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Editorial: Bio-accessibility of functional compounds and nutrients of animal diets

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Editorial on the Research Topic
Bio-accessibility of functional compounds and nutrients of animal diets

Nutrition plays a pivotal role in preserving the health of both human and animal populations, necessitating an increasing reliance on empirical evidence for the development and evaluation of optimal functional diets. The effectiveness of functional compounds and nutrients in animal diets depends on multiple variables, such as digestibility and bioavailability. Their effects can be assessed by various approaches that include metabolomics and nutrigenomics, among others. The introduction of functional compounds in animal nutrition can contribute to the sustainability of livestock production through precision management of the critical phases and, at the same time, increase profitability and lead towards the reduction of antimicrobial use according to the "one health" principles (Figure 1).

Several studies have highlighted the correlation between a healthy body and a balanced microbiota in a state of *eubiosis*. In monogastrics, gut health profoundly impacts the host's physiological, developmental, nutritional, and immunological processes, thus influencing host health and performance. In ruminants, rumen microbes are the major source of protein in the diet: the increase in the production of ruminal microbes as well the modulation of microbiota biodiversity are the keys to modifying milk production and composition.

Diet plays a key role in shaping the rumen and intestinal microflora, and different nutritional strategies can be used to positively modulate the 'microbial organ'. In this scenario, many innovative functional feed ingredients have been investigated in livestock to better understand their effects on metabolism and animal health. For example, hemp by-products can improve the nutritional and health-promoting value of feed due to their residual nutritional quality and functional properties. In this field, by-products resulting from the extraction of the oil from industrial hemp (*Cannabis sativa*) have become more available but remain largely unutilized due to their novelty and current restrictions on animal feeding. In one of the contributing articles of this Research Topic (Altman et al.), non-extracted and cannabidiol-extracted hemp inflorescence from multiple hemp cultivars

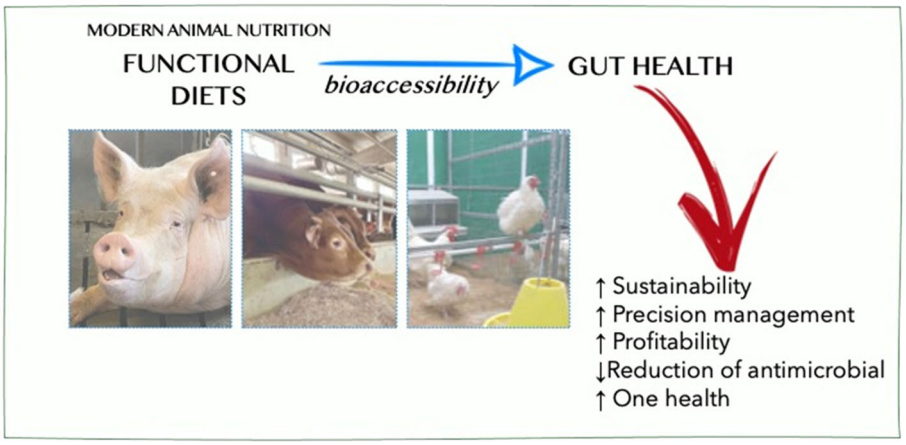

FIGURE 1
Bio-accessibility of functional compounds and nutrients of animal diets.

were evaluated for digestibility and the formation of products of digestion. In addition, this study examined how the nutrient composition of this plant may relate to the prediction of digestibility using established summative equations.

To reduce the use of animals for experimental purposes, innovative, reliable, and informative models simulating complex gastrointestinal physiology represent an expanding research field. *In vitro* methodologies allow researchers to determine the bio-accessibility of bioactive compounds and nutrients through liberation from the food matrix, simulation of gastrointestinal digestion, and absorption by the intestinal epithelium. In the study of Zhu et al. the artificial rumen was used to examine the effects of different non-protein nitrogen (NPN) sources, such as ammonium chloride, biuret, and glutamine, on rumen fermentation characteristics and microbial diversity, providing novel information for elucidating the effects of NPN sources on rumen fermentation and microbial composition and guiding the formulation of ruminant diets in practice.

Bioavailability assessed through *in vivo* methodologies provides valuable data on gastrointestinal digestion, absorption, metabolism, tissue distribution, and bioactivity. The use of multi-disciplinary tools provides new opportunities to investigate the complex interactions of the genome and the diet, such as the interactions between the gut microbiota and functional ingredients or nutraceuticals. The intestinal microbiota is both a target for nutritional intervention and a factor influencing the biological activity of food/feed compounds. Nutraceuticals and functional ingredients used as dietary supplements can improve health status, delay the aging process, and play a role in the prevention and treatment of several diseases in both humans and animals. As an example, phytochemicals and their metabolic products may also inhibit pathogenic bacteria while stimulating the growth of beneficial bacteria, exerting prebiotic-like effects.

In this context, the study by Palamidi et al. described the effects of dietary energy and protein levels with or without phytogenic addition on the cecal microbiota composition and its metabolic activity, signaling of cecal microbiota, and the expression of critical genes relevant for inflammation and defense in the cecal mucosa of broilers.

Considering the widely accepted problem of antibiotic resistance, the use of antibiotics in livestock production has decreased considerably. However, it has yet to disappear, especially during the critical weaning period. Functional ingredients can promote health through different mechanisms of action and can be considered for the reduction of the use of antibiotics in animals.

The development of natural, broad-spectrum antimicrobial solutions to combat viral and bacterial pathogens is an absolute priority for the livestock industry. As such, there is significant interest in exploring the use of natural antimicrobial compounds that can act against a wide range of pathogens, are safe to use, and do not promote pathogen resistance. Recent discoveries in the field of human antiviral medicine demonstrate the effectiveness of targeting the lipid membrane surrounding bacterial cells and most viruses in physiological environments. These findings support the potential for translating such strategies to animal husbandry, especially if cost-effective antimicrobial compounds with acceptable regulatory profiles can be utilized. The mini-review of this Research Topic (Jackman et al.) described the latest advancements in the use of lipid-based monoglycerides as feed additives. It outlines the current industry needs for effective antimicrobial strategies. It critically analyzes recent application examples in which monoglycerides have demonstrated superior activity in preventing virus transmission in swine through feed and mitigating bacterial infections in poultry, along with their ability to modulate the intestinal microbiome.

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