UPDATE ON THE OMEGA-3 MARKET

November 7, 2013
There is both a supply and a demand problem with omega-3s.
How much omega-3 do we need?
<table>
<thead>
<tr>
<th>Intake</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 mg/day</td>
<td>WHO and EU Recommended Intake</td>
</tr>
<tr>
<td>400 mg/day</td>
<td>Omega-3 Mortality Paper</td>
</tr>
<tr>
<td>1000 mg/day</td>
<td>Japanese Recommended Intake</td>
</tr>
</tbody>
</table>

250 mg/day
0.65 million tons per year

400 mg/day
1.02 million tons per year

1000 mg/day
2.55 million tons per year

Source: GOED analysis
The problem is the oceans do not provide enough EPA and DHA today and there are already fears about overfishing in many species.

Our EPA/DHA Needs (thousands of tons)

- Japan Model: 2550
- Mortality Model: 1020
- WHO Model: 650

The Oceans' Capacity (thousands of tons)

- WHO Model: 530

Seafood Consumption: 125
Seafood Waste: 200
Reduction Fisheries: 205

Source: GOED analysis of FAO and USDA data
In addition, there is a clear nutrition need in most of the world to increase intakes of EPA+DHA.

The Gaps Between RDIs and Average EPA+DHA Intakes, mg/day

Source: GOED/Cantox study, Hibbeln et al 2006, Chinese CDC
There is both a supply and a demand problem with omega-3s.

Let's look at the demand side of the equation.
Consumer awareness is high in most countries, but there are some worrying trends in countries like Japan.

Sources: GOED Proprietary Consumer Research, Leatherhead, YouGov
In developed countries usage rates are generally high when you consider all sources of omega-3s, but supplements are not always a main driver.
The BRIC countries are interesting because of their high acceptance of omega-3s and recently gained economic power.

Source: GOED Proprietary Consumer Research
There are countries with avid omega-3 supplement usage, but there are also highly aware countries with very low usage.

Reported Omega-3 Supplement Usage by Adults

Source: GOED Proprietary Consumer Research, Dentsu, YouGov
An "awareness conversion" opportunity exists in countries where the usage-awareness spread is highest.

Gap Between Omega-3 Awareness and Omega-3 Supplement Usage

Source: GOED Proprietary Consumer Research
$25.4 Billion

2012 Estimated Global Consumer Spending on Products Containing EPA/DHA Oils
Through our life stages, we can see why omega-3s may be valuable:

- **Fetal growth**
  - Maternal stores

- **Brain Growth**
  - Visual Development

- **Brain Growth**

- **Regulating Inflammation Proper Protein Function**

- **Neurological Cell Preservation**
  - Regulating Inflammation
  - Cellular Health
Accurate estimates for spending to manage lifestage issues do not exist, but infant nutrition is a clear focus.

Source: GOED estimates
China is now the third largest market for EPA and DHA oils and will be larger than Europe shortly.

### Consumption of EPA- and DHA-Rich Oils by Region, 2011 (metric tons)

- **North America**: 39,806
- **Europe**: 22,574
- **China**: 14,009
- **Rest of Asia**: 12,792
- **Rest of World**: 10,259
- **Japan**: 3,809

*Source: GOED, Frost & Sullivan, IMF*
Spending in these categories is concentrated in premium product categories.

Global Consumer Spending on EPA & DHA Omega-3 Products, 2011
Billions of US$

- Infant Formula: $10.2
- Fortified Food and Beverage: $7.9
- Dietary Supplements: $3.2
  - Clinical Nutrition: $1.3
  - Pharma: $1.9
- Pet Foods: $0.9

Source: Packaged Facts
However, dietary supplements dominate consumption.

Global Consumption of EPA & DHA Omega-3 Products, 2011

- Dietary Supplements: 62,569 metric tons
- Pet Foods: 21,623 metric tons
- Fortified Food and Beverage: 12,950 metric tons
- Infant Formula: 3,457 metric tons
- Pharma: 1,922 metric tons

Source: Frost & Sullivan
EPA and DHA omega-3s have become attractive targets for new pharma products.

