Chapter 08

Use of Botanicals for Prevention and Treatment of different Poultry Diseases

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ABSTRACT

Poultry diseases are a major global public health concern, affecting millions of individuals globally. This research explores the potential impacts of plants and their bioactive compounds, frequently employed in treating different chicken illnesses. The medicinal properties of natural herbs depend on their bioactive compounds extracted from raw plants, leading to distinct effects on the body. The poultry industry faces substantial financial losses due to the emergence of drug resistance in many harmful parasites and bacteria, worsened by limited access to efficient treatments and their expensive nature. This necessitates the development of new sources for medications to overcome therapeutic deficiencies. Ecologically sustainable feed supplements have proven to be excellent substitutes for antibiotic growth promoters (AGP) in broilers. Utilizing natural substances with medicinal qualities is an age-old practice that is gaining more recognition. Around 20,000 species of higher plants are used worldwide for medicinal purposes, although traditional medicine does not have a complete understanding of their efficacy and safety. This study investigates the use of medicinal herbs for parasitic disorders in chickens, analyzing existing information and pinpointing research areas that may be explored to harness herbal medicines for this specific application. Herbal medications provide crucial components for identifying poultry diseases and creating phyto-pharmaceuticals to manage parasite infestations.

KEYWORDS
Poultry, Botanicals, Essential Oils, Antimicrobial

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INTRODUCTION

In this chapter, we delve into the fascinating world of botanicals and their role in the prevention and treatment of various poultry diseases.

Pakistan is an agricultural country located in the subtropical region of the world. As such, livestock is essential for the basis of agriculture. Poultry is highly valued in this nation's livestock industry, so poultry has a significant impact on the national economy. Exporting chicken eggs and meats contributes substantially to the country's foreign exchange earnings. Poultry are domesticated birds raised for meat, eggs, and feathers, such as chickens, turkeys, guinea fowls, ducks, and other species like pigeons. Chickens constitute over 90% of the global chicken population and are the most important poultry species worldwide. Poultry farming is becoming increasingly important globally, especially in Asia. Poultry farming in Asian countries has the potential to offer economic advantages such as enhanced nutrition, increased income for farmers, job possibilities, a steady grain market, and an affordable source of protein.

Poultry farming can be a viable occupation for unemployed young people, landless farmers, impoverished individuals, divorced women, and children to increase their family's earnings. Poultry eggs and meats are high in protein content. Poultry meats are nutritious, tasty, and contain less fat. Poultry farming is vital for the survival of rural communities in Pakistan. Farmers raise hens to meet family food needs and earn additional income. However, avian breeding is impeded by many diseases. Underprivileged communities lacking modern veterinary facilities experience substantial disease burdens and rely on traditional remedies to cure livestock infections. We study the medicinal plants used to treat chicken diseases in Pakistan and worldwide.

Farmers may find it difficult to get or afford traditional drugs or immunizations for preserving their flocks' health. Impoverished farmers turn to unconventional remedies since they do not have access to conventional treatments or vaccinations. Conventional poultry disease treatments are designed for large-scale commercial farms with numerous birds, but small-scale poultry farmers handle tiny flocks of birds at different stages of growth. The flocks may comprise multiple species. Rural farmers claim that ethno-veterinary approaches are effective, but additional research is required to confirm their assertions.

Mechanism of Action of Botanicals

Plants possess antibacterial characteristics that are primarily generated during secondary metabolism. Plant-based antimicrobial drugs have significant therapeutic potential by effectively carrying out their function without the common adverse effects of synthetic medications. The antimicrobial mechanisms of phytobiotics are not completely understood. Proposed mechanisms include disrupting pathogen cellular membranes, altering cell surface hydrophobicity and virulence, stimulating the immune system (including lymphocytes, macrophages, and NK cells), and shielding intestinal cells.

The inherent value and functional use of plant extracts including garlic, cinnamon, tulsi, and ginger etc. are well known. Plants frequently contain bioactive compounds that are less harmful and more environmentally friendly. They have shown antibacterial activity against methicillin-resistant Staphylococcus aureus (MRSA) and various other bacteria such as Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Proteus mirabilis, Brevibacterium ammoniagenes, Streptococcus mutans, and Propionibacterium acnes. Although there is growing worldwide attention towards plant-based antimicrobials, numerous plants are not fully utilized in addressing antibiotic-resistant bacteria. Botanicals, or phytobiotics, consist of primary and secondary plant components. Protein, fat, and carbohydrates are the primary nutrients, accompanied by secondary elements such as essential oils, bitter chemicals, colourants and phenolic compounds.

