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| **Title and Code** of the subject: **Functional foods MTBE7040A** | **ECTS Credit Points: 3** |
| **Type** of the subject: **compulsory** / optional | |
| **Ratio of theory and practice: 100/0** (credit%) | |
| **Type and number of classes per semester**: 42 hour(s) lecture and 0 hour(s) practice per semester | |
| **Type of exam**: **exam /** practical course mark | |
| **Subject in the curriculum:** semester 6 | |
| Preliminary requirements:- | |

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| **Summary of content - theory**: |
| Course objectives:  **Schedule:**  **1. Introduction. Basic concepts.** Definitions. What makes a food functional? Physiological effects of functional foods. How to produce functional foods? Consumer expectations in connection with functional foods. Food safety and functional foods. Functional foods and legislation.  **2. Producing functional foods with fortification 1.** Basic concepts. Fortification of the functional components of foods. Substitution of the components of foods. Supplementation. Fortification of foods with vitamins and minerals. The necessity for fortification. Iron deficiency and its consequences. Iodine deficiency and its consequences. Vitamin A deficiency and its consequences. Zinc deficiency and its consequences. Calcium deficiency and its consequences. Folic acid deficiency and its consequences. Fortification of foods with vitamins.  **3. Producing functional foods with fortification 2.** Fortification of foods with polyphenols. The properties of polyphenols. The technological aspects of making plant extracts. Fortification of foods with carotenoides. Fortification of foods with oils containing essential fatty acids. Polyunsaturated fatty acids. Biological effect of polyunsaturated fatty acids. The sources of polyunsaturated fatty acids. Conjugated linoleic acids. Technological aspects connected to lipids. The oxidation of lipids during the manufacture of fish oil and microalgae oil. The refining of fish oil. The fortification of the foods with biologically active lipids. Examples for the fortification of CLA, sterols and PUFA-s in foods. Enhancing the effectiveness of functional food components. Beauty care functional foods. Flavonoids, as components of functional foods. The structure of the flavonoids. The grouping of flavonoids. The intake of flavonoids into the body by foods.  **4. The bioactive components in milk and their production 1.** The bioactive components in milk. Bioactive proteins. The biological effects of main milk proteins and their application. The application of whey proteins in industry and trade. The production of bioactive peptides and their functionality. Bioactive peptides and innovative applications. The bioactive peptides and their activity in dairy products. Dairy products and additives containing bioactive peptides.  **5. The bioactive components in milk and their production 2.** Bioactive lipids. Conjugated linoleic acids (CLA). The increase of the quantity of CLA. The fatty acid content, KLS content and their change during the lactation. The influence of the different microorganism cultures for fatty acid and CLA composition of dairy products. The CLA content of butter, cheeses and margarine. The changes of the CLA content of different cheeses during storage. Polar lipids. Factors affecting growth. Other bioactive compounds in milk. Exopolysaccharides (EPS) and oligosaccharides produced by lactic acid bacteria. Determination of the structure and measurement of the quantity of EPS produced by different lactic acid bacteria. The possibilities to produce galactose oligosaccharides (GalOS) in industrial scale. The determination of the quantity and structure of EPS-s. The monosaccharide composition of EPS-s. The chemical modification and structure research of EPS-s. Summary of the bioactive components in milk.  **6. Prebiotics, probiotics, symbiotics.** Basics related to probiotics. Probiotics and their basic characteristics. The scope of prebiotics and their basic characteristics. The micro flora of the human digestive system. The germ number. The different germs and their proportion. Causes for the modification of the gut flora. The possibilities for the modification of the gut flora. The current probiotic cultures and their determined requirements. The probiotic phylums developed by Hungarian researchers. The basic principles of probiotic uptake. The uptake of probiotics by dairy products. The uptake of probiotics with dietary supplement in capsule form. The benefits of probiotics. Summary of the more important human physiological benefits of probiotics.  **7. The role of the meat in nutrition and in health protection.** The proteins of the muscle tissues. Water soluble proteins. Insoluble proteins. Biogenic amines. Creatine and creatinine. Meat maturation. Quality failures occurring in the case of pork. The meat, as functional food. The meat as protein source. The meat as fat source. The fat and cholesterol content of meats. The fatty acid composition of the different fats and fish oil. The meat as source of vitamins. The meat as source of mineral materials. Unprocessed meats. Slice, soups and goulash meats. The pork in culinary use. Protein products. Additives. Product groups in meat industry. Digestibility of meats. The meat and the allergy. Delightful effect.  **8. The soya as functional food 1.