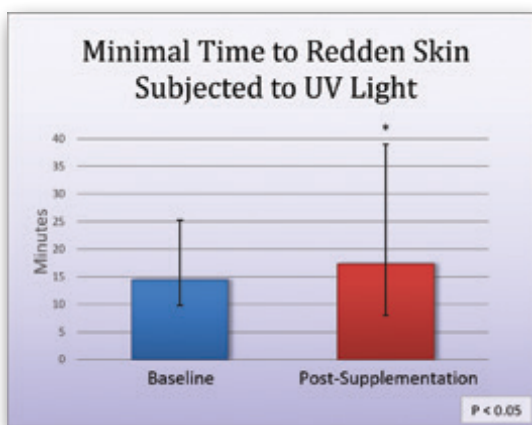
- Natural Astaxanthin was found to be more effective than Synthetic Astaxanthin in inhibiting skin cancer in rats. In fact, the natural forms tested were effective in reducing UV-induced tumor incidence by 96% and 88%, while the synthetic form attained only 66% reduction. Other markers tested were also more positive in the Natural Astaxanthin groups. The researchers hypothesized that “the better anti-cancer potency of Natural Astaxanthin could be due to increased bioavailability” (Rao et al., 2013).
- Astaxanthin showed anti-cancer potential in a mouse study which used UV radiation to induce carcinogenesis. This study tested two other carotenoids in addition to Astaxanthin. The results showed that, while both Astaxanthin and beta-carotene helped prevent cancer, lycopene had no effect (Black, 1998).
- A study was published last year on atopic dermatitis, a common chronic inflammatory skin disease that is caused by several different factors such as allergic reactions or immunological abnormalities. Due to Astaxanthin's known anti-inflammatory activity, researchers in Japan tested its effects in a mouse model of atopic dermatitis. After 26 days of supplementation, the mice in the treatment group showed significant improvements in all 10 factors tested (Yoshihisa et al., 2016).

Astaxanthin was shown to reduce DNA damage in skin cells. Since DNA damage is commonly considered a root cause of carcinogenesis, the researchers theorized that Astaxanthin may be useful in preventing the formation of skin cancer (Lyons and O'Brien, 2002).

- Lastly, in a promising cell study, researchers chose Natural Astaxanthin from a variety of antioxidants as the likeliest candidate to repair oxidative stress-induced skin damage. This study compared the effects of Natural Astaxanthin with doxycycline (a common antibiotic) and found that Astaxanthin is a better alternative for collagen production (Chou et al., 2016).

UV Protector (and Internal Sunscreen?)

A US patent for the use of Astaxanthin as an internal sunscreen was awarded in 2002 (US Patent #6,433,025, 2002). The company that holds this patent sponsored a clinical trial to test if Natural Astaxanthin can increase the amount of time it takes for UV light to cause sunburn. This trial dosed subjects at 4mg per day and lasted for only two weeks. Yet, at the end of this very short supplementation period, subjects taking Astaxanthin showed a statistically significant increase in the amount of time it took to cause erythema (reddening of the skin or sunburn). This is especially promising at this low dose and for such a short period of time—it would be interesting to see what results larger doses over longer trial periods would yield (Lorenz, 2002).



Natural Astaxanthin showed effectiveness as an internal sunscreen in a human clinical trial.

The mechanism of action for how Astaxanthin prevented sunburn was not established in this trial. The logical answer would be its anti-inflammatory function: sunburn is inflammation of the body's largest organ—the skin. When UV light penetrates to the skin's dermis layer, it creates inflammation which manifests as reddening. Earlier in this chapter, you read that Astaxanthin can reduce eight

different inflammatory markers. By reducing inflammatory markers in the skin, Astaxanthin decreases sunburn and skin damage.

Pre-clinical research also has shown that Astaxanthin can effectively protect skin from the ravaging effects of UV exposure. There have been several studies on UV exposure and the end result of this exposure, which is photo-aging. An early study using hairless mice measured the effects of Astaxanthin as well as beta-carotene and retinol in preventing UV damage. Astaxanthin performed better than beta-carotene either by itself or in combination with retinol. In fact, it was extremely proficient at preventing photo-aging of the skin (Savoure et al., 1995).

In addition, Astaxanthin was found to protect skin cells from UV-induced oxidative stress. In fact, a study demonstrated in vitro that Astaxanthin is 100 times stronger than beta-carotene and, remarkably, 1000 times stronger than lutein in protecting cells against UVA light-induced oxidative stress! (O'Connor and O'Brien, 1998). (The studies above are only some early examples demonstrating Astaxanthin's action as a UV protector. Many subsequent studies have corroborated these early findings.)

Hot Off the Presses: Astaxanthin Prevents Weather-Related Skin Deterioration

A brand new study on skin has just produced a novel finding. The study was done in Japan over the course of four months as weather got colder and dryer. Starting in August and ending in December, 65 healthy female subjects took either 6mg or 12mg of Natural Astaxanthin or a placebo each day.

This human study was preceded by an in-vitro survey of epidermal-dermal interactions. The findings of the in-vitro analysis showed that Astaxanthin suppressed UVB-induced inflammatory cytokine secretion.

In the human phase, women who took



*Women taking
Natural Astaxanthin
showed no worsening
of skin quality from
winter weather.*

the placebo had significantly more wrinkling and lower skin moisture content, while the Astaxanthin groups showed no significant skin deterioration. “In conclusion, our study suggests that long-term prophylactic Astaxanthin supplementation may inhibit age-related skin deterioration and maintain skin conditions associated with environmentally induced damage via its anti-inflammatory effect (Tominaga et al., 2017).

Topical Effects of Astaxanthin

Based on several studies, it appears that Astaxanthin works not only as an internal beauty pill, but also as a topical ingredient for skin health and beauty.

- ✓ In a human clinical trial, Astaxanthin applied topically to skin showed a wrinkle-reducing effect (Taisuke et al., 2001).
- ✓ In research done at Japan's Kose Corporation, Astaxanthin was compared to other common cosmetic ingredients that are used to protect skin from sun damage. The researcher's conclusion was that Astaxanthin shows greater potential than the other ingredients against premature signs of aging (Arakane, 2001, 2002).
- ✓ In a study done on hairless mice that were irradiated with UVB to induce photo-aging, researchers tested Astaxanthin's effects on wrinkle formation, skin elasticity, collagen fiber bundles and the level of MMP-1 (matrix metalloproteinase-1) activity. The results indicated that Astaxanthin exhibits a high level of protection against photo-aging as a reactive oxygen species scavenger (Mizutani et al., 2005).
- ✓ Astaxanthin used topically on mice and in vitro exhibited properties indicating that it may be effective in treating patients with allergic skin conditions (Kim et al., 2015).
- ✓ An Astaxanthin liposome product applied topically

prevented UV-induced skin damage and inhibited melanin production (Hama et al., 2012).

- ✓ Finally, a fascinating study in mice showed that eye drops with Astaxanthin prevented UV damage to the eyes (Lennikov et al., 2012).

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

- Astaxanthin successfully protected against UV-induced inflammation by decreasing inducible nitric oxide and the Cox-2 enzyme in vitro. This helped in reducing the death of skin cells (Yoshihisa et al., 2014).
- In a recent study, Astaxanthin successfully inhibited damage from both UVA and UVB and suppressed the secretion of “wrinkle-inducing cytokines” (Nakajima et al., 2016).
- Hyper-pigmentation can be an unsightly problem as we age, especially when it manifests as age spots. In a model of skin pigmentation done in Japan, Astaxanthin was found to dose-dependently inhibit pigmentation due to stem cell factor-associated stimulation. In fact, at the highest dosage, Astaxanthin was found to almost completely inhibit this pigmentation (Nakajima et al., 2012).
- Astaxanthin was found to prevent

Researchers proclaimed Astaxanthin to be “a new candidate for a potent anti-pigmenting substance that avoids the risk of hypopigmentation” (Imokawa and Ishida, 2014). In other words, unlike other potent anti-pigmenting agents used to prevent age spots that may lead to loss of skin color, Astaxanthin can help prevent increased pigmentation of the skin without the risk of losing normal skin color.

photo-aging better than other carotenoids such as beta-carotene and canthaxanthin in vitro. (Camera et al., 2009).

- An in-vitro study of human skin cells concluded: “We hypothesize that Astaxanthin would have a significant benefit on protecting against UVA-induced skin photo-aging such as sagging and wrinkles” (Suganuma et al., 2010).

In conclusion, clinical evidence points strongly to Natural Astaxanthin’s ability to improve skin appearance and health from the inside out. A single human study showed that it may also work as an internal sunscreen. Meanwhile, several pre-clinical studies support these benefits as well.

Because there is only one human clinical study on Astaxanthin as an internal sunscreen, it is premature to recommend it in this area; however, there is already sufficient clinical research to recommend with confidence that people who want to improve their skin’s appearance and health should supplement with 4mg to 6mg of Natural Astaxanthin each day.



Energy, Strength, Performance, Endurance and More: 12 Ways Astaxanthin Can Help Athletes and Active People

Q: Which one of these benefits can athletes get from Natural Astaxanthin?

- a. Faster results in races
- b. Improved recovery from exercise
- c. Increased strength
- d. Decreased heart rate during distance training
- e. Overall increased endurance
- f. Improved mood state
- g. Reduced muscle and joint soreness after exercise

A: All of the Above!

In recent years, Astaxanthin is becoming the supplement of choice for many athletes, particularly endurance athletes. Marathon runners, long distance cyclists, triathletes, distance swimmers and other athletes looking for an advantage are finding out for themselves that the answer to the above question is, indeed, “All of the Above.” (It’s not just salmon anymore that use Astaxanthin to get stronger and increase their endurance.)

The leading sports drink brand in USA is Gatorade®. Gatorade sponsored a clinical study on competitive cyclists to see if Natural Astaxanthin could improve their performance. Guess what? These highly trained athletes got 5% faster and increased their power output by 15% on average in just one month at the lowest commonly recommended dose of 4mg per day.

Think about this for a minute. Can you imagine if a bronze medal Olympic runner or swimmer could get 5% faster in a month by taking one small capsule each day? They'd move from the bottom step on the podium to the top at the awards ceremony and they'd be listening to their own national anthem instead of someone else's. Even based only on this one study, I think that every athlete owes it to themselves to give this natural tool a try to see what it can do for their performance.

And it's not just this one study that shows how Astaxanthin can help athletes. There have been 12 different human clinical trials demonstrating a variety of benefits specifically applicable to athletes and active people.

The Athletes' Dozen

12 Ways Natural Astaxanthin Can Help Athletes and Active People

1. Prevent muscle (physical) fatigue
2. Reduce mental fatigue
3. Improve recovery after exercise
4. Increase strength and power output
5. Improve performance in timed racing events
6. Decrease heart rate during endurance training
7. Reduce joint and muscle soreness after exercise
8. Enhance energy metabolism
9. Improve endurance
10. Reduce lactic acid levels after exercise
11. Help prevent muscle damage and inflammation
12. Reduce exercise-induced free radical production

What is driving all of these potential benefits? You probably guessed the answer: Astaxanthin's intense antioxidant power and its broad spectrum anti-inflammatory activity. Both of these attributes are critical to Astaxanthin's benefits for athletes. Physical exertion is known to generate a tremendous increase in reactive oxygen species (ROS). As far back as 1978, researchers suggested that physical exertion creates damage to muscle tissue as a result of free radical proliferation. The increase in ROS occurs during both the contraction and resting of muscles. Intense exercise over a long training session can result in oxidative damage to both lipids and proteins in the body. "Interestingly, low and physiological levels of reactive oxygen species are required for normal force production in skeletal muscle, but high levels of reactive oxygen species promote contractile dysfunction resulting in muscle weakness and fatigue" (Powers and Jackson, 2008). A powerful, effective antioxidant such as Natural Astaxanthin can scavenge these high levels of ROS in our bodies and prevent weakness and fatigue.

As an anti-inflammatory, Natural Astaxanthin can also make a big difference for athletes in preventing muscle damage and reducing joint and muscle soreness after exercise, thus allowing for better training with less down time. Recovery after exercise is a huge concern for athletes, and Astaxanthin's anti-inflammatory activity can help promote quicker recovery and help reduce overuse injuries. Once again, we see that this perfect combination of antioxidation and anti-inflammation works magic.

"The Athletes' Dozen" **12 Clinical Trials Showing Benefits** **for Athletes and Active People**

When I first started taking Astaxanthin 17 years ago, very little was known about how it might benefit athletes and active people. But since then, 12 solid human studies have been done along with dozens of supporting pre-clinical trials. (In fact, this "Athletes' Dozen" is actually a baker's dozen—13 for the price of 12. I've combined two studies by the same group of researchers into one section since they both show essentially the same result.) I'll review each of the human studies and then look at

some of the best pre-clinical trials (including a substantial mass of research on how Astaxanthin supports the part of cells that generates energy—the mitochondria).



#1

“The Athletes’ Dozen”

Gatorade® Sponsored Study Finds Competitive Cyclists Became Faster with Higher Power Output. When a company like Gatorade pays to do a study on how an ingredient affects competitive athletes, you can bet that they are fairly certain of the outcome before making the investment. Gatorade looked at the existing research on Astaxanthin as the world’s strongest natural antioxidant and as a broad spectrum anti-inflammatory, and they reviewed the earlier human trials

on athletes, and then decided to sponsor the study I described in the opening of this chapter to see if Natural Astaxanthin could make competitive cyclists faster and stronger. As expected, it did just that.

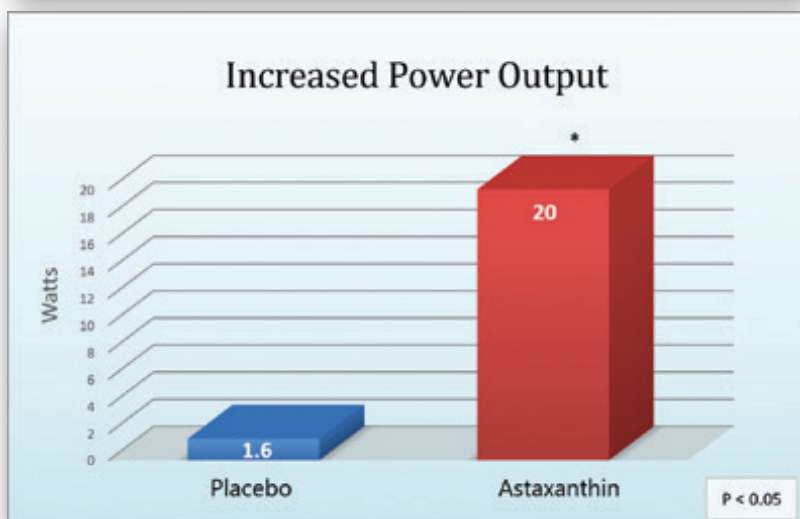
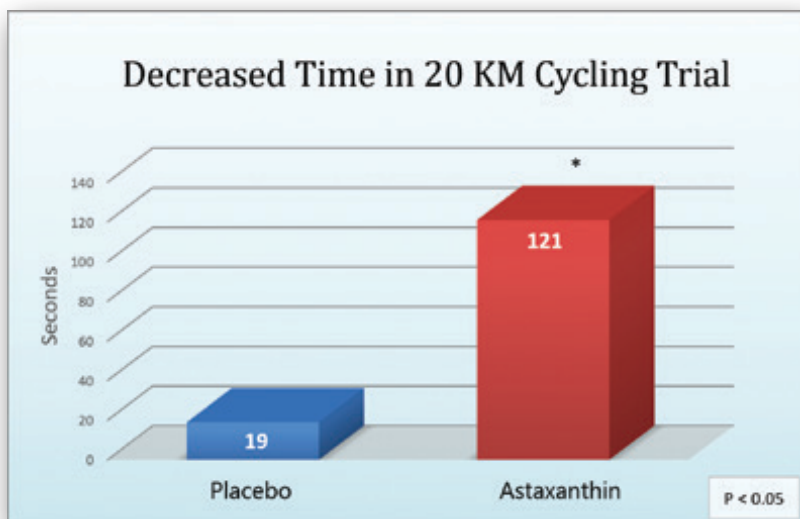
This study lasted only four weeks, a relatively short time for Astaxanthin to concentrate in the bodies of the athletes and improve their race times. It also was done at the very minimum dose generally recommended by Astaxanthin experts: 4mg per day. The researchers tested the cyclists in a 20-kilometer (about 12.5-mile) time trial before the supplementation began and again at the end of four weeks of supplementation. We must keep in mind that these were not average people, but highly trained, competitive athletes. Even marginal improvement from a supplement regimen after just four weeks would be an important result in this particular group of subjects.

At the end of four weeks, the placebo group showed no significant improvement in their cycling times. But the cyclists taking Natural Astaxanthin were on average 5% faster. In addition, their power output increased by 15% (Earnest et al., 2011). In just



Gatorade’s study wasn’t on weekend warriors; it was on highly-trained, competitive cyclists.

four weeks and at the very lowest recommended dosage, Natural Astaxanthin made these competitive cyclists significantly faster and stronger. (To really understand how much of a difference Astaxanthin can make to athletes, future research should explore supplementation for longer durations and at higher dosages.)



Faster and stronger from one little capsule: In a Gatorade-sponsored study using competitive cyclists, just 4mg of Astaxanthin per day improved racing time by 5% and power output by 15%.



#2

“The Athletes’ Dozen”



Astaxanthin helps soccer players’ muscles recover faster.

Muscle Inflammation and Recuperation in Elite Soccer Players. This study looked at the effect of 4mg per day Astaxanthin supplementation on young elite soccer players in Europe. The study was randomized and placebo-controlled and spanned 90 days of supplementation. Shane Starling, a leading supplement industry journalist, summed up the results very well.

Shane Starling

They gave 4mg of Astaxanthin daily to 40 young, trained soccer players and found via plasma testing better results for the Astaxanthin group in inflammation, immune system function and muscle recuperation...the researchers said the study showed Astaxanthin ‘attenuates muscle damage, thus preventing inflammation induced by rigorous physical training’ (Starling, 2015).

In their conclusion, the researchers hypothesized that the mechanism of action may be that Astaxanthin “protects the cell membranes against free radicals generated during heavy exercise, thus preserving the functionality of muscle cells” (Baralic et al., 2015).



#3

“The Athletes’ Dozen”

Reduced Free Radical Production in Elite Soccer Players.

I’m condensing two separate clinical trials into one for #3 of the Athletes’ Dozen. That’s because both were done by the same group of researchers as the study cited above, and the results essentially corroborated each other. The researchers had conducted two preliminary human clinical trials before starting on their breakthrough study. The first of these preliminary studies found that 90 days of supplementation with

Astaxanthin reduces free radical production after intense two-hour long exercise. The conclusion stated that “Supplementation with Astaxanthin could prevent

exercise-induced free radical production and depletion of non-enzymatic antioxidant defense in young soccer players” (Djordjevic et al., 2012). The second study also showed that Astaxanthin supplementation led to improvement in oxidative status (Baralic et al., 2013).

This series of studies on young elite soccer players demonstrates far-ranging benefits for athletes, from improvement in cellular health to reduction in inflammation and oxidation to optimizing muscle function and preventing muscle damage. The implications extend to all athletes engaged in heavy physical exertion and endurance sports.



Increased Strength and Endurance Improvement in Healthy, Young Men.

This was the first study ever done on Astaxanthin's effects on strength and endurance. (The Swedish researchers who conceived this study might have been thinking of salmon when they designed this clinical trial.) They tested young, healthy men to see if Astaxanthin would have the same effect on strength and endurance in our species as it does in salmon. They had the men do



Deep knee bends until exhaustion: an effective way to measure both strength and endurance.

deep knee bends until exhaustion. Again, the study featured a very low dose of Astaxanthin—only 4mg per day—but fortunately the study lasted six months, so the Astaxanthin had time to concentrate throughout the treatment group's bodies. Results showed that strength and endurance in the Astaxanthin group increased by 54.8% in six months. The placebo group also showed improvement of

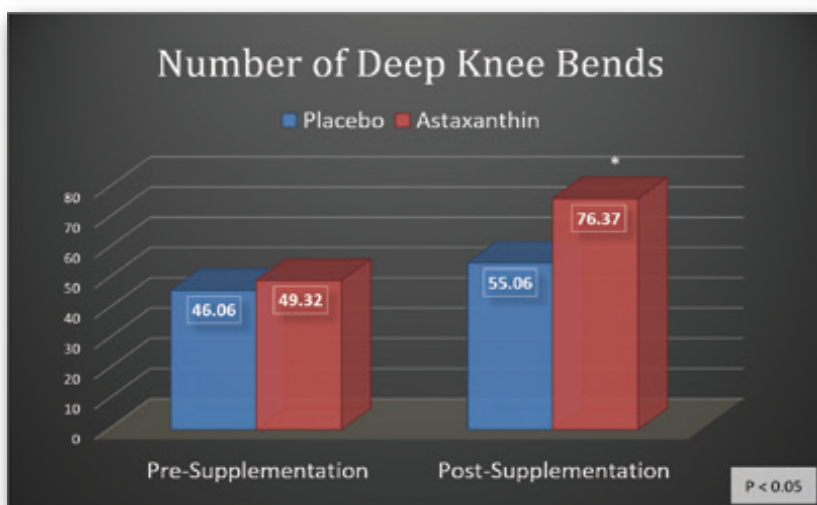
19.5% (which is normal for young people who are participating in sports over a six-month period). This is a stunning difference—strength and endurance increased almost three times faster in the young men taking Astaxanthin compared to the placebo group. The summary stated:

Malmsten and Lignell, 2008

The marked improvement in strength/endurance would seem very interesting, since it cannot be explained by improved fitness (step-up test) or improved lactic acid tolerance (Wingate test). Furthermore, since there was no significant increase in body weight, an increased muscle mass cannot be used to explain this positive effect. Because of this, Astaxanthin seems to have the beneficial effect on strength/endurance.

This is the first study in humans to show that Astaxanthin supplementation has a positive effect on physical performance. The result of this study is supported by earlier findings that Astaxanthin supplementation in mice increases swimming time before exhaustion, and that biomarkers of muscle fatigue decrease in humans after exercise due to Astaxanthin supplementation.

Further studies need to be designed to find the explanations to the mechanisms behind the increased muscle endurance. It can be hypothesized that Astaxanthin protects the membrane structures of the cells, like the mitochondrial membrane, against oxidative stress generated during heavy exercise and thereby preserves the functionality of the muscle cells (Malmsten and Lignell, 2008).



Young men taking 4mg of Astaxanthin per day improved their strength and endurance almost three times faster than those taking placebo.



#5

“The Athletes’ Dozen”



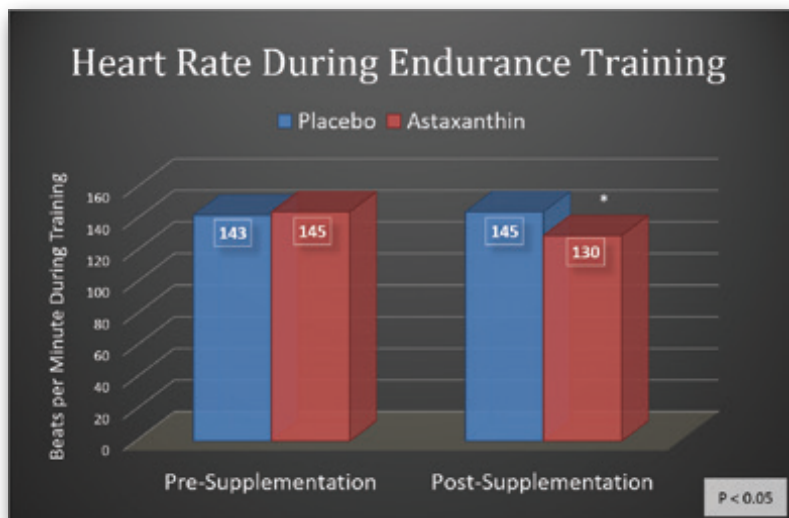
Long distance athletes are gravitating to Astaxanthin for its endurance benefits.

Decreased Heart Rate During Endurance Training. In a landmark study that has implications for both athletes and anyone concerned with heart health, researchers sponsored by Algae Health Sciences tested AstaZine® Natural Astaxanthin on trail runners. These were amateur athletes who were training for a half marathon (as compared to the elite athletes in the Gatorade cyclist and European soccer player studies). The group of 28 subjects was comprised of half men and half women. They were randomly assigned to receive 12mg of AstaZine per day or placebo for eight weeks. This was a state-of-the-art study: double-blind, placebo-controlled, randomized with a parallel design.

Heart rate during training was tested before and after the 8-week course of supplementation. The Astaxanthin group had an average decrease in heart rate of 10% by the end of the study. This decrease was found at sub-

maximal endurance intensities (in other words, when running long distance as compared to sprinting). When interviewed by a leading supplement trade journal “NutraIngredients USA”, the head researcher (Shawn Talbott, PhD) explained, “The subjects in this study were able to perform the same amount of ‘work’—but at lower cardiovascular ‘strain’ after supplementing with Astaxanthin.” The authors concluded, “These results suggest that Natural Astaxanthin may be a beneficial ergogenic aid for long/ultra-distance endurance athletes, but not necessarily for athletes competing in shorter, high intensity efforts. In addition, these data are also suggestive of a general ‘cardiotonic’ effect of Natural Astaxanthin that should be investigated in non-athletic populations including elderly subjects and those with cardiac complications including post-myocardial infarction, heart failure, statin usage, mitochondria dysfunction, chronic fatigue and related conditions” (Talbott et al., 2017b).

While there are many studies indicating cardiovascular benefits from Astaxanthin (which you'll learn about in the very next section), this is the first study showing that Natural Astaxanthin can reduce heart rate. (A patent for this unique application has been submitted as of the writing of this book.)



AstaZine® Natural Astaxanthin reduced heart rate by 10% in runners during endurance training.



#6

“The Athletes’ Dozen”

Recovery from Exercise. A randomized, double-blind, placebo-controlled crossover study in Japan measured recovery from exercise in healthy volunteers. They had both the placebo and the Astaxanthin groups do progressively greater loads in a stepwise exercise. Again, the dosage was low (5mg per day), and remarkably, the study duration was extremely short (2 weeks).



Faster recovery means quicker results.

For the subjects taking Astaxanthin, metabolism during exercise became more efficient, respiratory-circulatory ability improved, fatigue decreased, and antioxidant profiles increased. These results led the researchers to conclude that recovery ability from exercise stress may be improved by taking Astaxanthin. Additional benefits were found through blood analyses: the Astaxanthin group had significantly less LDL cholesterol in their bloodstream and significantly higher creatine phosphokinase (Nagata et al., 2003).



