Closing the Omega 3 Gap: Stearidonic Acid as a Heart Healthy Choice

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Outline

- Benefits of long chain omega-3 fatty acids for heart health
- Overview of omega-3 sources
- Stearidonic (SDA) soybean oil, rich in omega-3 fatty acids, provides health benefits
- Use of Stearidonic (SDA) soybean oil in culinary applications

Cardiovascular Disease and other major causes of death for white males & females in the USA

Source: NCHS

Heart Disease and Stroke Statistics – 2009 Update, American Heart Association.
http://www.americanheart.org/presenter.jhtml?identifier=3018163
AHA 2009 update
Estimated direct and indirect costs of major cardiovascular diseases and stroke

![Bar graph illustrating the estimated direct and indirect costs (in billions of dollars) of major cardiovascular diseases and stroke (US: 2005). Source: NCHS](chart.png)

EPA Reduces Risk for Major Coronary Events in JELIS

18,645 Japanese (70% women, 61 yrs) randomized to statin alone or statin+EPA (1.8 g/d) and followed for 5 years

<table>
<thead>
<tr>
<th>Entire Cohort N=18,645</th>
<th>1st Prevention=14,981</th>
<th>2nd Prevention=3,664</th>
</tr>
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<tbody>
<tr>
<td>RRR=19% P=0.011</td>
<td>RRR=18% P=0.13</td>
<td>RRR=19% P=0.048</td>
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Major coronary events included sudden cardiac death, fatal and nonfatal MI, unstable AP, and angioplasty/stenting or CABG

(Yokoyama et al. Lancet 2007;369:1090-98)

Omega-3 Consumption

Omega-3 LC–PUFA Intakes are below what is considered optimal for health

![Graph comparing LC–PUFA intakes across different countries](graph.png)
Omega-3s Are Polyunsaturated Fatty Acids

- **Fats and fatty acids**
  - Saturated fats: Animal fats, butter, lard
  - Unsaturated fats:
    - Polyunsaturated fats: Omega-3 fatty acids
    - Fish, shellfish
    - Docosahexaenoic acid: Fish, shellfish
    - Eicosapentaenoic acid: Fish, shellfish
    - α-Linolenic acid: Flaxseed, soybean, walnut, rapeseed oils
  - Omega-6 fatty acids: Corn oil, Safflower oil, Sunflower oil
  - Omega-9 fatty acids: Olive oil, Avocados, Peanuts, Almonds


Seeds & Nuts are sources of ALA. Require you to eat a lot to reach recommended intakes of long chain poly-unsaturated fatty acids.

In Omega-3, plant, dense Omega and use in the their very strong ingredients and nausea.
The “Soylution”

- We are able to produce soy beans with high levels of stearidonic (SDA) in the soybean oil which can be efficiently converted to heart healthy long chain omega-3 fatty acids.

- Stearidonic (SDA) soybean oil is a sustainable and neutral tasting source of omega-3s that greatly enhances our culinary options.

**Omega–3 Challenges for Foods**

<table>
<thead>
<tr>
<th>Bioactivity</th>
<th>Stability</th>
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<tbody>
<tr>
<td>Low Bioactivity</td>
<td>High Stability</td>
</tr>
<tr>
<td>Minor Conversion to</td>
<td>Easily formulated</td>
</tr>
<tr>
<td>LC–PUFAs</td>
<td>into food &amp; feed</td>
</tr>
<tr>
<td>High Bioactivity</td>
<td>Low Stability</td>
</tr>
<tr>
<td>Proven heart health</td>
<td>Challenging and</td>
</tr>
<tr>
<td>benefits</td>
<td>costly to</td>
</tr>
<tr>
<td></td>
<td>incorporate in</td>
</tr>
<tr>
<td></td>
<td>everyday foods</td>
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</tbody>
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**Production of SDA Soybean Oil**

- The process involves growing soybeans, extracting the oil, and processing it to contain high levels of stearidonic acid (SDA).