Essential Oil Used in Disease Control

Essential oils are commonly used as phytobiotics because of their antibacterial and growth-promoting properties. Essential oils are derived from fragrant plants, herbs, or spices using solvent or distillation methods. Essential oils containing multiple active components often serve to shield plants from insect and bacterial damage. Each component may have distinct mechanisms, but they collaborate synergistically. The effectiveness of essential oils is dictated by their chemical makeup. Thymol and carvacrol exhibit similar antibacterial capabilities, but their mechanisms of action differ due to changes in the position of the hydroxyl group. Limonene and p-cymene have distinct alkyl group locations and antibacterial properties. Assessing the effectiveness of essential oils is challenging because of variables such as extraction method, geographic location, plant genetics, harvest time, and storage period. Out of 3,000 essential oils, 300 are crucial for commercial use in various industries such as pharmaceuticals, agriculture, food, hygiene, cosmetics, and perfumes, as stated. Essential oils (EOs) are being increasingly utilized in the food industry and by animal producers due to their antioxidant, anti-inflammatory, antimicrobial, coccidio-static, anti-helminthic, and antiviral properties, as confirmed by different researchers. Carvacrol, thymol, and eugenol extracted from clove oil are effective antibacterial agents against several harmful microorganisms. Oils are being studied as potential additives to enhance food microbiology. Essential oils are increasingly being used in both conventional and organic poultry feed to enhance gastrointestinal health. Enhancing the stability of gut flora enhances the absorption of meals. Essential oils improve nutrition absorption by enhancing the activity of digestive enzymes like trypsin and amylase. Furthermore, active components increase intestinal mucus production, which helps to avoid bacterial adhesion.

Botanical Characteristics

A-Antimicrobial Characteristic

Many plant extracts include chemical components with anti-inflammatory, antimicrobial (Hammer et al., 1999), antioxidant (Hashemi and SR, 2010), and anthelmintic properties. Proteins, peptides, oligosaccharides, fatty acids, vitamins, and micro-minerals make up the majority of plant extracts. Plant extracts are multifunctional and their active secondary plant metabolites are mostly classified as flavonoids and isoprene derivatives (Tajodini et al., 2015). They engage in a variety of activities. Their chemical and biological variety is influenced by various elements such as the agricultural area, climatic circumstances, vegetation phase, genetic alterations, and others.

B- Sensory Characteristics

Essential oils possess antioxidant capabilities because of their redox features, chemical makeup, and the presence of phenolic groups. Certain botanicals can influence the sensory characteristics of the meat. Research indicates that fragrant plants like rosemary, oregano, and sage, together with spices such as cinnamon, can decrease the oxidation of oils and fatty acids. Precooked and ready-to-eat poultry products are prone to oxidative degradation due to their high polyunsaturated fatty acid content. Research has shown a reduction in lipid metabolism and cholesterol levels. Research has discovered that limonene plays a role in cholesterol production. Research has shown that Thymol, carvacrol, and β-ionone control non-sterol molecules. Lipid oxidation happens during meat processing, cooking, and refrigerated storage, impacting food quality by leading to a change in color, smell, and taste, and reducing the shelf life. Research suggests that herbs like rosemary, tea catechins, and essential oils can aid in preserving raw and precooked chicken when refrigerated. Poultry nutritionists study the antioxidant capabilities of several plants and essential oils to enhance meat quality.

C- Antioxidants

There have also been reports of hypo cholesterolemic effects and lipid metabolism,documented limonene's function in the production of cholesterol (Qureshi et al., 1988). According to reports from other authors, non-sterol products are regulated by thymol, carvacrol, and β-ionone (Case et al., 1995). Processing, cooking, and refrigerated storage of meat all involve lipid oxidation, which reduces the shelf life and results in the loss of desired colour, flavour, and odour in food products. According to (Brenes and Roura, 2010), the presence of phenolic groups, along with their chemical structure and redox characteristics, are primarily responsible for the antioxidant activity of EOs. Extensive research has been conducted on the potential benefits of aromatic plants like rosemary, oregano, sage, and spices like cinnamon in delaying the process of lipid peroxidation in oils and fatty acids. Poultry items that are precooked and ready to eat are especially vulnerable to oxidative degradation due to their high polyunsaturated fatty acid concentration. It has been seen those herbs like rosemary, tea catechins, and essential oils help to stabilize both raw and cooked chicken flesh while it is refrigerated. The antioxidant qualities of several plants and essential oils are also of interest to poultry nutritionists as they may enhance the quality of meat. The antioxidant activities of grape seed and grape pomace concentrate as free radical scavengers have made them seem like potential supplements (Viveros et al., 2011). Nevertheless, a few of these herbs may have an impact on the meat's flavor. Grape seed and grape pomace concentrate are recommended as useful additives because of their antioxidant properties in neutralizing free radicals.

Impact on the Digestive Process

Plant-based treatments are referred to as phytobiotics or botanical medicine. Medicinal plant components consist of flowers, fruits, roots, leaves, seeds, bark, berries, and complete plants. Phytobiotic feed additives are plant-derived components incorporated into animal feed to enhance performance. Phytobiotics can enhance the efficiency and quality of broiler and layer chickens by decreasing gut microbe populations through various mechanisms such as antimicrobial properties, promoting mucous secretion, preventing bacterial adhesion to cell membranes, altering gut bacterial populations, stimulating digestive secretions, improving nutrient absorption, and offering antioxidant, anti-inflammatory, and immune modulatory effects.

