

The Development and Application of Food Fiber in Food

Zhao Xianlin² Tang Xiaozhen³ Wei Siqing⁴ Wei Xuelian⁵ Huang Chao^{1✉}

1 School of Medicine, Jiaying College, Meizhou, Guangdong 514015, China

2 Jinan Daxin Biotechnology Co., Ltd., Jinan, Shandong 250000, China

3 School of Food Science and Engineering, Shandong Agricultural University, Tai'an, Shandong 271099, China

4 Shandong Vocational College of Foreign Trade, Tai'an, Shandong 271000, China

5 State Power Investment Group Green Energy Technology Development Co., Ltd., Haidian, Beijing 100000, China

Abstract: Dietary fiber is essential to human health as the seventh source of nutrients. In recent years, with changes in dietary habits, dietary fiber has become increasingly important for human health and has begun to be included in dietary studies. This article briefly introduces the physiological functions of dietary fiber, its development in food, the importance of its application, and also discusses the understanding regarding the development and comprehensive utilization of dietary fiber.

Keywords: dietary fiber; food; development; application

Introduction

Dietary fiber is defined as an indigestible food nutrient, a substance present in plant cell walls. With the scientific development of food nutrition and health concepts, it has become increasingly clear that dietary fiber is not only not a waste but also makes significant medical contributions to disease prevention, thus appearing particularly important. China is rich in dietary fiber sources, which are extensive, but the per capita intake is severely insufficient. The number of people suffering from various diseases due to a lack of dietary fiber is increasing year by year. As people's understanding of the nutritional value of dietary fiber grows, foods rich in dietary fiber are receiving more attention from consumers and have broad market prospects. This article briefly introduces the significance of the development of dietary fiber in the food

industry and its various applications in food, and looks into the market prospects of dietary fiber.

1 The Development of Dietary Fiber in Food

1.1 Definition of Dietary Fiber

Dietary fiber typically possesses the following characteristics: it is a carbohydrate found in plant-based foods that cannot be digested by the body's starch-digesting enzymes. Although dietary fiber has no nutritional function and cannot provide energy for the body, it is an essential nutrient for the body. In summary, the definition of dietary fiber includes the following concepts: [1]

- (1) The source must be a proven food source.
- (2) It cannot be digested and absorbed by digestive enzymes in the body.
- (3) Its chemical nature is that of a sugar, but it basically provides no energy under environmental.
- (4) Other physiological functions can be clearly detected in the human body.

1.2 Physiological Functions of Dietary Fiber

- (1) Dietary fiber helps Escherichia coli in the intestines synthesize various vitamins, improves intestinal function, prevents colon cancer, and reduces serum cholesterol, which can prevent heart disease.
- (2) Dietary fiber has a relatively low density and large volume, occupying more space in the human stomach and intestines, making people feel full and helping to prevent energy surplus and obesity.
- (3) As a fibrous food material, after consumption, it stimulates an increase in gastrointestinal waste, accelerates gastrointestinal peristalsis, prevents the formation of gallstones, and can also prevent and treat constipation and diabetes.
- (4) A high-fiber diet can reduce the stimulation of intestinal factors on pancreatic β -cells, reduce insulin release, increase the sensitivity of insulin receptors, and enhance glucose metabolism [2].

1.3 Significance of the Development of Dietary Fiber in Food

Scientific research has found that dietary fiber has good effects in inhibiting the rapid rise of postprandial blood sugar and improving glucose tolerance. Dietary fiber can delay the absorption of glucose, slow down the absorption of digestible sugars and starches, avoid a sharp increase in postprandial blood sugar, enhance sensitivity to insulin, improve the regulation of insulin in the blood, and increase the

body's glucose tolerance, which is beneficial for the treatment and rehabilitation of diabetes. Foods with added high fiber have special effects in both preventing and treating diabetes [3].

The significance of the development of dietary fiber in food is mainly reflected in the following aspects:

Supplementing the amount of dietary fiber required by the human body: Dietary fiber is a polysaccharide that can be derived from various foods such as grains, vegetables, and fruits. In food, beverages, health products, and pharmaceutical products, dietary fiber can be used as an additive to supplement the physiological requirement for dietary fiber.

