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ORIGINAL ARTICLE

Essential Oils: Alternative to Improve Production, Health and Immunity in Poultry

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With continuous increase in human population, modernization and livelihood created a huge global demand for animal origin protein. The poultry industries had been successful and manage this increase in demand by continuous improvements in genetics, nutrition, and health. However, common challenges in poultry production system are 1) Production stress 2) Immature immune and digestive systems; 3) increased susceptibility towards disease-causing organisms and compromised gut integrity; 4) The use of cheaper raw materials and 4) Consumer pressure from food safety and antibiotics residue free food products has called producers to find alternatives for achieving healthy growth performance. As an approach towards antibiotic-free poultry production, there has been great urgency to find substitute having a best multidimensional property containing Phyto additives with a wide range of effects on health status and production of birds. Production of high-quality protein, genetic selection for fast growing strains has altered the immune system of modern poultry and increased challenges for the nutritionists to balance rapid growth with maintaining optimum gut health in poultry (Gopi *et al.,* 2014). Essential oils (EO) are one of best emerging tools available that supports the challenges faced by this quick growing poultry industry in the present era.

The ultimate aim of poultry rearing is to achieve uniform growth, better performance and healthier birds and that ultimate depends upon the nutrition and healthy gut. Healthy gut is a challenge, due to the presence of certain pathognomonic microflora and have critical role in imparting health and welfare of birds (Gomathi *et al.,* 2017).

ESSENTIAL OIL?

EOs are aromatic, oily extraction from different parts of a plant, like flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits or roots. The term "Essential oil" is being derived from '*Quinta essential*' of the major plant families, coined in the sixteenth century by Paracelsus von Hohenheim for the effective component of a drug (Burt, 2004). EOs is formed in plants from isopentenyl pyrophosphate units which are polymerized yielding a large variety of components. EOs having complex interactions of different classes of compounds such as, aldehydes, ketones, phenols, esters, alcohols, hydrocarbons or ethers in plants (Krishan and Narang, 2014).

CLASSIFICATION OF ESSENTIAL OIL

EOs are basically comprises of two classes of compounds: Terpenes (ginger and turmeric) which have 5 carbon isoprene unit and Phenylpropenes (clove, nutmeg and cinnamon). On the basis of carbon atom terpenes is further divided into monoterpenes ($C_{10}H_{16}$), sesquiterpenes ($C_{15}H_{24}$) and diterpenes ($C_{20}H_{32}$). Terpenes is synthesized by melonic acid pathway, by which using acetyl-coA is a precursor source and phenylpropenes is synthesized by shikimic acid pathway, a seven step metabolic route used by bacteria, archaea, fungi, algae, protozoans and plants for the biosynthesis of folates and aromatic amino acids (phenylalanine, tyrosine, and tryptophan) (Seigler, 1998). EOs are extracted by various method like steam distillation, solvent extraction, CO_2 extraction, Maceration, Enfleurage and also through aater distillation (Stevanovic *et al*., 2018).

EFFECT OF ESSENTIAL OIL ON GROWTH PERFORMANCE

The essential oils as single or mixture may be used as a growth promoter in broiler production; they are expected to stimulate appetite, which is particularly crucial for young animals/birds to thrive. As dietary essential oils having flavouring characters, resultant stimulate appetite, enhancing digestive enzymes secretion, improved nutrient utilization, optimizing the gut microbial ecosystem and ultimate better growth performance in poultry birds (Bento *et al.,* 2013). Karangiya *et al.,* (2016) reported that the dietary supplementation of garlic, ginger and their combination at the rate of 1% revealed the average body weight and average final body weight gain improved in garlic and ginger supplemented group. Patel *et al.,* (2017) found significant increase in average daily gain when birds were supplemented with 0.5 % of ginger, fenugreek and their combination as compared to control. Similarly, Ibrahim *et al.,* (2018) reported that the inclusion of EEO at 400mg/kg significantly increased (P>0.05) body weight, body weight gain and feed intake compared to control group. However, there were no significant effects but improved in feed conversion ratio (P<0.05). Many researchers (Khattak *et al.,* 2014 and Giannenas *et al*., 2014) found improvements in broiler growth when the bird diets were supplemented with commercial mixtures of essential oil.

EFFECTS OF ESSENTIAL OIL ON NUTRIENT UTILIZATION:

Essential oils favourably affect gut functions by stimulating digestive secretions e.g. bile and mucus, and enhanced enzyme activity (Platel, 2004). In broilers, EOs enhance the secretion of trypsin, amylase and jejunal chime (Jang *et al.,* 2007). It reduces the adherence of pathogens (*E. coli* and *C. perfringens)* with intestinal wall (Jamroz *et al*., 2005). Yildirim *et al*., (2018) reported that supplementation of rosemary in broiler feed increased activity of antioxidant enzymes; prevent

lipid peroxidation, lowered blood glucose level and LDL "bad" cholesterol. Eltazi, (2014) observed that the total tract apparent retention of dry matter, organic matter and crude protein for Cinnamon oil supplemented group was greater than for the Clove oil and Ajavain oil and non-supplemented group. The improvements in retention of nutrients particularly in Cinnamon supplemented group may be due to the active principle such as cinnamaldehyde, which is considered as a digestion stimulating agent.

