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Review paper

EFFECTS OF PHYTOADDITIVES IN POULTRY AND PIGS DISEASES

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ABSTRACT: The medicinal plants and herbs have been used for many years in the treatment and prevention of various diseases in animals and human beings. Nowadays, utilization of these medicinal plants is increasing. This article summarizes the experimental knowledge on efficacy, possible modes of action, and aspects of application of phytogenic products as feed additives for treatment pig and poultry diseases. Phytobiotics is a term used to describe plant-derived natural bioactive compounds, which affect animal growth and health, and is often applied to essential oils, botanicals, and extracts derived from herbal plants. Some phytobiotics are known to have antimicrobial or antiviral activities. Selected herbs, however, are known to possess natural antibacterial activity and other characteristics that could be useful in value-added animal protein production. This area of investigation has not received substantive examination because of the relatively low costs, proven effectiveness, and ready availability of synthetic growth-promoting antibacterial products. Herbs and spices have always been helpful to cure diseases. In modern animal nutrition, they are forgotten because of use of synthetic antimicrobial growth promoters (AGP). But due to the prohibition of most of AGP, plant extracts have gained interest in animal feed strategies. The risk of the presence of antibiotic residues in milk, meat, egg and their harmful effects on human health have led to their prohibition for use in animal feed in the European Union. Many plants also produce secondary metabolites such as phenolic compounds, essential oils and saponins. They act as antibacterial, antioxidant, anticarcinogenic, antifungal, analgesic, insecticidal, anticoccidial and growth promoters. *Azadiracht indica*, *Zizyphus vulgaris*, *Ocimum gratissimum* and *Atlanta monophylla* have the strong antibacterial activity, whereas ocimum plant has strong antioxidant, anticarcinogenic, antifungal, analgesic and antipyretic properties. Leaves of *Azadirachta indica* are used for feeding and reducing the parasitic load of animals. The fruit of *Azadirachta indica* and *Artemisia annua* also has the anticoccidial activity for poultry. These plant extracts compete with the synthetic drugs. Majority of medicinal plants do not have the residual effect, because have an approved application in human medicine and which can be added to animal feed for use in preventive and therapeutic treatment of different animal health disorders.

Key words: *phytogenic product, pig, poultry, diseases*

INTRODUCTION

The prevention of diseases and enhancement of growth, feed intake and feed efficiency are critical factors in modern animal production (Varel, 2002). Current farm livestock production systems face challenges with a concept of 'clean, green and ethical' (CGE) animal production being promoted (Puvača et al., 2013; Kostadinović et al., 2015). This concept involves limited use of drugs, chemicals and hormones, while reducing the

impact of food production on the environment and considering animal welfare (Dajić Stevanović et al., 2018). The prophylactic use of antibiotics in poultry and pig nutrition to cause improvements in growth, feed consumption, feed utilization and decreased mortality from clinical diseases is well documented (Kostadinović et al., 2001). However, the growing concern over the transmission and the proliferation of resistant bacteria via the food chain has led to a ban of the feed use of antibiotic growth promoters (AGP) in livestock within the European Union since 2006. As a result, new commercial additives derived from plants including aromatic plant extracts and their purified constituents have been examined as part of alternative feed strategies for the future. Such products have several advantages over commonly used commercial antibiotics since they are residue free and they are also, generally recognized as safe and commonly used items in the food industry (Varel, 2002). These botanicals have received increased attention as possible growth performance enhancers for animals in the last decade. Bioactive plants and plant compounds, when included as feed or food components, have a broad range of effects in the animal, from health promoting and beneficial for animal production to toxic or even lethal. There is interest in using plants and plant extracts as alternatives to synthetic drugs, because they can have potent properties and more complex bioactivity (Ricke and Kundinger, 2004; Si et al., 2006). Bioactive plants and plant compounds may assist in some aspects of the proposed concept, as they are often inexpensive and considered to be environmentally safe (Blache et al., 2008). Following the era of artificial synthesis, plant extracts and etheric oils have been increasingly used for their antimicrobial (Lević et al., 2011), antioxidative (Botsoglou et al., 2002) and hypocholesterolemic effect [12,55] as well as for their stimulatory effect on the digestive system (Platel and Srinivasan, 2004) and digestive enzymes production (Langhout, 2000). Also, herbal plant or their components have been shown to exhibit antiviral, antimycotic, antitoxigenic, antiparasitic and insecticidal properties as well as inhibition of odour and ammonia control (Kostadinović et al., 2015). Recent publications demonstrate renewed research interest in the use of medical plants as feed supplements for pig and poultry diseases (Dajić Stevanović et al., 2018). These characteristics are possibly related to the function of these compounds in plants (Mahmoud and Croteau, 2002). In contrast, many herbs and spices are popular food condiments. Etheric oils and oleoresins of garlic and capsicum as well as cinnamic aldehyde, carvacrol and pipperine among others, have long been used due to their food flavour enhancement properties (Puvača et al., 2016). Some researchers have found that many herbs and botanicals are able to improve growth rate through increased feed intake (Kostadinović et al., 2001) nevertheless, others have reviewed the topic and found no clear evidence that herbs and spices improve palatability in farm animals (Windisch et al., 2008). Most studies investigate blends of various active compounds and report the effects on production performance rather than the physiological impacts. In this context, the following provides an overview of recent knowledge on the use of phytogenic feed additives in piglet and poultry diets, possible modes of action, and safety implications. Animal welfare is an important desired feature of livestock production. Besides health problems, the risk of zoonotic disease affecting food safety is an issue often mentioned in the literature. In the sections below we shall list the current literature on disease incidence in poultry and pig and collected information on traditional preparations with the objective of documenting existing plant material and any other traditional preparations used for poultry and pig health management in intensive production systems.

