



Composition of Functional Food in World Diet

1

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Abstract

The interest of researchers and consumers for functional food is rapidly growing along with exhaustive research to find out the properties and applications that are beneficial to human health. The main reason for growth of functional food market is the lifestyle and ever-growing population. With competition at every level, at times health takes the last seat which effects life in the long run. Today in twenty-first century, obesity is recognized as a global issue which has severely affected the United States, followed by India. Genetics play a major role in the development of diseases, but today lifestyle has a dominant effect. This chapter analyzes the current Indian market situation for function foods as compared to the market across the globe. It also covers the major food segments that are now regarded as functional foods. Probiotics, some fruits and vegetables, and beverages like green tea and wine are regarded as functional food. Lastly, the chapter also talks about the challenges and future aspects of functional foods.

Keywords

Functional foods · Probiotics · Functional food market · Antioxidants

1.1 Introduction

There is not much of a difference in western parts of the world and India when it comes to food and health. The Indian food industry is rapidly growing with exhaustive response to the demand of healthy food. The Indian consumer of the

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twenty-first century is looking for food options that are beyond nutrition, options that provide specific health benefits and benefits related to skin and beauty and decrease risks related to diseases. Functional foods for this reason as readily being accepted in the Indian market and the consumers for the same are demanding this type in food categories [36]. But there is still a lot of scope for functional food in the Indian scenario before it is established naturally. This chapter provides in-depth knowledge about benefits of functional foods and its status in the Indian market.

Industrialization and globalization of the country have a major impact on the food habits of the citizens. The bifurcated urbanization of the country has led to two major nutritional issues: excess and deficiency of nutrition. The changes in lifestyle of the consumers have led to a shift to functional foods from ordinary food. The diseases related to lifestyle like diabetes, obesity, and blood pressure are increasing at an alarming rate. This is due to high work pressure and cut throat competition where health and nutrition are gradually taking a back seat. Decrease in field activities and more dependence on fast foods are also major causes for the birth of such diseases in India [46].

Due to such rationales and limited physical activities, consumers are looking for options in food that provide them limited risks of diseases and more health benefits, something that functional food is fulfilling. The children nowadays are more into gadget gaming than playing in the field. Along with this they are taking food with high calories and low nutrition value which leads to lifestyle diseases in early stages of life. Such urbanization has led to change in the eating habits and lifestyles affecting majorly the children and elderly with diseases that stick with them throughout the lifetime [32].

In the course of the most recent decade, interest for nourishments and refreshments that enhance or advantage well-being has expanded in numerous parts of the world, close by increasing expenses of social insurance, increments in future, and longing for a higher nature of life. In such regard, functional foods play a vital part, offering another sort of well-being instrument that guarantees particular impacts identified with specific nourishment components.

Functional foods were first introduced in Japan in the mid-1980s. At that time, it referred to processed foods containing ingredients that beneficially influence specific body functions, in addition to being nutritious. Today, there is no accurate definition of what functional foods exactly are. A functional food can thus be a natural food or it can be a food that has been modified to have a functional influence on the health and well-being of the consumer through the addition, removal, or modification of specific components.

Functional foods are divided into three classes: food items that have increased content of fatty acids, vitamins, minerals, or fiber, allergy or intolerance-causing food with eliminated active components, and food items with nontraditional nutrients having immune boost [17].

The rise in functional food usage can be credited to advances in science and technology, expanding social insurance costs and changes in nourishment laws influencing marketplaces.

Another term homogeneously used with functional foods is “nutraceuticals,” although it is less supported by the consumers. Nutraceuticals refer to nearly any bioactive component that delivers a health benefit. Functional food carries a different meaning to different countries of the world. The difference lies in the regulatory market and different definitions. The concept of functional food was first promoted in 1984 by Japanese scientists who studied the relationships between nutrition, sensory satisfaction, fortification, and modulation of physiological systems [40]. There it referred to the food products fortified with special constituents that possess advantageous physiological effects [21, 42].

In Europe, functional food is defined as “a food product that can only be considered functional if together with the basic nutritional impact it has beneficial effects on one or more functions of the human organism, thus either improving the general and physical conditions or/and decreasing the risk of the evolution of the diseases. The amount of intake and form of the functional food should be as it is normally expected for dietary purposes. Therefore, it could not be in the form of pill or capsule just as normal food forms” [16].

