# Спортивное питание

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## EFFECTS OF DIETARY FIBER ON HUMAN HEALTH: A REVIEW

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**The aim** of this article is to review literature data on the terminology, classification and physiological effects of dietary fibers. **Results.** The scientific studies on the terminology, classification and characteristics of various types of dietary fiber are presented, the sources of dietary fiber and their positive physiological effects are described. Nowadays no consensus definition has been given to the concept of dietary fibers. The authors point to dietary fibers being related to chemical compounds defined by structure, or functional properties, and/or a combination of both structural and functional properties. The authors noted one commonality in these definitions: each mentioned positive physiological effects. The modern classification system for dietary fibers is wide and diverse and can be based on origin, structure of polymers, solubility, ion exchange, sorption or physiological effect. Many studies have shown that dietary fibers can promote human health and help prevent specific chronic diseases that increase mortality and reduce life expectancy. Numerous healthful effects of the dietary fibers have been documented. These include curative and preventive effects for diseases such as obesity, certain types of cancers, cardiovascular diseases, diabetes, and constipation. **Conclusion.** Fibers are considered before other nutrients to ensure a healthy nutrition. Research continues to contribute new data on the effect of dietary fiber on the human body.

***Keywords:*** *dietary fiber, terminology, classification, essential components of nutrition, physiological effects.*

**Introduction.** Human well-being is mostly related with metabolic processes in the body and therefore nutritional disorders lead to serious health problems of people of all ages. The analysis of daily diet composition devotes special attention to the availability of essential components of nutrition, which deficiency leads to irreversible disturbance of the homeostasis state.

Numerous studies published in recent decades revealed the problem of inadequate intake of dietary fiber in human diet. Deficiency of dietary fiber can lead to the pathological changes in organs and systems of human body.

Dietary fibers play an important physiological role in the human body. For this reason, dietary fibers are considered before other nutrients to ensure a healthy nutrition. Lack of fibers in the diet is associated with gastrointestinal diseases, including constipation, colon cancer, and hemorrhoids; cardiovascular diseases, including hypercholesterolemia, stroke, and ischemic heart; and metabolic diseases, including obesity and diabetes [9].

Many studies have shown that dietary fibers can promote human health and help prevent specific chronic diseases that increase mortality and reduce life expectancy [4, 8]. In particular, dietary fibers show antiproliferative activity against cancer cells, they are suggested to treat diarrhea symptoms, and present antihyperlipidemia and antidiabetic effects. Authors report that non-fermentable fiber identify a non-invasive dietary strategy to prevent central nervous system autoimmunity [3]. Dietary fibers have a wide range of physiological effects, and are considered crucial for human health. Several recent reports showed that the end-products of the fiber fermentation have protective functions in autoimmune and allergic diseases [42, 45].

In addition, the authors of the publications reveal the terminology and classification of dietary fibers, represent the characteristics of different types, describe the sources of fibers and the possibility of their incorporation in food formulations. Numerous data presented in scientific publications are often contradictory and therefore systematization of such studies is quite important.

**The concept of "dietary fiber".** The term dietary "fiber" was first used in an article by H. Hipsley (1953). Trowell (1978) defined dietary fiber as "the sum of polysaccharides and lignin not digested by the human gastrointestinal tract". Later Jimenez-Colmenero et al. [22] defined dietary fibers as carbohydrate food components, which are not hydrolyzed by the endogenous enzymes in the small intestine.

Zielinski and Rozema [48] analyzed the three definitions of "dietary fiber", formulated by the Institute of Medicine, AACC International and Codex Alimentarius Commission. The definition suggested by the Institute of Medicine: *Dietary Fiber* consists of nondigestible carbohydrates and lignin that are intrinsic and intact in plants [20].

The AACC International [1] suggested definition: *Dietary fiber* is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. Dietary fiber includes polysaccharides, oligosaccharides, lignin, and associated plant substances. Dietary fibers promote beneficial physiological effects including laxation and/or blood cholesterol attenuation, and/or blood glucose attenuation.