POULTRY DISEASE INCIDENCE AND INFLUENCE OF DIETARY PHYTOADDITIVES AS AN ALTERNATIVE TO SYNTHETIC DRUGS

The most common viral infections of poultry are: Chicken pox or fowl pox; epidemic tremor, infections bronchitis, Marek's disease; Newcastle disease and Avian influenza. The antiviral drugs fail to treat the infection due to viral resistance and viral latency which leads to recurrent infection in immunocompromised animals (Field and Biron, 1994). Success in using herbs and medicinal plants extract as antiviral agent has raised optimism about phyto antiviral agents (Jassim and Naji, 2003). Plants contain a wide variety of diverse phytochemicals, such as alkaloids, tannins, saponins, flavonoids, terpenoids, lignans, cou-marins, and many other components. Plants like *Bergenia ligulata*, *Nerium indicum* and *Holoptelia integrifolia* showed significant antiviral activities against Influenza virus (RNA) and Herpes Simplex virus (DNA) (Rajbhandari et al., 2001). The antiviral activity of *Azadirachta indica* and *Ocimum sanctum* against Newcastle Disease virus is well known (Kumar et al., 1997). Providing chickens with access to an outdoor area may increase the risk of poultry becoming infected with *Salmonella* and *Campylobacter* due to contact with wild birds and other animals and their faeces. Earlier studies indicate that many plant extracts have antimicrobial actions *in vitro* against important pathogens, including fungi (Si et al., 2006). The active substances are largely the same as mentioned previously for antioxidative properties, with phenolic compounds being the principal active components. Again, the plant family of *Labiatae* has received the greatest interest, with thyme, oregano, and sage as the most popular representatives. The *Origanum vulgare* is described as containing more than 30 antibacterial chemicals (Popović et al., 2016). The antimicrobial mode of action is considered to arise mainly from the potential of the hydrophobic essential oils to intrude into the bacterial cell membrane, disintegrate membrane structures, and cause ion leakage. High antibacterial activities are also reported from a variety of nonphenolic substances, for example, limonene and compounds from *Sanguinaria canadensis* (Burt, 2004). Hayat et al. (2004) studied the in vitro antimicrobial activity of *Zizyphus vulgaris* root extract against both gram positive and gram negative organisms using *Staphylococcus aureus* and *Escherichia coli*, respectively. Three different concentrations of the ethanol extract of the roots were used and the activity compared with the standard antibiotics. All the concentrations showed excellent inhibitory effect on the growth of gram positive and gram negative microorganisms. It is evident, however, that in practice most individual herb or spice extracts must be included at a high concentration to observe effects comparable to those of antibiotics. Akilandeswari et al. (2003) tested aqueous *Azadirachta indica* extract against the strain of bacteria *Proteus vulgaris* and fungi *Candida albicans*, to examine its efficacy as an antimicrobial agent. The growth of *Proteus vulgaris* and *Candida albicans* was inhibited remarkably due to aqueous *Azadirachta indica* extract. Out of these two organisms tested in the experiment, the bacteria *Proteus vulgaris* showed more susceptibility to *Azadirachta indica* extracts in comparison with fungi *Candida albicans*. Some studies with broilers demonstrated *in vivo* antimicrobial efficacy of essential oils against *Escherichia coli* and *Clostridium perfringens* (Jamroz et al., 2003). In total, the available literature suggests that, at least for broilers, an overall antimicrobial potential of phytogenic compounds *in vivo* cannot generally be ruled out. Furthermore, some phytogenic feed additives have been shown to act against *Eimeria sp.* after experimental challenge (Hume et al., 2006).

