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Conceptual Paper

Essential Oils from Plants – A Potent Substitute for Antimicrobials

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Poultry birds are frequently affected by microbial pathogens which are highly resistant to conventional antimicrobials. Essential oils of the plant seem to be useful against microbes which have least or no adverse effects on poultry and humans too. The earlier studies show that essential oils of some common Indian plants like Neem, Clove, Cinnamon, Ashwagandha, Ginger, Garlic, Turmeric are effective against pathogenic microbes verified by both *in vivo* and *in vitro*, further study on the oils would be useful to treat the diseases of animals.

Introduction

Poultry is a huge industry in developing countries like India, the demand for eggs and poultry meat is increasing day by day. Young chicks are highly affected by the infection of various bacterial, fungal and viral diseases in the early days of their life which are acute and highly fatal. The common etiological agents being bacteria like *E coli, Clostridium perfringens, Salmonella enterica, mycoplasma* spp., fungal species of *Aspergillus fumigates, Candida albicans* and viral pathogens like New Castle Disease Virus, Marek's disease virus, etc. The mentioned pathogens cause a high amount of loss in the layer and broiler production. The treatment of antimicrobials is ineffective majorly due to AntiMicrobial Resistance [AMR] of the bacteria. AMR is a great threat to humans as the resistance can be easily transferred to humans from food-producing animals. The problem of AMR started soon after the discovery of the first antibiotic Penicillin and became a global crisis. This occurred due to frequent use of antibiotics or use of antibiotics as a growth promoter in poultry and other dairy animals and as a result of natural selection AMR developed Keeping this fact under consideration the European Union banned the use of antibiotics as growth promoter. Selling the poultry meat product within the withdrawal period of antibiotics causes the transfer of drug residues to humans also makes a major concern. During the selling of meat products, instead of taking all precautions, food spoilage occurs by attack of MDR bacteria. So to deal with such deteriorating problems, we need new techniques with more efficacy and low side effect. Plants are considered to be one of the great sources of antimicrobials since ancient times as it is also mentioned in the Indian, Roman and Chinese writings. Since the era of Shalihotra Samhita, Ayurvedic Veterinary Medicine existed in India

Neem

Neem [*Azadhirachta indica*], an Indian origin plant belonging to the family Meliaceae, is used as a food preservative for ages. The secondary metabolite produced by the plant such as Azadirachtin, Azadirone, Gedunin, Meliacarpin, Nimbin, Salannin, Vilasinin show pesticidal and/or medicinal properties. Neem having medicinal values has proven to confirm bacteriostatic effect in certain *in vivo* and *in vitro* experiments. Neem leaf extract was provided to broiler chicken in their feed which was artificially infected with E coli078 and showed milder lesions than those which were untreated With the help of biochemical essay, we can understand the modulatory effect of Neem Leaf Extract (NLE) on enzymes like serum alanine transaminase (ALT), aspartate transaminase (AST), lactate dehydrogenase (LDH) activities, globulin concentration, total

protein (TP), albumin concentrations, and alkaline phosphatase (ALP) showing cardioprotective and hepatoprotective effect. NLE can be used in prophylactic treatment in the future solely or in a combined form with other antibiotics, etc.

Clove

Clove [*Syzygium aromaticum*] one of the cuisines widely used in Asian and African countries. The chief phytochemical available in clove, Eugenol, exhibits microbicidal effect against *Salmonella typhi* by disrupting the cellular membrane. In addition to this, Clove showed an inhibitory effect against *L. monocytogenes* and *S. Enteritidis in soft cheese.* Clove oil showed the highest inhibition in Escherichia coli, Staphylococcus aureus and Bacillus cereus in the well method even at 1% concentration. An experiment was done on the isolates of E coli from retail chicken meat produced 14.76, 16.67 and 18.29 mm area of Zone Of Inhibition with 10, 20 and 30 mg of concentration of clove extract respectively. Experimentally infected poultry was treated with clove extract which reduced 15% of the total mortality

Cinnamon

Cinnamon [*Cinnamomum verum*] the broadly used spice is obtained from the inner bark of Cinnamomum has numerous health-promoting activities. Seyed Nabavi., *et al*. documented about antimicrobial activity of cinnamon which even can be used in cosmetics and food products. Rao reviewed antioxidant, antidiabetic, anticancer, lipid-lowering properties and activities against neurological disorders. E. coli with TEM_{bla} gene were studied with essential oils of *Cinnamomum camphora* and *Syzygium aromaticum* showed an inhibitory effect on their growth.

An *in vitro* experiment was performed on 150 isolates of respiratory diseased birds with cinnamon oil showed downregulation of genes of *Staphylococcus aureus sed* gene, *Escherichia coli stx1* gene, *Avibacterium paragallinarum* HPG-2 *gene*, *Pasteurella multocida ptfA* gene, *Mycoplasma gallisepticum Mgc2* gene, and *Ornithobacterium rhinotracheale adk* gene.

Ashwagandha

Ashwagandha [*Withania somnifera*] is a medicinally valued plant in India since time immortal. It acts as a great antioxidant, memory enhance and shows antiparkinsonian, antivenom, antitumor property.

Day-old chickens experimentally infected with E. coli were treated with 20% aqueous WSR root extract through oral route in the drinking water @ 20 ml per liter of water. The clinical signs, biochemical, immunological and pathological parameters were supportive with the group treated than the control one. S. Arora., *et al*. in her *in-vitro* experiment illustrated that WSR extract produced a synergistic effect with a combination of rifampicin and isoniazid.