The Codex Alimentarius Commission (FAO/WHO 2010) [14] formulated following definition: *Dietary fiber* means carbohydrate polymers with ten or more monomeric units, which are not hydrolysed by the endogenous enzymes in the small intestine of humans and belong to the following categories: edible carbohydrate polymers naturally occurring in the food as consumed; carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities; synthetic carbohydrate polymers which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities.

The authors noted one commonality in these definitions: each mentioned positive physiological effects [48]. This reflected that, in the international scientific community, the importance of dietary fibers in human nutrition was increasingly recognized. More recently, Fuller et al. [17] reported that the definition of dietary fibers is elusive. The authors point to dietary fibers being related to chemical compounds defined by structure, or functional properties, and/or a combination of both structural and functional properties. The various classifications used to describe dietary fibers reflect such a complexity.

**Classification of dietary fibers.** Different characteristics can be used as a basis for the classification of dietary fibers [29]. The most common classification strategies are described below.

*Origin.* Dietary fibers can be distinguished based on the type of raw materials from which they originate. For example, they can be obtained from lower plants (algae, fungi), higher plants (cereals, grasses, and wood species) or animals (chitin and collagen) [23]. Distinctions can also be made between traditional (cereals, vegetables, fruits, berries) and non-traditional (like herbs, algae and wood) sources of raw materials [29, 41].

*Polymer structure.* The classification of dietary fibers according to the structure of polymers is generally done on the basis of homogeneity and heterogeneity. Homogeneous dietary fibers consist of homogeneous high-molecular substances (like cellulose, pectins, arabinose and lignin) while heterogeneous dietary fibers consist of biopolymers of several types (holocellulose, cellulose-lignins, hemicellulose-cellulose-lignin, protein-polysaccharide complexes are examples) [38].

*Fiber content.* The ratios of fibers to accompanying substances (starches, lipids, proteins, minerals and tannins) is also used to classify dietary fibers. Classifications based on this include food fibers, semi-concentrates of dietary fibers, concentrates of dietary fibers, and isolates of dietary fibers. In food fibers, the dietary fiber content of the feedstock does not exceed 30 %. Byproducts of processing raw materials, fruit squeezes, grasses, and some vegetables often fall within this group. Semi-concentrates of dietary fibers contain 30–60 % of fibers. Concentrates of dietary fibers comprise 60–90 % of fibers. Tomato pomace, grapevine or wheat bran are typically in this group. Finally, isolates of dietary fibers have a dietary fiber content exceeding 90 %. This category includes lignin, cellulose, and other highly purified plant products [37].

*Water solubility.* Based on the ability to dissolve in water, dietary fibers can be divided into two categories: water-soluble fibers and poorly soluble and insoluble fibers. From McKee and Latner [28], water-soluble are pectins, alginic acid, gums, mucus, and arabinoxylans. According to Fernández-Ginés [15], poorly soluble and insoluble fibers include cellulose, lignin, cellulose-lignin complexes, and a number of hemicelluloses.

*Water retention capability.* When dietary fibers are classified by the ability to retain water, they are divided into 3 groups: highly water-binding, medium-water-binding and weakly water-binding. Highly water-binding dietary fibers are able to bind 8 g of water per 1 g of fibers. Dietary fibers of sugar beet pulp, grapevine, galleys are in this category. Medium-water-binding dietary fibers are able to bind 2–8 g of water per gram. Dietary fibers from wheat bran, alfalfa food fiber, grape pomace often fall within this range. Finally, the weakly water-binding category binds less than 2 g of water per gram of fiber. Examples include dietary fiber grape seed meal and cellulose seed cake [37].

*Ion-exchange properties.* Ion-exchange and sorption properties can be used as a differentiators of dietary fibers [31]. It follows that dietary fibers can be classified as cation exchangers, anion exchangers and ampholytes, which are strong (more than 3 meqv of sorbate per 1 g), medium (1–3 meqv of sorbate per 1 g) and weak (up to 1 meqv of sorbate per 1 g). Strong cationites include food fibers of rice husk. Fibers of soya and buckwheat shells fall within the medium category. Weak cationites include fibers of sugar beet pulp [13].

