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ASPECTS OF THE INVOLVEMENT OF BIOTECHNOLOGY IN FUNCTIONAL FOOD AND NUTRACEUTICALS

Elena BONCIU

University of Craiova, Faculty of Agronomy, 19 Libertatii Street, Craiova, Romania

Corresponding author email: elena.agro@gmail.com

Abstract

The purpose of this paper is to briefly present the most important benefits of consuming of functional foods and nutraceuticals as well as the involvement of biotechnology in obtaining of these new foods. The functional food is a typical food that has specific nutrients added to it, like vitamins or minerals, fibres, probiotics or prebiotics. In general, this includes anything added for a specific functional purpose. Food science enables us to make some functional foods that wouldn't ordinarily be available. Knowing the science and chemistry of food and how ingredients interact helps us make some nutrients more readily available. The designation of functional foods and the attribution of health benefits of any kind are based on precise scientific criteria and rigorous safety and efficacy studies. The involvement of biotechnology in obtaining of functional foods and nutraceuticals is maximized and reproduced through: fermentative processes capable of generating functional compounds; correlating the structure of food macromolecules with their physiological function; modern non-thermal processing techniques, which provide nutrients in food but also ensure their stability and safety, etc. The beneficial effects of functional foods on health are due to biologically active compounds with physiological roles in the body. But these foods are not panacea for the wrong eating habits but they are adjuvants within a balanced diet. Diet is just one aspect of a complex approach to improving consumer's health. In fact, the functional foods are not tablets or capsules, but a healthy way of eating.

Key words*: biotechnology, functional food, nutraceuticals, trends.*

INTRODUCTION

Alteration of the health status of humans due to the diet is closely monitored by researchers and nutritionists, which has led to the emergence of a new concept, that of "functional food".

The U.S. is the largest consumer of functional foods, it was a 44 billion dollar market in 2012 and it's increasing with at least 60% of people consuming functional foods, occasionally. By definition, a functional food is a typical food that has specific nutrients added to it like vitamins and minerals, to serve a specific purpose (Mulry, 2008).

A functional food can be a natural product, which contains biologically useful components or a food obtained through a technological intervention that increases its level of biologically active compounds. Biologically active compounds are components of foods that act positively on key functions of the body, relevant to health. They reduce the risk of diseases such as atherosclerosis, high blood pressure, myocardial infarction, diabetes, etc. Without a doubt, the richest sources of compounds with beneficial health effects are vegetables. Fresh fruits and vegetables, tea (especially the green one) are, due to their richness in polyphenols, a very efficient source of antioxidants necessary to prevent the excess accumulation of free radicals in the body.

Functional foods and beverages are not really new. The first functional beverages were wine and beer because they were consumed for their functional effects rather than just hydration. Tea is the most common functional beverage used worldwide today. Gatorade was one of the first modern functional products; it was specifically designed to replace sugars, calories and minerals lost during exercise (Mulry, 2008). Now, the functional foods trend is capitalizing on consumers' knowledge that diet has a major impact on health, both positive and negative.

Recent scientific research supports the health benefits of many common foods, and consumers increasingly recognize that incorporating more orange juice, carrots, broccoli, fish, garlic and green leafy vegetables into their diets can make a difference. Consumers are making the connection between a good diet and optimal health or disease prevention, but they do not really understand

the term "functional foods". The International Food and Information Council reported "low to moderate" consumer awareness for functional foods, although awareness of foods that reduce cancer or heart disease risk was "fairly high" (Mulry, 2008).

MATERIALS AND METHODS

This is a documentary study. The main sources of the study consisted of various results published in scientific literature, some journals and scientific communications.

RESULTS AND DISCUSSIONS

Demographic trends of the population and socio-economic changes indicate the need for foods with higher health benefits (Roșculete and Roșculete, 2018). An increase in life expectancy and a desire for a better quality of life, as well as increased health care costs, have stimulated governments, physicians, researchers, agriculture and the food industry to find how to manage these changes more effectively.

The intersections of agriculture, biotechnology, and wellness are transforming global food industry (Bonciu and Sarac, 2016). Innovators are harnessing emerging technologies or applying existing technologies in new ways to design new ways to eat, responding to both to consumer trends and the imperative to improve the sustainability of the planet and human health. The resource management is a complex process involving an interdisciplinary approach because the management of natural resources has become a challenge at all levels (Butnariu, 2012; Butnariu and Caunii, 2013; Pandia et al., 2018, 2019; Rosculete et al., 2018, 2019).