- The resulting SDA soybean oil is a sustainable and neutral tasting source of omega-3s that greatly enhances culinary options.

- Stearidonic (SDA) soybean oil is a sustainable and neutral tasting source of omega-3s that greatly enhances our culinary options.
Stearidonic Acid (SDA) Enriched Soybean Oil - Product Concept

ALA, the major plant Omega-3 Fatty Acid in our diets today, is inefficiently converted to EPA and DHA in humans.

This is because the enzyme responsible for conversion of ALA to SDA, 6 desaturase, is a rate-limiting enzyme in the conversion process.

As a “pro-EPA”, SDA may play a role in helping individuals “maintain a healthy heart”.

Stearidonic Acid (SDA) Enriched Soybean Oil - Product Concept

Inserting 6,15 and 6,6 desaturase enzymes into soybeans leads to production of stearidonic acid (18:4) in oil, delivering this dietary fatty acid in the diet & bypassing the inefficient 6,6 desaturase step.
Relative Risk of Sudden Cardiac Death and Blood Omega-3 Levels - Physicians’ Health Study


Relative Risk

Average USA

Blood Omega-3 FA (%) by Quartile Means

90% reduction in risk
p for trend < 0.001

Relative Risk of Sudden Cardiac Death and Blood Omega-3 Levels

Omega-3 Index: A new CHD risk factor?

A measure of the amount of EPA+DHA in red blood cell membranes expressed as the percent of total fatty acids


Omega-3 Index: estimating targets

Greatest Protection

GISSI-P: -9.1-10%
CHS: 8.6%
DART: -8.9%
SCHIMO: 8.3%

5 epi studies: -8%

PHS: 7.3%
Seattle: 6.5%

Least Protection

PHS: 3.9%
SCHIMO: 3.4%
Seattle: 3.3%

Data from multiple epi and clinical studies reviewed for risk vs omega 3 index values.
Relative Risk of Sudden Cardiac Death and Blood Omega-3 Levels - Physicians’ Health Study

![Graph showing relative risk and blood omega-3 levels.](image)


Clinical trials with SDA

- James et al., 2003, AJCN 77:1140-5 (Pilot Study-1 with ethyl esters)
  - Proof of concept that demonstrated SDA could enrich tissues with EPA, efficiency compared to EPA of ~4:1
- Tolerability study (SDA oil)
  - 10 subjects, chose packaging, refined subject instruction and dietetic counseling
- Harris et al., 2008, Lipids 43:805-11 (“pilot” study-2, with SDA oil)
  - SDA oil raised red blood cell %EPA and Omega 3 Index
  - Efficiency compared to EPA of ~6:1
  - Enabled power calculations
- Lemke et al., 2010, AJCN 92:766-75
  - 252 enrolled, 157 per protocol subjects
  - SDA oil, soybean oil, and EPA parallel treatments for 12 weeks
  - SDA-enriched soybean oil increased the omega-3 index by raising erythrocyte EPA concentrations.

SDA supplementation increased Omega 3 Index

![Graph showing SDA supplementation results.](image)

Conclusions: Health benefits of SDA

- SDA soybean oil significantly raised the omega-3 index by raising the absolute levels of RBC EPA
- Based on epidemiological and clinical trial data, a change in the omega-3 index such as that observed here would be expected to reduce risk for major cardiac events, including sudden cardiac death
- SDA soybean oil significantly broadens the potential for heart-healthy omega-3 enriched foods

Serving up stearidonic (SDA) soybean oil

- Utilizing new soy technology to enrich consumer food products
Applications In all Market Segments

- With this new technology we can add omega-3 fatty acids to our foods without sacrificing flavor or quality.
- The new SDA oils can easily be used in every restaurant from quick service to fine dining to enrich our health and dining experience.
- These oils can be used in just about any fat containing products on the shelves today to enrich our entire food supply.

