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Astaxanthin **FORMULATION STRATEGIES**

Examining the science behind this
powerful carotenoid, to the art of
formulating it successfully

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Viewpoint: Working with Astaxanthin



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The Art of Astaxanthin Application

The health benefits of astaxanthin range from heart to sports to skin and beyond, but nutrition brands that offer this “king of carotenoids” need to ensure the potent antioxidant doesn’t degrade during the formulation process, and they need to target a specific demographic to ensure success, explains **Danielle Rose**.



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Takeaways for Your Business

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Working With Astaxanthin

I'm just back from a trip to [Neptune Technologies & Bioresources](#), where I toured the plant that makes the company's flagship NKO® (Neptune Krill Oil).

Krill is an omega-3 that offers health benefits similar to other omega-3s, but unlike fish, squid, flax or chia, krill oil is a beautiful red color. At the production facility, I saw the process where krill, in whole form, is transformed from pink into the vivid scarlet oil.

That red is due to the naturally occurring astaxanthin that is contained in the crustaceans, and astaxanthin helps protect the krill oil from oxidization (*Food Chem.* 2014 Aug 15;157:398-407), allowing krill's health benefits to get to the end consumer.

But astaxanthin's applications go beyond helping krill oil stay fresh. As this Digital Magazine explains, astaxanthin's health benefits—proven without krill—include eye, skin, brain, heart and sexual health.

Krill manufacturers are lucky in the sense astaxanthin is naturally occurring, meaning brands don't need to be concerned with how to ensure the astaxanthin is formulated into the oil.

Other product suppliers must address the needs of the potent antioxidant to create their goods, which include managing degradation and color issues. And this Digital Magazine is here to help.

As noted by writer Danielle Rose, brands wishing to offer the benefits of astaxanthin to consumers must ensure it is extracted properly and that it is efficacious in the many forms available, from cracked and uncracked powders to oil extracts, and microencapsulated, gelatin-coated beadlets.

Gerald Cysewski, founder, CEO and chief science officer at Nutrex Hawaii, noted most astaxanthin is offered to consumers in supplements, but the market for foods and beverages with added astaxanthin is a burgeoning opportunity. However, foods and beverages are trickier to formulate since there's more surface area, and thus more oxygen that could degrade the antioxidant. Add to that the taste and color considerations, and brands who want to enter this market must navigate and understand how astaxanthin works in foods and beverages to formulate a successful product.

But that doesn't mean supplement formulation is easy either. All the same issues apply, but fortunately, more industry expertise is available in the astaxanthin supplement category.

To get a bit of that expertise, scroll through this Digital Magazine.

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EXPLORE OPPORTUNITIES IN THE **Natural Beauty Market**

Tuesday, September 26 | 1:30-4:30pm

Consumers are seeking natural solutions for every aspect of their lives, and the personal care segment is no exception. Further, the interest in transparency means it's not enough to offer "fairy dusting" of ingredients; there is a need for efficacious active ingredients, whether the product is for topical use or an internal "nutricosmetic."

This must-attend workshop at SupplySide West will focus on trends and innovations driving the personal care market; unique active ingredients and whitespace opportunities; and more.

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The Art of Astaxanthin Application

by Danielle Rose

INSIDER's Take

- Research has shown astaxanthin's benefits to immune health, inflammation, heart health, brain health, skin health and sports nutrition.
- Advancements in astaxanthin delivery forms allow it to be in liquid or powder form, paving the way for innovation in supplements, foods or beverages.
- Astaxanthin's potent antioxidant properties means doses can be small in finished products, but brands need to ensure the ingredient isn't degraded during manufacturing.

Astaxanthin belongs to the class xanthophylls, and according to Steve Holtby, president and CEO of Soft Gel Technologies Inc., this naturally occurring marine botanical is best known for its commercial use, providing salmon, trout and shellfish their natural reddish hue, giving it a long history in human diets.