Key Botanicals and Their Function in Managing Certain Poultry Diseases

Garlic

Garlic, scientifically known as Allium sativum, is a perennial plant with bulbous flowers belonging to the amarylidaceae family and originating from Central Asia. It is stated that both cooked and raw garlic offer various health advantages (Kovarovič et al., 2019). Garlic was widely utilized by ancient Chinese, Egyptians, Greeks, Babylonians, Hindus, and Romans. Garlic has various functional qualities, including sulfur-containing chemicals, essential oils, and polyphenol compounds. Rats given 5 mL/kg of garlic oil daily for three months showed reduced toxicity and oxidative stress caused by $NaNO_2$ (Hassan et al., 2010). This unusual spice includes the allicin precursors L-gamma-Glutamyl-(S)-Allyl-Cysteine and ACSO, as well as the lipid-soluble sulfur compounds di-2-propenyl disulfide and diallyltrisulfide. Garlic has antioxidant and antimicrobial properties. Propyl propane thiosulfonate (PTS-O) generated from garlic is effective in eradicating Salmonella typhimurium, Escherichia coli, and Campylobacter jejuni in diets with concentrations of 45, 90, and 135 mg/kg, respectively. Thiosulfinate and allicin in garlic may possess antibacterial effects (Curtis et al., 2004). These compounds contribute to the scent, fragrance, and biological properties of garlic. Garlic extracts containing phenolics (0.05-0.98 mg gallic acid equivalents/g) and flavonoid aglycones (4.16-6.99 µg quercetin equivalents/g) demonstrate antioxidant and chemo-preventive effects in response to chemically produced oxidative stress in a manner that depends on the dosage. Garlic's antimicrobial and antioxidant properties could stimulate growth. Garlic essential oil, a potent antioxidant, decreases TBARS levels and hinders DPPH-free radicals in grilled breast muscles. It has been discovered that garlic increased HDL levels and reduced cholesterol and triglycerides in grilled hens (Rusli et al., 2022).

Jir/Bootae

Jir/Bootae (Artemisia scoparia) is classified under the Asteraceae family, Artemisia genus, and scoparia species Waldstand Kit. The Asteraceae family comprises a multitude of plant species. This plant is cultivated in many regions worldwide, including Asia and Europe. Mint oil comprises sesquiterpenes, oxygenized sesquiterpenes, cis-arteannuic alcohol (25.9%), β-caryophyllene (5.5%), β-maaliene (6.3%), β-farnesene, caryophyllene oxide (4.4%), and 2-phenylbenzaldehyde (3.5%).Additional chemicals include artemisia ketone, eugenol, germacrene-D, capillin, transpinocarveol, verbenone, and 1,8-cineole (Goel et al., 2007). Artemisia scoparia has the ability to produce antibacterial chemicals. The annual plant includes bioactive chemicals with antibacterial, antifungal, anti-leishmanial, and anticancer properties. It has been found that its use inhibits the development and production of Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Mycobacterium. Studies conducted in a laboratory setting show that compounds from Jir have antioxidant properties by scavenging free radicals (Bhowmick et al., 2020).

Cumin

Cumin is scientifically referred to as Cuminum cyminum L. Belonging to the family Apiaceae, this slender, fragrant plant is an annual plant that completes its life cycle in one year and contains two seed leaves. Natural herbal remedies and derivatives are known to promote growth (Granados-Chinchilla, 2017). The seeds are used to enhance the flavor of foods.

Cumin is preferred by both human and animal nutritionists owing to its many medical properties (Shafiee et al., 2020). Broilers given a basic diet supplemented with 0.75% cumin showed increased immunological response, enhanced growth, and lower cholesterol levels. Cumin includes many significant compounds, including pyrazines, cuminaldehyde (4-isopropylbenzaldehyde), 2-methoxy-3-methylpyrazine, 2-methoxy-3-secbutylpyrazine, carvone-limonene, and linalool (Kaur and Sharma, 2012). Cumin seeds include phytochemicals that have antioxidant, carminative, and anti-flatulent properties. Cumin's active substance promotes gastrointestinal motility and enzyme synthesis(Platel and Srinivasan, 1996). Spices are thought to help digestion by increasing the activity of digestive enzymes.

Fennel

Fennel, scientifically named Foeniculum vulgare, is a biennial plant that possesses medicinal and aromatic characteristics. It is a member of the Apiaceae family and is frequently seen in Central Europe and the Mediterranean region (Foroughi et al., 2016). This plant has demonstrated efficacy in treating respiratory and gastrointestinal disorders because of its antibacterial qualities. Fennel extract exhibited strong antibacterial activities against respiratory tract infections in comparison to broad-spectrum medicines. Furthermore, they contain volatile scent molecules as fenchone, estragole, and trans-anethole. Phyto-constituents primarily include glycosides, phenolic compounds, and phenols. The fennel seed has 42.3% carbs, 18.5% fiber, 13.4% minerals, 93.7% dry matter, 9.5% protein, and 10% fat. Fennel is high in B vitamins and minerals. Fennel extracts in water and ethanol at a concentration of 100 mg/mL have substantial antioxidant properties, including reducing power, hydrogen peroxide scavenging, metal chelating activity, superoxide anion radical scavenging, and free radical scavenging. The pharmacological properties of fennel fruit are mostly derived from its essential oils. The primary component, trans-anethole, ranged from 81.63% to 87.85%. Fennel contains phytochemicals include phenols, phenolic glycosides, and flavonoids (Kwon et al., 2002). Fennel has high antibacterial effects owing to components such as coumarin and phenyl propanoid derivatives.

