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ORIGINAL ARTICLE

Functional, health protecting and health maintaining food products

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Abstract - Functional foods contain sufficient quantities of ingredients that have a positive effect on life functions, contribute to the prevention of diseases, they have a health-protective effect and overall have a positive effect on the human body. In terms of functional foods, we need to look at what kind of food ingredient is given, what impact it can be expected from such a food, what component it is expected to be, and what the product will be for the consumer. The physiological effects of functional foods, consumer expectations on these foods, processes in which we are preparing functional foods, food safety in relation to functional foods, and statutory regulation should be clarified. Within food production is a new area has been defined, where technology is being developed, its effects are being accepted by buyers and producers and consumers together manage the processes that can be incorporated into traditional food production in a few years. In the first half of our communication, we discuss the basic concepts, and readers will get to know the functional foods produced by food supplements.

Keywords – functional food, prebiotics, probiotics, nutraceuticals, food safety, food enrichment, food supplements, mineral deficiency, vitamin deficiency, flavonoids

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Introduction, definitions

Functional food is a food that contains components, which have a positive effect on one or more life functions, contribute to the state of mental well-being, and their regular consumption can reduce the risk of nutritional diseases. Besides the energy and nutrition value of foods, they also have a health-protective effect (Csapó et al., 2015). In other words, a functional food is a food that contains more of one or more component, that have a positive effect on the health of the human body. Those foods are also functional in which one or more component is less than in usual foods of the same category (reduced fat, reduced carbohydrate content with reduced protein content), or more than usual due to enrichment of some substances (Csapó & Albert, 2017).

Nutraceuticals are foods that are at the margins of medicines and foods. Their exact names are dietary supplements, medicinal products, which are not considered as medicines. Prebiotics penetrate into the guts, promote proliferation of beneficial microorganisms, suppress harmful microorganisms, and promote the formation of the most favourable microflora. Probiotics are living microorganism cultures that are either present or enriched in food, proliferating in people's digestive tract, suppressing the life cycle of harmful microorganisms (Shahidi, 2009; Farnworth, 2005).

What makes a food product functional?

There are three topics to be discussed about functional foods: what ingredients should be added to the food or what ingredients should be found in it, which is present in a larger quantity and makes it functional? What effect can be achieved by dosing this component? What will be the product, what do we manufacture? What is the specific component, which in greater proportion can make a food functional? Such constituents are for example dietary fibres and natural antioxidants, which may be effective against cancers, and microelements that are essential to the function of enzymes as cofactors. Polyunsaturated fatty acids, which are heat-sensitive, and special proteins may also be components of functional foods. Baking products can be enriched with milk, whey, and casein, but also enrichment with certain peptides can occur. There are many health-protection components that are produced from colostrum or milk and used to prevent or cure certain diseases (Hilliam, 2000).

Oligosaccharides may be prebiotics because they favourably influence the development of intestinal microorganisms. Supplementation with vitamins is very important, but the overdose of certain vitamins can be dangerous. Phytochemicals are chemical compounds, many of which utilized by the pharmaceutical industry. They contain natural antioxidants and microelements. Natural sweeteners are used to replace energy-rich sugars (Gibson et al., 1996; Barreteau et al., 2006).

The physiological effect of functional foods

What physiological effects can be expected from functional foods and which diseases might be prevented by the consumption of these food products? The effects may include inhibition of oxidative damage, antimutagenic activity, inhibition of microbial infection, dietary fibre activity, immunomodulatory effect, neuro-regulative (nervous system stimulating) effect, estrogenic effect, antihypertensive effect, cholesterol-lowering effect and anti-allergen effect. Heart-friendly foods have been developed for the prevention of heart and circulatory diseases and reducing the cholesterol level. Functional foods have also been developed to prevent obesity, and salt-reduced foods have also been marketed (Mussamato & Mancilha, 2007).

How to make functional foods? What to produce, how to make it to become functional food?

The concentration of a typical beneficial component of a given food should be increased, during the enrichment process a useful but not necessarily food-typical component should be added, the existing useful component should be modified, the harmful components, such as the allergen protein should be removed, or the harmful components replaced with something else. Thus, the increase of dietary fibre content, the addition of vitamins, microelements, the production of gluten-free products, and the enrichment of protein are used when most milk and milk-related products are produced and, due to its high protein content, soy is used. The applications of fruit juice concentrates, extracts, herbal concentrates and extracts are spreading and functional beverages are also used to enrich normal fruit drinks with multivitamins, calcium, magnesium and carotenoids (Csapó & Albert, 2017).

