Applications of Herbs in Poultry

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Abstract: The practice of using traditional herbal medicine based therapy is nowadays gaining more attention worldwide in both human and animal health care systems. Among the livestock sectors, poultry production systems are the most intensively reared with developments especially in the areas of nutrition, disease control, genetic improvement, management and organization of dietary requirements along with the pressure of increasing demand for poultry products as well as threats of emerging pathogens. So this sector is badly in need of sustainable therapeutic and production aids especially based on herbs because of the advantages like, low cost, easy availability, no residual effect, free from the threat of antibiotic resistance etc. The present study discusses the various useful and practical applications of the rich heritage of herbal wealth for safeguarding poultry health in general, combating infectious as well as non-infectious diseases caused by microbes and parasites (both ecto- and endo parasites). Moreover, highlighting herb-based poultry growth promoters for increasing production performances use of herbs as antioxidants and their role in organic egg and meat production. The information will be useful to increase poultry production and protect the health of birds in a better way from traditional ways towards modern perspectives and also would promote and popularize usage of herbs amongst poultry producers.
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Introduction

Due to the emergence of drug resistance microorganisms, side effects of antimicrobials and the harmful residual toxicity effects of drugs observed in the food chain, there is an increasing trend towards the use of alternative or complementary medicines for the general health maintenance, immunomodulation and therapeutic purposes for treating various diseases Herbal medicine**s** are widespread throughout the world and have been used by all cultures for centuries with the best known practices being Ayurvedic medicine from the Indian sub-continent, traditional Chinese medicine, medicinal herbs from African tradition, native North American herbal lore and western herbal medicine, derived from Europe and the Arabic culture. India, possessing one of the richest treasures of herbalism in the world, accounts around 20,000 medicinal plant species where about 800 plant species have been used by different medicinal communities for curing different diseases **(Mahima *et al.*, 2012).**

. People around the world are now aware of the limitations of synthetic drugs and chemicals in terms of higher cost, anticipated toxicity and adverse effects **(Adu *et al.*, 2009)**. On the other hand, the natural medicines are more suitable for animal and human health care with the benefits of low cost and total safety. Some of them are studied scientifically by *in vitro* and *in vivo* studies but most of them are yet to be scientifically validated. In this era of food safety concern, emerging antibiotic resistance and residual effects in food products, these can play wonderful role for safeguarding health of humans and animals. But unfortunately, these medical traditions are being mislaid mostly as they are communicated only orally from generation to generation and are largely undocumented (**Mahima *et al.*, 2012**). Herbal therapy needs to be practiced in poultry industry as growth promoters and also for fighting against various infections. The shortcomings are that they are bulky substances which cannot be used as such, most of the herbs have poor bioavailability and hence needs a good carrier. Nanotechnology has revolutionized the world and this technology can also be applied safely for the delivery of herbal drugs **(Patel *et al.*, 2013)**.

Nature has always had its own medicine for animals as well as birds and herbs have been the medicine and food since their life emerged. Animals as well as birds are instinctively able to self-medicate with herbs, known as the zoo pharmacognosy and early man would almost certainly have been just as capable, later refining it to the ancient art that still have today **(Adu *et al.*, 2009)**. Having originated in the same environment as plants, it is not surprising that animals have an inherent instinct for herbal medication of their health problems, whether horses, dogs, cats, cattle, rabbits, birds or other species. Herbal medicine**s** are being practiced in the form of therapy for livestock among resource poor smallholder

farmers worldwide and in a therapeutic aspect; many herbs are being used by veterinarians fruitfully to treat a variety of conditions of animals. Improvements have been shown or reported with those suffering from flu, allergies, colds, rheumatoid arthritis, bacterial/viral infections, hepatitis, heart disease, asthma, chemical intoxication etc. and even effective in treating cancers (**Umashanker and Shruti, 2011**). Apart from infectious and systemic diseases, topical botanical/herbal application is also effective for specific conditions like ageing, skin infections, ear infections, wounds, burns and skin irritations (**Mirzaei-Aghsaghali, 2012**).

India is a rich source of medicinal plants and a number of plant extracts are being used against diseases in various systems of medicine such as Ayurveda, Siddha and Unani. Ayurveda is the traditional Indian system of medicine from ancient times, mostly using herbal preparations, to prevent or cure various tumors. The first written records on the medicinal uses of plants appeared in about 2600 BC from the Sumerians and Akkadians. The best known Egyptian pharmaceutical record, "Ebers Papyrus" recorded more than 700 drugs, represents the history of Egyptian medicine dated from 1500 BC. Thousands of herbal and traditional compounds are being screened worldwide to validate their use and several of them find their application in poultry production as well (**Rehman *et al*., 2011**).

