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Phytobiotics incorporation in feed: Case of ruminants and monogastric animals

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Abstract: The ban on growth-promoting antibiotics (GPAs) in livestock feed in 2006 was primarily driven by growing concerns over antibiotic resistance, which poses a threat to both human and animal health. The widespread use of antibiotics in agriculture led to the development of resistant bacterial strains, reducing their effectiveness in treating infections. Additionally, the presence of antibiotic residues in animal products raised significant concerns regarding food safety and consumer health. These challenges prompted the search for alternative solutions that could maintain or even improve animal health and productivity without contributing to these issues. Phytobiotics have emerged as a promising alternative to antibiotics. These natural compounds, derived from various herbs, spices, and plants, have long been recognized for their health benefits. Historically appreciated for their antimicrobial, anti-inflammatory, and digestive properties, they are now being explored for similar uses in animal nutrition. The renewed interest in phytobiotics reflects their potential to address growing concerns about antibiotic resistance and chemical contamination in livestock products. This study aims to review the progress of research on the use of phytobiotics as an alternative to antibiotics in both monogastric species (e.g., poultry) and ruminants (e.g., cattle, sheep, and goats). It also aims to evaluate their impact on key factors, including animal performance, welfare, and the environmental footprint of farming practices. Previous studies have demonstrated that phytobiotics enhance animal performance by improving growth rates, feed conversion efficiency, and overall productivity. They also play a crucial role in maintaining animal health by boosting immune responses and gut health. Additionally, the use of phytobiotics has been linked to reduced environmental impact from farming, particularly by lowering methane emissions from ruminants and reducing the need for synthetic chemical additives in animal feed. These benefits highlight the potential of phytobiotics as a sustainable, health-conscious alternative to conventional antibiotics in livestock farming.

Keywords: Additives, phytobiotics, antibiotics, monogastric, environment, farming, performance, ruminants.

1. Introduction

The use of antibiotics in animal production has long been a common practice to prevent and treat infectious diseases and enhance growth performance. However, their intensive and uncontrolled use has led to the emergence of resistant microbial strains, compromising treatment efficacy and posing a risk to public health (Marazuela, Bogialli, 2009; Nisha, 2008). Chronic exposure to antibiotic residues in animal-derived products can lead to direct toxic effects and alter the human microbiota, thereby promoting the development of resistance (Anadón, 2006).

In response to these concerns, the European Union banned the use of antibiotics as growth promoters (AGPs) in 2006, after more than 50 years of use in livestock farming (Greathead, 2003; Rochfort et al., 2008; Mohammadi Gheisar, Kim, 2018). However, this ban led to a resurgence of animal infections, compromising livestock productivity and health. At the same time, increasing demand for sustainable and environmentally friendly farming has promoted the development of alternative methods to synthetic antibiotics, particularly in organic farming, where their use is strictly limited (Bourgoin et al., 2017; Nagarajan et al., 2017).

In this context, research has intensified to identify efficient substitutes for AGPs. Among the studied solutions, feed additives play a prominent role. According to the American Feed Control Officials (AFCO), a feed additive is a substance added to animal feed to meet a specific need, usually in small quantities and requiring careful incorporation (AFCO). These additives can be of plant, animal, or mineral origin and are widely used to improve digestion, stimulate growth, and enhance animal health (World Health Organization, 2018).

Among the most studied additives are probiotics (live microorganisms), prebiotics (substrates that promote the growth of specific bacteria in the digestive microbiota and are indigestible by the host animal), enzymes, organic acids, and natural phytobiotics. The latter, also known as phytoactive compounds, refer to a group of bioactive compounds extracted from plants and incorporated into animal feed for their beneficial effects on growth and health (Windisch et al., 2008).

Phytobiotics, or phytoactives, are derived from a wide variety of herbs, spices, and plant extracts and are known for their distinctive aromas and pharmacological properties. They contain secondary plant metabolites—such as essential oils, alkaloids, flavonoids, and phenolic compounds—which are responsible for a range of biological activities, including antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory effects (Bakkali et al., 2008; Schwab et al., 2008). These substances are typically classified as herbs (non-woody, non-perennial plants), plant parts (leaves, roots, bark), essential oils (volatile compounds obtained by distillation), and oleoresins (solvent-extracted compounds).

When incorporated into animal feed, phytobiotics have been reported to enhance digestive function, stimulate gastric and bile secretions, improve nutrient absorption, reduce gut pathogen load, and support the immune system (Kamel, 2001; Athanasiadou et al., 2007; Brenes & Roua, 2010). Their application, however, requires strict regulation and evaluation regarding dosage, composition, efficacy, and safety for animals, humans, and the environment (Anonymous, 2009).

Since ancient times, medicinal plants have been used to prevent and treat diseases in both humans and livestock (Radkowska, 2013). Advances in biochemistry have enabled the identification and characterization of numerous plant-derived active compounds,

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