Consumer expectations for functional foods

Be delicious, tasty, practical, varied, "like the rest", but have a positive effect on your health! The trust in the buyer for special foods shall be developed, buyers should believe that they need these products which shall increase their well-being (Síró et al., 2008).

Food safety and functional foods

From the point of view of food safety, functional foods are subject to the same laws and rules as other foodstuffs. Food quality is the sum of all the properties of the food that make it suitable to satisfy the requirements set out in the regulations and the consumer's expectations. Food is safe, which does not constitute any health risk for the consumer. Absolutely risk-free food consumption does not exist, so we are always exposed to a certain likelihood of health damage (Hammond & Jez, 2011).

What are the typical dangers of functional foods?
It is a relatively new food group, so for the first time it is not known whether it is good, does it cause other problems with over-consumption, whether there is no adverse cross-reaction with commonly consumed foods, medicines, novel foods that are not toxic, whether there are sufficient amounts of nutrients in it suitable for human consumption.

Functional foods and legislation
In Europe, regulation is quite heterogeneous, and different countries are using their own directives for the time being. Integration of functional foods is ongoing and there is no uniform definition of what we call food. There is regulation for pure, isolated additives and supplements (Holdt & Kraan, 2011).

Production of functional foods with food supplements

Supplementation of foods with various micro-nutrients may have a history of centuries: iron nails put in apple, maize soaked in calcareous water, salt supplemented with iodine to prevent gout, vitamin A deficiency was suppressed by addition of vitamin A to margarine, wheat flour supplemented with thiamine, niacin and iron, and even flour supplemented with calcium was produced.

Some basic concepts

There are several notions about supplementing foods with nutrients. Fortification is the process by which a nutrient is added to a food that was originally not present or the concentration remained below the limit of detection. A good example of this is to strengthen margarine with vitamin A and later with vitamin D. During restoration, they replace the nutrients that have been lost or transformed, for example during the technological processes, such as supplement of flour withiron and vitamin B1 or supplement of potato products with vitamin C. The production of fruit juice reduces vitamin C content, which should be compensated (Bucci & Unlu, 2000). In enrichment, the food is supplemented with a substance that contains more than one ingredient than the basic food. In practice it is also used as a synonym for reinforcement and restoration. During standardization, the different compositions of a foodstuff of the same category are approximated to a standard in some way. Substitution is the process of adding nutrients to foods to reach the same levels as in the original non-substituted food. During the supplementation, a micro-component is added, alone or in combination, to the food to increase its nutritional value (Noorhorm et al., 2014).

Increasing the functional component content of foods
In addition to the well-known supplements (iodized salt, margarine supplementation with vitamin A and vitamin D or flour restoration and strengthening), methods have been developed to prevent rickets by increasing the vitamin D content of milk, niacin, thiamine and folic acid have been added to the flour to prevent beriberi and pellagra and iron for the prevention of anaemia. The addition (fortification) does not affect the organoleptic properties of the food. In developing countries, the complementation of the most important basic alimentary products with vitamins and minerals has become a daily routine such as the supplementation of cereals with micro nutrients or the enrichment of juices or potato-based foods with vitamin C ((Prokisch, 2010; Csapó et al., 217a b).

Most of the micro nutrients studied the effect of folic acid supplementation on health. As folic acid deficiency increased the proportion of infants born with open spine, folic acid was added to foods made from grain in the United States and the consumption of such foods with high levels of folic acid is recommended for pregnant mothers. Folic acid supplementation, however, has led to a deficiency of vitamin B12 in older people, so if you want to supplement our foods with a micro-nutrient, you should be careful with it because this addition may have potentially damaging consequences beyond beneficial effects in certain physiological conditions (Csapó et al., 2014; Albert et al., 2017).

Substitution of food components
A problem is the substitution of fatty milk and milk products with other food ingredients because fatty milk contains significant amounts of fat-soluble vitamins. When meat was replaced with soy, vitamins, minerals and essential amino acids were added as supplements. Producing fat replacement margarines, it was necessary to supplement them with vitamin A and vitamin D as well as with carotene (Harika et. al., 2017).

