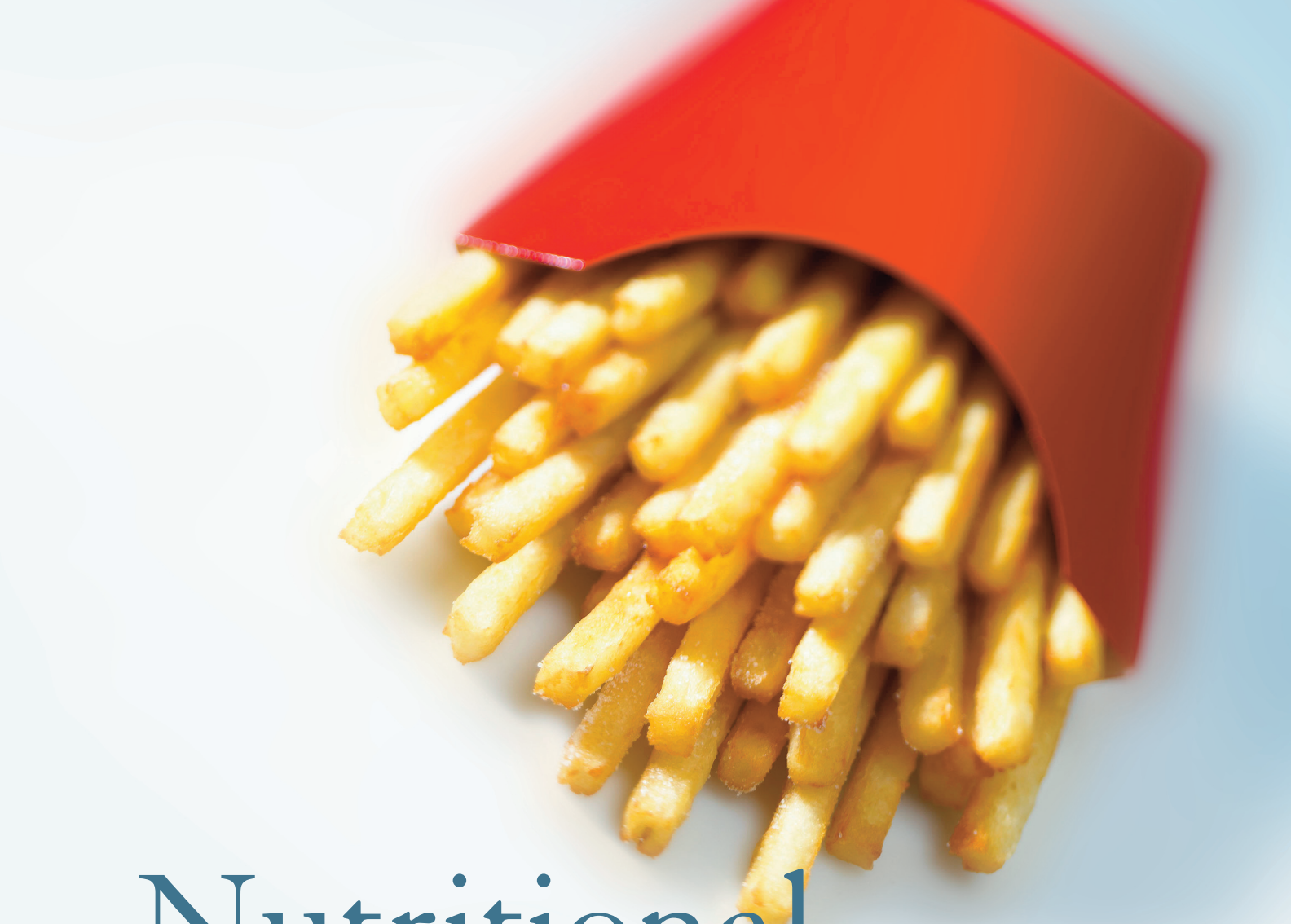


Nutritional Chemistry

Students study omega-3 fatty acids and raise health awareness in the school community

Janice Crowley

With the convenience of fast-food restaurants on almost every corner, many young people are consuming these foods too often. Are young people as concerned about this problem as the media appear to be? Yes, young people are concerned, and the students at our school decided to do something about it. They felt that scientific evidence would help people make better dietary choices. Therefore, students designed various investigations to provide that evidence (Bachta 2001).