*Physiological properties.* According to Mogilny et al. [30], the physiological properties of dietary fibers can also be used as classifiers. These could include fibers that contribute to accelerating and increasing the sense of saturation (like pectins), inhibiting the evacuation function of the stomach (like guar), stimulating the motor function of the large intestine (for example, cellulose and collagen), retaining water in the lumen of the large intestine (like fibers of wheat and legumes), increasing the mass of the microflora of the large intestine (like cabbage fibers), sorbing bile acids and cholesterol (like guar, cellulose, pectin), retarding absorption of carbohydrates (like pectin and guar), blocking receptors to estrogens (an example is dietary fibers of cereals), and having an antioxidant effect (like citrus fiber and oat fiber).

**Dietary fibers and health.** Epidemiological studies have shown a correlation between dietary fiber consumption deficiency and obesity as well as the development of several chronic diseases including colon cancer and cardiovascular disease (WHO / FAO 2003). Dietary fibers are an important part of the daily diet [33]. It is advisable to consume 30–40 g of fibers per day. Half of those fibers should come from the cereal bran and the rest from fruits and vegetables. The differences in fiber consumption recommendations for in different countries tend to follow regional and cultural eating habits, lifestyles and the degree of processing of various food products.

Reports on the benefits of dietary fibers are numerous. For example, Yilmaz [46] noted on the effect of rye bran in inhibiting the growth of mammary and colon tumors in laboratory animals. The author's studies showed a decrease in glucose levels in diabetics, as well as a reduced risk of death from coronary heart disease. Sze et al. [41] showed that fibers reduce the glycemic index. The presence of fibers in the diet was also shown to promote the elimination of heavy metals, toxins, carcinogens, and other substances that are potentially hazardous for humans [25, 43]. An overview of research data regarding the effects of dietary fibers on the body are presented in Table 1.

The high moisture-binding capacity of dietary fibers triggers the feeling of satiety and affects stool bulking, which in turn accelerate gut transit [4, 5, 11]. The time of action of secondary bile acids, therefore, decreases. It follows that fibers help to prevent and treat constipation [11]. The water-holding capacity of dietary fibers is dependent on the structure, the chemical composition and the relative proportions of different types of fibers [4].

Casas et al. [6] conducted a meta-analysis of data on the impact of various nutrients on the development of cardiovascular diseases and noted the important role of dietary fibers in reducing their number. Slavin [39] noted that adequate fiber intake consistently reduces the risk of cardiovascular disease and coronary heart disease by reducing low-density lipoprotein levels.

LeBlanc et al. [27] noted that the risk reduction of the cardiovascular diseases in the consumption of dietary fiber is due to their prebiotic effect and stimulation of growth of *Bifidobacterium* and *Lactobacillus*.

Soluble and insoluble dietary fibers have different effects on the body. Water-insoluble dietary fibers (IDF) affect intestinal regulation, while

