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Review Article

Effects of Herbal Medicine in the Treatment of Poultry Coccidiosis

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ABSTRACT

Poultry coccidiosis is a common and economically significant disease that affects poultry worldwide. Current treatment options for coccidiosis include using chemical agents such as ionophores and antiparasitic such as Metronidazole. However, there is growing interest in alternative treatments, such as herbal medicines, due to concerns about antiparasitic resistance and residues in poultry products. This review article aims to provide an overview of herbal medicines as potential treatments for poultry coccidiosis. The article summarizes the current research on herbal medicines for coccidiosis and highlights the potential benefits and limitations of using herbal medicines as an alternative to conventional treatments. The article explores the effectiveness of various herbal medicines in treating poultry coccidiosis, explaining how they work and presenting research findings on their efficacy. It also addresses challenges related to using herbal medicines, such as establishing standardized doses and conducting clinical trials. The review concludes by summarizing the main points and recommending further research on herbal medicines for poultry coccidiosis. Ultimately, the review underscores the potential of herbal medicines as alternative treatments and emphasizes the importance of continued investigation in this field.

1. Introduction

Poultry coccidiosis is a widespread disease affecting domestic and wild birds worldwide[1]. The disease is caused by different species of *Eimeria* (protozoa) that infect the intestinal tract of chickens, turkeys, ducks, and other poultry species[2]. The infection can lead to severe damage to the intestinal lining, resulting in malabsorption of nutrients, diarrhea, and dehydration. In addition, coccidiosis in poultry results in reduced weight gain, decreased egg production, and increased mortality rates, resulting in significant economic losses to the poultry industry[3]. The most common approach to control coccidiosis in poultry is using chemical agents, including ionophores and antiparasitic, such as Metronidazole[4]. However, the overuse of antibiotics in animal production has been linked to the development of antibiotic-resistant bacteria, which can pose a threat to public health[5]. In addition, antibiotic residues in poultry products have raised concerns among consumers, leading to a shift towards using natural and organic products in animal production[6].

Herbal medicines have been used as alternative treatments for various diseases for centuries[7,8]. Plants, such as *Echinacea purpurea* and *Glycyrrhiza glabra* contain a diverse range of bioactive compounds, including alkaloids, flavonoids, and terpenoids, which have a wide range of pharmacological activities[9-11]. Herbal medicines are known to have fewer side effects than synthetic drugs, making them a potential alternative to chemical agents for controlling poultry coccidiosis. In recent years, there has been a growing interest in using herbal medicines to control poultry coccidiosis, with several studies investigating the potential of herbs and plant extracts as alternative treatments[12,13]. Multiple studies have demonstrated that specific herbs and plant extracts possess properties that can combat coccidiosis in poultry. These findings have highlighted the potential of using these herbs as alternative treatments for the disease[14,15].

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Herbs with anti-coccidial properties include turmeric (*Curcuma longa*), neem (*Azadirachta indica*), oregano (*Origanum vulgare*), garlic (*Allium sativum*), sweet wormwood (*Artemisia annua*), and thyme (*Thymus vulgaris*)[16-18]. These herbs have been shown to possess antimicrobial, antioxidant, and anti-inflammatory properties and effectively reduce the severity of coccidiosis in poultry[19]. The use of herbal medicines as alternative treatments for poultry coccidiosis has the potential to reduce the reliance on chemical agents, mitigate the development of antiparasitic resistance, and promote the use of natural and organic products in animal production. However, further research is needed to determine these herbal medicines' optimal dosages, safety, and efficacy in controlling poultry coccidiosis.

The purpose of this review was to offer a thorough and detailed summary of the existing research on herbal medicines and their potential as treatments for poultry coccidiosis. This review aimed to inform and guide future research on using herbal medicines as alternative treatments for poultry coccidiosis by summarizing the existing knowledge on this topic.

2. Herbal medicines history

Herbal medicines, such as *Echinacea purpurea* and *Glycyrrhiza glabra* have been used in traditional medicine systems for centuries to treat various diseases, including infections[20,21]. There has been growing interest in using herbal medicines as alternative treatments for poultry coccidiosis in recent years[22,23]. Herbal medicines are plant-derived products that contain active compounds, such as curcumin and allicin with therapeutic properties. These compounds can act on different targets in the body to exert their beneficial effects, including anti-inflammatory, antimicrobial, and antioxidant properties[24]. Herbal medicines, with their longstanding use in traditional medicine systems like Chinese medicine. In the context of poultry diseases, including poultry coccidiosis, there is increasing interest in investigating the efficacy of herbal medicines as alternative treatments[25].

In modern times, herbal medicines have gained attention as alternative treatments for animal diseases due to concerns about developing antiparasitic resistance and using chemical agents in animal production[26].

Research on using herbal medicines for poultry coccidiosis is still in its early stages, but several studies have shown promising results[27,28]. These studies have investigated the potential of different herbs and plant extracts for controlling the disease and reducing its impact on poultry production.

3. Herbal medicines with efficacy against poultry coccidiosis

Several herbal medicines are effective in treating poultry coccidiosis. These herbs contain active compounds that have anti-coccidial properties and can act on different targets in the body to reduce the severity of the disease.