EFFECT OF ESSENTIAL OIL ON HEALTH STATUS:

Antioxidant properties of essential oils may reduce lipid peroxidation at cellular level; thereby enhance the immune status, resistance and health of bird. Effect of stress factors (such as high temperature, noise, transportation) may upset the activity of antioxidant enzymes (e.g. glutathione peroxidase) and oxidative balance of the bird's (Amorati *et al*., 2013). These parameters are commonly attracting to test new phytogenic feed additives, such as natural antioxidants to check toxic metabolites in a chicken (Akbarian *et al.,* 2014). High efficacy in inhibiting oxidation of fatty emulsions was demonstrated for thyme (88.0%), rosemary (78.8%), sage (73.9%), and lavender (72.5%) oils (Belenli *et al.,* 2015). A significant decrease in BUN, creatinine, total cholesterol, triacylglycerol, LDL and free fatty acids concentration was observed in quails supplemented with 0.75 and 1.5 mL cold pressed clove oil (CCPO)/kg diet as compared with the control group. However, the concentration of HDL was significantly increased ($P < 0.05$) in the group supplemented with 0.75 and 1.5 mL CCPO/kg diet as compared with the control group reported by Hussein *et al*., (2019)

ROLE OF ESSENTIAL OIL ON IMMUNE STATUS:

Some essential oils positively influence the avian immune system, since they promote production of immunoglobulins, enhance lymphocytic activity and boost interferon-γ release (Krishan and Narang, 2014). Supplementing diets with essential oils containing herbal mixtures positively influenced the activity of the intestinal lymphatic system. Eucalyptus and peppermint essential oils added water in the amount of 0.25 ml/L results in an enhanced both cell-mediated and humoral immune response in broilers (Awaad *et al.,* 2010). Rahimi *et al*., (2011) reported that garlic supplementation improved ($P< 0.05$) relative weight of bursa of fibricious in broilers, while the coneflower supplementation improved ($P<0.05$) the antibody titer against antigen supplemented group then compare control. Antibody response to Newcastle disease vaccine (LaSota) was unaffected by the treatments but the antibody levels were improved in the coneflower supplemented group ($P> 0.05$). Awaad *et al*., (2014) observed that humoral immune response increase in the specific combination of carvacrol, cinnamaldehyde and capsicum oleoresin treated group over the blank control group in the HI titres against ND vaccine at different examined intervals in broiler chickens.

EFFECT ON CARCASS CHARACTERS AND MEAT ATTRIBUTES:

Poultry meat has high contents of polyunsaturated fatty acids that can cause off-flavours, off-odors and reduce meat shelf life. Consumers demanded to reduce synthetic preservatives with increased interest in the antioxidant, antimicrobial properties and thereby shelf life of meat (Luna *et al.,* 2010). The antioxidant properties of EOs on meat suggest the retention of metabolites of EOs in the meat which may exhibit positive influence in flavor (Luna *et al.,* 2010). Parmar *et al*., (2019) revealed that dressing percentage was increased ($P<0.05$) on quercetin

supplemented group of broilers, which might be due to apparent increase in relative weight of internal organs. Supplementation of clove and cinnamon oils at the rate of 100 ppm each in broilers resulted significantly (P≤0.001) increase in breast weight as a percentage of carcass (Isabel and Santos, 2009).

EFFECT OF ESSENTIAL OIL ON GUT HEALTH:

Decreased numbers of pathogenic bacteria in the gut may improve the ability of epithelial cells to regenerated villus and thus enhance intestinal absorptive capacity (Mourao *et al.,* 2006). Skoufos *et al.,* (2016) observe that blend of oregano essential oil and attapulgite increases the counts of lactic acid bacteria and make lower counts of coliform bacteria in both the ileum and the caecum compared with the non-supplemented group. Studies indicated that an increased, unchanged as well as reduced villus length and crypt depth in the jejunum and colon for broilers when fed EOs (Manzanilla *et al.,* 2009). Though, beneficial effects on gut health (i.e. reduced pathogen pressure) could favourably increased villus length and gut surface. Awaad *et al.,* (2014) reported that specific combination of carvacrol, cinnamaldehyde and Capsicum oleoresin increased the villus height and villus height/crypt depth ratio in ileum; however the ileal crypt depth was decreased. Bravo *et al.* (2014) suggested the effect of a mixture of carvacrol, cinnamaldehyde and *Capsicum oleoresin* leads increased in efficiency of nutrient utilization, this might be due to decreased proliferation of potentially harmful gram-negative microbiota and increased growth of beneficial microflora.

EFFECT OF ESSENTIAL OIL ON ECONOMY OF PRODUCTION:

Cost of EOs will depends of sources, method of extraction and dose rate of utilization in ration. However, many scientists reported the cost of production or return over feed cost (ROFC) was not affected on utilization of EOs. Karangiya *et al.,* (2016) reported that ginger did not show any negative effect in ROFC. This study was in accordance with Mohammed and Yusuf, (2011) who found no differences in cost of feed per kg gain for broilers on dietary supplementation of ginger. It means that the cost of additives were not a matter when the final product was value added. Similarly, Ibrahim *et al.,* (2018) and Igorevna and Yuryevich, (2019) revealed cost of production was alike in broilers supplemented with phyto-additives.

CONCLUSION

Essential oils are one of best emerging tools comprised of a multi-dimensional property such as growth enhancer, antioxidant, antimicrobial, digestive stimulant, immunomodulation and gut modulatory action in the poultry birds. It improved nutrient digestibility by stimulating digestive secretions and enhanced enzyme activity thereby growth performance and feed efficiency of poultry birds. Inclusion of EOs boosting up the intestinal lymphatic system results increases the release of immunoglobulins thus enhancing the immune response. Antimicrobial properties diminished pathognomic microbes ensuing balancing gut microbiota, may leads epithelia regeneration of intestinal villus and crypts resulting augmented intestinal nutrient absorptive capacity, thereby improve gut health. Antioxidant action of EOs decreased lipid peroxidation, enhancing health status, growth performance, production and economy of rearing/feeding.

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