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Full Length Research Paper

A Review of the Use of Herbal Feed Additives in Animal Nutrition

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Because of the cost-effectiveness, negative side effects, and prohibition on the use of some antibiotics, the use of herbal feed additives is becoming more and more significant in animal production. Numerous feed additives, including organic acids, plant extracts, probiotics, and prebiotics, have been shown to improve animal productivity. The antibacterial, anti-inflammatory, anti-oxidant, immune-stimulating, and digestibility-enhancing qualities of medicinal herbs must be utilized in the production of safe human food products as well as animal feed. Additionally, studies on the standardization of appropriate amounts of herbal feed additives for specific purposes must be conducted.

Key words: Antimicrobial, Anti-Oxidant, Immune-Stimulant, Feed Additive, Herb, Spices

INTRODUCTION

First off, microbial resistance to antibiotics and its effects on human health have sparked an increasing interest in using herbal feed additives in animal production. The second is a reaction to consumer demands that all non-plant xenobiotics be removed from animal diets. Herbal feed additives are important for nutrition and overall wellness. Webster's Encyclopedic Unabridged Dictionary of the English Language (1989) defines herbal feed additives as herbs, spices, and botanicals.

Herb: A flowering plant whose stem above ground does not become woody and persistent. A plant when valued for its medical properties, flavor, scent, or the like.

Spices: Any of a class of pungent or aromatic substances of vegetable origin, as pepper, cinnamon, cloves, and the like, used as seasoning, preservatives etc.

Botanical: A medication derived from a plant's roots, leaves, bark, etc. Any of a class of volatile oils derived from plants that have the scent and other distinctive qualities of the plant are called essential oils, and they are mostly employed in the production of tastes, fragrances, and medications.

Action Mechanisms and Advantageous Impacts of Herbal Feed Supplements

Numerous low molecular weight secondary metabolites have emerged in plants. These substances often let plants to communicate with their surroundings and may serve as a defense mechanism against environmental and physiological stressors, as well as diseases or predators. Several of these secondary plant metabolites have been shown to have positive impacts on food products and animal metabolism in addition to having harmful qualities. The majority of these active secondary plant metabolites are members of the flavonoid, glucosinolate, and isoprene derivative groups; many of these chemicals have been proposed to have antioxidant or antibacterial properties (Rhodes, 1996 or Hirasa and Takemasa, 1998). Herbs first appear as flavor in farm animal feed, and as a result, they can affect the way that animals eat, the release of digestive fluids, and the amount of feed that they consume overall. Herbs and phytochemicals have the ability to specifically affect microbes through their antimicrobial properties or by favorably stimulating the microflora's eubiosis. Most herbal feed additives work by affecting the structure of the bacterial cell wall, denaturing and coagulating proteins to produce their antibacterial effects. The cytoplasmic membrane's permeability to H+ and K+ ions is changed by the essential oils. This alteration results in the loss of chemiosmotic regulation and, ultimately, bacterial mortality by interfering with vital cellular functions as electron transport, protein translocation, oxidative phosphorylation, and other enzyme-dependent activities (Dorman & Deans, 2000). The lipophilic nature of the essential oils that build up in the membranes causes the bacterial cytoplasmic membrane to rupture. Additional actions could be connected to the bacterial cells' inhibition of protein synthesis, enzyme inhibition, DNA and RNA production, and food absorption. The presence of phenolic chemicals, flavonoids, and terpenoids, which shield food, tissues, and cells from the damaging effects of autoxidation reactions, is primarily responsible for the antioxidant activity of essential oils.

Herbal feed additives can boost the immune system or enhance nutrient uptake and utilization. Changes in the intestinal microbiota, improved digestibility and nutrient absorption, improved nitrogen absorption, immune response enhancement, morphological and histological alterations of the gastrointestinal tract, and antioxidant activity are some of the potential mechanisms of action of herbs in animals for growth promotion. Lastly, herbs can help animals meet their

nutritional needs by stimulating the endocrine system and the metabolism of intermediary nutrients.

