Review Paper

Herbal plants as an appropriate stimulus with prophylactic potential in livestock: A review

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Abstract:
The industrial maintenance of livestock and poultry on a large scale in an intensive manner has increased the possibility of diseases, which reduces the occurrence of these diseases helps to boost growth and improves production traits. Today, the use of growth-promoting antibiotics has been limited due to the possibility of bacterial resistance and also transmission through manufactured products to consumers. Medicinal plants with antimicrobial effects and reduced serum lipids have been proposed as suitable alternatives for antibiotics. The origin of many medicines are herbal plants because due to the lipophilic nature of the effective oils found in some medicinal plants, these compounds can completely disrupt the membrane structure of bacteria, especially Gram-negative bacteria, and even some effective oils in essential oils have Irritation of the digestive system, increasing the production of digestive enzymes, improving the use of digestive products and the body's immune response. The most important biological activity of medicinal plants is related to antioxidant and antibacterial activities, related to their biologically active molecules such as carvacrol, thymol, cineol, allicin, capsaicin, piperine, *etc*. The property of stopping the reproduction of the disease agent or the lethality of the disease agent is a common point between chemical drugs and medicinal plants, but creating a protective layer on the intestine to prevent the penetration and growth of the coccidiosis agent in the intestines and stimulating the body's immune system against the disease agent is a unique feature. The desire of the world community to consume animal products free of chemical compound residues and to prevent the development of bacterial resistance has led to more use of plant resources.

Keywords: Essential oil, Medical plants, Livestock, Phytochemical, Prophylactic potential

1. Introduction

The country's livestock and poultry industry have grown significantly to respond to the increasing needs of human societies for animal protein sources [1, 2]. The industrial keeping of livestock and poultry on a large scale and intensively has increased the possibility of the occurrence of diseases, which reduces the incidence of these diseases and also to help increase the growth and improve production traits, various chemicals, including antibiotics, are used in livestock and poultry breeding units [3-5]. Today, the use of growth-promoting antibiotics has been limited due to the possibility of bacterial resistance and also the transmission through manufactured products to consumers [6, 7]. Medicinal plants with antimicrobial effects as well as reducing serum lipids have been proposed as suitable alternatives for antibiotics [8, 9].

Medicinal plants have a special value and importance in providing health and wellness to communities both in terms of treatment and prevention of diseases [10]. This part of natural resources is as old as humans and has been one of the most important sources of human food and medicine supply for generations. From a historical point of view, plants have been very important in the development of societies, and extensive research has been done to find natural herbal medicinal products and substances throughout history [11, 12], but the important point here is that only less than 10% of the total of 600,000 plant species in the world for more than biological, have been identified and used [13, 14]. The general tendency of society to use medicines and herbal treatments and natural products, in general, has been increasing especially in recent years and the most important reason for this is the proof of the harmfulness of chemical drugs and the creation of environmental pollution that threatens the planet. Today, paying attention to medicinal plants, which form a major part of traditional medicine and are widely used among the people, is of particular importance, and in the meantime, the quality control of medicinal plants is carried out to provide access to products of standard quality to different classes of people.

Herbal medicines have been the only available source for treating pains and ailments for many centuries [15]. In today's era, despite the significant development and expansion

of the use of synthetic drugs, medicinal plants and medicinal forms derived from them are still used on a large scale, so that in some countries they are considered an integral part of the drug therapy system, and their trade market is also in compared with other chemical drugs, it is more prosperous.

In addition to the effect on the growth rate and improvement of production, phytobiotics can create other positive effects such as improving the health status, effect on the intestinal microbial population, increasing the concentration of disease antibodies, and effect on the blood parameters of livestock. Medicinal plants, as they are used in human medicine, also play a role in the field of veterinary medicine, medicinal plants are used in two fields: prevention and, to some extent, treatment [16-23]. In recent years, planning and research related to the use of medicinal plants and their effective substances in the field of animal husbandry and veterinary medicine have been started [20, 21]. Of course, according to scientific information provided by some knowledge-based centers and faculties of agriculture and veterinary medicine, herbal medicines are well used in some diseases such as microbial infections (in poultry and ruminants). In field of using herbal medicines in the field of animal sciences, it is at the beginning of the path, and more steps must be taken to gain a real position. For this purpose, the private sector should have a stronger role in the medicinal plant technology sector. Many human and animal medicine specialists have little information about medicinal plants and their compounds, so conducting scientific research on medicinal plants and publishing scientific articles can eliminate the negative view of them [22, 23]. Some features of medicinal plants are shown in Table 1.