Improvement of Energy Metabolism. This double-blind crossover study was done by the same researchers as the study just described above. The volunteers had to run on a treadmill until they reached 70% of maximum heart rate. Again, the study lasted only two weeks, yet improvements in energy metabolism were found in the Astaxanthin group (Tajima and Nagata, 2004).



Reduction of Physical and Mental Fatigue. This study, which I described earlier in the Brain Health section, is all about energy. The study was designed to simulate the fatigue and stress that we all face in daily life (conditions that are among the most common complaints to doctors currently). Astaxanthin reduced both physical and mental fatigue significantly (Hongo et al., 2016). (For more information, please see page 137.)



Astaxanthin may help fend off physical and mental fatigue—a huge advantage in sports.



#9 “The Athletes’ Dozen”

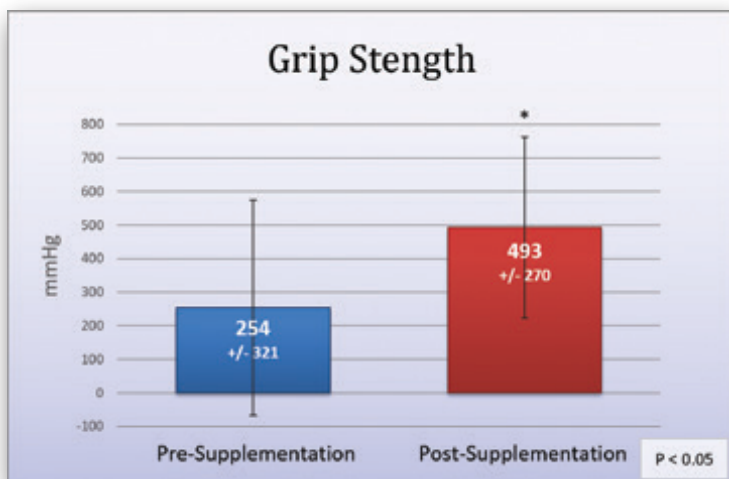
Increased Strength in Patients Suffering from Tendonitis.

The final four studies in “The Athletes’ Dozen” all involve inflammatory conditions such as sore joints, tendons and muscles. I reviewed each of these in detail starting on page 107 in the anti-inflammatory section, but I’ll touch on each of them again since they are particularly applicable to athletes.

The study in patients with tennis elbow illustrates just how much Astaxanthin can do for athletes suffering from overuse injuries. The eight-week study at 12mg per day found an astounding 93% increase in grip strength in the Astaxanthin group. The authors concluded that using Natural Astaxanthin may alleviate pain and increase mobility. “This improvement may greatly improve the standard of living for those who suffer from such joint disorders” (Spiller et al., 2006b).



Tennis elbow is very common in people who spend several hours per week playing tennis due to the repetitive motion.



Sufferers of tennis elbow almost doubled their grip strength on average after eight weeks taking Astaxanthin.



#10

***“The Athletes’
Dozen”***

Reduced Muscle Fatigue from Lactic Acid Buildup During Exercise. Lactic acid builds up during physical exertion and causes fatigue and burning in the muscles. A four-week study at 6mg per day showed that men taking Astaxanthin had 28.6% lower lactic acid levels than the placebo group after running 1200 meters (Sawaki et al., 2002).



Decreasing lactic acid levels in the muscles reduces soreness and improves recovery time to enable a quicker return to training.



#11

***“The Athletes’
Dozen”***

Prevention of Joint Soreness After Exercise.

Young men doing weight training took placebo or 4mg per day of Astaxanthin for three weeks. They did intense knee exercises

in a resistance-training apparatus during the treatment period. The young men taking placebo had significant joint pain in their knees immediately after the exercise. This pain was tested again at 10, 24 and 48 hours after the heavy exercise. At every interval up to 48 hours, increased pain levels persisted for the placebo group. But the young men taking Astaxanthin had no additional pain (Fry, 2001).



Both are bad, but joint pain is worse than temporary muscle soreness.



#12

***“The Athletes’
Dozen”***

Prevention of Muscle Soreness After Exercise. The same researcher who conducted the above study found that Astaxanthin prevented muscle soreness after heavy exercise, but only for people whose muscles have high fiber content (Fry et al., 2013). So the benefits of Natural Astaxanthin for muscle soreness appear to be limited to a subset of people, unlike the benefits for joint pain which apply more generally.

In addition to “The Athletes’ Dozen,” related benefits have been demonstrated in Astaxanthin research that would be of particular interest to athletes, for example:

- ➔ **Mood state** benefits found in runners (decreased feelings of depression, confusion, fatigue, tension and anger along with an increased feeling of vigor) can give athletes a mental edge.
- ➔ **Skin health and UV protection** are important to athletes who do much of their training outdoors.
- ➔ **Immune** markers are positively affected by Natural Astaxanthin which can help keep athletes healthy and training hard.
- ➔ **Eye health** benefits are important for many athletes. (In fact, one of the eye studies showing improvements in depth perception and visual acuity was done in handball players, but would be important to participants in many sports.)

Protecting the Cell's Powerhouse

Mitochondria are commonly referred to as the “powerhouse of the cell.” A major function of mitochondria is to produce ATP (adenosine triphosphate) which is known as the “energy currency” of cells. Mitochondria are also responsible for regulating cellular metabolism (Voet et al., 2006). Keeping the mitochondria healthy is essential to maintaining robust energy levels. Fortunately, Astaxanthin may aid in this pursuit: there has been extensive research demonstrating potential benefits for the mitochondria from Astaxanthin supplementation in mammals.

Free radicals (including those resulting from physical exertion) can undermine the mitochondria. An onslaught of free radicals from hard training can shut down the mitochondria’s chief function: energy production. When this happens, people feel tired and muscles can become sore from inflammation. Due to Astaxanthin’s antioxidant and anti-inflammatory activity, mitochondria can continue to function

normally during vigorous exertion, resulting in sustained energy levels. This characteristic makes Astaxanthin an excellent choice not only for athletes and active people, but also for anyone looking for more energy. We saw a demonstration of this energy lift in the physical and mental fatigue clinical trial reviewed above, and it's backed up by many pre-clinical trials:

- Astaxanthin was found capable of protecting the mitochondrial membrane and preventing DNA damage and cell death in vitro in a university study done in Taiwan (Chan et al., 2009).
- In a study done at Washington State University under the auspices of the renowned carotenoid researcher Boon Chew, PhD, Astaxanthin prevented age-related mitochondrial dysfunction in dogs (Park et al., 2013).
- Astaxanthin extended the lifespan of *C. elegans* (a model organism used in longevity studies) by protecting the mitochondria and the nucleus of the cells (Yazaki et al., 2011).
- In a study done at the University of Pittsburgh's School of Medicine, Astaxanthin protected against mitochondrial dysfunction and reactive oxygen species in a mouse model of Parkinson's disease and also in vitro (Lee et al., 2011).
- Cells subjected to heat stress in vitro were protected by Astaxanthin,

Astaxanthin can protect mitochondria that are subjected to oxidative stress. A study done at Japan's Nippon Medical School summarized what is happening in the mitochondria and what it means:

"Mitochondria combine the production of energy with an efficient chain of reduction-oxidation (redox) reactions but also with the unavoidable production of reactive oxygen species. Oxidative stress leading to mitochondrial dysfunction is a critical factor in many diseases, such as cancer and neurodegeneration and lifestyle-related diseases. Effective antioxidants thus offer great therapeutic promise...Astaxanthin at nanomolar concentrations was effective in maintaining mitochondria in a reduced state. Additionally, Astaxanthin improved the ability of mitochondria to remain in a reduced state under oxidative challenge. Taken together, these results suggest that Astaxanthin is effective in improving mitochondrial function through retaining mitochondria in a reduced state" (Wolf et al., 2009).

which the researchers attributed to Astaxanthin's positive effect on the mitochondria (Kuroki et al., 2013).

- In the earliest study on Astaxanthin's effects on mitochondria, researchers at Japan's Kochi Medical School found that Astaxanthin protects the mitochondria of rats better than alpha-tocopherol (Kurashige et al., 1990).
- Several studies have demonstrated Astaxanthin's protective effects on the mitochondria in diverse body organs including:
 - Liver (Ma et al., 2011; Song et al., 2011)
 - Kidneys (Manabe et al., 2008)
 - Heart (Nakao et al., 2010)
 - Brain and central nervous system (Liu and Osawa, 2009; Liu et al., 2009; Lu et al., 2010)

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

- Mice fed Astaxanthin had lower lactic acid levels in their muscles which enabled them to swim significantly longer before exhaustion (Ikeuchi et al., 2006).
- Corroborating the study above, research in rats showed that Astaxanthin can delay physical exhaustion. In fact, it was so effective that the time to exhaustion in a swimming test was delayed by 29% (Polotow et al., 2014).
- A study that was designed to investigate muscle lipid metabolism in mice found positive results that would be of interest to athletes. Mice in the Astaxanthin group had:
 - Longer running time before exhaustion
 - Better muscle lipid metabolism
 - Better fat utilization
 - Reduced fat tissue (Aoi et al., 2008)

- In addition, another study by the same lead researcher found that Astaxanthin can reduce oxidative stress in muscles caused by exercise (Aoi et al., 2014).
- Astaxanthin improved lipid metabolism during exercise in mice. This study also tested inter-muscular pH levels and found that Astaxanthin prevented the normal decrease in pH levels due to exercise. Of particular interest in this study was the finding that the mice fed Astaxanthin had an increase in their muscles of PGC-1 α , which is a key regulator of energy metabolism (Liu et al., 2014).
- Finally, two rodent studies done in Japan have shown that Astaxanthin can prevent muscular atrophy. Muscular atrophy is common due to aging and also in people who have had part of their bodies immobilized in a cast.
 - Muscular atrophy due to aging is known as “sarcopenia.” Oxidation is thought to be a significant contributing factor to age-related sarcopenia. In a rat study done over the course of a year, rats were separated into two groups and fed either an Astaxanthin-enhanced diet or a control diet. The rats fed Astaxanthin had a muscle weight/body weight ratio significantly heavier than the control group. The aging rats’ muscles maintained their size when supplemented with Astaxanthin (Shibaguchi et al., 2008).

Mouse Study Demonstrates Huge Reduction in Muscle Inflammation and Oxidation

I talked about this study in the section on inflammation. Researchers in Japan had mice run on a treadmill until exhausted. Mice that were supplemented with Astaxanthin had 50% reduction in muscle inflammation. They also had less oxidative damage in the two muscles tested (heart and calf) as well as reduced oxidation in their plasma and cell membranes and less damage to DNA. The conclusion pointed out that most carotenoids accumulate in the liver and don’t reach the heart or skeletal muscle, a huge advantage for Astaxanthin over closely-related molecules (Aoi et al., 2003).

- Researchers immobilized rats' muscles by applying casts, and then tested an Astaxanthin diet against a control diet. The conclusion found that "Astaxanthin prevents muscular atrophy by protecting membranes, preventing oxidative stress which results in atrophy and preventing facilitation protease and ubiquitination" (Sugiura et al., 2005).

In conclusion, the wealth of athlete-related studies clearly shows that competitive athletes should take at least 4mg of Astaxanthin each day. To be honest, if I were a competitive athlete, I would definitely take 12mg of Natural Astaxanthin every day. And before a big event, I'd load up for a month with 24mg per day.

At the risk of dwelling on one study, the trial sponsored by Gatorade® is perhaps the most indicative study of what Astaxanthin can mean for athletes: any athletes who would like to improve their racing time by 5% and increase their power output by 15% in just four weeks have a great shot of attaining those goals simply by taking one 4mg Natural Astaxanthin capsule every day—precisely what the results of the Gatorade study indicated. (And if they were to take 12mg each day over a longer term, they would probably have even better results.)

Extrapolating the results of the Gatorade study to other sports—runners and swimmers, soccer and basketball players, even power lifters and boxers—pretty much every athlete would love to get 5% faster and 15% stronger. And every non-athlete who wants more energy, better endurance, quicker recovery from exercise or any of the other "Athletes' Dozen" should also supplement with Astaxanthin every day.



Keeping the Heart Ticking and the Blood Pumping: The Cardiovascular Benefits of Astaxanthin

According to the World Health Organization, approximately one in four people in the world will die from heart disease or stroke. The odds are even worse in the USA where the Centers for Disease Control estimates the figure at one in three. So what should we do to keep our hearts healthy? And how can we measure our cardiovascular health?

For many years, cholesterol levels were viewed as the #1 predictor for developing cardiovascular disease. From about 1980 to 2000, controlling cholesterol levels became the mantra of cardiologists around the world. To this day, most medical doctors still go to great lengths to keep their patients' bad cholesterol (LDL) and triglyceride levels in what they consider a healthy zone. The volume of prescriptions written every year for statin drugs to control cholesterol levels is staggering. (In fact, Pfizer's statin drug Lipitor® is far and away the best-selling drug of all time.)

Yet a few years ago, the American Heart Association made headlines by saying that testing C-reactive protein levels (abbreviated as CRP) may be a better indicator of potential heart disease than testing cholesterol levels. This was based on extensive research from prestigious institutions such as Harvard University (Perry, 2006). (As discussed in the anti-inflammatory section, CRP is a marker in the blood for silent inflammation and has been connected to a host of life-threatening diseases in addition to heart disease.) Fortunately, three human studies have

"Antioxidant and Anti-Inflammatory... Antioxidant and Anti-Inflammatory." By now, I bet many readers are tired of hearing about these two properties which are the foundation of every health benefit I've talked about so far. I apologize if anyone is bored, but it's a fact that these two key attributes lead to all the other paths by which Astaxanthin can help keep us healthy. And in no area are they more relevant than when we discuss cardiovascular health.

already shown that Natural Astaxanthin can reduce CRP. (Please see page 112 for detailed information.)

What many people don't know is that cholesterol, in and of itself, may not be harmful. Even LDL (which is frequently called “bad” cholesterol) is not necessarily bad for you on its own. It's *oxidized* LDL that is really the “bad” cholesterol that can start clogging up your arteries. Excessive free radicals target LDL and cause an autoimmune condition where the immune system begins to attack itself. This creates an inflammatory response which, in turn, is what creates plaque in the arteries. The end result—oxidation and inflammation have caused atherosclerosis. And over time, this condition can lead to a heart attack or stroke.

“An Astaxanthin Capsule Each Day Helps Keep the Cardiologist Away”

Natural Astaxanthin has been shown to help fight the evil twins Oxidation and Inflammation. It can neutralize free radicals before they begin to oxidize LDL cholesterol. It can decrease CRP, the marker for silent inflammation. It has also been shown to decrease overall cholesterol and triglyceride levels in patients with mild hyperlipidemia. It can improve blood flow and, as I talked about in our review of the trail runner study, it may be able to decrease heart rates. All these benefits make Natural Astaxanthin a great friend to your heart.

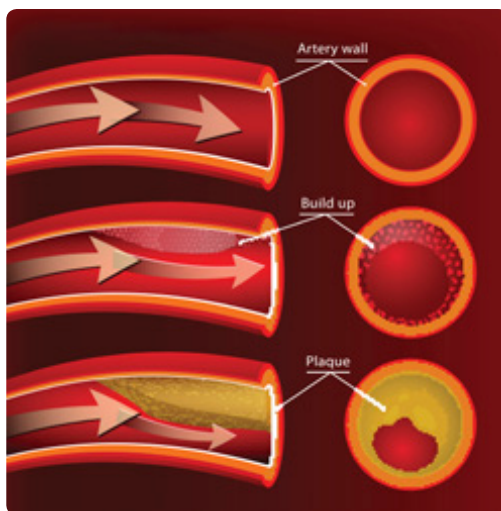
Combatting Cholesterol with Astaxanthin

In addition to the anti-inflammatory and antioxidant studies I reviewed earlier that have cardiovascular implications, there are currently over 40 published medical research studies that document Astaxanthin's cardioprotective properties. These properties may help people prevent heart disease and may also help people with heart disease to minimize their risk of a heart attack or stroke. The main focus of

this research in both humans and other mammals has been on Natural Astaxanthin's ability to improve blood lipid profiles and to prevent oxidation of LDL cholesterol.

Astaxanthin Inhibits Oxidation of LDL Cholesterol. As discussed above, preventing oxidation of LDL is more important for cardiovascular health than lowering cholesterol levels. A clinical trial in Japan found a very promising effect on LDL both in test tubes and in human volunteers. The in-vitro test showed that Astaxanthin dose-dependently prolonged the oxidation lag time of LDL (meaning that oxidation took significantly longer to occur). The test was then repeated in humans: four groups of subjects were administered Natural Astaxanthin for 14 days at doses ranging from 1.8mg per day to 21.6mg per day. This study found that the three highest doses led to statistically significant increases in LDL oxidation lag time:

- At 1.8mg per day, LDL oxidation lag time was 5% longer
- At 3.6mg it was 26% longer
- At 14.4mg it was 42% longer



Oxidized LDL is a key trigger of plaque buildup in the arteries.

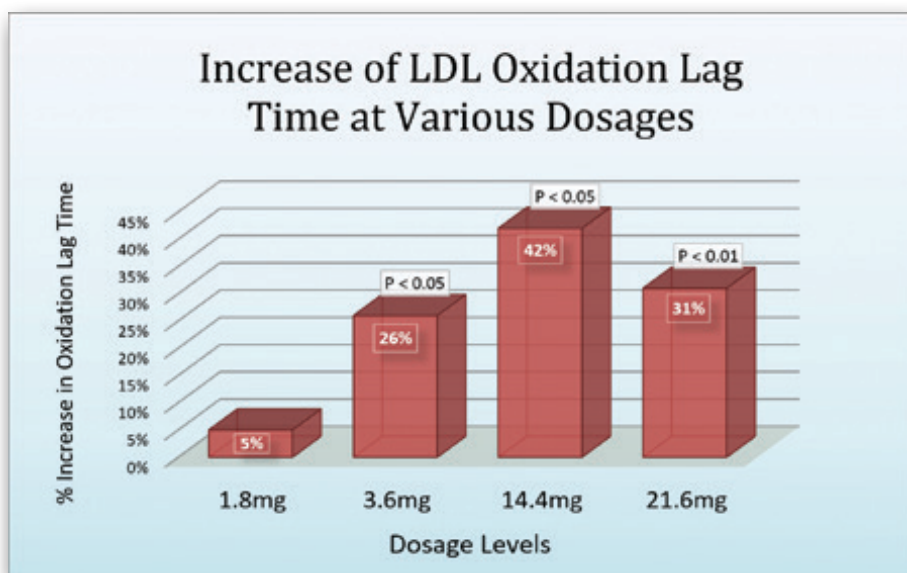
The Best Carotenoid for Cardiovascular Health

A study pitted five carotenoids against each other to see which would be the best at reducing lipid peroxidation in cell membranes. The two carotenoids with the highest pro-oxidant potential (beta-carotene and lycopene) ended up increasing lipid peroxidation. Two xanthophyll carotenoids tested (lutein and zeaxanthin) did not increase peroxidation, but showed a limited ability to decrease it. However, because Astaxanthin is much more potent as an antioxidant and never has a pro-oxidant effect, it caused a whopping 40% reduction in lipid peroxidation in the membrane (McNulty et al., 2008). Once again, Astaxanthin proved itself the “King of Carotenoids.”

- At the highest dose of 21.6mg, the upward trend declined and the lag time was 31% longer.

These data indicate that the optimum dose for quick results is somewhere between 14.4mg per day and 21.6mg per day. The researchers concluded that consumption of Astaxanthin “inhibits LDL oxidation and possibly therefore contributes to the prevention of atherosclerosis” (Iwamoto et al., 2000). A university study from Japan found similar results (Hiroshige, 2004). In both cases, there was no improvement in oxidation of LDL in the placebo groups.

A related study showed excellent results as well. This randomized double-blind, placebo-controlled study was done on healthy young men in Finland at the Research Institute of Public Health to test the effect of Astaxanthin on lipid peroxidation. Subjects in the treatment group were given 8mg of Natural Astaxanthin each day for three months. At the end of the study, the researchers found that Natural Astaxanthin significantly reduced the levels of two fatty acids in the subjects’ blood plasma. The researchers concluded that Astaxanthin may decrease in-vivo oxidation of fatty acids (Karppi et al., 2007).



In just 14 days of supplementation at dosages ranging from 3.6mg per day to 21.6mg per day, Astaxanthin significantly increased the time it took for LDL to oxidize.

Astaxanthin Improves Blood Lipid Profiles. A placebo-controlled human clinical study on 61 volunteers with mild hyperlipidemia showed that Astaxanthin improved blood lipid profiles and also increased adiponectin in the serum. (Adiponectin is a protein involved in regulating glucose levels and breaking down fatty acids.) Various dosage levels were used in different treatment groups (6mg, 12mg and 18mg per day) over a 12-week supplementation period. Results showed improvements in blood lipid profiles at all doses with significantly increased levels of HDL (good) cholesterol and significantly decreased triglyceride levels (Yoshida et al., 2010).

In another human clinical trial done in Eastern Europe, researchers identified men with high cholesterol and supplemented them with 4mg of Astaxanthin per day for one month. The average decrease in cholesterol levels was impressive for such a short period of time: subjects supplementing with Astaxanthin showed an average decrease of triglycerides of 24%, an average decrease in total cholesterol of 16%, and an average decrease of LDL of 17% (Trimeks, 2003).

An exercise study described in the last section also tested LDL levels. This study was done at 5mg per day over two weeks. In addition to finding improvements for fatigue and antioxidant profiles in the Astaxanthin group versus placebo, the researchers also found a significant decrease in LDL levels (Nagata et al., 2003).

Finally, a similar study done in Japan had men averaging 35 years old do an exercise stress test on a treadmill. During the stress test, their heart rate reached 70% of maximum. They found a significant decrease in LDL and concluded that “Astaxanthin may contribute to enhancement of lipid metabolism” (Tajima et al., 2004).



*Keeping your heart healthy
is essential to enjoying
your golden years.*

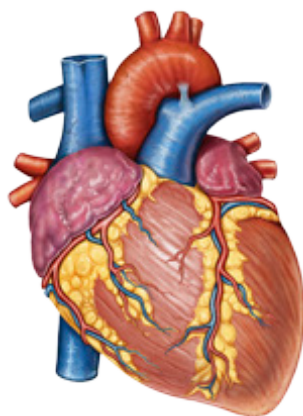
Other Ways Astaxanthin Can Help our Hearts

Besides combatting inflammation, preventing oxidation of LDL and improving lipid profiles, Astaxanthin supports cardiovascular health in other ways. Recent research has demonstrated other mechanisms through which Astaxanthin can help keep the heart ticking and the blood flowing.

Astaxanthin Decreases Blood Pressure. This study was done on post-menopausal women who had high levels of oxidative stress. The dose used in the treatment group was 12mg per day and the study lasted eight weeks. Several different parameters improved, most notably a significant decrease in both systolic blood pressure (which decreased by 5% on average) and diastolic blood pressure (which decreased by 7% on average). The researchers concluded, “Results show that Astaxanthin may enhance antioxidant capacity, reduce lower limb vascular resistance, decrease blood pressure and improve physical symptoms in women with high oxidative stress” (Iwabayashi et al., 2009).

Astaxanthin Increases Blood Flow. In a placebo-controlled trial, researchers gave human volunteers a dosage of 6mg of Astaxanthin per day for only 10 days. At the end of the 10-day period, a significant improvement in blood flow was found in the treatment group (Miyawaki, 2008). This study is noteworthy because blood flow improvement can have a positive effect on different aspects of cardiovascular health, for example by reducing blood pressure and preventing atherosclerosis.

Astaxanthin decreases heart rate during endurance training. I spoke about this study on AstaZine® Natural Astaxanthin in the section on athletes. During long distance running, AstaZine® was effective in lowering heart rate by 10%, allowing the heart to function well without having to work as hard (Talbot et al., 2017b). (For a more detailed discussion, please see page 165.)



Blood pressure, blood flow, heart rate, inflammation, oxidation, cholesterol, CRP—Astaxanthin positively affects numerous cardiovascular factors to help keep the heart pumping.

For the Scientists

(A quick review of some excellent supporting pre-clinical studies)

There are approximately 40 different pre-clinical trials that further validate the research done in humans. Let's review a few of the key studies:

- Researchers at the Kyoto University of Medicine in Japan had mice run on a treadmill until they were exhausted. The treatment group was fed Astaxanthin while the control group was not. At the end of the study, the scientists examined their hearts and found that the mice fed Astaxanthin had significantly less heart damage (Aoi et al., 2003).
- Another study done with rats showed a similar effect. This study was done at the Medical College of Wisconsin. Rats in the treatment group were fed Astaxanthin before inducement of a heart attack. After the study, the hearts of both the control and treatment groups were examined. The researchers found significantly less damage and a reduced area of infarction caused by the heart attack in mice that were fed Astaxanthin (Gross and Lockwood, 2004).

A research group in Japan has done three separate experiments on the effects of Astaxanthin in rodents with high blood pressure.

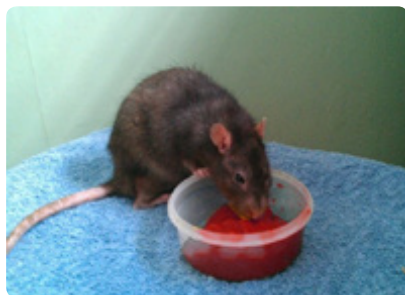
They found that:

- Hypertensive rats who were supplemented with Astaxanthin for 14 days showed a significant decrease in blood pressure, while rats with normal blood pressure levels showed no decrease.
- Stroke-prone rats that were fed Astaxanthin for five weeks had a delayed incidence of stroke and decreased blood pressure.
- Mice with poor blood flow to the brain improved their memory when fed Astaxanthin, probably due to improvement in blood flow and reduced plaque in the arteries to the brain.

The researchers concluded:

- Astaxanthin's mechanism for decreasing high blood pressure may be due to its modulating effect on nitric oxide.
- Astaxanthin may help reduce the consequences of a heart attack.
- Astaxanthin may help with blood fluidity in hypertension.
- Astaxanthin may restore vascular tone.
- "These results indicate that Astaxanthin can exert beneficial effects in protection against hypertension and stroke and in improving memory in vascular dementia" (Hussein et al., 2006; Hussein et al., 2005a; Hussein et al., 2005b).