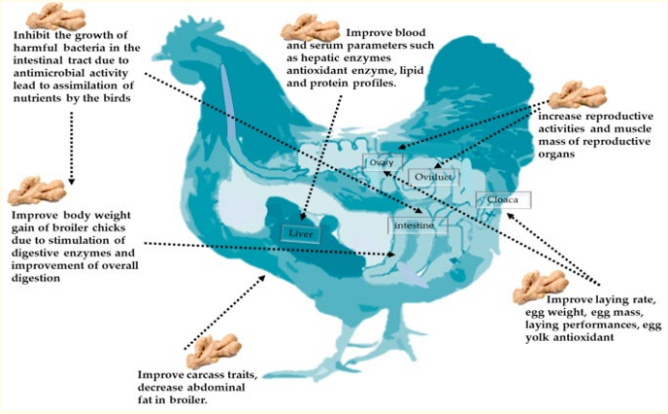

Figure 1: Ref. The beneficial application of ginger and its derivatives in poultry nutrition. Mohamed E. Abd El-Hack Ginger and Its Derivatives as Promising Alternatives to Antibiotics in Poultry Feed Animals 2020, 10(3), 452; https://doi.org/10.3390/ani10030452.

Ginger

Ginger [*Zingiber officinale*] a spice being used as a folk medicine in India and other Asiatic countries. Gingerol chemical found in ginger has antiviral, anti-inflammatory, antifungal properties. Ogbuewu in his review mentioned about the effect of ginger on the promotion of egg and semen production without producing an adverse effect on hematological values and improved dressed carcass weight of the broiler. Furthermore, an *In vitro* experiment was performed to observe the effect of Z. officinale on the vaccine of New Castle Disease which showed an increased in hemagglutination inhibition (HI) titer against ND virus. 4 - 6 g/kg of GG additives to broiler chicks feed, enhanced growth performance, enhance WBC, RBC, PCV, Hb and showed significant ($P < 0.05$) increases in hemagglutination inhibition (HI) titers against ND virus,

Garlic

Garlic [*Allium sativum*] a native plant from India and central Asia, commonly used on daily basis in food, has secondary metabolites containing sulphur viz. alliin, alliinase, allicin, S-allycystein, etc. posseses neuroprotective properties. In a recent study, it was confirmed that 50% GBM (Garlic Bulb Meal), 50% GRM (Ginger Rhizome Meal) and 25% GBM and 75% GRM showed zero mortality of broiler indicating the antibiotic and antihelminthic effect of garlic and ginger. Essential oils of garlic, thyme (*Thymus vulgaris*) and honey at a concentration of each 1% and 10% respectively on chicken meat which was inoculated with *E. coli* and *S. aureus* were studied which effectively improved the meat quality. Hence this can be used for increasing shelf life for packed meat also essential oil won't produce an adverse effect on humans. Moreover, ChowdhurySR in 2002 attested that garlic given in the form of feed shows Hypocholesterolemic Effect in serum.

Turmeric

Turmeric [*Curcuma longa*] the Golden Spice of India is a perennial rhizomatous plant, a potent immunostimulant. Curcumin a major secondary metabolite found in turmeric shows antimicrobial, antioxidant property. A recent study showed Anticoccidial activity of turmeric on broiler feed with 300 mg/kg body weight. Turmeric decreased oocyst production and cecum. Ali., *et al*. in his *in vivo* experiment showed that turmeric decreases the count of Clostridium perfriengens and also decreases FCR

Other plants showing antibacterial properties

Dried leaf powder of *Ocimum sanctum* was confirmed to inhibit the replication of Infectious Bursal Disease Virus *in vivo*. Mint a major flavoring substance exhibits some antimicrobial effect and helps in the production of good quality carcass. Corriander used on daily basis for making curries inhibits the growth of major pathogens. *Artemisia nilagirica* locally known as ‹Indian wormwood' belonging to the family Asteraceae shows antimicrobial property against *E coli, Salmonella Gallinarum* and *Salmonella typhimurium* Many more plants native to the Indian subcontinent are having potent medicinal values.

Future aspect

Nanomedicine which uses nanotechnology for diagnosing and treating the disease can contribute to resolving this problem. Using nanoparticle for the plant-based drug will improve the efficacy of delivery by increasing its half lifetime, and better pharmacodynamic effect. *Immunostimulants* are substances which stimulate the immune system by inducing activation of any of its components *Emblica officinalis*, *Azadirachta indica, Allium sativum*, *Ficus benghalensis*, Andrographis paniculata, Aloe vera has immunostimulatory effect. Various other advances like Crisper cas, Quorum Sensing Inhibitors, Antimicrobial peptides along with phytochemicals are coming to deal with this problem.

Conclusion

AMR is a highly emerging problem for which strategies are being planned to mitigate the crisis at a global level. Conventional therapies of antimicrobials have some or the other side effects. Phytoconstituents can be a remedy for this. They can be used as therapeutic as well as preventive medicine. Being natural, it has no adverse effects unless taken in consumable limits. Phytochemicals can be used as a natural feed additive to replace the synthetic antibiotic growth promoters in poultry feed. The drawback of drug residuals in chicken and egg can cause allergic reactions and disturb the gut biome that can be worked out with phytochemicals. The development of plant-based nanoparticles can be a task to accomplish which could make the therapeutics more efficient.