

Nutritional Value of Plant-Based Foods and Their Potential Impact on Health

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Abstract. Global population growth, accelerated urbanization, and rising per capita income have driven a continuous increase in the demand for meat consumption. However, traditional livestock production models not only impose a significant environmental burden, such as greenhouse gas emissions, land and water resource consumption, but are also closely associated with various health risks, including foodborne illnesses, antibiotic resistance, and zoonotic diseases. As a sustainable alternative to animal-derived food, plant-based food has experienced rapid development in the global food industry in recent years. This paper systematically reviews the definition, raw material composition, and processing technologies of plant-based foods, with a focus on analyzing research progress in their nutritional value, health effects, environmental sustainability, and market acceptance. Additionally, it explores technological innovations in areas such as protein structure modification, texture simulation, and functional component enhancement of plant-based food, as well as challenges and prospects in nutritional optimization, long-term health effect evaluation, and market promotion. This study aims to provide reference and insights for scientific research, product development, and industrial application of plant-based food.

Keywords: Plant-based Food, Nutritional Value, Health Effects, Sustainable Development, Market Trends.

1. Introduction

Driven by global population growth, rising personal income levels, and accelerated urbanization, global meat production and consumption have shown a significant upward trend due to sustained demand[1][2]. The Food and Agriculture Organization of the United Nations (FAO) predicts that by 2050, global meat demand will increase by 76% compared to 2005 levels[3], while global fish demand is expected to reach 140 million tons during the same period[4]. However, the rapid expansion of animal husbandry not only contributes to environmental issues such as greenhouse gas emissions, land and water resource consumption, but is also closely associated with foodborne illnesses, chronic diseases, antibiotic resistance, and zoonotic diseases [5][6]. Particularly during the COVID-19 pandemic, meat processing plants in the United States became high-risk sites for virus transmission, further exposing the vulnerability of the livestock industry in terms of public health[7].

Plant-based foods are products primarily derived from plant-based ingredients as sources of key nutrients such as protein and fat, manufactured through modern processing technologies[8]. In the early 20th century, their main representatives were soybean and grain-based products, with soybeans standing out as a core raw material for producing plant-based meat alternatives due to their excellent gelling properties, potential for fibrous structures, and balanced nutritional profile. Extrusion technology is the most widely used process in current plant-based meat production, significantly improving the structural organization of plant proteins to mimic the texture and fibrousness of conventional meat[9]. With advancements in industrialization and food science, the variety of plant-based foods has expanded considerably since the 21st century, and the applications of textured plant proteins have continued to diversify[10]. In addition to their advantages in environmental sustainability and animal welfare, plant-based foods have garnered attention for health promotion due to their richness in dietary fiber and natural antioxidants. Studies indicate that soluble dietary fiber, such as oat β -glucan, can delay glucose absorption and regulate blood sugar levels, while insoluble fiber, such as cellulose and lignin, promotes intestinal motility and maintains digestive health[11-12]. Furthermore, active components in plant-based foods, such as soy isoflavones, polyphenols, and

carotenoids, exhibit significant antioxidant and disease-preventive effects, demonstrating positive outcomes in cardiovascular health maintenance and alleviation of menopausal symptoms[13-15].

With progress in raw materials and processing technologies, plant-based meat is increasingly regarded as a healthier protein source compared to conventional meat. However, its health benefits remain debated. To mimic the characteristics of animal products, plant-based foods often incorporate flavor enhancers, thickeners, and other additives to improve taste and texture. For instance, soy-based plant meats frequently rely heavily on seasonings to mask beany flavors, while plant-based milks commonly use carrageenan as a thickening agent. Additionally, although high-temperature processing enhances safety, it may lead to nutrient degradation, reducing protein digestibility and amino acid availability. Due to variations in raw materials, plant-based products still face challenges such as insufficient protein content, lack of essential amino acids, low digestibility, and potential allergenicity[16].

In summary, as a significant alternative to animal-derived foods, plant-based foods demonstrate considerable potential in nutritional optimization, environmental protection, and health promotion. This paper systematically reviews the nutritional value of plant-based foods and their potential impact on health.

2. Definition and Classification of Plant-Based Foods

2.1 Concept of Plant-Based Foods

Plant-based foods are products primarily derived from plants or their processed forms, where proteins, fats, and other key nutrients originate from plant sources, with no animal ingredients incorporated into their formulations. These foods not only mimic animal-derived products in terms of morphology, flavor, and texture but also reflect advancements in modern food processing technologies[17]. The core feature of plant-based foods lies in substituting animal proteins with plant proteins, catering not only to the needs of vegetarians but also expanding the consumer base to include “flexitarians”. Their objective is to meet dual demands for sensory experience and nutritional supplementation, serving as a beneficial complement or alternative to animal-derived products, thereby offering consumers more choices and an enhanced consumption experience.