- Researchers in Italy tested Astaxanthin against three other carotenoids in vitro—lutein, beta-carotene and canthaxanthin—and found that Astaxanthin was the best at inhibiting cholesterol oxidation (Palozza et al., 2008).
- Astaxanthin proved more effective than alpha tocopherol at preventing plaque buildup in the arteries of rabbits with high cholesterol (Li et al., 2004).
- Astaxanthin lowered cholesterol and reduced atherosclerosis in mice (Ryu et al., 2012).
- Astaxanthin prevented clogging of cerebral blood vessels in rats with high blood pressure (Sasaki et al., 2011).
- Astaxanthin demonstrated cardioprotective properties in rabbits with high cholesterol levels (Riccioni et al., 2012).
- Astaxanthin reduced blood pressure and improved cardiovascular parameters in rats with high blood pressure (Monroy-Ruiz et al., 2011).
- Astaxanthin reduced the risk of clogged arteries in dogs (Lauver et al., 2008).
- Astaxanthin prevented damage from stroke in rabbits (Lauver et al., 2005).
- Astaxanthin demonstrated potential against obesity and metabolic syndrome (a leading cause of heart disease) in obese mice fed a high-fat diet (Ikeuchi et al., 2007).
- Astaxanthin showed various cardioprotective properties in rats such as inhibition of stroke, anti-hypertension, and inhibition of vascular contraction (Watanabe et al., 2006).
- Astaxanthin lowered blood pressure in overweight rats (Preuss et al., 2009).
- Astaxanthin reduced blood pressure and improved other cardiovascular parameters in rats with high blood pressure (Fassett and Combs, 2009).



Rodents whose food was supplemented with Astaxanthin showed a variety of heart health benefits.

In conclusion, if I had to pick one study that gets to the essence of how powerful Astaxanthin may be for cardiovascular ailments, I would pick the Harvard Medical School study that examined Astaxanthin's effects on Vioxx®. Vioxx is the prescription anti-inflammatory drug that caused some users to develop cardiovascular disease and heart attacks due to its pro-oxidant effects. Remarkably, the researchers at Harvard found that Astaxanthin completely neutralized Vioxx's pro-oxidant effect. If they had simply added a little Astaxanthin to their drug, the maker of Vioxx could have prevented consumers from getting cardiovascular disease and dying of heart attacks (Mason et al., 2006).

As more cardiovascular research is done and publicized in the media, I hope to see more people employing Natural Astaxanthin as compared to relying solely on synthetic statin drugs. When one considers the published clinical research already available showing Astaxanthin's potential in improving blood lipid profiles, reducing CRP, increasing blood flow, reducing high blood pressure, reducing heart rates and, of course, preventing oxidation of LDL cholesterol, it seems clear that people concerned with the world's #1 killer should strongly consider supplementing with Astaxanthin.



No Colds or Flu for 17 Years! Astaxanthin, The Immune System Modulator

In the first chapter I mentioned that I haven't had a cold or flu since I started taking Astaxanthin. That was 17 years ago. I started taking another microalgae product called Spirulina about a year and a half after starting my Astaxanthin supplementation, but I already felt something had changed during that first year and a half since I went from two or three colds a year down to zero. So I'm inclined to believe that my outstanding immune system function is due to Astaxanthin.

I'm aware that such a dramatic change isn't typical for most Astaxanthin users. However, many people have told me that they get sick less often after starting to take Astaxanthin. And close to 30 medical research studies as well as a consumer survey validate these testimonials. The survey once again proved the 80/20 rule I talked about in Chapter 1.

Survey Says 80% of Consumers Improved Their Immune System with Astaxanthin

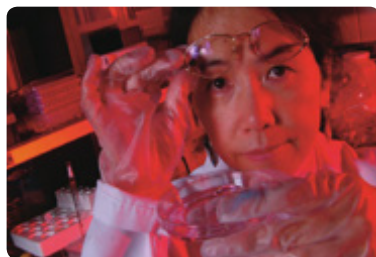
In conducting this survey, a medical doctor, a PhD and I employed an inclusive criterion for "Astaxanthin users." We started by polling 1584 people who had bought at least one bottle of Astaxanthin over the last seven years. Of the 423 people who responded, we disqualified 121 who hadn't used the product for at least a month or were not taking Astaxanthin at least three times per week.

The survey asked respondents to answer "true" or "false" to a series of statements about Natural Astaxanthin. Of the 302 qualified respondents, exactly 80% said it was "true" that their immune systems improved and/or they were getting fewer colds and flu since supplementing with Astaxanthin (Capelli et al., 2008). (Precisely 80% said "true" and 20% said "false"—the 80/20 rule can't get any more exact than that.)

Where it All Began: The Pioneering Work of Dr. Harumi Jyonouchi

Dr. Harumi Jyonouchi, a medical doctor and university professor, was working at All Children's Hospital at the University of South Florida when she began exploring the effects of Astaxanthin on the immune response and cancer prevention in the early 1990s. Dr. Jyonouchi truly was a pioneer of Astaxanthin research. Before she embarked on her immunity studies, very little research had been done on Astaxanthin. Her experiments were confined to pre-clinical trials in test tubes and rodents, but she published many different studies that set a great foundation for the immunity research that followed.

Dr. Jyonouchi did several experiments testing Astaxanthin against beta-carotene. In the 1980s and 1990s when I began working in the natural supplement industry, beta-carotene was all the rage as an immunity supplement. Yet in her experiments, Astaxanthin consistently far outperformed beta-carotene in every way. She also tested Astaxanthin against several other carotenoids and, as expected, it outclassed them as well. Let's briefly look at the important work she did, which set the stage for the human research that followed.



Pioneering investigator Harumi Jyonouchi, MD, the initiator of immunity research on Astaxanthin.

#1 Astaxanthin is superior to beta-carotene in immune modulation in vitro. Dr. Jyonouchi tested beta-carotene against Astaxanthin in mouse cells and found that, while beta-carotene worked well, Astaxanthin was superior in all four parameters tested. The conclusion stated: "These results indicate that immunomodulating actions of carotenoids are not necessarily related to Pro-Vitamin A activity, because Astaxanthin, which does not have Pro-Vitamin A activity, showed more significant effects in these bioassays" (Jyonouchi et al., 1991).

#2 Astaxanthin enhances in-vitro antibody production to T-dependent antigens. After moving to the University of Minnesota's School of Medicine, Dr. Jyonouchi examined the mechanism of action involved in enhancing antibody production. This experiment showed that Astaxanthin may be able to

augment antibody production by affecting the initial stage of antigen presentation (Jyonouchi et al., 1993).

#3 Astaxanthin is superior to beta-carotene in preventing formation of cancer in mice. In her first animal trial in this area, Dr. Jyonouchi and her colleagues found Astaxanthin to be more effective than beta-carotene in preventing carcinogenesis in autoimmune-prone mice (Tomita et al., 1993).

#4 Astaxanthin enhances humoral immune response in old mice better than lutein or beta-carotene. The following year, Dr. Jyonouchi expanded the carotenoids she was testing and included both beta-carotene and lutein. She demonstrated that Astaxanthin performed better in older mice than both of its carotenoid cousins (Jyonouchi et al., 1994).

#5 Astaxanthin increases antibody response in vitro. An additional test-tube study corroborated earlier results showing that Astaxanthin has more profound effects than beta-carotene on antibody response in animal cells (Jyonouchi et al., 1995a).

#6 Astaxanthin enhances human immunoglobulin in culture more effectively than beta-carotene. Dr. Jyonouchi moved to human cells in this experiment and found that, again, Astaxanthin's effects in enhancing immunity in vitro were far superior to those of beta-carotene (Jyonouchi et al., 1995b).

#7 Astaxanthin enhances immunity in-vitro and was the sole carotenoid of several tested that performed as a T1-helper cell clone. This time, Dr. Jyonouchi's group tested Astaxanthin against several carotenoids: lutein, lycopene, zeaxanthin and canthaxanthin. As expected, Astaxanthin's effects in immune enhancement in vitro were the most potent. In fact, Astaxanthin was the only one of these antioxidant carotenoids that enhanced the number of antibody-secreting cells and performed as a T1-helper cell clone. Furthermore, both Astaxanthin and zeaxanthin successfully increased the number of immunoglobulin M cells while none of the other carotenoids had this effect (Jyonouchi et al., 1996).



A healthy immune system is essential to fight off germs.

#8 Astaxanthin may exert anti-tumor activity through the enhancement of the immune response in mice. The year 2000 marked the final study from Dr. Jyonouchi's decade of pioneering research on Astaxanthin. This study was done in mice to test Astaxanthin's ability to suppress fibrosarcoma tumor growth. The mice were fed a diet containing 0.02% Astaxanthin (which equates to 40mcg per kg of their body weight). The mice in the Astaxanthin group had significantly lower tumor size and tumor weight than the control group. Improvements in blood immune markers were also noted in the Astaxanthin group (Jyonouchi et al., 2000).

The Preliminary Research of Drs. Chew & Park

You may remember Dr. Boon Chew from Chapter 2. He's a prolific researcher at Washington State University and is regarded as an expert on carotenoids. Along with long-time associate Jean Soon Park, Dr. Chew has added a great deal to the research of Astaxanthin, including a landmark human clinical trial on immunity.

In 1999, two early studies published by Drs. Chew and Park showed great potential for Astaxanthin to positively affect the immune response of mice. Like some of the research by Dr. Jyonouchi, the first study compared Astaxanthin to other carotenoids, in this case beta-carotene and canthaxanthin. The researchers focused on how these carotenoids fare against the growth of breast tumors in mice. They tested two different strengths of each carotenoid against placebo, starting the treatment feeds three weeks before the introduction of tumor cells. The result: "Mammary tumor growth inhibition by Astaxanthin was dose-dependent and was higher than that of canthaxanthin and beta-carotene." All three carotenoids showed some positive effects, with Astaxanthin demonstrating a clear advantage. Additionally, lipid peroxidation activity in the tumors was lower in mice fed the stronger dose of Astaxanthin but not in mice fed beta-carotene or canthaxanthin (Chew et al., 1999a).

Later that year, a mouse trial showed that both Astaxanthin and beta-carotene stimulate lymphocyte function while canthaxanthin had no effect (Chew et al., 1999b). Lymphocytes are white blood cells in the body that provide a baseline defense against infection and help to fight off disease. By stimulating the function

of these disease fighters, Astaxanthin helps improve resistance to disease.

Another mouse study on tumor growth and immune response headed by Dr. Chew found corroborating results. Again, Astaxanthin was found to delay tumor growth, but only when the Astaxanthin feeding was started before tumor initiation. A corresponding modulation of the rodents' immune response was also found in the Astaxanthin treatment group (Nakao et al., 2010).

Moving up the mammal chain, Drs. Park and Chew did their next two experiments on cats and dogs. Both studies were done using similar methods, and both studies yielded similar results. The cat study showed that Astaxanthin improved immune function in multiple ways: it increased T helper cells, increased concentrations of plasma immunoglobulin G and immunoglobulin M, and heightened NK cell cytotoxic activity. The results showed increases in both the cell-mediated and humoral immune response in cats fed Astaxanthin (Park et al., 2011).

The dog study tested additional parameters and showed even more impressive results than the cat study. In addition to increases in several immune markers, Astaxanthin supplementation resulted in other important benefits. For one, DNA damage was reduced in the dogs that were fed Astaxanthin, indicating a potential for cancer prevention. Additionally, C-reactive protein (CRP) was reduced, indicating a reduction in systemic inflammation (Chew et al., 2011).



Across a variety of mammal species, Drs. Chew and Park found Astaxanthin to have consistently positive effects on immune function.

Landmark Human Clinical Trial Shows Immune Response Benefit

The promising pre-clinical research by Dr. Jyonouchi and the steady progression of mammal studies by Drs. Chew and Park led to a seminal human clinical trial. The study was done in healthy, young women averaging just over 20 years old. And, of course, the study was state-of-the-art: randomized, double-blind and placebo-controlled. The study lasted for eight weeks. The women were separated into three different groups: the control group took placebos every day, while the two treatment groups took either 2mg or 8mg of Natural Astaxanthin per day. The researchers assessed immune response at the beginning of the trial as a baseline, then halfway through the trial, and finally at the end of the trial after eight weeks of supplementation.

Landmark Clinical Trial Showed That Astaxanthin:

- Increased the total number of antibody-producing B cells
- Amplified natural killer cell cytotoxic activity
- Led to increased number of T cells
- Stimulated lymphocyte counts
- Significantly increased delayed-type hypersensitivity response
- Dramatically decreased DNA damage
- Reduced CRP, the key marker for systemic inflammation (Park et al., 2010)

While these findings contain technical language, they can be summed up easily in plain English: just as Astaxanthin works through multiple pathways as an anti-inflammatory, an antioxidant and a cardiovascular aid, it also works through multiple pathways to support the immune system. Based on research reviewed in previous sections of this chapter, readers may have discerned a pattern emerging. Astaxanthin tends to improve individual health systems from a variety of angles at

the same time. This may be why Astaxanthin is more effective than other nutrients (and why it is “The Supplement You Can Feel”).

One counterintuitive finding of this study was that the group supplementing with 2mg per day of Natural Astaxanthin showed slightly better results than the group taking 8mg per day. While the difference was not statistically significant, this result was unexpected, particularly since research on the many other health benefits of Natural Astaxanthin have generally found optimal results at levels significantly above 2mg per day. Further studies would be necessary to determine the optimum dosage for immune system modulation.

This research led to a patent for Drs. Chew and Park on the use of Astaxanthin to prevent DNA damage from oxidation. The patent states that administering as little as 2mg per day of Natural Astaxanthin over a four-week period is sufficient to reduce DNA damage by approximately 40% (Chew and Park, 2006).



The Washington State University landmark clinical trial showed multiple pathways for Astaxanthin's immune system benefits.

Additional Human Clinical Research

Improvement in Immunoglobulin, Pro-Oxidant/Antioxidant Balance and CRP Levels. Another clinical trial was done recently which further validates Astaxanthin's ability to improve the immune response in humans. This was the study done in Europe on young elite soccer players that I cited in the section on athletes. The 40 young men were randomly separated into two groups, one that took 4mg of Natural

Astaxanthin each day for 90 days, and the other that took placebos.

This study found that, in the young athletes supplementing with Astaxanthin:

- ➔ **Immunoglobulin levels increased.** Immunoglobulins are proteins present in immune cells that function as antibodies, chemically combining with bacteria, viruses and foreign substances invading the body.
- ➔ **The Pro-Oxidant/Antioxidant balance decreased.** Pro-oxidants create more harmful free radicals in the body while antioxidants combat these destructive substances.
- ➔ **Plasma muscle enzyme levels decreased.** Muscle enzyme levels are a predictor of muscle disease and also cardiovascular problems.
- ➔ **CRP levels remained constant in the Astaxanthin group while they increased in the placebo group.**

The summary stated, “This study indicates that Astaxanthin supplementation improves immunoglobulin response and attenuates muscle damage, thus preventing inflammation induced by rigorous physical training. Our findings also point that Astaxanthin could show significant physiologic modulation in individuals with mucosal immunity impairment or under conditions of increased oxidative stress and inflammation” (Baralic et al., 2015).



Athletes' immune systems can become compromised by intense physical activity, but Astaxanthin can provide protection.

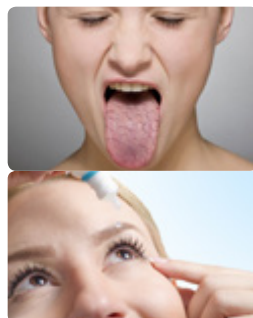
Astaxanthin Supplementation Leads to Improvements in Patients Suffering from an Auto-Immune Disorder. This study (also mentioned earlier) was done in Japan at the Tsurumi University School of Dental Medicine in patients suffering from an autoimmune disorder called Sjögren's syndrome. Sjögren's syndrome is a

systemic chronic inflammatory condition. What happens to people with Sjögren's is that lymphocytes infiltrate glands such as salivary and sweat glands. The result is symptoms such as dry mouth and eyes.

This study was done in three parts: in vitro, using a mouse model, and lastly as a human clinical trial with both patients suffering from Sjögren's syndrome and healthy subjects.

- ➔ In the in-vitro study, Astaxanthin partially suppressed hydrogen peroxide-induced oxidation in human salivary gland epithelial cells.
- ➔ In the mouse model, Astaxanthin helped keep the animals' mouths salivating after they were exposed to radiation.
- ➔ In both the healthy human group and the group with Sjögren's syndrome, Astaxanthin acted to increase salivary output and decrease the level of an oxidative stress marker (Yamada et al., 2010).

This study and the study on rheumatoid arthritis mentioned in the anti-inflammatory section were both done in patients with auto-immune disorders. Astaxanthin's benefits for these two different auto-immune conditions demonstrate that it modulates the immune response rather than simply boosting it—when the immune system needs a boost, it seems to enhance it; but when the immune system is overcharged, as in auto-immune diseases, it seems to reduce the self-destructive effects.



Auto-immune condition Sjögren's syndrome manifests as dry mouths and eyes.

Astaxanthin Suppresses Lymphocyte Activation in Human Cells of Patients Suffering from Allergic Rhinitis and Pollen-Related Asthma. Allergic rhinitis is commonly called hay fever. It is characterized by inflammation in the nose. Pollen-related asthma is also an allergic condition. Both of these disorders can lead to runny noses, sneezing and itching. This in-vitro study showed that Astaxanthin suppressed the activation of lymphocytes taken from people suffering from these conditions. This resulted in improved activity of antihistamines and led the researchers to suggest a dosing strategy for further trials (Mahmoud et al., 2012).

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

I covered many of the most important pre-clinical studies already in the first sections about Dr. Jyonouchi and Drs. Chew and Park. Other studies of interest have shown that Astaxanthin:

- Improved the tumor immune response in mice (Kurihara et al., 2002).
- Stimulated immune response in-vitro and in mice (Lin et al., 2015).
- Reduced immune liver injury in a rat model of autoimmune hepatitis (Li et al., 2015a).
- Slowed the spread of human liver cancer cells and induced cancer cell death in vitro (Li et al., 2015b).
- Slowed the growth of a human gastric cancer cell line (Kim et al., 2016).
- Improved the function of human neutrophils (a type of white blood cells) (Macedo et al., 2010).
- Changed the immune response to *H. pylori* bacteria (Akyon, 2002).
- Is superior to other carotenoids in enhancing immunity in vitro (Okai and Higashi-Okai, 1996).

It isn't only mammals whose immune systems are improved by Astaxanthin. I'll review a study in salmon in Chapter 5 and one in shrimp in Chapter 7 that both demonstrated huge improvements in survival rates of juveniles (which the authors attributed to improved resistance to disease and stress). In addition, a study in fish showed that Astaxanthin helps modulate their immune systems (Jagruthi et al., 2014).

In conclusion, I can't say that you won't get a cold or flu for 17 years like me if you start supplementing with Astaxanthin every day. But the research suggests that you're likely to see an improvement in your immune function with Astaxanthin supplementation. Though there haven't been as many clinical trials on immunity as on the other health benefits I've covered, the findings so far are compelling. The landmark study by Dr. Chew, coupled with a few other human clinical studies and many pre-clinical trials, lead to my recommendation that anyone wishing to improve their immune response should strongly consider supplementing with Natural Astaxanthin.



Helping Sperm Reach the Egg: Astaxanthin's Enhancement of Male Fertility

Throughout history, fertility has been viewed as a really big deal in most societies. Primitive cultures practiced rituals and offered sacrifices to the gods of fertility. Kings and princes commonly divorced or even murdered their wives if they couldn't bear them heirs. In today's world, many couples who want to have a baby and can't conceive go through tortuous and expensive measures to attain their goal. Yet after years of trying and a huge investment, many end up failing to get pregnant. I'm happy to announce that there is a little-known alternative with some promising initial research that these couples should consider: Natural Astaxanthin!

Males and females are equally likely to be the source of infertility. In couples who can't conceive after more than one year of unprotected sex (which is the generally accepted definition of infertility), approximately one third of the cases are the result of infertile men, one third are the result of infertile women, and for the remaining one third, there are both male- and female-rooted causes. This condition is much more common than some might think—in fact, 15% of couples trying to conceive do not get pregnant after one year of trying, thus qualifying them as infertile (National Institute of Child Health and Human Development, 2017).

There is evidence that over the past 30 years, infertility has been on the increase, particularly among males. The primary causes of male infertility are abnormal sperm production or function, or alternatively, problems with the delivery of sperm. These primary causes can be triggered by environmental factors such as pesticides and other chemicals, certain



Infertility is equally common in males and females.

medications, or treatments for cancer (Mayo Clinic, 2017). All of these environmental factors are modern-day conditions that didn't exist during our great-grandparents' time. And conditions are worsening as more chemicals are released into the environment and included in our diets and as doctors prescribe more medications to treat illnesses rather than encouraging prevention.

Human Clinical Trials Show a Possible Natural Treatment for Male Infertility

Three human clinical studies show that Natural Astaxanthin has potential to help infertile men. Two were very similar, while one followed a completely different protocol. Compared to the other nine health benefits described in this chapter, infertility is the least researched. But the early results are very promising.

The first study was done in couples who had been trying to conceive for over 12 months. This study followed all the commonly accepted parameters for high quality clinical research—it was double-blind, placebo-controlled and randomized. In addition, it followed World Health Organization (WHO) guidelines for determining fertility. There were 30 couples in all, and in each couple, the men were diagnosed as being infertile according to WHO guidelines while the women showed no signs of infertility.

Due to the ethical obligation that requires researchers working with humans to treat patients in accordance with the rules of good medical practice, all 30 couples received conventional infertility treatment, again according to WHO standards.

Because the study was randomized, there were no significant differences between the two groups in any fertility-related characteristics such as semen parameters, hormone results, duration of abstinence before semen donation or epidemiological characteristics. The men in the treatment group were administered 16mg per day of Natural Astaxanthin, while the men in the control group received placebos.

Basically, Natural Astaxanthin made men's sperm swim faster to fertilize the women's eggs, which most likely was due to Astaxanthin eliminating a lot of the



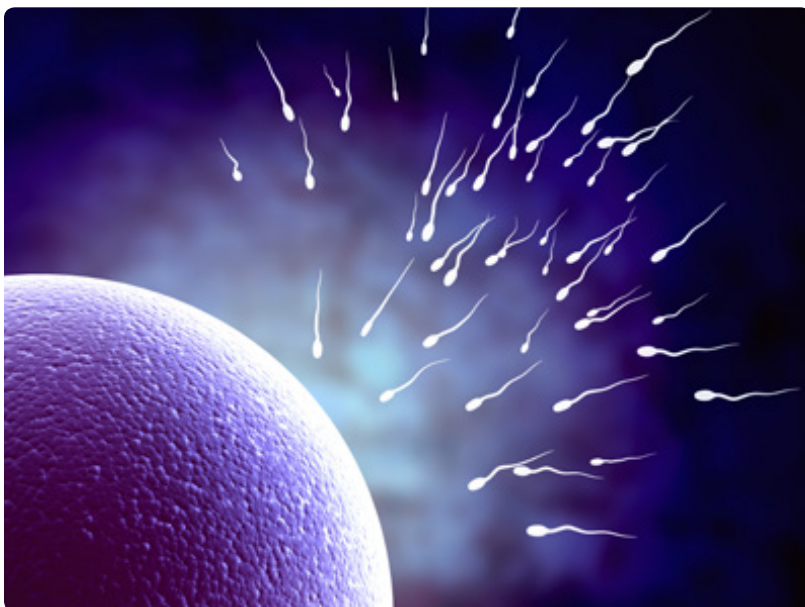
End result of improved fertility!

were used.” That is to say, other antioxidants can also help increase male fertility, but according to the results of this study, Natural Astaxanthin works better. The authors went on to point out that over half of the couples in the Astaxanthin group that got pregnant did so within three months (while the average amount of time of trying to conceive prior to the Astaxanthin treatment was 20 months). They theorized that this quick result probably means that Astaxanthin helps improve the functional capacity of the sperm, as compared to changing the sperm themselves. “Functional improvement may be related to the reduction of reactive oxygen species resulting in enhancement of linear velocity and reduction of DNA damage” (Comhaire et al., 2005). Another study showing excellent results had been published previously in which the Astaxanthin group of infertile men outperformed the placebo group by 478%. The researchers concluded that Astaxanthin improved the quality of sperm (Garem et al., 2002).

(Comhaire et al, 2005)

At the end of the study, significant differences between the two groups included:

- Reactive oxygen species decreased in the Astaxanthin group
- Sperm linear velocity increased in the Astaxanthin group
- 11% of the placebo couples got pregnant
- **55% of the Astaxanthin-treated couples got pregnant!**



Sperm trying to reach the egg call to mind salmon trying to reach their birthplace to spawn. It appears that Astaxanthin can help both sperm and salmon swim better.

The final human clinical trial was done recently by a group of researchers supported by the government of Italy. Unlike the previous two human studies, this study was done on men with no fertility issues. Their fertility was determined by evaluating their sperm in a “spermiogram” (a series of biochemical, physical and morphological tests on a man’s semen including sperm count, motility, morphology, volume, fructose level and pH). The analysis of the subjects in this study determined that their sperm fell into the normal range on all parameters tested, including a specific evaluation to ensure that the amount of reactive oxygen species was at the correct level. In addition, the men all had at least one child and were within a normal age group for new fathers (24 to 37 years). Results showed a net increase in different motility parameters and sperm functioning, leading to the conclusion that “Astaxanthin, by ameliorating the patient group’s sperm functioning, may be utilized to decrease male idiopathic infertility” (Andrisini et al., 2015). Thus, we see that Astaxanthin helps improve the functionality and motility of sperm in both fertile and infertile men.

Early Research in Pigs

Way back in 1998, a US patent was filed by a company based in Sweden called AstaCarotene that was an early pioneer of Natural Astaxanthin production. The lead inventor on this patent is Ake Lignell, PhD, one of the true grandfathers of Astaxanthin research and production. Dr. Lignell has some other patents and publications, and while the company he co-founded went bankrupt many years ago and the patent is set to expire next year, Dr. Lignell is still a key player in the Astaxanthin field, working with another large producer.

The title of this patent is “Method of increasing the production and improving the quality of semen,” but essentially, it’s really about the vitality of sperm. “More precisely, the invention relates to a method of increasing the volume, the total sperm count and the reproductive performance of semen from human and animal males” (Lignell et al., 2002). This patent references an earlier patent of Dr. Lignell’s which showed that Natural Astaxanthin can increase the breeding of mammals. This earlier patent described experiments where female pigs were given Natural Astaxanthin, which led to healthier and more bountiful piglet litters. In the treatment group of female pigs fed Natural Astaxanthin, the number of piglets increased and their average weight increased, while the percentage of stillborn piglets decreased (Lignell and Inboor, 2000).

The experimentation they did in male mammals was also done with pigs. The male pigs were fed either a normal diet or a diet containing 0.15% Natural Astaxanthin for 16 weeks. The male pigs’ semen was collected and female pigs were artificially inseminated. Over 500 inseminations were done in each group: 513 for the Astaxanthin-enriched group and 523 for the unenriched group.