Commonly referred to as “the king of carotenoids,” astaxanthin has been found to be at least 10 times more powerful than lycopene or beta-carotene,¹ according to Rodger Jonas, vice president of sales & business development at MTC Industries Inc. It is several hundred times more powerful than antioxidants such as vitamins C, E and coenzyme Q10 (CoQ10),² according to a document produced by AlgaeHealth.

Astaxanthin naturally occurring marine botanical is best known for its commercial use, providing salmon, trout and shellfish their natural reddish hue, giving it a long history in human diets.



Demand for astaxanthin is growing at a rate of approximately 15 percent annually—from US\$450 million in sales in 2014 to \$520 million in 2015, and a projected \$1.1 billion by 2020, according to MTC, making this red botanical a hot product.

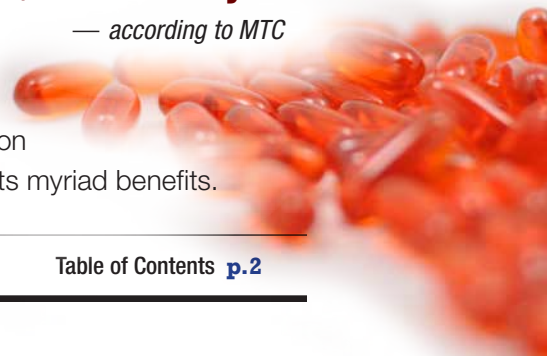
“A key difference with astaxanthin compared to many other antioxidants is that many users report that they actually feel a difference when taking astaxanthin,” said Gerald Cysewski, founder, CEO and chief science officer at Nutrex Hawaii. “We’ve heard countless testimonials about how astaxanthin has improved the quality of their life, from less joint and muscle pain to better-looking skin. This unique characteristic alone allows astaxanthin to stand out among other nutrients, and garners repeat and continued consumption from users.”

The Benefits of Astaxanthin

Astaxanthin supports immune system modulation—the foundation of the anti-inflammatory and antioxidant activity that precipitates its myriad benefits.

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— according to MTC



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“Natural astaxanthin holds the distinction of being the strongest natural antioxidant, having 40 times the power to neutralize reactive oxygen species compared to either beta-carotene or lycopene,”³ said Karen Hecht, Ph.D., technical marketing specialist at AstaReal Inc.

Additionally, its ability to lower low-density lipoprotein (LDL) cholesterol,⁴ and support epidermis,⁵ eye,⁶ brain,⁷ and cardiovascular⁸ health makes astaxanthin a powerful anti-aging and cellular health supplement. It also has benefits to the immune systems,⁹ Bob Capelli, executive vice president of global marketing at AlgaeHealth, a division of BGG, said, while improving strength, endurance and energy levels. It also has proven anti-carcinogenic and anti-diabetic benefits,¹⁰ according to David Chance, U.S. sales and marketing manager, Innobio, and it can improve male fertility.¹¹

Astaxanthin provides cardiovascular support by improving blood lipid parameters,¹² lowering cholesterol,¹³ and Capelli said it improves blood flow¹⁴ and decreases the heart rate of endurance training athletes.¹⁵

These same benefits support brain health, helping to prevent dementia and other neurodegenerative conditions.¹⁶ The benefits extend to eye health, as well, Hecht said—easing sore, tired eyes,¹⁷ and other vision considerations.¹⁸

“We call astaxanthin ‘the ultimate anti-aging nutrient,’” Capelli said, “because it addresses most of the concerns people have with aging all in one product.”

As a cosmeceutical, Efrat Kat, vice president of sales and marketing at Algatech, said astaxanthin supports skin health both topically and internally, resulting in several formulation and marketing options.

“We call astaxanthin ‘the ultimate anti-aging nutrient’ because it addresses most of the concerns people have with aging all in one product.”

