Long Chain Omega-3’s: Strategies for Product Development and Commercial Success.

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Managing Director
CERES Consulting.
Long Chain Omega’s: Strategies for Product Development and Commercial Success

- **Milestones/History**
- **Market size and growth**
- **Key issues**
- **Commercial Drivers for success**
- **Future view**
Milestones and Historical Perspective

• 1780: Fish oil (CLO) taken for arthritis relief
• 1935: Prostaglandins (PG) discovered
• 1970: Eicosanoid, leucotriene, prostaglandin metabolism elucidated
• 1971: Prostaglandins recognized as causing bad inflammatory health effects
• 1971: Dyerberg & Bang showed diet high in LC lipids reduced heart disease
• 1982: Nobel prize awarded for PG discovery and role in human health
• 1985-1990: Benefits of LCP shown for the developing embryo and infants
• Late 1980’s: Growing scientific data on benefits of LCP for CVD
• Late 1980’s-early 1990’s: supplements of LCP launched for CVD and general health
• Early-Mid 1990’s: Large ingredient companies enter fish oil business and specialty refining commences. Investments made in research and marketing
• Early 2000’s: Explosion in science papers on LCP, NGO recommendations and governments permit fortification, some RDA’s developed
Long Chain Omega-3’s
The Event(s)

1971: Dyerberg & Bang showed
diet high in LC lipids reduced
heart disease

1985-1990: Benefits of LCP shown
for the developing embryo and
infants

Late 1980’s: Growing scientific
data on benefits of LCP for
CVD, and other diseases

Late 1980’s-early 1990’s: Many
supplements with LCP
launched for CVD and general
health

Early-Mid 1990’s: Large companies
enter LCP business specialty
refining, investments in
research and marketing

Early 2000’s: Explosion in LCP
science, NGO recs. and
governments now permit
fortification

“What it Meant”

You need to eat whale blubber every day!

Confirms the benefits of LCP but
LCP difficult to refine, formulate, expensive

Many Gov’s see LCP as drugs requiring expensive
clinical data

Supplement Co’s make many varied claims and
products seen by consumers as ‘Snake Oil”, and too
good to be true. Key health professionals
skeptical/non supportive.

New food forms developed. Gov’s not convinced of
health benefits, no RDA’s, few recs. Health
professionals more positive

Food forms variable quality, food companies with
little interest, commercial potential unclear. DS
sector strong growth.

H Professionals supportive, wide media, H Claims
limited, food fortification still difficult, expensive.
“... and every day you should eat something from each of the five basic food groups: fried fish, boiled fish, stewed fish, baked fish and raw fish!”
# Omega-3’s Today: The Grades

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Parameter</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Quantity/quality</td>
<td>B+</td>
</tr>
<tr>
<td>Government Recommendations</td>
<td>US, Global, RDA’s etc.</td>
<td>C+</td>
</tr>
<tr>
<td>Health/label Claims</td>
<td>Available, friendly</td>
<td>B-</td>
</tr>
<tr>
<td>NGO Support</td>
<td>Number, relevance of group</td>
<td>B</td>
</tr>
<tr>
<td>Consumer Awareness</td>
<td>USA, global</td>
<td>B</td>
</tr>
<tr>
<td>Product Forms available</td>
<td>Provide, no taste issues, stable, easy to use</td>
<td>A</td>
</tr>
<tr>
<td>DS</td>
<td></td>
<td>B-</td>
</tr>
<tr>
<td>Funct. Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Quality</td>
<td>Raw material ingredients</td>
<td>B+</td>
</tr>
<tr>
<td>Raw material supply</td>
<td>Availability FO, future sources</td>
<td>A</td>
</tr>
</tbody>
</table>
Omega-3’s: Large & Growing Science Base

- 16,000 published papers
- Meta analyses show health benefits in many areas
- Excellent rationale based on the science and the human inflammatory response
- Brain and eye function with a well documented need for DHA (EPA?)
- IOM Reviews
- AHRQ Reports 3/2004 confirm the science
- Very long history of use
- Gene signaling by omega-3’s the new frontier for research
Clinical Conditions with Possible Involvement of Omega-3 EPA/DHA

- Coronary heart disease
- Hypertriglyceridemia
- Hypertension
- Atherosclerosis
- Thrombosis
- Vasospasm
- Mental/visual development