Enrichment
Enrichment results in a special product that contains a significant amount of one or more food component and is aimed to fast modify a small target group of the population in a good direction. The best-known recipes are multivitamins, vitamins mixed with minerals, and recently very popular capsules containing different amounts of vitamin C. Supplements for safe food and nutrition are used for therapeutic purposes, and sometimes we expect a specific therapeutic effect. Elderly people could effectively fight against osteoporosis with preparations containing mainly calcium and vitamin D at different concentrations (Prokisch et al., 2017).

Supplementation of foods with vitamins and minerals

Especially the widely consumed foods and their raw materials, such as cereal flour, salt, sugar or soy sauce, are complemented with micro components (Prokisch, 2010).

The necessity of supplementation
Mineral deficiency mainly includes low levels of zinc, selenium, iron, iodine and calcium, while the deficiency among vitamins occur with A and D vitamins and folic acid, frequent niacin deficiency has been observed in the corn-consuming societies, thiamine deficiency occurs in rice-consuming populations, and scurvy (vitamin C deficiency) in those groups who consume little fresh fruit or vegetables. Today, two billion people suffer from iron deficiency, 1.9 billion in diabetes, and in the absence of vitamin A 250 million school-age children are exposed to the risk of blindness. Deficiency diseases occur mainly in those regions where nutrition is based on grain and legumes and the population does not consume sufficient quantities of animal food, especially meat, fresh fruit and vegetables. Low selenium and yeast deficiencies in food are due to the low concentrations of these elements in the soil, which are reflected in both plant and animal foods (Cook et al., 1994).

Iron deficiency and its consequences
As a result of iron deficiency, 30% of the world's population is anaemic and one billion suffer from iron deficiency anaemia (IDA), another one billion in iron deficiency, without anaemia. In the human body, 95% of the total iron content is found in haemoglobin and myoglobin and even cytochromes and NADH dehydrogenase contain iron. Some iron-containing enzymes are a means of immunization; iron deficiency causes fatigue, weakness, resistance to infections decreases, work capacity decreases, mortality increases, babies are born with lower body mass, children's learning and learning ability decreases. Very good iron sources are meat and meat products because they contain iron in hem form. The absorption of hem iron is not affected significantly by the condition of the food or its iron, but the absorption of non-hem iron is significantly influenced by the condition of the iron and other nutritional components. In recent years iron supplemented flour, rice, fish, soy sauce, corn, milk and

dairy products have been produced (Looker et al., 1997; Lee & Song, 2009).

Lack of iodine and its consequences

Iodine deficiency occurs throughout the world. In Europe, 60% of children suffered from iodine deficiency until the use of iodized sodium salts has spread in practice. Iodine is an essential component of thyroid hormones that are necessary for the development of nerve tissue and brain in intrauterine life and postnatal period. Inadequate iodine intake results in functional abnormalities, which are commonly called iodine deficiency disorders. Illness due to low iodine intake is exacerbated by the lack of selenium and iron because both microelements are necessary for the synthesis of thyroid hormones. The best solution to eliminate iodine deficiency is the use of iodized salt. In addition to iodized salt, iodized water, various iodized sauces and iodinated wheat flour can be a good iodine source for humans (Vitti et al., 2001).

Vitamin A deficiency and its consequences

The vitamin A deficiency is responsible for the development of childhood blindness. About 500,000 children acquire blindness every year due to vitamin A deficiency and 50% of them die within one year. Vitamin A is needed for rhodopsin, the formation of the visual system, and retinoic acid, a metabolite of vitamin A, is required for growth and development, for the development of immune functions and for reproduction. In case of intake of large amounts of vitamin A, the excess amount, which is released from the diet is stored in the liver, and will be available to the body when needed. Milk and dairy products as well as the liver are the most important vitamin sources. The vitamin A content of cereals and legumes is low, so vitamin A deficiency is very common in those individuals who rely on grain and legumes in their diet. To satisfy vitamin A requirements, vitamin A supplementation of margarine, vegetable oils and cooking oils has been used for a long time (Palace et al., 1999).

Zinc deficiency and its consequences

Zinc is required for the function of about 100 enzymes that are involved in metabolism, growth, immune system, reproduction and the development of the nervous system. Zinc deficiency occurs primarily in cereal and leguminous nutrition, coupled with low meat, milk and dairy consumption. Supplementation of foods with zinc has not spread in practice (Jayawardena et al., 2012).