Table 1

**Overview of research data regarding the effects of dietary fibers**

| Condition | Effect | Reference |
|---|---|---|
| Obesity | In the stomach dietary fibers slow the evacuation of food, create a lasting sensation of satiety. This limits the consumption of calories and promotes weight loss | [3, 7, 11] |
| Some types of cancers (colon cancer, prostate cancer, breast and uterine cancer) | Dietary fibers protect against certain types of cancers by reducing the concentration of carcinogenic substances in the body. This is done by accelerating the passage of chime which translates in the reduction of the period of contact of carcinogens with the intestinal mucosa | [13, 20, 24, 27, 36, 37] |
| Allerges | Fibers prevent allergies by reducing the endogenous level of histamines and absorb allergens. Dietary fibers, therefore, increase the resistance of the body | [42, 45] |
| Atherosclerosis | The development atherosclerosis is slowed by dietary fibers. This is because they absorb cholesterol and lipids and then remove them from the body | [40, 47] |
| Diabetes | Water-soluble dietary fibers, by forming colloidal solutions, slow down the absorption of fat, simple carbohydrates thereby they contribute to lowering cholesterol and normalizing blood glucose levels | [5, 35, 46] |
| Gastritis | By inhibit the secretory activity of gastric juice, dietary fibers have a stimulating effect on the stomach wall's reparative processes | [19] |
| Gastroesophageal reflux disease | Consumption of fibers reduces the reflux of bile into the stomach by increasing the absorption of bile acids | [33] |
| Cardiovascular disease | Fibers has a positive effect on the biomarkers of heart disease, they reduce the level of C-reactive protein, apolipoprotein and blood pressure | [39, 40] |
| Irritable bowel syndrome, constipation | Fibers increase the mass of feces along with their liquid content. Dietary fibers also reduce the time of intestinal transit | [5, 19] |
| Hepatic encephalopathy | Dietary fibers adsorb ammonia and shorten the transit time of intestinal transit | [22] |
| Autoimmune disease | Dietary non-fermentable fiber alters the composition of the gut microbiota and metabolic profile | [4] |
| Chronic kidney disease | Dietary fibers reduce indoxyl sulphate and p-cresyl sulphate levels better than peritoneal dialysis and haemodialysis | [7, 44] |

water-soluble dietary fibers (SDF) contribute to lowering cholesterol levels and glucose adsorption in the intestine [24]. Numerous studies have documented the use of dietary fibers for the reduction of blood cholesterol levels and regulation of blood glucose levels. The SDF β-glucan was shown to promote the reduction of blood glucose and blood cholesterol levels [8, 39]. Also, Fukushima et al. [16] noted that Shiitake fiber influenced the decline of the serum total cholesterol level by enhancement of fecal cholesterol excretion. Due to their high viscosity, the SDF have an effect on glucose and lipid metabolism. IDF assumed not to affect the viscosity of gut contents. It has been found that SDF have better cholesterol-reducing properties than IDF [45]. IDF intake, however, reduces the risk of prostate cancer [12].

Chitosan satisfies the requirements of dietary fiber as it is not digested in the upper gastrointestinal tract, and it provides high viscosity and high water binding capacity in the lower part of the gastrointestinal tract. Chitosan differs from other dietary fibers in that it has the ability to bond chemically with the negatively charged lipids, fats, and bile acids due to its positive ionic charge [7]. Incorporation of chitosan or cellulose in the diet reduced cholesterol intake [23]. Chitin and chitosan exhibit hypolipidemic properties as cholesterol and triglyceride levels were reduced in the blood plasma (serum) and in the liver of rats. Foods containing chitosan could be designed to reduce obesity and cholesterol levels. Chitosan can also contribute to reducing the incidence of colon cancer [23].

Nurdin et al. [35] noted that purified sources of natural dietary fiber, especially pectin, demonstrate a protective effect against colorectal cancer and they are recommended for creating functional foods. Pectin has a positive effect on health due to the ability to form a gel or to thicken a solution. It is known that to have positive effects on dumping syndrome patients, it improves the metabolism of cholesterol and lipids and it prevents and control diabetes. Adam et al. [2] determined that the fermentable fibre pectin effective for increasing satiety and decreasing caloric intake, it promote the weight loss in obesity.

Iwasa et al [21] conducted a study to evaluate if it was possible to use fiber to prevent and treat latent hepatic encephalopathy. The results showed that, during 30 days, a significantly increase in the contents of lactic bacteria does not produce urease, which was accompanied by a reduction in the level of ammonia in the blood. This lead to the reversal of signs of hepatic encephalopathy in 50 % of the patients, a significant decrease of endotoxemia.

Consuming enough dietary fibers has undeniable benefits. Including fibers in products has therefore the potential to enhance public health.