This review article is written to investigate the effects of the extracts of various medicinal plants on the economic and physiological traits of farm animals.

Table 1 Medicinal properties of some herbal plants [20, 24]

Spice	Medical property
Ajowan (*Trachyspermum ammi*)	Corrects digestive disorders
Anise seeds (*Pimpinella anisum*)	Carminative
Asafoetida (*Ferula asafetida*)	Laxative, antispasmodic, Carminative, ant flatulent
Black pepper (*Piper nigrum*)	Carminative and laxative; remedy for dyspepsia, diarrhea, flatulence, nausea and vomiting
Cardamom (*Elettaria cardamomum*)	Antiemetic and stomachic
Clove (*Eugenia caryophyllus*)	Gastric stimulant and carminative; useful in nausea, indigestion and dyspepsia
Cinnamon (*Cinnamomum zeylanicum*)	Carminative, astringent and stimulant; antiemetic
Coriander (*Coriandrum sativum*)	Stimulant and carminative; stomachic, antibilious, digestive stimulant
Cumin (*Cuminum cyminum*)	Stimulant and carminative; stomachic and astringent; useful in dyspepsia and diarrhea
Fennel (*Foeniculum vulgare*)	Carminative
Fenugreek (*Trigonella foenumgraecum*)	Carminative, tonic
Garlic (*Allium sativum*)	Gastric stimulant; carminative
Ginger (*Zingiber officinale*)	Remedy for dyspepsia and indigestion; stomachic relieves stomach pain and nausea
Mint (*Mentha spicata*)	Carminative, stomachic, tonic, antispasmodic

Mustard (*Brassica nigra*)	Useful in abdominal colic, vomiting; gastric stimulant
Red pepper (*Capsicum annuum*)	Remedy for dyspepsia, stomachic and carminative
Turmeric (*Curcuma longa*)	Ant flatulent, stomachic, tonic, antacid & carminative; reduces pungency of food by increasing mucin content of gastric juice
Thyme (*Zataria Multiflora)*	Antifungal, Anti-inflammatory, Strengthening good digestion and reducing gas and bloating, Antiseptic and antibiotic, An excellent source of vitamin K, iron, calcium, and manganese, Antioxidants, Blood pressure and heart rate control, Boosting immunity system
Ziziphora (*Ziziphora clinopodioides Lam)*	Anti-diabetes, Prevention and treatment of diarrhea, Fix digestive problems, Anti-inflammatory and soothing, Increased blood pressure, Strengthening sexual desire
Eryngos *(Eryngium billardieri)*	Stimulation of insulin production, Antifungal, Anti-inflammatory, Anti-bacterial, For the digestive system and treating colitis and activating the liver and bile production

2. Phytochemicals and food intake

The use of medicinal plants with antimicrobial effects and strengthening the digestive system in the feeding of broiler chickens and other farm animals can reduce the existing concerns regarding the increase in production costs as well as the possibility of bacterial resistance and the subsequent risk to the health and safety of the community [20, 25, 26].

In general, appetite or lack of appetite refers to eating or avoiding eating certain ration. Palatability refers to the conditions and characteristics of a feed, which cause the animal to move and the animal chooses that feed. Chemical compounds of plants are one of the important factors that determine the palatability of plant species [27]. Extracts of most medicinal plants such as oregano, thyme [20], *Achillea millefolium*, *Adiantum capillus-veneris* [10], carrot powder [28], *etc*. can stimulate and increase the appetite of poultry. Mint has also been used in traditional medicine for a long time and its beneficial effects have been mentioned. This plant has anti-bacterial and anti-viral properties and its extract is anti-ulcer, anti-inflammatory, and anti-pain [29]. It stimulates the production of bile, prevents excessive contractility of intestinal smooth muscles, normalizes intestinal activity, and improves digestive system dysfunction. One of the important compounds of mint is menthol. This combination is appetizing and stimulates digestion. The essential oils present in medicinal plants act as digestive stimulants and by creating balance in the intestinal microbial ecosystem and stimulating the secretion of endogenous enzymes, they improve the digestion of nutrients and as a result, growth in poultry [30-32].

