Food Technology Innovations: Formulating Grain-based Foods that Support Dietary Guidance

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There is considerable pressure on the grain-based food industry to develop food products that include more ingredients (e.g., whole grains, dietary fiber) that support dietary guidance and fewer ingredients (e.g., fat, sugar, sodium) that do not, while still maintaining a profitable business. Meeting this challenge requires a new way of working together throughout the food system. The first challenge is an unintended consequence of a food system that has evolved over time to address issues of availability, affordability, convenience, adequate calories, and nutritional deficiencies. Food producers and manufacturers, especially grain-based food developers, led the way in reducing nutritional deficiencies through the implementation of fortification and enrichment of refined flour beginning in the 1940s. Although the primary objective to reduce acute illness resulting from insufficient calorie and nutrient intake was achieved, the incidence of chronic disease gradually grew, with a dramatic increase in incidence in the 1980s. The next several decades produced growing numbers of people who suffered from a variety of chronic diseases, including heart disease, type 2 diabetes, and various cancers, despite government efforts, beginning in the late 1970s, to develop dietary guidance; the first "Dietary Guidelines for Americans" was released in 1980.

The current food environment encourages overconsumption of calories (19). Products in the marketplace provide too many solid fats and added sugars, too much sodium, and not enough fruits, vegetables, low-fat dairy, and whole grains (17,18) (Fig. 1). This is also true of foodservice systems in schools (1,3). Measuring the food environment based on available ingredients has often been questioned, because chronic disease is generally framed as a result of poor choices made over an individual's lifetime. Although there is always an element of personal choice, which may be influenced by lack of education, resources (including time and money), and/or access to healthier products, some studies have demonstrated that even highly motivated individuals may have difficulty maintaining a healthy weight given the current food environment (19). Therefore, it is time to focus on creating a food environment that provides healthy, attractive foods for current and future generations.

Sustainable change will require innovative technologies and creative product developers to continue working on ways to make healthy choices easy and attractive. Until now considerable emphasis has been placed on establishing dietary guidance for individual use to assist in improving dietary habits. This process should continue and continue to improve as new evidence becomes available. However, there is also a dire need to translate dietary guidance into recommendations for product development. Little effort has been focused on industry-wide recommendations for food product formulation to increase the availability of foods with added nutritional value. Industry-wide guidelines or targets for creating foods that support dietary guidance could level the playing field for manufacturers and expand options for consumers at every selling point in the marketplace, including restaurants, retail, schools, and other foodservice venues.

Product development guidelines would include strategies for creating convenient and widely available healthy food options. For example, based on dietary modeling, including low levels of whole grains in foods commonly consumed by children 9–18 years of age could increase overall intake from 0.6 to 2.1 servings of whole grains per day, regardless of socioeconomic status (15). To address chronic disease several strategies should be considered, including foods that are lower in calories, have a smaller portion size, and/or possess greater nutrient density. To succeed, however, product changes cannot exceed the threshold of acceptability determined by consumer preferences. Changes that occur too suddenly or that are too extreme may result in consumer backlash against the brand or company. Although product changes pose a risk, creating an industry-wide infrastructure that provides incentives and clear guidelines based on evidence would allow for shared risk across the food system and enable a seamless translation of dietary guidelines into foods with enhanced nutritional value.

Reassessing the food environment and planning calculated steps will take time. A gradual approach to change is the most likely to be successful. Grain-based foods possess a unique opportunity for step-wise, gradual change over time to slowly increase whole-grain content in popular foods. For example, white whole wheat and other lighter colored whole grains can be used

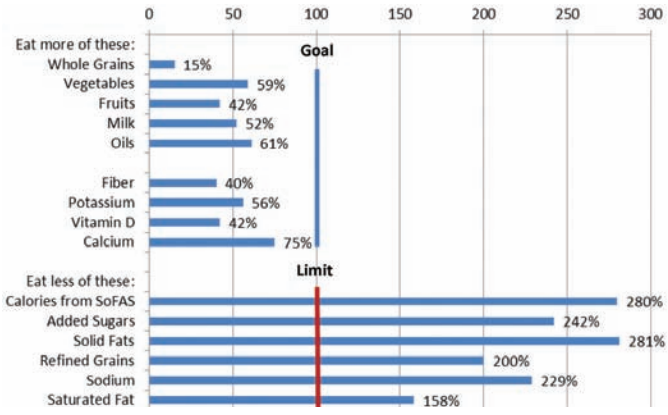

Fig. 1. Comparison of dietary intakes with recommended intake levels. SoFAS = solid fats and added sugars. (Replicated from the 2010 "Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans" [5].)

