NATURAL PRODUCTS INSIDER®

Omega-3s

Vegetarian Omegas: The Importance of SDA

by Greg Cumberford

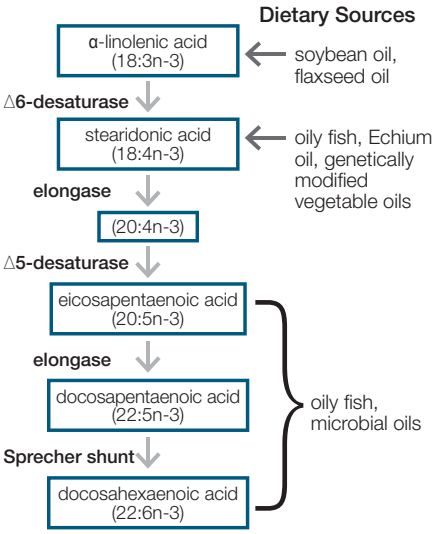
STEARIDONIC ACID (SDA), A long-chain omega-3 fatty acid (C18:4) with a range of health benefits, could be a game-changer in supplements and foods. It offers a clean label, is vegan and traceable, and may offer a highly scalable pathway to meeting recommended daily intakes for omega-3s.

SDA in Omega-3 Metabolism

Significant dietary SDA is commercially available only from vascular plant origins, although it occurs naturally at low levels (0.5 to 2 percent, typically) in edible oily fish. Metabolically, SDA is synthesized by humans from dietary alpha-linolenic acid (ALA, C18:3), a more widely abundant omega-3 found in some seed and nut oils such as flax and chia. ALA is converted into SDA by delta-six desaturase (Δ6D), an enzyme originating in the liver. While critical to the synthesis of very long-chain omega-3s, this enzymatic conversion is particularly inefficient in humans. SDA is then further converted to the widely studied and well-known omega-3 eicosapentaenoic acid (EPA, C20:5). Human cell membranes require the highly unsaturated fatty acids to be incorporated as phospholipids in order to maintain proper fluidity, porosity and integrity, and to serve as reservoirs of anti-inflammatory response mediators. While SDA is itself a product of ALA metabolism, direct dietary SDA intake offers people a much more efficient way to synthesize EPA from non-marine sources. (See chart.)

As such, SDA has been dubbed a "pro-EPA" omega-3 fatty acid because it bypasses the Δ6D rate-limiting step in humans that causes plant-derived ALA sources to convert poorly to the more elongated omega-3 fatty acids EPA, DPA (C22:5) and DHA (C22:6). Clinical studies have shown that while SDA does not convert to DHA to any significant degree, SDA converts to EPA in tissues and circulating cells up to five times more efficiently than ALA. Further, because SDA is less unsaturated than EPA and DHA, it is more stable, less prone to oxidation, and therefore more amenablein a wide variety of food and beverage applications where resulting "fishy" off-flavors present challenges to palatability and consumer acceptance.

Metabolism and dietary sources of omega-3 PUFAs



(Modified from Lipid Technology 2008 20:7, 152)

SDA Commercial Supply and Sustainability

Commercially available oil seed sources of SDA are as follows:

Oilseed source	SDA level
Hemp	**up to 2%**
Black currant	**2.5-4.5%**
Echium plantagineum	**12-14%**
Buglossoides arvensis	**18-20%**

SDA came to prominent awareness in the U.S. natural products industry due to developmental work announced by Monsanto and Solae of a genetically modified (GM), SDA-enriched soya oil in 2008 to 2010. The Monsanto product, whose commercialization rights are now owned by DSM, does not yet appear to be commercially available for human consumption. Recently, Nature's Crops International gained regulatory approvals in the United States and European Union for refined *Buglossoides arvensis* seed oil (tradename: Ahiflower), which has the highest SDA content from a single non-GM plant source.

In 2013, the Global Organization for EPA and DHA Omega-3s (GOED) reported that in 12 industrialized countries, 220 million consumers had stopped taking marine-derived omega-3 supplements due to sustainability concerns. This is a large and expanding consumer market. More recently, in 2014 and 2015, one of the Peruvian anchoveta fisheries and the U.S. West Coast sardine fishery were closed due to concerns over fish stock levels. This is significant because the Peruvian fishery is responsible for supplying about 70 percent of the world's omega-3 fish oil, as reported by GOED.

This event, though relatively short-lived, underscored the growing need for an "all-in" approach to supplying omega-3 fatty acids globally—from marine, algal and plant sources. While the Peruvian, Moroccan, U.S. West Coast and other anchovy and sardine fisheries that are subject to intermittent population collapses can recover with proper management, diverse new omega-3 nutritional sources are needed to address long-term demand, let alone respond to consumers who cannot or choose not to eat marine animal products.

SDA, a readily scalable and sustainable plant-based omega-3 source that does not rely on marine fisheries, nor on more

costly algal or microbial omega-3 sources of EPA and DHA, will help solve a global supply dilemma. SDA presents formulators, manufacturers and consumers an alternative to current plant-derived omega-3s from flax and chia while increasing the overall effective omega-3 payload, and hence, reducing the total caloric intake and/or dosing.

SDA Clinical Science

SDA has its own emerging body of scientific and clinical research supporting health benefits that are both aligned with, and in some cases, independent of omega-3 ALA, EPA and DHA findings. This is true in topical and in ingestible SDA applications. Recent peer-reviewed published references include the following benefits or activities associated with SDA:

- **Anti-aging**: Topical SDA oil increased dermal structural proteins and reduced fine lines and wrinkles, while inhibiting UV-induced inflammation.[1]
- **Anti-obesity**: SDA suppressed adipocyte (fat cell) differentiation.[2]
- **Anti-diabetes (type 2):** SDA suppressed type-2 diabetes biomarkers.[3]
- **Anti-inflammation**: Plant SDA oil decreased intestinal prostiglandin (PGE2) sequestration and reduced endogenous production of COX-derived arachidonic acid metabolites.[4]
- **Coronary heart disease (CHD)/ cardiovascular disease (CVD) prevention**: Plant SDA oil sources decreased cholesterol blood fractions and triglycerides, benefiting people at risk for CHD/CVD.[5,6]
- **Anti-tumorigenesis**: SDA reduced growth of human breast cancer cells in vitro and in vivo. SDA enhanced chemosensitivity of canine lymphoid tumor cells. SDA enhanced anti-tumor activity of doxorubicin in human prostate cancer cell lines.[7,8,9]

Long-term prospective studies in humans investigating specific health effects of SDA consumption have yet to be carried out and published. However, preliminary cell line, animal and human studies indicated that SDA has beneficial effects on various biomarkers of disease, particularly relating to CVD and inflammatory pathways, as distinct from ALA and DHA. SDA is indeed a promising "pro-EPA" omega-3 alternative, especially for vegetarians or people choosing not to consume marine or algal omega-3 sources. In the natural products industry's efforts to respond to consumer concerns about the sustainability, traceability, purity and sensory appeal of omega-3 nutrition sources, SDA is truly a market-responsive omega-3 fatty acid.

Greg Cumberford is a 25-year natural products industry executive and is vice president of strategic initiatives with Nature's Crops International (naturescrops.com).

For a list of references, email
references@naturalproductsINSIDER.com