Conclusions and Recommendations from the Symposium, Heart Healthy Omega-3s for Food: Stearidonic Acid (SDA) as a Sustainable Choice

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Abstract

Faculty who had presented at the symposium “Heart Healthy Omega-3s (n-3 fatty acids) for Food: Stearidonic Acid (SDA) as a Sustainable Choice” met and agreed upon conclusions and recommendations that could be made on the basis of evidence provided at the symposium. The participants also submitted manuscripts relating to their topics and these are presented in this supplement. These manuscripts were reviewed and also contributed to the conclusions and recommendations presented herein. The three major objectives of the symposium were to: 1) increase understanding of the current and emerging knowledge regarding the health benefits of (n-3) fatty acids (FA) including a focus on stearidonic acid (SDA) and EPA; 2) evaluate the importance of increasing (n-3) FA consumption in the US and the current challenge of doing so via mainstream foods; and 3) consider the health and food application benefits of SDA as a precursor to EPA and a plant-based sustainable source of highly unsaturated (n-3) FA for mainstream foods. Specific areas for future research were defined and included in the summary and conclusions herein. Overall evidence-based conclusions included: the current evidence provides a strong rationale for increasing (n-3) FA intakes in the US and other populations; current consumption of (n-3) FA in most populations is either insufficient or not efficient at providing adequate tissue levels of the long-chain (n-3) FA EPA and DHA; SDA in soybean oil appears to be a cost-effective and sustainable plant-based source that could contribute to reaching recommended levels of (n-3) FA intake, but more research and surveillance is needed; and adding SDA-enriched soybean oil to foods should be considered as a natural fortification approach to improving (n-3) FA status in the US and other populations. References for these conclusions and recommendations can be found in the articles included in the supplement. J. Nutr. doi: 10.3945/jn.111.149831.
Introduction

This paper summarizes the conclusions and recommendations from the symposium, Heart Healthy Omega-3s (n-3 fatty acids) for Food: Stearidonic Acid (SDA) as a Sustainable Choice. The 3 major objectives of the symposium were to: 1) increase understanding of the current and emerging knowledge regarding the health benefits of (n-3) FA, including a focus on SDA and EPA; 2) evaluate the importance of increasing (n-3) FA consumption in the US and the current challenge of doing so via commonly consumed foods; and 3) consider the health and food application benefits and risks of SDA as a precursor to EPA and as a plant-based, sustainable source of highly unsaturated (n-3) FA for commonly consumed foods.

Immediately after the symposium, the speakers met to summarize major conclusions gathered from the presentations and discussions during the conference and outlined recommendations that could be made based on existing evidence as well as identifying future research and policy recommendations that need to be considered. This paper summarizes key points and recommendations from the symposium presentations, the follow-up meeting, the independent symposium manuscripts, and additional correspondence among the participants.

Roles of (n-3) FA in Health and Disease

Current knowledge for which a general consensus exists. Consistent evidence indicates that (n-3) FA contribute in a positive way to a number of benefits in health promotion and disease prevention (1,2). The available literature indicates a role for (n-3) FA in decreasing morbidity and mortality from cardiovascular disease, especially coronary heart disease, with some evidence, although weaker, for decreasing risk of cerebral vascular disease (stroke) (2). Strong evidence exists that (n-3) FA lower serum TG, reduce sudden cardiac death from arrhythmias, and likely exert antiinflammatory effects that may benefit processes relating to atherogenesis and atherosclerotic plaque rupture (2). Of note, some trials of supplemental EPA and DHA have not shown positive coronary heart disease outcomes. These inconsistent results may be related to a number of factors such as small numbers of coronary deaths and use of composite coronary outcomes, low (n-3) FA dosage levels, high background intake of dietary (n-3) EPA and/or DHA in the populations, late initiation of (n-3) FA supplements after the initial cardiac event, and use of plant-based essential (n-3) FA or (n-6) FA such as ALA and LA, respectively. Overall, these more limited recent trials do not strongly alter existing conclusions or recommendations about long-chain (n-3) FA for preventing coronary death (2).

Mechanisms of action of (n-3) FA. The consumption of (n-3) FA likely affects health and disease through multiple mechanisms. The (n-3) FA influence metabolism and/or hormone concentrations that affect cell physiology. They also interact with transcription factors and affect gene expression, either directly or indirectly, through metabolites. Also, (n-3) FA affect oxidative stress and production of reactive oxygen species (4). Recent evidence shows that (n-3) FA can influence metabolism via interactions with cell surface and intracellular FA receptors and sensors. Finally, (n-3) FA can affect changes in membrane physiochemistry by altering cell membrane phospholipid composition (1,2).

There is general agreement that the long-chain (n-3) FA EPA and DHA are much more bioactive in health promotion and disease prevention than their (n-3) essential FA precursor, ALA (1,5). However, ALA may provide benefits in certain individuals and/or populations, particularly those with very low intakes of (n-3) FA.