- Depression
- Cognitive
- Rheumatoid Arthritis
- Allergic asthma
- Inflammatory diseases (e.g. GI tract)
- Premature birth
- Cancer
The Omega-3 Index

Omega-3 index of >8% associated with lowest risk of CHD, whereas an Index of <4% is associated with the highest risk

DHA Essential for Fetus and Newborn

- Human milk contains DHA
- DHA passes through placenta and is accreted in brain and eye
- Intellectual performance, psychomotor development and visual function are better in breast-fed babies
- DHA supplementation improves development of formula-fed infants
A significant part of the body of science for omega-3s has never been accounted for.

Source: NIH Pubmed Database
## Omega-3 LC-PUFA Science

<table>
<thead>
<tr>
<th>Target concentration</th>
<th>Target indication</th>
<th>Scientific evidence</th>
<th>Gov Rec’s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC PUFA EPA</td>
<td>Heart health</td>
<td>Unequivocal</td>
<td>Yes</td>
</tr>
<tr>
<td>LC PUFA DHA</td>
<td>Infant/toddler brain/vision</td>
<td>Very strong</td>
<td>Yes</td>
</tr>
<tr>
<td>LC PUFA EPA</td>
<td>Enteral Nutrition</td>
<td>Excellent science</td>
<td></td>
</tr>
<tr>
<td>LC PUFA DHA</td>
<td>Elderly Cognition</td>
<td>Strong</td>
<td></td>
</tr>
<tr>
<td>LC PUFA DHA</td>
<td>Depression/mood</td>
<td>Considerable science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>suicide, child behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC PUFA EPA</td>
<td>Joint health</td>
<td>Sound rationale, varied results</td>
<td></td>
</tr>
<tr>
<td>LC PUFA DHA</td>
<td>Elderly, dementias</td>
<td>Science building</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC PUFA EPA</td>
<td>Skin, allergy, GI</td>
<td>Emerging science</td>
<td></td>
</tr>
<tr>
<td>LC PUFA EPA/DHA</td>
<td>Elderly AMD, diabetes</td>
<td>Emerging science</td>
<td></td>
</tr>
</tbody>
</table>
Relative Risk Odds for Six LC Omega-3 Trials at Varying Dietary Intakes EPA/DHA per day.
Published Papers on Omega-3 PUFA’s

Total Papers in PubMed

- n-3s through 2001: 7,894
- n-3s through 2008: 13,500
- Lipitor: 3,117

RCT Studies in PubMed

- n-3s through 2001: 612
- n-3s through 2008: 1,127
- Lipitor: 624

Meta-Analyses and Systematic Reviews

- n-3s through 2001: 55
- n-3s through 2008: 288
- Lipitor: 115

Source: NIH Pubmed Database

Copyright Ceres Consulting 2008
US Fish Oil Sales Retail 1997-2007
($ millions)
## 2007 Top Supplements by Sales