—Bob Capelli, executive vice president of global marketing at AlgaeHealth



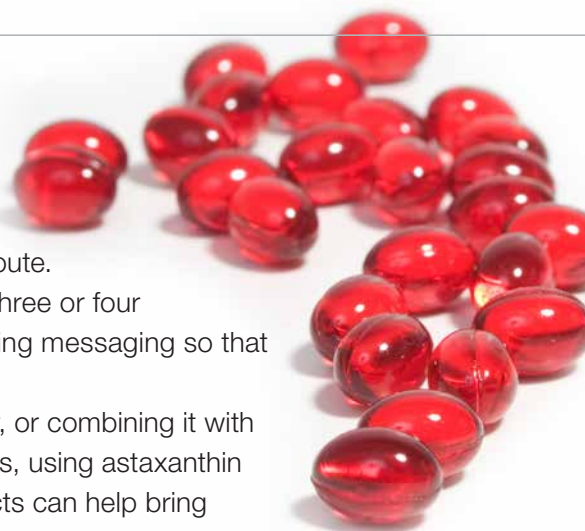
Tom Vierhile, innovation insights director, GlobalData said the company has, “identified the ingredient as an up-and-coming dermocosmetic within the context of its use as an anti-aging ingredient.”

Astaxanthin can help reduce fine lines and wrinkles, prevent sagging, and improve skin moisture and elasticity.¹⁹ It can also inhibit age-related skin deterioration and environmental damage, making it beneficial for ultraviolet (UV) protection and sunburn relief when used in oil-based formats.²⁰ However, Cheow said a combination of oral supplementation and topical treatment has been found to be the best way to improve skin conditions.²¹

Despite the myriad benefits astaxanthin offers, consumer perception is everything, and promoting all of the benefits in one product may not be the best marketing route.

"I recommend choosing anywhere from one to perhaps three or four (maximum) of the health benefits to focus on in your marketing messaging so that it doesn't become perceived as a 'snake oil,'" Capelli said.

Whether utilizing astaxanthin both internally and externally, or combining it with other actives known to promote one or more health concerns, using astaxanthin with familiar delivery formats and already established products can help bring awareness of this powerful ingredient to a larger population segment.



Formulation Considerations

As a carotenoid, astaxanthin has unique formulation considerations that are dependent on extraction, degradation and delivery.

"To date, well over 90 percent of astaxanthin is delivered to the market through supplements," Capelli said. "But all of us in the astaxanthin industry foresee food and beverage being a huge growth vehicle in the future."

Astaxanthin is available in cracked and uncracked powders, oil extracts, and microencapsulated, gelatin-coated beadlets. Each form has benefits and challenges, and choosing which format to use takes a variety of factors into consideration.

For example, Carol Cheow, CEO of Cactus Botanics CA Inc., suggested liquid oil for soft capsules, beverages, foods and cosmetics. Because it is fat soluble, powdered forms are preferred for beverages.²²

Oil suspension also works well with gummies, chocolate confectioneries and standard food products, Chance said. Cold water dispersible powder, on the other hand, is excellent for instant drink mixes, any type of reconstituted food, tablets and two-piece hard gel capsules. The beadlet form works best for tablets and two-piece hard gel capsules, as it can withstand compression and reduce dust. Nutrex prefers the gelcap delivery system for its efficacy and improved absorption.

"For the industry, gel capsules are the best-established form for astaxanthin delivery," Hecht said. "However, in sports nutrition, powdered instant drinks are very popular, and astaxanthin represents a new ingredient for this market that would provide a distinguishing feature and added health benefits."

Astaxanthin's vivid red color is another formulation consideration. While it works well in berry flavored or red-colored foods, Hecht warns against utilizing it in drinks that are white or that will look unappetizing with the addition of a red colorant.

"The finished product determines the most appropriate form required," Chance said.

Dosing

Since it is such a powerful antioxidant, Kat said low doses are effective and can easily be incorporated into a wide range of products without affecting quality or benefit.

Depending on the application, Capelli said 2 mg to 16 mg per day is sufficient, a dose that Tryggvi Stefánsson, science manager at Algalif, said is comparable to the amount of natural astaxanthin consumed in a salmon meal.

Because it's fat soluble, astaxanthin takes about four weeks to accumulate in the body to therapeutic levels.

