



## Postbiotics and Their Application in Food and Nutrition: A Perspective

Merih Kivanc\*

a. Department of Biology, Anadolu University Faculty of Sciences, Eskisehir 26470 , Turkey

**Abstract:** In recent years, the concept of postbiotics has gained significant attention in the field of food and nutrition. Postbiotics are non-viable microbial products or metabolic byproducts generated during the fermentation of probiotics. These compounds, which include organic acids, peptides, and polysaccharides, have demonstrated numerous health benefits. This comprehensive perspective explores the emerging science of postbiotics, their mechanisms of action, and their diverse applications in food and nutrition. Drawing on recent research and clinical studies, this review highlights the potential of postbiotics to revolutionize functional foods, dietary supplements, and personalized nutrition strategies.

### 1. Introduction

The human gut is home to a complex and diverse community of microorganisms, collectively known as the gut microbiota. These microorganisms play a crucial role in maintaining human health and well-being by contributing to digestion, metabolism, immune function, and more (Kho and Lal, 2018). Probiotics, live microorganisms with proven health benefits when consumed in adequate amounts (Hill et al., 2014), have received considerable attention for their role in promoting a healthy gut microbiota.

While probiotics have demonstrated numerous health benefits, recent research has revealed that their metabolic activity can yield a spectrum of bioactive compounds with potential health-promoting properties. These compounds, collectively referred to as postbiotics, include a wide range of substances such as short-chain fatty acids (SCFAs), peptides, polyamines, and exopolysaccharides (Marco et al., 2017). This comprehensive perspective delves into the emerging science of postbiotics and explores their mechanisms of action, potential health benefits, and applications in food and nutrition.

### 2. Mechanisms of Action

Postbiotics exert their effects through several mechanisms, contributing to their potential health benefits.

#### 2.1 Immunomodulation

Postbiotics have been shown to modulate immune responses. For instance, certain bacterial cell wall components, such as peptidoglycans and lipopolysaccharides, can stimulate immune cells, leading to enhanced host defense (Vinderola et al., 2019). This immunomodulatory activity contributes to the potential of postbiotics to strengthen the immune system.

#### 2.2 Anti-Inflammatory Effects

Postbiotics can possess anti-inflammatory properties. SCFAs, such as butyrate, propionate, and acetate, are metabolic byproducts of probiotic bacteria and have been associated with reduced inflammation in the gut and other body tissues (Parada Venegas et al., 2019). These anti-inflammatory effects are crucial for managing chronic inflammatory conditions.

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Corresponding email: [mkivanc@anadolu.edu.tr](mailto:mkivanc@anadolu.edu.tr) (Merih Kivanc)

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### **2.3 Enhanced Gut Barrier Function**

Postbiotics can improve gut barrier function by promoting the synthesis of tight junction proteins, which help maintain the integrity of the intestinal lining (Jandhyala et al., 2015). A robust gut barrier is essential for preventing the leakage of harmful substances into the bloodstream.

### **2.4 Antimicrobial Activity**

Certain postbiotics exhibit antimicrobial properties, inhibiting the growth of pathogenic bacteria and potentially reducing the risk of infections (Haghshenas et al., 2015). This activity is vital for maintaining a healthy microbial balance in the gut.

## **3. Applications in Food and Nutrition**

The potential of postbiotics in food and nutrition is multifaceted and holds promise for various applications.

### **3.1 Functional Foods**

Postbiotics are increasingly being incorporated into functional foods, such as yogurt, kefir, and fermented dairy products (Sarkar et al., 2021). These foods serve as convenient vehicles for delivering postbiotics to consumers, promoting gut health, and offering additional health benefits.

### **3.2 Dietary Supplements**

Postbiotic supplements are gaining popularity as a convenient way to enhance the intake of these beneficial compounds. These supplements are available in various forms, including capsules, powders, and liquids, making them suitable for a wide range of consumers.

### **3.3 Personalized Nutrition**

Postbiotics align with the concept of personalized nutrition, which tailors dietary recommendations to an individual's unique physiological and microbial profile (He et al., 2018). This approach allows for precision nutrition strategies that can optimize health outcomes based on individual needs.

### **3.4 Disease Management**

Postbiotics show promise in the management of various health conditions. For example, they have been investigated for their potential in alleviating symptoms of gastrointestinal disorders, such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD) (Rigotti et al., 2021). The anti-inflammatory and gut-strengthening properties of postbiotics make them a valuable component of dietary interventions for these conditions.

### **3.5 Obesity and Metabolic Health**

Research suggests that specific postbiotics, such as SCFAs, can have a positive impact on metabolism, improve insulin sensitivity, and aid in weight management (Morrison and Preston, 2016). These metabolic effects have significant implications for addressing conditions like obesity and type 2 diabetes.

### **3.6 Regulatory Considerations**

Regulatory bodies are increasingly recognizing the potential of postbiotics in food and dietary supplements. The European Food Safety Authority (EFSA) has issued guidance on health claims related to the immune system, the gastrointestinal tract, and defense against pathogenic microorganisms, underscoring the importance of postbiotics in food and nutrition (EFSA Panel on Nutrition, Novel Foods, and Food Allergens, 2021).

## **4. Conclusion**

The concept of postbiotics represents a promising frontier in food and nutrition science, offering a diverse range of health benefits through their influence on the gut microbiota, immune system, and metabolism. As our scientific understanding of postbiotics continues to evolve, their applications in functional foods, dietary supplements, and personalized nutrition strategies are poised to revolutionize the field. By harnessing the potential of postbiotics, we can develop innovative dietary interventions that promote optimal health and well-being in an era of personalized nutrition.



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