Improving food texture and stability: Dietary fiber can affect the texture and stability of products. In some foods, such as ice cream and milkshakes, dietary fiber can act as a stabilizer, maintaining the product's structure and stability, and extending its shelf life.

Promoting digestion, cardiovascular health, and boosting immunity: Due to its unique physical and chemical properties, dietary fiber is considered to have various physiological functions, such as promoting digestion, lowering cholesterol, and controlling blood sugar. Therefore, in new functional food and beverage products, dietary fiber has become an important raw material that can add benefits such as promoting digestion, cardiovascular health, and boosting immunity to the product.

As people's attention to healthy eating continues to increase, the application fields of dietary fiber will become increasingly wider. Especially against the backdrop of an aging population, following the dietary principles for the elderly and developing foods that are low in salt, fat, and energy, but high in dietary fiber, can reduce the incidence of nutritional diseases among the elderly and improve their quality of life and health levels. Therefore, the development prospects of dietary fiber in the food industry are promising.

Application of Dietary Fiber in Food

2.1 Application of Dietary Fiber in Staple Foods

In staple foods, it mainly involves adding a certain amount of dietary fiber to rice, steamed buns, and noodle products. Foods with added dietary fiber have toughening, freshness-enhancing, and flavor-enhancing effects, which are beneficial for people's physical and mental health. Adding dietary fiber to rice can enhance its fluffy and fragrant taste. Adding 5% dietary fiber to steamed buns results in buns with a special aroma and good texture, similar to those made from whole wheat flour. Adding 4% dietary fiber to noodles increases their strength after cooking, resulting in good toughness, resistance to overcooking and soaking, and a more refreshing taste [4].

The application of dietary fiber in staple foods mainly involves grain-based staples. The following are some main applications of dietary fiber in staple foods:

Whole Grain Staples: Whole grains, such as whole wheat, brown rice, and corn, are primary sources of dietary fiber. They are rich in dietary fiber, which can help maintain intestinal health, control weight, and lower cholesterol. Whole grain staples are also believed to improve insulin sensitivity, lower blood sugar and triglycerides. Among whole grain staples, products like whole wheat flour and whole wheat bread are common sources of dietary fiber.

Oats: Oats are a staple food rich in soluble dietary fiber, which helps control blood sugar and lipids, and improves intestinal health. Oats can be used as a staple for breakfast, lunch, or dinner, and can also be made into oatmeal, oat bread, and other foods.

Legume Staples: Legume staples such as red beans, mung beans, and black beans are also good sources of dietary fiber. They are rich in dietary fiber, which helps maintain intestinal health and lower cholesterol. Legume staples can serve as the main food source for vegetarians or be consumed with meat or grains.

Sweet Potatoes and Potatoes: Although not strictly staple foods, sweet potatoes and potatoes are good sources of dietary fiber. Sweet potatoes are rich in pectin and dietary fiber, which can improve intestinal health. Potatoes are rich in resistant starch, which is beneficial for maintaining intestinal health.

2.2 Application of Dietary Fiber in Baked Goods

Baked goods are foods made primarily from basic cereal wheat flour and matured through a high-temperature baking process, mainly dominated by the baking industry. China is a major producer and

consumer of barley products. With the advancement of science and technology and the increased refinement of flour processing, many nutrients in food are lost. Therefore, adding dietary fiber to products can not only enhance nutrition but also improve people's dietary structure. Adding a certain amount of dietary fiber to baked goods affects their taste and quality. For example, a high content of dietary fiber and protein from potato peel significantly improves the quality of cakes, greatly enhancing their texture and color. If potato peel is used instead of wheat flour, the hardness of the cake decreases significantly, and the color value of the dough also decreases. Furthermore, 6% potato peel powder can produce good quality, protein-rich, and fiber-rich pastries compared to wheat flour [5].

Improving the taste and texture of baked goods: Dietary fiber can serve as a natural thickener and stabilizer in baked goods, increasing the volume and mouthfeel of the food while improving its texture. For example, adding dietary fiber when making bread can make it softer, more porous, and easier to digest.