Currently, plant-based foods have become a focal point of research globally, with numerous commercial products gradually emerging. Innovations in food processing technologies, such as non-thermal processing and raw material pretreatment, continue to drive the deep development of plant-based ingredients, providing technical support for the industrialization of plant-based foods. In 2021, the global plant-based meat market reached 5.3 billion USD and is projected to expand to 33.3 billion USD by 2031, with a compound annual growth rate (CAGR) of 20.5% from 2022 to 2031[18]. Similarly, the plant-based dairy market was valued at 11.2 billion USD in 2021 and is expected to rise to 31.5 billion USD by 2028, fueled by a CAGR of 10.5% from 2022 to 2028[19].

2.2 Major Categories of Plant-Based Foods

Plant-based foods can be classified into various categories based on raw material sources and processing methods, including plant-based meat products, plant-based dairy products, plant-based egg products, plant-based frozen desserts, and other plant-based foods. Each type exhibits distinct characteristics in nutritional composition, sensory properties, and market applications.

Plant-based meat products aim to replicate the texture and taste of animal meat. Common examples include bean-based meat, vegetarian chicken, and sliced vegetarian meat. Raw materials encompass legumes, grains, vegetables, edible fungi, and algae. Through extraction, processing, and flavoring, coupled with modern technologies, the protein structure of these products is reorganized at the molecular level to achieve a texture and mouthfeel similar to animal meat[20]. Key techniques for plant protein fibrillation include extrusion, fermentation, freezing, and spinning, with extrusion being the most commercially mature method. Currently, the Chinese market primarily focuses on low-moisture plant-based meat products.

Plant-based dairy products refer to beverages processed from nuts, grains, legumes, and seeds as alternatives to animal dairy, providing nutritional benefits. They are particularly suitable for individuals with lactose intolerance, dairy protein allergies, and those adhering to vegan or vegetarian lifestyles. In recent years, the plant-based beverage market has experienced rapid growth, with products such as almond milk, soy milk, potato milk, oat milk, rice milk, and coconut milk emerging successively. These products offer diverse flavors, textures, and nutritional profiles, meeting consumers' varied tastes and dietary needs. SETHI et al.[21] categorized plant-based milk into five types based on raw materials, grains, legumes, nuts, seeds, and pseudo-grains. Processing methods for plant-based dairy include direct grinding, enzymatic hydrolysis, and fermentation.

Beyond meat and dairy products, plant-based foods also include plant-based egg alternatives that simulate animal eggs, plant-based frozen desserts, e.g., plant-based ice cream, that replace dairy and egg ingredients, and other products such as chocolate and instant noodles. Data indicate that the Chinese market is predominantly focused on plant-based meat and beverages, which accounted for 30.5% and 63.1% of the market share in the first half of 2020, respectively, with domestic brands comprising 60.2% of the market. Although market growth has slowed in recent years, the future of plant-based foods remains broad due to their health and sustainability benefits. However, current limitations in nutritional value and processing methods, such as low protein content in plant-based milk and high additive usage in plant-based meat, necessitate ongoing improvements in nutrient fortification, reduced processing, and optimized sensory experiences for future development.

3. Nutritional Value of Plant-Based Foods

3.1 Analysis of Macronutrients

3.1.1 Protein Quality Assessment

One of the important roles of plant-based foods is to provide high-quality protein. Legumes, represented by soybeans, have a protein content of approximately 40%, which is significantly higher than most animal-based foods[22]. However, from a quality perspective, plant-based protein quality is generally lower than that of animal-derived protein[23]. The Protein Digestibility Corrected Amino Acid Score (PDCAAS) and the Digestible Indispensable Amino Acid Score (DIAAS) are important indicators for evaluating protein quality. Among these, PDCAAS is a protein quality evaluation system recommended by the Food and Agriculture Organization of the United Nations (FAO)[24], with a maximum score of 1.0, comparable to eggs and dairy products[25]. In contrast, DIAAS, as a newer evaluation standard[26], more accurately reflects the actual utilization rate of essential amino acids in the human body.

