

Phytochemistry and Functional Food: The Needs of Healthy Life

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Abstract

Getting nutrients for the physical activities, growth, and maintenance of body from food is essential for all of the living organisms. Human being continues to increase its knowledge and understanding about the food and their role in maintaining and optimizing health. It is well-established now that intake of nutrients in appropriate quantity is essential for a healthy life. Certain nutrient becomes essential to be taken up under a particular deficiency condition or for a specific purpose/gain. However, for the benefits to be gained/validated or the claims to be made, a strong and reliable regulatory framework is required based on the scientific evidence. For the functional food to deliver its potential health benefits, the product must contain the ingredients in the quantity and form described in the health statements and claims. With the scientific and technological advancements in the fields of health and nutrition, increasingly more focus is directed toward personalized nutrition or nutrigenomics. Although increasing the availability of healthy foods has become a necessity in today's world, the regulatory framework is needed to protect consumers' right. Making the consumers aware of the health benefits of functional foods available in the market is critically important.

Keywords: Nutrigenomics; Phytochemistry; Balanced diets; Bioactive compounds; Flavonoids

Introduction

Food is inevitable for living organisms, and humankind has always been interested in search and research on food materials. Ever since the domestication of plants, considerable progress has been made in agriculture due to the behavioral/social changes in human being from food gathering to farming [1]. Domestication followed by the selection of plants with desirable traits, breeding varieties for higher yield, tolerance to abiotic & biotic stresses, better quality and nutrition, and the technological advancements have enabled a significant increase in food grain production. Global population is expected to reach 9 billion by 2050. This increase (2 to 3 billion people) in global population over the next 35 years would require increasing the food production by 70% [2]. To feed the ever-growing population, we need to produce more food and feed from less per capita arable land, water, and other natural resources availability of which is shrinking day-by-day. Providing ample food and feed to the global populations is only the preliminary challenge; the major challenges would be to produce these in a safe and sustainable manner under the increasingly unfavorable environmental conditions [3]. The global climate change is resulting in adverse climatic conditions which not only affect the productivity of crop and animal husbandry but the quality of the produces is also affected adversely. In the present century, we must not only bother about producing sufficient food to fill the stomach of burgeoning global population but also to produce nutritious foods to provide a healthy diet to the population. This is why phytochemistry and functional foods have become important areas of research and development.

Needs of the Healthy Life

Food is the basic fuel of life. Nutritious/balanced diets are essential for the maintenance of the healthy body. Basic food groups like whole grains, fresh vegetables and fruits, dairy and other animal products can provide the essential nutrients (carbohydrates, proteins, fat, vitamins, minerals, fibers etc.) required for the healthy life. However, it is essential to take these basic nutrients in the balanced and bioavailable forms [4]. As the natural laws, we must remember here also that either the deficiency or the excess of everything is bad. For example, cholesterol is an essentially present component of our blood-stream and in every

cell of our body where it helps in the working of cell membranes, producing hormones, vitamin D, and bile acids. It also helps in keeping our memories and is vital for neurological functions. But many of us are also aware that a higher-level of cholesterol in the blood can be harmful to healthy life. Therefore, it is essential to balance the intake of nutrients in our diet. This is where balanced diet comes in the picture. A balanced diet is nothing but a diet containing all of the essential nutrients needed for the growth, development, maintenance, and functions of our body in appropriate quantities. This essentially means that the balanced diet is not only comprised of the right food items but also in the proper amounts. Biochemical studies indicate that in addition to the balanced diet, physical activity is also important for suitably metabolizing the nutrients, and reducing the risks of lifestyle problems like obesity, diabetes, heart disease etc. [5]. It also stimulates mental wellness by producing brain chemicals (noradrenaline, serotonin, dopamine etc.) involved in regulating mood, sleep, appetite and physical activities. Thus, biochemistry is important to understand the needs of healthy life as well as to successfully manage it. As a larger part of our foods (particularly vegetarian diet) comes from different parts of the plants, we need to study chemical properties of the compounds produced by plants. These would not only help in the formulation of a balanced diet, but also in other areas like their usage in medicines, industries etc.

Phytochemistry: Characterization of plant products

The compounds produced by the living organisms are studied under a specialized branch of chemistry known as biochemistry. Though plants produce a huge number of compounds (phytochemicals), phytochemistry focuses mainly on study of the phytochemicals relevant

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for nutrition, protection, medical treatment, and industry. The major group of phytochemicals currently being studied under this branch of science is the secondary metabolites of the plant. Phytochemistry not only deals with biosynthesis, structure, and functions of secondary metabolic compounds found in plants but also related their functions in animal/human bodies. The phytochemicals are synthesized by plants mostly for protecting themselves from invaders, particularly insect pests and diseases. Plants being sessile organisms, they are frequently exposed to a variety of environmental stresses [6]. Since the plants cannot move away to escape from unfavorable environmental factors, they have developed the capability to produce a variety of protective compounds against the stressful conditions they face in their niche [7]. Many a time, these phytochemicals have been proved to be equally protective for animal bodies, may be under a similar or different environmental stress like radiations [8]. Plants contain several active phytochemicals beneficial for human biology, and in many cases, they have health benefits for human beings. Broadly, these phytochemicals can be grouped into four major chemical classes namely alkaloids, glycosides, polyphenols, and terpenes. In addition to these, various phytochemicals particularly flavonoids, stilbenoids and essential oils have received increased attention because of their benefits becoming known to us day-by-day [9]. Epidemiological data show that bioactive phytochemicals play an important role in preventing and managing several diseases like cancer, diabetes, Alzheimer's diseases and cardiovascular diseases [10]. For example, Thymus species are widely used as aromatic and medicinal plants in pharmaceutical and food industries, peptides from buckwheat seeds are prospectively applied in the function food. Similarly, isoflavones (genistein, daidzein and glycitein) from soybean are important bioactive compounds having antioxidant, antibacterial, and free radical-scavenger activities [11].