** The conformation of the quality of soya proteins during processing. The influence of the oxidation for the damage of the proteins. The influence of heat for the damage of proteins. Reactions in the side chain of the amino acids and between protein molecules. Influence of the basic treatment. Reactions between proteins and carbohydrates. Reactions between proteins and lipids. Connection between proteins and polyphenols.  **9. The soya as functional food 2.** The demonstration of the heat damage of soya proteins. Technologies influencing the protein quality. Antinutritive and toxic materials influencing the utilization of the protein. Heat resistant antinutritive materials in soya. The elimination of the effect of the antinutritive materials in soya. Examinations suitable for the qualification of soya protein. Some chemical methods for the determination of the quality of protein. The complex qualification of soya proteins.  **10. Foods supplemented with selenium.** In general about selenium. Selenium as an essential microelement. The different forms of selenium in the living world. The antioxidant properties of selenium. Enzymes with selenium content. The utilization of selenium. The selenium content of foods of plant origin. Foods supplemented with selenium. The selenium content of plants. The accumulation of selenium. Selenium species in the biosphere. Selenoaminoacids. Selenium deficiency and its prevention. Enrichment with selenium. The total selenium-, seleno methionine- and organic selenium content of wheat grass and seed. Edible sprouts enriched with selenium. Edible sprouts with high selenium content in the prevention of cancer. Supplementation of the foods with selenium. Egg supplemented with selenium. Milk and dairy products supplemented with selenium. Selenium content of the dairy products made from high selenium content milk.  **11. The egg and lipids as functional food.** The egg yolk. The egg whites. Egg colouring materials. Changes during the storage of egg. Important characteristics of egg base products. Dried egg based products. **Lipids of plant and animal origin.** Lipids of plant origin. Lipids of animal origin. Lipids from marine animals. Factors affecting the quality of fats and oils.  **12. Cereals, vegetables and fruits as functional foods.** Cereals. The composition of the cereals. The carbohydrate content of the cereals. The proteins of the cereals. The protein components and the structure of wheat gluten. The lipid content of cereals. Processing of cereals. Enzymes playing role in processing of cereals. Thiol components of wheat flour. Baking tests. The influence of ascorbic acid on the pasty production in the case of wheat flour. The influence of the added wheat flour with lipoxigenase enzyme activity on the wheat flour. The influence of the added cysteine on the wheat flour. The influence of the added α-amylase on wheat flour. The influence of the emulsifiers and fats. Vegetables and fruits. Vegetables. The composition of vegetables. Flavouring substances. The vitamin content of vegetables. Pigments of plant origin. The shelf life of vegetables. Fruits.  **13. Edible sprouts as functional foods.** The significance of sprouts in nutrition. Biochemical changes during sprouting. Sprouts enriched by selenium. The utilization of the selenium. Our own investigations in relation to the sprouts.  **14. The red wine as functional food.** The chemical composition of grape, must and wine. The biochemistry of grape maturation. Accumulation of the sugar in the berry. The determination of the maturity. The structure and composition of the cluster of grapes. The chemical composition of the must. The biochemistry of fermentation. The chemical composition of wine. Alcohols. Sugars, organic acids, volatile acids, phenolic components. Possibilities of the objective determination of the colour of red wines. The nitrogen containing materials of the wine. Pectins and polysaccharides. Aromatic components in wine. Polyphenols in aroma production. Components causing typical taste failure in wine. Vitamins in wine. The chemistry of wine development. Oxidation-reduction phenomena in wine. Aromatic components produced during storage and maturation of wine. The red wine as functional food. The health protection role of wine. The effects of moderate red wine consumption. |
| **Literature, handbooks in English**  Ghosh, D. – Das, S. – Baghchi, D. – Smarta, R.B.: Innovation in healthy and functional foods. CRC Press, Taylor & Francis Group, 2013. 1-598.  Kanekanian, A.: Milk and dairy products as functional foods. Wiley Blackwell, 2014. 1-406.  Kristbergsson, K. – Ötles, S.: Functional properties of traditional foods. Springer Science+Business Media, New York, 2016. 1-369.  Noorhorm, A. – Ahmad, I. – Anal, A.K.: Functional foods and dietary supplements. Processing, effect and health benefits. Wiley Blackwell, 2014. 1-527.  Ottaway, P.B.: Food fortification and supplementation. Technology, safety and regulatory aspects. Woodhead Publishing Limited, 2008. 1-297.  Shi, J. – Mazza, G. – Le Maguer, M.: Functional foods. Biochemical and processing aspects. CRC Press, 2002. 1-542.  Shi, J.: Functional food ingredients and nutraceuticals: Processing technologies. CRC Press, Taylor & Francis Group, 2016. 1-681.  Smith, J. – Charter, E.: Functional food products development. Wiley Blackwell, 2010. 