3.1. *Garlic (Allium sativum)*

Garlic is a popular herb used for culinary and medicinal purposes for thousands of years. It is a member of the *Allium* genus, including onions, leeks, and chives[29]. Garlic is known for its distinct aroma and flavor from sulfur-containing compounds such as allicin[30,31]. Allicin, the active compound in garlic, effectively inhibits the growth and development of *Eimeria* parasites[32,33]. It achieves this by disrupting the parasite's cell membrane and inhibiting its ability to replicate[34]. In addition, allicin has been shown to stimulate the immune system, which can help chickens fight against parasitic infections[35].

3.2. Thyme

Thyme is a culinary herb used for centuries for its distinct flavor and aroma. It belongs to the mint family, *Lamiaceae*, and is commonly found in Mediterranean and Middle Eastern cuisine[36]. Thyme has also been used for medicinal purposes, with its essential oil being used as an antiseptic and disinfectant both in humans and veterinary medicine[37,38].

Recent studies have shown that thyme possesses anti-coccidial properties and can effectively control poultry coccidiosis[39,40]. A study indicated that an active compound in thyme (thymol) is particularly effective in reducing the severity of *Eimeria* infections in chickens[41]. Thymol is a natural phenol that has been found to have antimicrobial, antifungal, and antiparasitic properties[42] by disrupting the life cycle of *Eimeria* parasites[43]. It interferes with the parasite's ability to reproduce and survive in the chicken's intestine, thus reducing the severity of the infection[44]. Thymol has also been found to have immunomodulatory effects, stimulating the chicken's immune system to fight off the infection[45].

In addition to thymol, thyme contains other bioactive compounds that may contribute to its anti-coccidial properties[46]. These include carvacrol, rosmarinic acid, and flavonoids, which have been found to have antimicrobial and anti-inflammatory properties[47].

3.3. Oregano

It has recently gained attention for its potential use in treating poultry coccidiosis[48,49]. The active compounds in oregano, carvacrol, and thymol, have been shown to possess potent anti-coccidial properties[50,51] by disrupting the development of the *Eimeria* parasite, which causes coccidiosis in chickens[52].

Several studies have shown that feeding oregano to chickens infected with *Eimeria* can reduce the severity of the disease and improve their overall health[53,54]. In one study, researchers found that supplementing infected chickens' diet with oregano essential oil reduced the number of the *Eimeria* spp. oocysts shed in their feces[55]. The treated chickens also had higher weight gains than infected chickens that did not receive oregano.

Another study tested the efficacy of oregano extract in treating poultry coccidiosis[56]. The results indicated that oregano extract significantly reduced the severity of the disease and the number of oocysts shed in the feces of infected chickens. The researchers concluded that oregano extract could be a safe and effective alternative treatment for poultry coccidiosis[57].

3.4. Neem

Neem, also known as Indian lilac, is a tree that is widely used in traditional medicine in India for its therapeutic properties[58]. Its active compounds, azadirachtin, and nimbin, have been found to have anti-coccidial properties, making it a promising candidate for the treatment of poultry coccidiosis[59].

A study on the efficacy of neem against poultry coccidiosis found that feeding neem to infected chickens reduced the severity of the coccidiosis disease and improved their weight gain compared to infected chickens that did not receive neem[60]. The active compounds found in neem were identified as responsible for their anti-coccidial properties, as they were observed to inhibit the growth of *Eimeria* parasites in chickens.

Neem has also been found to have other health benefits for chickens[61,62]. It can act as an immune booster and promote gut health, which is crucial for preventing poultry diseases, including coccidiosis[63,64].

In addition to its anti-coccidial properties, neem has also been found to possess other medicinal properties[65]. It has anti-inflammatory, antioxidant, and antibacterial properties, making it useful for treating various diseases in chickens[66].

3.5. Curcumin

Curcumin, the active compound in turmeric, has also been studied for its potential anti-coccidial properties in chickens[67]. Turmeric is a spice commonly used in Indian cuisine and has been used for its medicinal properties in traditional medicine systems[68].

A study on the efficacy of curcumin against poultry coccidiosis found that feeding curcumin to infected chickens reduced the number of *Eimeria* oocysts shed in their feces and improved their weight gain compared to infected chickens not receiving curcumin[69]. The researchers attributed the anti-coccidial properties of curcumin to its ability to modulate the host immune response and inhibit the development of *Eimeria* parasites in chickens.

Curcumin has also been found to have other health benefits for chickens[70]. It can act as an antioxidant, anti-inflammatory, and antibacterial agent, which makes it useful for the prevention and treatment of various poultry diseases, including coccidiosis[71].

Moreover, curcumin is a natural and organic product safe for chickens and humans[72]. Its safety and efficacy make it a valuable natural and organic treatment for poultry diseases.