Soybeans are a common raw material in plant-based foods. Soy protein has a relatively balanced amino acid composition, meeting the standard requirements set by the FAO. Its PDCAAS score is close to 1.0, and its digestibility exceeds 95%, approaching the levels of milk and eggs. Therefore, it is considered a high-quality plant-based protein source comparable to animal protein[27][28]. However, most plant-based proteins generally suffer from deficiencies in lysine or methionine. Therefore, protein complementation is necessary to improve protein quality. For example, legume proteins are rich in lysine, while grain proteins are rich in sulfur-containing amino acids. By combining them appropriately, complementary and synergistic effects can be achieved, thereby enhancing overall nutritional value. Currently, blending multiple plant-based protein sources has become an important direction in product development. For instance, combinations such as soy-pea can significantly improve protein utilization. Additionally, fermentation or enzymatic hydrolysis treatments can markedly enhance the digestibility and absorption rate of plant-based proteins. Thus, although single plant-based proteins are slightly inferior to animal proteins in terms of essential amino acid composition, their potential as dietary protein substitutes remains significant through formula optimization and processing technology innovation.

3.1.2 Fatty Acid Composition

The overall fat content of plant-based proteins is lower than that of animal proteins, but significant differences in fat content and composition also exist among proteins from different plant sources. The fatty acid composition of plant-based foods is predominantly unsaturated fatty acids and contains no cholesterol. Among these, the ratio of essential fatty acids ω -3 to ω -6 has an important impact on health value, with an ideal ratio of approximately 4:1. However, this ratio is often imbalanced in modern diets, and excessive intake of ω -6 may promote inflammatory responses. The ω -3 to ω -6 ratio in flaxseed oil is 4:1, which is close to the ideal level, while the ratios in corn oil and soybean oil are approximately 1:10 or even higher. Nuts and seeds, such as flaxseeds, walnuts, and chia seeds, are rich in alpha-linolenic acid, an important plant-based source of ω -3 fatty acids. Alpha-linolenic acid can be converted in the human body to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), supporting nervous system development and function maintenance[29]. Additionally, phytosterols commonly found in plant-based foods can not only block the absorption of cholesterol in the intestines but also have mild anti-inflammatory effects. Furthermore, DHA extracted from algal oil compensates for the deficiency of long-chain ω -3 fatty acids in plant-based foods.

In summary, polyunsaturated fatty acids, such as linoleic acid and alpha-linolenic acid, in plant-based foods help reduce the risk of cardiovascular diseases, regulate blood lipid levels, and promote normal brain and nervous system function. However, over-reliance on oils high in ω -6, such as soybean oil and sunflower oil, may pose inflammatory risks. Therefore, future efforts should promote plant-based ingredients rich in ω -3, such as flaxseeds, chia seeds, and algal oil, to optimize fatty acid balance.

3.2 Characteristics of Micronutrients

3.2.1 Impact of Fortification Technologies on Nutrient Levels

Vitamins and minerals are key nutrients essential for maintaining human metabolic and physiological functions. Compared to animal-derived foods, plant-based foods lack certain essential micronutrients such as iron, zinc, selenium, calcium, vitamin B12, vitamin B6, and vitamin D, and therefore often require fortification technologies to enhance their nutritional value[30]. Common food fortification techniques include direct addition, such as adding B12 directly to soy milk, biofortification, such as breeding iron-rich wheat, and microencapsulation or nanoencapsulation to improve nutrient stability and absorption rates. Studies have shown that B12-fortified plant milk can provide B12 levels comparable to cow's milk, and iron-fortified plant-based meat can significantly improve the bioavailability of iron. Although fortified foods can compensate for the nutritional shortcomings of plant-based foods, the stability and bioavailability of nutrients remain key challenges. Therefore, future efforts need to incorporate microencapsulation and nanoencapsulation technologies to further enhance the effectiveness of nutritional fortification.

3.2.2 Strategies for Removing Antinutritional Factors

Plant raw materials contain certain antinutritional factors, such as trypsin inhibitors, phytic acid, lectins, and tannins[31]. Among these, phytic acid is a natural compound found in grains and legumes that binds to minerals such as calcium, iron, and zinc, significantly reducing their bioavailability. Since minerals are essential elements for constituting human tissues and maintaining normal physiological functions, special processing treatments are required, such as using heat treatment to reduce trypsin inhibitor activity, and employing ion exchange, enzymatic hydrolysis, fermentation, and heat treatment technologies to reduce or even completely remove antinutritional factors. For example, under high-temperature and high-pressure conditions, the phytic acid content in chickpeas decreases by more than 50%. After fermenting soybeans, phytic acid can be reduced by over 60%, thereby improving the utilization rates of minerals such as iron and zinc. Thus, through appropriate processing techniques, the negative effects of antinutritional factors can be significantly reduced, thereby improving the overall nutritional value of plant-based foods.