Increasing the nutritional value of baked goods: Adding dietary fiber to baked goods can increase their nutritional value. For instance, adding dietary fiber, vegetables, or fruits when making cakes can increase the content of vitamins, minerals, and dietary fiber in the cake.

Controlling the calorie and fat content of baked goods: Dietary fiber can help control the calorie and fat content of baked goods, aiding in the management of dietary intake and blood sugar levels. For example, adding dietary fiber when making cookies can reduce their calorie and fat content.

Promoting the digestion and absorption of baked goods: Dietary fiber can promote the digestion and absorption of baked goods, increase the transit time and water content of food in the intestines, and help improve intestinal health. For example, adding dietary fiber when making biscuits can promote intestinal peristalsis and digestion and absorption.

2.3 Application of Dietary Fiber in Meat Products

Meat is nutritious, providing high-quality protein, various minerals, and vitamins. However, meat products are rich in fat and cholesterol and contain no dietary fiber. Adding dietary fiber to meat products can not only improve their water-holding capacity and emulsion stability but also enhance their health-care functions [6].

The polyglycans in dietary fiber are low molecular weight polymers that are difficult to digest and absorb in the body. Adding dietary fiber to meat products imparts a thick, smooth mouthfeel and sensory characteristics similar to fat. Moreover, the addition of dietary fiber, through the action of salt and some

hydrophobic bonds, allows the dietary fiber and protein to form a more stable coagulant at high temperatures, greatly increasing the yield of meat products.

2.4 Application of Dietary Fiber in Beverages

Fiber-based beverages are very popular in the West. They can quench thirst, replenish water, and provide the body with needed cellulose. These products, especially those containing water-soluble dietary fiber, are more common in developed countries like Europe and the United States. For example, Japanese companies produce fiber-based mineral water; in addition, Western European countries produce high-fiber orange juice, high-fiber tea, etc., which is quite common [7]. In the long term, drinking water rich in dietary fiber can prevent constipation and gallstones, and lower cholesterol. It is also possible to regulate blood lipids and blood sugar by helping to reduce weight, making it especially suitable for people with diabetes and obesity. Flavored beverages have been sold on domestic and international markets for many years and are very popular. Besides the milky taste, they also taste fruity and have a good mouthfeel. Adding dietary fiber to dairy-containing beverages can significantly improve their nutritional and health functions. Water-insoluble dietary fiber is a good choice for beverage manufacturers because they are very effective in terms of health benefits.

2.5 Application of Dietary Fiber in Dairy Products

Studies have shown that dietary fiber can be used as a functional food ingredient in fermented milk to improve its quality and antioxidant activity. Adding dietary fiber to dairy products can meet people's needs for protein, animal nutrients, and phytonutrients, further enhancing the nutritional value and application scope of dairy products. Dietary fiber can improve the flavor and stability of dairy products, and none of its components cause adverse physical or chemical reactions in the human body. Long-term consumption of milk containing dietary fiber can make the intestines feel comfortable, lower cholesterol, regulate blood lipids and blood sugar, making it particularly suitable for the elderly. Adding dietary fiber to dairy products can meet the demand for protein, vitamin A, and other animal nutrients, further improving the nutritional value of dairy products [8].

The application of domestic dietary fiber in dairy products is also developing rapidly and has huge market potential. For example, the national dairy market is transitioning from the era of pure milk to the era of high-end functional dairy products. As Chinese people's awareness of the importance of dietary fiber

continues to increase, dietary fiber diets will become a new trend in China's functional health foods, and dietary fiber milk will also become a new highlight in functional dairy products.

2.6 Application of Dietary Fiber in Health Products

In today's society, the application of dietary fiber in health products and medical products is becoming more and more widespread. The main purposes of its application are to supplement the physiological requirement for fiber in the human body, enhance the health functions of products, improve product flavor, and increase product quality.

Domestically, functions such as lubricating the intestines, relieving constipation, detoxifying, and beautifying the skin are particularly popular in the health product industry, and dietary fiber has particularly significant effects in these aspects, so its market prospects are very optimistic. The main components of dietary fiber products can be widely used, for example, to supplement calcium and blood with good effects. Moreover, adding dietary fiber can stimulate the body to produce lactic acid, which in turn can dissolve minerals and promote their absorption by the body [9].

