

# Functional Food Components: A Role for Mineral Nutrients?

By T.W. Bruulsema

Functional foods are defined as foods that contain bio-active ingredients thought to enhance health and fitness. The active ingredients are phytochemicals, such as lycopene in tomatoes, allicin in garlic, or isoflavones in soybeans (Table 1). These phytochemicals, also called “nutraceuticals”, may be extracted and consumed as supplements, or may have therapeutic value when consumed in whole food.

Functional food ingredients are associated with the prevention and treatment of several leading causes of death: cancer, diabetes, hypertension, and heart disease. In addition, some help with other medical ailments including neural tube defects, osteoporosis, abnormal bowel func-

tion, and arthritis. Their modes of action are diverse.

The functional food industry is considered to have tremendous potential for market growth. In the U.S. alone, sales of dietary supplements, herbs and botanicals, natural foods, and personal care products amounted to \$25.8 billion in 1998.

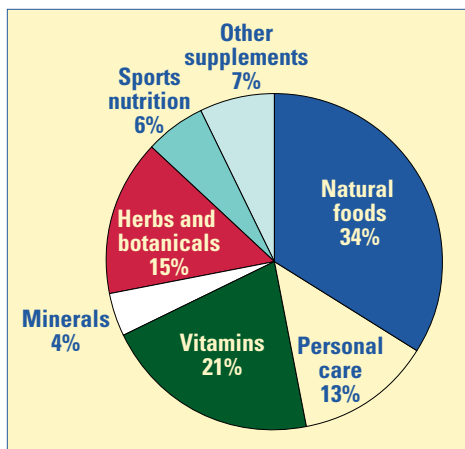
The components of this industry are shown in Figure 1. In Japan, functional foods are regulated as “Foods for Specified Health Use” (FOSHU). Over 154 products are already regis-

tered as FOSHU, and their sales in Japan amount to \$1.5 billion annually.

The fastest growing category of dietary supplements in 1998 was herbs and botanicals, with sales increasing 18 percent over 1997 levels. Their prospects for future growth are even higher. Why? When science can determine the phytochemicals that truly promote health, their use can be justified on a measurable basis. However, future medical and nutritional research will need to sort out many claims for potential functional food ingredients.

Food and feed crops that are enhanced in nutritional or nutraceutical content offer opportunity to almost every crop producer. While most of the attention is paid to food crops, the benefits to animal feeds may be equally valid. One study at Iowa State University indicated that isoflavones may enhance swine carcass muscle percentage. Thus, the discoveries in this new area of science have potential to impact the definitions

Consumer interest in healthy food is expanding rapidly, particularly as the “baby boom” generation ages. The new concept of “functional food” gives a fresh perspective to the mineral nutrition of plants.



**Figure 1.** The \$25.8 billion U.S. Nutrition Industry, 1998. (Source: *Nutrition Business Journal* Vol. 4 No. 6).

**TABLE 1.** Examples of functional foods and their active phytochemical ingredients.

Functional food	Nutraceutical ingredients
Broccoli, cabbage, cauliflower	sulphoraphanes, indoles, carotenoids
Cranberries	quinic acid
Echinacea angustifolia	echinacosides, polysaccharides
Flax	lignans
Garlic	allicin, flavonoids, organosulfur compounds
Ginseng	more than 30 ginsenosides
Red grapes, red wine	resveratrol, quercetin, anthocyanidins
Soybean	isoflavones, saponins
Tomato	lycopene, carotenoids
Whole grains (oats, wheat, barley)	beta-glucans, saponins, terpenoids, phytic acid

of quality in both animal and human nutrition.

While functional food components are controlled strongly by genetics, other important factors include crop cultural practices, nutrient management, and weather. Plant metabolism of secondary phytochemicals is anabolic and energy-consuming. Thus, one might expect that well nourished plants would be more capable of producing phytochemicals. One example is a study that showed potassium (K) enhanced the lycopene content of tomatoes by 67 percent.

However, some phytochemicals are produced in response to stress conditions and might actually be enhanced under nutrient deprivation or adverse weather conditions. Finding the nature of these plant responses is an important agronomic research priority. Levels of fertility considered optimal for yield could be either suboptimal or excessive for optimum nutraceutical content.

How will the exciting changes in the food retail market impact the traditional agronomy



**Potassium may enhance** the lycopene content of tomatoes. Lycopene is a phytochemical with known health benefits.

of corn, wheat and soybeans? We can expect that future quality standards for many commodity crops will be influenced by new knowledge of nutraceuticals. The quality standards will become more complex than simple measures of test weight, crude protein, oil content, etc.

Many quality traits are indeed impacted by the weather. It is uncertain whether identity-preserved contract production will be successful in providing grains with targeted standards for functional food components. However, premiums may be offered even on commodity crops that meet measurable standards. This will lead growers to manage variety selection, nutrient inputs, and other cultural practices to maximize chances of meeting standards for the quality components of interest.

The improvement of food quality is an important priority for agriculture. Deficiencies of trace minerals [iron (Fe), zinc (Zn), iodine (I), and selenium (Se)] and vitamin A currently affect more than two billion people worldwide. Enhancing the nutritional value of foods is not only a market opportunity, it meets real human needs.

Research on the role of soil fertility has much to discover about myriad crop phytochemicals and nutritive minerals. Soil fertility specialists must pay particular attention to developments that enhance mineral uptake in plants and their content of beneficial phytochemicals. [BC](#)

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