Spices probably stimulate the secretion of bile by stimulating the liver, which in this way increases the digestion of fatty foods. The effects of ginger, coriander, cumin, fenugreek, mustard, asafetida, ajowan, fennel, cinnamon, tamarind, onion, garlic, mint, and spices - curcumin, capsaicin, and piperine were investigated on the secretion of bile acids. Laboratory studies showed that curcumin, capsaicin, piperine, ginger, fenugreek, and cardamom showed their effect on cholesterol circulation in terms of bile acid secretion and hypocholesterolemia. Hypocholesterolemic spices such as curcumin, capsaicin, ginger, and fenugreek stimulated the production of bile acid and increased liver function. While piperine did not have such a stimulating effect. Curcumin nearly doubled bile production by increasing bile salts, bilirubin, and cholesterol. Although cardamom is not a known hypocholesterolemic spice, the cholagogic effect of the presence of glucosides increased bile acid [33, 35].

Some medicinal plants have flavonoid and carotenoid nutrients, and flavonoids have antioxidant properties that can prevent cholesterol deposition in arteries and improve blood parameters. Another medicinal plant is milk thistle, whose chemical compounds can reduce glucose. Considering that one of the influencing factors on food consumption is blood serum glucose level, it can increase food consumption [8, 10]. Medicinal plant extracts and essential oils can have a significant effect on the digestion and absorption of nutrients by correcting the blood serum profile and improving the function of the liver, kidney, small intestine, *etc*.

Researchers have conducted studies on the effect of medicinal plants on the activity of digestive enzymes of different aquatic species and by examining the effect of replacing the fish powder with chlorella powder on the performance of digestive enzymes of *Carassius auratus*. They showed that instead of replacing *Chlorella vulgaris* instead of fish meal in the diet, an increase in the activity of amylase and lipase enzymes was observed. Some researchers investigated the effect of *Allium sativum* L. extract on the sur-

vival rate and biochemical parameters and digestive enzymes of *Mugil cephalus* larvae and reported that the highest levels of amylase, lipase, and protease enzymes were related to the diet containing garlic extract, which is a significant difference compared to the control group [36, 37].

The effect of plant extract on increasing the length of villi is also well known. In a study, it was shown that the use of a mixture of essential oils of several plant species (*anise*, *citrus peel*, and *oregano*) prevented the reduction of villi height. Although in the condition of animal health, the use of a mixture of herbs and medicinal plants could increase the growth of intestinal villi compared to the control, which was consistent with the results of this study [38, 39]. Therefore, plant extracts and essences can increase food consumption through the mentioned cases.

3. Phytochemicals effects on body weight and metabolism

The use of plant products in the diet of livestock, poultry, and aquatic animals has been considered due to their availability and reasonable price. Plant additives can affect the growth rate by affecting indicators such as digestibility and food consumption. Medicinal plants do not contain harmful chemicals such as corticosteroids found in chemical drugs and help to increase weight, strengthen the body in general, build bones, and improve the constitution of the animal [6, 7, 15].

There are numerous and different chemical compounds in plants, each of which has specific physiological properties. One of the compounds in plant extracts is saponin. Saponin is an active substance with unique biological and medicinal properties. Another property can be mentioned as an antioxidant, a free radical scavenger, and promoting fat metabolism. The use of plant materials containing saponin in the diet increases the activity of amylase and protease enzymes in the intestine and increases the digestion process and improves the absorption of feed. Due to the presence of manganese, some plant extracts reduce the blood glucose level, and also the effective substances in the plant extract reduce liver steatosis through the effect of genes involved in cholesterol metabolism. Among these upregulation effects of the LDR receptor, the liver X-type receptor a (LXRa) and its use in liver lesions have been proposed as a liver protective agent.