Coriander

Coriander (Coriandrum sativum) belongs to the Apiaceae/Umbelliferae family, with the genus Coriandrum L. and the species sativum. The herb dhanya has beneficial medicinal effects and has been used in various locations for a long time. Coriander's bioactive components have anti-inflammatory, hypoglycemic, and hypocholesterolemic properties. Coriander contains phytochemicals such as flavonoids, essential oils, sterols, isocaumarins, fatty acids, coriandrones, and phenolic components such caffeic acid, protocatechinic acid, and glycitin. Coriander essential oil contains geranylacetate (4%), geraniol (1.9%), alpha-pinene (10.5%), gamma-terpinene (9%), linalool (67.75%), and camphor (3%). In vitro research have shown that coriander essential oil has antibacterial capabilities against microorganisms. Kovarovič et al. (2019) found that Subtilis, Stenotropomonas maltophilia, and Penicillium expansum have antioxidant activity with 51.05% radical scavenging. Furthermore, it enhanced liver function, blood-related signs, and digestion. In 2014, Hosseinzadeh and colleagues studied the impact of incorporating 750, 1000, or 1250 ppm coriander extract into drinking water, or 1.5%, 2.0%, or 2.5% coriander powder into grilled meals over a period of 42 days (Hosseinzadeh et al., 2014). All therapies greatly reduced E. coli levels in the ileum, but had no impact on Lactobacillus. Coriander extract in water increased humoral immunity against Newcastle, infectious bursal disease, and infectious bronchitis vaccines, suggesting its potential as an antibiotic in grill diets.

Oregano

Oregano, technically known as Origanum vulgare L., is a fragrant plant prevalent across the Mediterranean and Asia. Oregano is a popular folk remedy and culinary plant. It is a helpful component in chicken feed that promotes bird development and strengthens the immune system (Young et al., 2003). Oregano is a fragrant plant with a high concentration of strong chemical components.Oregano essential oil (OEO) comprises Thymol (15.9%), Z-sabinene hydrate (13.4%), and -terpinene (10.6%), along with p-cymene (8.6%), linalyl acetate (7.2%), sabinene (6.5%), carvacrol methyl ether (5.6%), and carvacrol (3.1%) (Simirgiotis et al., 2020). Oregano meal has essential oils strong in antioxidants such as carvacrol and thymol. Oregano is beneficial due to its antibacterial, anti-inflammatory, and antioxidant qualities. Oregano essential oil has been shown to be effective in eliminating plant-damaging bacteria and fungus according to studies. Origanum vulgar extract, containing antioxidant and phytophenolic components, enhanced hepatic activity in grilled chicken when added at a concentration of 50 ml per litre of water (Alagawany et al., 2018). Oregano essential oil at 600 and 1200 mg/kg in chicken feed increased growth and inhibited caecal Eimeria coli. A combination of OEO with carvacrol and thymol reduced subclinical Necrotic Enteritis in broiler chickens by changing host inflammatory responses and improving intestinal barrier function. It is proposed that a 100-400 ppm OEO preservative might replace synthetic antioxidants in chicken meat. Adding 5% oregano powder had no influence on the production of grilled chicken or cell-mediated immunity. To increase antioxidant qualities, add 0.05% OEO to broiler chicken diets. Oregano oil is a suitable substitute for chemical BBQ enhancers. On day 28, administering 200 mg/kg of OEO enhanced globulin levels in laying hens, presumably altering the inflammatory response and raising blood immune globulins and proteins. A diet rich in oregano (3 g/kg) enhanced egg lipid profiles and reduced the incidence of cardiovascular disease in chicken egg consumers (Migliorini et al., 2019). Oregano extracts in chicken diets may improve feed intake, digestion, productivity, illness prevention, and cost effectiveness. Oregano's antioxidant and antibacterial qualities may be useful as a phytobiotic feed supplement for chickens.

Sinna

Sinna, also known as Senna alexandrina Mill. or Cassia angustifolia, is an important medicinal plant in Indian, Chinese, and Arabic civilizations (El-Morsy, 2013). Senna leaves and pods have long been used as a stimulating laxative. The chemical components of leaf and pod walls may include 2-5% anthra quinone derivatives and similar dianthrone glycosides in dry matter. Sinna contains many chemical components, including flavones, β-Sitosterol, mucin, essential oil, tartaric acid, tannin compounds, mucilage, and resin (Singh et al., 2013). The dehydrated medication is largely composed of sennosides A and B, with trace levels of other chemicals. Sennosides have poor absorption in the small intestine. However, bacterial flora in the colon convert anthraquinones into active anthrones, which stimulate bowel motions by increasing peristalsis. The antibacterial activity of ethyl acetate, chloroform, n-hexane, and methanolic extracts from Cassia angustifolia leaves was tested by disc diffusion against five Gram-positive bacteria, eight Gram-negative bacteria, and three fungi. The methanol extract had minor antibacterial activity, but the chloroform and n-hexane fractions had moderate to poor efficiency against various infections when compared to Kanamycin. El-Morsy (2013) tested the antibacterial activity of Senna alexandrina leaf extracts (water, acetone, dichloromethane, hexane, and methanol) against gram-positive and gram-negative bacteria, fungus, and yeast in a laboratory environment. Various activities were observed, with the acetone extract demonstrating the greatest activity and the water extract having the lowest.