The present study discusses the multiple beneficial applications of herbs for protecting poultry health in general, countering infectious as well as non-infectious diseases, immunomodulatory effects, increasing production performances, potential to be used as growth promoters, antioxidant usage and their role in organic egg and meat production. The valuable and updated information in the review paper regarding herbs and their various beneficial applications in poultry will be helpful to increase production and safeguard the health of birds in a better way from traditional ways towards modern perspectives and also would promote and popularize usage of herbs amongst poultry producers.

Beneficial Applications of Herbs in Poultry

Since time immemorial, plants and plant parts have been serving as an indispensable source of medicine for indigenous poultry production systems. Conventional disease prevention methods are geared towards birds in confinement and not free range in an indigenous poultry production system. However, the existing indigenous technical knowledge inherited from past generations has sustained the local poultry production system (**Mirzaei-Aghsaghali, 2012**). This knowledge is passed on verbally and is hardly documented. Due to high cost of conventional medicines and vaccines coupled with the lack of knowledge on their use, these drugs are usually out of reach of the small-scale farmers. There is, therefore, need for cheap, easy to use and sustainable local poultry disease control programs (**Mahima *et al*., 2012**). The inherent utility and practical applications of indigenous medicinal herbs/plant extracts (garlic, cinnamon, tulsi, ginger, turmeric, lemon, neem, yucca, thyme, rosemary, etc.) are being explored for improving poultry health as well as production with fruitful results (**Sridhar *et al*., 2014**).

Herbal medicines as antimicrobials for poultry**:** The practice of pharmacological treatment of disease conditions began with the use of herbs (**Tyler, 2007**) and most of the drugs in vogue to treat bacterial and other infections were first isolated from ethno-medicinal plants and other natural sources (**Coe and Anderson, 1996**). Antimicrobials based on herbal origin represent a vast untapped source of medicines with tremendous therapeutic potential (**Cowan, 1999**). The indiscriminate use of conventional antimicrobials has led to a steady increase in the drug resistance and the low-income countries, home to the majority of the world's population are particularly affected by this phenomenon (**Radyowijati and Haak, 2003**). Antibiotic resistant strains of bacteria are an increasing threat to animal and human health with resistance mechanisms having been identified and described for all known antimicrobials in vogue (**McDermott *et al*., 2002**). This, therefore, necessitates a newer alternative for antimicrobial substances and many plants have been shown to possess antimicrobial traits which are chiefly synthesized during secondary metabolism of the plant (**Rusenova and Parvanov, 2009**). Neem (*Azadirachta indica*) is one of the most prominent herbal medicines with different biologically active principles like azadirachtin, nimbin, salanin, meliacin etc. and many other derivatives of these principles which belong to natural products called triterpenoids (**NRC., 1992**). The *A. indica* leaf exhibits potent antimicrobial action as it has proven its, anti-bacterial, anti-viral, anti-malarial, anti-fungal and anti-oxidant properties in various experimental studies in poultry (**Subapriya and Nagini, 2005**). Neem oil selectively activates the cell mediated immune response by activating macrophages and lymphocytes have been reported effective as a potent bio-insecticide. Apart from this, it exhibits a wide range of other pharmacological activities viz., anti-inflammatory, anti-hyperglycaemic, anti-ulcer, anti-mutagenic, anti-carcinogenic, immunomodulatory and various other properties without showing any adverse effects (**Chakraborty and Pal, 2012**). Essential oils derived from plants have provided enough evidences to suggest as a tool in defending bacterial diseases in poultry (**Gopi *et al*., 2014**). They consist of complex mixtures of secondary plant metabolites like