Many plant extracts contain flavonoid and carotenoid nutrients, flavonoids have antioxidant properties that can prevent cholesterol deposition in the arteries. In general, the nutrients in plant extracts and essential oils reduce blood cholesterol levels and improve blood parameters. Wang et al. (2011) demonstrated it was found that the use of 0.1% and 1% aloe vera extract in rainbow trout food had a positive effect on the growth performance of this fish. Of course, the high amount of raw fiber, protease inhibitors, and tannins in plants can cause weight loss. The effect of increasing growth by using plant extracts as a food supplement depends on the appropriate concentration of the extract, diet composition, and breeding management [40-42]. Some plant extracts also have an increasing effect on the secretion of testosterone and then the process of protein synthesis and the production of muscle tissues and as a result increase body weight. The use of Turnip Leaf (*Brassica Rapa* L.) in the diet of rainbow trout caused a significant increase in serum testosterone levels [43-45].

4. Medicinal plant compounds on intestinal microbiota

Microbiota is a collection of microorganisms that live in different parts of the body, including the digestive system. Three hundred to thousand different types of bacteria live in the intestine, which approximately has more than four million genes [46]. These bacteria together with other microorganisms such as fungi, viruses, and parasites form microbiota or microbiome, which was called intestinal microbial flora in the past. The microbiota of each animal is unique, like a fingerprint, and differs from the microbiota of another animal. The microbiome is formed from birth and is influenced by the mother's microbiota, living environment, and nutrition. Bacteria that live specifically in the digestive system (mainly the small intestine and colon) have the greatest impact on health and affect various aspects of health, from the body's metabolism to mental health and the immune system. These bacteria are related to the immune system and brain and play a role in the digestion and absorption of food and the conversion of nutrients. Gut health depends on the correct balance of different bacteria to digest food and prevent infection and inflammation.

It has been demonstrated that the presence of beneficial microflora increases the length of villi, crypts, and intestinal cell proliferation, but pathogenic bacteria destroy the epithelium layer by producing toxic compounds such as ammonia, and by increasing cell transformation to renew atrophied cells, the height of villi decreases and the depth of crypts decreases [45, 47]. The intestine increases.

Lactobacilli are considered to be one of the most important populations of beneficial flora in the intestines of poultry and are beneficial for the health of the digestive system of birds. The increase of lactobacilli can prevent the growth of gram-negative pathogens, such as *Escherichia coli* and *Salmonella*, through the production of oxygenated water. Probiotics can compete with pathogens by settling in the digestive system, and by occupying the receptors of the mucous cells of the digestive system, they can prevent the establishment of harmful bacteria in this system and increase the function of the immune system in the gut. Probiotics increase the function of the immune system in the gut and the general body. Lactic acid-producing bacteria, including *Lactobacillus*, can stimulate the bird's immune system by increasing lymphocyte B and increasing the production of antibodies [47].

Researchers have studied the antimicrobial effect of essential oils and extracts of different plant species such as *Ziziphora clinopodioides* Lam and stated that the main compound in several plants of the mint family is Pulegone. The appropriate concentration of Pulegone can prevent the growth and proliferation of both groups of gram-positive bacteria (*Bacillus subtilis*) and gram-negative bacteria (*Salmonella typhimurium*) [20, 48].

Medicinal plants and spices act as antimicrobial agents by changing the properties of the cell membrane and causing the leakage of ions and thus reducing the virulence of microbes [48]. Exploring the exact antimicrobial mechanism of medicinal plants and spices *in vivo* is difficult due to the complexities and balance of microbial populations in the gastrointestinal tract and the reaction of active compounds from medicinal plants and spices with other food substances. In laboratory conditions, the strong antimicrobial activity of plant extracts against Gram-positive and Gram-negative bacteria has been investigated [49]. Teymouri Zadeh

et al. showed that the use of 0.1% thyme extract in the diet of male broilers significantly reduced the population of *Escherichia coli* and increased the population of *Lactobacillus* bacteria in their ileum and cecum [50]. In a study, thymol, carvacrol, and eugenol decreased the intracellular adenosine triphosphate (ATP) production and disintegrated the cytoplasmic membrane of *Escherichia coli* [51]. Plant extracts stimulate the growth of beneficial intestinal flora and thus reduce the presence of gram-negative bacteria such as *Escherichia coli*. In Jamroz *et al*.'s study, the use of carvacrol increased the count of lactic acid bacteria [52].

