

CURRENT ISSUES

THE INSIDE STORY



Food or Pharmacy? An Introduction to Functional Foods and Nutraceuticals

As our knowledge of nutrition and food science has expanded, so too has interest in the role of foods in disease prevention and treatment. There is growing recognition that foods, or components of foods, can offer benefits that extend well beyond meeting basic metabolic requirements, offering the opportunity to maximize health, and reduce the risk for chronic conditions such as heart disease, stroke, diabetes, and cancer. Consumers have latched on to this emerging body of knowledge and current estimates suggest that consumer interest in functional foods and nutraceuticals will remain high into the near future. This edition of *Current Issues* will help dietitians understand functional foods and nutraceuticals so as to better translate this knowledge for the consumer.

The term, “functional food” was first introduced in Japan in the mid-1980s to describe foods that, in addition to being nutritious, offer distinct health benefits¹. Despite the relative longevity of the term, there remains no universally accepted definition of functional foods, fueling confusion in the literature and lay media.

Health Canada defines functional foods as, “similar in appearance to, or may be, a conventional food that is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions, i.e. they contain a bioactive compound.²” Bioactive compounds are defined as “naturally occurring chemical compounds contained in, or derived from, a plant, animal or marine source, that exert the desired health/wellness benefit (e.g. omega-3 fatty acids in fish oils; lutein in green vegetables; stanol esters in soy products)²”. This definition of functional foods is much broader than that from the Institute of Medicine of the National Academy of Sciences who limit the notion of functionality to those foods where “the concentrations of one of more ingredients have been manipulated or modified to enhance their contribution to a healthful diet.³”

Agriculture and Agri-Food Canada further refined the definition of “functional foods,” by creating three categories: Basic Foods, Processed Foods with Added Ingredients and Foods Enhanced to Have More of a Functional Ingredient⁴.

Basic Foods

Many of the foods we enjoy on a daily basis have functional properties. These foods, which Agriculture and Agri-Food Canada terms “basic foods” are defined as “natural and processed foods that contain bioactive compounds⁴”.

Examples of “basic foods,” abound. Many vegetables and fruits could be considered basic foods, as could whole grains like oats, whose functional component, beta glucan, has health benefits that have been well documented in the literature. Cranberries are another example of a basic food.

Cranberries and cranberry juice, in particular, have been touted as having antibacterial properties and are a long-standing home-remedy to prevent urinary tract infections (UTI). Such a relationship is plausible given some of the bioactive compounds that have been identified in cranberries. Cranberries contain fructose in combination with 1-O-methylgalactose, prunin, and phlorizin. In-vitro assays of these compounds suggest that they function synergistically to prevent pathogenic strains of bacteria from adhering to cells that line the wall of the bladder^{5,6,7}.

Evidence to support a role for cranberries or cranberry juice in preventing UTI's exists; however, the evidence is not conclusive⁸. Currently, only a handful of randomized, controlled human trials have examined the efficacy of cranberry juice in preventing UTI and many of these employed small sample sizes and select populations (e.g. women only)⁸. While some of these studies have demonstrated an effect for cranberry juice or cranberry preparations in preventing UTI, more research is needed to quantify the true magnitude of this effect⁸.

Challenges exist with respect to recommending even “basic” functional foods to consumers. In recent months, acai berries and juice have been the subject of great media interest and health claims. Several studies have demonstrated the anti-oxidant capabilities of acai berries (which are derived from a the *Euterpe oleraceae* species of palm), which are currently sold in Canada through health and natural foods stores, foodservice operations and by Internet sales^{9,10,11}. However, randomized, placebo-controlled human trials of acai have yet to be conducted, making it difficult, if not impossible, to say with

CURRENT ISSUES

THE INSIDE STORY

confidence what amount of intake would be likely to offer a health benefit. Strong evidence to support positive human health outcomes is lacking for many functional foods and nutraceuticals. Recognizing this, dietitians and other practitioners need to be careful not to inadvertently misrepresent the established benefits of foods or nutraceutical products.

Processed Foods with Added Ingredients

Agriculture and Agri-Food Canada define this category of functional foods as “processed foods that contain added bioactive compounds⁴”. Advances in food science and technology have allowed bioactive compounds or food items containing bioactive compounds to be added to processed foods in which they are not normally present. This approach allows the concentrations of bioactive compounds in a processed food to be increased in order to promote specific health benefits.

The addition of flaxseed and ground flax to breads, pastas and other products exemplifies this category of functional foods. Flaxseed is a source of lignans, estrogen-like compounds that has been linked to both cancer and cardiovascular risk-reduction^{12,13}.