phenylpropenes and terpenes, they are particularly associated with characteristic plant fragrances and essences. Essential oils can be applied as potential feed additives for the prophylactic action against microbial infections (**Brenes and Roura, 2010**). Among the various essential oils, thyme, oregano and garlic have shown to be the most pronounced antimicrobial activity (**Iten *et al*., 2009**). Thyme oil and its components (thymol and carvacrol) demonstrated high antimicrobial activity against most of the poultry pathogens that include *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia coli*, *Salmonella enteritidis*, *Salmonella typhimurium* etc. (**Levic *et al*., 2011**). The essential oil from *Origanum vulgare* which is obtained by steam-distillation of its leaves and flowers is well known for its antimicrobial activity along with potent antifungal, antioxidant and insecticidal activities (**Marcincak *et al*., 2008**). Oregano has shown to be an excellent alternative for ionophore antibiotics thereby providing protection against *E. tenella* infection in birds (**Giannenas *et al*., 2004**). A study conducted in live birds showed that certain primary components namely curcumin, piperin, thymol and eugenol of the *Curcuma longa* (turmeric), *Piper nigrum* (black pepper), *Thymus vulgaris* (thyme) and *Syzygium aromaticum* (clove), respectively are effective in the control of *Clostridium perfringens,* an important enteropathogenic bacteria (**Mitsch *et al*., 2004**). Garlic (*Allium sativum*) possesses excellent antimicrobial properties which have been proven by various researchers (**Rehman *et al*., 2011**). The aqueous extract of garlic has been shown to inhibit *E. coli* and *Salmonella* Typhimurium *in vitro* (**Kumar and Berwal, 1998**). *In vitro* antimicrobial activity against *E. coli* has been shown by cinnamon oil that necessitates further *in vivo* studies for possible benefits in poultry production (**Griggs and Jacob, 2005**). A variety of other plant based remedies have been proven to possess antimicrobial effect and an important one among them is the aqueous extract of the seeds of *Carica papaya* which lyse bacteria using the enzyme papain (**Adu *et al*., 2009**).

Herbs as antiviral agents for poultry:

Ou *et al*. (2013) investigated the therapeutic effects of the combined extracts of Rhizoma *Dryopteridis Crassirhizomatis* and *Fructus Mume* (RDCFM) against Infectious Bursal Disease Virus (IBDV) infection. They reported that the herbal extracts increased the survival rate, antibody levels and relative body gain and significantly decreased the virus loads in bursa of Fabricius**. Liu *et al*. (2009)** reported that sweet wormwood (*Artemisia annual* L.) extracts inhibited the Newcastle Disease Virus (NDV) proliferation in chicken embryos without causing side effects. Most of the herbal preparations contain various bioactive molecules namely flavonoids, polyphenols, lignans and alkaloids which shows many pharmacological activities such as anti-bacterial, anti-inflammatory, anti-fungal, anti-oxidant and analgesic properties. **Sood *et al.* (2012)** reported that *Eugenia jambolana* extracts showed 100% virucidal activity against highly pathogenic avian influenza (H5N1) virus in chicken embryonated eggs (ECE) inoculated *in-ovo* and in tissue culture. Essential oils derived from peppermint and eucalyptus showed protective action in broilers against multiple respiratory pathogens mainly *Mycoplasma gallisepticum* and H9N2 influenza virus infections (**Barbour *et al*., 2011**).

Herbal medicine**s** as anti-coccidiosis in poultry**:** Due to vast usage of sulphanilamide, ionophorous antibiotics, amprolium or synthetic chemical compounds for the treatment of coccidiosis in poultry results in emergence of drug-resistant strains and antibiotic residues in poultry meat posing serious problems to the meat consumers. To overcome this major threat, safe alternative anti-coccidial herbs preparations are required for the treatment and control of avian coccidiosis. Several herbs possess anti-coccidial effects namely *Sophora flavescens* Aiton, *Ulmus macrocarpa*, *Bupleurum chinese* DC, *Sinomenium acutum*, *Artemisia asiatica*, *Pulsatilla koreana*, *Artemisia annua* Linne, *Quisqualis indica*, *Foeniculum vulgare*, *Torilis japonica* and Galla Rhois powder increases survival rates and body weight gains of birds, reduces bloody diarrhea symptoms and oocyst excretions from birds infected by *Eimeria tenella* (**Dragan *et al*., 2014**).

Herb-Based Poultry Growth Promoters

Among the major aspects of food production and safety in nowadays, reduction in the use of antibiotics and other medicinal products in the poultry production is a major concern, especially due to over bacterial resistance and possible transmission of these antibiotic residues into the human food chain (**Sanjyal and Sapkota, 2011**). Consequently, the poultry feed industry is facing increased consumer pressure to reduce the use of those antibiotic growth promoters (AGPs) in poultry diets. In broiler diets, the beneficial effects of medicinal plants and their various products including plant extracts and essential oils as phytogenic feed additives are proven (**Dalkilic and Guler, 2009**). Plant extract**s** and various phytobiotics that originate from leaves, roots, tubers or fruits of herbs, spices and other plants have shown to be excellent growth enhancers in poultry industry (**Wallace *et al*., 2010**). This effect may be due to the synergistic action of various active molecules in them and the greater efficiency in the utilization of feed, resulting in enhanced growth and production (**Hashemi and Davoodi, 2010**). The basic strategies

