Nutrition and Food Science – An Obvious but Little-Appreciated Partnership: Lessons Learned from the Road Less Traveled*

What is a Trailblazer?

The Institute of Food Technologists (IFT) and the Academy of Nutrition and Dietetics (AND) partnered in creating an award to recognize "exceptional leaders" who have advanced the science at the nexus of nutrition or dietetics and food science for at least five years. By virtue of the joint interest of the two sponsoring societies, the award is aimed at people who appreciate the link between food and nutrition. I am honored to join the ranks of the two previous winners, Johanna Dwyer and Gilbert Leveille, who are champions of appreciating the link between food and nutrition. They have both had illustrious careers that serve as models for professionals in these disciplines. I hope that my own experiences described as lessons learned in this article can inspire and guide professionals who aspire to improve the health of the population through their work.

1st Lesson: Interdisciplinary interfaces are the pathway to discovery

The important questions that need to be addressed in modern society are complex and require multiple disciplines working together to find solutions (Weaver 2013). When the problem concerns improving human health, the greatest impact in current times can be made in primary prevention of chronic disease and promoting health. Diet, together with physical activity, is the most important modifiable factor that can keep our bodies functioning healthily as we age. Modern medicine is designed to intervene after tissues and organs have become abnormal and unhealthy. Our ability to detect most of the changes that occur as cells and tissues transform from healthy to early unhealthy status is crude. Imaging modalities usually detect problems after the condition is rather advanced. Treatments of chronic disease rarely offer cures. Thus, prevention is our most effective and financially viable strategy.

Preventing osteoporosis is a good example of the value of prevention over treatment and the value of interdisciplinary approaches to prevention. Osteoporosis is diagnosed when bone mineral density scores fall below Z scores of -2.5 (or 2.5 standard deviations below average for age) as detected by the clinical standard of imaging using the standard bone mineral density measure by dual energy X-ray absorptiometry or DXA. There is no cure once bone has been lost to this extent, though there are therapies to reduce further loss or even to build some bone, but the treatment is very expensive and inconvenient. I have spent much of my career determining nutrient requirements to build maximal peak bone mass during growth and evaluating dietary interventions to prevent menopausal-induced bone loss (reviewed in Weaver 2006a,b; Pawlowski 2016; Jakeman 2016). My training in food chemistry led to experimental designs to determine mineral absorption enhancers and inhibitors. Partnering with a food scientist, a physicist, a statistician, and clinician led to development of a rapid screening method for efficacy of interventions to prevent bone loss (Pawlowski and others 2015).

2nd Lesson: Trust and transparency

Scientific integrity has been a core value in training scientists from every discipline. But the environment has shifted with rapid communication that allows unprecedented access for anyone to provide information to the public. It has become very difficult for the public to distinguish between information grounded in science vs. opinions. It is made more complicated when professionals with differing opinions or disagreements with policies go directly to the public. It would not have much impact if the public did not care about the topic, but few topics interest consumers more than their diet and health. The conflicting and changing messages levy a large price on public trust.

Another liability to public trust in science is the current trend to challenge discoveries or public health recommendations based on conflict of interest, especially in the realm of industry-funded research. This trend led the International Life Sciences Inst. (ILSI) to lead an effort engaging many relevant stakeholders in creating guiding principles for industry-funded food science and nutrition research to manage financial conflicts of interest and maintain scientific integrity. Several publications reported the nine guiding principles aimed at ethical consideration promoting trust and transparency with the public (Rowe and others 2009a,b,c). I share these guiding principles with my faculty who are considering submitting industry-funded proposals.

Creating an environment in a research group that promotes scientific integrity in terms of honesty in data collection and reporting should be second nature to anyone properly trained in science. Following the ethical guidelines for industry-funded research and public-private partnerships developed under ILSI leadership (Rowe and others 2009a,b,c; 2013) should also be routine behavior for professionals who have appropriate ethics training, required by all federally-funded universities today. Perhaps a bigger challenge is being willing to let data drive messages contrary to long-held positions. A widely exposed example of that was described in a recent book "The Big Fat Surprise" (Teicholz 2014). The author contends that much guidance regarding dietary fat is based on selective data. It is difficult to spend years of one's career reporting findings that lead to a position and later abandon that position with a negative finding. It has been said that "Science advances one funeral at a time". Steven Woods gave an example

