FUNCTIONAL FOODS: THE NEW CONCEPT EMERGING FROM THE TRADITIONAL NUTRITION

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ABSTRACT

The present study was aimed to review the scientific evidences that the traditional nutrition of Bulgarians during the centuries could be considered as a dietary pattern with functional characteristics. Historical sources indicated that the diet of our ancestors was low processed, rich in dietary fibers, polyphenols and many other functional components. Traditional foods and beverages containing probiotics were identified as traditional functional foods. Based on the concept of functional foods we concluded that the traditional diet of Bulgarians could be considered as a healthy nutritional pattern.

Keywords: functional foods, traditional nutrition, healthy diet

INTRODUCTION

It is not a new knowledge that the dietary pattern may modulate target functions in the body and thus may have various beneficial physiological effects. Along with the healthy lifestyle, the diet could contribute for maintaining optimal health and for reducing the risk of certain diseases (50). Modern nutritional science aims at identifying biologically active components in foods and revealing the mechanisms behind their benefits. In the last 15 years the accumulation of scientific data led to formation of a new concept in nutritional science: the concept of functional foods (65).

It is believed that changing in nutritional habits after the World War II is one of the factors contributed to increased morbidity, especially with regard to cardiovascular diseases, diabetes and cancer (34). Bulgaria, like most European countries, was also affected by these changes due to adopted “western diet” pattern. A cross-country survey among young people in four European countries reported that a high percent of Bulgarian students very frequently consume fast foods and products containing refined sugar (9). Moreover, according to an observation and analysis focusing European countries, approximately one third of adult Bulgarians are obese and more than 20% of children in pre-puberty age are overweight or obese (93,155). A survey aiming to assess differences in functional foods consumption between European countries revealed that consumers in only few European countries are familiar with functional foods as a part of their everyday diet. It is not a surprise that most of these countries are Mediterranean and Scandinavian (107). Both Mediterranean and Nordic diets are considered as healthy dietary patterns that are low or maybe not affected by the western lifestyle (20,126,134). Thanks to the advances of nutritional science technologies, particularly of molecular biology and nutrigenomics, it is known that the genetic pool of population plays a crucial role in the met-
abiotic response to environmental factors, including the diet (34). In this respect, functional foods are vital to health. The question arises, which of the traditional foods in the diet of the Bulgarians could be regarded as functional.

**FUNCTIONAL FOODS CONCEPT AND DEFINITION**

There is no universally accepted definition for functional foods. A large number of conceptual definitions could be found in the scientific literature and on the websites of many organizations, in the nutrition sciences field (40). Most of these definitions are based on several common key concepts: a) health benefits: a food could be classified as functional if it is known to enhance target functions or to reduce the risk of specific diseases; b) level of function: to provide benefits beyond the basic nutritional functions; c) nature of food: a functional food should be or should look like a traditional food; d) dietary pattern: a functional food should be a part of the normal diet. In this context, the most complete working definition of functional foods was proposed by the EC Concerted Action on Functional Food Science in Europe (FUFOSE): “...a food that beneficially affects one or more target functions in the body beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease. It is consumed as part of a normal food pattern. It is not a pill, a capsule or any form of dietary supplement.” (44).

**SCIENTIFIC BASIS OF FUNCTIONAL FOODS CONCEPT**

In 1980s the government in Japan introduced a regulatory system for certain foods with documented health benefits, with the intent to improve the health of the aging population (10,133). This could be considered as the birth date of the functional foods concept, adopted and developed later by the United States and by other economically developed countries (132). This governmental attitude provoked the scientific interest to investigate the relationship between foods beneficial characteristics and related target functions (40,44). Any claim for health benefits attributed to functional foods should be based on strong scientific proofs. The effect of the active compounds on target functions as well as the interactions with other dietary components and possible adverse interactions with pharmaceutical agents should be clarified (90).

Thanks to the rapid development of nutrition science in recent years, accumulated scientific data about health benefits of the functional foods became a fundamental knowledge.

Table I summarizes the major groups of functional components/foods and scientific data supporting their specific health benefits:

**RECOGNITION OF FUNCTIONAL FOODS IN BULGARIAN TRADITIONAL DIET**

Sufficient scientific data exist supporting the theory about functional characteristics and health benefits of some traditional dietary patterns, such as Mediterranean, Nordic and Maori diet (14,23,24,78,106,159). Based on the historical sources and in accordance with existing scientific data this study was aimed to examine which foods in the traditional diet of our ancestors could be considered as functional.