**Conclusions.** Although the existing definitions have common elements, nowadays no consensus definition has been given to the concept of dietary fibers. The modern classification system for dietary fibers is wide and diverse and can be based on origin, structure, solubility or physiological effect. Numerous positive physiological effects of the use of dietary fibers have been documented. These include curative and preventive effects for diseases or conditions such as obesity, certain types of cancers, cardiovascular diseases, diabetes, and constipation. Research on various types of dietary fibers continues to contribute new data on the effect of dietary fiber on the human body.

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**Conflict of Interest:** The authors declare that they have no conflict of interest.

**References**

1. AACC International. Cereal Foods World, 2001, vol. 46, no. 3, pp. 112–126.

2. Adam C.L., Gratz S.W., Peinado D.I. et al. Effects of Dietary Fibre (Pectin) and/or Increased Protein (Casein or Pea) on Satiety, Body Weight, Adiposity and Caecal Fermentation in High Fat Diet-Induced Obese Rats. *PLOS ONE*, 2016. DOI: 10.1371/journal.pone.0155871

3. Berer K., Martínez I., Walker A. et al. Dietary Non-Fermentable Fiber Prevents Autoimmune Neurological Disease by Changing Gut Metabolic and Immune Status. *Scientific Reports*, 2018, vol. 8, p. 10431. DOI: 10.1038/s41598-018-28839-3

4. Buttriss J., Stokes C. Dietary Fibre and Health. An Overview. *Nutrition Bull*, 2008, vol. 33, no. 3, pp. 186–200. DOI: 10.1111/j.1467-3010.2008.00705.x

5. Camerotto C., Cupisti A., D’Alessandro C. et al. Dietary Fiber and Gut Microbiota in Renal Diets. *Nutrients*, 2019, vol. 11, p. 2149. DOI: 10.3390/nu11092149

6. Casas R., Estruch R., Sacanella E. Influence of Bioactive Nutrients on the Atherosclerotic Process: A Review. *Nutrients*, 2018, vol. 10, p. 1630. DOI: 10.3390/nu10111630

7. Chawla S.P., Kanatt S.R., Sharma A.K. Chitosan. In Polysaccharides. *Mumbai, India: Springer International Publishing Switzerland*, 2014, pp. 1–24. DOI: 10.1007/978-3-319-03751-6_13-1

8. Chen J., Raymond K. Beta-Glucans in the Treatment of Diabetes and Associated Cardiovascular Risks. *Vascular Health Risk Management*, 2008, vol. 4, no. 6, pp. 1265–1272. DOI: 10.2147/VHRM.S3803

9. Cheung K., Mehta M. Chemical Properties and Applications of Food Additives: Preservatives, Dietary Ingredients, and Processing Aids. *Springer. Handbook of Food Chemistry. Berlin, Heidelberg*, 2015, pp. 101–129.

10. Cruz-Requena M., Aguilar-González C.N., Prado-Barragan L.A. et al. Dietary Fiber: An Ingredient Against Obesity. *Emirates Journal of Food and Agriculture*, 2016, vol. 28, no. 8, pp. 522–530. DOI: 10.9755/ejfa.2015-07-521

11. Dahl J., Lockert A., Cammer L., Whiting J. Effects of Flax Fiber on Laxation and Glycemic Response in Healthy Volunteers. *Med Food,* 2005, vol. 8, no. 4, pp. 508–511. DOI: 10.1089/jmf.2005.8.508

12. Deschasaux M., Pouchieu C., Hercberg S. et al. Dietary Total and Insoluble Fiber Intakes are Inversely Associated with Prostate Cancer Risk. *Journal of Nutrition*, 2014, vol. 144, no. 4, pp. 504–510. DOI: 10.3945/jn.113.189670

13. Dronnet V.M., Axelos M.A.V., Renard C.M.G. C. et al. Improvement of the Binding Capacity of Metal Cations by Sugar-Beet Pulp. Impact of Cross-Linking Treatments on Composition, Hydration and Binding Properties. *Carbohydrate Polymers*, 1998, vol. 35, pp. 29–37. DOI: 10.1016/S0144-8617(97)00118-5