"This is why in applications where faster results are expected (i.e., sports applications), for those new to astaxanthin, formulators may consider combining astaxanthin with a more rapidly acting ingredient," Hecht said. "In the cosmetics industry, however, four weeks is a good timeframe for results."

Astaxanthin and Oil—the Perfect Match

Whether naturally occurring, extracted or at work in the body, astaxanthin has a close relationship with fats and oils. It benefits from being stored and used with oil—whether for bioavailability, stability or quality.²³

In the body, Holtby said astaxanthin attaches itself to fat cells, protecting proteins and fatty acids.

Cyanotech tested six different formulations of astaxanthin and found minimal difference in bioavailability between formulations as long as astaxanthin was consumed with fat. Cheow said vitamin E further increases its absorption. Fats also enhance astaxanthin's health benefits.²⁴ Therefore, for optimal absorption, astaxanthin should be taken with fats, immediately prior to meals.²⁵

This action within the body mimics astaxanthin's natural state. For example, it is naturally found in krill oil, which Holtby said naturally and synergistically combines antioxidants and omega-3 fatty acids.

Temperature is the most influential factor in degradation, severely limiting astaxanthin's use.

"Being an antioxidant, astaxanthin complements other fat-soluble nutrients like fish oil very well because the oils help maximize astaxanthin absorption in the gut, and the astaxanthin helps protect the fish oils from oxidation," Hecht said.

Degradation

From light to temperature, oxidation and contamination from other ingredients, degradation of astaxanthin is the result of many different factors.

Temperature is the most influential factor in degradation, severely limiting astaxanthin's use. However, oil-encapsulated forms retain close to 100 percent of the botanical's active properties, even after 21 days of cold storage.²⁶



Foods fortified with microencapsulated fish oil were found to have minimal deterioration of astaxanthin after 12 days of dark storage,²⁷ making refrigeration the best way to preserve astaxanthin in functional foods, as well.²⁸ However, oil forms should still be used as soon as possible after opening, Cheow said.

Capelli said oxygen degradation makes both the production and packaging process essential to preservation.

“More consumers are looking at whole foods that are organic,” Huff said. “Special care needs to be taken when using this form so that the products are packaged under an oxygen-free environment.”

The packaging for tablets, gel capsules, stick packs and gummy blister packs protects against light and oxygen, Hecht said, making these great delivery options to prevent untimely or rapid expiration. Stefánsson added that food with astaxanthin should also be packaged airtight, and soft gel encapsulation offers the best bioavailability and protection for astaxanthin oleoresin during manufacturing, transportation and storage.

Metals such as iron can also degrade astaxanthin, Cysewski said. Beadlets mitigate this by separating and protecting astaxanthin from other ingredients, Chance added. This increases shelf life and prevents discoloration and off-flavoring.

“Isolation of the astaxanthin can help preserve activity level, and adding preferentially oxidized ingredients will help protect and extend the shelf life,” Jonas said. “Make certain the shelf life requirement is addressed in coordination with the form to be used. Processing does make an impact on activity level, and the finished product should be tested for efficacy.”

Marketing Perspectives: Know the Target Group

“It’s important to find ways in which astaxanthin can easily fit into the consumer’s routine and emphasize that the benefits of astaxanthin are part of a long-term approach and commitment to overall health,” Hecht said.

Since oxidative stress is a concern that spans multiple age groups, Hecht said this offers astaxanthin quite a bit of marketing flexibility.

A 2015 Consumer Survey on Dietary Supplements from the Council for Dietary Supplements for Responsible Nutrition (CRN)



Source: Council for Dietary Supplements (CRN)

A 2015 Consumer Survey on Dietary Supplements from the Council for Responsible Nutrition (CRN) found well over 50 percent of Baby Boomers (74 percent of women and 63 percent of men) take dietary supplements. Despite not having the same health issues as older generations, the survey also found more than 50 percent of Millennials (62 percent of women and 61 percent of men) are also taking supplements. Although the end goal is the same (general health and wellbeing), the presentation of a product will vary between these different consumers. For example, Seward said healthy aging products must allow for age-related concerns (i.e., packaging that is easy to open and read) without treating this more active generation as “elderly,” said Simon Seward, global business director at Algalif.