2.7 Application of Dietary Fiber in Other Foods

Dietary fiber is not only widely used in staple foods, beverages, and other products, but its application in other foods also has great practical significance. For example, dietary fiber is used in fillings, soups, and other foods. To improve the appearance quality of pasta, mixing dietary fiber with trace elements and heating it to make fillings yields good results. Salad dressings, condiments, pastries, etc. Adding dietary fiber to these foods can increase their nutritional value and taste, while controlling their calorie and fat content. Dietary fiber can be directly added to some soups to supplement the body's required cellulose. It can also be added to fried foods to make tasty balls; these products have good flavor and nutritional effects and can extend the shelf life of such foods [10].

3 Conclusion and Outlook

3.1 Conclusion

Dietary fiber is an important nutrient with unique physiological functions. Currently, China not only applies dietary fiber in various foods but also uses fiber as an additive to produce capsule and tablet products, achieving significant social benefits. As people's understanding of dietary fiber deepens and research advances, it will play a huge role in future development.

3.2 Outlook

Currently, the development trends in dietary fiber research mainly include the following aspects:

The development and utilization of dietary fiber resources, including further utilization of existing resources on one hand, and the investigation and development of unexplored resources on the other hand.

(2) Establishing efficient methods for determining dietary fiber to promote research in this field.

(3) Improving the scale of instrumentation for industrial production of dietary fiber, finding feasible industrial preparation methods, strengthening research on dietary fiber modification, and promoting the industrial production of dietary fiber.

(4) Encouraging in-depth research on the functional properties and nutritional significance of dietary fiber.

(5) Through the development of dietary fiber applications in food, further expand the scope of dietary fiber development. China should fully utilize its resource advantages in dietary fiber, vigorously develop the dietary fiber industry, meet the needs of the food market, and optimize and improve the dietary structure of our people.

As more and more people domestically and internationally increase their awareness of the nutritional value of dietary fiber and conduct in-depth research on its application in food, the use of dietary fiber in food will have important practical significance and broad market prospects.

Fund Project:

Shandong Provincial Natural Science Foundation, China, ZR2021MC004, Chain Conformational Changes of Ginger Triple-Helix Polysaccharide in Aqueous Solution and the Structural Basis of Its High Immunological Activity, 2022.1-2024.12, Ongoing, Host.

References

- [1]Zhang Xiaoqiang. Definition, Classification and Physicochemical Properties of Dietary Fiber [J]. Technology Outlook, 2016, 26(20): 285-286.
- [2]Huang Qiang, Shu Ting, Wang Chuan, Ouyang Man, Zheng Min. A Brief Discussion on Dietary Fiber and Health [J]. China Food Safety Magazine, 2018, (27): 68.
- [3]Wang Lili. A Brief Discussion on the Medical Value of Dietary Fiber [J]. Everyone's Health (Academic Edition), 2015, 12: 42-43.
- [4]Li Dandan. A Brief Discussion on the Physiological Functions and Applications of Dietary Fiber [J]. Food Engineering, 2015, (1): 20-21.
- [5]Zhang Song. Functional Properties of Dietary Fiber and Research Progress in the Food Field [J]. Food Research and Development, 2018, 39(17): 214-218.
- [6]Zhang Bohua, Zhang Ming, Yang Lifeng, et al. Study on the Extraction of Dietary Fiber and Its Application in Food [J]. China Fruits and Vegetables, 2019, Vol. 39(4): 1-5.
- [7]Sun Guangyan. Application of Water-Soluble Dietary Fiber in Functional Foods [J]. Technological Innovation and Application, 2012, (3): 249.
- [8]Yang Zhiyuan, Yang Haijun. Functional Properties of Dietary Fiber and Its Application in Dairy Products [J]. China Dairy, 2003, 11: 33-34
- [9]Cao Rong'an. Physiological Functional Characteristics of Dietary Fiber and Its Application in the Food Industry [J]. Meat Research, 2010, 2: 76-78.
- [10]Zhao Li, Li Qian, Zhu Dashi. Research Status and Prospects of Dietary Fiber [J]. Food and Fermentation Technology, 2014, 50(5): 76-82.