New fields of application of in food products

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What is so special about fish oils?

- Health benefits
- Decreasing consumption
- Better utilization of fish -raw materials

Possible applications in foods
- Our experience
- New possibilities

Fish oil and health benefits

Omega-3 fatty acids play a crucial role in maintaining optimal mental and physical health.

- EPA is believed to help maintain a healthy heart by improving circulation, lowering homocysteine levels and improving immune function.
- DHA is being heavily studied for its positive effects on the improvement of memory and cognitive function as well as its role in infant brain development.

Few review papers on fish oils (n-3) and health

- Biological basis for the benefit of nutraceutical supplementation in arthritis. Drug Discovery Today, Volume 9, Issue 1, February 2004, Pages 100-112, Gilbert S. Lehrer, Richard J. Head, and Brent Colburn
- Persistence of sudden cardiac death by α-linolenic acid supplementation. Pharmacology & Therapeutics, Volume 98, Issue 1, June 2003, Pages 1-17, Alexander Looff, Yang Fu, Tao, Jing, H. King, and George S. Hohensee

DHA Home page: www.panix.com/~dha/
**Famous omega-3 fatty acids**

- EPA (Eicosapentaenoic acid - 20:5n3)
- DHA (Docosahexaenoic acid - 22:6n3)
- α-Linolenic acid (18:3n3)

**Dietary fatty acids and possible changes subsequent to industrial food processing**


**Fish consumption**

3 times a week or more


**Cod liver oil consumption in Iceland**

frequency

Fish oil products as supplements

Fish oil export - 2002

0.1-0.2% of the capelin oil is used for human consumption

Capelin – highest in fisheries quantity (> 40%)
- Mainly utilized as feed ingredient
- Capelin oil is 2-3% of the total value

Summary of fish oil use for the period 1990-2010

World exports of fishery commodities in 2001, in value

Fish oils

- Fish oils are healthy for you
- Lacking in diet
- Better utilization of resources
- What can we do about it?

Fish oils in other foods

- Direct addition
- Microencapsulation
- By animal feeding

Influence of cod liver oil on fatty acid composition of pork-subcutaneous fat

<table>
<thead>
<tr>
<th>g fish oil/kg feed</th>
<th>EPA-DHA</th>
<th>DPA+DHA</th>
<th>EPA+DPA+DHA</th>
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<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
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<td></td>
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<td></td>
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<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0.7</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td></td>
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<td></td>
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<tr>
<td>0.9</td>
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<td></td>
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</table>


Stability of microencapsulated n-3 cod liver oil

In Table 1, key aroma compounds identified by SPME, GC/O and GC/MS in fresh microencapsulated fish oil

<table>
<thead>
<tr>
<th>Possible compound</th>
<th>r (min)</th>
<th>RI</th>
<th>Odor description</th>
<th>Odor intensity</th>
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</thead>
<tbody>
<tr>
<td>1-butanol</td>
<td>1, 2</td>
<td>MS</td>
<td>caramel, vanilla</td>
<td>3.5</td>
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<tr>
<td>3-hydroxy-2-butanone</td>
<td>3.4</td>
<td>274</td>
<td>heavy, milk-like</td>
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<tr>
<td>hexanal</td>
<td>6.1</td>
<td>369</td>
<td>gras</td>
<td>2.0</td>
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<tr>
<td>cis-4-heptenal</td>
<td>10.7</td>
<td>500</td>
<td>rancid, potato-like</td>
<td>4.5</td>
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<tr>
<td>heptanal</td>
<td>11.0</td>
<td>507</td>
<td>rancid</td>
<td>2.8</td>
</tr>
<tr>
<td>1-octen-3-ol</td>
<td>14.0</td>
<td>579</td>
<td>mushroom</td>
<td>3.0</td>
</tr>
<tr>
<td>2,4-heptadienal</td>
<td>14.8</td>
<td>MS</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>2,6-nonadienal</td>
<td>20.6</td>
<td>759</td>
<td>cucumber</td>
<td>4.0</td>
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<tr>
<td>2,4-decadienal</td>
<td>25.0</td>
<td>930</td>
<td>rancid</td>
<td>3.5</td>
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<tr>
<td>1.2.4.6 octanol</td>
<td>19.6</td>
<td>629</td>
<td>mushroom</td>
<td>3.5</td>
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<tr>
<td>2.4.6 octanol</td>
<td>23.6</td>
<td>669</td>
<td>mushroom</td>
<td>3.5</td>
</tr>
</tbody>
</table>


Spray-drying microencapsulated oil
Feta cheese produced with capelin oil (CO)

The problem of oxidation and possible solutions

- Hydrogenation – out
- Eliminate
  - Prooxidants
  - Oxygen
  - Heat
  - Light
- Preserve natural antioxidants

Organoleptic evaluation on Feta cheeses three days after processing

<table>
<thead>
<tr>
<th></th>
<th>Appearance</th>
<th>Smell</th>
<th>Taste</th>
<th>Odour</th>
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</thead>
<tbody>
<tr>
<td>Feta cheese</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7% CO + toc</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7% CO + PG/BHA/BHT/citric acid</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Capelin oil for human consumption

- Low in n-3 fatty acids (12-15% - 20%)
- Relatively stable
- High in natural antioxidants
- Economical
- As food grade oil?

Capelin oil as food grade oil processing and storage

- Raw material quality
  - cooling systems onboard ships
- Minimal processing
- Preserving stability
  - by use of natural antioxidants
  - by use of suitable packaging

Processing of Fish Oil

The effect of processing on capelin oil stability

Crude capelin oil
Alkali refining
Bleaching
Deodorization

O₂ (µmol/g)


Antioxidant activity of therapeutic plants

Oxipres test

Wild thyme - 500 mg/kg


Possible solution for fish oil?

12.5 cm

Source: Icelandic Fisheries Laboratories.
Conclusions

- The technology is almost there
- Several solutions
- Appeal to consumers

Tank you for listening