In India, functional foods are defined as “foods which are specially processed or formulated to satisfy particular dietary requirements which exist because of a particular physical or physiological condition or specific diseases and disorders and which are presented as such, wherein the composition of these foodstuffs must differ significantly from the composition of ordinary foods of comparable nature if such ordinary foods exist, and may contain one or more of the following ingredients, namely plants, minerals or vitamins, substance from animal origin and a dietary substance used to supplement the diet”.

This definition is according to the Food Safety and Standards Act, 2006, which is an amalgam of functional foods, nutraceuticals, and health supplements. This includes food present in different forms like powder, capsules, and granules.

1.2 Market of Functional Foods

Food that has health and nutritional benefits has made a significant impact on changing consumers’ lifestyle. This provides a great opportunity for the market of functional foods. Today food not only satisfies hunger but also a sense of satiety. Factors like demographic, economic, social, and cultural have a significant impact on attitudes toward consumers for food products. The consumer today understands the relationship between diet and health and demand products that are beyond nutrition.

1.2.1 Status of Functional Food at International Level

The global market of functional foods today is estimated to be at least 33 billion US \$. The food market of the United States has almost 50% of the market share. Out of this 50%, 2–3% is owned by the functional foods market [25].

Japan is regarded as the birthplace of functional foods which have more than 1700 types of products available [25]. In 2006, the market was at 5.73 billion US \$ with almost 500 products under the umbrella of FOSHU (Foods for Specified Health Uses) [40].

Europe, Germany, France, the United Kingdom, and the Netherlands hold the dominancy in functional food. Euromonitor has predicted that the sales will boom in regions of Poland, Hungary, and Russia [6].

Today, not only the food manufacturers but even pharmaceutical industries are trying to enter the market of functional foods [28]. Some leading pharmaceutical industries that have entered this domain are Novartis Consumer Health, Johnson & Johnson, and Abott Laboratories. These companies organize clinical trials to prove health claims of a particular food product [5].

1.2.2 Status of Functional Foods at Indian Level

The market of functional foods today functions by keeping in mind that the urban lifestyle of India is rapidly damaging the health and food habits of the citizens. The companies and various startups are keen on the experimentation of products even though there is a high risk of long-term losses. Various consultancies present in India estimate that Health & Wellness (H&W) food markets in India reach INR 101 billion in 2012 and forecast it to grow at a CAGR of 33% to INR 550 billion by fiscal year 2015 with advances in product development and government-mandated fortification [22].

There have been various new products launched in the Indian market which come under the category of functional foods. According to a report by Mintel, a UK-based market research company, 116 new products were launched in the Indian market. Eighty products were aimed at benefitting the cardiovascular functioning of the human body, while 36 were promoting strong immunity and health. Products launched were mainly edible oil, baby food, dairy, bakery, and confectionaries.

Since a basic Indian household uses edible oil as a chief cooking medium, it was considered as the main category of functional foods. Consumers now look for edible oil that has low trans-fat and low cholesterol which results in reduced cardiovascular diseases.

Another category which was very popular among the Indian consumers were dairy and baby food categories, where probiotics and prebiotics are increasingly becoming popular due to their abundant health benefits like providing immunity by increasing the population of good bacteria in the gastrointestinal tract.

1.2.3 Suppliers of Functional Food to the Indian Market

The Indian food market is divided into six segments as summarized in Table 1.1 (Adapted and modified from [34]).

Table 1.1 Indian functional food companies and startups

Main segments	Companies and start ups	Functional foods
Broad product range	Nestle, Danone, Unilever, Kelloggs, Pepsico, Yakult, Danone	Probiotic yoghurt/Dahi, snacks, energy drinks, breakfast cereals
Pharmaceuticals	GSK, Amway, Ranbaxy	Malted food, supplements, fortified products
National Category leaders	Amul, Dabur, ITC, Britannia, Parle	Dairy products, fruits & vegetable juices, biscuits
Small and medium sized companies	Heritage Foods, Ruchi Soya, Mother Dairy	Soya milk, dairy, oils
Retail companies	Reliance Wellness, Apollo Pharmacy, Patanjali	Sweetners, cereals, energy drinks, ayurvedic & herbal products
Functional ingredients	Chr Hansen, Orana, Danisco	Cultures, enzymes, phytonutrients, natural colors

The food industry is increasingly becoming “health conscious,” where the main players of the industry are focusing more on nutrition, health, and safety to gain a competitive edge. Multinational food companies like Nestle and Pepsico have introduced the concept of functional foods in the market. Nestle has been the market leader of the food industry since long. It has introduced many healthy food product chains like infant food, noodles, condensed milk, and vegetable multigrain Maggi noodles, while Kelloggs holds a 60% share in the INR 4 billion cereal markets in India. The brand is popular for breakfast cereals, Muesli, Kelloggs Special K for weight reduction, and various flavors of cereals.