Neem tree

Azadirachta indica, also known as Neem, is a plant belonging to the Meliaceae family. It is used to prevent Newcastle disease and is frequently found in Pakistan. Neem has specific chemical and physical properties that can fight against this deadly virus. A study was undertaken in 2015 at Agricultural University, Faisalabad, to evaluate the antiviral activities of Neem bark extract. For in-vitro assessment, spot assay and micro-hemagglutinin test were utilized, whereas in-ovo evaluation entailed injecting the extract into 11-day-old embryonated eggs. The data show that Neem is directly correlated with antiviral activity in reducing ND.

Thyme

Thyme, scientifically known as Thymus vulgaris L., is a medicinal herb belonging to the Lamiaceae family and is commonly utilized globally. It is frequently used in human cooking to enhance a specific taste. Due to its antioxidant, antibacterial, and therapeutic qualities, it is frequently utilized in livestock farms as a substitute for antibiotics to enhance animal productivity and health. Dry thyme essential oil contains a blend of mono terpenes, primarily thymol and carvacrol. Thyme contains phenolics such as bi phenylics and flavonoids, which have been shown to have antioxidant properties and be good to birds. Phenolic components in essential oils increased catalase activity, leading to the detoxification of hydrogen peroxide and the conversion of lipid hydro peroxides into innocuous compounds. Thyme extracts are suggested for use in laying farms to enhance egg quality, particularly by improving the fatty acid composition in the yolk.

Ginger

Zingiber officinale, usually known as ginger roots, contain significant levels of volatile oils, gingerols, and zingerone, making them popular therapeutic plants worldwide. Ginger roots enhance digestive enzymes and antioxidant activities in birds. Adding 5000 mg/kg of ginger powder to grilled meals enhanced antioxidant capacity and blood metabolites. Quails fed a diet supplemented with ginger at a concentration of 125 mg/kg showed the best feed conversion ratio, body weight, and humoral immunity. In addition, including ginger enhanced the lipid profile in blood serum and elevated the bird's antioxidant status. Combining bee propolis at a concentration of 500 mg/kg with ginger powder at 125 mg/kg enhanced growth performance and health in chicken. Adding ginger powder at a rate of 10-15 g/kg to the meals of laying hens improved their laying performance and enhanced their serum antioxidant levels. Adding 2.5 and 5 g/kg of ginger to the grill breeder's diet enhanced male reproductive function, such as semen ejaculate volume, sperm concentration per ejaculate, live sperms, and viability.

Aloe vera

Aloe vera's antibacterial, anticoccidial, and immunomodulatory characteristics can improve gut health and function. Studies are needed to understand the mechanism of action, effective forms, and dosage levels of Aloe vera for its proper utilization in the chicken sector, both in feed and drinking water. Aloe vera shows promise in improving growth performance in meat type birds, but its impact on egg output and quality in commercial laying hens remains unexplored. The advantages of incorporating Aloe vera into broiler feeds depend on various aspects such as dosage, diet composition, broiler genetics, application method (powder, gel, ethanolic or aqueous extract, and polysaccharide generated from gel), and other relevant variables.

Turmeric

Turmeric, scientifically named Curcuma longa L. (Zingiberaceae), is a tropical plant that is widely used and grown for its therapeutic properties. Turmeric powder is fed to grill chickens in poor nations like Pakistan in order to prevent coccidiosis (Abbas et al., 2010). Curcumin, a phenolic molecule that is the major ingredient in turmeric, has been demonstrated to have immunomodulatory, anti-inflammatory, and antioxidant qualities (Allen et al., 1997). In an experiment, 1% curcumin supplementation to the meal had an anticoccidial effect on hens infected with E. maxima and E. tenella species. When E.

maxima was the only target, better weight gain, lower lesion scores, and oocyst numbers were seen. Only E. maxima-infected and curcumin-treated birds showed a considerable drop in plasma $NO2^{-}$ and $NO3^{-}$, which may account for the variation in anticoccidial activity observed for the two Eimeria species. Subsequently, showed that food supplementation with 3% C. longa powder was successful in treating a mild E. tenella infection. Curcumin, or C. longa, is thought to work by inducing oxidative stress to inhibit coccidia (Abbas et al., 2010).

Licorce

The manufacture of various medicinal substances for subsequent usage in the poultry industry may involve the extraction of G. glabra, which could have a significant impact. Bioactive substances found in licorice, such as glycyrrhizin and flavonoids, have pharmacological and therapeutic uses. It has been discovered that the licorice extract exhibits immunogenic and antioxidant properties. These properties may enhance the growth performance, feed efficiency, carcass characteristics, and blood biochemical indices of the poultry birds as well as serve as a potential treatment for respiratory, digestive, and immune issues in poultry. The addition of LE up to 0.4 g/L to chicken drinking water improved the lipid profile, immunological response, and antioxidant indices in addition to increasing feed consumption. It has been discovered that supplementing laying hens' diets with 50 _g/mL of LE has some positive effects on their cellular immunity. G. glabra extract exhibited strong antiviral activity against NDV at a dosage of 300 _g/mL. Additional research is required to determine the advantages of adding licorice herbs to poultry feed and to investigate other characteristics of this medicinal plant that may improve chicken health and productivity.