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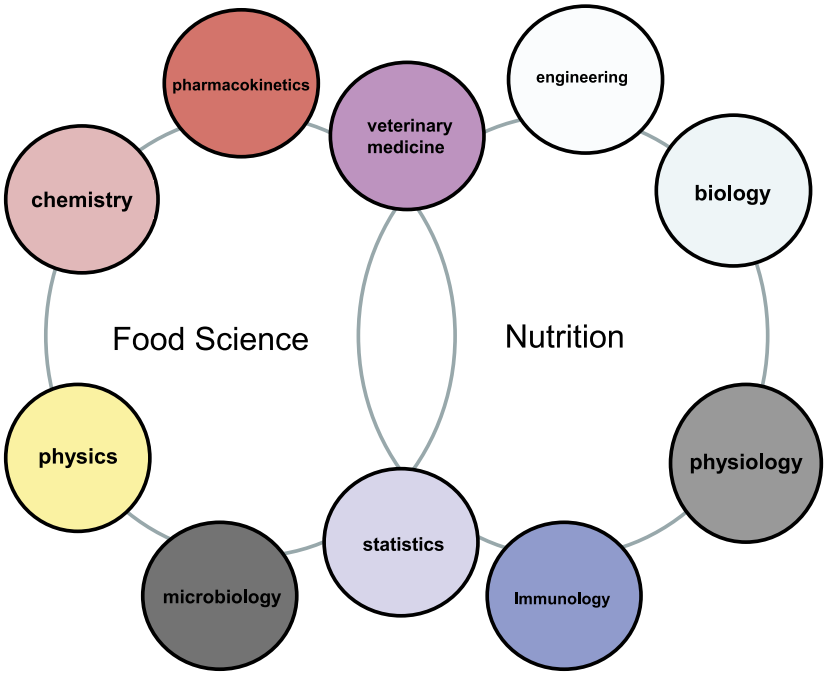
Food Science and Nutrition – An Obvious Partnership

Interdisciplinary interfaces are the pathway to discovery and outreach



to us when, at the end of his distinguished career, he acknowledged that regulators of food intake that he had studied his whole career, like leptin, are not certain and depend on other influences (Woods and Langhans 2012).

3rd Lesson: The more you give away, the more you get

Some scientists have the tendency to guard their unpublished ideas and preliminary data for fear of being scooped. Others refrain from asking questions for fear or appearing stupid. I have found that these are worthwhile risks. The opportunities for collaboration, mentoring others, and increasing one's knowledge base and skillset far outweigh the occasional adverse consequences of being open and sharing. Early in my career, I shared my first National Inst. of Health grant proposal, which was unfunded, with an established, well known investigator: the late Robert Heaney of Creighton University. We re-submitted the proposal collaboratively with him as Principal Investigator. That led to 10 years of funding on that project and my entrée into NIH funding. I have now been funded by NIH as a Principal Investigator for over 25 years. The cost of losing exclusive credit for my early ideas was well worth it.

The project described above was to determine factors affecting calcium absorption, including bioavailability of calcium from foods, beverages, and supplements, which was previously largely unknown. The results of that work have been reviewed (Weaver and others 2000; Weaver 2006b). This whole project resulted from considering food chemistry influences on the nutrient calcium. This type of research can influence policy. For example, our finding that calcium absorption from calcium-fortified soy beverage can be as good as from milk (Zhao and others 2005) led to this alternative calcium source being allowed in federally funded feeding programs such as school lunch.

4th Lesson: Do not be afraid to speak out

Avoidance of controversy and risk of public distrust has led to some individuals and professional societies to avoid activities that might benefit public health. If scientists are unwilling to communicate the evidence to the public via the media, we leave it to self-proclaimed experts to advise the public. If professional societies stop creating position papers because they fear freedom of information requests by advocacy groups, there will be less guidance to professionals based on current evidence. If professional societies limit industry sponsorships, there will be fewer members and attendees at educational meetings because of the higher cost of membership, publications, meeting registrations, and continuing education programs. When the real costs are transferred to the membership, then we reduce the opportunities for professionals to become familiar with the evolving science base.

Scientists should also not be afraid to do research that is highly controversial or to participate in rigorous efforts to evaluate the evidence to inform public policy even on contentions topics. How else can the controversies be resolved? My career has been rich with opportunities to increase the evidence base to resolve controversies and to inform public policy. These opportunities have been among the most rewarding because they have had great

interest and have become part of the conversation to influence public guidance. One recent example was leading a writing effort with the two previous Trailblazer Awardees and other talented professionals to produce a Scientific Statement for the American Society for Nutrition on the nutritional contributions of processed food (Weaver and others 2014). Processed foods have become controversial around the world, in part because consumers think of them as providing poor nutritional value with harmful additives. Our efforts showed that processed foods contribute a large portion of essential nutrients and especially shortfall nutrients, as identified by Dietary Guidelines committees. They also contribute more than their proportion of energy contribution of salt, added sugars, and saturated fats. We concluded that the recipes or formulas of some processed foods could be improved for health but that the extent of processing steps that transform raw materials into food purchased by the consumer has little to do with the nutritional contribution of the food.