Early Research in Male Pigs Showed these Positive Results:

- Semen volume increased significantly
- Total sperm count increased by 6.2%
- Number of piglets born alive increased by 5.4% (Lignell et al., 2002)

This research in mammals was promising and led to the human research that followed. In addition, fish and shrimp breeders have found similar results in breeding marine species (which I'll discuss later).



The first Astaxanthin fertility experiments showed positive effects in both male and female pigs.

For the Scientists (A quick review of some excellent supporting pre-clinical studies)

Before they did their study on fertile men, some of the researchers from the Italian study described above had conducted an in-vitro study. This experiment examined the effect of Astaxanthin on human sperm capacitation. The term “capacitation” refers to transformations that sperm must go through that enable them to successfully fertilize the egg. One of these transformations is production of a controlled amount of reactive oxygen species (ROS). This is a finely tuned process since too many ROS will result in an oxidative state and will damage the sperm, while too few ROS will mean that the sperm will not be able to fertilize the egg.

In this study, sperm cells were incubated without Astaxanthin and then also in increasing concentrations of Astaxanthin. The cells were analyzed for ROS production and capacitation parameters. The results showed that Astaxanthin improved the capacitation parameters without affecting the ROS generation curve. This led

the research team to hypothesize that Astaxanthin can enter the cell membrane to enhance capacitation (Dona et al., 2013).

Additionally, studies in pigs, rodents and fish showed that:

- Astaxanthin improves development, maturation and fertilization of pig ovarian cells exposed to heat stress (Do et al., 2015).
- Astaxanthin decreases oxidative stress in testicular mouse cells and improves hormone production (Wang et al., 2015).
- Astaxanthin improves fertilization rate, osmolality, motility and sperm concentration in goldfish (Tizkar et al., 2015).
- Astaxanthin improves egg quality in fish (Sheikhzadeh et al., 2012).
- Astaxanthin combined with Vitamins C and E was fed to rats on a restricted diet, resulting in improved male fertility (Vahidinia et al., 2017).
- In combination with Vitamins A and E, Astaxanthin improved sperm parameters in rats fed a high fat diet and led the researchers to conclude that this could be of clinical value in obese patients with infertility (Mortazavi et al., 2014).

A study in male mice that were exposed to a chemotherapy drug called Cyclophosphamide showed that, compared to untreated mice, mice treated with Astaxanthin had significantly:

- Increased testes weight
- Higher sperm count
- Improved sperm morphology
- Superior sperm comet assay
- Reduced levels of sperm DNA damage

The authors concluded that Astaxanthin protects against testicular toxicity and may be effective in preventing testicular cancer from chemotherapy drugs (Tripathi and Jena, 2008).

In a recent study, diabetic rats that received Astaxanthin supplementation over seven weeks demonstrated:

- Improved sperm viability
- Improved DNA integrity
- Movement toward normal sperm morphology
- Improvement in some of the detrimental health effects of diabetes (Bahmanzadeh et al, 2016)

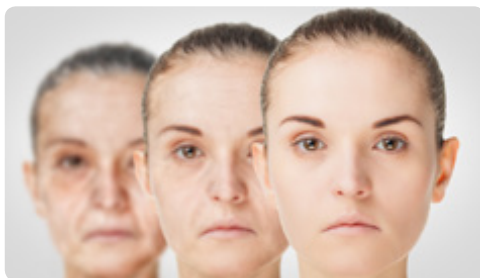
In conclusion, with only three human clinical trials so far, it's still too early to decisively conclude that Natural Astaxanthin is an effective treatment for male infertility. And it's unquestionably premature to recommend it for female infertility. But the existing evidence is promising enough that, before any friend or family member of mine went to the trouble and expense of fertility treatments, I would absolutely recommend that they take 16mg per day of Natural Astaxanthin for about six months to see what happens.



The Ultimate Anti-Aging Nutrient

You've made it through nine of "The Healthy Ten." Congratulations! And this final section on Anti-Aging will be the shortest in this whole chapter because I've already covered all of the ways Astaxanthin can help people age gracefully and healthfully. Think about all of the problems that occur due to the aging process: the risk of heart disease increases; you get tired more easily; you lose your strength; your immune system weakens; your eyes and brain start to decline; sperm becomes less motile and lose their potency; and your skin gets wrinkled and rubbery. In short, your body becomes more vulnerable to the health problems that make up this chapter. When you consider everything it can do for you as you age, it becomes apparent that Astaxanthin is the very best supplement for anyone over the age of 40.

Note: When some people think of the phrase "anti-aging," they think primarily about skin appearance. In my humble opinion, they're dead wrong. To me, anti-aging is first and foremost about preserving your health, energy levels and vitality. Far behind these crucial aging issues comes how your skin looks.



While many people focus on skin appearance when they think of "anti-aging," the fundamental issues are health and vitality.

What is Your Own Biggest Health Concern About Aging?

Think about this question for a moment. Regardless of what your answer is, the root cause of your biggest health concern is most likely based in your cells. Lack of energy occurs when the mitochondria of the cells are under attack. Cancer starts when DNA in your cells is damaged. The eyes and brain become compromised when oxidation and inflammation in the cells go unchecked. Even skin appearance deteriorates because of UV damage to skin cells.

If you've read the previous nine sections of this "Healthy Ten" chapter, you are by now exquisitely aware that Astaxanthin is a great cell defender. The ongoing mantra in this chapter has been that most health concerns are caused by oxidation and inflammation, and that Astaxanthin is an excellent antioxidant and anti-inflammatory. Add to this the other cell-protective properties that I talked about over the course of this chapter—reduction of DNA damage and protection of the mitochondria—and it becomes clear that Natural Astaxanthin is both "The Ultimate Anti-Aging Nutrient" and the "Consummate Cell Defender."

Scripps Center for Integrative Medicine is a leading health resource that combines allopathic medicine (meaning modern Western medicine) with natural healing techniques. It is geared toward Western-style medical doctors with an open mind to alternative approaches. Scripps put out a list of the "Top 10 Health Concerns for Baby Boomers." Although in my opinion there are a few key health concerns missing from this list, it covers many important issues that worry people as they age. If you examine the list, you'll see that the great majority of these concerns have been in previous sections of this chapter, and that Astaxanthin has been shown to have positive effects in each of these areas.



*Scripps—Combining the Best of
Allopathic and Traditional Medicines.*

Top 10 Health Concerns for Baby Boomers (Scripps, 2015)
and Corresponding Astaxanthin Research

Rank	Health Concern	Astaxanthin Research on this Health Concern
1	Type 2 Diabetes	25 pre-clinical trials, mostly in rodents.
2	Heart Disease	6 human clinical trials and 40 pre-clinical trials.
3	Cancer & Tumor Prevention	46 pre-clinical trials, mostly in rodents.
4	Depression	One human clinical trial showed a 57% reduction in feelings of depression in runners.
5	Eye Problems	14 human clinical trials and 24 pre-clinical trials.
6	Alzheimer's Disease	While not specifically on Alzheimer's, there are 5 human clinical trials on brain function, 3 of which are in age-related areas, plus 50 supporting pre-clinical trials.
7	Arthritis & Joint Replacement	While not all are specifically on arthritis and none are on joint replacement, there are 9 human clinical trials on joint, tendon and muscle issues (mostly involving pain and mobility) and 51 supporting pre-clinical trials.
8	Osteoporosis	There is no research in this area.
9	Flu/Pneumonia	While there are no studies specific to flu or pneumonia, there are 4 human clinical trials and 26 supporting pre-clinical trials on immune system modulation.
10	"Sandwich Generation" Stress	This refers to people who have to care for their children and their parents at the same time. While there is no research on Astaxanthin specifically mentioning "Sandwich Generation Stress," there are dozens of studies that mention "stress."

Going by the Scripps list, we’ve seen from the research that Natural Astaxanthin may help address all but one of the top ten health concerns of Baby Boomers. And beyond this list, there are other important health concerns where Astaxanthin may also be of help.

Health Concern	Astaxanthin Research on this Health Concern
Skin Health & UV Protection	7 human clinical studies and 27 pre-clinical trials.
Energy Levels & Performance	12 human clinical studies and 27 supporting pre-clinical trials on a wide range of topics related to energy and performance levels.
Liver & Kidney Support	23 pre-clinical trials, mostly in rodents.
Gastrointestinal Health	13 pre-clinical trials, mostly in rodents.
Cellular Protection	Depending on how you classify them, there are hundreds of studies showing how Astaxanthin can defend cells efficiently from many different pathways. (And ultimately, if you can defend cells this well, you’re taking good care of the whole body!)

While I’m sort of rehashing the research summary from the first section of this chapter, this information is crucial to our understanding of how Astaxanthin can support healthy aging. This information has led health experts to call Astaxanthin “The Ultimate Anti-Aging Nutrient.”

We've Learned from Salmon. Now Let's Learn from Worms: Astaxanthin May Help You Live Longer

Why would scientists use a worm to try to understand longevity in humans? Worms certainly aren't closely related to humans—they're not even mammals. However, there is a worm named *Caenorhabditis elegans* (commonly called *C. elegans*) that is used in longevity research as a model organism. These worms have intracellular pathways that are closely related to pathways that determine longevity in mammals. Basically, what this means is that if a nutrient can make *C. elegans* live longer, there's a good chance it can make humans and other mammals live longer. (Surprisingly, these worms have 60% to 80% of human gene homologues, which is why they're considered a model organism for human longevity testing.)

In a groundbreaking study done by university researchers in Japan, Astaxanthin increased *C. elegans*' lifespan between 16% and 30% in both wild-type worms and long-lived mutant worms. The worms were fed Astaxanthin during their larval stage through their young adult stage. The authors suggested protection of the cells' nucleus and mitochondria as the probable mechanism for the lifespan extension (Yazaki et al., 2012).

A recent trial with this worm tested the three major forms of Astaxanthin against each other and against placebo. Astaxanthin again increased longevity of the worms and Natural Astaxanthin from algae outperformed Synthetic Astaxanthin from petrochemicals and *Phaffia* Astaxanthin from mutated yeast in several parameters (Liu et al., 2016). (I'll discuss this study in more detail in Chapter 7.)



***Astaxanthin made *C. elegans*
worms live 16% to 30% longer.
What can it do for you?***

And it's not only in worms that Astaxanthin has demonstrated its longevity potential—Astaxanthin can also extend the life of species as diverse as fish, shrimp and fruit flies. I'll talk about the fish and shrimp in Chapters 5 and 7. Now let's

talk about the fruit flies.

While not the model organism for mammal longevity that *C. elegans* is, a type of fruit fly called SOD mutants also showed increased lifespan due to Astaxanthin intake. The study was done at two doses with both increasing longevity significantly. In fact, in the flies given the higher dose, the average lifespan increased by 28%. This study also found an additional benefit: Astaxanthin prevented age-related decline in locomotor function. The conclusion stated “These results, taken together, strongly support the anti-aging properties of *Haematococcus* and its therapeutic rather than preventive potential against age-related diseases” (Huangfu et al., 2013).



*Astaxanthin can add life to your years, and it
may even add years to your life!*

In conclusion, I can quickly state the key point of this section in one sentence—if you’re over 40, I strongly encourage you to take at least 4mg of Natural Astaxanthin every day.

4

“The Unproven Five” Emerging Research on Astaxanthin

Notice: The information in this chapter does not directly pertain to humans. This is preliminary research done in animals and in test tubes. **No extrapolation should be made that the health benefits discussed in this chapter relate to humans.** I include it simply to show that there is strong potential in these areas (with hopes for human studies in the future).

There are several health concerns for which pre-clinical trials have shown great potential for Astaxanthin. However, as I mentioned at the beginning of “The Healthy Ten” in Chapter 3, my iron-clad rule about animal studies is that they don’t justify conclusions related to humans (unless there are already two human clinical trials for a particular health benefit, in which case the animal studies lend additional support). Humans are substantially different from rats and mice (the species studied in about half of the pre-clinical studies on Astaxanthin), and even if there are many studies showing potential for Astaxanthin to prevent or treat a health condition in these animals, it does not mean that it will deliver a similar effect in humans.



Rats and test tubes ≠ clinical validation for humans.

Most of the last chapter on “The Healthy Ten” focused on human research. There is undeniably strong evidence that Astaxanthin has benefits for these ten health

concerns. “The Unproven Five” are very different: these are five areas of research with multiple pre-clinical studies but, so far, no human clinical trials. The depth of this pre-clinical research ranges from four studies in one area up to 46 studies in another. “The Unproven Five” merit attention for two reasons: because they suggest that there might be similar results in humans; and because they show additional ways that Astaxanthin can help pets and farm animals.

This chapter will be limited to a quick review of a few indicative studies for each area of research. I’ll start with the area that has the most pre-clinical studies and work down to the one with the least.



Cancer Prevention and Tumor Reduction: 46 Pre-Clinical Studies

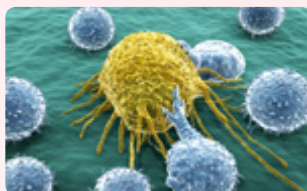
Along with heart disease, cancer is a leading cause of death in humans and animals alike. Of “The Unproven Five,” research related to cancer is by far the most voluminous. And besides the 46 pre-clinical studies on cancer prevention and tumor reduction, there’s an interesting epidemiological indication to consider: there is an extremely low occurrence of cancer in Eskimos and certain coastal tribes in North America that consume large quantities of wild salmon on a regular basis (Bates et al., 1985). And as you already know, wild salmon contain more Astaxanthin than any other natural food source.

I touched on cancer research in the section on immunity in Chapter 3 when discussing the animal research of Dr. Jyonouchi and Dr. Chew. Each of these pioneers did cancer research in vitro as well as in rodents, and both of them found that Natural Astaxanthin has protective effects.

Astaxanthin’s cancer preventive potential has been investigated in diverse organs. For example, promising results have been found against colon cancer in mice (Kochi et al., 2014); oral cancer in hamsters (Kowshik et al., 2014), skin cancer in rats (Rao et al., 2013), and liver cancer in obese mice (Ohno et al., 2015). The research related to cancer has taken three pathways; while there are many studies for each pathway, in the interest of brevity I’ll summarize just two studies for each.

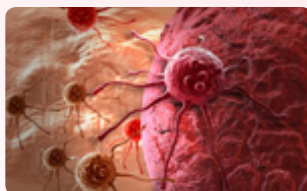
➔ **Test tube experiments showing Astaxanthin's ability to fight cancer cells.**

1. Astaxanthin was the best of eight different carotenoids tested in inhibiting liver tumor cells in vitro (Kozuki, 2000).
2. Astaxanthin-treated human colon cancer cell lines were significantly less viable than control lines in culture (Onogi et al., 1998).



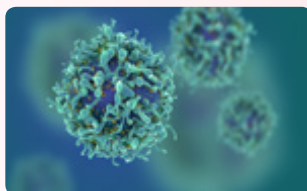
➔ **Animal studies showing Astaxanthin's ability to prevent the formation and proliferation of cancer.**

1. Astaxanthin prevented the formation of UV-induced cancer in mice (Black, 1998).
2. Rats with colon cancer that were fed Astaxanthin showed an increase in cancer cell death and a decrease in proteins involved in carcinogenesis (Nagendraprabhu et al., 2011).



➔ **Animal studies showing that Astaxanthin can shrink tumor size.**

1. A series of trials on rodents at Gifu University Medical School in Japan found Astaxanthin to be an effective anti-tumor agent. For example, Astaxanthin reduced both the proliferation and the incidence of bladder tumors in mice (Mori et al., 1997; Tanaka et al., 1994).
2. A study in mice led by the renowned carotenoid researcher Dr. Boon Chew from Washington State University showed that when Astaxanthin was introduced before tumor initiation, tumor growth was delayed and the immune response was effectively modulated (Nakao et al., 2010).



Cancer cells come in many forms, all of which can spread.

*“The
Unproven
Five”#2*

Support for Diabetes: 25 Pre-Clinical Studies

Along with skin cancer and neurological disease, diabetes is one of the fastest growing afflictions nowadays, particularly in affluent societies where a sedentary lifestyle has become more common and obesity levels have increased. Diabetes has been closely linked to silent inflammation, so it makes sense that Astaxanthin should have a positive effect in its prevention. Researchers at Kyoto University of Medicine in Japan got the ball rolling with diabetes research in mice with the first two studies below, followed by other groups from around the world.

- A model of human diabetes done in obese, diabetic mice found reduced blood glucose levels in the Astaxanthin group. In addition, Astaxanthin allowed the mice to continue to secrete insulin (Uchiyama et al., 2002).
- Using this same mouse model with obese, diabetic mice, researchers found that Astaxanthin led to lower blood glucose and also prevented diabetic nephropathy (malfunctioning of the kidneys caused by diabetes) (Naito et al., 2004).
- Astaxanthin also demonstrated potential to treat diabetic nephropathy in mice by preventing the damaging effects of high glucose exposure (Kim et al., 2009).
- Georgetown University scientists found that Astaxanthin decreased insulin resistance (a pathological condition that results in cells failing to respond normally to insulin) in rats. In addition, systolic blood pressure levels were lower in rats with high blood pressure (Preuss et al., 2011).
- Diabetes is known to increase oxidation in white blood cells. Astaxanthin helped to mitigate this effect in rats (Marin et al., 2011).



Obese, diabetic mice provide a research model for diabetes in humans

Serious cardiovascular issues are common in diabetics. A few diabetes-related rat studies showed that Astaxanthin has positive effects for cardiovascular health:

- Blood vessel health was improved in diabetic rats fed Astaxanthin (Zhao et al., 2011).
- Diabetic rats had improved blood lipid profiles and better antioxidant activity when supplemented with Astaxanthin (Otton et al., 2010).
- A study of non-diabetic rats showed improved insulin resistance and fasting blood glucose levels after Astaxanthin supplementation. In addition, the Astaxanthin group had reduced blood pressure and improvements in cholesterol and triglyceride levels (Hussein et al., 2006).



Liver and Kidney Health: 23 Pre-Clinical Studies

The key detoxification organs in mammals are the liver and kidneys. These organs remove dangerous substances from the body before they can damage other organs, tissues and cells, making their healthy functioning critical for good health.

It has been known for a long time that Astaxanthin may support liver health. Back in 1990, a study tested Astaxanthin against Vitamin E in rat liver cells for their ability to reduce lipid peroxidation. Astaxanthin was the clear winner with superior activity in reducing peroxidation (Kurashige et al., 1990).



Detoxification is critical to good health.

Here's a good example of how Astaxanthin can help our detoxification organs function well. When the liver performs some of its critical functions, such as destroying viruses and eliminating dead red blood cells, it causes high levels of oxidation. In addition, the liver oxidizes fats in our diets to produce energy, which also produces free radicals and increases oxidative levels. Astaxanthin's superior antioxidant activity helps enable the liver to work at top efficiency under this onslaught of free radicals.

Many other studies have shown that Astaxanthin has a variety of benefits for the liver and kidneys:

- A study pitting Astaxanthin against Vitamin E showed potential benefits both for the liver as well as support for diabetes in mice fed a high-cholesterol and high-fat diet. Astaxanthin-fed mice had better results than Vitamin E-fed mice in all parameters tested:
 - Reduction in lipid accumulation in the liver
 - Reduction in liver inflammation
 - Reversal of liver fibrosis
 - Improvement in insulin resistance (Ni et al., 2015).
- Astaxanthin reduced immune liver injury in mice with autoimmune hepatitis (Li et al., 2015).
- Astaxanthin increased antioxidant levels of superoxide dismutase and glutathione in rats' livers and appeared to protect them from liver damage (Kang et al., 2001).

Liver Cancer Research

Early exploration by government researchers in France showed that Astaxanthin has potential to prevent liver cancer. In the first study, Astaxanthin and canthaxanthin increased the release of beneficial enzymes that may help prevent the formation of cancer in rats' livers, while lutein and lycopene did not (Gradelet et al., 1996). Inhibition of liver cancer formation in rats was demonstrated in a study the following year (Gradelet et al., 1997). The last study in this series showed that Astaxanthin can prevent DNA damage to the liver in rats (which may inhibit formation of a cancerous cell line) (Gradelet et al., 1998).

- Mice fed Astaxanthin showed a decrease in inflammation markers and oxidative stress levels in kidneys and preservation of kidney function (Qiu et al, 2015).
- Astaxanthin supplementation in rats reduced kidney calcium crystal deposits more effectively than citrate (a molecule commonly combined with calcium in supplements to improve efficacy) (Alex et al., 2014).
- A study at Federal University in Brazil found that Astaxanthin protected rats' kidneys against lipid increases and protein oxidation when mercury was introduced (Augusti et al., 2008).



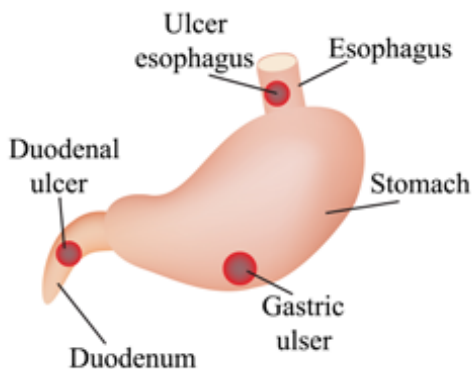
Ulcers and Gastrointestinal Health: 13 Pre-Clinical Studies

Controlling “bad” bacteria. We’ve all got bacteria in our gastrointestinal systems. In fact, the “good” bacteria are an essential element of both our digestive process and our immune response. However, about half of the world’s population has “not-so-good” bacteria in their stomachs called *Helicobacter pylori* (commonly called *H. pylori*). In large quantities, these bacteria can lead to ulcers and chronic gastritis. If left unchecked, they can ultimately result in stomach cancer. Diet can be a primary cause of large infestations of *H. pylori*. “A low dietary intake of antioxidants such as carotenoids and Vitamin C may be an important factor for the acquisition of *H. pylori* by humans” (Bennedsen et al., 1999). Astaxanthin has shown an ability to decrease *H. pylori* levels:

- A study done in Sweden showed positive effects of Astaxanthin both in vitro and in live mice. In test tubes, Natural Astaxanthin inhibited the growth of *H. pylori*. In mice fed Astaxanthin, lower *H. pylori* bacteria levels and lower levels of inflammation were seen both one day after treatment and 10 days after treatment (Wang et al., 2000).
- A similar study in neighboring Denmark also showed that Astaxanthin can lower *H. pylori* bacteria levels and gastric inflammation in mice (Bennedsen et al., 1999).
- In addition, Astaxanthin has been shown capable of changing the

immune response to *H. pylori* (Akyon, 2002).

Prevention of ulcers. A fascinating study that I'll discuss in detail in Chapter 7 showed that Natural Astaxanthin from algae is more potent than either Synthetic Astaxanthin from petrochemicals or Astaxanthin from the mutated yeast *Phaffia rhodiza* in protecting rats from the formation of gastric ulcers. The study tested the three different forms of Astaxanthin and also Vitamin C and beta-carotene and found that ulcer indexes were smallest in the Natural Astaxanthin-fed group (Nishikawa et al., 2005).



Gastrointestinal ulcers can occur in different locations.

Additional studies corroborate Astaxanthin's propensity to combat gastric ulcers. Rats with ulcers caused by different irritants such as acetic acid (present in vinegar) and ethanol (present in spirits, wine and beer) showed a reduction in ulcers when treated with Astaxanthin (Kamath et al., 2008; Yang et al., 2009).

Other Gastrointestinal Effects

- ✓ Korea University researcher J.H. Kim, PhD, investigated Astaxanthin's ability to prevent gastric damage in rats. He found significant reduction in stomach lining damage caused by either alcohol (Kim et al., 2005a) or the non-steroidal anti-inflammatory drug naproxen (Kim et al., 2005b) in rats supplemented with Astaxanthin. In both cases, antioxidant activity of superoxide dismutase, glutathione peroxidase and catalase increased as well.
- ✓ Moving down the gastrointestinal system, a Japanese study found that Astaxanthin suppressed the formation of colitis

and colonic ulcers and also prevented colon cancer in mice. They credited Astaxanthin's ability to cause cell death in colon cancer cells and its reduction of inflammatory markers for these three diverse benefits related to the colon (Yasui et al., 2011).



Respiratory Health: 4 Pre-Clinical Studies

Respiratory health is connected to inflammation. For example, asthma is caused by allergens or irritants that inflame the airways and make it difficult to breathe. Reducing inflammation leads to diminished symptoms of asthma and easier breathing.

The pre-clinical research on Astaxanthin related to respiratory health is really in its infancy—there are only two rodent trials and two in-vitro studies to date, and some of these involve additional active ingredients combined with Astaxanthin. Nevertheless, Astaxanthin's ability to reduce eight different inflammatory markers suggests substantial potential in this area (since a reduced level of inflammation is closed linked to good respiratory health).

- Blood cells from asthmatic and healthy patients were cultured for 24 hours in combination with plant proteins and two antihistamine drugs. Introduction of Astaxanthin to these cultures improved the activity of the antihistamines, leading the authors to suggest animal trials with Astaxanthin for seasonal allergic rhinitis and asthma (Mahmoud et al., 2012).
- Astaxanthin was tested in mice and in vitro and, in both cases, positive effects were found on 5-LOX (an enzyme that is linked to inflammation, immunity and allergies). The authors concluded, "These preliminary studies provide the foundation for more detailed evaluation of the therapeutic effects of this compound on the 5-LOX enzyme, important in chronic diseases such as atherosclerosis, asthma

and prostate cancer in humans (Lockwood et al., 2006).

- Astaxanthin was combined with ginkgolide B to see if this combination could be a new way of treating asthma and respiratory infections. The combination suppressed T-cell activation as well as two commonly-sold antihistamines in-vitro (Mahmoud et al., 2004).
- At a university school of pharmacy in Hungary, researchers combined Astaxanthin with Vitamin C and ginkgo biloba extract and tested the effects on respiratory inflammation in asthmatic guinea pigs. They tested different combinations of these active nutrients and found they could suppress inflammation better than the non-steroidal anti-inflammatory drug ibuprofen. They concluded, “Such combinations of non-toxic phytochemicals constitute powerful tools for the prevention of onset of acute and chronic inflammatory disease if consumed regularly by healthy individuals, and may also augment the effectiveness of therapy for those with established illness” (Haines et al., 2010).

While there are no human clinical trials on Astaxanthin and respiratory health, a consumer survey noted that respondents with asthma reported an improvement in their symptoms from Astaxanthin supplementation (Gueren et al., 2002).

In conclusion, five areas of emerging research suggest the possibility of benefits of Natural Astaxanthin for humans, but we need to undertake clinical trials before we can draw strong conclusions about these benefits. Here are the numbers to date of the studies showing positive effects:

- 46 animal trials and in-vitro experiments on cancer prevention and tumor reduction.
- 25 studies on diabetes support.
- 23 studies on liver and kidney health.
- 13 studies on gastrointestinal health.
- 4 studies so far on respiratory health (two of which combined Astaxanthin with other active ingredients).