All functional food products require a strong R&D department. Many of the multinational companies have their own R&D on which they spend about 2–3% of the annual turnover. Domestic companies have a low R&D budget due to which they lag behind, and multinational companies having their own R&D with appropriate budget lead the food industry. Also the multinational companies are more capable to establish the specific health claim related to the functional food products with the scientific verification of the efficacy of functional food based on statistically validated data from different model systems, from retrospective and prospective epidemiological studies, as well as from intervention studies on humans [36].

1.3 Fast-Growing Categories of Functional Foods

Functional foods are regarded as any substance that may be considered food or a part of food that provides health benefits that includes treatment and prevention of diseases. The products range from dietary, genetically engineered food, herbal products, and processed food. The potential of such type of food is often related to the maintenance and improvement of health beyond nutrition [1, 44].

1.3.1 Probiotics as Functional Foods

Probiotics are defined as selected, viable microbial dietary supplements that, when introduced in sufficient quantities, beneficially affect human organism through their effects in the intestinal tract [15, 20].

Probiotics have been extensively consumed in Japan, European countries, and the United States. It is now emerging as an important category of food supplement in India. Probiotics are considered functional foods because they provide benefits apart from nutrition [30].

The health benefits of bacteria in foods and consumption led to the concept of probiotics. Probiotics are live microbial feed that when consumed provide beneficial health effects by maintaining the flora in the intestinal tract. Probiotics, antonym of antibiotics, is now increasingly rising as an alternative approach for the latter.

Probiotic bacteria are present in yogurt, kefir, dark chocolate, microalgae, kimchi, raw cheese, apple cider vinegar, salted gherkin pickles, and miso (Japanese spice).

The human body is a place of residence for microorganisms and has more prokaryotic cells than eukaryotic cells. Some situations alter the ecology maintained by the microorganisms, thus exposing the body to pathogenic bacteria and infections [20]. These situations include misuse of antibiotics, the diet we take, and the environment we live in. Hence, probiotics acts as a rescuer and helps to reflowerish the microflora present in our body, thus promoting health.

Benefits of probiotics include reduced lactose intolerance, blood pressure, and respiratory infections and increased resistance to pathogens causing infections [26]. Sources of probiotics include yogurt, kefir, dark chocolate, raw cheese, kimchi, and apple cider vinegar.

1.3.2 Beverages as Functional Foods

Beverages are fortified with vitamins A, C, and E along with antioxidants and other functional ingredients. There are a number of products available under this domain, yet the market for beverages is still small and limited to European countries. Germany is the only country that has a good functional beverage market [40].

1.3.2.1 Green Tea

Tea is the most common drink consumed after water in India. Green tea is a “non-fermented” tea and contains more catechins than black tea or oolong tea. Catechins are strong antioxidants which reduce the formation of free radicals leading to prevention of cell damage. Green tea is proven to reduce cardiovascular diseases by maintaining the blood pressure and lowering the cholesterol [10].

The health benefits are due to its polyphenol content. Flavonols, a class of flavonoids, comprise 30% of the dry weight of the leaf. The benefits are due to the presence of catechins [10].

Green tea in Asia is known to effectively treat diarrhea and typhoid [7]. The catechins present have been shown to have an inhibitory effect on infections caused by *Helicobacter pylori* [43]. Green tea has the right amount of caffeine and amino acid L-theanine. When these two work synergistically, they contribute toward better functioning of the brain.

The laboratory trials have proven to show health benefits. Human trials are still limited, and further extensive research is required to analyze the health benefits of green tea along with their mechanism of action. The catechins present reduce the risk of cancer as well by preventing cell damage [45].