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to minimize changes in product appearance. Formulators can also choose a flour particle size to customize product appearance and texture, select grain types or mixtures to optimize end-product flavor, partially substitute whole grains for refined flour to make whole grains available in more types of foods, and develop innovative whole-grain products. Gradually changing 100% enriched grain-based foods to foods that contain some whole grain has been successful in schools (2,21) and presents a "win-win" solution for industry, researchers, and consumers. Industry wins because gradual change allows for a more natural transition of ingredients from totally enriched to partially whole. Researchers win because it allows time for further inquiry into the health benefits of whole grains, improvement of technologies, and substantiation of the basic research foundation. More importantly, consumers win because they will be closer to meeting the recommendation to consume half of their grain servings as whole grains.

Although increasing whole-grain consumption is an easier change relative to increasing vegetable consumption, changes must still be slow and deliberate and cannot exceed the threshold of acceptability determined by consumer preferences. As new technologies and ingredients become available, grain-based foods possess unlimited potential for inclusion of ingredients that support dietary guidance. Grains are the vehicle that drives or limits consumption of several other ingredients (e.g., whole grains, dietary fiber, fruits and vegetables, fat, sugar, sodium, and calcium) found in commonly consumed grain categories such as pizza, tortillas, pasta, bread, etc.

A potential strategy for creating the coordinated infrastructure needed to translate dietary guidance into food products may be the formation of a National Academies of Sciences/Institute of Medicine committee that would examine the problems, solutions, and benefits of translating dietary guidance into practical food products for consumers. As part of this process several questions need to be answered. A few questions were developed during the Leveraging Food Technology for Obesity Prevention and Reduction Effort Workshop (7). For instance, is it more effective to make small changes to many products or large changes to a few products? Should changes be made silently? Should efforts focus on calories, since some segments of the population are not reachable through conventional public education venues? This type of process would take time and considerable effort, coordination of multiple sectors, and new approaches for working together.

Because grains have one of the most complex supply chain systems, the grain industry and community must meet the challenge of creating fluid connectivity throughout all parts of the chain. Currently, individuals often interact with segments once or twice removed, upstream or downstream in the chain, but seldom further out. Sector gridlock among various disciplines and cultures would impede progress, when cooperation and collaboration could allow for healthier foods to reach consumers in a more efficient and cost-effective manner. Generally, a lack of trust, appreciation, understanding, and respect make working together challenging at best and fruitless at worst. Without a sense of group ownership of societal issues, progress on the most complex issues, such as chronic disease, is unlikely.

Working together to accomplish a goal, such as creating a healthy food environment, is a simple definition of collaboration. Values such as sharing, idea generation, interdependence, empowerment, strategy setting, and trust are just a few of the keys to establishing relationships that can create meaningful change (4,8). The benefits of collaboration in research and across sectors include increased work capability and use of individual talents, decreased duplication of efforts, greater potential for innovation, and a broader participant network (9). Specifically, a collaborative approach to translation of dietary guidance for use in developing grain-based products will require the expertise of key players throughout the food system. This would provide a broader network of potential contributors to establish the necessary infrastructure and recommendations. Bringing varied voices into the conversation would help balance basic and applied research needs, provide greater potential for innovation, and create win-win solutions for everyone.

Certainly barriers and challenges exist when embarking on collaborative projects. Issues such as what or who will own the intellectual property, bear overhead costs, and manage shared risk should be discussed and agreed on in advance. Models have been developed and are being refined to manage conflict of interest, promote transparency in partnerships, and build trust (16,22).