5. The effect of herbal compounds on immunity

The improvement of the immune system is caused by the use of plants rich in flavonoids and carotenoids due to having vitamin C and also antibacterial effects. Some medicinal plants contain the effective compound of flavone apigenin, which prevents the growth of harmful microorganisms [53, 54]. In a study, the effect of the natural herbal medicine "Immunopropofit", containing the extract of sorghum, licorice extract, and propolis extract, on the function of the immune system of chickens was investigated. 60-day-old commercial chickens were randomly divided into 6 groups of 10. Chickens in groups A and B from 5 to 42 days old were treated with immunopropofit drug in the amount of 250 ml in drinking water. According to the obtained results, the use of the herbal medicine "Immunopropofit" improved the function of the immune system in response to vaccination against acute Newcastle virus by increasing the antibody titer. Also, when chickens were exposed to acute Newcastle virus, the use of this drug prevented the multiplication and shedding of the virus [55]. Diterpenes, including carnosol, isorsmanol, carnosic acid, and caffeic acid, are the active compounds of *Rosmarinus officinalis* that have antioxidant activity. On the other hand, the main components of the final monoterpene rosemary fatty acids include alpha-pinene, myrcene, cineole and Brunel, which have the possibility of strong antibacterial and anti-microbial activity [55]. *Thymus vulgaris* is a medicinal plant that can be used as a natural alternative to antibiotics in poultry production, in addition, it has inhibitory effects on the abdominal fat characteristics of broiler chickens, so adding 200 mg/kg of thyme essential oil to the diet Broiler chickens caused a significant decrease in the percentage of abdominal fat compared to the control group, and this significant decrease in abdominal fat can be due to the composition of saponin in thyme, which has inhibitory effects on lipogenesis. The main components of thyme essential oil are thymol and carvacrol, which comprise about 3 to 60% of all thyme essential oils [20]. *Satureja hortensis* essential oil contains significant amounts of two phenolic ketones, carvacrol and thymol. Different types of spices are known for their antifungal, antiviral, antiprotozoal, anti-inflammatory and antioxidant effects. Such medicinal plants can play an important role in improving the immune system with the various effects of their effective compounds [56, 57].

The most important compound *of Artemisia annua* L. is Artemisinin. Turmeric and artemisinin have shown very good effects in reducing the number of coccidiosis oocysts. Or *Peganum harmala* L., having the compounds Tetra Harmine Hydroharmine, Harmalol, and Harmaline have been able to reduce the number of oocysts by 99% without causing any complications. *Melia azedarach* L., *Melia Azadirachata* L., *Polygonum aviculare* L., *Larrea tridentate*, *Dichroa febrifuga*, *Curcumina longa* L., *Saccharum officinarum*, and *Origanum aetheroleum* are also effective in controlling coccidiosis by having effective compounds [58, 59].

An experiment showed that the increase in liver enzyme activity is the result of liver damage and enzyme leakage into the blood. The addition of 0.5% of *Silybum marianum* L. seed powder, 1% of *Silybum marianum* L. powder and 1000 ppm of *Silybum marianum* L. extract to the contaminated diet significantly reduced the plasma concentration of ALT. The significant reduction of plasma ALT concentration in the contaminated diets containing seed powder, extract and powder of thistle plant compared to the contaminated control diet can be due to the mitigation of the negative effects of aflatoxin on the destruction of liver cells. Because silymarin is a very strong antioxidant, by inhibiting the peroxidation of lipids, especially in liver cells, it inhibits the metabolic disorders of these cells. Another group of researchers suggest that the strengthening of the weakened immune system by silymarin is the cause of liver protection by it, in fact, silymarin protects the cell against any acute or chronic destructive damage regardless of the factors that cause disorders in the liver cells [60].

6. Conclusion

Considering the availability of conditions for the growth and expansion and diversity of medicinal plants around the world and the development of this industry, as well as the desire of the world community to consume animal products free of chemical compound residues, conducting extensive research to use these plants or their products in Feeding livestock and poultry can be necessary. Although medicinal plant products have been able to improve the microbial flora in addition to physiological changes, more research is needed, especially in the field of using different plants for animal use. Geographical location and time of collection of plant samples as well as extraction methods of plant products are important and standardization should be done in this field.

Conflicts of interest

The authors declare that there is no conflict of interest. The authors alone are responsible for the accuracy and integrity of the paper content.

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