I hope to see human studies in these areas in the near future.

5

Dogs & Horses, Chickens & Fish: As Good for Animals As It Is for Humans

My job is practically done for this chapter before I even start. In the previous chapters, I've already covered 15 specific reasons why pet owners and animal breeders should strongly consider giving Astaxanthin to their animals. For each of "The Healthy Ten" benefits in humans, I reviewed studies in animals showing related benefits. And in "The Unproven Five" chapter you just read, I covered many animal studies on cancer prevention, liver and kidney health, diabetes support, gastrointestinal health and respiratory health. At this point, it's already clear that Natural Astaxanthin is a great supplement for animals as well as humans.

Because I've already covered 15 ways animals can benefit from Astaxanthin, in this chapter I'll focus on new information that pet owners, breeders, farmers and animal lovers may find interesting (with just a few references to a handful of important studies I mentioned earlier).

Nestle Purina's Top Animal Researcher Loves Astaxanthin for Dogs

Arleigh Reynolds, PhD, has been researching which nutrients are best for dogs for about 25 years. Dr. Reynolds works for Nestle Purina, one of the leading producers

of pet food in the world. Some other interesting facts about Dr. Reynolds—he lives in Alaska and he’s an open-class competitive sled dog racer.

I spoke to Dr. Reynolds several years ago about Astaxanthin. He loves it. He told me it was the best thing he ever found for his prized sled dogs. He was interviewed in May 2006 for the sled dog racers’ favorite publication, “Mushing Magazine.” Here’s what he said in the interview about Astaxanthin: “It is one of the few things I have studied that not only shows measurable improvement in blood parameters but also visibly improves the dogs’ performance.” Basically, he saw benefits in the dogs in two different ways: numerically (when he quantified changes in their blood profiles) and visually (when he saw the dogs’ improved performance pulling sleds). From what you’ve read in previous chapters, the changes in blood are probably no surprise. But for an experienced, open-class sled dog racer to be able to actually *see* his dogs perform better from taking one natural supplement is really astounding. (Word has spread about Astaxanthin’s performance-enhancing capabil-



Astaxanthin is the best nutrient you can give dogs to keep them active, strong and healthy. (Just ask Nestle Purina’s top researcher.)

ity among sled dog racers, and it has developed a cult following.)

As I talked about in the Athletes section of Chapter 3, intense physical activity creates a huge increase in free radicals in muscle tissue, resulting in fatigue and soreness. So giving these sled dogs the world’s strongest and highest quality natural antioxidant that can bond with muscle tissue has a tremendous impact on their strength and endurance.

But that’s not all it can do for dogs. In the Immunity section of Chapter 3, I described a study in dogs by Dr. Chew from Washington State University. He found that Astaxanthin can increase immune markers, decrease DNA damage and also decrease C-reactive protein levels (Chew et al., 2011). This covers a lot of ground—immunity, prevention of cancerous cell lines and reduction of systemic inflammation among other potential benefits.

Additional research has shown potential for cardiovascular benefits in dogs. One study found that Astaxanthin reduced the risk of clogged arteries in dogs (Lauver et al., 2008) and another showed “marked cardioprotective properties in both rodents and canines” (Gross and Lockwood, 2005).

The most recent study found that Astaxanthin can prevent dysfunction of the mitochondria in dogs as they age (Park et al., 2013). As you may recall, mitochondria are cells’ power source, so enhancing their function can help older dogs maintain energy and vitality.



Don't think that Astaxanthin is just for sled dogs—it can help every dog stay healthy and youthful.

Remedy for a Life-Threatening Disease in Horses

There is a potentially fatal muscle disease specific to horses called equine exertional rhabdomyolysis (sometimes called “tying-up syndrome”). This affliction is surprisingly common. In the early stages, it begins to destroy muscle tissue when oxygen transport to the muscles becomes compromised and the muscles lose their capacity to store protein. Race horses that are heavily trained can be struck down and killed in their prime by this terrible ailment.

No recognized treatment for this condition exists other than resting the horse.

Research conducted by Ake Lignell, PhD (the Swedish Astaxanthin expert I wrote about in Chapter 3) found extraordinary results from feeding Natural Astaxanthin to horses with exertional rhabdomyolysis. A study was done on eight horses suffering from this disease. After two to three weeks feeding these horses 100mg Natural Astaxanthin per day, all eight horses in the study were symptom free and able to train and race as if they never had the disease. But when the supplementation was stopped or was decreased to less than 30mg per day, the symptoms began to reappear after just two weeks (Lignell, 2001).



Race horses with a life-threatening muscle disease were completely free of symptoms within three weeks of Natural Astaxanthin supplementation.

Pioneering Study: Astaxanthin Increases Salmon Survival from 17% to 98%

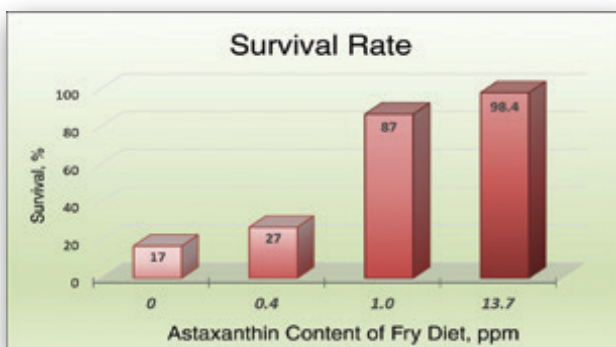
Several different species have experienced significant increases in survival rates from Astaxanthin supplementation. I talked about worms and fruit flies in Chapter 3, and in Chapter 7 I'll talk about a study in shrimp where Natural Astaxanthin from algae far outperformed Synthetic Astaxanthin and Astaxanthin from the mutated yeast called *Phaffia*. However, none of these studies was as striking as the study done in salmon where only 17% of the fish fry were surviving to maturity. But when small amounts of Astaxanthin were added to their feed, survival rates skyrocketed. At only 1 part per million (ppm) in their feed, 87% of the salmon lived to maturity. When increased to 13.7 ppm, 98% of the fish survived. Can you imagine the difference Astaxanthin can make for salmon farmers? Over 500% more of their fish can survive to maturity by adding 1 ppm of Astaxanthin to their feed during the early life stage. (Please note: 1 ppm is equivalent to 0.0001%. As I've said before, a little Astaxanthin goes a long way.)



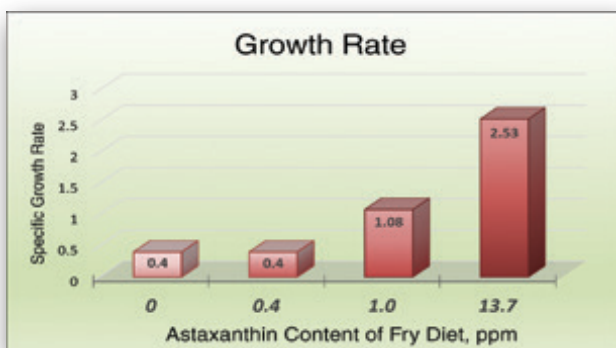
Astaxanthin at only 1 ppm increased young salmon's survival rates by a whopping 500%!

In addition to vastly improving survival rates, Astaxanthin also dramatically increased the salmon's growth rate. Feeds with 1 ppm Astaxanthin resulted in the salmon fry growing more than twice as fast. And at 13.7 ppm, there was a six-fold increase in growth rate (Christiansen, 1995a and 1995b).

How does Astaxanthin help these fish survive so much better and grow so much faster? The mechanism wasn't proven in this study, but it's likely related to improvements in immunity, stress resistance, and (once again) the dynamic duo of antioxidation and anti-inflammation.



Remarkably, adding a miniscule amount of Astaxanthin to salmon feed increased fry survival rates from 17% to 98%!



In addition to increasing survival rates, Astaxanthin helped the salmon to grow much faster.

Improved survival rates and increased growth rates are only two of the many different health benefits that have been documented in fish and other marine species. Additional research has found several other benefits:

- Improved immunity to disease
- Increased stress resistance
- Increased breeding
- Improved egg quality
- Increase in quantity of eggs
- Better feed conversion ratio (the amount of feed needed for weight gain) (Luzzano et al., 2003; Ilyasov and Golovin, 2003; Watanabe et al., 2003; Aquis et al., 2001; Darachai, 1999; Darachai, 1998.)

Chickens love Astaxanthin too. Dr. Lignell was awarded a US patent based on research that found diverse benefits from feeding Astaxanthin to breeding hens:

- Mortality and sickness both decreased
- Overall health status increased
- Fertility, hatching percentage and egg production increased
- Salmonella infections decreased dramatically
- Feed consumption decreased while feed utilization improved
- Growth rates during the first three weeks of life increased
- Mortality of young chicks caused by yolk sac inflammation decreased
- Interestingly, the eggs from chickens fed Astaxanthin retained the characteristics of fresh eggs for longer periods of storage (Lignell et al., 1998)

Summary: Potential Health Benefits of Astaxanthin for Animals

There have been so many studies showing so many potential health benefits for animals that I’ve already covered, I will simply list them here in one handy place:

Promotes cardiovascular health	Promotes energy	Increases longevity
Reduces high blood pressure	Prevents age-related macular degeneration	Reduces damage caused by blocked arteries
Improves blood lipid levels	Prevents cataracts	Decreases oxidative damage to the heart
Prevents clogging of cerebral blood vessels	Reduces blood pressure in the eyes	Reduces metabolic syndrome
Prevents cancer	Promotes kidney health	Improves blood flow
Prevents diabetes	Inhibits <i>H. pylori</i> bacteria	Reduces blood glucose levels
Prevents diabetic nephropathy	Prevents DNA damage	Increases insulin resistance
Improves immunity	Improves fertility	Reduces tumor size
Increases endurance	Improves semen quality	Increases strength
Prevents muscular atrophy	Promotes healthy mitochondria	Increases resistance to stress
Protects the brain	Prevents UV damage to skin	Protects brain cells from alcohol’s effects
Improves memory	Prevents cell death	Prevents muscle disease
Protects the eyes	Decreases oxidation	Decreases dementia

Reduces ulcers	Increases sperm count	Improves skin health
Improves growth rate in young animals	Reduces stillborn deaths	Reduces lactic acid levels
Aids the liver in detoxification	Prevents stomach lining damage	Reduces systemic inflammation
Improves survival rates	Improves spatial memory	Prevents cell membrane damage

In conclusion, if you love your pet or make a living from your farm animals, share your Astaxanthin with them.



Important Stuff: Safety, Bioavailability, Dosage & Delivery Methods

There are a few fundamental questions that many people will want answered before trying Astaxanthin. Chief among them is “Can I be sure that Natural Astaxanthin is safe?” People will also want to know if Astaxanthin is absorbed in the bloodstream and gets to all the important parts of the body. Next on the list is dosage levels for the various health benefits, followed by how to get that dosage into the body each day. I’ll start this chapter with a discussion of safety and then work through the rest of these important concerns one by one.

Safety

Number one on the list of “Important Stuff” is certainly safety. I talked about the safety of Astaxanthin in the anti-inflammatory section of Chapter 3: a major difference between Natural Astaxanthin and anti-inflammatory drugs is that there has never been a documented side effect or contraindication found for Natural Astaxanthin, while anti-inflammatory drugs have many side effects (some of which can be life-threatening).

However, not all Astaxanthin is equal. A vital factor to consider is the source of the Astaxanthin you’re considering. (As you’ll learn in the final chapter, the safety of Synthetic Astaxanthin made from petrochemicals and Astaxanthin produced from mutated *Phaffia* yeast is still in question.)



Astaxanthin is completely safe—provided it's derived from algae. That's the form that is found naturally in the food chain (in all of the seafood pictured here and more).

Natural Astaxanthin from algae is a health-giving part of the food chain that many marine species thrive on. It's been in the human diet since the first humans began eating salmon (or any other marine animal that's red). Salmon have the highest quantity of Astaxanthin of any animal. (But don't forget—you have to consider the source of the salmon: if it's wild, you're eating Natural Astaxanthin, while if it's farmed salmon, there's about a 98% chance you're eating Synthetic Astaxanthin.) The salmon species with the highest amount of Astaxanthin is sockeye salmon. If you eat 100 grams (about four ounces) of sockeye salmon each day, you'll get the equivalent of one 4mg capsule of Natural Astaxanthin. But if you eat farmed Atlantic salmon,

Natural Astaxanthin is Safe

In over 20 years of consumer consumption and extensive human clinical safety experiments (including acute and chronic toxicity tests), Natural Astaxanthin has never been shown to have any side effects or contraindications. In fact, there has never been a documented indication of toxicity or negative interaction between Natural Astaxanthin and any drug, supplement or food—not even an allergic reaction. Unlike synthetic and yeast-based forms, Natural Astaxanthin from algae has been deemed safe and accepted for human consumption by governmental regulatory authorities around the world.

you'd have to eat almost one kilogram (10X as much) to get 4mg of Astaxanthin, and it would almost definitely be the inferior and potentially unsafe synthetic variety.

Astaxanthin Levels in Wild Salmon

Species	Astaxanthin Range	Astaxanthin Average
Wild sockeye salmon	30-58 mg/kg	40.4 mg/kg
Wild coho salmon	9-28 mg/kg	13.8 mg/kg
Wild chinook king salmon	1-22 mg/kg	8.9 mg/kg
Wild chum salmon	1-8 mg/kg	5.6 mg/kg
Wild pink salmon	3-7 mg/kg	5.4 mg/kg
Wild Atlantic salmon	5-7 mg/kg	5.3 mg/kg
Average of all species		13.2 mg/kg

(Turujman et al., 1997)

Besides being an expert on Astaxanthin, Dr. Robert Corish (whom I quoted in Chapter 2) is also an expert on clinical toxicology. He clearly explains Natural Astaxanthin’s immaculate safety record in his book on Astaxanthin from a toxicologist’s perspective.

Dr. Robert Corish

The definition of LD-50 is the particular dose of medicine, nutritional supplement or other specific agent that will cause 50% of the subjects to die.

I know this sounds pretty scary and extreme, but rest assured,

Dr. Robert Corish (cont.)

these tests are performed on rats and usually at enormously unrealistic doses. The result from this data is then heavily adjusted to very safe levels for human use.

When the LD-50 was determined for Astaxanthin, rats were given over 12,000 mg per kg of body weight for over 90 days. Even at this huge dose there was no evidence of problems. Astaxanthin demonstrated:

- No signs of toxicity
- No evidence of tissue damage
- No blood bio-markers indicated damage

Another test called NOAEL (no adverse-effect level) determines the highest safe dose of an ingredient that can be given without causing side effects. Astaxanthin showed absolutely no mutagenicity (no cancer), no embryological toxic effects, and no teratogenic side effects (birth defects) in pregnant rabbits at doses up to 17,000 mg per kg.

The LD-50 and NOAEL results for Astaxanthin have proven it to be incredibly safe and would be considered very desirable if it was a pharmaceutical drug (Corish, 2015).

Bioavailability

After safety, bioavailability is the next most important factor to consider. This denotes how much of an ingested substance is getting into the bloodstream. A related consideration to bioavailability is what parts of the body the substance is able to reach after it gets into the bloodstream.

As with safety research, many animal and human studies have proven that Astaxanthin is bioavailable both as an extract as well as in its most natural form—as a dried algae powder. Once it gets into the bloodstream, it has been shown in various human clinical studies to act throughout the entire body and positively affect different organs and tissues.

Three different bioavailability studies have demonstrated that, regardless of

the form of Astaxanthin raw material, Astaxanthin appears in the bloodstream when ingested. These three clinical studies cover the three commercially available forms of Natural Astaxanthin raw materials, demonstrating bioavailability of each form in humans:

- Microencapsulated beadlets (Osterlie et al., 2000)
- Dried algae powder (Odeberg et al., 2003)
- Oil-based algae extract (Ruiz-Nunez et al., 2014)

(Please note: Microencapsulated beadlets are tiny gelatin capsules containing Astaxanthin. The capsules are so small that they cannot be distinguished as capsules without a microscope. The microencapsulation process is used as a protective measure for added stability. This is because different delivery methods may be compromised by oxygen and light, which can render Astaxanthin ineffective.)

So it's been demonstrated in clinical research that Astaxanthin is absorbed regardless of the form of the raw material. But there are still two important considerations to remember to get the maximum benefit from Astaxanthin supplementation:

- ➔ **Astaxanthin is absorbed better when taken with fat** (Odeberg et al., 2003). So always be sure to take Astaxanthin with a meal that has some fat in it.
- ➔ **Astaxanthin should be taken daily** (Ruiz-Nunez et al., 2014). These researchers concluded “Astaxanthin should be taken daily, at least in the early phase when total body equilibrium, if any, has not been reached yet.” While this study only lasted for 17 days, there is evidence from several human clinical studies that results generally improve after daily supplementation for 30 days and longer.

Dosage

Included in “The Healthy Ten” in Chapter 3 are dosage ranges for each of Astaxanthin's ten clinically-validated health benefits. Dosages for all health benefits fall

in the range of 4mg to 12mg per day with a few exceptions:

- One outlier is completely above this range (16mg per day for improving male fertility).
- While some studies of cardiovascular health have shown benefits from dosages as low as 4mg per day, others range as high as 18mg per day.
- On the lower end of this range, for immune system modulation and as an antioxidant, consumers can derive benefits from as little as 2mg per day. (However, that dosage may result in missing out on several of Astaxanthin's other health-giving properties.)

Recommended Dosages		
	Antioxidant	2 – 4 mg per day
	Immunity	2 – 4 mg per day
	Skin Health	4 – 6 mg per day
	Eye Health	4 – 8 mg per day
	Anti-Aging	4 – 12 mg per day
	Athletes & Energy	4 – 12 mg per day
	Joints & Inflammation	4 – 12 mg per day
	Cardiovascular Health	4 – 18 mg per day
	Brain Health	6 – 12 mg per day
	Male Fertility	16 mg per day

There are a few other key points to think through when considering the proper dosage for yourself, some of which I mentioned previously:

- ✓ Different people's bodies absorb carotenoids very differently. Generally, the range appears to run from as low as 5% absorption to over 90%. In fact, one early study found the range ran from 1% up to 99% (Parker et al., 1999). So if you don't find good results at 4mg per day, you should consider increasing to 12mg per day or even higher to improve the probability of attaining your desired results.
- ✓ As I mentioned in the section on bioavailability above, one way to ensure that the Astaxanthin is absorbed well is to always take your daily dose with a meal with some fats in it. Like all carotenoids, Astaxanthin absorbs better when taken with fat.
- ✓ An interesting study from Purdue University found that taking carotenoids with eggs leads to superior absorption (Kim et al., 2015).
- ✓ Starting supplementation with a "loading phase" of 24mg per day for the first month will allow the Astaxanthin to get throughout your body swiftly and start working its magic.
- ✓ Athletes and other people with an important event or a high intensity activity should consider taking 24mg per day for the month leading up to the event.
- ✓ For topical applications, make sure the product you use has at least 20 ppm Natural Astaxanthin and preferably 40 – 50 ppm to ensure a high level of efficacy.



Are you a 5% absorber or a 90% absorber? If you're not getting good results at 4mg per day, try upping your dose to 12mg or more per day since your body may only absorb as little as 5% of the carotenoids you ingest.

The average dose taken in the USA has increased over the last several years. When I first started taking Astaxanthin 17 years ago, most brands sold 2mg or 4mg capsules. Now, over 50% of the capsules sold in USA are 12mg. This may be more than necessary for people who absorb carotenoids well. But for those who don't, the chance of obtaining favorable results is greatly enhanced at 12mg per day as compared to 4mg per day. Without complicated blood analyses, it's not possible to know in advance how well your body will absorb carotenoids, so I recommend erring on the upper side when considering how many milligrams to take each day. And since Natural Astaxanthin has no known toxicity level, using a higher dose can't hurt you.

Delivery Methods

“Delivery methods” are ways to get a nutrient or drug into the body. These include capsules and tablets, functional foods and drinks, injections, transdermal topical products and more. You can also get your daily dose of Astaxanthin from eating red seafood, but only wild salmon has sufficient quantities of Natural Astaxanthin to have a preventive or therapeutic effect. (Don't forget that farmed salmon almost always contains Synthetic Astaxanthin, and other red seafood like crab, lobster and shrimp have very low levels of Astaxanthin.)



You can get the equivalent of 4mg of Natural Astaxanthin by eating 100 grams (about 4 ounces) of wild sockeye salmon every day.

To date, apart from natural food sources like salmon, about 90% of the Astaxanthin used by consumers around the world is ingested in softgel capsules,

hardshell capsules and tablets. Softgel capsules (which contain an oil-based extract of *Haematococcus* algae) have been the #1 delivery form for the last 15 years. Hardshell capsules and tablets (which contain either dried algae powder or microencapsulated beadlets, respectively) are next on the popularity list. A vital consideration (which I'll discuss in detail in Chapter 7) is that the quality of the Astaxanthin product varies substantially among suppliers, so be sure you get Astaxanthin from a reliable brand that sources from a NAXA (Natural Algae Astaxanthin Association) member.

Why I'm Not "Wild" About "Wild Salmon"

In 2005, the "New York Times" reported that most salmon being sold as "wild" in supermarkets was actually farmed. In 2006, "Consumer Reports" ran a similar article. Consumers were being cheated—paying more for fish they believed was wild when, in fact, it was plain old farmed salmon. Even if you can find genuine wild salmon, it's very expensive to eat every day. So unless you're eating wild salmon every day and you're sure that it's really wild, you're probably better off taking Astaxanthin in a capsule.



Dark red or almost black in color, softgel capsules have been the #1 delivery method for Astaxanthin for many years (left and center photos). This may change in the future as more foods and beverages with Astaxanthin emerge as well as whole food-based hardshell capsules containing Astaxanthin-rich natural algae powder (right photo).

It's important to remember that Astaxanthin is available not only as a pure "standalone" capsule or tablet, but also in formulas. Many excellent supplement brands include Astaxanthin in condition-specific formulas targeting a particular health concern (such as skin health, eye health, cardiovascular health, etc.). There are even a few human clinical studies on some of these "Astaxanthin Plus" formulas,

particularly for skin health. But the bulk of human research on Astaxanthin has been on standalone products. (The key concern with formulated products is whether they have a sufficient dose of Astaxanthin to get the desired result.) Also, some leading multivitamin brands add Natural Astaxanthin to their formulas. For example, GNC's two top-selling products (their men's and women's multivitamins) contain a small amount of Natural Astaxanthin.



GNC has been adding Natural Astaxanthin to their flagship multivitamin formulas for over 10 years.

The remaining 10% of the Astaxanthin used by consumers is mainly delivered topically or in beverages and foods. There are some Astaxanthin drinks in USA, Japan and Germany. Astaxanthin is also beginning to show up in some food products such as energy bars and chocolate. And there are a variety of topical products on the market (such as creams, lotions and sunscreens) for applying Astaxanthin directly on the skin.

There is a mountain of evidence demonstrating that antioxidants benefit the skin when applied topically, and because Astaxanthin is the strongest natural antioxidant, a little of it will go a long way. Concentrations as low as 20 parts per million (ppm) to 50 ppm are sufficient to have significant benefits for skin.

Most of these topical products have not been on the market as long as Astaxanthin capsules and tablets, so they are less widely used. But in the coming years, I expect to see the emergence of many more cosmetic products as well as foods and drinks containing Astaxanthin launched as consumers learn more about its outstanding health benefits and more companies seek innovative products to bring these benefits to their customers.

Currently, the most commonly used antioxidant in topical formulations is Vitamin E. However, Astaxanthin has 550X the singlet oxygen quenching ability of Vitamin E, so even as little as 20ppm in a topical product can yield real benefits.



Topical beauty and skin health products with Astaxanthin are becoming more popular.

Sunscreens with Astaxanthin from around the world. The middle product says on the label “Anti-Aging Formula,” and points out that Astaxanthin is 100 times more powerful than Vitamin E.

Astaxanthin can be used as a food color as well. Depending on the concentration, it can have a light peach to an intense blackish-red color. In the photo below, you’ll notice that at minute concentrations, Astaxanthin has an intense impact on the color of soy oil. At 20 – 50 ppm, the oil ranges from a salmon-hue to a medium red, but when you get up to 500 ppm, it’s almost black. And 500 ppm is only 0.05% Astaxanthin. (Once again, a little Astaxanthin goes a long way.)

Astaxanthin in Soy Oil

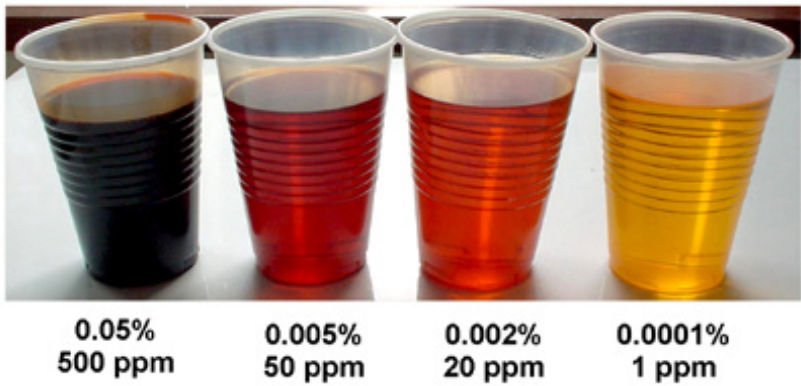


Photo courtesy of Food Ingredient Solutions, LLC, Teterboro, NJ.

At present, other natural sources for red food colors are limited and may not be desirable. The most popular one at this time is carmine, which is extracted from dead beetles. Natural Astaxanthin may be a more attractive choice for many people such as vegans and vegetarians and others averse to eating dead insects.

There are some unique delivery methods to get Astaxanthin into consumers' bodies. One of my favorites is used by the egg company from Sweden “Kronaggs Guldgula” that I mentioned in Chapter 1. This company feeds their hens Natural Astaxanthin, which makes the egg yolks come out a beautiful, deep golden color. In fact, this is how they named their product—“Guldgula” means “Golden Yolk.”

This company educates consumers about Astaxanthin's antioxidant benefits on their labels. So while many would consider eggs a commodity, they've created a *New and Improved Egg*. They price their eggs about 15% higher than competing eggs, but because consumers know how beneficial antioxidants are and want to eat healthier products, Kronaggs Guldgula carved out a nice market share with about 20% of the Swedish egg market.



Swedish egg producer Kronaggs educates consumers about Astaxanthin's antioxidant benefits right on their front label.

All internal delivery methods—capsules, tablets, food and drinks—seem to work equally well, as long as the manufacturer of the finished consumer product (1) uses a high quality Astaxanthin raw material and (2) protects the Astaxanthin from oxygen and light well during processing, packaging and shelf storage. Topical Astaxanthin products are used exclusively for skin health and have not been shown to have effects for the remaining nine of “The Healthy Ten” benefits, so their efficacy is not comparable to internal delivery methods.