Functional food

The primary role of food is to provide nutrients to meet the nutritional requirements of an organism. The increasing scientific evidence supports the view that some foods and food components possess beneficial biochemical, medicinal, physiological and/or psychological effects in addition to providing the basic nutrients. Now, nutrition science is moving from the classical concepts of avoiding nutritional deficiencies and nutritional adequacy to the newer concept of "positive nutrition". Accordingly, the research focus has also shifted towards the identification of bioactive compounds in food materials that have the potential benefit of medicinal, physiological and psychological well-being. Several traditional foods including whole grain cereals, fruits, vegetables and other parts of the plants have been found to possess the phytochemical(s) having potential health benefits. In addition to these, new foods (named as functional food) are being developed to augment or incorporate such beneficial components for the desired health benefits. Thus, we are at a new frontier where we transcend from 'adequate' to 'optimal' nutrition and this convergence of diet and health emerged as a new concept of 'functional food'.

The idea of functional foods was conceived in Japan in the 1980s. Japanese health authorities recognized that increased life expectancy of the increasing number of elderly people must accompany an improved quality of life if healthcare costs were to be controlled. Therefore, the concept of functional food was developed specifically to promote the health and reduce the risk of diseases. Therefore, an idea of Foods for Specified Health Use (FOSHU) was established in 1991, and the food to be certified as FOSHU must have the approval of the Minister of Health and Welfare, Japan, based on the comprehensive science-based evidence. Thus, functional foods are supposed to provide benefits beyond the basic nutrition and must play role in minimizing the risk of particular diseases and improving health conditions. Functional

properties of traditional foods are being studied, and new food products are being developed to incorporate the beneficial phytochemicals. By having the knowledge about which food can provide specific health benefits, one can make choices of food and beverage to have the health benefits. Many scientific and regulatory bodies are developing guidelines based on the scientific evidence to support and validate the claims about the functional foods. One of the familiar examples of functional food is oatmeal which contains soluble fiber that helps lowering cholesterol level. Another example of functional/fortified food is orange juice added with calcium for healthy bones.

As a result of scientific and technological advances in the fields of health and nutrition, increasing focus is directed towards an emerging field of nutrigenomics or personalized nutrition. Nutrigenomics involves the application of genomic information to assess nutritional requirements for a healthy lifestyle of a person. By linking genetic makeup with nutritional requirements of an individual, one-day scientists/dietitian will have greater ability to minimize the risk of disease and optimize the health benefits simply with the food. While nutrigenomics is a promising branch of science, research in this area is still in the preliminary stages, and it may take years to make accurate and effective recommendations for an individual.

Phytochemical fingerprints of several plants have revealed them to be a compendium of chemical entities, particularly secondary metabolites, having a tremendous impact on treating diseases and promoting health in natural ways. New sources of the secondary metabolites are being discovered and products with high amounts of these compounds are being developed. Processing may affect the amount and profile of the phytochemicals in the processed food, more information is required about the stability and conversions, if any, taking place during the processing. Variation in the phytochemical composition can be seen as a function of the factors such as cultivar, cultivation practices, the degree of maturity of the plant at harvest, climatic/geographic effects, soil composition etc. Agronomic practices, post-harvest handling, and processing measure considerably affect the levels of phytochemical in the produce. In order to utilize the full potential of phytochemicals, a holistic, concerted, multidisciplinary research is imperative, involving researchers from diverse fields such as organic chemistry, biochemistry, nutrition, medicine, epidemiology, immunology, agriculture, food science, food technology and engineering.

Functional food, mainly a marketing term as of now, is globally not recognized by law. Functional food has not yet been defined by legislation in many countries. Generally, they are considered as the foods containing biologically active compounds and intended to be consumed as part of the diet for the potential health benefits or reduced risk of particular disease. A functional food may contain specific minerals, vitamins, fatty acids, dietary fiber or added with bioactive substances such as antioxidants, probiotics etc. As the interest in functional foods is growing rapidly, new products are developed and marketed which require the development of standards and guidelines for the benefits of producers and consumers of such foods. The regulatory framework is needed to protect consumers from false and misleading claims, as well as to satisfy the needs of industry, for innovation product development, marketing, and promotion. Consumers' interest in health and diet has increased substantially all over the world. Today, the people recognize that they can help themselves and their families to minimize the risk of diseases, and in maintaining their health status and well-being through a healthy lifestyle particularly the diet. Population demographics and socio-economic changes also point to the need for foods with added health benefits. If combined with a healthy lifestyle, functional foods can make a positive impact on health and well-being of human being.

Conclusion

The Scientific community continues to understand the potential of foods and their role in maintaining and optimizing health. However, the strong and reliable body of scientific research is needed to confirm the health benefits of a particular food/component, and effective and efficient regulatory network would be required for the functional foods to be produced and delivered to the public for potential health benefits. There are opportunities for research in nutritional science to establish a convincing relationship between a food or a food component and an improved state of health, well-being or reducing the risk of disease. This presents a great challenge to the scientists in enabling the consumers to adopt functional food now and nutrigenomics in the future. Communication with the potential consumers about the health benefits is also critically important so that they have the knowledge to make informed choices of the foods they eat, enjoy, and those available in the market which can be used for specific purposes.

The views expressed herein are those of the authors only, and these may not necessarily be the views of the institution/organization the authors are associated with.

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