38 Pharmaceuticals or pharma targets in development or on the market using EPA and/or DHA omega-3s

14 Companies that are publicly looking into new pharma targets using EPA and/or DHA

21 Health indications being targeted by these new and existing pharma products

Source: GOED Analysis
Very High TGs $8.0B
EPA/DHA $1.9B
Borderline High TGs Potential Unknown
Mixed Dyslipidemia $10.5B
Cardiac Failure Prevention $11.0B
All Cardiovascular Drugs $144.7B

Asthma / COPD $11.2B
Rheumatoid Arthritis $12.2B
IBDs $2.4B
Multiple Sclerosis $6.3B
Type 2 Diabetes $23.3B

Psoriasis $2.5B
Opioid Arthritis $12.2B
Near Sclerosis $6.3B
Dry Eye $1.9B
Retinal Diseases $5.2B

Chronic Inflammatory Diseases $35.5B

Omega-3 drugs / targets
All pharmaceuticals
Source: GOED Analysis, BCC Research, MarketScope, GlobalData, Company Filings
The pharmaceutical market will shape the supply of omega-3s going forward. If omega-3s achieve the same penetration in other indications as they achieved in the very high triglyceride market, the omega-3 drug market could reach more than $23 billion in global sales. At this level, these products could demand around 460,000 tons of crude fish oil with 30% EPA/DHA.
There is both a supply and a demand problem with omega-3s.

Now let's switch to issues in the supply side of the equation.
Small-volume segments of the market like krill have been able to achieve premium positioning and value.

2011 Global Sales of EPA and DHA Ingredients

- Natural Anchovy / Sardine Oils: $608 million
- Algae Oils: $330 million
- Low Concentrates: $45 million
- High Concentrates: $400 million
- Medium Concentrates: $198 million
- Tuna Oils: $128 million
- Cod Liver Oils: $63 million
- Krill Oils: $51 million
- Salmon Oils: $40 million
- Cod Liver Oils: $63 million
- Cod Liver Oils: $63 million

Total: $1.81 billion

Source: Frost & Sullivan
And krill oil grew faster than any single segment of the omega-3 market despite being at the high end of the market.
It is no secret that understanding of omega-3 supply trends is tied intimately to the anchovy fisheries.

### DROPS OF OIL

2012 Estimated Crude Oil Usage for Omega-3 Applications in Metric Tons

- YEAST: 50
- HERRING: 100
- KRILL: 580
- HOKI: 1,200
- ALGAE: 3,500
- SALMON: 3,900
- SQUID: 5,000
- POLLOCK: 7,500
- TUNA: 9,200
- COD: 11,300
- MENHADEN: 15,000
- ANCHOVY: 185,000

Source: GOED Members
However, omega-3 growth is going to reach the sustainable limits of supply from that fishery.
Dietary supplements are still demanding the bulk of anchovy oils

Omega-3 Demand Outlets for Crude Anchoveta Fish Oil
(in metric tons)

- Dietary Supplements: 122,980
- Pharmaceutical: 41,780
- Pet Food: 26,490
- Functional Food: 16,420
- Clinical Nutrition: 3,090

Source: Frost & Sullivan, GOED Analysis
Much of the omega-3 demand for crude anchovy oils was driven by demand from fish oil concentrates in the past.

Fish oil concentrates account for 11% of EPA/DHA omega-3 products, but 51% of anchovy oil demand from omega-3 applications.
Concentration of fish oils is becoming more efficient though, and we have heard of at least three concentrators that claim to be launching new manufacturing processes that waste no EPA and DHA.
The effects on crude fish oil demand from improvements in concentration could lead to much lower demand in the near-term.
Eleven fishery groups account for 55% of the earth's EPA and DHA capacity today, so any threat to these fisheries is significant to humans. This includes overfishing, pollution, and of course, improper management of the gene pool.