A second example of addressing a controversy through research is related to a controversy that influences clinical guidelines for calcium supplementation. The controversy is about whether calcium supplementation intended to prevent or ameliorate osteoporosis leads to increased risk of coronary artery calcification and ultimately risk of cardiovascular disease. The controversy is more thoroughly described in my review (Weaver 2014). The evidence linking calcium supplementation to cardiovascular risk had no evidence for a mechanism and outcomes were inconsistent. Our research team undertook a controlled feeding study in a pig model prone to metabolic syndrome to test the effects of high calcium intakes from supplements or dairy foods on calcification of arteries using a sensitive novel method as well as a number of traditional outcomes to measure calcification and cardiovascular function (Phillips-Eakley and others 2015). High calcium intakes were not associated with increased calcification of soft tissues or greater metabolic syndrome. This report has been widely reported by the National Osteoporosis Foundation (NOF) and a critical component on a NOF-American Society for Preventative Cardiology position paper on the lack of a link between calcium supplementation and cardiovascular disease in generally healthy adults (Kopecky and others 2016).

5th Lesson: Outreach is a multiplier of impact

An essential part of communicating science to the public and translating discoveries into public health guidance is to have a communication or outreach plan. Government and ILSI committees typically have this component as part of the planning process as investors want to see the impact of their work. Scientists are less likely to build this component into their research planning. University news services help take discoveries to the media and journals may develop a press release on an article, but their activities are not systematic and they are typically not proactive efforts initiated by the scientist. One of the most unusual venues our group has initiated to translate messages to the public have been through state fair exhibits. Inspired by two decades of determining lifestyle factors that influence the development of peak bone mass, we solicited a grant from the Indiana Dairy and Nutrition Board to build a state fair walk through exhibit. The exhibit "The Bone Zone" was built with a carnival midway theme that provided a number of interactive components. After two years at the Indiana State Fair, the *Bone Zone* has been a traveling exhibit to children's museums and other venues for 14 years. We repeated the effort in 2012 and built a 2000 sq. ft. state fair exhibit "MyPlate and Beyond" based on the 2010 Dietary Guidelines.

6th Lesson: Keep the priority

If the main goal is to improve the health of the nation, we need to keep our primary efforts on achieving that end. The consumer is worrying about clean labels, GMOs, ultra-processed foods, expiration dates, and what they saw on the latest blog. Do these concerns match with what is needed to feed the growing population around the world or to control alarming health statistics? These consumer concerns may be a privilege of the well fed.

In the U.S., over one-third of U.S. adults are obese and 12.3% have diabetes. Adolescents consume 40% of their calories from solid fat and added sugars (DGAC 2010). Sodas have displaced milk as a beverage of choice.

The gap between population intakes of essential nutrients is far below their estimated average requirements for a number of vitamins and minerals (DGAC 2015). The gap between intakes of fruits and vegetables, dairy, and legumes is far below recommendations by the Dietary Guidelines.

What are the solutions?

Determining and offering health-promoting diets depends on food and nutrition scientists and related professionals working together. Nutrients and bioactive constituents identified as important to health come to us as parts of foods, beverages, and supplements. To ignore the role of the food matrix, the effect of processing and storage, and the capacity for distribution of foods risks compromise of the health benefits of the nutrients or bioactives provided. Yet, these partner disciplines often do not work together, and the failure to even appreciate each other leads to suboptimal diets, foods with poor nutrition profiles, and impractical dietary guidance. Without an appreciation for nutrition, the food scientist may design an extruded starchy snack with a bioactive ingredient or an essential nutrient in pursuing a goal of improving the nutritional value of the product, or a nutritionist may advocate including a nutrient or eliminating a constituent without consideration of its function or preservative value. We are embarking on an experiment on a large scale with new FDA guidance that calls for a reduction in salt and will learn whether hypertension is truly lowered and whether there are unintended consequences in shelf life and food safety on a population level.

When food scientists are not involved in setting dietary guidelines, recommendations are made that leave food manufacturers scrambling to revise formulas. In some instances, the food supply is improved as when major RTE cereal manufacturers switched to formulas with only whole grains rather than refined grains. In other instances, the verdict is out and changes over time. Is reducing fat wise when products are re-formulated to have more sugar? Is displacing sucrose with HFCS an improvement? Is butter or margarine better for health? Is coconut oil or polyunsaturated vegetable oil better for health?

The ultimate concern for the health of the population is when nutrition and food science are missing in education with the result that people do not know how to feed themselves a healthy diet. Many individuals are unfamiliar with a kitchen, how to prepare a meal or select a healthy diet. In the U.K., practical cookery in schools was made mandatory in 2014. Meanwhile in the U.S., enrollment in family and consumer science classes declined 38% over the last decade and there is a shortage of trained teachers (Werhan 2013).

The Food and Nutrition Solutions Task Force sponsored by IFT, AND, and the American Society for Nutrition and the International Food and Information Council was created to consider problems needing input from both food science and nutrition. But few resources are allocated to address such an important and widespread knowledge gap.

Technology provides a means for reaching the population with unprecedented speed and penetration. The content to be delivered to assist in improving the diet, and ultimately health, requires nutrition and food scientists to work together with the commitment, integrity, and courage to provide the best evidence available to the public.

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