Below given Table 1 summarizes various plants with potential anticoccidial properties, highlighting their common names, active compounds, and proposed mode of action against coccidiosis in poultry (Jamil et al., 2022).

Table 1: Plants with Potential Anticoccidial Properties

Plant (Scientific Name)	Active Compounds	Potential Mode of Action
Camellia sinensis Kuntze (Green tea)	Polyphenolic compounds	May inactivate enzymes needed for coccidian reproduction
Pinus radiate D. Don (Pine bark)	Tannins	May be effective against specific Eimeria species
Cyamopsis tetragonoloba Taub (Guar bean)	Saponins	May damage the protective outer layer of coccidian oocysts
Berberis lycium Royle (Barberry root bark)	Berberine	May inhibit the development of coccidian parasites
Olea europaea L. (Olive tree)	Maslinic acid	May improve the effectiveness of other anticoccidial treatments
Quisqualis indica L. (Rangoon creeper)	Gallic acid and ellagic acid	May reduce tissue damage and parasite production
Morinda lucida Benth. (Brimsstone tree)	Alkaloids, anthraquinones, anthraquinols	May decrease the number of coccidian oocysts produced
Artemisia afra Jacq. (African wormwood)	Flavonoids, terpenes, coumarins, phenolic acids	May reduce parasite numbers, improve feed intake, and lessen tissue damage
Echinacea purpurea Moench (Coneflower)	Echinolone, chlorogenic acid	May stimulate the immune system to fight coccidiosis
Curcuma longa L. (Turmeric rhizome)	Curcumin	May inhibit parasite development and reduce gut damage
Aloe vera (L.) Burm. f. (Aloe vera)	Acemannan sugars, anthraquinones	May lessen intestinal damage caused by coccidiosis
Phyllanthus emblica L. (Emblic fruits)	Tannins	Potential anticoccidial effects require further investigation
Moringa oleifera Lam. (Drumstick tree)	Flavanols, rutin, glycosides	May decrease parasite numbers and improve weight gain

Various Poultry Diseases and Their Management with Botanicals

Parasitic Diseases

Ethnoveterinary medicine is the source of the application of herbal remedies for the management and treatment of gastrointestinal parasites. Herbal remedies have long been used to treat parasitism, and these medicinal herbs are being utilized today in many parts of the globe to cure parasites (Practices, 1994). Almost each parasite infection in cattle and poultry can be treated with a variety of medicinal plants and their extracts in ethnoveterinary medicine, which is inspired by ancient methods. It has been reported that animals and birds with parasitic gastrointestinal diseases can be treated with seeds from plants including onion, garlic, and mint.

In many parts of the world, gastrointestinal nematodes and other infections have been treated with the well-known therapeutic qualities of the Azadirachta indica tree, also known as neem (Subapriya and Nagini, 2005). Additionally, data demonstrating the great anthelmintic efficacy of anti-helminth species of N. sativa extract in poultry (Aseel chicken). The strong anthelmintic efficacy of N. sativa extract against helminth species that infect poultry (Aseel chicken) has also been

identified. Thymoquinone is one of the bioactive substances present in N. sativa seeds and oils, and it has been noted to be a significant phytochemical anthelmintic.

Furthermore, N. sativa's other bioactive ingredients, which enhance nutritional status and host immunity, may possibly be responsible for its anthelmintic effect.

Coccidiosis

Drug-resistant species have emerged due to the improper usage and excessive use of anti coccidial medications, and their presence in poultry products can be harmful to humans. Anti coccidial drugs typically necessitate a seven-day withdrawal period before being sold commercially. Concerns about drug residues contaminating poultry and posing a risk to people have led to legislation limiting medication administration until the animals are slaughtered. Discontinuing the medicine could leave the bird susceptible to sickness due to a lack of acquired protective immunity from the anti-coccidial drugs. Contaminated eggs in the litter could lead to serious sickness. Therefore, it is necessary to implement effective avian coccidiosis management strategies. Various botanical supplements and herbal treatments have demonstrated efficacy against protozoa, arthropods, and helminths.

Viral Diseases

Newcastle Disease

Various medicinal plants possess potent antiviral and immune-enhancing properties against Newcastle Disease (ND), a significant ailment in the chicken sector. These plants could serve as alternatives to commonly used synthetic medications, which pose risks such as drug resistance in local pathogen populations and drug residues in poultry. This could be a method to enable chicken farming with reduced dependence on chemical prophylactics. It is suggested that active components from medicinal plants proven to improve immunity and provide therapeutic effects in poultry should be extracted and made available for practical usage in feed.

Decoction procedures were utilized to extract the components of A. annua and their impact was assessed in chicken embryos to determine the suppression of NDV (Liu Yali et al., 2009). The extracts inhibited the proliferation of NDV in chicken embryos, as shown by the results.