Coccidiosis is the most common infectious disease of the digestive tract of poultry, causing a decrease in daily increment, prolonged fattening, poorer skin pigmentation, slower feed conversion and increased mortality (Kostadinović et al., 2015). The disease is caused by protozoas from the genera of *Eimeria*, *Isospora* and *Cryptospora*, and it is manifested by the damage of the intestine epithelial cells, less frequently the bile duct and renal tubuli. The medicinal plants especially *Azadirahta indica*, *Hobrrhena antidysentrica*, *Barberis aristata*, *Embelia ribes*, *Acorus calamus*, *Artemisia annua* and *Artemisia absinthium* have showed strong anticoccidial activity (Kostadinović et al., 2016). Tipu et al. (2002) compared the anticoccidial efficacy of salinomycin sodium and neem fruit in boilers. They concluded that the addition of 0.3% ground neem fruit in boiler feed has tremendous efficiency in combating coccidiosis as compared to salinomycin sodium. They reported that neem fruit had compound margosate, responsible for the breakdown of *Eimeria* life cycle. According to Youn and Noh (2001), the *Sophora flavescens* extract was the most effective for survival rates, controlling bloody diarrhea symptoms, lesion scores, body weight gains and oocyte excretion in the faeces.

PIGS DISEASE INCIDENCE AND INFLUENCE OF DIETARY PHYTOADDITIVES AS AN ALTERNATIVE TO SYNTHETIC DRUGS

Parasites in pigs have an impact on performance, with effects ranging from impaired growth and wasteful feed consumption to clinical disease, debilitation, and often even death. It is particularly important to diagnose subclinical parasitism, which can have serious economic consequences and which should be treated with on-going preventive measures. Internal parasitism is caused by nematode roundworms and coccidia in the gastrointestinal tract, lungworms in the respiratory tract and also in the similar measure by ectoparasites. The most commonly encountered gastrointestinal parasites are the large roundworm *Ascaris suum*, the threadworm *Strongyloides ransomi*, the whipworm *Trichuris suis*, the nodular worm *Oesophagostomum dentatum*, while concerning the coccidia, there is *Isospora suis* and *Cryptosporidium parvum,* as well as *Eimeria spp* (Solano Aguilar et al., 2018; Shittu et al., 2018). In the treatment of ectoparasitoses and endoparasitoses a positive effect of a great number of plant species which used a singular or combined has been observed. White mugwort (*Artemisia absinthium* L.) and black mugwort (*Artemisia vulgaris* L.) had for centuries been used as anthelmintics especially against oval and cylindrical worms, and in the treatment of animals infected by blood parasites (*Trypanosoma*, *Plasmodium spp.*). Today these plants are used also in various disturbances of gastrointestinal tract, diminished secretion of digestive enzymes, disturbed creation and secretion of bile and for strengthening of the organism. *Artemisia absinthium* L. is administered as food supplement to improve appetite and food digestion (Kostadinović et al., 2015). Because of its exceptionally strong action even small doses can cause coma or death in adult animals so dried plant material is used instead of ether oil. In the treatment of diseases of digestive tract a great number of plants is used whose active principles include bitter substances, glucosides (for example salicine in *Salix alba* L.) essential oils and jelly (*Linum usitatissimum* L.; *Malva sylvestris* L.). In folk veterinary medicine (Lans et al., 2007) the treatment of diarrhoea in pigs means the use of following plants: plantain (*Plantago major* L.), marigold (*Calendula officinalis* L.), nettle (*Urtica dioica* L.), marshmallow (*Althaea officinalis* L.), dill (*Anethum graveolens* L.), willow (*Salix alba* L.) and seed (Davidović et al., 2010) of dock (*Rumex*

sp.). Sambuca (*Sambucus ebulus* L.), thanks to its antiinflamatory action of the root and leafs are used in the treatment of burns, inflammations, oedema, eczema and urticaria (Ebrahimzadeh et al., 2006). In folk veterinary medicine the plants which have antiinflammatory and antiseptic action are used in healing of the wounds and they help forming of granular tissue and accelerate the wounds epithelisation: yarrow (*Achillea millefolium* L.), marigold (*Calendula officinalis* L.) and aloe (*Aloe sp*.). The oily extract of Klamath weed (*Hypericum perforatum* L.) is used externally in various skin and mucous membrane injuries and wounds as well as in burns (Kostadinović et al., 2015).

CONCLUSIONS

The increasing pressure on the livestock industry to reduce or eliminate feed antibiotics as growth enhancers has initiated new research to find safe and efficient alternatives. This new generation of feed additives includes herbs and essential oils. This paper gives a review of the plants most frequently used in folk veterinary medicine, but the number of plant species which are successfully used in the prevention and treatment of poultry and pig diseases is far greater. Phytotherapy is one of the oldest and the most widely spread systems of therapy based on the use of plants regardless whether the healing properties of certain plants have been scientifically confirmed or not. Unfortunately, respective experimental results are available only from commercial products containing blends of phytogenic substances. Therefore, there is still a need for a systematic approach to explain the efficacy and mode of action for each of type and dose of active compound, as well as its possible interactions with other feed ingredients. Scientific findings on active ingredients, mechanisms of action and application of certain plants preparations are still incomplete, therefore it is necessary to intensify phytochemical, physiological and phytopharmacological research on insufficiently studied or less known plant species.

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