So what's the best delivery method to get Natural Astaxanthin into your body? My recommendation is simple: find any product that you're willing to use on a daily basis from a brand that you trust and start taking Astaxanthin every day (and as soon as possible).

**Astaxanthin-enriched eggs already exist in Europe.
What will be the next unique delivery method?**



Maybe Astaxanthin toothpaste. There is a great deal of anecdotal evidence that Astaxanthin can help combat gum disease, most likely due to its anti-inflammatory properties. (In fact, one of the leading toothpaste manufacturers is already experimenting with Astaxanthin.)

In conclusion, Natural Astaxanthin is clinically proven to be safe. It is bio-available in humans regardless of the form of the raw material, and it has a unique property that allows it to reach throughout the entire body—into the skin, the muscles, the brain, the eyes, the heart and other organs—unlike many other antioxidants and anti-inflammatories.

Dosage in the range of 4mg to 12mg per day is a good general guideline that covers most of “The Healthy Ten” clinically-validated health benefits in humans. However, a loading dosage of 24mg per day for the first month of supplementation is a good way to ensure quicker action as the Astaxanthin concentrates throughout the body. The internal delivery methods currently used all seem to work equally well with regards to efficacy. Whether taken as an extract in gelcaps, as a powder or microencapsulated beadlet in hard-shell capsules or tablets, or incorporated into a food or beverage, Astaxanthin’s health benefits should be felt by most consumers (provided the Astaxanthin is derived from algae and comes from a quality producer and a trusted brand, as I’ll discuss in detail in the next chapter).

7

The Differences Chapter

I could have named this chapter “More Important Stuff” because what you’ll read below is equally important to what I covered in the chapter named “Important Stuff.” Below, I’ll summarize the crucial differences between:

- Astaxanthin and other supplements
- Sources of Astaxanthin
- Natural Astaxanthin producers
- Astaxanthin consumer products

Another way of putting what I’ll cover in this chapter—I’ll be answering these key questions that consumers should all ask themselves:

1. Why would I choose to take Astaxanthin instead of another supplement?
2. Why should I take Natural Astaxanthin from algae instead of Synthetic Astaxanthin or Astaxanthin from mutated *Phaffia* yeast?
3. Does it matter which company produces the Natural Astaxanthin I take?
4. How do I decide which of the many consumer products with Natural Astaxanthin is the highest quality and has the best chance of yielding the benefits I seek?

The Vast Differences Between Astaxanthin and Other Supplements

First of all, I must point out that there are many wonderful, health-giving nutritional supplements. There are also many other supplements that I wouldn't consider taking because there is insufficient research to establish their efficacy or safety. I've

The Supplement Funnel: Choosing a Supplement



Put all the supplements into a funnel to find your optimal choice.

DIFFERENCE #1: DIFFERENCES WITH OTHER SUPPLEMENTS

personally taken numerous different supplements over the years, but in the last 15 years I've isolated a small handful that I faithfully take on a daily basis. What is the primary reason I take these particular supplements? Because there is a solid body of human clinical research demonstrating efficacy for a specific health benefit I seek. In my particular case, the two major benefits of interest are: cardiovascular support and general “anti-aging” protection. Astaxanthin is by far the top supplement that I will never go without due to the mass of evidence that demonstrates efficacy for anti-aging and cardiovascular health. And when I think about how I no longer suffer from joint and muscle soreness or get colds as I used to before starting on Astaxanthin 17 years ago, it's a complete no-brainer that this is far and away the best supplement for me.

But different people have different health priorities. The fundamental question for each person deciding which supplement to take really comes down to “What's in it for me?”



There is a dizzying array of different supplements to choose from. The key question in deciding which to take is: “What's in it for me?”

To help readers understand why Astaxanthin is such a great choice for so many people, I'll first tell you the reasons why it should be the #1 choice for people over 40, and then briefly state why it is also a smart choice for younger people as well.

Top Ten Reasons Natural Astaxanthin is the Ultimate Anti-Aging Supplement



Depth of Research

Many people in the supplement business can't believe the depth of research when I send them the compilation of Astaxanthin medical research summaries. There is one study summary per page and the document is over 600 pages long! Along with #2 below, this is the best proof that Natural Astaxanthin works.



Quality of Research

If the 600+ page compilation of research summaries were full of studies with mixed results or inconclusive findings, or if there were no human clinical trials, it wouldn't be a meaningful list. But the fact is that the quality of the research is first-rate, with dozens and dozens of positive human clinical studies and straightforward, conclusive results showing great potential for Astaxanthin as a preventive and, in many cases, therapeutic health aid. This is truly remarkable for a nutritional supplement.



Diversity of Health Benefits

Many supplements target just one health issue. (For example, glucosamine is marketed exclusively for joint health.) Most of the others target two or maybe three health issues. (For example, fish oil is for cardiovascular health and brain health.) As you've learned in "The Healthy Ten" chapter, Natural Astaxanthin targets ten different health issues (so far), making it the champ with regard to diversity. (And if some of "The Unproven Five" potential benefits are validated in human clinical trials, the contest will be even more of a rout for Astaxanthin.)



Quality of Health Benefits

When you examine "The Healthy Ten," you see that, for the most part, they address critical issues for people as they age. Vitality, cellular health, preventive health in diverse organs that decline

in middle age and beyond—most of the key concerns of aging are covered in a single supplement.



Diversity of Health Benefits Within Each Area

In many of “The Healthy Ten,” we see a pattern in which Astaxanthin addresses numerous health issues for each organ or health system. For example, it can help the eyes in a dozen different ways—improving the ability to see fine detail, preventing eye fatigue, reducing eye strain, improving focus, increasing blood flow to the retina, and more.

There are other, often better known, supplements that are marketed to many of the health concerns described in “The Healthy Ten.” But if you compare their performance to Astaxanthin, they usually fall short. For example, comparing Astaxanthin as an antioxidant to commonly used supplements like CoQ10 and Pycnogenol® is easy. You can do it numerically—Astaxanthin is 18X stronger than Pycnogenol® in free radical elimination and 800X stronger than CoQ10 in singlet oxygen scavenging. Or you can do it qualitatively—Astaxanthin has a package of six qualitative properties that neither Pycnogenol® nor CoQ10 can boast.

This advantage holds in other areas described in “The Healthy Ten,” as can be seen if you examine the clinical research more closely. For example, the most well-known supplement for joint health issues is glucosamine. Yet some studies on glucosamine have shown little or no effect. One large-scale study showed that subjects given the full recommended dose of glucosamine fared no better than subjects who were given a placebo (Clegg et al., 2006). Astaxanthin consistently shows positive effects across each of “The Healthy Ten.”



Broad Spectrum Activity

Complimenting #5 above, the research shows that Astaxanthin often attacks a single problem from multiple angles. For example, as an anti-inflammatory, it doesn't simply target the Cox-2

enzyme like many NSAIDs; rather, it gently targets eight different inflammatory markers. And this is the case in several other areas such as cardiovascular health, antioxidant activity and immune system modulation, where Astaxanthin consistently assumes a multiple-pathway approach.

Ultimate Anti-Aging Supplement #7

Ability to Act Throughout the Entire Body

A supplement can't help an organ if it can't reach it. Astaxanthin acts throughout the entire body to help all of our vital organs and protect all our cells. Most supplements can't do this. Even some other carotenoids in the same family as Astaxanthin can't reach the brain and eyes or bond with muscle tissue.

Ultimate Anti-Aging Supplement #8

Strongest and Highest Quality Natural Antioxidant

This and the following two anti-aging qualities in this list are all related to cellular health. And cellular health is probably the single most essential function of an anti-aging supplement: if you can keep the various cells throughout the body healthy, there's a very good chance the whole body will remain healthy. Keeping free radicals from damaging cells is one of Astaxanthin's two foundational properties in keeping human cells healthy.



Protecting cells becomes more important after you reach age 40.

Ultimate Anti-Aging Supplement #9

Safe and Natural Anti-Inflammatory

The second foundational property for cellular health is controlling inflammation. Astaxanthin acts through multiple pathways to gently and safely reduce inflammation in the body. This includes

silent inflammation which, along with oxidation, is one of the “evil twins” and a root cause of many life-threatening diseases. It also reduces acute inflammation which can result in chronic pain.



Other Cellular Health Properties

Astaxanthin has also been shown in many studies to protect two vital cell components: DNA and mitochondria. It has been documented that Astaxanthin prevents damage to DNA (up to 40% reduction at low dosage according to the research by Dr.

Chew). Plus, over a dozen pre-clinical trials have shown that it also protects the energy-producing part of the cell, the mitochondria.

Outstanding for People Under 40 As Well

I've focused on the anti-aging properties of Astaxanthin to demonstrate the ten ways it's superior to other supplements. But it's important to remember that it's not just for people who are over 40—it's a fantastic supplement for younger people as well. What person of any age wouldn't want benefits like more energy, better resistance to colds and flu, improved performance in athletic activities, increased strength and endurance, and improved skin health and protection from UV damage? There is no doubt that Astaxanthin is beneficial for everyone, regardless of age.



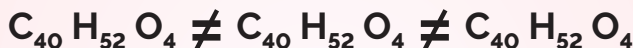
Natural Astaxanthin: Good for young people and the young-at-heart.

In conclusion, there are ten clear reasons why Astaxanthin should be the supplement of choice for anyone over the age of 40. And there are several reasons why it's a great supplement for people under 40 as well.

The Vast Differences Between Sources of Astaxanthin



I give a lot of credit to anyone who understands the subtitle of this section:



Unless you're a PhD organic chemist like my co-author Dr. Lixin, you probably have no idea what I'm trying to say. $\text{C}_{40}\text{H}_{52}\text{O}_4$ is the chemical formula for Astaxanthin. In fact, it's the chemical formula for all three Astaxanthin forms I'll discuss in this section. These three products are from extremely different sources. And other than sharing the same chemical formula, they have absolutely nothing in common with each other—they're as different as black and white.

The Astaxanthin source I've focused on in this book is the natural one from algae. But I've also mentioned the two other sources that are sold in a few consumer products (albeit in extremely small quantities and from supplement brands who may not be aware of the huge differences between the different forms). Synthetic Astaxanthin is made from petrochemicals—the same thing you put into your car's crankcase, and also one of the main components in plastic. *Phaffia*-derived Astaxanthin is made from yeast that has been genetically manipulated. As you'll soon see, both of these forms are vastly inferior to Astaxanthin from algae, and neither has been proven safe for long-term human consumption as Astaxanthin sourced from algae has. As my friend Dr. Bill Sears says when comparing Natural to Synthetic Astaxanthin, "Remember: Dr. Mother Nature has had a much longer history of 'manufacturing' the right nutrients in the right proportion than have chemical factories" (Sears, 2015).



Supplementing with Synthetic Astaxanthin from petrochemicals can be compared to drinking motor oil.

Know the Source!

The source of Astaxanthin is a critical topic for people in the supplement industry, as well as consumers, since synthetically-produced Astaxanthin is now being misleadingly promoted as “Nature Identical.” Synthetic Astaxanthin has been used for over 30 years in the animal feed industry, primarily to pigment the flesh of farm-raised salmon. In fact, it’s the most commonly sold form of Astaxanthin due to the huge size of the farmed salmon industry. Yet it was only introduced as a human nutritional supplement in 2013 after several famous doctors and opinion leaders started publicizing what an excellent supplement Natural Astaxanthin is, and Astaxanthin’s popularity skyrocketed. Fortunately,

Go Wild

The small amount of Synthetic Astaxanthin found in farmed salmon isn’t going to kill you, but it’s nothing like eating wild salmon that are loaded with Natural Astaxanthin. Wild salmon also taste better and have higher levels of Omega-3 fatty acids, another health-giving nutrient.

you still can't buy Synthetic Astaxanthin as a human health supplement in most countries because governmental regulators don't allow it to be sold due to efficacy and safety concerns.

Phaffia rhodozyma (whose official nomenclature was changed recently to *Xanthophyllomyces dendrorhous* but is still commonly referred to as “*Phaffia*”) is a species of yeast which, in nature, produces small amounts of Astaxanthin (only about 300 ppm). Companies involved in the commercial production of *Phaffia* have genetically manipulated this species to produce exponentially more Astaxanthin—more than 30X the amount found in wild *Phaffia*. This genetic manipulation can involve mutagenic chemicals, gamma radiation or other unnatural treatments or processes. The genetic manipulation results in changes to metabolic pathways in the yeast, meaning that *Phaffia*-derived Astaxanthin is not a natural product.

Government Regulators Have Concerns with Synthetic and *Phaffia*-derived Astaxanthin

Important safety concerns have been raised about human consumption of both *Phaffia*-derived and Synthetic Astaxanthin. Use of these forms in human nutritional supplements is still prohibited in most countries. In the USA, Synthetic Astaxanthin has never undergone a New Dietary Ingredient petition with the U.S. Food and Drug Administration, while algae-based Astaxanthin has been allowed by FDA at doses as high as 24mg per day. Astaxanthin from *Phaffia* is allowed for human consumption by the US FDA. However, due to safety concerns, the FDA places these restrictions on its use:

- Maximum dosage of 2 mg per day
- Only permitted for limited durations of time
- Not permitted for use by children

Natural Astaxanthin from algae is a 100% natural product. It comes in a synergistic complex that includes three different types of Astaxanthin along with a blend of naturally-occurring carotenoids (which, while not as extraordinary as

DIFFERENCE #2: DIFFERENCES WITH OTHER SOURCES OF ASTAXANTHIN

Astaxanthin, have some health-giving properties in their own right). Algae-based Astaxanthin has been approved by regulatory bodies around the world after intense scrutiny of its safety profile and its long list of clinically-validated health benefits.

Petrochemical Plant



Genetic Manipulation



Natural Astaxanthin Farm



Which would you rather take: Astaxanthin from petrochemicals, from a genetically manipulated yeast, or from an algae farm in a pristine growing region?

Natural Astaxanthin from Algae is 20X to 90X Stronger as an Antioxidant than Synthetic Astaxanthin

A groundbreaking series of head-to-head antioxidant experiments demonstrated that Natural Astaxanthin is clearly superior to Synthetic Astaxanthin in antioxidant strength. In both university research at Creighton University (under the auspices of acclaimed antioxidant researcher Debasis Bagchi, PhD), as well as in independent laboratory testing at Brunswick Laboratories, Natural Astaxanthin extracted from microalgae was found to be a minimum of 20X stronger in antioxidant activity than Synthetic Astaxanthin produced from petrochemicals (Capelli et al., 2013).

Further corroborating this breakthrough research, a recent study by French university professors in conjunction with a leading medical doctor again showed how much stronger Natural Astaxanthin is than Synthetic Astaxanthin. These researchers tested two forms of Natural Astaxanthin from *Haematococcus* microalgae against Synthetic Astaxanthin in two different models: the Trolox equivalent antioxidant capacity assay and HUVEC (human umbilical vein endothelial cells). The two natural forms tested were algae extracts produced by supercritical CO₂

extraction and by solvent extraction. Both of the extracts with Natural Astaxanthin were found to be 90X stronger as an antioxidant than Synthetic Astaxanthin—and with absolutely no sign of toxicity. The research team concluded: “The intracellular antioxidant activity in natural extracts was approximately 90 times higher than Synthetic Astaxanthin... Therefore, these results revealed the therapeutic potential of the natural extracts in vascular human cell protection against oxidative stress without toxicity, which could be exploited in the prevention and/or treatment of cardiovascular diseases” (Regnier et al., 2015).

Natural Astaxanthin  **Synthetic Astaxanthin**
(by 20X to 90X)

University research in USA and Europe as well as independent lab analyses confirm that Natural Astaxanthin is 20X to 90X stronger than Synthetic Astaxanthin as an antioxidant. You can't beat Mother Nature.

Animal Research Shows Huge Differences in Efficacy Between Algae-Based Astaxanthin and *Phaffia*-Derived and Synthetic Astaxanthin

There are five pre-clinical trials indicating that Natural Astaxanthin from algae is superior to Synthetic and *Phaffia*-derived Astaxanthin in different animals and in many ways.



Natural Astaxanthin fed to rats was shown to have superior antioxidant activity and better protective properties for the liver as compared to Synthetic Astaxanthin. The researchers concluded that Natural Astaxanthin showed “better hepatoprotection and antioxidant activity, therefore it can be used in pharmaceutical and nutraceutical applications” (Rao et al., 2013).



A study published as a joint project between the Department of Food Science at the University of Massachusetts and the Department of Food Science at South China Agricultural University tested all three forms of Astaxanthin against each other. This trial employed *C. elegans*, the worm species I mentioned in Chapter 3 that is commonly used as a model organism for longevity and antioxidant testing. The worms were separated into four groups: an untreated control group; a group treated with Natural Astaxanthin from algae; a group treated with Astaxanthin from the mutated yeast *Phaffia*; and finally, a group treated with Synthetic Astaxanthin.

The worms underwent oxidative stress for 24 hours by being treated with paraquat (a toxic, fast-acting herbicide). The worms were tracked for five days after exposure. Amazingly, by the fifth day, Natural Astaxanthin had kept approximately 50% more of the worms alive compared to the control group. Though the two unnatural Astaxanthin forms also decreased mortality, they were less effective than Natural Astaxanthin. Additional results indicated:

- Antioxidant enzyme superoxide dismutase (SOD) was approximately 50% higher in the Natural Astaxanthin group than the control group.
- Antioxidant enzyme catalase was approximately 90% higher in the Natural Astaxanthin group than the control group.
- The Natural Astaxanthin group was higher than both the *Phaffia* Astaxanthin and Synthetic Astaxanthin groups in SOD and catalase.
- Relative fluorescence intensity (which indicates the accumulation of reactive oxygen species) was much lower in all Astaxanthin groups compared to the control group, again with Natural Astaxanthin being the best performer:
 - Natural Astaxanthin performed 33% better than *Phaffia*.
 - Natural Astaxanthin performed 82% better than Synthetic Astaxanthin.
- SOD-3 is an enzyme that neutralizes free radicals in the mitochondria of the cells. The Natural Astaxanthin group had significantly higher levels of SOD-3 than the *Phaffia* and Synthetic Astaxanthin groups during the first to third days after paraquat was introduced (Liu et al., 2016).

**Proof that
Natural is
More Effective
#3**

A study done in 2005 at a university in Japan showed that algae-based Astaxanthin protects rats from ulcers. This was not surprising, as it's been documented that Astaxanthin has potential to prevent ulcers, particularly ulcers caused by the bacterium *H. pylori* (Bennedsen et al, 1999; Wang et al., 2000; Akyon et al., 2002) and ulcers caused by damaging substances such as alcohol (Kim et al., 2005a; Kamath et al., 2008), naproxen (Kim et al., 2005b) and acetic acid (Yang et al., 2009).

Of greater interest were the comparisons between the different forms of Astaxanthin. This study tested the three forms of Astaxanthin as well as beta-carotene and Vitamin C. All the rats given carotenoids (all three forms of Astaxanthin and beta-carotene) were appreciably protected against the formation of gastric ulcers as compared to rats in the control group and the group given Vitamin C. But the rats given algae-based Astaxanthin did the best of all: "Ulcer indexes in particular were smaller with the rat group fed Astaxanthin extracted from *Haematococcus* than the other groups" (Nishikawa et al., 2005).

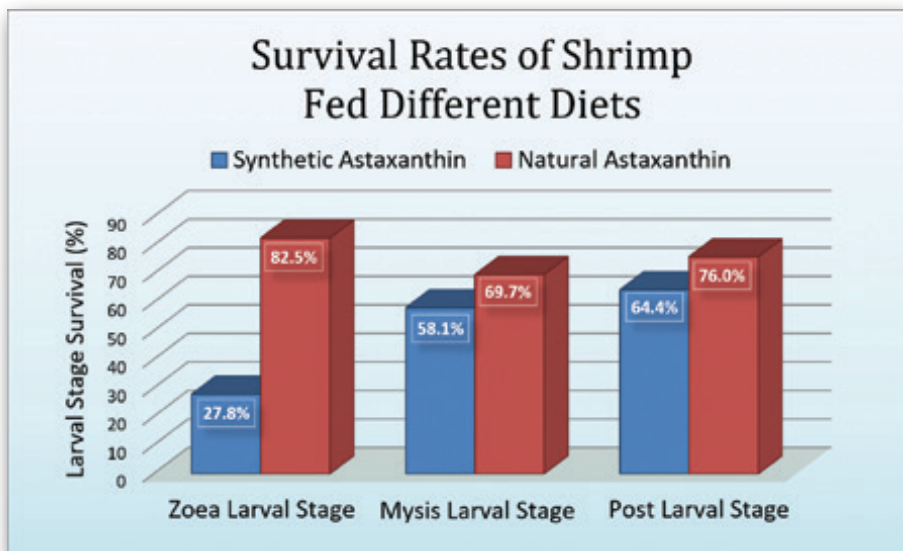
**Proof that
Natural is
More Effective
#4**

In 2008, a similar study was done on the effects of Astaxanthin on ulcers in rats. This study tested synthetic against algae-based Astaxanthin, but did not include *Phaffia*-derived Astaxanthin. They pretreated rats with either Natural or Synthetic Astaxanthin, and then subjected the rats to ethanol to induce ulcers. Synthetic Astaxanthin was completely ineffective at inhibiting ulcer formation. But remarkably, Natural Astaxanthin showed inhibition of ulcers at a level that is better than the ulcer drug omeprazole (which is sold under the brand name Prilosec®). In addition, inhibition of lipoxxygenase was 23X stronger for Natural Astaxanthin compared to Synthetic. Natural Astaxanthin showed a "dose-dependent gastroprotective effect on acute, ethanol-induced gastric lesions in rats... Presence of Astaxanthin esters in *Haematococcus pluvialis* has an added advantage that, generally carotenoids, although potential antioxidants, may lack such properties in vivo because of the pro-oxidant effect. Esterified Astaxanthin [Natural] shows comparatively better stability than free Astaxanthin [Synthetic], and hence it may exhibit more health beneficial effects than free Astaxanthin" (Kamath et al., 2008).

**Proof that
Natural is
More Effective
#5**

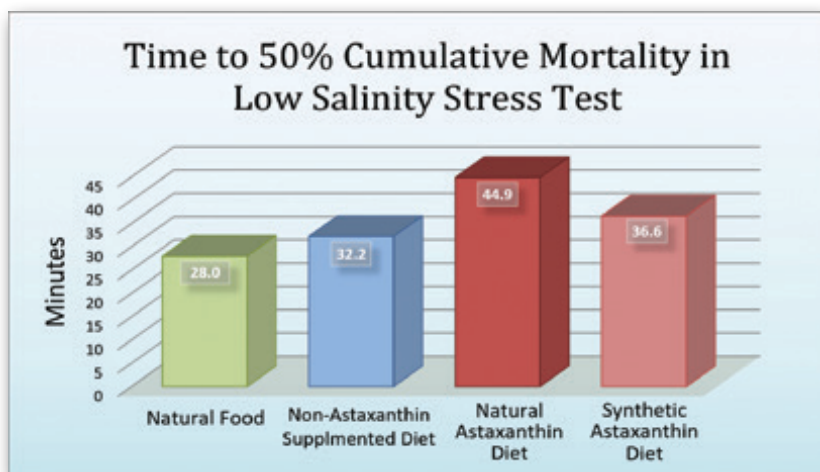
The very first study of how different forms of Astaxanthin affect the health of an animal was done in 1998. This study focused on a species of shrimp called *Penaeus monodon* (commonly known as the giant tiger prawn). The research was conducted at a university in Thailand in support of the large shrimp-farming industry in that country. They did a series of tests at three different larval and post-larval stages during the shrimp's life cycle. They separated the shrimp into four different groups:

- One treatment group was fed a commercial diet with Natural Astaxanthin from *Haematococcus* algae.
- The second treatment group was fed a commercial diet with Synthetic Astaxanthin.
- One control group was fed the same commercial diet without any addition of Astaxanthin
- A different control group was fed a natural diet that the shrimp would normally eat in the wild.



Huge Differences in Survival Rates: In the Zoea (middle) stage, only 28% of the larvae fed Synthetic Astaxanthin survived while 83% of the larvae fed Natural Astaxanthin survived.

In all three life cycle stages tested, the shrimp fed Natural Astaxanthin survived at higher rates than shrimp fed Synthetic Astaxanthin. Fifteen days after the post larval stage, shrimp fed algae-based Astaxanthin were showing better survival rates than all three other groups (even better than the shrimp fed a diet that they would normally eat in the wild). In addition, tests in low water salinity (to examine effects on environmental stress) were performed to examine the different groups' tolerance levels. The shrimp fed the algae-based Astaxanthin diet again outperformed all others—shrimp from all three other groups died sooner than the shrimp fed Natural Astaxanthin when subjected to low salinity.



The Natural Astaxanthin diet was the most effective in preventing larvae death under stressed conditions (low salinity).

There were statistically significant differences in growth rates as well—shrimp fed either Natural Astaxanthin or the natural diet grew faster than shrimp fed Synthetic Astaxanthin or the commercial diet without Astaxanthin.

A particularly interesting finding of this study was that, in many cases, the shrimp fed Synthetic Astaxanthin were the poorest performers. For example, in two larval stages, all three other groups outlived the shrimp fed Synthetic Astaxanthin. This shows that Synthetic Astaxanthin is certainly not “Nature Identical.” Not only couldn’t Synthetic perform as well as Natural Astaxanthin in this study, it actually made the shrimp die sooner than they would have without it!

Darachai et al., 1998

From our results, the highest survival rate of zoea and mysis [two larval stages] was obtained with shrimp fed algae-based Astaxanthin, followed by the natural diet, the commercial diet without Astaxanthin and the Synthetic Astaxanthin diet in descending order. This indicated that shrimp larvae accept Natural better than Synthetic Astaxanthin... The postlarvae after 15 days fed natural diets containing Natural Astaxanthin were larger than those fed diets containing Synthetic Astaxanthin or no Astaxanthin. The best postlarval growth was in the group fed algae-based Astaxanthin and was significantly better than that for the groups fed Synthetic Astaxanthin. This indicated that Astaxanthin from *Haematococcus pluvialis* (mostly in esterified form) performs significantly better than free, Synthetic Astaxanthin... Determination of 50% cumulative mortality upon low salinity challenge showed that larvae fed algae-based Astaxanthin endured better than larvae fed the natural diet, the Synthetic Astaxanthin diet and the commercial diet without Astaxanthin (Darachai et al, 1998).