Calcium deficiency and its consequences

Calcium deficiency occurs in populations worldwide where there are no traditions of milk and dairy consumption. The calcium concentration is well controlled in the body, and in case of deficiency, the body replaces the required amount from the bones. In children, inadequate calcium and vitamin D supply does not allow the development of strong bones, and later on this organism will be more prone to osteoporosis. In industrial countries 60-70% of the calcium requirement comes from milk and dairy products. Where the consumption of milk and dairy is minimal, calcium deficiency can be expected. Calcium absorption is closely related to optimal vitamin D intake, because where the vitamin D content of foods is low, disruption of calcium absorption can be expected. Foods enriched with calcium and vitamin D help the young organism reach the genetically determined maximum calcium content in the bone, which subsequently reduces the risk of osteoporosis (Walker et al., 2006).

Folic acid deficiency and its consequences

Folic acid deficiency can develop where foods are consumed from refined feedstocks or people do not consume enough leafy vegetables. Folates contribute to the synthesis of coenzyme A in the body as part of Vitamin folic acid in B complex, in the absence of which many biochemical processes stop in the body. Inadequate folic acid supply or disturbance of folic acid metabolism may result in increased number of infants born with open vertebrate column, megaloblastic anaemia, neurological degeneration, cancer and cardiovascular complaints. Supplementation of foodstuffs, especially flour, with folic acid, significantly reduced the occurrence of diseases previously attributed folic acid deficiency (Carrero et al., 2004).

Supplementation of foods with vitamins

Vitamins are among the less stable food components. Stability changes from the type of vitamin; there are more stable (niacin) and are less stable ones (vitamin B12). The stability of the vitamins is mostly influenced by temperature, moisture, oxygen, light, pH, oxidation or reduction components, heavy metal ions (copper, iron), sulphur dioxide, other vitamins or the combination of the aforementioned effects. Of these factors, most important are temperature, humidity, oxygen, pH and light. Particularly high vitamin losses can be expected, where substantial heat treatment is applied. Vitamin content may vary from time to time. Inspection authorities are always testing the component that is most sensitive to technology, warehousing and transport conditions. Adhering to the declared vitamin content is rather difficult because every vitamin is broken down in different ways and it is very difficult to declare how the vitamin composition of a product will change during its lifetime (Molto-Puigmarti et al., 2011; Csapó et al., 2017a, b). Vitamins may interact with one another and help each other to break down. Studies in fluid multivitamin preparations have shown that 13 vitamins have been identified to facilitate the breakdown of other vitamins by their interaction. The most important of these are ascorbic acid, thiamine, riboflavin, and cyano-cobalamin. Ascorbic acid increases the instability of folic acid and cyanocobalamin, thiamine has a similar effect on folic acid and cyanocobalamin and riboflavin increases the instability of thiamine, folic acid and ascorbic acid. Vitamins can reduce or increase the solubility of the other vitamins. Irradiation decreases the vitamin content of foods, the degree of this decrease is clearly related to the intensity of irradiation. Already at 3-10 kGy irradiation, in the presence of air, vitamin loss can occur, which increases with storage. The fat-soluble vitamins A, E, and K are sensitive to irradiation, of the water-soluble ones thiamine is the most sensitive, while niacin, riboflavin and the fat-soluble vitamin D are not sensitive to irradiation (Abudu et al., 2004; Eidelman et al., 2004).

Supplementation of foods with polyphenols

Properties of polyphenols
Polyphenols, also known as flavonoids, are secondary metabolism products of plants, of which over six thousand have been identified to date. The hydroxyl groups attached to the phenolic ring make them an excellent antioxidant. The flavonoids can be divided into six groups according to their structure: flavonols, flavones, catechins, flavonones, anthocyanidins and isoflavones. They are antioxidants and can modify the activity of key enzymes, they have vasodilatatory, anti-cancerogenic, anti-inflammatory and immune-enhancing effects. Most important flavonoid sources include fruit juices, coffee, tea, red wine, onions, apples and berries, black currants and blueberries. The main flavonoids that occur in foods are catechin and catechin gallates, as well as quercetin and campherol, and their glycosides (Scalbert & Williamson, 2000; Mannach et al., 2004).