Current Intakes and Sources of (n-3) FA

Participants at the symposium stressed that current world supplies of wild and farmed fish and fish-derived fish oil might be insufficient to meet recommended (n-3) FA intakes globally, especially for EPA and DHA (2,4,6). In addition, the world demand for seafood is predicted to grow over the next several decades, putting further strains on world seafood supplies (4). The WHO and FAO recently recommended an intake of 250 mg/d of EPA+DHA for adults (6,7) as did the 2010 Dietary Guidelines of the US (8). These are in parallel to recommendations in the UK and Australia/New Zealand (9). With current mean intakes estimated at ~110 mg/d EPA and/or DHA in the US, other sources for long-chain EPA and DHA are clearly needed (3,5). Whereas certain algae can produce DHA, genetically modified yeast can produce EPA, and krill oil can supply EPA and DHA, all of these are presently relatively expensive sources. Ethyl esters of fish-oil derived EPA and DHA are also costly (2,6).

Therefore, (n-3) FA-enriched plant sources could be a more cost-effective source of (n-3) longer chain PUFA such as EPA (6). However, current plant sources of (n-3) FA mainly provide ALA and not EPA or DHA. Because conversion of ALA to EPA or DHA is inefficient in humans, with most being utilized as an energy source, identification of alternatives is relevant. One such possibility discussed by some speakers at the symposium was soybean oil enriched with SDA (2,6,10,11). Such oil can contain ~18–20% of total FA as SDA. Data presented during the symposium and supported by peer-reviewed literature show that SDA is much more efficiently converted to EPA than is ALA (5). Following consumption, the apparent conversion of SDA from soybean oil to EPA can be as high as 20% of the SDA consumed compared to 1–5% for ALA (10). Evidence presented in this...
supplement suggests that SDA-enriched soybean oil incorporated into foods would contribute to meeting current recommended (n-3) FA intakes in the US and likely other populations (5,10). Moreover, in an analysis of costs for providing adequate intakes of (n-3) FA, fortification of foods with SDA-enriched soybean oil was predicted to be less costly than other current sources, such as supplements of EPA and DHA derived from fish, algae, or krill (6). SDA is also less susceptible to oxidation in foods than are the long-chain (n-3) FA EPA and DHA, increasing its potential generalizability to a wider range of products (4).

Current Evidence for Effects of SDA

Evidence presented at the symposium showed that intakes of SDA ≥ 1 g/d was effective for raising tissue membrane levels of EPA and improving the omega-3 index (erythrocyte EPA+DHA) in adults (12–14). Interestingly, in the different trials where SDA was provided via oral supplements, no increase was seen in erythrocyte SDA. The effects of SDA-enriched soybean oil on intermediate cardiovascular risk factors have been examined in a few studies, but no clear relationships have emerged to date. This is similar to the situation with EPA, which also has little effect on intermediate risk factors. Although increases in tissue and blood levels of EPA derived from SDA could result in decreased cardiovascular disease risk [as has been reported with EPA supplementation (15)], this has not yet been directly tested.

Recommendations for Research and Policy

Symposium participants provided a number of recommendations as follows: 1) Dose responses for specific individual (n-3) FA for various specific health and disease conditions need to be determined. Although evidence is available for providing recommendations for intakes for diminishing some cardiovascular disease risk factors and risk of coronary death, such dosage information is still not available for many other health areas such as other cardiovascular risk factors, nonfatal coronary events, specific inflammatory diseases, mental health disorders, and stroke. 2) More research is needed to determine whether specific (n-3) FA (ALA, SDA, EPA, and DHA) differentially affect health outcomes and whether differences in the ratio of EPA (or SDA):DHA consumed has clinical relevance. 3) Although increasing SDA intakes has been shown to increase membrane and phospholipid EPA levels, physiologic risk factor and clinical endpoint studies still need to be conducted with SDA to determine whether effects of its consumption on health and disease outcomes are similar to those that have been shown for EPA and DHA. 4) Recognizing that tissue levels of SDA are very low after supplementation, a better understanding is required of the metabolic fate of SDA other than its conversion to EPA. For example, does SDA lead to the production of other bioactive metabolites, perhaps some not yet identified? 5) Although no evidence exists that SDA intakes are harmful, long-term surveillance regarding potential adverse effects needs to be carried out.

More research is needed on the cost effectiveness of different approaches for increasing (n-3) FA consumption in various populations, including in the developing world.

General Conclusions

The current evidence provides a strong rationale for increasing (n-3) FA intakes in the US and other populations. The current consumption of (n-3) FA in most populations is either insufficient or not efficient at providing adequate tissue levels of the long-chain (n-3) FA EPA and DHA. SDA in soybean oil appears to be a potentially cost effective and sustainable plant-based source that could contribute to reaching recommended levels of (n-3) FA intake, but more research and surveillance is needed. Adding SDA-enriched soybean oil to foods should be considered as a natural fortification approach to improving (n-3) FA status in the US and other populations. Physiologic risk factor and clinical endpoint studies need to be conducted with SDA to determine the effects of its consumption on health and disease outcomes.

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Literature Cited