Biotechnology presents an extremely rapid development and responds in the most natural way to major, fundamental human needs. It has a pronounced impact on society and environment. One of the most important implications of biotechnology in food science is that of ensuring nutritional value and amplifying the biological effects of food, which is actually the functional role of biotechnology. From this point of view, some of the strategies proposed by modern biotechnology are: use of lactic bacteria, true "cell factories" of functional compounds with altered metabolism, and with considerable yields of biosynthesis functional biocompounds, such as vitamins, for example; exploring the potential of lactic bacteria to produce exopolysaccharides; improvement of molecular tools to monitor the gene activity of probiotic species in the human intestine and to explain their functional activity; development of "vaccine foods", which contain strains of lactic bacteria that express epitopes of pathogenic species, for the purpose of immunizing the host, etc. (Abdel-Rahman and Sonomoto, 2016; Bosma et al., 2017).

Flavones contained in many functional foods can help lower mortality due to cardiovascular disease, reducing the risk of malignant disease. Soybean plays an important role in the prevention of cardiovascular disease, cancer and osteoporosis. Recent research suggests that isoflavones, compounds present in soy beans, prevent atherosclerosis (Pabich and Materska, 2019).

Oats are an important source of compounds (beta glucans) that reduce blood cholesterol levels and thus the risk of cardiovascular disease (Grundy et al., 2018).

Cold water fats (salmon, sardines, cod) and oilseeds (in pumpkin, nuts, walnuts) contain omega-3 polyunsaturated fats with anti-inflammatory effect, which limits the development of diseases such as rheumatoid arthritis, Alzheimer's, atherosclerosis, and with stimulating effect of the immune system (Bibus and Lands, 2015).

Dairy products are, without any reservation, excellent health-beneficial foods, especially fermented foods known as probiotics, foods that contain living microorganisms with complex effects on the host organism. Membranes of ingested bacteria can stimulate interferon formation, and the administration of yogurt containing live bacteria alters the immune response. Also, there is a decrease in cholesterol and an improvement in the associated cardiovascular disorders.

A food can become functional by the following biotechnological methods:

- Increasing the bioavailability or stability of a component recognized for its functional effects or for reducing the potential risk of disease;
- Increasing the concentration of a component present in the food to a point where it can

induce beneficial effects. For example, bio-fortification with a micronutrient to increase the daily intake;

- Replacing a component, usually macronutrient that is excessive, with a component with beneficial effects;
- Elimination of allergenic through biotechnology.

An item that is a functional food would include a note about added nutrients on its ingredient statement; the Nutrition Fact Panel would also identify additional nutrients and their levels, as well as nutrient content claims like "good source of," or "excellent source of," a particular nutrient. A functional food may also have structure/function claims like if orange juice has added calcium the package may say "calcium builds strong bones" (Mulry, 2008).

Nutraceuticals, a term often used interchangeably with functional foods, is, more accurately, parts of a food or a whole food that have a medical or health benefit, including prevention or treatment of a disease. Thus, the nutraceuticals definition is broader than that of functional foods. Included are dietary supplements or medical foods and functional foods (Mulry, 2008).

Functional genomics in food biotechnology involves: estimating the side effects of genetic changes in correlation with the behaviour of microorganisms in the product or the human gastrointestinal tract; estimating and anticipating the response of cells to stress; designing new antimicrobial systems; developing new metabolic engineering tools; implementation of specific and rapid methods of identifying the microorganisms of alteration and of the pathogens.

Microorganisms with incidence in food microbiology and biotechnology have relatively small genomes. An average bacterial genome can be sequenced in just a few days, becoming even a tendency for any study involving an industrial microbial strain to begin sequencing the genome.

In Figure 1 are indicated numerous biochemical nutraceutical categories including alkaloids, lipids, organic acids and polysaccharides, organosulphurs, phenols, phytic acids, phytosterols, and terpenes (Nwanodi, 2017).

Nutraceuticals represent an evolving new field of research that may generate a deeper knowledge of the mechanisms of action and the benefits that may derive from the use of evidence - based dietary patterns (Minuz et al., 2017). It is worth to mentioning the important role of some foods (such as fruits, vegetables and whole grains) or of their compounds (antioxidants, vitamins, prebiotics, etc.) in the prevention of diseases, which has led to the development of the functional food market in the context of profiling a new concept, that of optimized nutrition. Some vegetables are true natural nutraceuticals, which helps in the treatment of many diseases such as cancer for example. From this point of view, the species of the *Allium* genus namely garlic (*Allium sativum* L.), onion (*Allium cepa* L.) and Chinese chive (*Allium tuberosum)* are representative (Zeng et al., 2017; Bonciu et al., 2018). Garlic is a very important source of dietary for antioxidant properties, including sulfur compounds, polyphenols, and carotenoids (Farooqui, 2013). Some effects of the garlic constituents to health's consumers is due by anticancer, antimicrobial, anti-inflammatory effect, etc. (Figure 2). Onion is an important source of dietary phytochemicals with proven antioxidant properties, such as organosulfur compounds, phenolic acids, flavonoids, thiosulfinates, and anthocyanins (Zhu et al., 2017). From this point of view, in Figure 3 is presented the physicochemical and functional properties of polysaccharides sequentially extracted from *Allium cepa*. Chinese chive is an important source of dietary phytochemicals with proven antioxidant properties, such as organosulfur compounds, flavonoids, and saponins. Major mechanisms of *Allium's* organopolysulfides for preventive chronic disease include anticancer, preventive cardiovascular and heart diseases, anti-inflammation, antiobesity, antidiabetes, antimicrobial activities, and neuroprotective and immunological effects (Zeng et al., 2017).