The Bulgarian nation was formed from the merging of three major ethnic groups: Thracian, Slavic and Bulgar tribes. Their nutritional habits along with the impact of other ethnic groups and nations, such as Cumans, Illyrians and mainly Ottomans were the basis in formation of Bulgarian traditional nutrition pattern during the centuries. Geographical location, socio-economical and agricultural development, religion, seasonal variations of the climate played significant role in this process (70).

Archaeological and historical sources point out that the main part of the diet of Thracians was natural rough plant-derived food. Slavs were the largest population in the Balkans. Thanks to the fact that their main livelihood was agriculture, their diet was rich in different varieties of grains, legumes and vegetables. Millet, oats, rye and wheat, cabbage, carrots, turnips, lentils and peas are some of the varieties remained until today as traditional foods in the Balkan region. Bulgars as semi-nomads consumed mainly meat and there is a lack of data about their contribution to our traditional nutrition (55,70,100).
Table 1. Major groups of functional components/foods and available scientific evidences supporting their health benefits.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>COMPONENTS</th>
<th>SOURCES</th>
<th>POTENTIAL BENEFITS</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLAVONOIDS</td>
<td>Anthocyanins</td>
<td>berry fruits; currant; red grape; plums; strawberry; black bean; eggplant; red cabbage; red onion</td>
<td>cellular antioxidant defenses; improved cognitive functions; antitumor effects; increased total plasma antioxidant capacity; improved lipid profile; anti-inflammatory effects</td>
<td>Busse-Valverde et al. (22); Ivanova et al. (71); Kong et al. (79); Lila (82); Tapsell et al. (143); Tasinov et al. (145);</td>
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<td></td>
<td>Flavan-3-ols:</td>
<td>green tea; cocoa; dark chocolate; apples; grapes</td>
<td>cardiovascular protection; increased insulin sensitivity; reduced total blood cholesterol; improved cognitive functions; blood pressure regulation; anticancer potential;</td>
<td>Baba et al. (13); Erdman et al. (43); Grassi et al. (60); Hooper et al. (68); Rao (118); Tapsell et al. (143);</td>
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<tr>
<td></td>
<td>-Catechins,</td>
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<td></td>
<td>-Epicatechins,</td>
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<td></td>
<td>-Epigallocatechin</td>
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<td></td>
<td>Procyanidins and Proanthocyanidins</td>
<td>cranberries; apples; strawberries; grapes; red wine; peanuts; cinnamon; cocoa; dark chocolate</td>
<td>antioxidant activity; urinary tract health, cardiovascular protection; antihypertensive effects; anticaries activity;</td>
<td>Busse-Valverde et al. (22); Chrubasik et al. (30); Erdman et al. (43); Gazzani et al. (54); Perez-Jimenez and Saura-Calixto (110);</td>
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<td></td>
<td>Flavanones:</td>
<td>orange, grapefruit and lemon juices</td>
<td>free radicals scavenging; cardiovascular protection; improved lipid metabolism; antidiabetic potential; estrogen-like effects;</td>
<td>Chiba et al. (28); Junga et al. (74); Nashar et al. (102); Surcheva et al. (142); Tapsell et al. (143);</td>
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<tr>
<td></td>
<td>-Hesperetin,</td>
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<td></td>
<td>-Naringenin</td>
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<td></td>
<td>Flavonols:</td>
<td>onion; apples; green tea; broccoli; citrus fruits; parsley; sage; red wine</td>
<td>free radicals scavenging; cellular antioxidant defense; anticancer potential; cardiovascular protection; improved HDL/LDL ratio; increased glucose uptake in myocyte and preadipocyte cell cultures; anti-osteoporotic effects; adipogenesis inhibition;</td>
<td>Erdman et al. (43); Hiroyuki et al. (67); Liu. (85); Liu. (86); Rao (118); Cazarolli et al. (26); Fang et al. (46); Suh et al. (140); Sumpio et al. (141); Zanatta et al. (162);</td>
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<tr>
<td></td>
<td>-Quercetin,</td>
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<td></td>
<td>-Kaempferol,</td>
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<td>-Isorhamnetin,</td>
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<td>-Myricetin</td>
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<td></td>
<td>ISOThIOCYANATES</td>
<td>Sulforaphane</td>
<td>body detoxification (induction of phase II enzymes); upregulation of antioxidant enzymes; cancer prevention; anti-inflammatory potential; bactericidal action against <em>H. pylori</em></td>
<td>Bacon et al. (15); Carlos et al. (25); Fahey et al. (45); Fimognari et al. (48); Gamet-Payrastre et al. (52); Heiss et al. (66);</td>
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<td></td>
<td>PHYTOSTEROLS</td>
<td>Phytosterols</td>
<td>reduced plasma cholesterol levels; reduced risk of atherosclerosis; cardioprotective potential</td>
<td>AbuMweis et al. (3); De Graaf et al. (36); Padro et al. (108); St-Onge, et al. (138);</td>
</tr>
</tbody>
</table>