3.3 Functional Components

3.3.1 Prebiotic Effects of Dietary Fiber

Dietary fiber in plant-based foods is not only abundant but also exhibits diverse structural characteristics of both soluble and insoluble types, which promote gut health and exert prebiotic effects. Dietary fiber possesses multiple functions, such as improving and promoting digestive health, reducing the absorption of fats and cholesterol, enhancing the utilization of nutrients, preventing cardiovascular and cerebrovascular diseases, boosting immunity, and aiding in the prevention and management of diabetes[32]. Prebiotics are a type of indigestible carbohydrates that stimulate the growth of beneficial gut bacteria. Daily intake of more than 10 grams of dietary fiber can significantly increase the population of bifidobacteria in the gut and improve intestinal barrier function. Plant-based foods, such as whole grains, legumes, and nuts, are important sources of prebiotics. Increasing the intake of whole-grain dietary fiber may reduce the risk of certain types of cancer[33]. Although dietary fiber has positive effects on gut health, excessive intake may cause gastrointestinal discomfort. Therefore, reasonable dietary recommendations should be made based on individual tolerance levels.

3.3.2 Bioavailability of Phytochemicals

Plant-based foods are rich in various natural antioxidants, including flavonoids, polyphenols, carotenoids, and vitamin E, which together form a multi-layered antioxidant defense system. This system helps alleviate oxidative stress and prevent chronic diseases[34]. Studies have shown that soy isoflavones not only possess free radical-scavenging capabilities but also exhibit estrogen-like activity. They can bind to estrogen receptors, providing positive effects in alleviating menopausal symptoms and reducing bone loss. Additionally, legumes are important sources of dietary fiber, vitamins, and minerals, and are highly antioxidative[35]. However, the metabolism and absorption of phytochemicals vary among individuals. For example, only 30%-50% of individuals can convert soy isoflavones into more biologically active metabolites. Fermented soy foods, such as natto, can significantly enhance their bioavailability. Therefore, future research should focus on personalized dietary patterns to explore ways to maximize the health benefits of phytochemicals.

4. Balancing the Health Effects and Risks of Plant-Based Foods

4.1 Health Benefits of Plant-Based Foods

4.1.1 Chronic Disease Prevention

Epidemiological studies indicate that children who adopt plant-based diets tend to have lower levels of low-density lipoprotein, suggesting a better cardiovascular risk profile. The abundance of dietary fiber in plant-based foods helps reduce the risk of chronic diseases such as type 2 diabetes[36] and coronary heart disease[37]. Furthermore, a higher intake of plant-based diets has been significantly associated with a reduced risk of fatal prostate cancer[38]. Additionally, research has found that increasing plant protein intake aids in protecting renal function, lowering the risk of chronic kidney disease, and improving blood pressure levels. These chronic diseases are closely linked to long-term poor dietary patterns, and plant-based diets have demonstrated significant advantages in epidemiological evidence. Allender et al.[39] conducted a meta-analysis of randomized clinical trials on the correlation between dietary calcium and blood pressure, revealing that a median calcium intake of 1 gram per day significantly reduced systolic blood pressure by 1-2 mmHg. High-calcium diets lower the risk of hypertension by reducing peripheral vascular resistance and blood pressure[40]. However, the health effects of calcium depend on its bioavailability and intestinal absorption rate, with the average absorption rate in humans being only 25%–30%[41]. Consumption of prebiotics, such as inulin, can enhance calcium absorption[42]. In summary, plant-based foods show potential in chronic disease prevention, but their actual effects are influenced by individual genetics, lifestyle, and other factors. Therefore, personalized dietary plans should be developed under scientific guidance.

4.1.2 Intestinal Health

Plant-based foods are rich in dietary fiber and prebiotics, which can effectively improve the structure of the gut microbiota and promote intestinal health[43]. The gut microbiota refers to the microbial communities residing in the digestive tract, playing crucial roles in nutrient metabolism, immune regulation, and intestinal function[44]. Studies have found that β -series oligosaccharides in chickpeas stimulate the proliferation of bifidobacteria at a rate three times that of ordinary prebiotics. Bifidobacteria are probiotics that help maintain the balance of the gut microecology, promote intestinal motility, and improve digestive function. Although plant-based diets are generally beneficial for intestinal health, excessive intake of high-fiber foods may cause gastrointestinal discomfort, particularly in individuals with irritable bowel syndrome. Thus, dietary adjustments should consider individual tolerance levels.