1.3.2.2 Dairy-Based Beverages

Under the category of dairy industry belong milk, fermented milk, and yogurt drinks. These beverages are loaded with ω -3 fatty acids, α -linoleic acid (C18:3 n-3, ALA), eicosapentaenoic acid (C20:5 n-3, EPA), and docosahexaenoic acid (C22:6 n-3, DHA) [35]. These have known to prevent and treat epilepsy [8].

Milk contains a protein called casein which is known to act as a precursor of biologically active peptides [12]. These compounds can inhibit the angiotensin-converting enzyme (ACE-I) playing a major role in converting angiotensin-I to angiotensin-II and degrading bradykinin by blocking the active site of the enzyme. The conversion of angiotensin-I to angiotensin-II and the degradation of bradykinin result to increased blood pressure, while the inhibition of the enzyme reduces pressure increase [35].

1.3.2.3 Sports Drinks

Sports drinks are drinks that are consumed before exercise or during exercise. The drink is infused with carbohydrates, vitamins, minerals, and electrolytes. There is no sign of caffeine in the drink due to strict safety regulations [23].

Sports drinks are considered to be the best substitute of water [24]. Various sports drink contains combination of sucrose, glucose, and maltodextrin/glucose polymers. Maltodextrin is less sweet than glucose and provides carbohydrates in larger quantities without making the drink sweet [11].

But consumption of such drinks is advised to be regulated and avoided because the overall intake of calories exceeds the daily limit. This leads to unnecessary weight gain, dental problems, and low nutrition diet [29]. Gatorade from Pepsico, Powerade, and Accelarade are a few examples of sports drink available.

1.3.2.4 Wine

Wine is traditionally regarded as health-promoting beverage due its positive effect on coronary heart disease [36]. It has antioxidant properties due to the presence of phenolic compounds [27]. Of the phenolics, the stilbene group is one of the most important, with resveratrol (3,5,40-trihydroxystilbene) being one of the main stilbenes found in wine [16]. The polyphenols present contribute to the aging process and give the characteristic taste and color. Red wine is preferred over white wine since it has 6 times more phenolic compound due to longer contact with grapes. The

concentration of phenolic compounds in red wine is 1800–3000 mg/L. These have healthy effects on the body due to the antioxidant properties [19].

Wine has been a popular beverage for consumption in the European Union, and a study conducted in Spain showed that the origin, price, and quality certification are some leading factors that consumers look into before the purchase [9]. Consumers in Europe have identified wine as a healthy product, while the similar trend is yet to touch India [4]. There have been several reports that wine was considered as a medicine in India and China in the prehistoric time [33]. Wine was used as a tranquilizer, an antiseptic for wounds, an appetite stimulant, and a cooling agent [33].

Benefits of wine consumption were first identified by the observations made by Renaud and de Lorgeril [36]. He along with his team reported there were low mortality rate from heart diseases in French people who were regular wine drinkers in spite of the fact that they consumed saturated fats and smoked a lot.

1.3.3 Dietary Fiber as Functional Foods

Dietary fiber is derived from plants and it is not digested by the stomach or small intestine. It reaches to the large intestine unchanged [39]. These fibers are not being able to get hydrolyzed by endogenous enzymes in the small intestine (indigestibility). Dietary fibers are the polymers of carbohydrate with ten or more monomeric units and belong to one of the three categories of carbohydrates: naturally occurring edible carbohydrate in food; carbohydrate polymers which have been obtained from raw food material by physical, enzymatic, or chemical means; and synthetic carbohydrate polymers. Many of these fibers are the source of food and nourishment for a large number of bacteria that normally reside in the colon. These bacteria play a major role in promoting and maintaining good health. They produce vitamins and enzymes, enhance the immune system, and control cholesterol and triglyceride level. It also helps in the prevention of certain cancers and provides many other health benefits when consumed in an adequate amount (25–35 grams per day) [41]. There are various types of fibers that are categorized. One type is insoluble fiber. This fiber is insoluble in water and is unable to get fermented by the bacteria in the gut. It helps to promote a softer, bulkier stool by retaining water. Thus these fibers may prove to be important in sweeping out certain toxins and cancer-causing carcinogens. Soluble type of fibers is the fibers that are fermented by colon bacteria. These microorganisms require their own support and nourishment source. The medical advantages these bugs give are entirely dependent on the amounts of solvent fiber.