<table>
<thead>
<tr>
<th>2007 rank</th>
<th>Supplement Product</th>
<th>2006</th>
<th>2007</th>
<th>07g</th>
<th>2007 rank</th>
<th>Supplement Product</th>
<th>2006</th>
<th>2007</th>
<th>07g</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>MultiVitamins</td>
<td>4,322</td>
<td>4,492</td>
<td>3.9%</td>
<td>21</td>
<td>Other specialty</td>
<td>177</td>
<td>198</td>
<td>11.8%</td>
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<tr>
<td>2</td>
<td>Sports Powders/Formulas</td>
<td>2,009</td>
<td>2,165</td>
<td>7.8%</td>
<td>22</td>
<td>Digestive Enzymes</td>
<td>181</td>
<td>196</td>
<td>8.3%</td>
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<tr>
<td>3</td>
<td>Weight-Loss Meal Supplements</td>
<td>2,067</td>
<td>2,154</td>
<td>4.2%</td>
<td>23</td>
<td>Mangosteen Juice</td>
<td>147</td>
<td>191</td>
<td>29.9%</td>
</tr>
<tr>
<td>4</td>
<td>Calcium</td>
<td>1,007</td>
<td>1,056</td>
<td>4.9%</td>
<td>24</td>
<td>Sports Pills</td>
<td>132</td>
<td>144</td>
<td>9.0%</td>
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<tr>
<td>5</td>
<td>B Vitamins</td>
<td>998</td>
<td>1,042</td>
<td>4.4%</td>
<td>25</td>
<td>green tea</td>
<td>144</td>
<td>139</td>
<td>-3.4%</td>
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<tr>
<td>6</td>
<td>Vitamin C</td>
<td>864</td>
<td>884</td>
<td>2.3%</td>
<td>26</td>
<td>garlic</td>
<td>150</td>
<td>137</td>
<td>-8.7%</td>
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<tr>
<td>7</td>
<td>Glucosamine/Chondroitin</td>
<td>803</td>
<td>831</td>
<td>3.5%</td>
<td>27</td>
<td>echinacea</td>
<td>125</td>
<td>126</td>
<td>0.6%</td>
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<tr>
<td>8</td>
<td>Homeopathics</td>
<td>710</td>
<td>781</td>
<td>9.9%</td>
<td>28</td>
<td>saw palmetto</td>
<td>129</td>
<td>125</td>
<td>-3.1%</td>
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<tr>
<td>9</td>
<td>Other vitamins</td>
<td>602</td>
<td>663</td>
<td>10.2%</td>
<td>29</td>
<td>Chromium</td>
<td>115</td>
<td>108</td>
<td>-5.8%</td>
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<tr>
<td>10</td>
<td>Fish/Animal Oils</td>
<td>486</td>
<td>627</td>
<td>29.0%</td>
<td>30</td>
<td>ginkgo biloba</td>
<td>102</td>
<td>107</td>
<td>4.4%</td>
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<tr>
<td>11</td>
<td>CoQ10</td>
<td>381</td>
<td>413</td>
<td>8.3%</td>
<td>31</td>
<td>MSM</td>
<td>104</td>
<td>105</td>
<td>0.5%</td>
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<tr>
<td>12</td>
<td>Vitamin E</td>
<td>409</td>
<td>391</td>
<td>-4.3%</td>
<td>32</td>
<td>SAMe</td>
<td>101</td>
<td>102</td>
<td>1.1%</td>
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<tr>
<td>13</td>
<td>Probiotics</td>
<td>301</td>
<td>366</td>
<td>21.3%</td>
<td>33</td>
<td>Goji Juice</td>
<td>65</td>
<td>98</td>
<td>50.4%</td>
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<tr>
<td>14</td>
<td>Vitamin A/Beta Carotene</td>
<td>290</td>
<td>315</td>
<td>8.6%</td>
<td>34</td>
<td>ginseng</td>
<td>96</td>
<td>95</td>
<td>-0.5%</td>
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<tr>
<td>15</td>
<td>Meal Medical/Wt Gain</td>
<td>295</td>
<td>308</td>
<td>4.3%</td>
<td>35</td>
<td>Bee Products</td>
<td>92</td>
<td>95</td>
<td>3.2%</td>
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<tr>
<td>16</td>
<td>Noni Juice</td>
<td>256</td>
<td>277</td>
<td>8.4%</td>
<td>36</td>
<td>Melatonin</td>
<td>81</td>
<td>93</td>
<td>14.1%</td>
</tr>
<tr>
<td>17</td>
<td>Magnesium</td>
<td>240</td>
<td>271</td>
<td>13.1%</td>
<td>37</td>
<td>milk thistle</td>
<td>91</td>
<td>93</td>
<td>1.9%</td>
</tr>
<tr>
<td>18</td>
<td>Iron</td>
<td>237</td>
<td>253</td>
<td>6.8%</td>
<td>38</td>
<td>psyllium</td>
<td>84</td>
<td>87</td>
<td>3.0%</td>
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<tr>
<td>19</td>
<td>Plant Oils</td>
<td>223</td>
<td>253</td>
<td>13.6%</td>
<td>39</td>
<td>5 HTP</td>
<td>79</td>
<td>83</td>
<td>5.8%</td>
</tr>
<tr>
<td>20</td>
<td>Sports Drinks (for core sports)</td>
<td>202</td>
<td>227</td>
<td>12.5%</td>
<td>40</td>
<td>Potassium</td>
<td>74</td>
<td>78</td>
<td>4.3%</td>
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</table>
Key Issues/Success Drivers for Omega-3’s

