OXIDATION: TAKING A STEP BACK
OUR PRIMARY WORK IS FOCUSED ON PUBLIC HEALTH

GOED’s Areas of Focus

1. Growing consumption of EPA and DHA to adequate levels worldwide.

2. Ensuring consumers have access to products they can trust in terms of both marketing claims and quality.
NEGATIVE MEDIA STORIES HAVE THE POTENTIAL TO IMPACT PUBLIC HEALTH

US Retail Omega-3 Sales vs. Media Sentiment

Source: AC Nielsen, GOED Analysis of Meltwater and Factiva data
SOMETIMES IT IS BEST TO AVOID DIRECT ATTACKS ON NEGATIVE MEDIA

**Media Reporting**

- **Inaccurate Reporting**
- **Overall Negative Sentiment**

**TACTIC TO ADDRESS ISSUE**

- ✔ Build network of media-trained scientists
- ✔ Engage reporters who inaccurately report on omega-3 science
- ✔ Promote positive studies to balance out the large media coverage of the few neutral studies
A Positive, Proactive Effort Can Yield Results

US Media Sentiment 2008-2016

Source: GOED Analysis of Meltwater and Factiva data
Negative media also drives us to improve.

Industry should:
- Address questions that have been raised with intellectual honesty
- Recognize problems when they exist
A NUMBER OF CLAIMS HAVE BEEN MADE IN THE MEDIA ABOUT OXIDATION

- Global supply chain = global oxidation problem
- Oxidation causes a significant loss of EPA and DHA
- Oxidized oils are toxic and hazardous
- Omega-3 oils are excessively oxidized

Source: GOED Proprietary Research
We first wrote a whitepaper to summarize the state of the science.

Oxidation in Omega-3 Oils: An Overview

A White Paper Prepared by the Global Organization for EPA and DHA Omega-3s and the Council for Responsible Nutrition

Key Points

- Oxidation is a normal process that happens in all fats and oils containing PUFAs.
- Omega-3 products usually contain antioxidants and have specialized manufacturing that manages oxidation.
- While there is concern that oxidative products could be harmful, current evidence suggests the potential for harm is related to dose, local concentration, type of oxidation product, and the activity of our own antioxidant defenses.
- Human clinical trials conducted so far with oxidized EPA and DHA oils have found no negative effects, and many have found benefits on oxidative status of tissues in our body.
- The two main tests to assess oxidation in omega-3 oils measure peroxide value and p-anisidine values.
- The p-anisidine value is NOT a valid test for flavored oils, or for oils with natural colors like krill or virgin salmon oils.
- The omega-3 industry has voluntarily established lower limits for oxidation than exist for other edible oils.
- The 2,000 publicly available test results show that more than 94% of products meet the stricter GOED limits for peroxide value and nearly 98% meet the limit for p-anisidine value.

SOME CONTEXT AROUND OXIDATION IS IMPORTANT DUE TO ITS PREVALENCE

GOED commissioned Nutrasource, one of the leading contract analytical labs in the omega-3 space, to mine its database of QA analytical test results. The data included test results on 1,900 samples from 710 products.

GOED also replicated the NZ study on the Top 50 selling products in the US.

<table>
<thead>
<tr>
<th></th>
<th>GOED Monograph</th>
<th>Typical Veg Oil Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peroxide Value</td>
<td>84%</td>
<td>96%</td>
</tr>
<tr>
<td>p-Anisidine Value</td>
<td>96%*</td>
<td>N/A</td>
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</table>

* Of the 23 unflavored oils included in the study. The pAV limit is not applicable to flavored oils.

These results are largely consistent with what GOED has observed in other markets. Importantly, these fifty products account for half of all consumption in retail channels in the US.

Source: Unpublished GOED data, 2017
THE US STUDY SHOWS THAT REPLICABLE ANALYSIS IS STILL A REAL ISSUE

Source: Unpublished GOED data, 2017
Assessing the quality and data in studies is important. We believe there are nine important criteria in product quality studies. You must ask, was the study:

1. Peer-reviewed?
2. Conducted at an accredited lab(s)?
3. Utilizing analytical chemists?
4. Using an accepted method?
5. Confirmed by another lab?
6. Blinded from the chemists?
7. Independent from industry?
8. Assessing products against the correct limits?
9. Testing products that were independently selected?