Technological aspects of making plant extracts

The possibility to use the extracts for production of functional foods depends on whether the plant has been used as a food traditionally and on the physiological and pharmacological properties of the active ingredient. Aqueous solvents that don't alter the composition of the desired material are suitable for extraction. Plant extracts may contain hundreds of substances that may have synergistic effects. The added extract might change the colour and taste of the supplemented food, turn it brown or cause a bitter taste. For these reasons, the extract should always be checked before being added to food. The most popular vegetable extract is green tea followed by rooibos tea extract, and the cactus extract closes the line (Higdon & Frei, 2003).

Supplementation of foods with carotenoids

Carotenoids form a large group of natural plant pigments. Their colour may vary from yellow to red in nature. Foods contain approximately 50 to 60 different carotenoids. β-Carotene is provitamin of vitamin A, of which the organism can synthesize two molecules of vitamin A with the carotinase enzyme. Supplementation of foods with β-carotene has a long history, for example fruit juices have long been complemented by β-carotene. Earlier carotenoids were used as natural food dye. Among the many carotenoids, β-carotene, α-carotene, β-cryptoxanthine, lutein and, which are not A-provitamins, zeaxanthin and lycopene are most important. Their health-protective effect is attributed to their outstanding antioxidant effect. β-Carotene, which can transform into two vitamin A molecules, lutein and zeaxanthin contribute to the healthy functioning of the eye, and lycopene helps prevent prostate cancer. The amount of added carotene is primarily determined by the achievement of the desired colour and health-related efficacy. Today, β-carotene and lycopene are widely used in the food industry to colour food. β-carotene is used in large quantities for margarines, butter, cheese, yoghurt and ice cream, in bakery products, soups, sauces, salads and sweets, and in particularly large quantities in the production of multivitamin drinks (Kurilik & Juvik, 1999; Mozaffarieh et al., 2003).

Supplementation of foods with essential fatty acids

Some lipids have been identified to have a health-promoting effect and sometimes are essential to the human body. The best known of these beneficial effects are plant steroids that have cholesterol-lowering effects or fatty acids that have anti-inflammatory effects. Plant steroids are highly cholesterol-related in terms of their chemical structure. Their most important representatives are sitosterol, campesterol and stigmasterol. Plant stanols are saturated plant sterols, as there is no double bond in the steroid ring. Plant steroids have no effect on HDL cholesterol, but as they improve LDL/HDL ratio, they have a health-protective effect (Patel & Savjani, 2015; Demonty et. al., 2013).

Polyunsaturated fatty acids
The term polyunsaturated fatty acid (PUFA) is used for all fatty acids containing at least two unsaturated bonds. For humans, linoleic acid (C18:2) and linolenic acid (C18:3) are also essential because our body cannot produce them. The body produces substances from both fatty acids such as eicosanoids, which are hormone-like compounds and modulate the cardiovascular system, respiratory system, immune system and reproductive functions and play a key role in preventing inflammation. The synthesis of eicosanoids in the human body depends on the type of fatty acids available, so the ratio of the food ω-3/ω-6 determines the amounts of eicosanoids that can be produced from them. It is believed that the ratio of 4:1 ω-3/ω-6 is optimal for the human body, but in many countries, ratios between 7:1 and 14:1 were measured, which is far from the optimum values (Shakar et al., 1994; Gogos et al., 1998; Christensen, 2011).

Sources of polyunsaturated fatty acids
The optimal raw materials for supplementing with PUFA are the various vegetable oils such as, for example, the primrose-oil and flaxseed oil, characterized by a typical ω-3/ω-6 ratio, and in particular the fish oil, which contains high amounts of eicosapentaene (C20: 5 n-3) and docosahexane (C22:6 n-3) fatty acids. Generally, vegetable oils contain many n-3 PUFA fatty acids in linoleic acid form. Since the same enzyme system further transforms linoleic acid and linolenic acid into longer chain unsaturated fatty acids, the two fatty acids are competitive inhibitors of each other, therefore only a small portion of linolenic acid is converted to eicosapentanoic acid (EPA) and arachidonic acid. The main sources of EPA and DHA (docosahexaenoic acid) are fish oils, which are "by-products" of fishmeal production. The fatty acid composition of fish oil depends on the composition of the feed consumed, and therefore the differences in the fatty acid composition of fish oils from different sites may also be present. EPA content of fish oils range from 5 to 18%, DHA content ranges from 6 to 13%. Sources of the n-3 PUFAs can also be various microorganisms, because these microbes are capable of synthesizing n-3 fatty acids having 20 or more than 20 carbon atoms. Sea microalga appear to be the best n-3 fatty acid source because they are able to accumulate long chain n-3 fatty acids in their bodies (Moffat et al., 1993; Salamon et al., 2007b).