1-537. |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**  * Familiar with the chemical, biochemical procedures, and the basic law of different processes involved in the manufacture of good quality functional foods. * Know the factors determining the basic quality of functional foods. * Familiar with the English technical language used in functional food science and practice.  1. **Skills:**  * Capable for performing routine problems in the process of functional food production and eliminate them. * Recognize the unity of natural sciences, so the problem solving ability increases. * They will be able to assess the risk of functional food safety in the food chain of raw materials, for safe storage, and for production and preservation of value-added very good quality safe and functional foods.  1. **Attitude:**  * With the acquisition of the learning material of the functional foods develops in the student the natural sciences thinking and approach. * Scientific thinking and attitude, professional interest.  1. **Autonomy and responsibility:**  * Due to the safe, accurate and thorough knowledge the students become for independent decision on the field of functional food production. |

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| **Responsible lecturer: Prof. Dr. Csapó János** |
| **Other lecturer(s): -** |

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| **Terms of course completion:** |
| Submitting essay. |
| **Form of examination:** |
| Submitting essay. |
| **Requirement(s) to get signature:** |
| 80% participation in the lectures and in the practice |

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| **Exam questions:** |
| 1. Definitions of the functional foods.  2. What makes a food functional?  3. Physiological effects of functional foods.  4. How to produce functional foods?  5. Consumer expectations in connection with functional foods.  6. Food safety and functional foods.  7. Functional foods and legislation.  8. Producing functional foods with fortification. Basic concepts.  9. Fortification of the functional components of foods.  10. Substitution, supplementation, fortification.  11. Fortification of foods with vitamins and minerals. The necessity for fortification.  12. Iron deficiency and its consequences. Iodine deficiency and its consequences. Vitamin A deficiency and its consequences.  13. Zinc deficiency and its consequences. Calcium deficiency and its consequences.  14. Folic acid deficiency and its consequences.  15. Fortification of foods with vitamins.  16. Fortification of foods with polyphenols. The properties of polyphenols. The technological aspects of making plant extracts.  17. Fortification of foods with carotenoides.  18. Fortification of foods with oils containing essential fatty acids. Polyunsaturated fatty acids.  19. Biological effect of polyunsaturated fatty acids. The sources of polyunsaturated fatty acids.  20. Conjugated linoleic acids. Technological aspects connected to lipids.  21. The oxidation of lipids during the manufacture of fish oil and microalgae oil. The refining of fish oil.  22. The fortification of the foods with biologically active lipids.  23. Examples for the fortification of CLA, sterols and PUFA-s in foods.  24. Enhancing the effectiveness of functional food components.  25. Beauty care functional foods.  26. Flavonoids, as components of functional foods. The structure of the flavonoids. The grouping of flavonoids. The intake of flavonoids into the body by foods.  27. The bioactive components in milk.  28. Bioactive proteins in the milk. The biological effects of main milk proteins and their application.  29. The application of whey proteins in industry and trade. The production of bioactive peptides and their functionality.  30. Bioactive peptides and innovative applications. The bioactive peptides and their activity in dairy products. Dairy products and additives containing bioactive peptides.  31. Bioactive lipids in the milk. Polar lipids.  32. Conjugated linoleic acids (CLA). The increase of the quantity of CLA. The fatty acid content, CLA content and their change during the lactation.  33. The influence of the different microorganism cultures for fatty acid and CLA composition of dairy products. The CLA content of butter, cheeses and margarine. The changes of the CLA content of different cheeses during storage.  34. Other bioactive compounds in milk. Factors affecting growth.  35. Exopolysaccharides (EPS) and oligosaccharides produced by lactic acid bacteria. Determination of the structure and measurement of the quantity of EPS produced by different lactic acid bacteria.  36. The possibilities to produce galactose oligosaccharides (GalOS) in industrial scale. The determination of the quantity and structure of EPS-s. The monosaccharide composition of EPS-s. The chemical modification and structure research of EPS-s.  37. Basics related to probiotics. Probiotics and their basic characteristics. The scope of prebiotics and their basic characteristics.  38. The micro flora of the human digestive system. The germ number. The different germs and their proportion. Causes for the modification of the gut flora. The possibilities for the modification of the gut flora.  39.The current probiotic cultures and their determined requirements. The probiotic phylums developed by Hungarian researchers. The basic principles of probiotic uptake.  40.The uptake of probiotics by dairy products. The uptake of probiotics with dietary supplement in capsule form. The benefits of probiotics.  