Commentary

Challenges related to the composition of functional foods

Joseph T. Spence*

Nutrition, Food Safety, and Quality, Agricultural Research Service, United States Department of Agriculture, 5601 Sunnyside Avenue, GWCC 4-2188, Beltsville, MD 20705, USA

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Abstract

There is a growing interest among producers and the public in functional foods or foods that may provide health benefits beyond basic nutrition. The availability of such foods highlights the changing nature of the food supply and the tremendous difficulty in trying to maintain accurate and timely food composition data. Key questions arise. How can and should we track and maintain a database of functional foods? What food components should we be measuring in order to meet the needs of users of the nutrient data? Do analytical techniques exist for some of these components and what effects do these components have on the measurement of other nutrients? We need to begin how to answer these and similar questions and the answers may vary depending on the nature of the variety of functional foods produced.

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1. Introduction

Maintaining accurate information on the composition of foods is a difficult and challenging task even under the best of circumstances. The food supply changes over time. These changes include the types of foods but also include changes in the underlying raw commodities that are used to produce foods. Often these changes are unanticipated and transparent to the consumer. To scientists who have the responsibility to determine nutrient content and maintain food composition databases, these changes cannot be ignored. More recently, the food industry, the agricultural community, and now consumers have shown a growing interest in the so-called functional foods. Such foods present unique and difficult challenges to those in the food composition community and the many entities and individuals that depend on high-quality food composition data.

Functional foods were first described by Roberfroid (1999) as “Food similar in appearance to conventional food that is intended to be consumed as part of a normal diet, but has been modified to subserve physiological roles beyond the provision of simple nutrient requirements”. More simply put, functional foods are foods that may provide health benefits beyond basic nutrition. Functional foods can arise from a desire to provide additional benefits to consumers in the way of enhanced nutrition. They can also be useful in making nutrients more available by providing particular dietary components in foods that will increase their availability and palatability beyond that which might normally be consumed.

2. Nutritional issues

While functional foods can offer potential benefits, there are a number of concerns that need to be considered before we can change the food supply in beneficial ways. Foods contain a variety of nutrients and nutritionally beneficial components—many of which are known, but many of which are not yet determined. Despite the fact that technology has progressed to a point where changes in foods can be made easily, one could reasonably argue that we do not know enough about the role of all dietary components, particularly the non-traditional or emerging nutrients such as phytoneutrients, to make meaningful changes to the food supply.
Several years ago, it was widely assumed that β-carotene provided protection against the development of cancer or heart disease, leading to increased consumption of this carotenoid in foods and supplements. However, as reported by Omenn et al. (1996) as well as others, this compound may increase the risk for cancer or heart disease in certain situations. Such findings highlight the need to look at the overall diet when looking at adequacy and desirability of an individual’s diet. In addition, in light of the potential for misunderstanding of the role of emerging nutrients or potentially bioactive food components in maintaining health, the design of functional foods must take a well-reasoned and careful approach in order to achieve the potential promise of functional foods.

Another nutritional concern with functional foods is the possibility of consuming an excess of nutrients, some of which may have toxic properties. While a functional foods approach might be desirable to increase the intake of particular nutrients, one of the concerns related to functional foods could be that by enhancing nutrient content, we may be reducing the variety in the diet as consumers rely on a smaller number of foods to meet their dietary needs. Most would agree that variety in the diet is essential, and functional foods can have the undesirable effect of reducing variety.

3. Types of functional foods

The variety of functional foods that can be developed is limited by our imagination, the perceived benefits, and the willingness of consumers to pay for those benefits. A number of prominent types of functional foods are indicated in Table 1. Examples of each of these types of foods can be found commonly in the marketplace. Some may be obvious that they are functional foods, but some such products in the marketplace are relatively transparent. This fact adds to the challenge of maintaining accurate food composition data and nutrition monitoring. Some examples of functional foods in each of the categories and the challenges that they present with regard to food composition are noted below.

3.1. Fortified foods

The simplest types of functional foods are those products that are fortified with additional nutrients. The food supply

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has abundant examples of such foods. Examples include the recent fortification of grain products with folic acid and various fruit juices that are fortified with additional vitamin C. This approach of fortification has proven to be an effective and economical way to improve nutrient quality and provide benefits to consumers. However, one can easily see the problems that it presents with regard to food composition. In instances such as folic acid fortification, the amounts are mandated, but in other instances the fortification is optional and dependent on the particular food item or brand of product. In addition, an added problem can exist in that the amount of fortification may not be accurate, and that fortification of identical products at differing manufacturing plants can lead to the same product with differing amounts of the nutrient that has been used to fortify the product.

