



Omega-3 **INSIGHTS**

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F O C U S R E P O R T

Tech Savvy Omega-3s

Global sales of omega-3 finished products are expected to hit US\$34.5 billion by 2016. With this type of growth, the industry is working overtime to find fresh sources of omega-3s—algae, krill, land-based sources, etc.—and working tirelessly to overcome challenges with stability, delivery, taste and more in functional foods and beverages via intelligent technology.

by Alissa Marrapodi

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Popular for their heart-health and brain-health benefits, omega-3s have a strong reputation not only in the industry, but with consumers as well. According to Packaged Facts, global sales of omega-3 finished products are expected to hit US\$34.5 billion by 2016. Although the market holds great potential, growth has been somewhat hampered by concerns about stability and delivery options. But smart, cutting-edge technologies are turning these problems into solutions, opening the doors for new applications, new sources of omega-3s and greater accessibility via everyday foods and beverages.

First, let's look at the challenges that come when working with omega-3s.

The Problems

Although anchovies have been the go-to raw material, accounting for 83 percent of omega-3s used in dietary supplements and functional foods, according to Ellen Schutt, communications director at the Global Organization for EPA and DHA (GOED), as the omega-3s market expands, newer sources such as algae are expanding even further with a greater number of companies exploring commercialized production. According to Frost & Sullivan, algae accounted for 4 percent of the raw materials in the global omega-3s market, while fish oil dominated with 79 percent of the market.

"A number of companies have sold DHA (docosahexaenoic acid)-rich algal oil from *schizochytrium* and *c. cohnii* single-cell organisms for the past 20 years," said Adam Ismail, executive director, GOED, "However, a new wave of algal oils is nearing entry into the markets. The first, which is now in limited commercial production, is *nannochloropsis* polar lipids. Qualitas has used open-air ponds to cultivate the *nannochloropsis* algae, which is rich in eicosapentaenoic acid (EPA).

"The source is different because it is the first oil from a new algae organism to be commercialized," Ismail continued. "Also, the oil contains omega-3s bound to phospholipids and glycolipids, so it is a vegetarian alternative to krill oils and other marine phospholipids. This source naturally yields an oil with about 30 percent EPA and no DHA. So the source alone allows it to compete on the basis of having a higher concentration, but also a unique composition. The production process for the *nannochloropsis* polar lipid oil also provides some



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unique positioning because, since it is grown in an open-air pond, the organism uses sunlight as a source of energy. The already-commercialized algal DHA sources are grown in fermentation tanks and use sugars as a source of energy."

In addition to algae, other raw materials are being explored. For example, squid is usually thrown away during seafood preparation, but it's quickly becoming a more sustainable omega-3 option; it also has a higher DHA content than most fish-derived omega-3s, according to Todd Parker, managing member of Pharma Marine. Furthermore, Eric Anderson, former senior VP global marketing, Aker BioMarine, said krill supplements grew more than 70 percent in the United States in 2012. Plant-based omega-3 production value is forecast to grow twice as fast as marine omega-3s during the next five years, according to a 2013 report from Amadee+Company.

Jennifer Andrews, M.Sc., manager, corporate branding, Nutrasource Diagnostics Inc., highlighted the expansion opportunities with land-based omega-3s. "Genetic modification techniques are being investigated as a means to increase the EPA and DHA content of certain plants," she said. "Although the GMO debate is currently in full swing, this advancement could lead to new plant-based sources of omega-3s, opening the door for vegetarian and vegan products as an alternative to animal-derived marine oils."

But these new sources raise new questions. "Each of these sources produces its own unique challenges as the composition of the final product may differ depending on the source," noted Kevin Yan, M.Sc., associate director, product analytics division, Nutrasource Diagnostics Inc. "Interferences with traditional testing methods have to be researched, accounted for and overcome to ensure that analytical testing is accurate."

Beyond the fatty acid material, Yan said: "The composition of the fatty acids themselves may also present challenges, as omega-3s are currently being sold in a variety of forms, including free fatty acids, triglycerides (TG), ethyl esters (EE) and phospholipid-bound. This can create challenges during testing, so communication is vital to ensure the correct components of the product are analyzed." And beyond material and composition, the use of additives in products creates another set of challenges. "These additives may interfere with traditional test methods that were developed specifically for use on purified oils and are now being adapted to test these new products entering the market," Yan pointed out. "The traditional test methods are not always suited for these novel products and new test methods will have to be developed to deal with these issues."



Most of the omega-3s are currently consumed via a dietary supplement, as the market has lacked an omega-3 that can be incorporated into functional foods and beverages that can overcome the problems of stability, sensory and cost-effective doses per serving.

Food and beverage technologists encounter many struggles in the lab, namely oxidative stability. EPA and DHA's multiple double bonds make them susceptible to oxidation, leading to an unpleasant fishy taste. Oxidation becomes even more of an issue when food is processed under high heat.

Along with oxidation, Richard Staack, Ph.D., MBA, CEO of SoluBlend Technologies LLC, said the two major challenges SoluBlend has confronted are sensory and shelf-life. "While the industry has used plant-based omega-3s in several foods and beverages, using fish- or algae-based omega-3s has posed several problems," he pointed out. "Most of the omega-3s are currently consumed via a dietary supplement, as the market has lacked an omega-3 that can be incorporated into functional foods and beverages that can overcome the problems of stability, sensory and cost-effective doses per serving."

Fortunately, there is a good deal happening in the technological sector to create solutions for these problems.

The Solutions

"Omega-3s are a great example of a product that at one time had a reputation for being challenging to work with that has really turned a corner," said Megan Gorczyca, marketing manager, DSM. "Omega-3 fatty acids are highly oxidative and therefore can be difficult to add to certain applications in terms of stability and sensory characteristics."

