Objectives: The goal was to obtain quantitative data on the sterol content and composition of shellfish and mollusks commonly consumed in the U.S. to update the USDA National Nutrient Database for Standard Reference, using a nationwide sampling plan and validated analytical methodology.

Materials and Methods: In 2007-8, the USDA sampled raw shrimp and sea scallops; steamed oysters, blue crab, and lobster; and clams (canned) from 12 statistically selected supermarkets across the U.S. Raw mussels and clams were sampled locally (Blacksburg, VA). For each species, four composites comprising 3 locations were prepared; shrimp and scallops from 8 different locations were analyzed. Fourteen steers, major and minor, were determined in total lipid extracts after isolation and derivatization, using GC-FID for quantification and MS for confirmation of peak identities.

Results: Lobster, shrimp, and scallop contained significant levels (96.1-127 mg/100g fresh wt) of cholesterol; canned clams and scallops had the lowest concentrations (23.3-30.1 mg/100g). Variability in cholesterol among single-location samples of shrimp was low. The major sterols in the mollusks were brassicasterol (12.6-45.6 mg/100g) and 24-methylenecholesterol (15.8-50.1 mg/100g), with the highest levels occurring in oysters. Total non-cholesterol sterols were 46.6-75.6 in five sample species, but only 107 mg/100g in one with cholesterol also higher in that sample.

Significance: Crustaceans contain significant amounts of cholesterol and a high ratio of cholestero1n-cholesterol sterols, while the opposite was found for mollusks. Between-sample variability in sterol content for some species suggests average concentrations may not represent those in specific local samples and demonstrates the importance of a representative sampling plan to obtaining reliable food composition data.

Introduction

• Cholesterol has been the only sterol reported for shellfish from the USDA National Nutrient Database for Standard Reference, through the current release, SR24; however, there are over 12 other sterols present in shellfish in amounts greater than trace levels.
• Numerous publications report on shellfish sterol composition based on limited sampling, with studies done mostly for comparative physiology or local food composition analyses.
• There is no report on the sterol (content and composition) of commonly consumed shellfish in the U.S. retail market.
• Accurate values and estimates of variability are essential to generate reliable data to estimate cholesterol and other sterols in the food supply.
• Given the research interest in health effects of dietary cholesterol and non-cholesterol sterols, such data are required to support epidemiological studies and feeding trials.

Figure 1. NFNAP Sampled Counties

Table 1. Sterol content of crustaceans and mollusks, mean (mg/100g)

<table>
<thead>
<tr>
<th>Steroid</th>
<th>Lobster, steamed</th>
<th>Shrimp, raw</th>
<th>Clams, canned</th>
<th>Oyster, steamed</th>
<th>Scallops, raw</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m</td>
<td>oocolesterol</td>
<td>22-dehydro-cholesterol</td>
<td>brassicasterol/24-methylenecholesterol</td>
<td>24-methylenecholesterol</td>
</tr>
<tr>
<td>Crab, steamed</td>
<td>3</td>
<td>&lt;0.1</td>
<td>1.52 (0.71)</td>
<td>1.41 (1.42)</td>
<td>0.70 (0.06)</td>
</tr>
<tr>
<td>Scallops, raw</td>
<td>4</td>
<td>2.98 (0.35)</td>
<td>9.64 (1.42)</td>
<td>16.3 (2.6)</td>
<td>---</td>
</tr>
</tbody>
</table>

*Each sample composite is comprised of sample from three locations.

Discussion

• Cholesterol levels in crustaceans are relatively higher than in mollusks. The lowest level of cholesterol in crustaceans (96 mg/100g in crab) is higher than the highest level in mollusks (82 mg/100g in scallops).
• Levels of total non-cholesterol sterols in mollusks are 2.3 times that of cholesterol, ranging from 70.9 to 181 mg/100g fresh wt.

• Mollusks have a higher content than crustaceans of sterols, primarily brassicasterol and campesterol.
• Between-sample variability in sterol content is greatest in oysters (Fig. 2).
• In contrast, lobster and shrimp showed little variability between samples. Most of the sterol content was cholesterol with a ±2SD of 9 and 5%, respectively. Crab was higher at 31%.

Conclusions

• For the mollusks, cholesterol was the most abundant sterol but several other sterols were present in significant amounts, particularly in oysters.
• For the crustaceans, the predominating sterol was cholesterol with only minor amounts of other sterols.
• Between-sample variability demonstrates the importance of a representative sampling plan to obtaining reliable food composition data applicable to national surveys.
• Data for sterols will be released in SR24, summer 2011-available at the NDL Web site (http://www.ars.usda.gov/composition/sterol/). Results for other nutrients (vitamins, minerals, proximates, fatty acids, amino acids) analyzed in the same composites were included in SR23, released in September 2010.

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References