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MECHANISMS OF POSTBIOTICS AND THEIR IMPACT ON HUMAN HEALTH

У статті надано чітке пояснення того, що таке постбіотики, чим вони відрізняються від пробіотиків, а також наукові пояснення, що стоять за їх створенням і функціями. Досліджено потенційні переваги постбіотиків для здоров'я, зокрема їх роль у підтримці здоров'я травлення, імунної функції та загального самопочуття.

Ключові слова: *постбіотики, мікроорганізми, пробіотики, імунітет, метаболізм.*

The article provides a clear explanation of what postbiotics are, how they differ from probiotics, and the science behind their formation and functions. The potential health benefits of postbiotics have been explored, including their role in supporting digestive health, immune function, and overall well-being.

Key words: *postbiotics, microorganisms, probiotics, immune, metabolism.*

According to extensive studies on microorganisms, probiotics are widely applied in food processing, infant formula, medical, agricultural, and even aquaculture sectors for their health-maintaining properties. Dietary supplements known as probiotics contain living, nonpathogenic bacteria that are beneficial to the host's health. They operate through various mechanisms, including immunomodulation, the generation of antimicrobial compounds, direct binding, or the competitive inhibition of pathogens. Additionally, they regulate electrolyte absorption and gut motility. Despite these advantages, challenges such as quality variations, a brief shelf life, diverse effects, and the inconvenience for immunocompromised individuals restrict their use in various transportation methods and storage conditions like pasteurization or baking.

To address this issue, new-era products such as postbiotics have emerged as the current research target. These products exhibit enhanced safety and stability, are more convenient for storage, and entail a lower risk of antimicrobial resistances.

According to the current literature, postbiotics are bioactive compounds that are produced during the fermentation process of probiotics or by the action of gut microbiota on dietary substrates. These compounds include various metabolites, cell wall components, and other byproducts of microbial activity. Typically, the forms could be a heterogeneous mixture of cellular structures and metabolites such as teichoic acids, exopolysaccharides, peptidoglycan, bacteriocins, etc [1].

At present, postbiotics find application not only in the fermented food industry but also emerge as a promising treatment approach for sub-health conditions, particularly in addressing gastrointestinal disorders like bloating and diarrhea [2]. Therefore, the application of postbiotics would be an efficient complement to probiotics and a driving force for the development of a comprehensive health industry.

Postbiotics exert a broad spectrum of positive impacts on human health by influencing the gut microbiota and modulating various physiological processes. These effects encompass:

1. Postbiotics can help regulate the immune system and reduce inflammation. Certain metabolites produced during the fermentation process, such as short-chain fatty acids (SCFAs), have anti-inflammatory properties. They can modulate immune cell activity and reduce the production of pro-inflammatory cytokines.
2. Postbiotics can interact with the immune system to enhance its function. They may stimulate the activity of immune cells, promote the production of antibodies, and contribute to a balanced immune response. This can be beneficial in preventing or managing immune-related disorders.
3. Postbiotics can strengthen the gut barrier, which plays a crucial role in preventing the entry of harmful pathogens and toxins into the bloodstream. By promoting

the production of mucins and enhancing tight junction integrity, postbiotics contribute to a healthy gut barrier.

4. Some postbiotics, particularly SCFAs like acetate, propionate, and butyrate, play a role in energy metabolism. They can influence glucose and lipid metabolism, contributing to improved insulin sensitivity and potentially aiding in the management of metabolic disorders such as diabetes.

5. Postbiotics may exhibit direct antimicrobial effects by inhibiting the growth of pathogenic bacteria. This helps maintain a balanced microbial community in the gut and prevents the overgrowth of harmful microbes.

6. Certain postbiotics possess antioxidant capabilities, helping to neutralize free radicals and reduce oxidative stress. This can contribute to overall cellular health and may have implications for preventing chronic diseases associated with oxidative damage.

7. There is emerging evidence that postbiotics can influence the gut-brain axis, affecting neurological function and mental health. They may produce neuroactive substances that impact mood, cognition, and behavior.

8. Postbiotics can influence gene expression in host cells, leading to changes in various physiological processes. This modulation of gene expression can contribute to the overall health-promoting effects of postbiotics.

9. Research suggests that postbiotics may have therapeutic applications in preventing and managing various conditions, including inflammatory bowel diseases, metabolic disorders, and neurodegenerative diseases.

The boundary between probiotics and postbiotics is blurred in some trials, as their impact on the results is often not evaluated separately [3]. Balancing the safety concerns against performance differences in probiotics and postbiotics, a compromised and optimal prescription is urgent to be proposed when facing a specific patient's state, which may lie in the combined administration of probiotics and postbiotics in appropriate proportion. Incorporating a diverse range of dietary fibers, prebiotics, and fermented foods can contribute to the production of beneficial postbiotics in the gut.

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