UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM TIMISOARA
"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES"
05-06 November 2026



Postbiotics in Animal Nutrition and Nutritional Physiology: Mechanisms, Species-Specific Applications, and Future Perspectives

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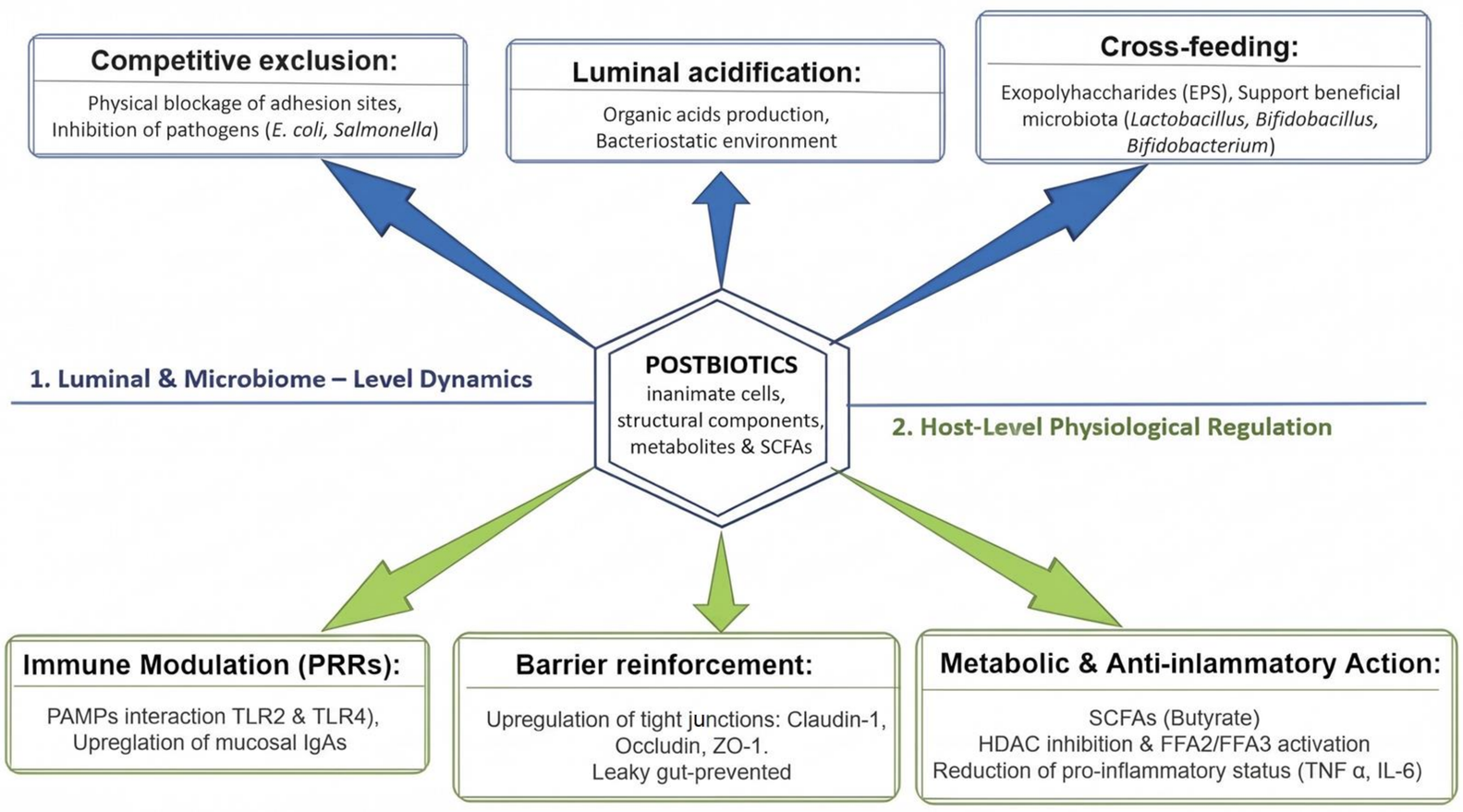
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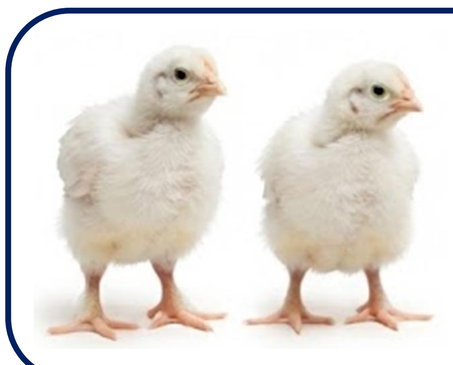
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The global livestock and aquaculture industries face increasing pressure to transition toward sustainable, antibiotic-free production models in response to escalating antimicrobial resistance concerns. Postbiotics—formally defined by international scientific consensus as preparations of inanimate microorganisms and/or their cellular components that confer a health benefit to the host—have emerged as a precision-targeted alternative to live probiotics and antibiotic growth promoters. Unlike live cultures, postbiotics offer exceptional thermal resilience during industrial feed processing, extended shelf-life, and predictable pharmacokinetic profiles. This paper critically evaluates and synthesizes the current understanding of postbiotic composition, detailing their multi-targeted dual mechanism of action encompassing microbiome-level eubiosis (competitive exclusion, cross-feeding, and luminal acidification) and host-level physiological regulation (pattern recognition receptor signaling, tight-junction reinforcement via claudins and ZO-1, and anti-inflammatory pathways mediated by short-chain fatty acids) (Figure1). Furthermore, we evaluate species-specific zootechnical applications across poultry, swine, ruminants, aquatic species, rabbits, and equine athletes, demonstrating how targeted postbiotic supplementation successfully mitigates critical production bottlenecks such as weaning stress, heat challenge, and subclinical enteropathies (Figure 2).

DUAL MECANISM OF ACTION OF PROBIOTICS



SPECIES-SPECIFIC APPLICATIONS



Intestinal Health
Feed Conversio Ratio
Egg Quality
Immunity

Gut Barrier Function
Reduced Pathogens
Growth Performance
Piglet Vitality





Rumen Fermentation
Fiber Digestion
Milk Production and Composition
Calf Health

Hindgut Health
Nutrients Absorption
Hoof Integrity
Performance





Digestive Stability
Enteritis Resistance
Growth Rate
Meat Quality

Water Quality
Disease Resistance
Feed Utilization
Growth



Conclusions & FUTURE PERSPECTIVES

1. Superior zootechnical performance: postbiotics improve key production metrics, such as average daily gain (ADG) and feed conversion ratios (FCR); **2. A scientifically validated strategy:** postbiotics represent a robust solution for optimizing intestinal barrier integrity and stimulating immune readiness; **3. Safety and sustainability:** postbiotics increase production efficiency without compromising animal welfare or food safety.