of including these herbs in poultry diets are to impact the metabolism by combating stress and microbial activity and there are scientific evidences to prove that herbal extracts stimulate the growth of beneficial bacteria and curtail pathogenic bacterial activity in the gastrointestinal tract of poultry. Prevention of the colonization of the pathogens and improvement of the production and activities of digestive enzymes are the essential functions of such phytogenic components (**Sanjyal and Sapkota, 2011**). Several strategies have been postulated to understand the growth promoting effects of herbs in poultry. First, the improved performance has been linked with increased secretion of digestive enzymes through the production of lipase, amylase, trypsin and chymotrypsin and enhanced nutrient utilization in the liver (**Langhout, 2000**). Second, the antibacterial action of essential components of these herbs may suppress the growth of pathogenic bacteria on one hand and promote the growth of probiotic (bacillus, lactobacillus and acidophilus etc.) bacteria in the gut. No doubt literature is full of the beneficial effects of herbs in improved poultry production; however, there are many reports which negate the beneficial effects of herbs. The reason may be due to the difference in experimental protocol, environmental conditions, reduced antimicrobial effect of any plant extract through altering the substrate and unavailability of bio-ingredients which are usually absent in pure conditions (**Barreto *et al*., 2008**). According to some author, the improved performance may be attributed to the essential components which have antimicrobial, antioxidant and antifungal effects **(Khan *et al*., 2012a**). Another hypothesis suggests that commercial products of a herb may exert different effects. For example, raw garlic (allicin rich (and processed garlic (non-allicin rich (differ in term of active ingredients which may potentially elicit different response in the host (**Khan *et al*., 2012b**). Herbs which are proven as excellent growth promoters in poultry includes *Withania somnifera*, *Ocimum sanctum*, *Emblica officinalis*, *Aloe vera***,** *Thymus vulgaris*, *Curcuma longa*, *Origanum vulgare*, *Allium sativum*, horseradish, cyenne pepper, ginger, anis, onions, fenugreek, cumin etc. Herbs like alfa alfa **(***Medicago sativa*), senna (*Alexandrian senna*), corn flower (*Centaurea cyanus*) and absinthe (*Artemisia absinthium*) when used as feed additives in broilers can also act as efficient as well as safe growth enhancers and thereby meet the demand of the poultry industry (**Mirzaei-Aghsaghali, 2012**). Most of these herbs initiate activity in the feed as flavor enhancers, stimulators of digestive secretions and total feed intake etc. They enhance the digestion and absorption of lipids through the synthesis of bile in the liver. They also accelerate the digestion and reduce the time of rate of passage through the digestive tract. Herbal growth promoters also include spices like cinnamon, cardamom, cloves, laurel, mint etc. (**Alsaht *et al*., 2014**). Broad antimicrobial activity is possessed by many herbs and their bio-active constituents. There exists scientific evidence that herbs and plant extracts can work by stimulating growth of microbiota and minimizing the activity of pathogens in the poultry gastro intestinal tract. In comparison to other type of dietary treatments herb like garlic (*Allium sativum*) when supplemented with antibiotic and thyme in broiler chick diet causes significant increase in the length of the small intestine. Significant lower concentration of *E. coli* is also achieved by supplementation of such combination from herbal extracts in the diet (**Sarica *et al*., 2005**). A study on Aloe vera gel has shown to improve the feed efficiency, increase gizzard weight, gastro-intestinal weight as well as length by increasing the size of digestive tract and also it has been found to reduce the total count of aerobic bacteria in the gastro intestinal tract in broilers (**Sinurat *et al*., 2003**).

Role of Herbs in Organic Egg Production in Poultry

Recently, organic egg production is gaining more importance and needs access to forage material such as pasture/crop in the hen yard or supplemented with roughage in the form of silages and vegetables in addition to the basal diet (**The Council of the European Union, 2007**). **Hammershoj and Steenfeldt (2012)** studied the effect of feeding kale (*Brassica oleracea* ssp. *acephala*), thyme (*Thymus vulgaris*) and basil (*Ocimum basilicum*) as a forage material on various egg quality parameters and egg production. They reported no significant difference in forage intake and laying rate between treatment groups but kale treatment significantly increased egg weight, higher egg shell strength; lutein, β-carotene and violaxanthin content. Several studies have emphasized on the importance of forage material (whole wheat, *Phacelia tanacetifolia*, *Fagopyrum esculentum* and *Linum usitatissimum*) on egg production, calcium supplements to laying hens, carotenoids in egg yolk, various egg quality parameters, conversion of oil rich forage material into specific fatty acids to the egg yolk and supply of vitamins, essential amino acids and minerals (**Hammershoj *et al*., 2010**).

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