There are some special types of fibers known as prebiotic soluble fiber which have shown to have the most significant medical advantages. Inulin, oligofructose, and galacto-oligosaccharide are the three proven prebiotic soluble fiber. Vegetables like onions, garlic, bananas, leeks, asparagus, chicory root, yams, wheat, and artichokes contain prebiotic fibers in large amount. Consumption of fibers have lots of

advantages like increasing the population of colon bacteria, enhancing immune system, controlling appetite and weight, increasing bowel regularity, increasing bone density, and many more.

Plants have both insoluble and soluble fiber present in it, but the amount of the fibers present varies. Fibers present in wheat and corn are 90% insoluble, while in oats the ratio of insoluble fiber to soluble fiber is about 50/50. Soluble fibers are present in large amounts in artichokes. Prebiotin™ is a dietary fiber supplement which can also be used.

1.3.4 Fruits and Vegetables as Functional Foods

Regular consumption of fruits and vegetables has proven to reduce the risk of cancer and heart-related diseases which are prevalent in industrialized countries and developing countries. The antioxidants present in fruits and vegetables are known to reduce the risks of Alzheimer's, stroke, cardiovascular disorders, and cancer [31]. Functional foods contain bioactive compounds that produce desirable health effects beyond the basic requirement of nutrition. They are a part of the daily diet which are easily available in all parts of the world. The benefits of some fruits and vegetables are summarized in Table 1.2.

Table 1.2 Fruits and vegetables as functional food

Food	Function
Berries	Berries are a rich source of phytochemicals and have flavonoids and other phenolics that promote health. Some examples are highbush blueberry, cranberry, and red and black raspberries [3]
Cranberries	Cranberries are known to reduce inflammation and were once used to dress wounds. Other than being a good source of fiber, cranberries serve as an excellent source of anthocyanins, flavonol glycosides, and phenolic acids [2]
Grapes	Phenolics like salicylic, gallic, and cinnamic are present in grapes. While flavonols like q 3-glucuronide and q 3-rutinoside are present, flavononols like astilbin and engeletin are present as well. The stem, grape seed, and skin are a rich source of flavonoids. Antioxidants present in grapes have reported to protect the body from heart and cancer diseases as well [13]
Tomato	Tomato is the world's largest cultivated vegetables consumed raw as well as fresh. They serve as a major antioxidant source containing vitamin C and lycopene. The red color of the tomato is due to the presence of lycopene which is the most effective carotenoid. A diet which includes moderate amount of tomatoes has reportedly reduced the cause of cardiovascular diseases [47]
Garlic	Garlic is a combination of spice, herb, and vegetable and is also known as Russian penicillin. Inclusion of garlic in diet reduces blood platelet clumping, blood clots, LDL cholesterol, as well as fungal infections. Therapeutic effects of garlic are categorized into antimicrobial properties, cardiovascular effects, and anticarcinogenic components [38]

1.4 Challenges and Opportunities of Functional Foods

Functional foods are called so because they provide health benefits from a particular known ingredient [18]. The challenge of researchers right now is to find that ingredient and manipulate it in the best possible way. Vegetables, fish, and fruits provide benefits which are known, but the exact molecular weight of the ingredient is unknown. Vegetables, for example, sometimes fail to give the expected benefits via involvement of minerals and vitamins. Much more knowledge is needed to bridge the gap between the mechanism of action of the molecule and the food that contains the particular molecule.

Functional food is a key concept for the future of nutrition as a science because it results from the implementation in nutrition of all the basic scientific knowledge that has accumulated over the past two or three decades. To the benefit of public health, this progress cannot be ignored; it needs to be recognized fully and used. But, today, functional food is still mainly a scientific concept that serves to stimulate research and the development of new products [18].

While functional foods provide number of health benefits, there are certain concerns that are to be taken care of before we permanently switch to this kind of food supply. Technology-wise speaking today there is number of ways with which we can alter the nutritional supply of food, but functions of many ingredients are not determined [37].

1.5 Conclusion

Functional food research is still in a state of infancy where there is a lot of scope of manipulating the ingredients present in the food. Every food item has some nutritious element in it, which when identified and isolated can make the food item as functional foods. The Japanese were the first to identify and associate with the term “functional foods,” which is now popularly followed by European countries. India is still figuring out the term and is rapidly growing in the market of food.

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