The phytoestrogens found in flaxseed are considered to be very bioactive; more active, in fact, than those found in soy protein¹⁴. On this basis, flaxseed has been proposed as a dietary means to decrease the risk for conditions that are influenced by circulating hormone levels such as heart disease and cancer.

Moderate evidence exists to support a relationship between flaxseed intake and cardiovascular risk reduction. Studies show that flaxseed in varying forms can modestly reduce serum total and low-density lipoprotein cholesterol concentrations in humans¹³. In addition, recent work indicates that adding ground flaxseed and flaxseed oil to processed foods can also positively affect blood lipids¹⁵.

Flaxseed shows promise as a potential dietary means to reduce the risk of certain types of cancers. Diets rich in flaxseed (ground or intact) and flaxseed oil have been shown to significantly attenuate tumour growth in animal models^{16,17,18,19}. The number of human studies assessing the impact of ground and intact flaxseed on cancer risk is very limited and while the results obtained are generally positive, more research is needed to quantify the impact flaxseed might play as a preventative influence^{20,21}.

Food Enhanced to Have More of a Functional Component

Agriculture and Agri-Food Canada define this category of functional foods as “foods that are cultivated or bred to enhance the amount of a bioactive compound they contain⁴”. Humans have been crossbreeding plants and animals for centuries to obtain new strains or breeds with specific, desirable, characteristics. In recent years these traditional processes have been used to enhance the levels of bioactive compounds found in some foods. The “Flora-Lee,” tomato cultivar is an example of a food that has been enhanced to have more of a functional component, namely lycopene²².

Lycopene is a carotenoid anti-oxidant that is found in relatively high concentrations in tomatoes and tomato-based products like tomato paste, watermelon, pink grapefruit, and papaya. Frequent intake of lycopene-rich foods is associated with reduced risk of heart disease, certain types of cancer, diabetes, and macular degeneration²³. The “Flora-Lee” tomato cultivator was developed by researchers at the University of Florida and contains approximately 25% more lycopene than standard tomato cultivars²². When released to growers in late 2006 or early 2007, it will be positioned as a more healthful tomato²².

A large number of functionally enhanced vegetables and fruits are currently in development in Canada, the United States and elsewhere in the world. In the years to come, consumers can expect to see products ranging from red-coloured carrots with higher than average of beta-carotene to high calcium beans.

Nutraceuticals

Advances in food science now make it possible to break foods into their constituent parts. Building on this capability, known bioactive compounds can be extracted from whole foods for sale as isolated, purified preparations or nutraceuticals. Agriculture and Agri-Food Canada define nutraceuticals as “A product isolated or purified from foods that is generally sold in medicinal forms not usually associated with foods⁴.” Probiotics are one example of a nutraceutical.

Probiotics are live microorganisms that, when ingested in appropriate quantities, have a beneficial effect in the prevention and treatment of specific medical conditions by improving the host's intestinal microbial balance²⁴. These microorganisms remain biologically active in the human body after they have been consumed (either in an isolated form or as part of a basic food such as yogurt). Evidence

CURRENT ISSUES

THE INSIDE STORY

suggests that probiotics exert positive influences on the micro-flora colonization of the gastro-intestinal which may, in turn, impact risk for certain types of cancer and infectious disease^{25,26,27,28,29}. In addition, probiotics have been shown to stimulate measures of immune function³⁰. However, despite these promising findings, many questions remain with respect to the preventative value of probiotic therapy and experts caution that more research is needed to determine best practices for the use of isolated probiotic preparations³¹. Limited information is available about appropriate probiotic dosing regimens. Few dose-comparison studies have been undertaken and methodological problems are an issue for those that have³¹.

Dietitian Practice Points

- Scientific knowledge related to functional foods has expanded significantly. However, much more study needs to be undertaken before well-supported guidelines or recommendations for intake of many functional foods and/or their bioactive components can be established. Researchers have yet to identify all of the potentially bioactive constituents in foods. And while some foods or food components have shown promise, there is, in many cases, a paucity of strong evidence to suggest the level of intake needed to offer bona fide health benefits (actual numbers).
- Our understanding of the role that specific constituents of foods play in promoting health and preventing disease will undoubtedly grow in the years to come. Recognizing this, dietitians must continue to expand their knowledge of foods, active food components and evidence-based practices for using the different kinds of functional foods. In doing so, dietitians will reinforce their position as the experts when it comes to the interplay between foods and nutritional health.

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CURRENT ISSUES

THE INSIDE STORY

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