As modern technology works behind the scenes, difficulties with oxidation, self-life, taste and texture can be addressed and overcome.

"Technological advancements are helping to address the major challenges that come with adding omega-3s to foods, namely stability, taste and odor," Andrews said. "Microencapsulation has helped get around these issues and has encouraged the development of shelf-stable products containing omega-3s, including infant formulas, baked goods, cooking oils, beverages and dairy products. Currently the biggest challenge is adding omega-3s to water-based products such as clear beverages."

With this concern in mind, many companies have explored beverage solutions. One commercialized option is SoluBlend's patented technology, which converts fat-soluble ingredients—including plant-, fish- and algae-based omega-3s—into water-soluble ingredients without compromising their actives or health benefits. Transparent beverages benefit from this technology without adversely impacting taste, texture or appearance. "The SoluBlend technology protects/slow downs the effect of oxidation resulting in an improved shelf-life for the finished product," Staack said. "The water-soluble omega-3 concentrates will not streak, float, fall out or have a typical oil-and-water phase separation when added to



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— Jennifer Andrews, M.Sc.,
manager, corporate
branding, Nutrasource
Diagnostics

aqueous mediums. Manufacturers can now take advantage of the volumes of research demonstrating actual health benefit of specific doses by incorporating these actives at those efficacious levels at a cost-effective price per serving."

Oceans Omega's patent-pending technology has also helped expand the use of omega-3s, specifically within the beverage industry in non-refrigerated products such as waters, seltzers, carbonated beverages, sports drinks, etc. In clear beverages, the technology enables the incorporation of omega-3 fatty acids without a change in the finished taste, smell or texture.

"Oceans Omega produces water-soluble liquid emulsions containing high-concentrations of omega-3s that are easily incorporated into standard mixing procedures of beverage manufacturing plants," said Benjamin Mamola, CEO, Mycell Technologies.

As Andrews and Schutt discussed earlier, land-based omega-3s are helping to expand the omega-3 market. Earlier this year, DSM Nutritional Products and Monsanto Co., developer of plant technology, partnered up to deliver stearidonate (SDA) soybean oil omega-3 soybean oil for use in foods in North America. SDA omega-3 soybean oil is a plant-based source of SDA, which naturally converts in the body to EPA. SDA soybean oil's clean flavor, ability to maintain shelf life and stability enable its incorporation in a variety of foods, including dressings, sauces, margarines, spreads, bakery products, soups, snack bars and dairy-based products, among several other food applications.

BASF's technology works with feedstock for various applications. "Our specialized low-temperature fractionation technology enables feedstock to be concentrated in its natural triglyceride form at up to 75 percent polyunsaturated fatty acids (PUFAs) in botanicals and about 50 percent PUFA in fish oils," said Ralf Fink, general manager omega-3, BASF. "The process involves cooling the feedstock so that unwanted fractions, including most saturates and monosaturates, are greatly reduced, leaving a product rich in potent polyunsaturates. The TG form is particularly suitable for food and nutritional applications, as it is very stable. Crystalpure™ oils hold cGMP accreditation and can therefore be used in pharma-grade products, including medical food.

At SupplySide MarketPlace 2013, Dave Shannon, managing director of consumer care at Croda, said new deliverables, among other technological advancements, are opening up omega-3 space. "Gummy bears and chewable soft-gels deliver omega-3s to a wider demographic such as kids," he said. "But with these types of deliverables, the organoleptic properties of the oil are important, so companies are developing deodorization technologies to make them more palatable to more people."



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One issue Yan pointed out earlier was the introduction of additives into omega-3 products, which comes into play with these new deliverables. "Many omega-3 companies have begun to color and/or flavor their products in order to appeal to more consumers such as children and individuals who do not like the taste of unflavored fish oil," he said. "These additives can interfere with the traditional markers of oxidation used to test the quality of a fish oil, particularly anisidine value, a measure of secondary oxidation in a fat or oil. Though the raw material product may have little to no oxidation, once the additive is introduced into the product and tested, it appears to be oxidized to levels that are unacceptable in the industry. Nutrasource is currently developing a method that eliminates the majority of the interference seen in anisidine value testing and allows for accurate oxidation analysis of products that contain additives, such as colorants and flavorants, known to create elevated anisidine values with traditional test methods."

Just as consumers want new ways to consume omega-3s, they also want more of it. "Many companies are pushing the boundaries of concentration," Shannon said. "Consumers want to take an efficacious dose of omega-3s in the smallest dose possible, and the challenge is to concentrate EPA and DHA to deliver in a small dose as possible." Companies are developing technologies to deliver these types of concentrations.

Andrews added: "As concentration technologies become more refined and less costly, dietary supplement products containing high concentrations of EPA and DHA are becoming more widely available. This trend is expected to lead to increased consumer preference and demand for highly concentrated/ultra-refined products versus those with a lower omega-3 content per capsule. Combination products are expected to increase over the next several years as new active ingredient combinations are investigated."

New deliverables, higher concentrations, combination products and technologies that enhanced omega-3s for aqueous delivery and functional food inclusion are helping consumers gain access to omega-3s in everyday products. "Products that fit seamlessly into a consumer's everyday life, e.g., drinking a bottle of water or a shot infused with healthy omega-3s, should assist in increasing consumption of these vital nutrients without the effort oftentimes needed to consume pills," Mamola said. "In the past, oxidative instability prevented the incorporation of omega-3s into certain food and beverage categories. Recent technological advancements have fostered the continued growth of the market." □

Alissa Marrapodi is a managing editor for the Informa Exhibitions Health & Nutrition Network.

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