Introduction

- Although omega-3 (n-3) fatty acids and vitamin D are available as dietary supplements, they also occur naturally, at various levels, in seafood.
- To obtain new analytical data on vitamin D in foods, a nationwide sample of seafood was considered for use. The Food and Drug Administration’s (FDA) list of the top 20 most frequently consumed fish in the United States was identified to determine the species to be sampled.
- Samples were obtained for a complete nutrient profile, including fat and fatty acids. The nutrient data will be included in the Nutrient Data Laboratory’s (NDL) Nutrient Data Bank System (NDBS), compiled, and released to the USDA National Nutrient Database for Standard Reference (SR) by September 2009 to provide current and accurate data for these foods.
- Preliminary results are presented here for eight seafood species which represent 75% of the per-capita consumption of seafood by organized by categories (low-fat finfish, high-fat finfish, crustaceans, and mollusks).

Materials and Methods

- **Sampling**
  - Retail samples of 21 species of fish and shellfish were obtained from a nationally representative sampling plan as part of the National Food and Nutrient Analysis Program (NFANAP).
  - Samples of fish were picked up in each of 12 supermarkets or nearby fish markets across the USA.
  - Supermarkets were randomly selected from a pool of stores with sales volumes exceeding $2 million/year.
  - Species and pick up dates of fish are shown in Table 1.

- **Sample Preparation and Storage**
  - All samples were shipped on dry ice (fresh samples) or at 4°C or frozen (-20°C) to the National Food Analysis Laboratory Center (FALC), Virginia Polytechnic Institute and State University, where they were stored prior to processing.
  - Fresh samples were frozen and stored at 4°C.
  - Shelf stable (canned) samples were stored at room temperature.
  - Sample composites were prepared using standard protocols previously established to insure homogeneity and to preserve nutrient integrity.
  - Composite homogenates were liquid nitrogen-placed in jars under nitrogen, and stored frozen at -40°C until they were shipped to the analytical laboratories.

Materials and Methods cont.

- **Nutrient Analysis**
  - Certified reference materials and in-house prepared control materials were also shipped to monitor the analyses done by the laboratories.2
  - Commercial analytical laboratories, pre-approved for participation in NFANAP, analyzed the food samples and quality control materials using AOAC or other acceptable methods for proximates and fatty acids. Vitamin D analyses were done at Food Composition and Methods Development Laboratory (FCMDL), USDA.2

- **Data Review**
  - FALCC and NDL conducted quality control review.
  - Approved data were migrated into the NDBS database for release to SR, located at the NDL Web site (http://www.ars.usda.gov/nutrientdata).

Table 1: Sampling schedule for fish samples.

<table>
<thead>
<tr>
<th>Sampling date</th>
<th>Fish species</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2007</td>
<td>Flounder (founder and sole species), wild sockeye salmon, shrimp, canned clams.</td>
</tr>
<tr>
<td>February 2007</td>
<td>Farmed catfish, cod (Atlantic and Pacific), haddock, rainbow trout, ocean perch</td>
</tr>
<tr>
<td>March 2008</td>
<td>Halibut (Atlantic and Pacific), wahoo pollock, Pacific sardine, salmon (chin and pink), swordfish, yellowfin tuna</td>
</tr>
<tr>
<td>May 2008</td>
<td>Eastern oyster, crab, and northern lobster (all steamed) and scallop</td>
</tr>
</tbody>
</table>

Table 2: Methods used for nutrient analyses of fish

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>AOAC Method Number</th>
<th>Method Description</th>
</tr>
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<tbody>
<tr>
<td>Fat</td>
<td>994.02</td>
<td>Acid hydrolysis and solvent extraction</td>
</tr>
<tr>
<td>Protein</td>
<td>990.06</td>
<td>Iodine titration with lead acetate and nitric acid</td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td>Iodine titration with lead acetate and nitric acid</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Combined 992.26 and 2002.05</td>
<td>HPLC with UV detection and vitamin D internal standard</td>
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Discussion

- As shown in Table 3, the amount of fat in seafood is highly variable. Among the other species of finfish analyzed but not shown here, swordfish and rainbow trout are also high in fat.
- The level of fat in farmed catfish may be due to the fact that these fish are farm fed and are raised in a controlled environment. None of the other shellfish sampled had a fat content as high as oyster.
- The high proportion of ALA in catfish may also be a result of their being farm raised and may specifically relate to the presence of soy meal in their feed.
- It isn’t clear why oyster has such a high percentage of total omega-3 fatty acids relative to fat content (23.6%) when compared to the relative percentages in salmon (14.7%) or in catfish (24%).
- The highest level of vitamin D was found in salmon which is also the fish with the highest fat level. Vitamin D may be somewhat proportional to the fat content since flatfish have a fat content of ... 1% of that in salmon. It is possible that this has to do with catfish being a freshwater species that is farm raised.

Conclusions

- Seafood species provide the major natural sources of omega-3 fatty acids and vitamin D in the US diet.
- With this variety of species, the consumer can choose among a wide range of seafoods, some of which provide significant levels of these important nutrients.
- Vitamin D levels in the seafoods evaluated were not proportional to fat. Vitamin D content appears to be species-dependent.

References