Among many interesting aspects of this study, one of the most intriguing is that both shrimp in a healthy environment and shrimp subjected to stress (by being put in a low salinity environment) were examined. In both cases, Natural Astaxanthin helped the shrimp survive much better when compared to Synthetic Astaxanthin. The final statement of this study summarizes the results nicely: "Although the mechanism by which Astaxanthin improved the response to stress cannot be explained, the information that Natural Astaxanthin (from *Haematococcus pluvialis*) is more efficacious than Synthetic Astaxanthin for growth, survival and stress resistance of shrimp larvae should be useful for further research on shrimp larval nutrition" (Darachai et al., 1998).

These five comparative animal studies show that survival rates, resistance to stress, protection of the liver, prevention of gastric ulcers, growth rates and longevity all show better results when animals are fed Natural Astaxanthin from *Haematococcus* microalgae than

when animals are fed Astaxanthin from other forms or control diets without Astaxanthin. But a key question remains: does this research relate to the use of Astaxanthin in humans? We don't know, because so far there hasn't been a single clinical trial showing **ANY** health benefit in humans for Astaxanthin from mutated *Phaffia* yeast or Synthetic Astaxanthin from petrochemicals. Of even more concern, I'm not aware of any safety studies in humans for *Phaffia* or Synthetic Astaxanthin. Without clinical trials showing health benefits and extensive safety research in humans for these other forms, I highly recommend that consumers avoid being the guinea pigs with these questionable products. In fact, it's hard to imagine why anyone would experiment on themselves by taking these untested forms since Astaxanthin from microalgae (which has approximately 100 human clinical trials showing various health benefits and extensive safety data) is widely available.

Safety of *Phaffia*-Derived and Synthetic Astaxanthin is a Troubling Question

It's particularly important to understand the safety concerns with Synthetic and *Phaffia*-derived Astaxanthin. As I mentioned above, the US FDA is so concerned with the mutated yeast form that they do not recommend it for long-term use or for children, and only allow it to be used at a level of 2mg per day. The safety concerns with Synthetic Astaxanthin are even more serious.

Other nutrients that come in synthetic forms also have safety concerns. In fact, even with molecules in the carotenoid family that are closely related to Astaxanthin, synthetic forms have been found to have grave concerns. The reason that synthetic nutrients may have compromised safety is not yet understood by scientists. One theory is that a molecule that has been synthesized may not contain all physiologically active components that exist in the natural version. A good example of this is Vitamin E, whose synthetic version is dl-alpha tocopherol which is a mixture of two molecules: d-alpha tocopherol and l-alpha tocopherol. But in nature, the Vitamin

E complex contains several different tocopherols and tocotrienols. And in fact, the tocotrienol constituents yield outstanding health benefits while the tocopherol constituents are not nearly as active (Sen et al., 2006; Beoy et al., 2010; Magosso et al., 2013; Haghighat et al., 2014).

As excellent examples of why we should be wary of synthesized nutrients, two carotenoids closely related to Astaxanthin have shown grave safety concerns in their synthetic forms:

Beta-Carotene. There are hundreds of published studies showing potential health benefits for beta-carotene for conditions including immunity as well as prevention of cancer (Moorhead et al., 2005). However, the natural and synthetic forms are very different. For one, synthetic beta-carotene is not absorbed well. In fact, one study indicated that natural beta-carotene absorbs 10X better than its synthetic cousin in rats and chickens (Ben-Amotz et al., 1989). With regard to antioxidant potential, synthetic versus natural beta-carotene mimics the results with Astaxanthin. The 9-cis beta-carotene form (which is found in high amounts in natural beta-carotene) is a more efficient lipophilic antioxidant than the synthetic form (Ben-Amotz et al., 1996).

Now for the top concern: safety. A famous study done in Finland in the 1990s tested synthetic beta-carotene on heavy tobacco smokers. The results of this study were surprising in light of dozens of pre-clinical trials and epidemiological studies that indicated natural beta-carotene has cancer-preventative properties (Moorhead et al., 2005). The results of this large-scale study showed a slight *increase* in cancer among the subjects supplementing long-range with synthetic beta-carotene (Heinonen and Albanes, 1994). Imagine how shocked people were who were taking beta-carotene as a cancer-preventive supplement when newspaper headlines read “Beta-Carotene Increases the Risk of Cancer.” However, subsequent research that compared natural beta-carotene extracted from *Dunaliella salina* microalgae with synthetic beta-carotene indicated that it's only the

Even though natural and synthetic beta-carotene have the same chemical formula (as is the case with the natural and synthetic forms of Astaxanthin), they are different in every other way. Natural beta-carotene is absorbed better, has stronger antioxidant activity, and may prevent cancer; meanwhile synthetic beta-carotene may actually cause cancer.

synthetic form which may be involved in the formation of cancer. In fact, the study concluded that natural beta-carotene could be valuable in tumor prevention and supplementary treatment (Xue et al., 1998).

Canthaxanthin. Another synthetic carotenoid was taken off the market because of serious health concerns. Canthaxanthin is much more closely related to Astaxanthin than is beta-carotene—it's in the same subgroup of carotenoids as Astaxanthin called “xanthophylls.” As in the case of Synthetic Astaxanthin, synthetically-produced canthaxanthin has been sold for many years for inclusion in animal feeds. But for a short time in the 1980s, synthetic canthaxanthin was sold for human use as an internal tanning pill—people who took high doses of this product got a tan without going out in the sun.

After consumers started using the tanning pills with synthetic canthaxanthin, an unforeseen side effect appeared: golden crystals formed in consumers' retinas. When this was discovered, synthetic canthaxanthin was immediately removed from the supplement market. In addition, regulators around the world began limiting or prohibiting the use of synthetic canthaxanthin in animal feed due to this serious safety concern (European Commission, 2002; Australia New Zealand Food Standards Code, 2011). The crystallization in the retinas eventually disappeared, but it is extremely disconcerting how long it took for complete reversal: follow-up

NAXA President Quashes Synthetic Astaxanthin

There are only a few consumer brands in the world that use Synthetic Astaxanthin or *Phaffia*-derived Astaxanthin. In the USA, there have been only two that I know of that knowingly marketed Synthetic Astaxanthin. In addition, there have been cases where small brands with insufficient quality controls have unknowingly marketed the synthetic form after an unscrupulous raw material supplier claimed it was the natural form.

But a few years ago, one of the three largest supplement brands in the USA (which shall remain nameless) knowingly launched a consumer product with Synthetic Astaxanthin. After learning of this, NAXA (Natural Algae Astaxanthin Association) President Scott Steinfeld carefully crafted a letter outlining some of the key points described in this chapter about Synthetic Astaxanthin's lack of safety data and unproven health benefits (due to the complete absence of human clinical studies). To its credit, the supplement brand promptly discontinued the Synthetic Astaxanthin product from its line.

research published in 2011 found that complete disappearance of the golden crystals took approximately 20 years (Hueber et al., 2011).

With evidence showing that other synthetic carotenoids increased the incidence of cancer and caused crystallization in the retina, I was very surprised to see Synthetic Astaxanthin introduced to the human supplement market without doing long-range safety studies in humans. In addition, Synthetic Astaxanthin's efficacy is poor—compared to Natural Astaxanthin, it's 20X to 90X less potent as an antioxidant. And as you've just read, five animal trials showed that Natural Astaxanthin has vastly superior health and longevity benefits compared to the synthetic form. Despite these profound differences, Synthetic Astaxanthin is being marketed as “Nature Identical,” which is very misleading. The conclusion of the Creighton University study testing Synthetic versus Natural Astaxanthin clearly summarizes the case against Synthetic Astaxanthin:

Capelli et al, 2013

For these reasons, the authors recommend against the use of Synthetic Astaxanthin in human nutraceutical supplements until extensive, long-range safety parameters are established and human clinical trials showing health benefits are conducted. In the event that Synthetic Astaxanthin attains these two milestones, due to the extensive differences between the two molecules, it should be distinctly labeled as “Synthetic Astaxanthin” on consumer product labels, and dosage levels should be approximately 20X to 30X higher than those of Natural Astaxanthin in order to obtain similar antioxidant activity (Capelli et al, 2013).

Summary of Differences Between the Three Sources of Astaxanthin

- ➔ **Shape.** Natural Astaxanthin molecule's stereochemistry is unique (it is shaped differently than the Synthetic and the *Phaffia* Astaxanthin molecules).

- ➔ **Esterification.** Natural Astaxanthin is 95% esterified (it has a fatty acid molecule attached to either one or both ends of the Astaxanthin molecule). Synthetic and *Phaffia* Astaxanthin are exclusively “free” Astaxanthin and do not have fatty acid molecules attached.
- ➔ **Synergy.** Natural Astaxanthin from algae comes complexed in nature with supporting carotenoids: there are small amounts of other antioxidant carotenoids such as lutein, beta-carotene and canthaxanthin (ranging from 3% - 15% of the total carotenoid fraction) which work in unison with Astaxanthin to provide a synergistic effect when ingested. Synthetic and *Phaffia* Astaxanthin do not contain supporting carotenoids.
- ➔ **Source.** Synthetic Astaxanthin is synthesized from petrochemicals in an elaborate process. *Phaffia* Astaxanthin is produced from genetically-manipulated yeast. Natural Astaxanthin is grown as natural *Haematococcus pluvialis* microalgae.
- ➔ **Safety.** Natural Astaxanthin has an extensive portfolio of human safety studies and a 20-year history of safe use as a commercially-sold nutritional supplement. Synthetic Astaxanthin has never been directly tested in humans for safety. (This is a vital concern due to serious safety issues with the related synthetic carotenoids beta-carotene and canthaxanthin.) Meanwhile, the US FDA is so concerned with *Phaffia* Astaxanthin from mutated yeast that they do not allow it for long-term use or for children, and they only allow it to be used at a level of 2mg per day.
- ➔ **Efficacy.** The fact is that Synthetic and *Phaffia* Astaxanthin have never been shown to have any health benefit in human clinical research. They are completely untested in humans and there is a possibility that they do not have any health benefit

at all, even at high doses. Meanwhile, Natural Astaxanthin has been shown to have diverse health benefits in approximately 100 different positive human clinical trials. The consistent findings in five different animal trials show that Astaxanthin from algae is superior to the other forms in increasing survival rates, improving resistance to stress, protecting the liver, preventing gastric ulcers, increasing growth rates and increasing longevity.

- ➔ **Antioxidant Strength.** Natural Astaxanthin is at minimum 20X to as much as 90X stronger than Synthetic Astaxanthin as an antioxidant. There have not yet been head-to-head antioxidant comparisons between Natural and *Phaffia* Astaxanthin. However, there is likely a vast disparity in antioxidant activity between these molecules as well (because *Phaffia* is chemically similar to Synthetic Astaxanthin).
- ➔ **Stability.** Testing by the independent trade association NAXA found that Synthetic Astaxanthin bought at retail showed significantly faster degradation than Natural Astaxanthin from algae.
- ➔ **Dosage.** In the event that Synthetic Astaxanthin is ultimately proven safe for long-range human consumption, dosages would logically be a minimum of 20 times greater than corresponding dosages of Natural Astaxanthin due to its vastly inferior antioxidant profile. This high dosage requirement would make Synthetic Astaxanthin too costly for the average consumer (Capelli et al., 2013). And while the difference in antioxidant strength between *Phaffia* and Natural Astaxanthin remains unknown so far, due to safety concerns, the maximum allowed dosage of *Phaffia* Astaxanthin in the USA is only 2mg per day. This dosage level is too low to achieve most of the health benefits which have been found through clinical research.

Shape Matters!



If a human being were shaped differently, would he or she be the same? If your arms were in a different location, you'd perform differently. (For example, you sure wouldn't win any Olympic medals for swimming.) Similarly, when Astaxanthin molecules are shaped differently, they perform differently.

In conclusion, other than sharing the same chemical formula, Natural Astaxanthin from algae is entirely different than Astaxanthin sourced from petrochemicals or from genetically manipulated *Phaffia* yeast, and is clearly superior as a human nutritional supplement.

The Vast Differences Between Astaxanthin Producers

It's clear that Astaxanthin is the supplement of choice for anyone over 40 (and a good choice as well for people under 40). It's also clear that Natural Astaxanthin from algae is the undisputed best source. The next logical question is: Which producers have the best technology and the best algae growing systems, and thus produce the best Astaxanthin raw materials?

There are about 25 companies that currently produce Natural Astaxanthin from algae. Of these, there are only five that have sufficient technology and consistency to have what I would consider a quality product. And of these five quality products, one emerges as the clear leader. It has the purest product, the best technology which yields the most potent algae, and it has other important differentiating factors such as the world's first certified organic Astaxanthin product.

I don't want to scare anyone—there have been no safety concerns with the 20 producers who have a lesser quality product. But there have been serious concerns about the stability of these products, and a related concern—whether they contain as much Astaxanthin as they claim. Together, these issues mean that many consumers of these products are not receiving as much Astaxanthin as the labels indicate and may not obtain the health benefits they seek.

The basic truth is “All Astaxanthin raw materials are *not* created equal.” Here's why:

Research and Development

Without a significant investment in R&D, producers are not going to know what they're doing. Algae Health Sciences (commonly called “AlgaeHealth”) spent seven

years (from 2006 to 2013) focused on R&D, while they produced small quantities (and sold only to a few customers in Japan), before expanding their production facility to become the world's second largest producer of Natural Astaxanthin. During this seven year period, a superior strain of *Haematococcus* algae was discovered and techniques for production of the algae and stabilization of the raw materials were developed. When everything was perfectly in place after seven years of hard work and a huge investment, it was time to go large scale.

This investment in R&D and mission for innovation and the highest quality product has been maintained at AlgaeHealth since the early days. For example, although AlgaeHealth was the fourth company to produce *Haematococcus* consistently, it was the first to figure out how to produce a certified organic Astaxanthin product and remains on the forefront of R&D in algae technology.

Technology

Successful R&D breeds leading technology. When Astaxanthin got popular from 2011 to 2014 due to extensive publicity from prominent doctors and opinion leaders, the entire worldwide supply was wiped out. Brands wishing to purchase Astaxanthin raw materials had to wait several months to receive an order. This led to many new producers jumping in and starting to grow *Haematococcus* algae as quickly as possible to make some fast money. But *Haematococcus* is extremely difficult to grow. Additionally, Astaxanthin itself is extremely unstable. It will start to degrade very quickly when exposed to oxygen. Exposure to UV light also degrades Astaxanthin (although not nearly as quickly as exposure to oxygen). The difficulty in growing *Haematococcus* and the unstable nature of Astaxanthin itself are the double whammy that led to some dramatically inferior Astaxanthin raw materials floating around. In the final section of this book, you'll see for yourself how serious this issue is when I reveal a test of 15 commercial products from *Haematococcus* producers that are not members of NAXA (Natural Algae Astaxanthin Association).

Production Facilities

Good R&D leads to superior production facilities. I say “production facility,” but in essence these are really “farms” that grow plants in water (the term for this is “aquaculture”). There are three types of farms that have produced significant and consistent quantities of *Haematococcus* over the last 20 years:

Types of Production Facilities		
Production Facility	Advantages	Disadvantages
Open pond systems	• Low cost production • Environmentally friendly	• Inconsistent production due to foreign algae and other unwanted organisms easily entering the ponds
Indoor systems	• Protection from contamination	• Least natural • Artificial light • Not environmentally friendly
Outdoor tube systems	• Purest product • Environmentally friendly • Natural system • Consistent production and most potent product • Protection from contamination	• Most expensive to build • Must use glass tubes instead of plastic to prevent leaching of chemicals into the algae cultures

Outdoor tube systems clearly have the most advantages. *Haematococcus* grows in a pH neutral environment, making it particularly susceptible to invasive species. So the algae must be protected as they grow. The use of glass or plastic tubes protects the algae from contaminants and invasive species. The tubes still harness the sun’s energy, allowing the algae to grow naturally. The downside for starting

such a system is that they are expensive to construct. But once they're running, they get the purest, most potent, most consistent and highest quality product. The main potential quality issue is with tube systems that use plastic tubes which can leach chemicals into the algae cultures when exposed to sunlight.

Experiments with other growing systems over the years have failed: only the three systems in the chart above have proven practical. Companies have tried growing *Haematococcus* indoors in bags or outdoors in greenhouses. One company developed a very expensive plant in Hawaii with about 1000 one-meter diameter glass domes. They bragged about having the most advanced technology for growing *Haematococcus* in the industry, but finally gave up after about five years and sold the land to a solar farm when their system proved to be inherently flawed.

In an article about a company that produces Astaxanthin from an open pond *Haematococcus* growing system, leading supplement industry journalist Hank Schultz from “NutraIngredients USA” said, “The company has struggled from time to time with production interruptions caused by contamination or weather-related issues at the facility” (Schultz, 2017). These are the quintessential problems with open pond systems: contamination and weather issues. When you grow algae in open ponds, anything can get into the algae cultures—including lots of things that shouldn't be there. And when you have too much rain or other weather problems, it can ruin several weeks of production. The glass-tube system is the superior system: it provides protection from contamination, foreign algae, protozoa, fungi and other organisms while still using natural sunlight as the energy source.



***Haematococcus
growing in a
tube system turns
from green to red
over the course
of approximately
one week as it
hyperaccumulates
Astaxanthin.***



The Algal Diva

Some huge companies have invested millions into *Haematococcus* farms and failed. It is a very difficult algae species to grow—some in the business call it “The Algal Diva.”

The first huge company to fail was Yamaha Motors. Growing *Haematococcus* was their first foray out of the motor industry in their long history. They produced *Haematococcus* for about five years in an indoor system and finally gave up.

The second huge company is just throwing in the towel as of the printing of this book. I won't mention the name of the company, but I can assure that most readers have heard of this huge multinational corporation and have bought some of their wide range of products before. They use an outdoor greenhouse system. Unfortunately, after about four years of trying, they too have decided to call it quits.

Yamaha and the other famous company got into the Natural Astaxanthin business because they believe in Astaxanthin as a wonderful, health-giving molecule. These are two examples of big, successful companies from other industries that failed to commercialize Astaxanthin, but the list of failures is much longer. More than a dozen companies in California, Hawaii, Europe, Asia and South America have all tried and failed.

***Haematococcus* is a true diva, and trying to tame her has led many to their downfall.**

AlgaeHealth Production



At AlgaeHealth's farm, the algae start out growing in spotless labs under super-hygienic operating conditions.



The final growth stage is outdoors in 100% glass-tube photobioreactors in a pristine environment. The water source originates on the Tibetan plateau in the Himalaya Mountains.



The algae are then dried into a powder rich in Astaxanthin.

- If you'd like to learn more about the state-of-the-art 100% glass tube growing system at AlgaeHealth's farm, please visit www.algaehealthsciences.com
- If you'd like to see a video about AlgaeHealth's production system, please visit <https://www.youtube.com/watch?v=GSRShc9-tsI>

Raw Materials

The different production facilities yield raw materials which are then used by brands marketing finished consumer products with Astaxanthin. There are drastic differences between the raw materials provided by different *Haematococcus* producers.

- ➔ **Stability.** Stability is a crucial concern when choosing raw materials. If producers don't protect the algae from oxygen and UV exposure every step of the way—from the culturing stage to harvesting, then from the drying to the packaging—stability will be lost. Only a few producers have mastered stability and can guarantee a two- to three-year shelf life for their raw materials. Others offer products that will lose Astaxanthin content quickly. This

means that consumers will end up with less Astaxanthin in their product than the label states. (And very likely, these consumers will not enjoy the health benefits that they seek.)

Two of the most popular forms of Astaxanthin raw materials are oil extracts and powders. In particular, stability of powder raw materials is a big concern. The early powder products launched over 10 years ago had serious problems in maintaining stability. AlgaeHealth's R&D has led to two algae powders that are highly stable: a conventional product as well as a certified organic product that contain 5% pure Astaxanthin. These products have shown a minimum of two to three years of shelf life during which the Astaxanthin remains intact.

➔ **Purity.** Purity is very important as well. Both purity from contaminants as well as obtaining as much pure Astaxanthin as possible in the carotenoid fraction. AlgaeHealth's glass tube growing system keeps contaminants out, while the pure Himalayan water (which goes through a reverse osmosis purification step for added safety) ensures super-low levels of heavy metals and other impurities. AlgaeHealth's Astaxanthin products have 97% pure Astaxanthin in the carotenoid fraction (Visioli and Artaria, 2017). This compares favorably with other producers whose products generally range from 85% to 95% pure Astaxanthin in their carotenoid fractions. **In short, AlgaeHealth's Astaxanthin raw materials are the purest in the world.**

➔ **Other Carotenoids.** The 3% to 15% of other molecules in the carotenoid fraction are also important to consider. Of course, Astaxanthin is the work horse, so you want to find a product with as much Astaxanthin in the carotenoid fraction as possible. But after getting as much Astaxanthin as possible, look for a product that has other healthy components.

I had never heard of a Natural Astaxanthin carotenoid fraction that contained the excellent eye-health carotenoid zeaxanthin in my first 12 years

in the Astaxanthin industry. But AlgaeHealth's Astaxanthin products contain a small amount of this eye health superstar (Visioli and Artaria, 2017).

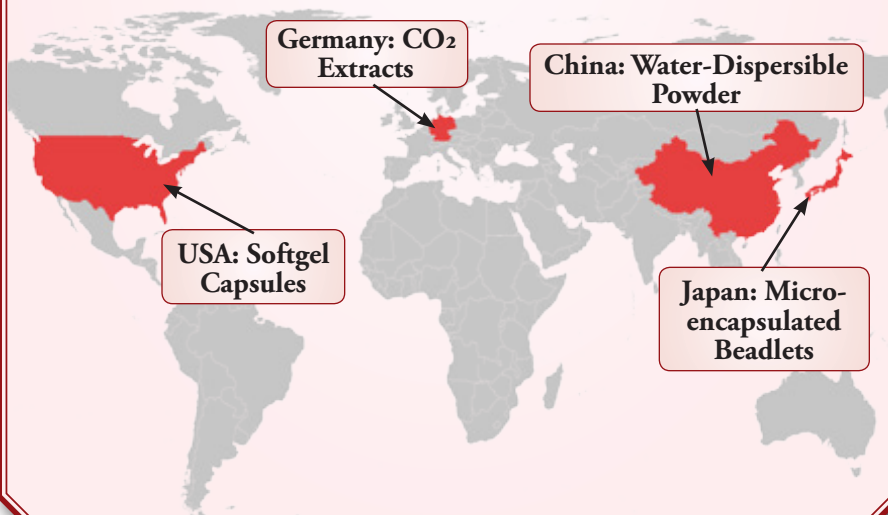
- ➔ **Potency.** Superior technology results in unprecedented levels of Astaxanthin in AlgaeHealth's dried algae biomass: 6% to over 8% (compared to other producers who generally attain from 2% to 5%). **In short, AlgaeHealth produces the world's most concentrated and potent *Haematococcus* powder.**

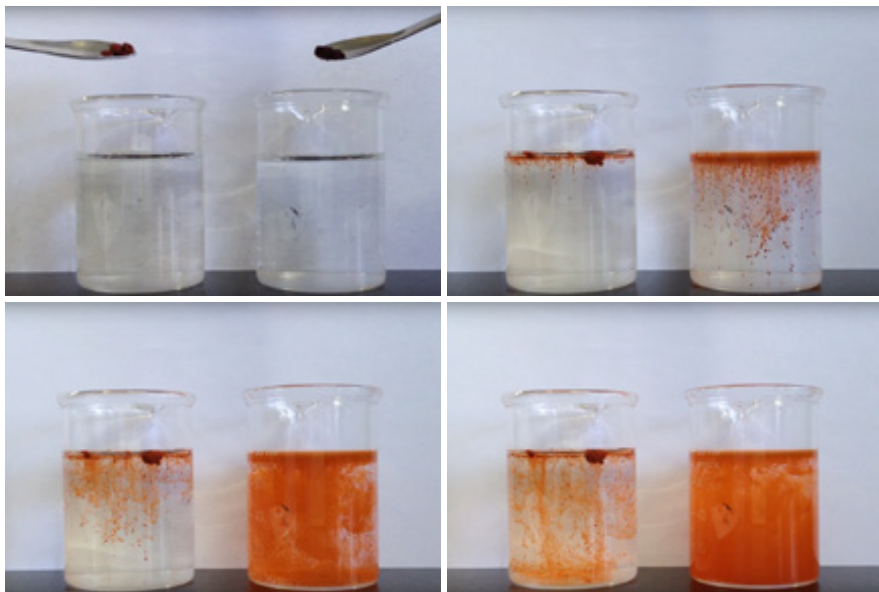
Global, Top-Quality Supply Chain

As I mentioned in Chapter 6, Astaxanthin raw materials come in different forms: oil extracts, microencapsulated powders and beadlets, and spray-dried powders. (Some suppliers also distribute Astaxanthin softgel capsules in bulk to supplement brands.) Each of these has its own quality concerns, and each has manufacturers whose products are the best within their class. AlgaeHealth has successfully sought out and qualified the best of the best for each of these processes and raw materials. AlgaeHealth's supply chain is truly global, utilizing expertise on three continents and four different countries for an array of industry-leading products:

- ✓ **Germany.** AlgaeHealth obtains its oil extracts from a supercritical carbon dioxide extractor in southern Germany with over three decades of experience and the highest quality facility of its kind. This extraction method is the gold standard. It uses absolutely no chemical solvents—only pure carbon dioxide (which is a harmless component in the air we all breathe).
- ✓ **Japan.** AlgaeHealth contracts with a microencapsulated beadlet manufacturer in Japan whose technology is known across the industry as the best of its kind. Their beadlet products can withstand the very highest compression tablet press without loss of stability.

- ✓ **USA.** There is a single softgel capsule producer in California that has made over half of the Astaxanthin softgels ever produced in the world. They have the most experience, and produce the highest quality, most stable Astaxanthin softgels. This is the company AlgaeHealth uses to produce its softgel capsules.
- ✓ **China.** In the past, many people considered products from China to be of lower quality, the result of inferior technology or bad imitations of other products. The reality has changed dramatically in recent years. China now has market-leading technology in many areas. For example, AlgaeHealth contracts with a company in China with state-of-the-art technology for making oil-soluble raw materials capable of dispersing in water-based finished consumer products. If you do a side-by-side comparison between this company's water-dispersible Astaxanthin powder and those of other companies, you will immediately see an important difference. When the Chinese company's powder is dropped into water, it will start to disperse before your eyes. The other companies' products float on top and have to be stirred to disperse (see page 272). This demonstrates the best technology in the world for water dispersion of oil-based products, and it was developed in China.





Superior technology from China (beakers on right): Made-in-China water-dispersible Astaxanthin powder easily dissolves while another producer's product floats.