4.1.3 Weight Management

Plant-based foods are typically characterized by low calorie content, low energy density, and strong satiety, making them conducive to weight management and obesity prevention. Weight management involves the balance of energy consumption and expenditure. Due to their high dietary fiber and low saturated fat properties, plant-based diets can regulate metabolism and enhance satiety. Tucker and Thomas [13] observed in a study involving 252 middle-aged women that over a 20-month follow-up period, for every additional 8g of dietary fiber intake per 1000 kcal, participants lost an average of 4.4 pounds, primarily due to reduced body fat. This result was independent of factors such as age, baseline fiber intake, and fat intake. Koh-Banerjee et al. [45] further proposed a dose-response relationship. For every 40g increase in whole grain intake per day, body weight increased by 1.1 pounds, whereas a daily increase of 20g in bran intake reduced weight gain by 0.8 pounds, indicating its role in controlling weight gain. Overall, plant-based foods offer advantages for weight management, but long-term interventions must consider dietary compliance, nutritional balance, and individual differences to avoid health risks arising from nutritional deficiencies.

4.2 Potential Risks and Considerations of Plant-Based Foods

4.2.1 Nutritional Deficiencies

Long-term adherence to a plant-based diet may lead to insufficient intake of certain key nutrients, particularly vitamin B12, iron, and calcium, which can adversely affect health[46]. Vitamin B12 is primarily derived from animal-based foods, and the absorption rate of non-heme iron from plant-based foods is relatively low, potentially increasing the risk of anemia. Studies have shown that some long-term vegetarians developed subacute combined degeneration of the spinal cord due to vitamin B12 deficiency, manifesting as unsteady gait or even loss of independent walking ability. To mitigate these risks, individuals following a plant-based diet should address potential nutritional gaps through reasonable food combinations, nutrient-fortified foods, or dietary supplements to ensure nutritional balance.

4.2.2 Food Processing and Additives

Some commercial plant-based foods undergo multiple industrial processing steps and may contain high levels of salt, sugar, trans fats, and various additives, whose long-term consumption could be detrimental to human health. Investigations have found that to mimic the texture of meat, some plant-based meat products add significant amounts of coconut oil, approximately 80% of which is saturated fat, and salt, making them high-calorie and high-sodium foods. Furthermore, the protein content in a well-known brand like OATLY's oat milk is about one-third that of cow's milk per 100 mL, but its carbohydrate content is significantly higher than that of milk. Its packaging indicates 7g of added sugar, which contradicts its advertised concept of being "low-fat and low-sugar". Therefore, although plant-based foods offer consumers a healthy dietary choice, consumers should pay attention to food labels and prioritize minimally processed foods with low additives to reduce potential health risks.

4.2.3 Allergic Reactions

Food allergy refers to an abnormal immune response of the body to certain plant proteins[47]. Components in plant-based foods, such as soy, nuts, and gluten, may trigger food allergies, affecting the health of specific populations. Globally, approximately 3%-6% of adults have allergic reactions to soy protein, and gluten-related disorders affect about 1% of the population. Recently, pea has been introduced as a gluten-free alternative protein source with lower allergenicity[48]. Therefore, when promoting plant-based foods, individual allergy profiles should be considered, and more low-allergenicity alternatives, such as peas, chickpeas, and quinoa, should be provided to meet the nutritional needs of specific populations.

4.3 Balancing Health Effects and Risks

Plant-based foods hold significant potential for health promotion and disease prevention, but potential nutritional risks and food safety issues also need attention to achieve a balanced diet. A balanced diet emphasizes the reasonable combination of macronutrients and micronutrients to ensure an adequate supply of all nutrients required by the human body. Studies have shown that a properly planned plant-based diet can provide sufficient nutrition and reduce the risk of chronic diseases without increasing the probability of nutrient deficiencies[49]. In the future, through food fortification, precision nutrition, and personalized dietary guidance, the health effects of plant-based foods should be maximized while minimizing potential risks, thereby promoting healthier dietary patterns.