### Oxidation Studies of Omega-3 Products to Date

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>n</th>
<th>Regulatory Compliance Rate (PV &lt; 10)</th>
<th>GOED Compliance Rate (PV &gt; 5)</th>
<th>pAV Compliance Unflavored Oils</th>
<th>Study Quality</th>
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<tbody>
<tr>
<td>GOED, 2017</td>
<td>New Zealand</td>
<td>47</td>
<td>98%</td>
<td>72%</td>
<td>86%</td>
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<td>Nichols et al, 2017</td>
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<tr>
<td>Jackowski et al, 2015</td>
<td>Canada</td>
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<td>&gt;95%</td>
<td>83%</td>
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<td>Albert et al, 2015</td>
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<td>69%</td>
<td>63%</td>
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<td>TGA, 2016</td>
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<td>15</td>
<td>100%</td>
<td>100%</td>
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<td>Turner et al, 2006</td>
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<td>67%</td>
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<td>Labdoor, 2017</td>
<td>United States</td>
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<td>69%</td>
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<td>Mason &amp; Sherratt, 2017</td>
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<td>100%</td>
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<td>88%</td>
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<td>100%</td>
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<td>Thorkildsen, 2010</td>
<td>Norway</td>
<td>56</td>
<td>50%</td>
<td>7%</td>
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<td>South Africa</td>
<td>57</td>
<td>84%</td>
<td>68%</td>
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<td>Consumerlab.com, 2001</td>
<td>United States</td>
<td>20</td>
<td>100%</td>
<td>100%</td>
<td>Not assessed</td>
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</table>

**Simple Average**

- 89%
- 79%
- 93%

**Weighted Avg (n)**

- 97%
- 93%
- 82%
THE OXIDATION WORK IS ONLY BEGINNING FOR THE OMEGA-3 INDUSTRY

WHAT HAPPENS AS PUFA OILS OXIDIZE?

• Critics of omega-3 oils have pointed to peroxide exposure as a likely source of harm, but exposure from the regular diet is 20-40 fold higher from vegetable oils than EPA/DHA oils.
• The Liggins rat pregnancy study from 2016 highlighted potentially harmful effects in pregnancy of oxidized fish oils, but the method of oxidation did not mimic the real world.
• However, replicating this oxidation method with a broader spectrum of oils and analyzing the generation of precise oxidative compounds over time can help us understand oxidation better.
• GOED has commissioned a study with three universities and one lab to analyze the formation of oxylipins, oxysterols, isoprostanes, neuroprostanes, oligomers and volatile compounds.

HOW CAN OXIDATION BE BETTER MANAGED?

• It is clear from studying the value chain that encapsulation of omega-3 oils has the potential to increase PVs and pAVs.
• There are more than seven factors that contribute to oxidation of oil over its shelf life, almost all of which can be managed in manufacturing.
• GOED is publishing a guidance document on best practices for bulk oil and finished product manufacturing to minimize oxidation.
KEY TAKEAWAYS

1. The omega-3 industry has a voluntary quality standard that is stricter than any regulation, that should be viewed positively.

2. Any industry where ~85% of products meets a voluntary standard and nearly 100% meet regulatory standards should be viewed positively.

3. It is difficult to fight negative media that seeks to impugn the reputation of an entire industry, and it is better to focus on the positive science if it truly outweighs the negative.

4. We still have much to learn about oxidation and the questions raised by those critical of industry give us an opportunity to do so.
HOW TO ACCESS THIS DATA FOR YOURSELF
This data represents only part of GOED’s proprietary research, and is freely available at varying degrees of curation to members of GOED, depending on their level of membership.

HOW TO JOIN GOED
Please contact Mike Roberts at mike@goedomega3.com with any questions about membership.

QUESTIONS ABOUT THIS PRESENTATION
Please contact Adam Ismail at adam@goedomega3.com with any additional questions regarding this presentation.