Another concrete example of nutraceuticals is the willow bark derived analgesic aspirin, Aspergillus terreus, derived cholesterol-lowering lovastatin (George et al., 2016; Yuan et al., 2016; Nwanodi, 2017).

Communicating the health benefits of consumers is of great importance, so that they have the information they need to make correct choices about the preferred foods.

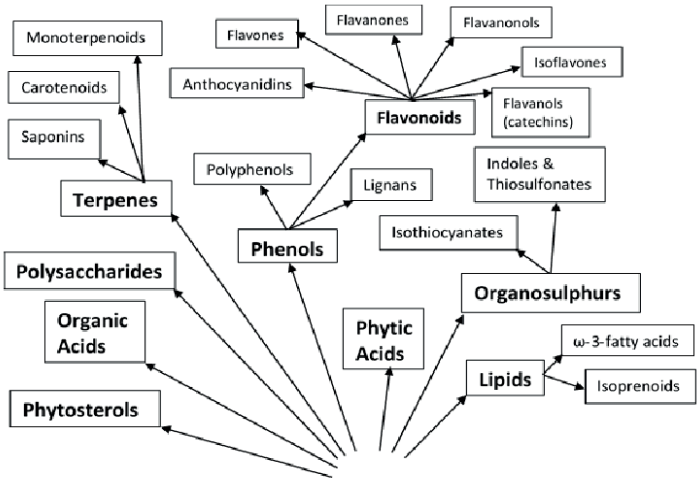

Figure 1. Nutraceuticals biochemical classification.
Source: Nwanodi, 2017

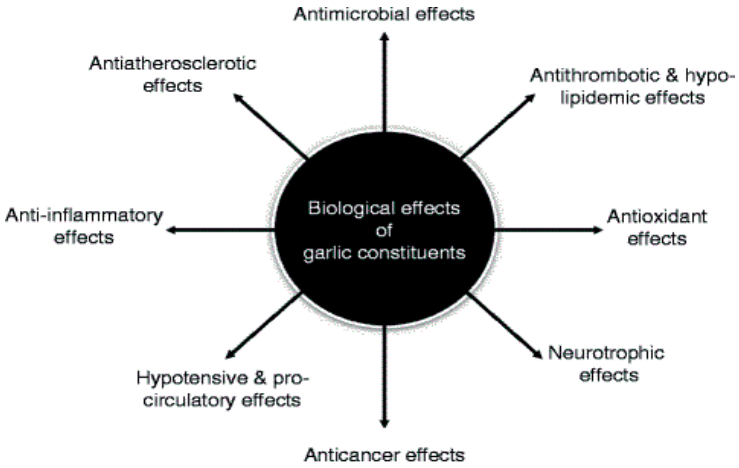

Figure 2. Some effects of the garlic constituents to health's consumers
Source: Farooqui, 2013

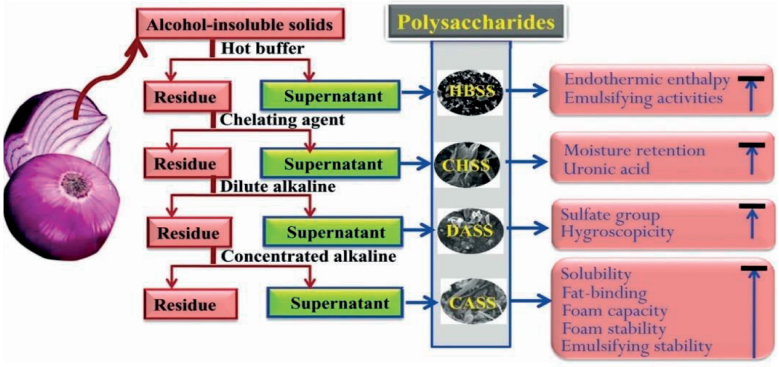

Figure 3. Physicochemical and functional properties of polysaccharides sequentially extracted from *Allium cepa*.
Source: Zhu et al., 2017

CONCLUSIONS

A functional food may be a whole natural food, a food to which it has been added or on the contrary, eliminated, a component by technological or biotechnological means, a food whose bioavailability has been modified or any combination of these variants.

Functional foods are products that contain various biologically active compounds and which consumed in a balanced diet, contribute to maintaining the optimum health of consumers; their role is rather to reduce the risk of some health problems.

The research opportunities in obtaining functional and nutraceutical foods as well as explaining the relationship between their consumption and improving the health of humans are the biggest challenge for scientists in the near future.

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