Up-and-Coming Products

Several different companies have shown innovation in their delivery and marketing of astaxanthin products. Some of them are unique in their presentation, while others incorporate new combinations of actives.

“Some of the more interesting launches globally include a dietary supplement called Capskrill, which consists of krill oil and includes astaxanthin as an ingredient, one that is actually called out on the packaging,” Vierhile said.

Other recent astaxanthin-containing product launches include innovative cosmetics such as Pdc. Inc.’s melting facemask, and MTMCO’s “Mood Therapy Masks.” Other astaxanthin cosmetics include a fragrance-eliminating soap for men by Osaka Ace Co., multifunctional moisturizer, and a complexion reviving oil by Biotherm (L’Oreal).

Meanwhile, boxed chocolates marketed for beauty-from-within, and astaxanthin-containing, on-the-go peanut butter products have innovated the food market for this supplement.

“The beauty of astaxanthin is that it’s good for practically everyone,” Capelli said. “The combination of preventive as well as potential therapeutic benefits can apply to almost anyone.”



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NUTRITION FOR Heart Health

Friday, September 29 | 8:30-11:30am

While heart health still means managing healthy cholesterol and blood pressure, consumers are also looking for different types of products and delivery systems that can bolster their cardiovascular health throughout a lifetime. What is the global market opportunity for heart health products, and what do sales trends tell us about the most common nutritional ingredients for this market? Learn more in this must-attend workshop at SupplySide West, while exploring some of the nutritional ingredients for heart health.

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Takeaways for Your Business

As a carotenoid, astaxanthin has unique formulation considerations related to extraction, degradation and delivery.

Astaxanthin's various health benefits are backed by research, which has significantly helped its market growth. "We call astaxanthin 'the ultimate anti-aging nutrient,'" Bob Capelli, executive vice president of global marketing at AlgaeHealth, a division of BGG, said, "because it addresses most of the concerns people have with aging all in one product."

The demand for astaxanthin is growing at a rate of approximately 15 percent annually—from US\$450 million in sales in 2014 to \$520 million in 2015, and a projected \$1.1 billion by 2020, according to MTC Industries Inc.—making the unique red botanical a hot product.

Astaxanthin also accommodates a range of delivery formats, and is available in cracked and uncracked powders, oil extracts and microencapsulated gelatin-coated beadlets. Each form has benefits and challenges, so choosing which format to use should take a variety of factors into consideration.

For instance, astaxanthin's vivid red color works well in berry-flavored or red-color foods. However, Karen Hecht, Ph.D., technical marketing specialist at AstaReal Inc., warned against utilizing it in drinks that are white or that will look unappetizing with the addition of a red colorant.

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EYE HEALTH: Exploring the Blue Light Opportunity

Thursday, September 28 | 2-4pm

While eye health has traditionally been connected to aging, concerns about younger adults are increasing due to the effects of blue light on visual function. The macular carotenoids lutein and zeaxanthin filter blue light and protect the eye from oxidative damage. During this panel discussion at SupplySide West, get the latest insights around the challenges of blue light, its effects on younger adults, and the types of nutritional interventions that could protect vision for a lifetime.

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MARKETING SERVICES

<i>Vice President, Marketing Services</i>	<i>Program Manager</i>
Danielle Dunlap	Kristin LaBarbera
<i>Art Director, Health & Nutrition</i>	<i>Senior Marketing Manager</i>
Andrew Rosseau	Jenn Moreira

EVENTS DEPARTMENT

<i>Event Director</i>	<i>Education Manager</i>
Marisa Freed	Alyssa Sanchez
<i>Event Manager</i>	<i>Exhibit Operations Director</i>
Carrie Freese	Lola Ortega