- Government recommendations (RDA’s,)
- Health Claims- few available, US and UK
- TG not recognized as major CVD factor
- Health professional support
- Consumer awareness/confusion (EPA, and ALA, good fats, plant oils vs fish oils)
- Too many health benefits, confuses consumers
- Quality of raw materials: safety, supply
- Taste/stability (RM and food forms)
- Food companies slow to fortify
- Safety (unfounded)
Omega-3 / DHA & EPA Recommendations

- PeriLip Consensus Conference - EU (2005)
- Food Standards Agency - UK (2004)
- Child Health Foundation (2001)
- International Society for the Study of Fats and Lipids (ISSFAL) (1999)

FDA issued a qualified health claim for Omega-3 fatty acids (2004)
- “Supportive but not conclusive research shows that consumption of EPA and DHA omega-3 fatty acids may reduce the risk of coronary heart disease.”

- AI (calculated) for DHA and/or EPA 160 mg for good health
- AMDR advises consumption of 133-267 mg/day DHA (and/or EPA) to reduce risk of cardiovascular disease
Numerous health bodies have set intake recommendations for EPA/DHA.

### Daily EPA/DHA Intake Recommendations from Global Health Bodies

- **American Heart Association (High Triglycerides - Max.)**: 2000 mg
- **American Heart Association (High Triglycerides - Min.)**: 1000 mg
- **American Heart Association (CHD)**: 1000 mg
- **Belgian Superior Health Council (2)**: 1000 mg
- **NATO Workshop on w-3 and w-6 Fatty Acids**: 800 mg
- **Nordic Council of Ministers (Max)**: 650 mg
- **Workshop on... RDIs from Omega-6 and Omega-3 (2)**: 500 mg
- **AFFSA**: 500 mg
- **Dietary Guidelines Advisory Committee**: 496 mg
- **WHO Health and Welfare Canada**: 450 mg
- **Belgian Superior Health Council (1)**: 300 mg
- **Workshop on... RDIs from Omega-6 and Omega-3 (1)**: 250 mg
- **ISSFAL**: 220 mg
- **British Nutrition Foundation**: 215 mg
- **Health Council of the Netherlands (2)**: 200 mg
- **COMA**: 200 mg
- **EANS**: 200 mg
- **EFSA**: 180 mg
- **Nordic Council of Ministers (Min.)**: 167 mg
- **ANZ Health Authorities**: 160 mg
- **Institute of Medicine (Men)**: 160 mg
- **Health Council of the Netherlands (1)**: 150 mg
- **Institute of Medicine (Women)**: 110 mg

*Source: Various*
Current Global Adult Intakes versus Recommendations of Long-Chain Omega-3s

**Recommendations:**

- LC n-3
- ADA (2007)
- France (2001)
- UK (2003)
- Netherlands (2006)
- Canada (2005)
- Australia (2005)

DHA alone
- France (2001)

**Intake:**

- Total Long Chain Omega-3
- DHA

*mg/day*

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Long Chain Omega-3†</th>
<th>DHA†</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.K. (1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>U.S. (4)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Canada (1)</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>Australia (2)</td>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td>Germany (2)</td>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>Sweden (1)</td>
<td>800</td>
<td>0</td>
</tr>
<tr>
<td>France (1)</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Denmark (1)</td>
<td>1200</td>
<td>0</td>
</tr>
<tr>
<td>Japan (1)</td>
<td>1400</td>
<td>0</td>
</tr>
<tr>
<td>Norway (3)</td>
<td>1600</td>
<td>0</td>
</tr>
</tbody>
</table>

† weighted means
†† DHA data not available

List of sources available upon request
Commercial Drivers for Future Success: NGO’s

- American Heart Association
- American Dietetic Association
- ISSFAL
- ESPGAN, PeriLip
- Pediatric Organizations
- Cardiology Associations
- Nutrition Groups
Commercial Drivers for Future Success: Science

- Continued science data
  - CVD
  - Infant
  - Vision
  - Joints
  - Alzheimers/cognitive
  - Asthma/allergy
  - Diabetes
Commercial Drivers for Future Success: Consumer Awareness

- Globally very high awareness, critical mass reached
- Consumer use of supplements, now 8% US population take on a daily basis
- Interest in fortified foods high
- Consumer confusion on types of Omega’s, terms used, varied health benefits. Fish oil vs Flax oil, ALA:EPA:DHA
Classification of Fats.... Very Complex!!

