POSTBIOTICS AS EMERGING ALTERNATIVES FOR GUT HEALTH AND PERFORMANCE IN MONOGASTRICS

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Abstract

In recent years, the gut microbiome has become one of the most studied topics in both human and veterinary medicine, particularly in light of the need to reduce the excessive use of antibiotics and combat antimicrobial resistance. The family of "biotics", which includes prebiotics, probiotics, synbiotics, and, more recently, postbiotics, offers promising alternatives for maintaining animal health and preventing dysbiosis. In this context, a new category, postbiotics, defined as "non-viable products or microbial metabolites with a beneficial effect on the host" has attracted increasing interest. Studies conducted to date show significant beneficial effects in monogastric animals. In pigs, postbiotics reduce post-weaning diarrhea and improve growth performance; in poultry, they optimise feed conversion, reduce pathogen colonisation, and support intestinal health; and in companion animals, emerging data suggest benefits for digestive health, including allergy control.

This study aims to synthesize the latest available data on the use of postbiotics in farm and companion monogastric animals, focusing on mechanisms of action, demonstrated effects, and potential practical applications.

Key words: *postbiotics, dysbiosis, animals, digestive health*

INTRODUCTION

The concept of postbiotics was defined in 2021 by the International Scientific Association for Probiotics and Prebiotics (ISAPP), which described postbiotics as "preparations of inactivated microorganisms and/or their components that confer health benefits on the host." The term derives from the Greek post ("after") and bios ("life"), suggesting that these products originate from microorganisms that are no longer viable [1].

Postbiotics may include inactivated bacterial cells (intact or fragmented), structural components (e.g., cell walls), but also substances resulting from fermentation, such as metabolites, proteins, or peptides [2]. The essential condition is that they must be obtained from microorganisms with a known genome, through standardized and reproducible technological processes.

Before 2021, the scientific literature was fragmented between a series of terms describing partially overlapping concepts like paraprobiotics [3], metabiotics [4], bacterial lysates [5], and tindalized probiotics [6]. Each term reflected an attempt to describe the beneficial effects of non-viable microorganisms or their metabolic products, but without a common definition. To standardize terminology and provide a coherent conceptual framework, Salminen et al. (2021), on behalf of ISAPP, proposed the general term "postbiotic," which encompasses all these forms of inactivated microbial products with positive health effects.

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MATERIAL AND METHOD

This article is a narrative mini-review based on current scientific literature on postbiotics and their effects in veterinary medicine, with a focus on their use in monogastric farm animals (poultry and pigs) and companion animals (dogs and cats).

The selection of papers aimed to include the most recent experimental studies and review articles (review or meta-analysis type), published between 1999 and 2025, also taking into account older studies in human medicine in which various names of the term accepted in the current international literature as "postbiotic" appear.

Sources were identified through systematic searches of scientific databases using keywords such as: "postbiotics," "inactivated probiotics," "paraprobiotics," "metabiotics," "tindalized probiotics," "bacterial lysates," "gut microbiota," "immune modulation," "pigs," "poultry," "dogs," "cats."

This study synthesizes the information available in the scientific literature on postbiotics, including both review articles that have contributed to defining and consolidating the concept of "postbiotic" (Salminen et al., 2021; Ma et al., 2023; Vinderola & Salminen, 2025), as well as experimental and clinical studies that have evaluated their effects on intestinal health, productive performance, and immune response in farm animals (AbdEl-Ghany et al., 2022; Urban et al., 2024; Ali et al., 2023; Kang et al., 2021). Controlled clinical studies in dogs and cats investigating the use of Saccharomyces cerevisiae fermentation products or other postbiotics were also analyzed (Wilson et al., 2022; Sordillo et al., 2025; Ishii et al., 2025).

RESULTS AND DISCUSSIONS

The definitions of the terms prebiotic and probiotic are already well established internationally [7], although, according to recent research, some challenges remain regarding the methods of standardization and quantification of these products. Traditionally, probiotics have been evaluated and standardized based on the number of colony-forming units (CFU), considered an indicator of the viability of microorganisms and their biological potential. However, this method has significant limitations, particularly for products containing multiple strains or species, but also because CFU does not always reflect the metabolic activity or structural integrity of probiotic cells [8].

The ISAPP definition [1] indicates that the manufacturing process and method of microbial inactivation (heat, pressure, radiation, lysis, etc.) are intrinsic to the functionality of the product. Final products may include inanimate bacteria, intact dead cells, cell fragments, or lysates along with microbial metabolites (or not, if the biomass is rigorously washed), examples of which researchers refer to as postbiotics, are highlighted in Figure 1. Therefore, each postbiotic product may be a complex mixture of functional components. This complexity is not unique to postbiotics: commercial probiotic products inevitably contain a percentage of dead cells due to processing (e.g., freeze-drying) or natural death during storage [8, 9, 10].

In some Lactobacillus/Bifidobacterium capsules, conservative estimates suggest that 10–30% of cells may be dead or inactive. Therefore, probiotic and postbiotic products can both be complex mixtures, but the key difference is that, in postbiotics, there is no requirement for viability as an essential part [8, 12].