In 2002 my research students studied ratios of omega-3 fatty acids to omega-6 fatty acids by performing experiments on french fries from five different fast-food restaurants (Crowley 2002). The 2003 research students decided to continue studying these fatty acids, this time by analyzing donuts instead of french fries.

The 2003 students also wanted to research a food that would be healthy. Salmon was chosen as the new food to investigate because it contains a great deal of omega-3. By researching current scientific literature, the students found that people need more omega-3 fatty acids than they are consuming (Sears 2002). Omega-6 and omega-3 are essential for the body, but if the ratio of omega-6 to omega-3 is too high it can be very harmful (Bagga et al. 1987).

Studies suggesting that the largest part of our diet should consist of fish oil, which can be found in supplements, led the research students to further study the proposed benefits of such supplements. Students discovered that to maximize the health benefits from fish oil, daily diet must also be improved because the negative effects of a diet high in omega-6 and excess saturated fats cancel out the benefits of taking a fish oil supplement. To learn more about the omega-3 found in fish oil, students decided to test pharmaceutical-grade fish oil supplements.

Why omega-3 research?

Students decided that omega-3 studies would give their community ideas about foods they can substitute for fast foods. It is common to hear that a fast-food diet is unhealthful. The evidence produced by the research students supports this and shows why it is unhealthful. The research interested students because it applied to them and diet was something they could control in their lives.

As the students have discovered, the difference of just one double bond has a tremendous effect on our health. Omega-6 fatty acids have double bonds between the sixth and seventh and between the ninth and tenth carbon atoms from the end of the molecule that is opposite the carboxyl group. They are essential fatty acids for proper health. Yet, when consumed in large amounts, as is typical in the American diet, omega-6 leads to increased risk of cancer and certain diseases. Omega-3 fatty acids have the same structure as omega-6 fatty acids with the exception of an additional double bond between the third and fourth carbon atoms. Omega-3 fatty acids are commonly found in some vegetable oils, such as soybean or canola, and some nuts. The best source of these essential fatty acids is fish.

It has been suggested that improved health is attained when omega-6 and omega-3 are consumed in a ratio of no more than 9 to 1 (Bagga et al. 1987). A ratio higher than that has been shown to have negative health effects, while a ratio of 3 to 1 is considered to be ideal. After learning about the health benefits of omega-3, students decided to study the amounts of omega-3 found in salmon and fish oil supplements.

Gas chromatography

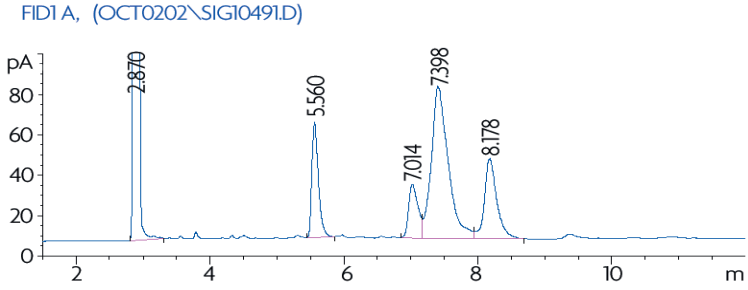
The key tool for investigating these ratios has been the gas chromatograph. Students used a procedure similar to the synthesis procedure used for french fries in an earlier study to convert fatty acids found in salmon, donuts, and fish oil into methyl esters (Crowley 2002). The methyl ester samples were injected into the gas chromatograph, which measured the amounts of the components of the methyl esters.