14. FAO/WHO (CODEX) Guidelines on Nutrition Labelling CAC/GL 2-1985, 2010.

15. Fernandez-Gines M., Fernandez-Lopez J., Sayas-Barbera E. Meat Products as Functional Food: A Review. *Food Science*, 2005, vol. 70, pp. 37–43. DOI: 10.1111/j.1365-2621.2005.tb07110.x

16. Fukushima M., Ohashi T., Fujikawa Y. et al. Choresterol-Lowering Effects of Maitake (Grifolafrondosa) Fiber, Shiitake (Lentinusedodes) Fiber, and Enokitake (Flammulinavelutipes) Fiber in Rats. *Experimental Biology and*

*Medicine*, 2001, vol. 226, pp. 758–765. DOI: 10.1177/153537020222600808

17. Fuller S., Beck E., Salman H. et al. New Horizons for the Study of Dietary Fiber and Health: A Review. *Plant Foods for Human Nutrition*, 2016, vol. 71, pp. 1–12. DOI: 10.1007/s11130-016-0529-6

18. Ganda Mall J.P., Löfvendahl L., Lindqvist C.M. et al. Differential Effects of Dietary Fibres on Colonic Barrier Function in Elderly Individuals with Gastrointestinal Symptoms. *Scientific Reports*, 2018, vol. 8, p. 13404. DOI: 10.1016/j.clnu.2018.06.1098

19. Huang T.B., Ding P.P., Chen J.F. et al. Dietary Fiber Intake and Risk of Renal Cell Carcinoma: Evidence from a Meta-Analysis. *Medical Oncology*, 2014, vol. 31, p. 125. DOI: 10.1007/s12032-014-0125-2

20. Institute of Medicine (us) Panel on the Definition of Dietary Fiber and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes Proposed Definition of Dietary Fiber. Washington (DC): National Academies Press (US), 2001. Available at: https://www.ncbi.nlm.nih.gov/books/NBK223587/

21. Iwasa M., Nakao M., Kato Y. Dietary Fiber Decreases Ammonia Levels in Patients with Cirrhosis. *Hepatology*, 2005, vol. 41, no. 1, pp. 217–218. DOI: 10.1002/hep.20481

22. Jimenez-Colmenero F., Carballo J., Cofrades S. Healthier Meat and Meat Products: Their Role as Functional Foods. *Meat Science*, 2001, vol. 59, pp. 5–13. DOI: 10.1016/S0309-1740(01)00053-5

23. Kardas I., Struszczyk M.H., Kucharska M. et al. Chitin and Chitosan as Functional Biopolymers for Industrial Applications. *P. Navard (Ed.) The European Polysaccharide Network of Excellence (EPNOE), Springer-Verlag Wien*, 2012, pp. 329–373. DOI: 10.1007/978-3-7091-0421-7_11

24. Kendall W., Esfahani A., Jenkins A. The Link Between Dietary Fibre and Human Health. *Food Hydrocolloids*, 2009, vol. 24, pp. 42–48. DOI: 10.1016/j.foodhyd.2009.08.002

25. Kieffer D.A., Martin R.J., Adams S.N. Impact of Dietary Fibers on Nutrient Management and Detoxification Organs: Gut, Liver, and Kidneys. *Advances in Nutrition: An International Review Journal*, 2016, vol. 7, no. 6, pp. 1111–1121. DOI: 10.3945/an.116.013219

26. Kunzmann A.T., Coleman H.G., Huang W.Y. et al. Dietary Fiber Intake and Risk of Colorectal Cancer and Incident and Recurrent Adenoma in the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial. *American Journal of Clinical Nutrition*, 2015, vol. 102, pp. 881–890. DOI: 10.3945/ajcn.115.113282

27. LeBlanc J.G., Chain F., Martin R. Beneficial Effects on Host Energy Metabolism of Short-Chain Fatty Acids and Vitamins Produced by Commensal and Probiotic Bacteria. *Microbial Cell Factories*, 2017, vol. 16, p. 79. DOI: 10.1186/s12934-017-0691-z