Adenovirus

Numerous diseases in humans and animals are caused by adenoviruses, or Ads (Whickam, 2000). A persistent, asymptomatic infection is created by the intermittent shedding of Ads (Garnett et al., 2002). Adenoviruses cause gastroenteritis and conjunctivitis, respectively, by infecting the lining of the stomach and eyes. In addition, they produce additional symptoms by colonizing the mucous membranes of the urinary and respiratory systems (Aslam et al., 2014). Green tea catechins block adenovirus proteases, which are involved in cancer spread. Green tea and EGCG in particular are effectively absorbed by the cells and prevent one or more of the late stages of viral infection against adenovirus. According to, green tea and its separated catechins have antiviral activity against the fowl adenovirus type-4 when tested in vitro in cell culture and in vivo against an IBH-HPS virus challenge in broiler chickens (Aslam et al., 2014).

Avian Infectious Bronchitis Virus (IBV)

Infectious bronchitis virus in birds (IBV) is one kind of virus belonging to the genus Gammacoronavirus. IBV emerged as the first coronavirus in 1931 found in chickens and was regarded as a very important pathogenic virus in animals. Regardless of vaccination, avian coronavirus IBV is now an important economic disease of domestic chicken, resulting in large production losses and death. Numerous studies have documented global outbreaks of IBV in chickens and other animals, which are marked by high rates of illness and death as well as subpar egg and meat output (Parvin et al., 2021). Live attenuated vaccines are now widely utilized to prevent and manage infectious brain disease. However, vaccine effectiveness is being seriously undermined by the increased genetic diversity of viruses and the appearance of new strains.

An evaluation of several plant extracts was carried out, and Mentha piperita, Desmodium canadense, and Thymus vulgaris all shown antiviral activity against IBV both pre- and post-infection (Lelešius et al., 2019). Saint John's Wort, or Hypericum perforatum L, has been extensively researched for its pharmacological properties and biochemical makeup (Zhou and Lai, 2008).

The antiviral properties of H. perforatum extracts, including hypericin (HY), quercetin, pseudohypericin, and quercitrin, were evaluated against IBV. It was shown that an increase in type I interferon via the MDA5 signaling route and a decrease in the mRNA expression of pro-inflammatory cytokines [tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6)] via the nuclear factor kappa B (NF-κB) signaling pathway.

Avian Influenza Virus (AIV)

Another significant virus that is a member of the Orthomyxoviridae family and causes enormous losses for the poultry industry worldwide is the avian influenza virus (AIV) (Parvin et al., 2018). This pathogen possesses an single-stranded RNA that is eight segments negative and encodes around 11 proteins (Liu Yali et al., 2009). Furthermore, AIV is classified into subtypes according to the surface proteins hemagglutinin (HA) and neuraminidase (NA), which are in charge of viral attachment and release, respectively.

In this sense, Rumex extract enhanced with polyphenols.
Acetosa inhibits the replication of AIV by reducing the viral particles' ability to adhere to target cells (Derksen et al., 2014).

Water extract of Psoraleae semen (WPS) has a promising function as a new anti-influenza agent due to its antiviral properties. Choi evaluated the inhibitory impact of the virus employing 100μg/ml in WPS in a thorough investigation using RAW 264.7 and MDCK cells (Choi et al., 2016). It has been shown that WPS functions as an immunomodulator and influenza HA and NA inhibitor.

Moreover, they proposed that WPS's ability to interrupt infection via the type I IFN-mediated signaling pathway involving RAW 264.7 cells make it a viable candidate as an antiviral therapeutic drug. Similar results have been documented, whereby WPS's anti-influenza properties directly limit the mediation of HA and NA.

Bacterial Infections

The use of antibiotics subtherapeutically to treat enteric and other illnesses in chicken has raised concerns, which has led to a rise in interest in effective and alternative treatments with antibacterial qualities.

Since the beginning of time, plants have been a valuable source of vital substances for medicine and therapy. It examined the antibacterial activity of Curcuma aromatica and Curcuma longa rhizome extracts against enteric infections in chicken as well as the presence of significant phytochemicals (Patil et al., 2019). Extracts of C. longa and C. aromatica were shown to contain phytochemicals of pharmaceutical importance, such as alkaloids, flavonoids, terpenoids, steroids, saponins, phenols, glucosides, etc. Escherichia coli and Salmonella entertidis were both effectively inhibited by C. aromatica extracts.On the other hand, C. longa extracts against E. coli alone demonstrated a zone of inhibition (Anjusha and Gangaprasad, 2014).

This work offers important new information about the therapeutic use of Curcuma spp. against enteric poultry diseases, indicating its potential as a substitute for antibiotics and pave the path for additional application in chicken feed for efficient production.

