Physiological Effects and Uses of Some Phytobiotic Compounds - A Review

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Phytobiotics have been used to supplement ingredients in poultry feeds for the last few years. A great deal of research has been conducted on this topic. Researchers highlight the multifaceted benefits of phytobiotics, underscoring their antimicrobial, antioxidant, and anti-inflammatory properties, in addition to their capacity to stimulate growth. Most of the phytobiotics currently in use are seamlessly incorporated into animal diets, with no reported palatability issues. In fact, there have been instances of enhanced feed intake when these additives are included.

The objective of this review is to comprehensively examine the utilization of phytophogenic feed additives in poultry diets, alongside a detailed exploration of the latest insights into their potential mechanisms of action.

Key words: botanical, herb, physiological impact, phytobiotics, poultry.

Introduction

Exogenous stress factors disrupt the mucosal immune response against other pathogens, leading to intestinal damage and poor growth performance. Therefore, to mitigate the adverse effects of environmental stress factors, to enhance growth performance, and to improve existing flora, various feed additives, such as antibiotics, probiotics, prebiotics, and phytochemicals, are added to animal diets.

In poultry production, antibiotics have been used at subtherapeutic levels since the 1950s to further improve growth and health (Barreto et al., 2008; Diaz-Sanchez et al., 2015; Oso et al., 2019). However, due to concerns about residue risks in poultry products and the potential development of antibiotic-resistant bacteria in humans (Windisch et al., 2008; Oso et al., 2019), coupled with increasing public awareness of environmental issues (Gheisar and Kim, 2017), the European Union decided to ban the use of antibiotics as growth promoters.

Probiotics or plant extracts can be used as alternatives to antibiotics in poultry nutrition due to their beneficial effects on intestinal microflora (Sarica et al., 2005). The "pro-" and "prebiotic" approach is continually evolving to enhance animals' immune responses and increase resistance to diseases using feed additives that pose no food safety risks (Kovacs et al., 2016).

The chemical composition of phytobiotics and the content of active components vary depending on factors such as the part of the plant used (leaves, seeds, roots, etc.), harvest season, and geographic origin (Windisch et al., 2008; Oso et al., 2019). These substances have low levels of weight and are produced in plant secondary metabolism, including glycosides, alkaloids, phenolic and polyphenolic molecules, terpenoids, saponins, gums, flavonoids and soluble oils. These plants have been bred for defense against external factors such as traits, stress factors, protection against predators and pathogens (Barreto et al., 2008). Numerous studies have shown that phytobiotics have antimicrobial, antioxidant and anti-inflammatory activities, as well as growth-promoting effects.

However, most studies have focused on the effects of active compounds used in terms of production performance rather than their physiological impact. This review aims to provide a general overview of the use of phytophogenic feed additives in poultry diets and the latest information on their potential modes of action.

Growth Promoting Effects

The stimulatory effect of adding plant-based products to poultry diets on growth has been reported in many studies (Gheisar and Kim, 2017). Antibiotics are commonly used in animal production facilities to maintain herd health, support growth, and increase productivity (Al-Kassie, 2009).
However, their use has been restricted in many countries, including the European Union, due to concerns about microbial resistance and residues in products (Haashemipour et al., 2013). As the poultry industry is one of the most common sectors for antibiotic use, research into alternatives to antibiotics is increasing in this field. Among the alternative methods for antibiotics in poultry, the use of plant-based products is prominent. In this context, the use of medicinal plants or extracts derived from these plants, known as phytobiotics, is becoming more widespread (Ghasemi et al., 2010; Zhao et al., 2011; Bölükbaşi et al., 2008; Zyla et al., 2012).

ANTIOXIDATIVE EFFECTS

The antioxidant properties of spices and herbs are well-defined. It is believed that many phytochemical compounds with antioxidant properties contribute to the protection of dietary lipids from oxidative damage, similar to added antioxidants in diets (e.g., α-tocopherol acetate or butylated hydroxytoluene) (Windisch et al., 2008).

Among the leading causes of harmful consequences of stress in poultry, there is an excessive production of free radicals, particularly perilous, and the resulting effects of antioxidant defenses and oxidative stress. Some studies have successfully used essential oils and dried powders from plants, especially from the Labiatae plant family, as natural antioxidants in animal diets (Botsoglou et al., 2002; Bolukbasi et al., 2006; Abd El-Hack and Alagawany, 2015; Gieasar and Kim, 2018).