3.6. *Artemisia annua*

Artemisia annua, commonly known as sweet wormwood. This herb has been used in traditional Chinese medicine for centuries and has been shown to possess anti-coccidial properties[73]. The active ingredient in *Artemisia annua* is artemisinin, which has been shown to have anti-coccidial activity against different species of *Eimeria* species[74]. Another study aimed to compare the effects of different *Artemisia annua* extracts on the sporulation rate of mixed oocysts of *Eimeria acervulina*, *Eimeria necatrix*, and *Eimeria tenella*[75]. Three types of *A. annua* extracts (petroleum ether, ethanol, and water) were prepared and analyzed. The results showed that petroleum ether and ethanol extracts inhibited sporulation at certain concentrations.

4. Mechanisms of action

Herbal medicines have been shown to possess a range of mechanisms of action that contribute to their efficacy against poultry coccidiosis. For example, many herbs contain active compounds with anti-inflammatory properties, such as curcumin in turmeric and gingerols in ginger[76]. Inflammation plays a critical role in the immune response to coccidiosis. It serves as a key component in the body's defense mechanism against the infection caused by coccidia parasites. By reducing inflammation, these herbs can help alleviate the symptoms of the disease and support the chicken's overall health.

Other herbal medicines have anti-parasitic properties, which means they can directly kill or inhibit the growth of coccidian parasites. For example, thymol and carvacrol in oregano have been shown to have strong anti-parasitic activity, while allicin in garlic has been found to inhibit the growth of *Eimeria*[77]. These anti-parasitic properties can help reduce the number of parasites in the chicken's gut, reducing the severity of the disease and supporting the chicken's recovery.

Finally, some herbs have immune-modulating properties, which can help regulate the chicken's immune response to the parasite. Neem has been shown to have the ability to enhance the production of specific cytokines, which are important signaling molecules involved in regulating the immune response. This suggests that neem may contribute to strengthening the immune response against coccidiosis and other infections[78].

By modulating the immune response, these herbs can help the chicken fight against the infection more effectively and reduce the damage caused by the parasite[79].

Overall, the range of mechanisms by which herbal medicines act against poultry coccidiosis highlights the potential benefits of using these natural remedies in place of or in conjunction with chemical treatments.

5. Future and Challenges

The use of herbal medicines for controlling poultry coccidiosis has shown promising results, but this approach

has several challenges and limitations. One of the main challenges is the need for standardized extraction methods and dosing protocols for herbal medicines[80]. This makes it difficult to compare results across different studies and hinders the development of consistent and effective treatments. Additionally, the variability in the composition of herbal extracts due to differences in soil, climate, and harvesting methods can further complicate the standardization process[81].

Another challenge is the need for more research to establish the safety and efficacy of herbal medicines[82]. Although many studies have reported positive results, there still needs to be comprehensive toxicity studies and clinical trials that can provide more robust evidence of their safety and effectiveness[83]. There needs to be more funding for research on herbal medicines to progress in this area.

The regulatory environment also challenges the use of herbal medicines in animal production. The approval process for herbal medicines is often more complex and time-consuming than chemical agents[84]. Additionally, the lack of standardized regulations across different countries can create barriers to the international trade of herbal medicines[85].

Moreover, there is a need for more awareness and education among farmers and veterinarians about using herbal medicines to control poultry coccidiosis[86]. Many farmers may hesitate to adopt alternative treatments due to a lack of familiarity and understanding of their mechanisms of action and potential benefits.

Despite these challenges, the use of herbal medicines for controlling poultry coccidiosis has the potential to offer several benefits over chemical agents. Herbal medicines are generally considered safe and have a lower risk of developing antiparasitic resistance than chemical agents. They are also compatible with organic and natural production systems, which are becoming increasingly popular among consumers. Moreover, using herbal medicines can help reduce the environmental impact of animal production by reducing the amount of chemical residues in animal products[87].

6. Conclusion

In conclusion, herbal medicines have shown great potential as alternative treatments for poultry coccidiosis. Various herbs and plant extracts have been shown to possess anti-coccidial properties. They can be used to reduce the reliance on chemical agents, mitigate the development of antiparasitic resistance, and promote the use of natural and organic products in animal production. Garlic, thyme, oregano, and neem are herbal medicines effective in treating poultry coccidiosis. The mechanisms by which herbal medicines act against poultry coccidiosis include their anti-inflammatory, anti-parasitic, and immune-modulating properties. However, further research is needed to better understand the mechanisms of action and optimize the use of these herbal medicines to control poultry coccidiosis.

Future challenges in using herbal medicines for poultry coccidiosis include standardization of products, development of effective delivery methods, and identification of optimal dosages. Additionally, regulatory issues, such as lack of approval for herbal medicines in some countries, may limit their widespread usage. In conclusion, while there are several challenges and limitations to using herbal medicines for controlling poultry coccidiosis, their potential benefits make them a promising area for further research and development. It is important to continue to invest in research to establish the safety and efficacy of herbal medicines, standardize extraction methods and dosing protocols, and raise awareness and education among farmers and veterinarians about their potential benefits.

Declarations

Competing interests

There is no conflict of interest.

Authors' contribution

The final manuscript draft was reviewed by all authors, who also gave their approval.

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Ethical considerations

Ethical issues (including plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy) have been checked by all the authors.

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