**Note:** The table above lists major groups of functional components/foods and the available scientific evidences supporting their health benefits. Each entry includes the class, components, sources, potential benefits, and references. The table is designed to provide a comprehensive overview of the health benefits associated with different classes of functional components.
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#### FATTY ACIDS

<table>
<thead>
<tr>
<th>Type</th>
<th>Subtype</th>
<th>Sources</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monounsaturated fatty acids (MUFAs)</td>
<td></td>
<td>tree nuts; olive oil; canola oil; peanut oil; safflower oil; sesame oil; avocado, peanut butter</td>
<td>reduced risk of CHD; reduced risk of atherosclerosis; anti-inflammatory potential;</td>
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<tr>
<td>Polyunsaturated fatty acids (PUFAs) in plants:</td>
<td>- Omega-3 fatty acids:</td>
<td>walnuts; flax seed; flax seed oil;</td>
<td>cardio protective effects; reduced risk of atherosclerosis; eye health benefits; improved cognitive function; reduced inflammatory-based conditions; antiproliferative effect on prostate cancer cells;</td>
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<td>ALA</td>
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<td></td>
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<td>Baril-Gravel et al. (16); Machowetz, et al. (92); O’Neil et al. (105); Psaltopoulou et al. (117); Sabaté J and Ang Y. (124); Viguiliouk et al. (153);</td>
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<td>Albert et al. (5); Ros et al. (121); Poulouge et al. (114); Pribis et al. (116); Ruxton et al. (123); Tarpila et al. (144);</td>
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<td></td>
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<td></td>
<td>Mozaffarian (98); Ruxton et al. (123); Serebruany et al. (130); Sirivradyhana et al. (135); Tokarz et al. (149); Wu et al. (158);</td>
</tr>
<tr>
<td>Polyunsaturated fatty acids (PUFAs) in marine sources:</td>
<td>- Omega-3 fatty acids:</td>
<td>cold water fishes (salmon, tuna); fish oils;</td>
<td>cardio protective effects; reduced risk of atherosclerosis; improved cognitive function; reduced risk of inflammatory-based diseases</td>
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<tr>
<td></td>
<td>DHA/EPA</td>
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<td></td>
<td></td>
<td></td>
<td>Mozaffarian (98); Ruxton et al. (123); Serebruany et al. (130); Sirivradyhana et al. (135); Tokarz et al. (149); Wu et al. (158);</td>
</tr>
<tr>
<td>Beta-carotenes</td>
<td></td>
<td>carrots; pumpkin; sweet potatoes; melon; spinach; tomatoes;</td>
<td>free radicals scavenging; antioxidant defenses; reduced risk of head and neck cancer; reduced photosensitivity; reduced risk of age-related macular degeneration;</td>
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<tr>
<td></td>
<td></td>
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<td>Buschini et al. (21); Leoncini et al. (80); Tokarz et al. (149); Vallverdú-Queralt et al. (152); Wildman (156);</td>