Examples

- We have prepared and consumer tested the following products and found no significant sensory changes in products prepared with SDA oil.
  - Bagels, Cream Soup, Strawberry Beverage, Chocolate Chip Cookies and Frankfurters

Sensory Methods

**Descriptive Profiling**
- Determine exact flavor profile of sample
- Describe SDA Oil sample relative to Soybean Oil and other Omega-3 oils
- Carefully selected & trained respondents
- Conducted at Beginning and End of Shelf Life
- Determine how the samples change over time

**Consumer Testing**
- Conducted at normal consumption and end of shelf life

**SQS (Solae Qualitative Screening)**
- Conducted Beginning, End, and Throughout Shelf Life
- Determine if samples continue on with shelf life and “acceptable” to go through profiling or acceptance
Plain Bagel Manufacturing Process

- Dough Mixing: Add water & oil to dry goods 30 sec. low speed 20 min med. speed Dough slightly sticky, smooth
- Proofing (20 min at 40°C)
- Stop Fermentation (4°C 30 min)
- Kisting (immerge in boiling water 1 minute)

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Flavor Profile of Plain Bagel

- Overall Flavor Impact
- Grain Complex
- Raw
- Cooked
- Yeast/Flavored
- Oily
- Cardboard/Woody
- Fishy/Pondy Complex
- Fatty
- Sweet
- Sour
- Salt
- Bitter

Plain Bagels made with Soybean Oil and SDA Oil have similar profiles

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Consumer Acceptability: Plain Bagel Model

There were no significant differences between Soybean Oil and SDA Oil in Overall Liking, Color Liking, Flavor Liking, Mouthfeel Liking, Texture Liking, and Aftertaste Liking
Cream soup manufacturing process

1. Disperse soy protein in cold water
2. Heat to 80°C with high shear
3. Hold 30 minutes
4. Add remaining dry goods
5. Add oils and cream. Reheat to 80°C

- (Batch tank)
- Homogenise

1. Add cold water to kettle
2. Add starches and flour
3. Mix thoroughly

Reheat to 85°C

1. Add remaining batch water
2. Add blanched, chopped vegetables
3. Reheat to 90°C

Can and retort
- 121°C F0=8

Consumer Acceptability: Cream Soup Model

There were no significant differences between Soybean Oil and SDA Oil in Overall Liking, Appearance Liking, Color Liking, Flavor Liking, Texture Liking, and Aftertaste Liking.

Flavor Profiles of Cream of Mushroom Soup

Cream soup made with Soybean Oil and SDA Oil have similar profiles.
Strawberry beverage

Acceptability of Strawberry Dairy Drink Over Time

- At 4 and 6 months there were no significant differences between Soybean Oil and SDA Oil in Acceptability
- Over time, acceptance ratings stayed about the same

Stearidonic (SDA) soybean oil can be added to a broad range of food products

Beverages
- Soy Milk/Smoothies
- Fruit Juices/Drinks
- Vegetable Juices/Drinks
- Enhanced Waters

Dairy Products
- Dairy Drinks
- Yogurt/Yogurt Drinks
- Cheese Products
- Sour Cream/Dips
- Ice Cream/Frozen Desserts
- Non Dairy Creamers

Baking
- Breads
- Muffins
- Cookies/Crackers
- Pastries/Cakes
- Baked Cereal Bars

Snack Foods
- Granola/Cereal Bars
- Nutritional Bars
- Snacks
- Confectionery

Oil Based Foods
- Margarine/Spreads
- Shortenings
- Mayonnaise
- Salad Dressings
- Peanut Butter

Prepared Foods
- Processed Meats
- Processed Fish
- Entrees/Sides
- Soups/Sauces
- Pet Foods

Sponsored by Solae
The last course

- By utilizing the new SDA technology, we can make the food we already enjoy more nutritious to our health without sacrificing quality.

- SDA soybean oil significantly broadens the potential for heart-healthy omega-3 enriched foods
  
  - SDA soybean oil significantly raises the omega-3 index by raising the levels of EPA in red blood cells