Conjugated linoleic acids
Conjugated Linoleic Acids (CLA) also contain two double bonds, but they are in a conjugated position in the molecule. CLA reduces fat storage after meals, reduces the total amount of fat cells and increases fats' involvement in energy production processes. CLA also has an immunomodulatory effect that influences the immune response of cells to vaccines, influences the body's cytokine levels and thus may also play a role in treating inflammation. Among the many CLA isomers, cis-9, trans-11, and trans-10, cis-12 isomers have biological activity. Commercially available CLAs are made from safflower oil, containing both isomers at 50:50 percent (Csapó & Vargáné, 2014).

Technological aspects of lipids
In CLA production, it is essential that isomers with biological activity are produced at the highest concentrations. Products containing many unsaturated fatty acids are very sensitive to oxidation, so often antioxidants are used in such compositions such as tocopherol blends, ascorbyl palmitate, rosemary extract or citric acid. Basic compounds of lipid oxidation are double bonded fatty acids. The more double bonds are in the molecule, the higher is its susceptibility to oxidation. Thus, DHA is five times more susceptible to oxidation than linoleic acid. Autooxidation is initiated by initiators, resulting in free radicals localized on carbon atoms from unsaturated fatty acids. These, after further degradation, form volatile or non-volatile secondary decomposition products (Salamon et al, 2006, 2007a). Volatile components include aldehydes, ketones and alcohols, hydrocarbons and those alcohols that are responsible for the formation of odour and taste. Photooxidation is a non-radical reaction that leads to the formation of hydroperoxides and volatile components, such as those produced by radical reactions. Light sensitizing compounds in foods are chlorophyll, riboflavin and hem-proteins. Lipid oxidation may in some cases be prevented by the administration of antioxidants. Primary antioxidants are also called free radical scavengers because they neutralize free radicals to stop radical reactions. Phenolic compounds are for example, BHA (butylhydroxyanisole), BHT (butylhydroxytoluene) and propyl gallate, and natural antioxidants include tocopherols and vegetable polyphenols (Csapó & Albert, 2017).

Supplementation of foods with biologically active lipids
Long chain PUFA, CLA, are usually formulated in esterified form after deodorization. It is always advisable to add emulsifiers to the oils, which increase dispersion, provide stability to the food, preventing the separation of the various phases. Generally, homogenization is also interspersed due to the degree of dispersion and stability required. To facilitate the addition of functional lipid components, various spray-dried products were produced which can easily and homogeneously be mixed in an aqueous medium. Sterols of the original state are difficult to disperse evenly in the aqueous medium because these compounds are highly hydrophobic and immediately separate from the aqueous medium after simple mixing (Salamon et al., 2006, 2007a).

Examples of increasing sterols, CLAs and PUFAs in foods
In the United States, drinks and cereals complemented with sterols are currently the most popular. The one-cup milk-based drinks are popular with a plant sterol content of 2-3 grams in 100 grams of liquid and people love yogurt, milk, milk powder and spreadable cheese with herbal sterol. Recently, infant formulas and food products for older people have been supplemented with PUFA, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). In addition to milk and milk products, many so called Omega-breads are commercially available, with PUFA concentrations averaging 80 mg/100 g (Kris-Etherton et al., 2002; Reisman et al., 2006).

Flavonoids as functional food components

The basic structure of the flavonoids, aglycone, is linked to a sugar molecule, so flavonoids are in fact glycosides. Flavonoids are derivatives of 1,3-diphenylpropane, isoflavonoids are derivatives of 1,2-diphenylpropane and neoflavonoids are 1,1-diphenylpropane derivatives, which include anthocyanide, cyanidine, anthocyanin and cyanine. Secondary metabolic products of plant metabolism are found mainly in the skins, seeds and stems of the fruits. As pigment-forming substances, they play a role in protecting against UV light and microorganisms and other plant pests, regulating enzyme reactions, and they have also signalling functions for nitrogen-binding bacteria. As a food ingredient in plant materials, they are colouring agents, flavour components and antioxidants (Agati et al., 2012).