Future and Potential of Plant-Based Ingredients in Organic Poultry Farming

Studying how herbal medicine works can help determine safe and effective dosages, proper storage methods, and ways to enhance its benefits. Advances in genomics, proteomics, metabolomics, bioinformatics, and chemo informatics can boost medicine detection and effectiveness. It is crucial to have cooperation between traditional medicine experts and well-established government and private research institutions. Biotechnological advancements can offer an efficient screening system for natural medicinal plant components. Herbal extracts can be kept for a long shelf life, turned into tablets, teas, and infusions, freeze-dried, or utilized to enhance dishes. Patents for indigenous knowledge should be utilized to incentivize stakeholders to collaborate and develop economically feasible herbal product models. Medicinal plants need to be collected and kept in a sustainable manner. Policies should restrict the removal of medicinal plants from natural habitats such as forests and instead promote community-based nurseries to conserve plant supply. When screening medicinal plants for anthelmintic activity, utilize both in vitro and in vivo models. It is crucial to do controlled trials when utilizing ethno veterinary data to verify if medicinal plants enhance parasite resistance. Observe the performance and conduct of hosts that have been parasitized. Track immunological reactions, host well-being, and performance consistently during research. Monitor the effectiveness of deworming agents in various environments as they may differ depending on the plant material present. Identify the active components. Determine bioavailability and devise methodologies. Studying pertinent literature is essential for gaining insight into the utilization of tropical medicinal plants in temperate environments. Conventional medicine is readily accessible in temperate countries, leading to its reduced obscurity (Gulzar and Ullah, 2023).

Distribution Mechanisms

One significant problem with certain essential oils is their decreased antibacterial effectiveness in animal feed because of their volatility and poor solubility. Phytobiotics can be given in feed or water, depending on the product’s composition. Using ground leaves instead of extracts may decrease effectiveness. Plant extracts are more potent than pulverised leaves because they contain higher concentrations of active compounds. Extraction costs have increased because of the rising demand for chemicals and the need for a large quantity of plants to provide an adequate supply. Novel methods of distribution are being investigated to transport phytobiotics to the animal intestines for maximum effectiveness. Research has shown that lecithin, extensively utilized in various applications, boosts the antibacterial effects of carvacrol and eugenol against both gram-positive and gram-negative infections.

Microencapsulation is a commonly studied technique used to enhance the antibacterial properties of isolated chemicals against E. Escherichia coli O157:H7 with Listeria. Listeria monocytogenes is prolonged in its antibacterial action by microencapsulation of coated essential oils, delaying absorption. Current research on essential oil encapsulation mainly involves micrometric capsules to shield active compounds from environmental factors such as oxygen, light, moisture, and pH. Microencapsulated additives offer benefits like improved palatability and reduced strong odours, leading to consistent feed intake.

Conclusion

Phytogenics and probiotics can stabilize the intestinal environment, promote the growth of Lactobacilli, and reduce harmful organisms. Additionally, utilizing medicinal herbs is both safer and more cost-effective. It could also help bridge the

gap between food safety and production and reduce mortality in animals. The primary expense in chicken production is the nutrients found in the feed. To improve nutrient absorption, several additions are commonly employed. Feed additives are growth-promoting substances added to chicken feed in specific amounts without causing substantial changes in composition. The prohibition of AGPs in the poultry sector in many nations led to the exploration of substitute sources. Using herbs has numerous advantages compared to antibiotics. Utilizing botanicals as feed supplements in poultry are valuable for optimizing performance and enhancing poultry health.The majority of the herbs tested in poultry demonstrated positive effects on production while having no detrimental effects on bird health or bird products. Phytochemicals have therapeutic advantages owing to their antiviral, antioxidant, anti-inflammatory, immunological modulatory, antibacterial, and antifungal properties. Thus, they may be used as botanical alternatives in poultry nutrition. Herbal therapy can effectively treat and manage various parasitic illnesses and is utilized in the development of phytopharmaceuticals for drug identification. According to the World Health Organisation, more than 80% of individuals rely on plants for treating common ailments. Despite the abundance of traditional medicinal resources, there has been limited initiative to endorse and understand its application in medical settings. The Drug Regulatory Authority of Pakistan (DRAP) is currently registering nutraceuticals and herbal products, such as Bio dewormer created by specialists from the University of Agriculture Faisalabad. These products utilize native plants with anti-parasitic qualities.

Future Perspectives

Currently, there is ongoing research on various herbal preparations used in poultry feeding to determine their potential benefits in improving health and performance. These investigations focus on areas such as feed intake, feed conversion, body weight, weight gain, growth performance, feed conversion ratio, gizzard function, gut development, nutrient digestibility, digestibility of organic matter and crude protein, gut microflora, and metabolizable energy content of feed mixture.These properties may include antibacterial, antiparasitic, or antioxidant effects. For instance, certain businesses in Austria are currently engaged in the following fields:

- Delacon for phytogenic feed additives
- Indian Herbs GmbH
- Biomin AG for feed additives

Clinical trials involving the feeding of herbal additions to various fowl, such as broilers, turkeys, and laying hens, are being conducted. PRATU (Poultry Research and Teaching Unit) is an organization based in Australia that provides financial support for research projects in several areas of poultry science, including nutrition and physiology, health and welfare, disease, productivity, and environment. Research groups engaged in similar work can be found globally, including in Germany, the United Kingdom, Poland, Finland, Spain, The Netherlands, Turkey, China, Taiwan, India, Pakistan, Ukraine, Lithuania, United States, Canada, Australia, and Brazil. These groups are affiliated with universities, institutes, and businesses.

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