</tr>
<tr>
<td>CAROTENOIDS</td>
<td>Lutein, Zeaxanthin</td>
<td>marigold; spinach; rosemary; corn; egg yolk; citrus fruits; asparagus; carrots; broccoli;</td>
<td>eye health benefits; reduced risk of age-related macular degeneration;</td>
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<td></td>
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<td>Berendschot et al. (19); Granado et al. (58); Rao (118); Ribay-Mercado end Blumberg (119); Tokarz et al. (149); Toyoda et al. (151); Vallverdú-Queralt et al. (152);</td>
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<td></td>
<td>Lycopenes</td>
<td>tomatoes and processed tomato products; watermelon; red/pink grapefruit;</td>
<td>antioxidant activity; anti-inflammatory effects; reduced risk of prostate cancer; cardio protective effects; neuroprotective effects; antiobesity potential; prostate cancer prevention;</td>
</tr>
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<td></td>
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<td>Abdali et al. (1); Guo et al. (64); Linnewed-Hermoni et al. (84); Luvizotto et al. (89); Preveen et al. (111); Prema et al. (115); Tokarz et al. (149);</td>
</tr>
<tr>
<td>DIETARY FIBERS</td>
<td>Insoluble fibers</td>
<td>whole grains; wheat bran; corn bran; fruit skins; oatmeal; brown rice</td>
<td>increased insulin sensitivity; improved lipid metabolism; improved blood glucose homeostasis; reduced BMI; antiobesity potential; blood pressure regulation and cardioprotection;</td>
</tr>
<tr>
<td>Soluble fibers:</td>
<td>oat bran; oatmeal; oat flour; barley; rye psyllium seed husk, peas, beans, apples, citrus fruits</td>
<td>improved cardiovascular function; reduce plasma LDL-cholesterol levels; reduced risk of CHD; reduced risk of metabolic syndrome; increased postprandial adiponectin concentration; antihypertensive effects; suppressed postprandial ghrelin levels;</td>
<td>Clemens and van Klinken (31); El Khoury et al. (42); Karhunen et al. (76); Liljeberg and Bjorck (83); Nwachukwu et al. (104); Rao (118); Sánchez-Muniz (128); Whitehead et al. (154);</td>
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<tr>
<td>Beta glucans</td>
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<td>Pectins</td>
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<tr>
<td>ORGANOSULFIDES/THIOLS</td>
<td>Diallyl sulfide, allyl methyl trisulfide</td>
<td>garlic, onions, leeks, scallions</td>
<td>cancer prevention; stimulating glutathione production; antimicrobial activities; inducing vasorelaxation; reduced platelet aggregation; inhibited lipogenesis; reduced LDL-cholesterol levels; increased plasma adiponectin levels;</td>
</tr>
<tr>
<td>SOY PROTEINS</td>
<td>Soy protein</td>
<td>soy beans and soy-based foods (milk, yogurt, cheese and tofu)</td>
<td>cancer prevention; reduced plasma cholesterol levels; anti-inflammatory properties; antioxidant activity;</td>
</tr>
</tbody>
</table>
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**Grains and whole grain foods**