Fats

Saturated: Bad Fats

Non-essential

Unsaturated: Good fats

Polyunsaturated (PUFA)

Monounsaturated (MUFA)

ESSENTIAL

Linoleic acid (Omega-6)

Gamma-linolenic acid (GLA)

Arachidonic acid (AA)

Alpha-Linolenic acid (Omega-3)

ALA (plants)

Eicosapentaenoic acid (EPA)

(docosahexaenoic acid (DHA)

marine)
Awareness Among Users USA

Prime reason is stated to be increased media exposure/spending

Omega-3 PUFA

Frost/Sullivan & DSM
Consumer Awareness of term Omega-3

Source: Leatherhead Data, June 2007
Recent paper highlights flax oil superior to fish oil as a source of n-3’s

Actual results:

• Low levels of fish oil intake led to higher serum levels of long-chain n-3’s than high intakes of flaxseed oil
• Fish oil led to higher serum levels of DHA, flaxseed oil did not
• The increase in serum long-chain n-3 levels was uniform for fish oils, but increases from flax oil were much more variable


Breaking News on Supplements & Nutrition - Europe
Dietary ALA sufficient to raise omega-3 levels, says study
Low levels of fish oil intake led to higher levels of LCn-3s than high intakes of flaxseed oil.

Fish oil led to higher serum levels of DHA, flaxseed oil did not

**Increase in Mean Serum DHA Levels**

*Expressed as a % of baseline value*

- Each 0.6g capsule of fish oil delivered 252mg of EPA and 3mg of DHA

*Source: Barceló-Coblijn et al, Am J Clin Nutr, 2008;88:801–9*
The increase in serum LCn-3 levels was uniform for fish oils, but from flax oil were much more variable.

* Each 0.6g capsule of fish oil delivered 252mg of EPA and 3mg of DHA

Commercial Drivers for Future Success: Quality/Quantity

- **Monographs (GOED)**
  - EU and US monographs, specify amounts omega-3’s, heavy metals, dioxins, oxidized molecules

- **GOED Activities**
  - Trade support, science support (Purdue Univ.), science writers support, consumer media support. Legislation; recommendations, claims, legislation

- **Fish Stock sustainability.**
  - Really a non issue but perceived by media/consumers to be a problem due to declining stocks of fresh fish.
  - Fish oils do not come from the main fish stocks.
  - Around 100,000,000 tons fish caught per year of which 90% of industrial fish catch goes to aquaculture, so still plenty of supply for human use. Fish oil is a by product of fish meal production.
SUMMARY OF FISH OIL USE FOR THE PERIOD 2002 AND 2010

2002
- Edible: 30%
- Industrial: 12%
- Aquafeed: 56%
- Pharmaceutical: 2%

2010
- Edible: 14%
- Pharmaceutical: 2%
- Aquafeed: 79%
World Fishery Catch 1950-2000

(FAO)

Figure A1.1 - World production (million tonnes) from capture fisheries and aquaculture

Source: FAO
The Many Distinct Benefits of Omega-3s

THE DISTINCT HEALTH BENEFITS OF

OMEGA-3s

Cognitive development & function
Visual development & function
Inflammation
Cardiovascular function

Supports EFA status

Inflammation
Cardiovascular function

DHA
EPA
ALA
# Positioning of Omega 3 Fatty Acids

<table>
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<tr>
<th>Fatty acid</th>
<th>Category</th>
<th>Target group</th>
<th>Health target</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>Enteral clinical nutrition</td>
<td>Patients</td>
<td>Immune system</td>
</tr>
<tr>
<td>DHA</td>
<td>Infant nutrition</td>
<td>Infants</td>
<td>Brain + eye development</td>
</tr>
<tr>
<td></td>
<td>Maternal nutrition</td>
<td>Pregnant mother</td>
<td>Brain + eye development</td>
</tr>
<tr>
<td></td>
<td>Maternal nutrition</td>
<td>Lactating mother</td>
<td>Brain + eye development</td>
</tr>
<tr>
<td>Dietary supplement</td>
<td>Population</td>
<td></td>
<td>Brain function (cognition, behavior, mood)</td>
</tr>
<tr>
<td>Dietary supplement</td>
<td>Population</td>
<td></td>
<td>Eye (macula degeneration, dyslexia, dark adaptation)</td>
</tr>
<tr>
<td>EPA/DHA</td>
<td>Mainstream food</td>
<td>Population</td>
<td>Heart</td>
</tr>
</tbody>
</table>
Marketing Dietary Supplements: Then and Now