3.2. Enriched foods

Other examples of functional foods are enriched products that might add additional components or components not normally found in great quantity in a particular food. An example of this type of food, with widespread availability, is orange juice that has added calcium. Another example is the inclusion in margarines of plant sterol esters that have been shown to lower blood lipids and cholesterol. These types of products provide clear benefits in dealing with a problem nutrient such as calcium, or have been shown to be effective in promoting cardiovascular health, respectively. However, with regard to food composition, this can create problems. The growing dissimilarity of what only a few years ago was a single product adds a higher degree of complexity in tracking food composition data.

Another interesting area of functional foods and one that has reached the grocery shelf is that of components classified as probiotics and prebiotics. Probiotics are live microbial food ingredients that have a beneficial effect on human health; they are traditionally found in fermented dairy products and fermented vegetables. Prebiotics are typically fermentable dietary fibres that provide a gastrointestinal environment in which beneficial bacteria can thrive. The health benefits of enhancing the microbial environment of the gastrointestinal tract are well documented and include systemic effects such as lowering of cholesterol and enhanced liver metabolism of xenobiotics (Roberfroid et al., 1995). Although not nutrients in the strictest sense of the word, foods that contain probiotics and prebiotics clearly have nutritional effects. As foods that contain them are more widely consumed, they have the potential for providing real health benefits. At the same time, such foods present a unique challenge with regard to food composition. Many probiotics and prebiotics are proprietary ingredients. Do we ignore such food components in terms of food composition or will there have to be some determination of their presence in functional foods? These types of food components might suggest that some
functional foods might require that functional assays for biological activity are needed in order to fully understand the composition of foods.

3.3. Altered products

Using different ingredients, food products can be developed whereby some potentially harmful or undesirable constituents could be replaced by more beneficial components, ideally without affecting product quality. A good example of this is the use of high fibre fat replacers, produced from grain products (Inglett, 2001; Romanchik-Cerpovic et al., 2002). A variety of these reduced fat and fat-free items have been available commercially for some time. Products that have reduced fat are widely consumed and largely unrecognized by consumers. The consumer knows the product is reduced in fat, but does not know how or what other changes have been made to the food. Scientists involved with food composition and those involved in nutrition monitoring face challenges trying to understand just how the foods have been altered and if there are any other nutritionally important changes, such as increased fibre content, that are important to measure and track in food composition databases.

3.4. Enhanced commodities

An exciting class of functional foods is enhanced commodities. Plant breeders can develop amazing varieties of products that have potentially important benefits to consumers. Examples include high lysine corn, fruits and vegetables with enhanced content of vitamins, and overproduction of phytonutrients in a variety of fruits and vegetables including the insertion of some of those components into food plants that do not normally produce those dietary components, such as golden rice or carotenoid containing potatoes. While such products can provide tremendous health benefits, they can create problems with regard to food composition. Many times, consumers may not be aware of what they are eating. What will it mean if one consumes a tomato when there will be large differences in the nutrient content of tomatoes or that a meal might include a potato that might contain β-carotene?

There are additional pitfalls with enhanced commodities. Tomatoes that have increased production of the phytonutrient lycopene have been developed by Mehta et al. (2002). The fruits offer potential benefits to the public based on some evidence that lycopene is beneficial for health. Obviously, for accurate food composition, one needs to know the content of the lycopene in the tomato. When looking at other components in these lycopene-enhanced tomatoes, it was noted that the synthesis of carnitine was also increased (Mehta, personal communication). Thus, it is highly likely that as we alter plants to overproduce certain compounds, the content of other plant components are also affected. Some of these additional components may or may not share common biosynthetic pathways, but potentially some of these will be nutritionally important. It may be that for accurate nutrient content, such enhanced commodities must not only be measured for their increased content of a particular nutrient but also for all other nutrients as well.

4. Conclusions

The promise and potential of functional foods offers many exciting possibilities. However, the examples cited herein indicate the complexity of trying to maintain accurate and relevant food composition data for functional foods. As the food supply becomes more varied with many more options available to consumers, it creates a challenge as to how to identify and track the particular properties of functional foods. The content of foods that might be enhanced for particular nutrients or changes that may occur to other components in these foods is poorly understood. However, functional foods are likely to be changed in many ways and determining those changes needs to be addressed. As mentioned earlier, food composition can be challenging under the best of circumstances and concerns related to the composition of functional foods are perhaps not much different than the general concerns about food composition in general. Issues related to portion size, sampling, growing conditions, processing, cooking, etc. are inherent in trying to measure the nutrient content of foods accurately. However, the challenges presented by functional foods serve to highlight the quickly changing nature of the food supply. Regardless of these changes, there is a continuing need to know the accurate composition of foods, both for nutrients and non-nutrients, and for understanding the amount of these components in foods.

References