Researchers have investigated the potential effects of phytobiotics derived from the Labiatae plant family, which contains phenolic compounds, on poultry (Botsoglou et al., 2003; Bolukbasi et al., 2006; Abd El-Hack and Alagawany, 2015). They have reported that a wide range of plants from the Labiatae family, especially rosemary, oregano, and thyme, and their extracts, have potential antioxidant functions.

In their broiler study, Abd El-Hack and Alagawany (2015) observed that the group fed with thyme-enriched diets showed significantly increased serum superoxide dismutase activity and decreased glutathione concentration. They also noted that the concentration of malondialdehyde (MDA) decreased in experimental groups compared to the control. Placha et al. (2010) similarly found that supplementing broiler chicken diets with thymol significantly reduced MDA concentration, and suggested that thyme oil concentration was sufficient to control the irregular release of reactive oxygen species (ROS).

Various plant species, such as ginger, resveratrol, rosemary, sage, curcuma, anise, coriander, among others, have demonstrated antioxidant activities (Sahin et al., 2010; Windisch et al., 2008; Gheisar and Kim, 2017). Evidence exists to support the antioxidant activities of black pepper (Piper nigrum), red pepper (Capsicum annum L.), and tomatoes (Akdemir et al., 2012; Puvaca et al., 2015). Similarly, there is information indicating that the antioxidant activities of plants, such as ginger root, thyme, and resveratrol, are transferred to eggs along with the body (Sahin et al., 2010; Zhao et al., 2011). Sahin et al. (2016) reported that dietary supplementation of lycopene in broilers exposed to heat stress increased serum and muscle malondialdehyde (MDA) levels.

ANTIMICROBIAL EFFECTS

It is well-known that herbs and many spice varieties exhibit in vitro antimicrobial effects against significant pathogens (Dorman and Deans, 2000; Barreto et al., 2008). This antimicrobial activity is reported to originate from the essential oil fractions found in spice and plant extracts (Nychas, 1995). Furthermore, citrus essential oils exhibit antimicrobial effects against foodborne bacteria and molds (Nychas, 1995). Additionally, the antibacterial and antifungal effects of thyme (Bolukbasi et al., 2008; Abd El-Hack et al., 2016; Gholijani and Anirghofran, 2016), and other natural products are well-documented (Abd El-Hack et al., 2022).

The antimicrobial action of hydrophobic essential oils is thought to arise from their potential to enter bacterial cell membranes, disrupt membrane structures, and induce ion leakage (Burt, 2004). In their study, Bolukbasi et al. (2008) applied thyme, rosemary, and sage oil to the diets of laying hens. They found that the concentration of E. coli in fecal samples significantly decreased when thyme oil and rosemary oil were used ($P < 0.05$). Additionally, they reported that thyme oil and rosemary oil exhibited higher antimicrobial activity than sage oil.
PALATABILITY AND EFFECTS ON INTESTINAL FUNCTION

Phytogenic feed additives are generally reported to enhance the palatability of feed and, consequently, improve production performance (Windisch et al., 2004). However, studies evaluating their palatability in terms of specific effects on the diet have remained limited.

In addition to the beneficial effects of a wide variety of spices and herbs, it has been reported that they also have positive effects on the digestive system, such as preventing spasms and bloating (Chrubasik et al., 2005). Furthermore, it is suggested that phytogenic additives stimulate digestion by increasing saliva, bile, and mucus production along with enzyme activity. Many spices have been reported to trigger increased secretion of bile acids, which play a vital role in fat digestion and absorption, and significantly stimulate pancreatic enzymes. These effects, in conjunction, lead to an acceleration of digestion and a reduction in the transit time of food in the gastrointestinal tract (Platel and Srinivasan, 2004). In a different study, it was reported that the sharp flavors of rosemary and sage herbs resulted in chickens showing a preference for additive-free diets (Loetscher et al., 2014).

CONCLUSION

In recent years, some of the functions investigated regarding phytobiotics include their growth-promoting effects, antimicrobial activity, antioxidant activity, and anti-inflammatory activity. According to the literature, phytobiotics have positive effects on improving poultry performance. Some researchers have even suggested that phytobiotics used as dietary supplements are consumed without any taste issues and may, in fact, lead to increased feed consumption, possibly due to improved palatability.

REFERENCES


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