Fish Byproduct Utilization

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World Capture by Species

- 26% - Small Pelagics (Sardines, Herring, Anchovies, etc)
- 21% - Large Pelagics (Tunas, Bonitos, Billfishes, misc. Pelagics, etc)
- 15% - Demersals (Flounders, Halibuts, Soles, Cod, Hakes, Pollock, etc)
- 7% - Crustaceans (Crabs, Shrimp, Lobsters, etc)
- 6% - Misc. Coastal Fish

John Messerich, Source FAO, 2002
Alaska Fish Species

- Pollock
- Pink salmon
- Arrow tooth flounder
- Rockfish
- Halibut
General Fish Processing Outline

Material Input

Fish Processing Flow Diagram

Wastes Generated

Product Receiving

Sorting & Weighing

By-catch, off-specification product, rubbish

Preparation

Butchering - scalping, filleting, skinning, & avisceration

Cuttings, skins, bones, blood, oils, viscera, spoiled material

Inspection & Trimming

Off-specification products, spoiled material, trimmings

Product Processing

Pickling, brining, etc...

Wastewater, brines, sauces, oils, spoiled material, damaged packaging

Further Processing

Freezing, canning, & bottling

Frozen

Damaged, out-of-date product, returned product, damaged packaging

Conned

Packaging materials

Packaging and Dispatch
Fish Processing Line
Harvesting Fish
## Seafood Harvest in Alaska

<table>
<thead>
<tr>
<th>Marine Fin Fish</th>
<th>2000 MT</th>
<th>2005 MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Pollock</td>
<td>1067738</td>
<td>1414962</td>
</tr>
<tr>
<td>Salmon</td>
<td>319472</td>
<td>408014</td>
</tr>
<tr>
<td>Pacific Cod</td>
<td>226709</td>
<td>225341</td>
</tr>
<tr>
<td>Flat Fish</td>
<td>141530</td>
<td>111357</td>
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<tr>
<td>Yellow Fin Flat</td>
<td></td>
<td>87787</td>
</tr>
<tr>
<td>Atka Mackerel</td>
<td>39986</td>
<td>58423</td>
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<tr>
<td>Perch</td>
<td>17077</td>
<td>21002</td>
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<tr>
<td>Sabel Fish</td>
<td>13547</td>
<td>14944</td>
</tr>
<tr>
<td>Rock Fish</td>
<td>10472</td>
<td>13447</td>
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<tr>
<td>Pacific Herring</td>
<td>32509</td>
<td>37610</td>
</tr>
<tr>
<td>Halibut</td>
<td>32686</td>
<td>26016</td>
</tr>
<tr>
<td>Others</td>
<td>3523</td>
<td>29092</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1905249</strong></td>
<td><strong>2447995</strong></td>
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</table>
## Alaska Seafood Harvest (MT)

<table>
<thead>
<tr>
<th>Marine Shell Fish</th>
<th>2000</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crab</td>
<td>22968</td>
<td>24145</td>
</tr>
<tr>
<td>Shell Fish</td>
<td>881</td>
<td>1286</td>
</tr>
<tr>
<td>Squid</td>
<td>333</td>
<td>1183</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24182</td>
<td>26614</td>
</tr>
</tbody>
</table>
Alaska Fish Harvest by Region and Sector

Region
- Largest percentage harvested in Bering Sea ~ 70%
- Second largest harvest from Gulf of Alaska

Sector
- Processed in land-based plants ~ 55%
- Processed at sea ~ 45%
Catfish and other Aquaculture Species

• Channel catfish is the fourth-most popular fish product consumed in the United States.

• United States production in Alabama, Arkansas, Louisiana, and Mississippi.

• Over 272,000 metric tons of catfish produced in 2005
Waste to By-product to Co-product

- In the past, “waste” was used for materials that were left over after primary food processing.
- However “waste” can be used as the raw materials to make other products, which increase profits and reduce environmental concerns.
- There are many examples where yesterdays “waste” became a valued raw material for further processing.
Fish Byproducts
What are Fish By-Products?