- Initially refined oils primarily for CVD (18/12)
- Highly refined oil now shifting to Concentrates
- Life stage marketing, primarily adults/seniors
- Varied ratios EPA:DHA
- Specialty marine oils (salmon, tuna, krill) niche markets.
- CVD engine and many niche products created
- DHA for cognitive benefits
- EPA benefits for infants and ALZ
Functional Foods: Then and Now

• “Good” quality oils promoted where ever we could find interest; spreads, breads, bars, surimi. Sometimes omega-3 added to help a “failing” product.

• Excellent quality oils in virtually any food, without taste compromise. Longer shelf life and stability still needs work

• Smaller innovative companies looking for advantage (niche opportunities)

• Major companies now aggressively looking to push bottom line revenues with big SKU’s

• Need to move from CVD to overall wellness position rather than niche areas.
Success Factors & Key Inter-relationships

**Consumers**
- Disease, Age, Awareness/health benefits, self help/care

**Distributors/retailers**
- Convenience, health, value, new channels

**Food Companies**
- Taste, healthy, MS, profits

**Health Costs**
- CVD, RA, Vision, ALZ

**Regulatory/Government**
- Claims, labeling, fortification

**Health Professionals**
- M.D.’s Awareness, NGO recommendations, policy

**Science**
- Basic and Applied

**Corporations/Producer Groups**
- R&D, IP, Science, adding value, funding

**University**
- Research, grants, IP

**Government**
- Regulations, research, policies/guidelines, funding

**TIME**
- >10 years

**Communications**
Product Development pathway & Potential Value Add/IP

IP Potential

Marine, SCO Oils

Fermentation

Extraction/refining Technologies

Highly refined, stable

Concentration

>50% AI

Formulated Varied Purity

Forms?

Concentration

Bioavail

Stability

Utilization

Rx Forms

O-T-C Forms

Food Forms

DS Forms

Combo’s

CVD Child

ALZ Vision

Ceres Consulting

Copyright Ceres Consulting 2008
## From Fishes to Drugs.....and beyond

### Increasing Concentration LC Omega-3’s

<table>
<thead>
<tr>
<th>% EPA/DHA</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40-45</th>
<th>50-75%</th>
<th>85%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola Oil</td>
<td>Flax Oil</td>
<td>Krill Oil</td>
<td>CLO</td>
<td>Fish Oil</td>
<td>SCO</td>
<td>FO Concentrates</td>
<td>Ultra Concentrates</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% ALA</th>
<th>10</th>
<th>54</th>
<th>?</th>
<th>2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>EPA:DHA</th>
<th>0</th>
<th>7.5:4.5</th>
<th>9:12</th>
<th>18:12</th>
<th>0:40</th>
<th>Highly variable, Ethyl esters and TG</th>
<th>46:37</th>
<th>0:95</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Use: Food</td>
<td>DS</td>
<td>DS</td>
<td>DS</td>
<td>DS</td>
<td>Infants</td>
<td>DS</td>
<td>DS, Rx</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FF</td>
<td>DS</td>
<td>FF</td>
<td>FF</td>
<td>Infants</td>
<td>FF</td>
<td>Infants</td>
<td></td>
</tr>
</tbody>
</table>

**New Frontier** 10-20% EPA GMO 30-40% EPA
## Success Stories, Product Launches with Omega-3’s (Mintel data)

<table>
<thead>
<tr>
<th>Types</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total New</td>
<td>120</td>
<td>NA</td>
<td>250</td>
<td>NA</td>
</tr>
<tr>
<td>Total EU</td>
<td></td>
<td>291</td>
<td></td>
<td>723</td>
</tr>
<tr>
<td>Total USA</td>
<td></td>
<td>315</td>
<td></td>
<td>541</td>
</tr>
</tbody>
</table>