In a recent study on the prevention of necrotic enteritis caused by Clostridium perfringens in broiler chickens, researchers compared the efficacy of a postbiotic in the form of a dry feed additive, obtained by aqueous fermentation with non-viable Lactobacillus species, with that of a probiotic also in the form of a dry feed additive, containing an aqueous mixture of Bacillus subtilis and licheniformis. A third experimental group received amoxicillin administered in drinking water. The study concluded that postbiotic treatment together with antibiotics (administered in feed and water) reduced the severity of necrotic enteritis and improved liver and immune status better than combining probiotics with the same antibiotics [13]. According to the analysis by Urban et al. (2024) [14], postbiotics are a safe and sustainable alternative to antibiotics, which are considered growth promoters in poultry farming. The synthesized studies showed significant improvements in productive performance, intestinal integrity, and immune status, along with a reduction in enteric pathogens. In addition, the inclusion of postbiotics in feed rations has been associated with an increase in the quality of poultry products and better oxidative stability of meat and eggs.

Studies conducted on weaned piglets have shown that the inclusion of inactivated Lactobacillus in feed rations can improve growth performance, reduce the incidence of post-weaning diarrhea, or favorably modulate the intestinal microbiota, increasing the proportion of beneficial species and reducing pathogenic flora [15].

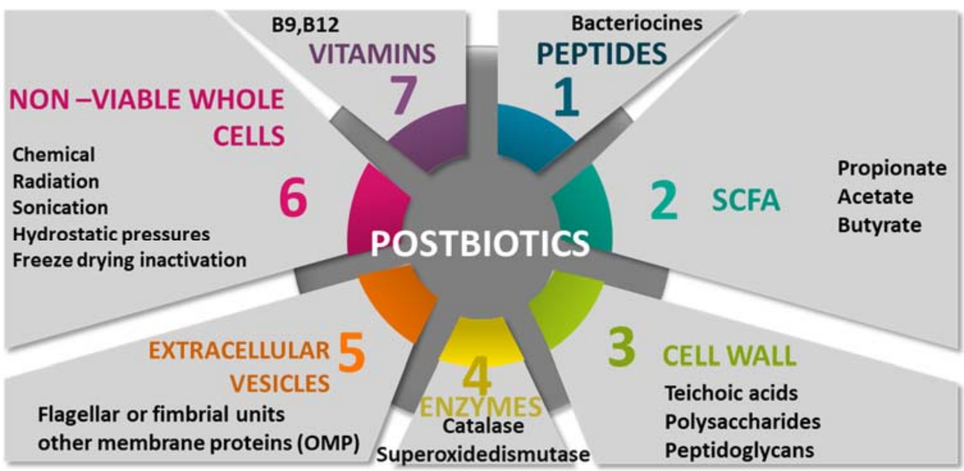

Fig. 1 Schematic diagram illustrating the main postbiotics [1, 8, 11]

For example, heat-inactivated *L. reuteri* I5007 administered to pregnant sows improved the performance of newborn piglets and reduced episodes of diarrhea after weaning [16]. Similarly, UV-inactivated *L. rhamnosus* HN001 reduced the severity of necrotizing enterocolitis in piglets [17].

These results suggest that postbiotics derived from Lactobacillus strains may be an effective strategy for supporting intestinal health and immunity in pigs [18], with advantages of stability, safety, and ease of formulation over live probiotics. However, the biological effect may vary depending on the strain used, the inactivation method, and the dose administered, which is why further research is needed to optimize the practical application of these products in swine nutrition.

The use of postbiotics in dog nutrition and therapy has been extensively studied in recent years, particularly for their immunomodulatory, antioxidant, and anti-inflammatory effects. Most research has focused on fermentation products obtained from *Saccharomyces cerevisiae* and postbiotics derived from lactic acid bacteria [19].

In a study conducted on healthy geriatric dogs [20], supplementation with short-chain fructooligosaccharides (scFOS) derived from yeast resulted in a significant increase in the CD4+:CD8+ ratio, associated with an improvement in mucosal immune response, suggesting that postbiotics may counteract immunosenescence and support T-helper cell function [20, 21, 22]

Another study, conducted on dogs subjected to transport and exercise stress, showed that postbiotics derived from S. cerevisiae prevented an increase in total leukocyte, lymphocyte, and eosinophil counts after periods of effort, maintaining immune homeostasis [23, 24].

A randomized, placebo-controlled clinical study by Sordillo et al. (2025) [25] evaluated the efficacy of a new indole-rich postbiotic (Canine Immune Health Postbiotic – CIHP) on skin health and the gut microbiome in dogs with subclinical pruritus. Over a 28-day period, animals receiving the postbiotic supplement showed a significant reduction in scratching behavior (−20%) and a 27% decrease in the Pruritus Visual Analog Scale (PVAS) score compared to the placebo group ($p < 0.05$).

Studies on the use of postbiotics in cats are still limited. In a recent study, Ishii et al. (2025) [26] evaluated the effects of adding a Saccharomyces cerevisiae fermentation product abbreviated SCFP to the diet of healthy adult cats. Over 42 days, supplementation did not affect nutrient digestibility but maintained stable gut microbiota diversity, favorably modulated immune response, and improved diet palatability, particularly at the moderate dose tested. The authors concluded that SCFP may act as a safe and beneficial functional ingredient for maintaining intestinal health and immune balance in cats. However, further research is needed to establish the optimal dose and long-term effects.

CONCLUSIONS

Although many compounds included in the postbiotics category, such as short-chain fatty acids, antimicrobial peptides, or enzymes, were already known for their beneficial effects, the term postbiotic was introduced to unite existing compounds under a common concept/term, therefore providing a common basis for regulation, research, and product development.

This reflects the idea that benefits to the host can be conferred not only by living microorganisms, but also by their inactivated bioactive products resulting from microbial processes. Therefore, the notion of postbiotic does not redefine existing compounds, but integrates into a coherent framework the set of inanimate microbial components with proven functional effects.

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