The 20th century called for knowledgeable workers with deep expertise. The 21st century requires leaders who can encourage integrative thinking among professionals in diverse fields and specialties. Collaboration, not just coordination, will be the task of these leaders (14). Managing collaboration involves multiple layers of social, cultural, and cognitive skills, including determining when and when not to collaborate, the types of professionals or organizations with which it is best to collaborate, the barriers to collaboration and how their impact can be minimized, and how to communicate effectively (9). Innovation is a day-by-day, conversation-by-conversation process and requires relationships that are built slowly and with care. Leaders of collaboration and innovation must truly believe their partners will get just as much, if not more, benefit from projects as they seek to build win-win solutions. Both industry and academic partners should seek to understand business and research philosophies that differ significantly from their own. When considering whether to collaborate, leaders must think about things such as the project goal, the character and values of a potential collaborator, and whether the outcome of the collaboration justifies the cost of the time and resources that will be used in the collaboration. In the end, the goal is not collaboration itself but to create better results. Leaders must also be adept at negotiating conflict and building trust (12).

Building trust is the most important step in developing a truly collaborative relationship (24). Establishing a framework of trust in advance allows collaborative groups the freedom to engage in "courageous" conversations that allow and encourage debate and disagreement for the purpose of creating better solutions (12). Trust can diminish barriers to collaboration and allow groups to work within a confidential and protective framework (24). According to Peter Drucker, world-renowned expert on management theory and practice, "trust does not necessarily mean people like one another, but that they understand one another" (6). Many books and articles have been written that dissect trust in an attempt to define it and offer the reader insight into how to build it. Stephen R. Covey (4) offers several suggestions in *The Speed of Trust*: 1) demonstrate integrity; 2) treat everyone with respect; and 3) clarify expectations. Although it may seem that Covey is stating the obvious, many collaborative efforts have failed due to one or more of these principles being ignored. Indeed, organizations routinely experience the negative effects of a low-trust environment.

Low-trust environments lead to redundancy in efforts, development of excessive bureaucracy to counteract distrust, politics or the use of tactics and strategy to gain power, disengagement among members of the group, turnover, and fraud (4). In addition to impacting the group internally, lack of trust may also turn away potential partners and lead to increased churn (the turnover of stakeholders other than core team members) (4). In a research setting this may mean losing key partnerships for dissemination of research results or potential financial sponsors. Lasting change requires the ability to work together differently than we have in the past. Rather than focusing only on isolated problems to develop solutions for one piece of the system, researchers must also think more broadly to create solutions within the entire system (23). A systems-based approach looks at each problem or situation as a whole rather than as an individual part. The central dogma of systems-based thinking states that it is the relationship between the internal structure of the system, or the inherent characteristics of the system, and the forces that act externally on the system that produces either positive or negative outcomes (20). Focusing on problem solving within either the internal structure or the external influences acting on the system, but not both, leads to short-term fixes instead of creation of long-term solutions (20). For example, studies by Huang et al. (13) and Heber (11) demonstrate a systems-based approach to addressing obesity by addressing societal systems and not focusing only on a single person's caloric balance. Research is a valuable tool for making sustainable and positive changes, if the research is used to answer targeted questions and is integrated into the greater system to make the desired changes.

Our current education system lacks systems-based thinking and training that would teach food technologists and health professionals how to work across silos. Because university programs generally lack intercultural, interdisciplinary, experiential, and systems training, professionals often do not appreciate differences and similarities, connectedness, respect, trust, and ownership (8). New research approaches for framing issues as systemic problems should encourage cross-disciplinary questions and hypotheses, focus on structural interventions, take a global perspective, and build the capacity for multilevel research and action (13). To leverage the strength of the food system, interventions may need to occur at every level, from development to delivery to consumption. Moving forward requires mutually supportive infrastructures that include new models for motivation, training, reward systems, competencies, information technology, and communication across silos (10). It is not enough to recognize the many ways in which we are all different; we need to go further to recognize and capitalize on the many ways in which we are similar (25). All those engaged in creating solutions for food products with added nutritional value must consider the interdependence and complexity of the system when making decisions or changes.

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