- Parts remaining after fillet and other parts removed for human consumption

- **Major Processing Line Components:**
  - Heads
  - Viscera
  - Frames
  - Skins
  - Others such as tails, fins, scales, mince, blood, etc.
Byproduct Organs and Tissues from Processing Line Components

- **Viscera**
  - Gonads – milt and roe
  - Livers
  - Stomachs
  - Intestine
  - Others

- **Heads**
  - Snouts
  - Brain
  - Gills
  - Others
Fish Processing Byproducts

Heads

Viscera

Frames

Roe

Skin
Milkfish Byproduct Utilization

- Deboned Fillets
- Packaged Fish Heads
- Liver for oil, vitamin, and minerals
- Intestines for proteolytic enzymes
- Battered Fish Frames
- Scales for special pigments
- Other parts fermented to fertilizer
- Stomach parts
Krill Byproducts

- Hydrolysates
- Chitin
- Enzymes
- Krill Oil
- Others
## Proximate Analysis of Dried Pollock Processing Byproducts

<table>
<thead>
<tr>
<th></th>
<th>% H₂O</th>
<th>% Protein</th>
<th>% Fat</th>
<th>% Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>WF</td>
<td>8</td>
<td>65.7</td>
<td>15.5</td>
<td>10.8</td>
</tr>
<tr>
<td>Fillets</td>
<td>8</td>
<td>84.9</td>
<td>1.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Heads</td>
<td>8</td>
<td>67.4</td>
<td>5.2</td>
<td>19.4</td>
</tr>
<tr>
<td>Frames</td>
<td>8</td>
<td>73.6</td>
<td>3.9</td>
<td>14.5</td>
</tr>
<tr>
<td>Viscera</td>
<td>8</td>
<td>41.2</td>
<td>47.2</td>
<td>3.6</td>
</tr>
<tr>
<td>Skin</td>
<td>8</td>
<td>87.5</td>
<td>1.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Alaska Wild Fish Byproduct Advantages

- Fish processing byproducts from sustainable fisheries
- Derived from fish processed for human consumption so are initially of high quality
- Large amount of byproduct from white fish (pollock, cod, flat fish)
- Cold water marine fish have high levels of 3-omega fatty acids and high quality protein
- High quality parts including skin, frames, heads, and viscera are available in large quantity directly from the processing line
Aquaculture Fish Byproduct Advantages

- Smaller and more constant amounts of byproducts available over longer periods of time
- Smaller sized equipment needed for processing
- Derived from fish processed for human consumption so are initially of high quality
- High quality parts including skin, frames, heads, and viscera available directly from the processing line
- High quality fish protein and oils
- Often close to an agriculture user (example: raw byproduct as feed ingredient)
Where Do Most of the Left Over Parts Go?
Fish Byproduct Uses:
Descending Value

- Human Supplements, Biochemicals, Proteins and Oils
- Human Foods and Ingredients
- Industrial Ingredients
- Pet Food Ingredients
- Aquaculture Ingredients
- Pig and Chicken Feed Ingredients
- Fertilizers
- Fuels
Products from Fish Byproducts

- Feed Ingredients for
  - Aquaculture
  - Companion Animals
  - Farm Animals
- Fertilizers
  - Natural fertilizers
  - Soil conditioners
  - Compost

- Human Ingredients
  - Oils
  - Protein powders
  - Hydrolysates
  - Mineral supplements
  - Pharmaceuticals
  - Gelatin films
- Industrial uses
  - Fuels
  - Cosmetics
  - Biodegradable materials
Fish Meals
World Fish Meal

- Approximately 6.5 million metric tons/year
  - Most from large scale industrial fisheries such as found in Peru

- Alaska produces about 1-2% of the world fish meal from processing byproduct

- Only small amounts of meals and oil from aquaculture in the US
## World Fish Meal Production

<table>
<thead>
<tr>
<th>Country</th>
<th>Tons X 000</th>
<th>Raw Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERU</td>
<td>1,407</td>
<td>Anchovy</td>
</tr>
<tr>
<td>CHILE</td>
<td>770</td>
<td>Anchovy, Jack Mackerel, Sprats, By-products</td>
</tr>
<tr>
<td>THAILAND</td>
<td>428</td>
<td>Various species &amp; By-products (Tuna etc)</td>
</tr>
<tr>
<td>USA.</td>
<td>252</td>
<td>Menhaden, Pollock By-products</td>
</tr>
<tr>
<td>CHINA</td>
<td>204</td>
<td>Anchovy, various species</td>
</tr>
<tr>
<td>JAPAN</td>
<td>200</td>
<td>Tuna by-products, various species</td>
</tr>
<tr>
<td>NORWAY</td>
<td>172</td>
<td>Herring, sprat, blue whiting, by-products</td>
</tr>
<tr>
<td>DENMARK</td>
<td>166</td>
<td>Sand eel, blue whiting, herring, by-products</td>
</tr>
<tr>
<td>ICELAND</td>
<td>152</td>
<td>Herring, by-products</td>
</tr>
<tr>
<td>SOUTH AFRICA</td>
<td>88</td>
<td>Sardines &amp; by-products</td>
</tr>
</tbody>
</table>

~24% total production from fisheries by-products
Approximation of USA Fish Meal Production

source John Messerich
Kodiak Fish Meal Company
Kodiak Alaska 2008:
Eagles and Fish Waste
Fish Meal Processing Equipment