28. McKee H., Latner A. Underutilized Sources of Dietary Fiber: A Review. *A Plant Foods for Human Nutrition Kluwer Academic Publishers*, 2000, vol. 55, pp. 285–304. DOI: 10.1023/A:1008144310986

29. Mehta N., Ahlawat S.S., Sharma D.P. et al. Novel Trends in Development of Dietary Fiber Rich Meat Products. A Critical Review. *Journal of Food Science and Technology*, 2015, vol. 52, no. 2, pp. 633–647. DOI: 10.1007/s13197-013-1010-2

30. Mogilny P., Shlenskaya V., Galyukova K. et al. Modern Trends of Using Food Fibers as Functional Ingredients. *New Technology*, 2013, vol. 1, pp. 27–31.

31. Mongeau R., Brooks P.J. Properties, Sources and Determination. Encyclopedia of Food Science and Nutrition. *Academic Press*, 2003, vol. 3, 2nd, pp. 1813–1832. DOI: 10.1016/B0-12-227055-X/00342-4

32. Morozov S., Isakov V., Konovalova M. Fiber-Enriched Diet Helps to Control Symptoms and Improves Esophageal Motility in Patients with Non-Erosive Gastroesophageal Reflux Disease. *World Journal of Gastroenterology*, 2018, vol. 24, no. 21, pp. 2291–2299. DOI: 10.3748/wjg.v24.i21.2291

33. Nayak K., Pattnaik P., Mohanty K. Dietary Fiber: a Low-Calorie Dairy Adjunct. *Indian Food Industry*, 2000, vol. 19, no. 4, pp. 268–274.

34. Nazare J.A., Sauvinet V., Normand S. et al. Impact of a Resistant Dextrin with a Prolonged Oxidation Pattern on Day-Long Ghrelin Profile. *Journal of the American College of Nutrition*, 2011, vol. 30, pp. 63–72. DOI: 10.1080/07315724.2011.10719945

35. Nurdin S.U., Le Leu R.K., Aburto-Medina A. et al. Effects of Dietary Fibre From the Traditional Indonesian Food, Green Cincau (Premna Oblongifolia Merr.) on Preneoplastic Lesions and Short Chain Fatty Acid Production in an Azoxymethane Rat Model of Colon Cancer. *International Journal of Molecular Sciences*, 2018, vol. 19, p. 2593. DOI: 10.3390/ijms19092593

36. O'Keefe S.J.D. Diet, Microorganisms and Their Metabolites, and Colon Cancer. *Nature*

*Reviews Gastroenterology & Hepatology*, 2016, vol. 13, pp. 691–706. DOI: 10.1038/nrgastro. 2016.165

37. Poznyakovskiy V.M. Hygienic Basis of Food, Quality and Safety of Food. *Novosibirsk, Siberian university publishing house*, 2007, pp. 28–29. (in Russ.)

38. Praznik W., Loeppert R., Viernstein H. et al. Dietary Fiber and Prebiotics. *Ramawat K.G., Mérillon J.M. (Ed.), Polysaccharides. Springer International Publishing Switzerland*, 2014. DOI: 10.1007/978-3-319-03751-6

39. Slavin J. Fiber and Prebiotics: Mechanisms and Health Benefits. *Nutrients*, 2013, vol. 5 (4), pp. 1417–1435. DOI: 10.3390/nu 5041417

40. Soliman G.A. Dietary Fiber, Atherosclerosis, and Cardiovascular Disease. *Nutrients*, 2019, vol. 11, p. 1155. DOI: 10.3390/nu11051155

41. Sze N., Sathyasurya R., Wan N. Incorporation of Dietary Fibre-Rich Oyster Mushroom (Pleurotussajor-Caju) Powder Improves Postprandial Glycaemic Response by Interfering with Starch Granule Structure and Starch Digestibility of Biscuit. *Food Chemistry*, 2017, vol. 227, pp. 358–368. DOI: 10.1016/j.foodchem.2017. 01.108