Activating feed intake and digestive secretion, immunological stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral, or anti-inflammatory activity, as well as antioxidant qualities, are some of the ways that herbs and botanicals might benefit farm animals. The herbal feed additives exert their beneficial effects by:

1. Influence of herbal feed additives on feed intake, digestibility of nutrients and animal performance:

Since antibiotics are no longer allowed, more herbs are being added to feed to improve growth conditions. Different herbs and spices have varying effects on gastrointestinal processes because of the large range of active ingredients. The majority of them promote salivary secretion. Curcuma, cayenne pepper, ginger, anis, mint, onions, fenugreek, and cumin all improve the liver's production of bile acids and their excretion in bile, which has a positive impact on lipid absorption and digestion. The majority of the spices on the list promote the activity of pancreatic enzymes (lipases, amylases, and proteases); some additionally boost the activity of the gastric mucosa's digesting enzymes. In addition to their impact on bile generation and enzyme activity, extracts from herbs and spices minimize the time it takes for food and feed to move through the digestive tract and speed up digestion (Frankic et al., 2009). Particularly in tropical areas, plant herbs like peppermint (Mentha piperita), garlic (Allium sativum), and lemongrass (Cymbopogon citrates, DC. Stapf.) are widely used as antibacterial agents and to preserve the microbial ecosystem of the gastrointestinal tract (Shin and Kim, 2004). Improved growth rate, digestibility, and carcass characteristics were found when garlic was used as an alternative growth booster in livestock production (Kongmun et al., 2011). According to Yang et al. (2007), peppermint and lemongrass have been used as feed additives to boost the productivity of dairy and beef cattle. According to recent reports, menthol (Mentha arvensis) enhances the digestibility of ileal protein and amino acids, improving feed efficiency in weaned piglets (Maenner et al., 2011), and black paper enhances broiler chicken performance (Tazi et al., 2014).

2. **Herbal feed additives as antimicrobial supplements:** Numerous investigations shown that specific plant extracts had potent antibacterial action against both Gram-positive and Gram-negative bacteria. Plants easily produce compounds to protect themselves against microbes, insects, and herbivores. Furthermore, as part of their regular growth and development or in reaction to stress, they could generate secondary antimicrobial compounds. Oriental herbs such as Allium sativum, Angelica dahurica, Anguisorba officinalls, Artemisia argyi, Coptis chinensis, Dictamnus dasycarpus, Fraxinus rhynchophylla, Geranium thunbergii, Hydrastis canadensis, Phellodenron amurense, Polygonum cuspidatum, Scutellria baicalensis, and Sophora flavesens have all been the subject of numerous studies on their antimicrobial properties. Along with other beneficial plants, these herbs have important flavonoid components that have antibacterial properties, such as baicalin, baicalein, limonene, cinnamon aldehyde, carvacrol, or eugenol. Gram-positive Staphylococcus and Streptococcus bacteria, as well as Salmonella or E. coli, are susceptible to the antibacterial properties of these herbs. The active ingredients in herbal feed additives alter the makeup of fatty acids, which can impact bacteria' capacity to survive by making them more hydrophobic. This demonstrates that herbs and spices have antibacterial properties by altering the properties of cell membranes and resulting in ion leakage, which reduces the virulence of microorganisms. Because of its antibacterial, anti-inflammatory, anti-oxidative, and anti-parasitic properties, plant extracts—also referred to as phytobiotics—have been used. The biological factors (plant species, growing location, and harvest conditions), manufacturing (extraction/distillation and stabilization), and storage conditions (light, temperature, oxygen tension, and time) all contribute to the wide range of variations in phytobiotic composition (Huyghebaert et al., 2011).

3. **Herbal feed additives as anti-inflammatory:** The anti-inflammatory properties of curcuma, red pepper, black pepper, cumin, cloves, nutmeg, cinnamon, mint, and ginger were demonstrated. Flavonoids, terpenoids, and phenols are the main active compounds that have anti-inflammatory properties. These compounds inhibit the production of prostaglandins that cause inflammation. Plant-based phenolic compounds, which are hydroxylated forms of benzoic and cinnamic acids, have been shown to have anti-inflammatory properties. The anti-inflammatory, anti-allergic, antiviral, and antiproliferative properties of flavonoids have long been known (Muanda et al., 2011). According to Frankic et al. (2009), chamomile, marigold, licorice, and anis are the most well-known herbs and spices having anti-inflammatory properties. Mint and other plants belonging to the Labiatae family have garnered a lot of attention. Phenolic terpenes are responsible for their antioxidative properties (Cuppett and Hall, 1998). Thymol, carvacrol, and other monoterpenes are abundant in oregano and thyme (Rahim et al., 2011). According to Wei and Shibamoto (2007), plants high in flavonoids, like green tea and other Chinese herbs, are naturally occurring antioxidants. Numerous antioxidative chemicals are also present in red pepper (Capsicum annuum L), black pepper (Piper nigrum), and chili (Capsicum fretuscene) (Nakatani, 1994). However, the sections of many of these plants that contain the active ingredients have a strong, spicy, and/or fragrant flavor, which limits their usage in animal feed. Aloe vera has recently been studied for its antibacterial, antiviral, antifungal, antitumor, anti-inflammatory, immunomodulatory, wound-healing, antioxidant, and anti-diabetic activities on poultry (Babak and Nahashon, 2014).