41. The proteins of the muscle tissues. Water soluble proteins. Insoluble proteins.  42. Biogenic amines. Creatine and creatinine. Meat maturation.  43. Quality failures occurring in the case of pork.  44. The meat, as functional food. The meat as protein source. The meat as fat source.  45. The fat and cholesterol content of meats. The fatty acid composition of the different fats and fish oil.  46. The meat as source of vitamins. The meat as source of mineral materials.  47. Unprocessed meats. Slice, soups and goulash meats. The pork in culinary use.  Protein products. Additives. Product groups in meat industry.  48. Digestibility of meats. The meat and the allergy. Delightful effect.  49. The conformation of the quality of soya proteins during processing.  50. The influence of the oxidation and heath for the damage of the soya proteins.  51. Reactions in the side chain of the amino acids and between protein molecules. Influence of the basic treatment.  52. Reactions between proteins and carbohydrates. Reactions between proteins and lipids. Connection between proteins and polyphenols.  53. The demonstration of the heat damage of soya proteins. Technologies influencing the protein quality.  54. Antinutritive and toxic materials influencing the utilization of the protein. Heat resistant antinutritive materials in soya. The elimination of the effect of the antinutritive materials in soya.  55. Examinations suitable for the qualification of soya protein. Some chemical methods for the determination of the quality of protein.  56. The complex qualification of soya proteins.  57. Foods supplemented with selenium.In general about selenium. Selenium as an essential microelement.  58. The different forms of selenium in the living world. The antioxidant properties of selenium. Enzymes with selenium content. The utilization of selenium.  59. The selenium content of plants. The selenium content of foods of plant origin. Foods supplemented with selenium.  60. The accumulation of selenium. Selenium species in the biosphere. Selenoaminoacids. Selenium deficiency and its prevention. Enrichment with selenium.  61. The total selenium-, seleno methionine- and organic selenium content of wheat grass and seed.  62. Edible sprouts enriched with selenium. Edible sprouts with high selenium content in the prevention of cancer.  63. Supplementation of the foods with selenium. Egg supplemented with selenium.  64. Milk and dairy products supplemented with selenium. Selenium content of the dairy products made from high selenium content milk.  65. The egg as functional food. The egg yolk.  66. The egg whites. Egg colouring materials.  67. Changes during the storage of egg.  68. Important characteristics of egg base products. Dried egg based products.  69. Lipids of plant origin as functional foods.  70. Lipids of animal origin as functional foods. Lipids from marine animals.  71. Factors affecting the quality of fats and oils.  72. Cereals, vegetables and fruits as functional foods. Cereals.  73. The composition of the cereals. The carbohydrate, lipid and protein content of the cereals.  74. The protein components and the structure of wheat gluten.  75. Processing of cereals. Enzymes playing role in processing of cereals. Thiol components of wheat flour. Baking tests.  76. The influence of ascorbic acid on the pasty production in the case of wheat flour.  77. The influence of the added wheat flour with lipoxigenase enzyme activity on the wheat flour.  78. The influence of the added cysteine on the wheat flour.  79. The influence of the added α-amylase on wheat flour.  80. The influence of the emulsifiers and fats on the functional properties of wheat flour.  81. Vegetables. The composition of vegetables. Flavouring substances.  82. The vitamin content of vegetables. Pigments of plant origin. The shelf life of vegetable.  83. Fruits as functional foods.  84. Edible sprouts as functional foods.The significance of sprouts in nutrition.  85. Biochemical changes during sprouting.  86. Sprouts enriched by selenium. The utilization of the selenium from sprouts.  87. The red wine as functional food. The chemical composition of grape, must and wine.  88. The biochemistry of grape maturation. Increase, maturation and over maturation of grape berry. 89. Photosynthesis, migration of materials.  90. Accumulation of the sugar in the berry. The change of the organic acid (tartaric and malic acid) in the berry.  91. The inflow of minerals into the berry. Protein synthesis.  92. The determination of the maturity and the time of the harvest.  93. The structure and composition of the cluster of grapes. The composition of the grape shell, the grape seed and the berry.  94. The chemical composition of the must. Carbohydrates, pectins and gums, organic acids, nitrogen containing materials, vaxes, oils and fats.  95. The chemical composition of the must. Polyphenols and colouring materials, colouring materials, flavouring substances, vitamins and enzymes in grape, must and wine, minerals.  96. The extract content, redoxpotencial, oxidation, reduction.  97. The biochemistry of fermentation and the chemical composition of wine.  98. The chemistry of wine development. Oxidation-reduction phenomena in wine. Aromatic components produced during storage and maturation of wine.  99. The red wine as functional food. The health protection role of wine.  100. The red wine as functional food. The effects of moderate red wine consumption. |