42. Trompette A., Gollwitzer E.A., Yadava K. et al. Gut Microbiota Metabolism of Dietary Fiber Influences Allergic Airway Disease and Hematopoiesis. *Nature Medicine*, 2014, vol. 20, no. 2, pp. 159–166. DOI: 10.1038/nm.3444

43. Wikiera A., Irla M., Mika M. Health-Promoting Properties of Pectin. *Postepy Higieny I Medycyny Doswiadczalnej*, 2014, vol. 68, pp. 590–596. DOI: 10.5604/17322693.1102342

44. Wu M., Caib X., Lin J. et al. Association between Fibre Intake and Indoxyl Sulphate/P-Cresyl Sulphate in Patients with Chronic Kidney Disease: Meta-Analysis and Systematic Review of Experimental Studies. *Clinical Nutrition*, 2019, vol. 38, pp. 2016–2022. DOI: 10.1016/j.clnu.2018.09.015

45. Yasuda A., Inoue K., Sanbongi C. et al. Dietary Supplementation with Fructooligosaccharides Attenuates Airway Inflammation Related to House Dust Mite Allergen in Mice. *International Journal of Immunopathology and Pharmacology*, 2010, vol. 23, pp. 727–735. DOI: 10.1177/039463201002300306

46. Yilmaz I. Effects of Rye Bran Addition on Fatty Acid Composition and Quality Characteristics of Low-Fat Meatballs. *Meat Science*, 2004, vol. 67, pp. 245–249. DOI: 10.1016/ j.meatsci.2003.10.012

47. Zacherl C., Eisner P., Engel H. In Vitro Model to Correlate Viscosity and Bile Acid-Binding Capacity of Digested Water-Soluble and Insoluble Dietary Fibers. *Food Chemistry*, 2011, vol. 126, pp. 423–428. DOI: 10.1016/j.foodchem. 2010.10.113

48. Zielinski G., Rozema B. Review of Fiber Methods and Applicability to Fortified Foods and Supplements: Choosing the Correct Method and Interpreting Results. *Analytical and Bioanalytical Chemistry*, 2013, vol. 405, pp. 4359–4372. DOI: 10.1007/s00216-013-6711-x

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# ВЛИЯНИЕ ПИЩЕВЫХ ВОЛОКОН НА ЗДОРОВЬЕ ЧЕЛОВЕКА: ОБЗОР

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**Целью** данного исследования являлся анализ литературных данных относительно терминологии, классификации и физиологических функций пищевых волокон. **Результаты**. Приведены данные научных исследований, касающиеся терминологии и классификации пищевых волокон, представлены характеристики различных типов, описаны источники пищевых волокон и их положительные физиологические эффекты. В настоящее время нет единой терминологии для характеристики понятия «пищевые волокна». Авторы указывают на общую концепцию в определениях: основанием к отнесению к группе пищевых волокон является соответствие химической структуры или функциональных свойств или сочетание как химического строения, так и функциональных свойств. Авторы отметили одну общность в этих определениях: в каждом из них отмечались положительные физиологические эффекты пищевых волокон. Современная система классификации пищевых волокон разнообразна и может быть основана на происхождении, структуре полимеров, растворимости, ионообменных свойствах, сорбционном или физиологическом эффекте. Множество исследований доказывают, что пищевые волокна благоприятно влияют на здоровье человека и способствуют предотвращению отдельных хронических заболеваний, которые увеличивают смертность и сокращают продолжительность жизни. В научных публикациях отмечены многочисленные полезные для здоровья человека свойства пищевых волокон. К ним относятся лечебные и профилактические эффекты при таких заболеваниях, как ожирение, некоторые виды онкологических заболеваний, сердечно-сосудистые заболевания, диабет и запоры. **Заключение.** Пищевые волокна являются незаменимыми питательными веществами, обеспечивающими рациональное питание. Продолжающиеся исследования вносят новые данные о влиянии пищевых волокон на организм человека.

***Ключевые слова:*** *пищевые волокна, терминология, классификация, незаменимые компоненты питания, физиологическое воздействие.*

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