4. **Herbal feed additives as antioxidants:** When added to food, antioxidants tend to reduce rancidity, slow the production of harmful oxidation products, and preserve nutritional value because they are substances that help delay and prevent lipid oxidation (Muanda et al., 2011). Antioxidants found in plants are believed to have a health-promoting effect because they defend against reactive oxygen species. Numerous studies indicated that eating plants high in antioxidants reduced the incidence of cancer, heart disease, hypertension, and stroke and served as a preventative factor against illnesses. The quantity of certain vitamins (E, C, and A) and phenolic compounds (flavonoids, hydrolyzable tannins, proanthocianidins, phenolic acids, and phenolic terpenes) may be linked to the antioxidant activity of medicinal plants. The biological action products of onions and garlic are attributed to their sulfur-containing active principle, which has been shown to have lipid-lowering properties and prevent low-density lipoproteins from oxidizing (Ahmed and Bassuony, 2009). Herbs high in phenolics that are frequently utilized include chamomile, ginko, marigold, dandelion, thyme, oregano, sage, green tea, and rosemary. Spices and herbs can shield the feed from oxidative degradation while it is being stored.

5. **Herbal feed additives as immunostimulant:** Herbs and spices high in flavonoids, vitamin C, and carotenoids are generally good for the immune system. The herbs cat's claw, liquorice, garlic, and echinacea all contain compounds that have immunostimulatory qualities. According to Frankic et al. (2009), these plants have the ability to enhance the activity of NK cells, macrophages, and lymphocytes by stimulating interpheron production or increasing phagocytosis. Essential oils derived from medicinal plants have been demonstrated by Lavinia et al. (2009) to enhance the immunological response and alter the duodenal mucosa in ways that are advantageous to the

animal. Cow urine distillate and β-glucan have recently been shown to have immunomodulatory effects in broiler chickens (Ganguly, 2013).

6. **Herbal feed additives as *coccidiostat*:** There is evidence that certain plant extracts are effective against coccidian and other poultry parasites (Naidoo et al., 2008; Arczewska-Wlosek and Swiatkiewicz, 2012). A byproduct of the sugar beet industry, betaine has recently shown promise in the fight against coccidiosis. It shields cells from the osmotic stress brought on by dehydration and allows for regular cell metabolism. Nevertheless, betaine's protective effects on intestinal cells also extend to parasite cells. Curcumin, a phenolic molecule derived from the rhizome of Curcuma longa, is the active ingredient. It works as an anticoccidial agent by boosting the immune system's antioxidant capacity (Allen et al., 1998). According to Lee et al. (2012) and Habibi et al. (2014), extracts from Galla rhois and Nectaroscordum tripedale have demonstrated encouraging results against coccidial infection.

Advantages of Herbal Feed Additives

Selection and feeding of herbal feed additives over other feed additives is due to:

1. Natural constituent of feeds.
2. Absence of residual effects.
3. Non-hazardous eco-friendly.
4. Minimum problem of drug resistance.

Limitations of Herbal Feed Additives

1. Not easily quantifiable and standardized due to their complex composition.
2. The location, soil type, weather conditions, altitude, season during which the plant is grown, harvesting procedure and storage conditions may affect the composition of plants.
3. Although majority of herbals are stable, there are various constituents which are photo labile, thermo labile thus less stable.
4. Variety and environmental growth conditions, harvesting time and state of maturity, method and duration of conservation and storing, extraction method of the plants, as well as possible synergistic or antagonistic effects, anti-nutritional factors or microbial contamination are factors which may substantially affect the use of herbal feed additives.

Conclusion

To produce healthy animal products, farm animals must be kept in good health. The use of natural additives in human and animal nutrition has been promoted for the past ten years. Clarifying the biochemical makeup and physiological roles of different feed additives, such as probiotics, prebiotics, organic acids, and plant extracts, was the topic of numerous studies. Herbs and spices can be added to food as dried plants, plant pieces, or extracts to increase their beneficial effects. To improve digestibility, antibacterial, anti-inflammatory, antioxidant, and immunostimulant effects, as well as their doses, more research is necessary on the different qualities of a particular herb.

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