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Editorial: Current insights on food digestibility and microbial diversity

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Editorial on the Research Topic
Current insights on food digestibility and microbial diversity

In recent years, the intricate connections between food digestibility and the gut microbiota have gained significant attention as key factors influencing overall health and disease outcomes. The growing recognition of the gut microbiome's role in modulating various physiological processes underscores the importance of understanding how different foods, their components, and preparation methods affect microbial diversity and function. This Research Topic of articles presents a comprehensive exploration of these critical interactions, shedding light on how targeted dietary interventions can enhance gut microbiota health, support digestive processes, and ultimately contribute to disease prevention.

Recent work by Venable and Carmody introduces the *Decoupled Nutrient Status (DNS)* framework, a novel approach that highlights the distinct ways in which hosts and gut microbes experience diet. Their research posits that the nutrients absorbed by the host in the small intestine may not fully represent the nutrient availability in the gut microbiota, primarily residing in the colon. This phenomenon creates a paradigm where the nutritional status of the host can be decoupled from that of the gut microbiome, often leading to a negative correlation between the two. For instance, while a host may experience satiety and sufficient nutrient intake, the gut microbes may thrive on undigested food particles, affecting their metabolic outputs and potentially influencing health.

Venable and Carmody's framework illustrates how gut microbes predominantly utilize the fraction of diet that escapes host-driven digestion. This is particularly relevant in the context of modern diets, which often prioritize calorie-rich, easy-to-digest foods. The authors argue that this evolutionary decoupling has profound implications for human health, particularly in populations following industrialized diets. They emphasize the need for future research that captures the microbial experience of diet more accurately, suggesting that understanding how dietary components interact with the gut microbiome could yield novel insights into diet-microbiome interactions and their health implications.

Complementing this theme of microbial interactions with food, Lerma-Aguilera et al. conducted an in-depth investigation into how various cooking methods and food types alter gut microbiota composition. Utilizing an *in vitro* digestion-fermentation model alongside 16S rRNA gene sequencing, their findings reveal significant differences in microbial community structures resulting from the consumption of plant- and animal-derived

foods. The study demonstrates that cooking methods, such as frying and boiling, exert distinct effects on microbiota composition, with certain bacterial taxa, including *Faecalibacterium*, *Blautia*, and *Roseburia*, showing notable increases following the consumption of specific food types.

These results have profound implications for personalized nutrition, as they highlight the importance of food preparation in shaping the gut microbiome. The individualized responses to different cooking methods and food types challenge traditional dietary guidelines, suggesting a need for more tailored approaches to nutrition that consider individual microbiota profiles and dietary preferences.

Expanding upon the impact of food components on digestibility, Brennan explores the role of phenolic compounds and valorized plant proteins in enhancing the nutritional quality of foods. His mini-review synthesizes recent research demonstrating how these bioactive compounds can manipulate the digestibility of carbohydrates and proteins, influencing metabolic disorders and the gut microbiota. Brennan emphasizes the pressing need for sustainable food practices within the resource-intensive food industry and highlights how valorization strategies can help repurpose fractions that may have traditionally been discarded in food production. By improving the digestibility of plant-based foods through the incorporation of phenolic compounds, researchers can contribute to a more sustainable food system that supports both human health and environmental stewardship.

In a practical application of these concepts, Oliveira et al. present an innovative study on a fermented plant-based beverage supplemented with uvaia pulp (*Eugenia pyriformis*) and pea and rice proteins. The authors explore the production and *in vitro* digestion of this beverage, which is fermented with *Lacticaseibacillus rhamnosus* GG. Their research highlights the potential of functional foods to deliver probiotics while maintaining high viability throughout the gastrointestinal tract. The findings suggest that the incorporation of uvaia pulp enhances the prebiotic action of the beverage, promoting the growth of beneficial bacteria. Furthermore, the study reports significant increases in total phenolic content and antioxidant activity post-digestion, indicating the functional benefits of this innovative plant-based product.

These insights underscore the importance of developing functional foods that not only meet consumer demand for plant-based options but also enhance gut health through microbial modulation. As the demand for plant-based alternatives continues to rise, the potential for such products to contribute to improved health outcomes becomes increasingly significant.

Adding to this discussion, Sadeghi et al. focus on the immune-modulating capabilities of exopolysaccharides (EPSs) derived from *Bifidobacterium*. Their review highlights the therapeutic potential of these microbial metabolites, which exhibit diverse physical, chemical, and biological properties. The authors summarize extensive research demonstrating how EPSs can enhance immune function, combat inflammation, and even contribute to the treatment of various ailments. The engineering strategies aimed at enhancing the immune-modulating capabilities of these compounds further suggest a promising avenue for future research and application in food, health, and medicine sectors.

Collectively, these studies illustrate the growing recognition of the gut microbiota's critical role in food digestibility and its far-reaching effects on human health. They emphasize the importance of understanding the complex interactions between food components, cooking methods, and gut microbiota dynamics. As researchers continue to explore novel plant-based foods, probiotic strategies, and sustainable approaches to food production, they pave the way for innovations that address global health challenges while promoting ecological sustainability.

As we move toward a more personalized and sustainable future in food science, understanding and leveraging the gut microbiota will be crucial in shaping health outcomes. By embracing the insights offered by this diverse body of research, we can better appreciate the role of diet in modulating microbial communities and the profound implications this has for human health, wellbeing, and the development of sustainable food systems.

In conclusion, the interplay between food digestibility and microbial diversity not only highlights the need for a more nuanced understanding of diet and health but also calls for continued collaboration across disciplines to drive forward the science of nutrition, microbiology, and sustainable food production. The ongoing exploration of these themes will undoubtedly lead to new discoveries that can transform our approach to health and nutrition in an ever-evolving world.

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