Students spent weeks adjusting ramping temperatures and pressures to create two separate peaks of the methyl esters of omega-6 and omega-3 fatty acids. The chromatograms revealed the correct components of the injections at specific times based on the sample's molecular weight and the speed at which these components passed through the instrument. The fatty acids appeared as peaks over a specific period of time based on purchased standardized fatty acid reference samples. The peak size determined the amount of each component (Christie 1989). The graph showed that the omega-6 peaks at approximately eight minutes and that the omega-3 peaks at approximately nine minutes. Fatty acid ratios were calculated by dividing the area under the omega-6 peak by the area under the omega-3 peak. A sample chromatograph is shown in Figure 1.

Obtaining good chromatograms is an art as much as it is a science. Students discovered causes of bad chromatograms through an exhaustive process of eliminating one variable at a time.

Analysis of the chromatograms for salmon revealed an average ratio of omega-6 to omega-3 of 4 to 1. This falls within the recommended guideline of 9 to 1, making salmon a healthy food choice (Erasmus 1993). Students found the ratio of omega-6 to omega-3 in fish oil supplements to be in approximately the 4 to 1 range, making them a healthy choice (Gunstone 1999). The ratio of linoleic to linolenic acid in a popularly consumed donut was 32 to 1. Students expected the ratio to be high but were surprised to learn that the ratios were twice that of french fries.

FIGURE 1.
Sample chromatograph.



Presenting the research

After analyzing the ratios of fatty acids in the french fries, donuts, salmon, and fish oil supplements, students began preparing presentations using PowerPoint. They did a poster presentation of their research results at the Eleventh Annual University of Kansas-Medical Poster Presentation. No other high schools were asked to present. Doctors were amazed by the detailed explanations and discoveries. As the semester drew to an end, each member of the research team was assigned a certain topic to discuss in a computer-aided presentation. The students chose to have these presentations serve as their final exams.

Students also presented their research to 25 scientists at Koch Industries. The feedback from the scientists was invaluable. The scientists grilled students on their knowledge of how the gas chromatograph works and of nutrition and fatty acids. Most of the scientists stated that they wish they had had these kinds of opportunities when they were in high school. Many of the scientists said they did not even get to touch a gas chromatograph until graduate school. The feedback gave the research team new ideas for future studies.

Raising health awareness

The student research team believes that they positively affect friends and family with their research. Students are driven to spread the word about healthy dietary choices upon discovering such facts as obese people have a 70 percent chance of dying at an earlier age (Zhou, Blackburn, and Heber 1999, p. 195–208). With their dedication and determination they hope to influence people of the community and persuade them to live healthier.

Since the students began the food research, students throughout the school have begun to look at everything they eat in a different way. When students started researching salmon, they were happy to be studying something healthful, but not too excited about eating fish. Determined, students perfected a recipe for marinating the salmon before cooking it on an electric grill. Not only did the research students acquire a taste for fish, but also the aroma attracted quite a few students from other classes. It was not long before the school community became aware of the fast-food studies (Hirshberg 2002). Student clubs began asking for vegetables and fruit at their meetings instead of the usual donuts. Many now think twice before ordering a cheeseburger, fries, and a soft drink. In this way, students have been able to reach outside the classroom to educate the school community about their evidence relating to diet.

Benefits for the lifelong learner

Leadership was one of the skills students gained while doing their research. Students in the research class rotated the leadership position each week. The leader kept track of each day's progress, assisted where needed, reported to the teacher, and ensured all closing procedures were followed. Each leader took the opportunity to learn and grow from the mistakes previous leaders had made. Eventually leaders developed their own styles of motivating the research team to accomplish the research mission.

The students' experiences in lab taught them the nuts and bolts of lab technique. Dirty syringes or glassware could cost the team a week of work since any microscopic amount of contamination could skew results of a chromatogram or destroy a good synthesis (McNair and Bonelli 1969).

Students also learned about teamwork and problem solving. When students encountered difficulties, they had to identify the problem and collaborate with each other for the most efficient, cost-effective way to solve it. These students will have an incredible foundation when they enter college as a result of this research. The most profound lesson these students have learned is that they can make a valuable and lasting contribution. ■

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