Classification of flavonoids

Typical representatives of the flavonol group are the catechins, the proanthocyanidins include oligomeric catechins, flavones are the quercetin and campherols, the biflavones are represented by the amentoflavone and bilobetine, the flavonones include the hersperidine and naringin, typical flavononol is the taxifolin, anthocyanins include the cyanidine, delphidine, malvidin and petunidin, the silmarin is a flavonolignane and isoflavones are the genistein and diadene (Peterson, 1998).

Intake of flavonoids with food

In 2001 adults in Hungary consumed 18.8 mg/person/day (0.5-309.7 mg) and children consumed 19.5 mg/person day (0-179.3 mg) of flavonoids while the recommended total dose is 1000 mg/person/day. It can be concluded from the above data that the consumption of vegetables and fruit in Hungary is far below the desirable level!

Absorption and metabolism of flavonoids

The absorption of flavonoids depends on the chemical structure, molecular size, polymerization, glycosidation and solubility. If badly absorbed, only 0.2-0.5% of all consumed quantities are utilized in the body. Usually, however, they are easily adsorbed, transformed by decarboxylation, demethylation, by the saturation of double bonds, and the aglycons are absorbed through the small intestine. Glycosides have to be hydrolysed prior to absorption, but the human body lacks the β-glucosidase enzyme, therefore the microflora of the colon hydrolyzes the glycosides, after which the metabolites pass through the blood into the liver where methylation and sulphonation occur, and the derivatives reach the kidneys with the blood where they are excreted in the urine (Knekt et al., 2002).

The most important biochemical properties of flavonoids include antioxidant activity with free radical capture, anti-inflammatory, anti-asthma and antiallergic activity, modification of enzyme activation, usually inhibition, antiviral, antibacterial effect, estrogen activity, influencing mutagenetic and carcinogenetic effects, hepatoprotective effect and they affect even the function of the blood vessel system. According to our present knowledge, cancer cannot be prevented by any nutrition or nutritional supplements, but the risk of cancer is lower among those who consume a lot of vegetables and fruits (Rice-Ewans et al., 1995).

In Mediterranean countries, the lower occurrence of cardiovascular diseases is believed to be due to the flavonoid content of red wine consumed. Flavonoids reduce fibrinogen and elevate plasminogen concentrations, increase protective HDL, while simultaneously reducing harmful LDL levels. Red wine is a functional food because the flavonoids in the aqueous, alcoholic liquids are absorbed more efficiently, but most likely not only the red wine but also the lifestyle and genetic differences cause the absence of the disease (Miean & Mohamed, 2001). Other beneficial effects of flavonoids have also been established: in case of osteoporosis and osteogenic diseases they restore the physiological metabolism of bones, increase insulin production in people with diabetes, affect oestrogen production in gynecological problems, play a role in the prevention of Alzheimer's disease, promote absorption of drugs (medicines), and quercetin inhibits the xanthoxidase enzyme required for uric acid formation (Christie et al., 2004; Hooper et al., 2008).

Medicinal products with high flavonoid content

Functional foods may have high flavonoid content, and there are medicines and preparations such as Rutascorbin, which strengthens the walls of the capillary blood vessels, the liver protector Legalon, medicines containing visual enhancement anthocyanins, and a large number of therapeutic and functional preparations, cosmetics and dietary supplements, contain flavonoids (Birth et al., 2001; Mink et al., 2007).

Discussion

In terms of functional foods, food production was about to create a new area of knowledge, which is now being developed and accepted by consumers, and producers and consumers will jointly guide the processes that, in a few years, will become part of the traditional food production. In a brief statement, of course, we could only touch the most important knowledge concerning functional foods, including the definitions of what kind of food would be functional, what are the physiological effects of functional foods, how to produce functional foods, what consumer expectations are for functional foods, and we were briefly dealing with food safety and legal regulation (Csapó et.al., 2015). Increasing the proportion of functional components of food includes substitution, enrichment and supplementation. More specifically, it is about supplementing foods with vitamins and minerals, enriching them with polyphenols and essential and health-promoting fatty acids. The scope of this study does not allow to include the bioactive components of the milk, their recovery, enrichment and production, bioactive proteins, lipids and carbohydrates, prebiotics, probiotics and synbiotics, and functional or potentially functional foods such as meat, eggs, soy, various cereals, vegetables and fruits, nutritional germs, and red wine. The main purpose of this study was to make readers aware of the importance of functional foods and their role in healthy nutrition (Csapó et.al., 2017).

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