Source: GOED analysis of FAO and USDA data
We know that fishery capacity of EPA and DHA is already changing and that we are more reliant on fewer fisheries for these nutrients, the anchoveta fishery in particular.

Source: GOED analysis of FAO and USDA data
The Peruvian Anchoveta fishery has suffered in the past from poor management, but has recovered due to successful, aggressive action.

Source: IMARPE
Many other fisheries can supply enough EPA and DHA to be attractive to the right omega-3 customers now.

Source: GOED Analysis of data from Anthony Bimbo
The list of omega-3 sources, both commercial and in research, is getting longer with new algaes, new fish and new zooplankton projects having been announced in the last six months.
New sources being launched will compete with anchovy oils. Each of these new sources is launching with their own unique value proposition to differentiate from the dominant anchovy.
We also need to find new sources of EPA and DHA to relieve pressure on fisheries. This includes more efficient use of fishery waste, genetically modified plants, improved efficiency in aquaculture, and of course algae.
Algal sources of omega-3s are being researched in three predominant types of production systems:

- **Fermentation**
  - Commercially producing DHA today
  - High cost of capital
  - Uses sugars as energy sources

- **Open-Air**
  - Limited production of EPA today
  - High cost of capital
  - Uses sunlight as energy source

- **Photobioreactor**
  - No commercial production today
  - High cost of capital
  - Uses sunlight as energy source
Most algal DHA is going into infant formulas and provides less than 0.2% of the world’s omega-3 nutrition needs today.

Source: Frost & Sullivan report commissioned by GOED
What is the potential of algae to fill demand that the oceans cannot provide?

It will depend on the economies of scale that these companies can achieve in order to displace their higher capital costs.
Individual segments will vary significantly from the overall trend, with more valuable ingredients exceeding the averages.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Sales (mil)</th>
<th>3-year Growth Trend</th>
<th>Growth Drivers</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calanus Oil</td>
<td>$1.5</td>
<td>Significantly Above Trend</td>
<td>New product launches</td>
<td>High cost; less developed science; developing a wax-ester story</td>
</tr>
<tr>
<td>Krill Oil</td>
<td>$86</td>
<td>Significantly Above Trend</td>
<td>New product launches and entry into China</td>
<td>Science developing and winning sustainability critics</td>
</tr>
<tr>
<td>High Fish Oil Concentrates</td>
<td>$400</td>
<td>Above Trend</td>
<td>New pharmaceutical approvals</td>
<td>Intellectual property and increasing raw material costs</td>
</tr>
<tr>
<td>Algae Oil</td>
<td>$330</td>
<td>At Trend</td>
<td>New entrants with unique oils</td>
<td>Educating consumers about an EPA-only story; reducing costs</td>
</tr>
<tr>
<td>Fish Phospholipids</td>
<td>$3</td>
<td>Above Trend</td>
<td>New product launches</td>
<td>Telling the phospholipid story</td>
</tr>
<tr>
<td>Medium Fish Oil Concentrates</td>
<td>$243</td>
<td>Above Trend</td>
<td>Upgrading consumers</td>
<td>Converting entry-level users</td>
</tr>
<tr>
<td>Tuna Oils</td>
<td>$128</td>
<td>Above Trend</td>
<td>Growth of infant formulas</td>
<td>Regulatory fears about fish oils</td>
</tr>
<tr>
<td>Salmon Oils</td>
<td>$43</td>
<td>Above Trend</td>
<td>Upgrading consumers to a virgin oil</td>
<td>Regulatory barriers in some countries</td>
</tr>
<tr>
<td>Cod Liver Oils</td>
<td>$63</td>
<td>Below Trend</td>
<td>Specialty consumers</td>
<td>Stigma about taste and consuming liquids</td>
</tr>
<tr>
<td>Natural Fish Oils</td>
<td>$608</td>
<td>Below Trend</td>
<td>Bringing new consumers to market</td>
<td>Largest markets becoming saturated</td>
</tr>
</tbody>
</table>
Questions?

Adam Ismail
adam@goedomega3.com