Historical sources indicate that a major part of the Thracians’ diet was comprised of cereals: barley, millet (sorghum), oats and wheat. It is worth mentioning that Thracians cultivated the wheat variety *Triticum spelta* (spelt) which is one of the oldest cultivated crops in human history (55). In recent years there is a rising interest in this plant based on the strong evidences about its nutritional value. Along with carbohydrates, spelt grains are very rich in fibers, proteins, vitamins, especially folic acid, and wide range of minerals. Moreover, spelt contains 40% less phytic acid compared to other wheat varieties. This could contribute to better intestinal bioavailability of spelt derived-minerals as the presence of phytic acid is associated with the chelation processes (122,139). Based on these data spelt could be considered as a functional food with high potential in regulating body metabolism and thus contributing to maintain the healthy phenotype.

Nowadays, the whole grain foods and products are well known as functional foods rich in dietary fibers, regulating lipid metabolism and blood glucose levels and their consumption could be associated with lower risk of type 2 diabetes, cardiovascular diseases and obesity (8,17,33,109,127,150,157,161).

**Fruits**

Because of the climate specificity and the seasonal nature of the fruits our ancestors prepared sun dried fruits such as apples, plums and pears. It is worthy to pay a special attention on prunes (dried plums) which nowadays are considered to be a functional food because of their mild laxative effect due to the high sorbitol content (38,81,136). Several studies revealed the phytochemical composition as well as the health effects of these dried fruits (136,137). Although, prunes are rich in simple sugars their consumption does not increase the blood sugar concentration, probably because of high fiber (approximately 60%), fructose, and sorbitol content (38). Moreover, they contain large amount of phenolic compounds mainly neochlorogenic and chlorogenic acids which are found to inhibit LDL oxidation (137). These data reveal the antidiabetic, antiobesity and cardioprotective potential of dried prunes. Scientific reports in recent years suggested that prunes consumption could be very efficient in both preventing and revers-
ing bone loss and could play a role in prevention and management of osteoporosis (11,69,136).

**Beverages**

Wine had a prominent place both in everyday life and in the ceremonial rites from the Thracians’ time until now (55). Scientific reports suggested that moderate consumption of red wine could be associated with many beneficial effects in cardiovascular diseases, diabetes, osteoporosis and longevity, probably due to the large quantity of polyphenols, especially resveratrol which is the major active compound in this beverage (12,22,99,113).

Historical sources indicate that Thracians prepared special beverages from fermented grains: “briton”, made from fermented barley and “parabia” - a mixture of fermented millet and aromatic herbs (55,70).

Another beverage made from fermented cereals and remained traditional so far is “boza”. It is a product based on spontaneous fermentation of cereals caused by lactic acid bacteria and yeasts (97). Several studies report that beverages made from fermented grains are source of probiotics and could maintain the gut function. Furthermore, it was estimated that extracted ferments could regulate HDL/total cholesterol ratio, suggesting an antiobesity potential (29,73). The fermented nondairy foods and beverages are considered as appropriate foods in cases of lactose intolerance (59).

**Wild plants**

Archeological and historical evidences exist that Thracians were familiar with many herbs and medicinal plants which were used in the healing rituals (148). Since the ancient ages until now our knowledge about the healing properties of many traditional plants was enriched (39,103). Accumulated scientific data in recent decades identified many of the functional components of the medicinal plants as well as some of the mechanisms of the beneficial effects reported by the folk medicine (18,112,129). Most of these benefits seem to be due to the plant polyphenols, reviewed in table 1.

Thracians used the small, rounded corms of water chestnut (*Trapa natans*) to prepare sweet bread. Except rich in starch, the phytochemical composition of this plant is characterized with significant amount of free amino acids, vitamins, minerals and polyphenols (45,75). Its health benefits are based on wide range of biochemical and pharmacological effects widely reviewed by Adkar et al. (4). Immunomodulatory, neuroprotective and antiulcer potential as well as antiinflammatory, antibacterial and antifungal action are some of the documented properties of water chestnut preparations. Recently, a significant potential of the plant to reduce blood glucose and serum insulin levels was estimated revealing its antidiabetic properties (35,160).

**Milk and dairy**

Since ancient times milk had a special place in the diet of Bulgarians (70,100). Bulgarian yogurt (sour milk) is a food known worldwide for its nutritional characteristics and health benefits. In the beginning of the 20th century the Bulgarian student in medicine Stamen Grigorov discovered the bacteria that caused the fermentation in the sour milk (61). The beginning of extensive research on the unique nutritional characteristics of the Bulgarian sour milk was several years later when Mechnikov and coworkers developed the theory of relationship between the increased life expectancy of the Bulgarians and the consumption of the sour milk (55,70). Several studies reported that this bacteria, currently known as *Lactobacillus delbrueckii* subsp. *bulgaricus*, possesses strong antimicrobial properties and ability to form colonies in the human intestines suggesting a potential probiotic function (2,63,96). Studies demonstrated that consumption of yoghurt containing viable *L. delbrueckii* and *S. thermophilus* improved lactose digestion and decreased lactose intolerance (62,131). The Bulgarian sour milk could be considered as a product with functional characteristics based on the scientific data that probiotic foods may modulate gut microbial composition, thereby improving the gut health (37, 57,120).

**CONCLUSION**

The present study does not claim to cover all aspects of traditional nutrition of Bulgarians. However, scientific data confirmed the functional characteristics of many of the foods included in the traditional diet. Based on this we concluded that the nutrition of our ancestors during the centuries could be positively associated with longevity and reduced risk of chronic diseases and obesity. Based on the alarming data about the overall health status of Bulgarian nation more attention should be paid on improving our
nutritional habits by adopting the old traditional dietary pattern.

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