5. Future Research Directions and Development Trends

5.1 Personalized Nutrition

Personalized nutrition integrates cutting-edge sciences such as genomics and metabolomics to develop precise plant-based dietary plans for different individuals, thereby enhancing health benefits. As a scientific strategy, personalized nutrition optimizes dietary patterns to improve health based on individual genetic characteristics, gut microbiota, metabolic status, and lifestyle. Research indicates that people with different genotypes exhibit significant variations in metabolic responses to plant-based diets. For instance, several studies have employed computer modeling to estimate the nutritional impact of replacing animal products with Plant-Based Alternative Protein Products (PBAPA) in specific populations. Vatanparast et al. simulated the nutritional effects of replacing meat with PBAPA in the United Kingdom. They found that PBAPA led to increased intake of carbohydrates, fiber, sugar, and sodium, but decreased intake of protein, fat, saturated fat, iron, and vitamin B12. The authors concluded that PBAPA could be a healthy alternative to meat if consumers opt for products low in salt and sugar, and high in fiber, protein, and micronutrients. They also suggested that manufacturers and policymakers should consider fortifying PBAPA with iron and vitamin B12 while reducing sugar and salt content[50]. Although the application of personalized nutrition in plant-based diets holds broad prospects, challenges such as high costs, data privacy concerns, and insufficient compliance remain. Future research should explore more feasible implementation strategies and integrate with intelligent health management platforms for optimization, thereby promoting the application of personalized nutrition in public health.

5.2 Food Innovation and Technology

The integration of advanced food technologies, such as 3D printing technology [51], fermentation technology, and cell culture technology, is driving breakthroughs in the nutrition, taste, and texture of plant-based foods. Food innovation encompasses not only improvements in production processes but also optimization of raw materials and product structure design to meet consumers' dual demands for sensory quality and health value. For example, 3D food printing technology can precisely control food texture[52]. It offers a method for producing plant-based meat that mimics the taste, texture, and appearance of traditional meat[53]. This technology has been successfully used to create plant-based

steaks that simulate the layered tissue structure of real meat, enhancing consumer acceptance. Fermentation technology, on the other hand, can improve protein digestibility and reduce anti-nutritional factors. Studies have shown that microbial fermentation can increase the Digestible Indispensable Amino Acid Score (DIAAS) of plant-based milk by 15%-20%, thereby enhancing amino acid utilization. Although food technology is significantly improving the taste and nutritional value of plant-based foods, its industrialization is still constrained by factors such as production costs, regulatory approvals, and consumer acceptance. Future development directions should focus on sustainable raw material sources, efficient and low-cost processes, and healthier product formulations.

5.3 Policy and Education

Government policies and public education play a key role in promoting the adoption of plant-based diets, including revisions to nutritional guidelines, formulation of food regulations, and enhancement of consumer awareness. Policy intervention refers to measures such as regulations, subsidies, and tax adjustments implemented by governments and public institutions to guide healthy dietary habits. For example, some countries have incorporated plant-based diets into official dietary guidelines and implemented food labeling regulations to help consumers make healthier choices. Canada's *Dietary Guidelines 2019* emphasized plant-based foods as the primary source and reduced the intake of red and processed meats, a policy that has stimulated a 20% growth in the plant-based food market. Additionally, a survey of 10,000 consumers found that government-supported nutrition education programs could increase acceptance of plant-based diets by 35%. Although policy support and educational promotion positively impact the development of plant-based diets, issues such as food affordability and cultural acceptance remain unsolved. In the future, governments and enterprises should strengthen cooperation to optimize the food supply chain and utilize social media and digital platforms to enhance public nutritional literacy.

6. Conclusions

Plant-based foods have emerged as a significant global dietary trend, driven by multifaceted factors such as health, sustainability, and environmental protection. Existing research demonstrates that plant-based diets offer notable benefits, including reduced chronic disease risk, improved gut health, and support for weight management. Concurrently, rapid advancements in food processing technologies have diversified and enhanced the quality of plant-based products, providing consumers with more attractive and varied choices. However, the development of plant-based foods still faces challenges. For instance, potential nutrient deficiencies, e.g., vitamin B12, iron, and calcium, ultra-processing issues in some products, and allergic reactions triggered by ingredients like soy, nuts, and gluten may pose health risks. Additionally, regional disparities in consumer acceptance and concerns about nutritional completeness highlight the need for further optimization of formulations and enhanced nutritional education. Looking ahead, the future of plant-based foods should focus on nutritional optimization through fortification, fermentation, and novel processing technologies, personalized nutrition strategies leveraging genomics, metabolomics, and gut microbiome research to maximize health benefits, and policy support and public education to improve consumer acceptance and promote healthier dietary patterns. By addressing these challenges, plant-based foods are poised to play a pivotal role in chronic disease prevention, sustainable food system development, and the advancement of global public health.

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