To see how this water dispersion works for yourself, please watch this YouTube video: <https://youtu.be/SIR0zD4SGsA>

- ➔ **Natural Ingredients.** Different nutrients are fed to the algae during their early growth stages and different substances can be added to Astaxanthin raw materials during manufacturing. Some companies use substances that are not natural such as synthetic Vitamin E and other synthetic stabilizers. And some producers use harsh chemical solvents instead of supercritical carbon dioxide because it's a much cheaper way to get the Astaxanthin into oil form. Pesticides have even been found in the product of some producers. AlgaeHealth does not use harsh chemicals or synthetic Vitamin E. Its products are not irradiated, are pesticide- and herbicide-free, and are never genetically manipulated.
- ➔ **Quality Certifications.** There are two important ways to judge if a company produces quality products in a safe, regulated environment. They should

have (1) third-party quality certifications and (2) outside auditing. AlgaeHealth has both. Among AlgaeHealth's long list of quality certifications is GMP (Good Manufacturing Practices), a vital consideration in the nutritional supplement industry.

→ **Outside Auditing.** AlgaeHealth's facility has gone through outside audits by many third parties including NAXA (which is the most important in the Astaxanthin business). In addition, AlgaeHealth's farm and product have been audited by many of the world's largest supplement brands from USA, Japan and Europe, and also by the Non-GMO Project (which ensures that genetically modified organisms never enter into AlgaeHealth's products).



AlgaeHealth's facility and product have been audited by independent trade association NAXA. Its Astaxanthin oils and powder are verified to be free of genetically-modified organisms by the Non-GMO project.

→ **Clinical Validation.** It is extremely important that the manufacturer has done clinical research showing that its product actually works. To date, I'm aware of only four Astaxanthin producers out of 25 whose product has been clinically validated (AlgaeHealth being one of these four leaders).

→ **Analytical Testing.** Lastly, once the raw material is produced, it has to be tested for contaminants and to see how much Astaxanthin is present. And while testing for Astaxanthin content sounds simple, it's actually a very complicated process with a few different testing systems employed by different Astaxanthin producers. Yet only one yields correct results. Leading producers follow the correct method and have experience to perform the analyses

The correct analytical method for testing Natural Astaxanthin is so difficult to perform that a government-sponsored lab in Japan (which is one of the most technologically advanced countries in the world) could not replicate results after trying for months, even though the procedures were written out step-by-step. An experienced analytical chemist had to fly to Japan to teach them in person how to do the analysis.

accurately. Other producers often falsely overstate the amount of Astaxanthin in their product.

There are two major problems with analytical methods for Natural Astaxanthin:

- **Problem #1:** Though only one analytical testing system can produce accurate results, another less accurate system is commonly used by some companies. The commonly-used system (called spectrophotometric analysis) is completely inaccurate and regularly overstates the Astaxanthin content by approximately 10% to 50%. (Sometimes even more if the producer has allowed the Astaxanthin to oxidize at one of the various flash points in the manufacturing process.) Nevertheless, this system is used by many Astaxanthin producers because it's easier and much cheaper. What it does is lump together all the different pigments in a product and spit out one number. So it's falsely telling chemists that there is a high amount of Astaxanthin in a product, when in reality what's being measured is a combination of chlorophyll, other carotenoids (such as lutein, beta-carotene and canthaxanthin), and—worst of all—Astaxanthin breakdown products. (When Astaxanthin is oxidized, it turns into breakdown molecules called “astacene” and “semi-astacene.” While these substances won't hurt you, they have absolutely no medicinal value or health benefits.)
- **Problem #2:** The other problem is that, even for companies who use the correct testing system, it's so hard to learn how to perform correctly that it can yield falsely high results quite easily. This system is called High-Performance Liquid Chromatography (HPLC), and it's the only viable way to test Astaxanthin content accurately. But as I pointed out above, even skilled labs have a long learning curve. While

Some Astaxanthin producers who use spectrophotometric analysis cheat and call the product they sell “Astaxanthin Complex.” Perhaps they feel this exonerates them for using an inaccurate testing method. This term even turns up on some consumer product labels. A capsule that has 4mg of “Astaxanthin Complex” will usually have about 3.0mg to 3.8mg of Astaxanthin in it. But it may have as little as 1.0mg or 2.0mg (which will render it ineffective for most consumers). Put simply, a product's label is at best misleading and at worst adulterated if it says “Astaxanthin Complex.”

not as flawed from an accuracy perspective as spectrophotometric analysis, HPLC analyses by an unskilled or inexperienced lab will often provide inaccurate results.

Things that Can Show Up as “Astaxanthin” in a Spectrophotometric Analysis of Natural Astaxanthin

Some of what is counted as “Astaxanthin” when using the vastly inferior spectrophotometric analysis system is good for you, while some of it does absolutely nothing for you. This is why it’s so important to get your Astaxanthin from a trustworthy producer who uses HPLC analysis.

Molecule	Health Value
Astaxanthin	Excellent for the body
Zeaxanthin	Very good for the body
Lutein	Very good for the body
Beta carotene	Good for the body
Canthaxanthin	Good for the body
Chlorophyll	Good for the body in very high quantities, but in small quantities in an Astaxanthin product, it’s only taking up space
Astacene	Inert—does nothing for the body
Semi-Astacene	Inert—does nothing for the body

In conclusion, AlgaeHealth should be the top choice Astaxanthin producer for quality-conscious consumers and supplement brands for several reasons: its investment in R&D; its state-of-the-art technology; and, most of all, the unsurpassed purity and potency of its raw materials.

The Vast Differences Between Astaxanthin Consumer Products

How would you feel if you went to the supermarket and bought a pound of butter, but when you got home, it was only half a pound? Or it turned out to be margarine? You'd feel cheated, and probably would never buy that brand of butter again. Unfortunately, this has happened to many consumers who purchased Astaxanthin in the past from low-quality brands that source raw materials from inferior producers. Here are the real facts from laboratory analyses of 15 different Astaxanthin products sourced from companies that are not members of NAXA (Natural Algae Astaxanthin Association).

Capelli and Cysewski, 2014

A survey of 15 different commercially sold products found that only three had the stated level of Astaxanthin present. This means that 80% of the products were cheating the consumer, and only 20% had the Astaxanthin that their label claims they have! And although some of them only missed their label claim by 5% or 10%, five out of these 15 products had less than half the Astaxanthin that their label stated. These are some very bad odds indeed—80% of the products had less than they claimed, and 33% had less than half of what they claimed (Capelli and Cysewski, 2014).

Solution: Always go with a trusted brand that sources their Astaxanthin from a high quality producer that is a member of NAXA.

Again, there won't be a safety concern if the Astaxanthin product you buy has half the amount of Astaxanthin that the label claims. But there's a very good chance you won't get the health benefits you want and deserve.

The other problem with lesser quality consumer supplement brands is that they may not be using Natural Astaxanthin from algae, so even if you do get the amount

of Astaxanthin that the label indicates, you still may not get any health benefits.

This testing was done a few years back during the height of the Astaxanthin shortage, and the situation has improved somewhat since then. But not in developing countries. The 15 commercial products in the test described above were all from developed countries. Things are much worse in some developing countries to this day. Several consumer Astaxanthin products tested in developing countries that were tested recently had absolutely *no* Astaxanthin in them! I can't stress enough how important it is to buy products from a trusted brand, especially in developing countries.

Why do you think that 80% of products tested didn't have the correct amount of Astaxanthin? I covered many of the answers to this question in the last section: inferior Astaxanthin raw materials; poor handling and poor packaging that lets oxygen in; improper analytical testing; poor quality softgel encapsulation; or other problems with delivery methods.



It doesn't matter whether you call it "half empty" or "half full," Astaxanthin from inferior consumer brands and raw material producers will usually cheat you out of your money and will almost certainly cheat you out of the health benefits you deserve.

Not All Softgels Are Created Equally

Putting powder into a 2-piece hardshell capsule is child's play compared to making a high-quality softgel capsule. I've met many softgel

manufacturers' technical staff, and they all say that making a good softgel is much more of an art than it is a science (especially with vegetarian softgels, which are a much newer technology. Over the years, I worked with seven different producers of vegetarian softgels before I found one that could maintain a good level of stability for Astaxanthin.)

Just as I highly recommend going with a trusted Astaxanthin producer and a trusted supplement brand, I also recommend using an experienced, high-quality softgel producer to ensure a stable Astaxanthin product. (Fortunately, trusted supplement brands know where to have their softgels made.)



Not only is growing Haematococcus a tricky business, so is making a high-quality softgel capsule.

Author's Recommendation: Go with the **ONLY** Independent Agency that Analyzes Astaxanthin

The single best thing you can do if you don't have a strong knowledge of supplement brands is to choose a brand that sources their Astaxanthin from a producer who is a NAXA member. Before being allowed to join NAXA, all their products must be qualified and audited by an independent lab and their farms must be audited in person by the NAXA President.

There are currently only four producers who are NAXA members. When an Astaxanthin producer becomes a NAXA member, the consumer supplement brands that they supply are allowed to use the NAXA Verified Seal. But the key point is this: consumer



NAXA is the only independent, non-profit trade association in the Astaxanthin industry. Producers are allowed to join only after their product has been tested at an independent laboratory and their facility has been audited by NAXA's President.

supplement brands that put the NAXA Verified Seal on their labels are tested at an independent lab annually and may be spot-checked in between as well. Currently, this is the only third-party verification process in the Astaxanthin industry, and the very best way for consumers to ensure they're getting a high-quality, efficacious product.



A new program has been launched by NAXA: the NAXA Verified Seal may be placed on consumer product labels only if the raw materials have been purchased from a NAXA member. These products are tested annually at an independent lab and may also be spot-checked in between annual testing. For more information, visit www.astaxanthin.org

Which Delivery Method?

The last decision in choosing an Astaxanthin product is what delivery method to use. As I explained in the last chapter, there have not been significant differences found between them with regards to bioavailability or efficacy. So I recommend you just find one you're comfortable with and go with it. But finding a food or beverage with Astaxanthin is still difficult in most countries because these delivery methods are just beginning to emerge on the market. The majority of Astaxanthin consumers will most likely continue to take their Astaxanthin in capsule form for the next several years.

Choosing what type of capsule to take is more of a personal choice than a technical or health question. Softgel capsules have been the most popular option for many years, but you may want to try a whole-food based Astaxanthin hardshell capsule. AlgaeHealth has figured out how to make Astaxanthin powders stable, so the hardshell capsule delivery method has now become a trustworthy alternative.

Many people who like to stay as close to nature as possible in their diet and supplement regimen will be attracted to the whole-food-based capsules. The argument is that these products are the way nature intended them. Oil-based extracts of *Haematococcus* use only about 25% of the algae and discard the remaining 75%.

The question is what is being thrown out in that 75%? Perhaps there are synergistic components that could make the Astaxanthin powder work even better than the extract found in softgel capsules. (You don't want to throw the baby out with the bath water.) Taking the whole-food-based capsules also allows consumers who prefer organically certified products to choose Astaxanthin that is grown organically.

But these products currently only make up a small percentage of the Astaxanthin products on the market, while softgels containing oil extracts still make up the lion's share. And the softgel products work great—that's the delivery method that both of the consumer surveys and most of the clinical research has been done on. So whichever you choose, you won't go wrong provided it's from a NAXA member and a trusted supplement brand.

The Supplement Funnel Says it All



My Final Recommendation

Take Astaxanthin every day. Make sure it's Natural Astaxanthin from algae. Make sure the raw material is from a high-quality producer that is a member of NAXA (such as AlgaeHealth). And make sure it's from a trusted supplement brand. Then I hope you'll join the 80% of people who understand why I call Natural Astaxanthin *"The Supplement You Can Feel."*

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– Bob Capelli, Holualoa, Hawaii, September 2017

Order Form

Additional copies of this book may be ordered directly from the Publisher, Algae Health Sciences. Our goal is to let as many people as possible know about Natural Astaxanthin so they can experience “The Supplement You Can Feel” for themselves, so we heavily discount this book when purchased in quantity.

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About the Authors



Bob Capelli has been involved in natural healing and herbology for over 30 years. After graduating from Rutgers University in 1982, Bob spent four years traveling and working in developing countries in Asia and South America. It was on these travels that Bob learned about the medicinal power of plants. Upon returning to the USA, he immersed himself in the natural supplement industry where he's held a variety of positions over the last 28 years. For the last 16 years, Bob has focused his attention on

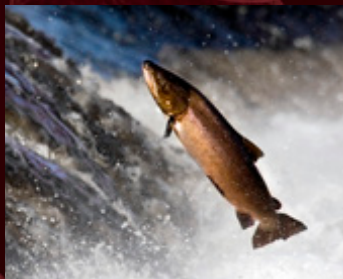
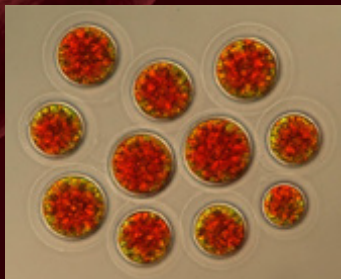
Astaxanthin after feeling for himself its joint and muscle health benefits and its ability to modulate the immune response (he hasn't had a cold or flu since he started taking Astaxanthin 17 years ago). Bob is the author of five books on nutritional supplements which have been translated into 12 different languages. He's written dozens of articles for trade and consumer publications as well as peer-reviewed technical journals, and he's appeared on over 200 television and radio programs around the world as an expert on Astaxanthin and other health supplements.



Lixin Ding, PhD, earned his doctorate in organic chemistry in 2010 from Texas Christian University, where he focused on natural products and their chemistry. Upon graduation, Dr. Ding began his work experience with International Flavors & Fragrances as a Research Chemist. After one year in this position, Dr. Ding chose a career path in the natural supplement business when he joined BGG, a pioneer and leader in herbal extracts and natural products. At BGG, Dr. Ding became interested in

Astaxanthin and its unique bioactivities. He has since focused on all aspects of the Astaxanthin business, including research and development, microalgae cultivation, production, quality control and business development. He has held a variety of positions with BGG, most recently serving as Research and Development Director for BGG North America. Dr. Ding has great enthusiasm for natural products and he believes that Mother Nature is generous in giving humans a tremendous treasure for natural healing and preventive medicine.

Astaxanthin is so protective to algae cells that it enables them to live for over 40 years without food or water and in extreme temperatures. And it's so protective to salmon's muscle cells that it allows them to swim up raging rivers for several days without rest. In this book, you'll find out what it can do for human cells and learn about all of the clinically validated health benefits which make Natural Astaxanthin "The Supplement You Can Feel."



"I was very impressed with the compelling research on the therapeutic benefits of Astaxanthin in Bob Capelli's book on Astaxanthin back in 2011. I have been regularly using it since then and believe it has great value for many conditions. Bob's book was a major factor when I decided to feature Astaxanthin as 'The #1 Supplement You've Never Heard of that You Should Be Taking' on the Dr. Oz show a few years ago."

— **Dr. Joseph Mercola, Renowned Internet Health Expert**

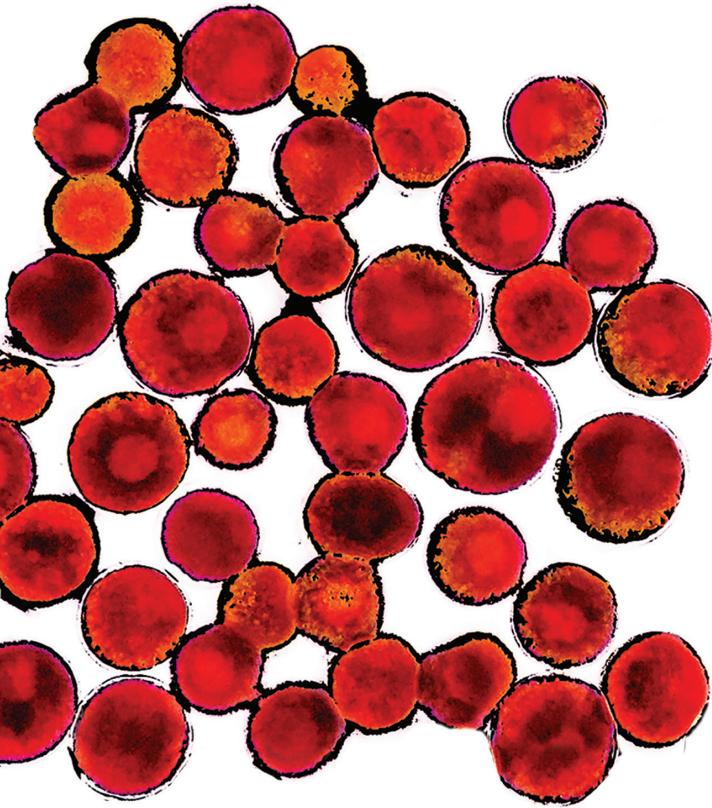
"Astaxanthin is, without question, one of the most potent and promising natural medicines yet known in the realm of nutritional science. I strongly recommend learning how to apply this astonishing discovery from Mother Nature by reading Bob Capelli's latest Astaxanthin book. Your approach to nutritional supplementation will be forever upgraded!"

— **Mike Adams, "The Health Ranger"**

"Natural Astaxanthin is one of my favorite nutrients to recommend to my readers because it does so many different positive things for people. It's a super-antioxidant and a broad-spectrum, safe & natural anti-inflammatory with over 500 medical research studies to back it up. Astaxanthin is the perfect nutrient in the battle against aging because of its clinically validated effects on a host of concerns people have as they reach middle age and beyond. I read Bob Capelli's first book on Astaxanthin back in 2007 and I've been a fan ever since. And with this new book, Bob has taken the understanding of Astaxanthin to a whole new level."

— **Suzy Cohen, "America's Most Trusted Pharmacist"**





ASTAXANTHIN - THE HEALTHY TEN

THE HEALTHY TEN

TEN CLINICALLY-VALIDATED BENEFITS
OF NATURAL ASTAXANTHIN



BRAIN HEALTH

4 Human Clinical Studies
50 Supporting Pre-Clinical Trials



SKIN HEALTH & UV PROTECTION

7 Human Clinical Studies
27 Supporting Pre-Clinical Trials



IMMUNE SYSTEM MODULATION

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EYE HEALTH

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40 Supporting Pre-Clinical Trials



ANTI-AGING & CELLULAR HEALTH

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214 Supporting Pre-Clinical Trials



JOINT, TENDON AND MUSCLE SUPPORT

9 Human Clinical Studies
51 Supporting Pre-Clinical Trials



WORLD'S STRONGEST & HIGHEST QUALITY NATURAL ANTIOXIDANT

Clinical Trial Results

- Reduces various oxidative stress markers
- Prevents oxidative damage
- Prevents peroxidation of blood lipids including LDL cholesterol
- Prevents depletion of non-enzymatic antioxidant defense
- Dosage range 2mg to 4mg per day

In-Vitro Research Results

- Multiple times stronger than all other antioxidants tested in various head-to-head antioxidant experiments regardless of testing method
- Generally at least 10X stronger than all other carotenoids
- 800X stronger than CoQ10
- 550X stronger than Vitamin E
- 6000X stronger than Vitamin C
- 20X to 90X stronger than Synthetic Astaxanthin as an antioxidant in three separate tests from two peer-reviewed studies



JOINT, TENDON & MUSCLE SUPPORT

Clinical Trial Results

- Decreases C-Reactive Protein (CRP) levels (key marker for systemic or "silent" inflammation)
- Prevents muscle damage and inflammation in athletes
- Reduces pain in rheumatoid arthritis sufferers
- Decreases pain rate and pain duration in carpal tunnel syndrome sufferers
- Improves grip strength by 93% in sufferers of tendonitis (tennis elbow) with reduced pain and improved mobility
- Reduces joint and muscle pain in heavily-training athletes
- Dosage range 4mg to 12mg per day

In-Vitro Research Results

Astaxanthin has been shown to support 8 different inflammatory response markers without side effects or contraindications

- Tumor Necrosis Factor-A
- Prostaglandin E-2
- Interleukin 1-B
- Interleukin 6
- Nitric Oxide
- Nuclear Factor Kappa-B
- Cox 1 Enzyme
- Cox 2 Enzyme



EYE HEALTH

Clinical Trial Results

- Dose-dependently improves visual acuity (the ability to see fine detail)
- Improves depth perception
- Improves eye fatigue
- Also can prevent eye fatigue
- Increases retinal capillary blood flow
- Increases blood flow velocity to the eyes
- Prevents eye strain
- Improves eye accommodation (adjustment of the lens that allows it to focus)
- Reduces blurred vision
- Reduces eye soreness
- Prevents eye dryness
- Prevents diplopia (double vision)
- Dosage range 4mg to 8mg per day



CARDIOVASCULAR SUPPORT

Clinical Trial Results

- Improves blood lipid parameters in patients with mild hyperlipidemia
- Dose-dependently inhibits LDL cholesterol oxidation
- May contribute to the prevention of atherosclerosis
- Improves blood flow rate
- Decreases heart rate of athletes when doing endurance training
- Dosage range 4mg to 18mg per day



BRAIN HEALTH

Clinical Trial Results

- Prevents age-related decline in cognitive function
- Improves psychomotor function in elderly subjects
- Improves marker for dementia in middle-aged and senior subjects and may contribute to the prevention of dementia from aging
- Improves cognitive function in healthy middle-aged and elderly subjects
- Decreases mental fatigue and confusion
- Improves erythrocyte antioxidant status to help transport oxygen to the brain
- Dosage range 6mg to 12mg per day



SKIN HEALTH & BEAUTY-FROM-WITHIN

Clinical Trial Results

- Reduces fine lines and wrinkles
- Increases skin moisture levels
- Improves skin elasticity
- Prevents skin sagging
- Reduces visible signs of UV-aging within four to six weeks of use
- Prevents photo-aging of skin
- Prevents UV damage
- Improves skin conditions in all layers of the skin (corneocyte layer, epidermis, basal layer and dermis)
- Dosage range 4mg to 6mg per day



ATHLETIC PERFORMANCE & ENERGY LEVELS

Clinical Trial Results

- Improves power output by 15%
and reduces racing time by 5% in competitive cyclists
- Promotes recovery from exercise
- Prevents muscle fatigue
- Improves endurance
- Increases strength in healthy subjects
- Increases grip strength in sufferers of tennis elbow by 93%
- Decreases lactic acid levels
- Decreases respiratory parameters during exercise
- Helps prevent muscle damage and inflammation in elite soccer players
- May be effective in preventing exercise induced free radical production
- Improves oxidative status in athletes
- Prevents joint and muscle soreness after exercise
- Decreases heart rate in athletes doing endurance training
- Dosage range 4mg to 12mg per day



IMMUNE SYSTEM MODULATION

Clinical Trial Results

- Improves a variety of immunity markers in subjects at only 2mg per day in eight weeks
- Increases the total number of antibody-producing B-cells
- Amplifies natural killer cell cytotoxic activity
- Leads to increased number of T-cells
- Stimulates white blood cell counts
- Significantly increases delay-type hypersensitivity response
- Dramatically reduces DNA damage
- Raises immunoglobulin levels in healthy athletes
- Suppresses lymphocyte activation in patients with allergic rhinitis and pollen-related asthma
- Leads to therapeutic improvement in patients suffering from auto-immune disease
- Dosage range 2mg to 4mg per day



FERTILITY & SPERM IMPROVEMENT

Clinical Trial Results

- Improves sperm functioning
- Increases sperm linear velocity
- Improves sperm quality
- Increases sperm motility
- Decreases reactive oxygen species in sperm
- May be used to decrease male idiopathic infertility
- Improves conception rate in infertile men
- Also improves sperm functioning and motility in normal men without any fertility issues
- Dosage 16mg per day



ANTI-AGING & CELLULAR HEALTH

Clinical Trial Results

- Skin Health and Beauty-from-Within
- Eye & Brain Health
- Joint, Tendon & Muscle Health
- Cardiovascular Protection
- Immune System Modulation
- Strength, Endurance and Energy
- Dosage range 4mg to 12mg per day

In-Vitro Research Results

- Mitochondria protection
- Prevention of damage to DNA
- Profound inhibition of oxidation
- Safe & natural anti-inflammatory activity

MAJOR AREAS OF PRE-CLINICAL RESEARCH

- Support of Healthy Cell Lines **46** studies
- Gastrointestinal Health **31** studies
- Glucose Metabolism Management **25** studies
- Liver & Kidney Health **23** studies
- Respiratory Health **4** studies

WHAT IS ASTAZINE®?

AstaZine®
Natural Astaxanthin

AstaZine® is a line of natural astaxanthin products from *Haematococcus pluvialis* microalgae produced in a fully-closed, 100%-glass tube ecofriendly photobioreactor system.

AstaZine®:

- Contains 97% pure astaxanthin in the carotenoid fraction and just 3% of other carotenoids
- The world's first Organically Certified astaxanthin product (certified by Ecocert®)
- Covered by two NDIs with US FDA at 12mg and 24mg per day
- Supported with 239 health claims submitted to US FDA without objection
- The only astaxanthin with two European Novel Foods approvals for both supercritical CO₂ and ethanol extracts.
- Self-affirmed GRAS
- Registered for sale in most of the world's most regulated markets



Algae Health Sciences, Inc., a subsidiary of BGG, focuses on the production and marketing of efficacious ingredients from natural algae sources. Algae Health Science's flagship product, AstaZine® Natural Astaxanthin, is extracted from the world's first Certified Organic *Haematococcus pluvialis* microalgae.



Algae Health Sciences, Inc., is a proud member of NAXA, the Natural Algae Astaxanthin Association. NAXA is dedicated to building awareness of the health benefits of Natural Astaxanthin. Algae Health Sciences and BGG support the NAXA Verification Program (NAV/P) to address the growing problem of adulteration within the dietary supplement industry and assure finished product manufacturers and consumers that the astaxanthin they are purchasing is natural astaxanthin derived from *Haematococcus pluvialis*.

	Astaxanthin content	 tablets	 hard capsules	 softGel capsules	 drinks	 sachets	 Cosmetics
Astaxanthin Oleoresin	5%, 10%, 20%			X			X
Astaxanthin Water Dispersible Powder	1%, 2%		X		X	X	
Astaxanthin Water Dispersible Emulsion	1%				X		X
Astaxanthin fish gelatin Beadlets	2%, 2.5%	X	X				
Astaxanthin veggie Beadlets	3%	X	X				
Astaxanthin Spray Dried Powder	4%, 5%	X	X	X			

Please note this documentation is available for various countries all over the world and hence it may contain statements or product classification not applicable to your country. The claims made are in reference to ingredients only, hence they do not refer to finished products. Marketers of finished products containing the ingredient described herein are responsible for determining whether the claims made for such products are lawful and in compliance with the laws of the country in which they will market the products. Please note that the physiological activity of the ingredient described herein is based on scientific literature done on Astaxanthin not necessarily sponsored or done with AstaZine®.

For extensive product information, please see www.algaehealthsciences.com

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