- Types: Baby Food, Bakery, Meats, Dairy, Yoghurt, Spreads, Beverages, Snacks, Juices

**Conclusion**: moving from niche to mainstream.
Mintel Consumer Study 2007 Summary

• Awareness reached globally
• Confusion regarding ALA, EPA, DHA and the need for message consistency
• 30% persons buying food specifically buy food with omega-3’s
• DS market at $489 million (NBJ),
• 8% of US population taking DS daily
• Market growth dependent on honest claims
• Market depends on regulation and validation through research
• Competing food additives such as antioxidants, probiotics, carotenoids, etc
Global new Products with Omega-3’s
Dollar Sales Growth (2006-'07):
Tropicana (USA) Healthy Heart Orange Juice

Source:
IRI Infoscan Reviews 2006, 2007 calendar years
Sales of Tropicana Healthy Heart Orange Juice

While Tropicana Healthy Heart sales increased by 18%, sales of Tropicana refrigerated orange juice actually decreased by 8% and the whole orange juice category increased by only 3%.

Source: IRI Infoscan Reviews
2006, 2007 calendar years
## Market Segmentation.....Too Much?

<table>
<thead>
<tr>
<th>Segment</th>
<th>CVD</th>
<th>Brain</th>
<th>Joints</th>
<th>Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors</td>
<td>X</td>
<td>Cognitive&lt;br&gt;ALZ</td>
<td>X</td>
<td>AMD&lt;br&gt;X</td>
</tr>
<tr>
<td>Adult</td>
<td>X</td>
<td>Depression&lt;br&gt;Suicide</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td>Learning, IQ&lt;br&gt;ADHD&lt;br&gt;ADD</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Infants</td>
<td></td>
<td>Development&lt;br&gt;IQ</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Future View

- **Sources:**
  - Marine; (Sources?, krill)
  - Fermentation; (Martek, Lonza, Others)
  - Plant; (Syngentia, Bayer, Dow, BASF)

- **Technology:** Forms development, clear beverages, extruded cereals, better stability. These are not forgiving lipids. Need hand holding and support to food companies.

- **Consolidation:** RM producers and technology providers or marketers?

- **New Science:** Gene signaling, diabetes, bones, cancer, as delivery molecules

- **Regulatory:** RDI’s, health claims, will be there just time
Market Forecast for Fish Oil Sales by Region ($MM)
(Retail supplements)

Global Fish Oil Sales Growth (Retail DS)

<table>
<thead>
<tr>
<th>Region</th>
<th>2003</th>
<th>CAGR</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>$183</td>
<td>30%</td>
<td>$262</td>
<td>$359</td>
<td>$489</td>
<td>$620</td>
<td>$806</td>
<td>$1,048</td>
<td>$1,362</td>
</tr>
<tr>
<td>EU</td>
<td>$600</td>
<td>10%</td>
<td>$660</td>
<td>$726</td>
<td>$799</td>
<td>$878</td>
<td>$966</td>
<td>$1,063</td>
<td>$1,169</td>
</tr>
<tr>
<td>Japan</td>
<td>$500</td>
<td>10%</td>
<td>$550</td>
<td>$605</td>
<td>$666</td>
<td>$732</td>
<td>$805</td>
<td>$886</td>
<td>$974</td>
</tr>
<tr>
<td>Rest of World</td>
<td>$300</td>
<td>20%</td>
<td>$360</td>
<td>$432</td>
<td>$518</td>
<td>$622</td>
<td>$746</td>
<td>$896</td>
<td>$1,075</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,583</td>
<td>18%</td>
<td>$1,832</td>
<td>$2,122</td>
<td>$2,472</td>
<td>$2,853</td>
<td>$3,324</td>
<td>$3,892</td>
<td>$4,581</td>
</tr>
</tbody>
</table>
Market Forecast Functional Foods

• Anybody’s guess:
• Frost and Sullivan EU analysis, ingredient market growing at 24% and estimated $1.6 billion in 2014
• Packaged Facts 2007, US market FF $2 billion, growing to $7 billion by 2011

If we believe the global EPA/DHA ingredient market is $700 million today (excluding infant foods), this is now a larger market than many vitamin markets for human use, and it is really only just starting to become mainstream for functional foods.
Thank You......Questions?

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