Essential Oils in Poultry: Does Scientific Evidence Support Broad Claims?

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Introduction:

As we approach an era of antibiotic-free poultry production, there is great urgency to identify feed additives that will elicit some of the same beneficial effects that have been conferred by antibiotics for over 50 years. A variety of products are commercially available, including prebiotics, probiotics, synbiotics, phytobiotics, and various other feed additives. One class of the feed additives that has recently received a large amount of media attention is essential oils. Essential (from 'quinta essentia' or quintessence for medical use) oils (from 'volatile oils' in medieval pharmacy) are volatile fragrant compounds that are though to elicit beneficial effects to the person or animal receiving them as supplement. They are typically obtained from distillation or solvent extraction from plants, herbs, or spices. Essential oils can broadly be placed into two classes: terpenes and phenylpropenes, with large numbers of compounds from each of these classes described. Truly, 'essential oils' as a term represents a huge class of greater than 3,000 compounds that have been identified. It is well recognized that combinations of essential oils exhibit synergistic effects; therefore, much research and development of products is devoted to optimizing the correct combinations of compounds for beneficial effects in the animal. Commonly used essential oil compounds include cinnamaldehyde, thymol, and carvacrol.

Properties of Essential Oils:

Essential oils have been shown to have a broad spectrum of activity against bacteria, including both Gram-positive and Gram-negative organisms. Although mechanisms of action are not completely described, it is thought that some components (terpenoids and phenols) of essential oils disrupt the cell membrane, while other components (coumarin and alkaloids) inhibit the growth of microogransims. A key question pertaining to this is whether there are differential effects against pathogens versus commensals in the poultry gut. The answer to this likely depends on who you ask – a comprehensive study examining the effects of essential oils on the total microbiome has not yet been performed. Essential oils also claim to have antiparasitic effects, particularly oregano oil which is thought to work against *Eimeria* species. Also included in the list of beneficial properties of essential oils are antifungal effects, anti-inflammatory effects, immunomodulatory activity, and stimulation of digestion.

Scientific Evidence:

Based on existing literature, the average improvements for weight gain and feed conversion in poultry administered some form of essential oils were 3% and 3%, respectively. However, results have been contrasting and inconclusive to date. Some studies have shown enhancement of digestive enzyme activity upon inclusion of essential oils. Some essential oils may impact feed conversion ratios, but not impact weight gain. Numerous studies have examined the effects of essential oils and aromatic plants on the avian microflora. Strictly speaking, essential oils have antimicrobial properties. Several *in vitro* studies have demonstrated reductions in counts of *Salmonella*, *Escherichia coli*, and *Clostridium perfringens*. However, these were typically performed using single compounds, in a test tube, against single organisms. The broader questions of antimicrobial activity are 1) the spectrums of activity of these products, and 2) their

interactions with other feed additive products. These will be important to assess in future work, because a benefit conferred against zoonotic pathogens might be negated due to impacts on the commensal microflora impacting performance.

One study examined the effects of different oregano plant extracts compared to chlortetracycline on performance and microflora communities in broilers (Betancourt et al., 2014). Sampling was only performed on 5 chicks from each group at 21 and 42 days of age. No differences in body weight parameters were seen for any treatment group compared to control at 42 days of age. The authors discussed changes in the differences of the microbial communities *between* anatomical sites in the bird (i.e., the changes from ileum to cecum were less dramatic between treatment versus control groups), but they did not identify shifts *within* anatomical site (i.e., control versus treatment ileal bacterial communities did not significantly differ). Furthermore, specific bacteria taxa changed were not identified. Thus, no beneficial effects of oregano oils were identified in this study.

Another study examined the effects of cinnamaldehyde, carvacrol, and Capsicum oleoresin on the gene expression of avian intestinal lymphocytes (Lillehoj et al., 2011). The combination of these three compounds enhanced coccidiosis resistance in a challenge model. Capsicum oleoresin exerted the greatest effects on host gene expression, including many pathways associated with metabolism and immunity. Cinnamaldehyde treatment impacted pathways associated with antigen presentation, humoral immune response, and inflammatory disease. One can conclude from this study that these compounds may impact the host immune system and metabolic function, which in turn provides added resistance against pathogen challenge.

Alali et al. (2012) examined the effect of an essential oil blend of carvacrol, thymol, eucalyptol, and lemon on *Salmonella* Heidelberg shedding in broilers. They found that a concentration of 0.5% of the blend in enhanced weight gain, feed efficiency, and colonization of *Salmonella* in the crop. However, the application did not impact colonization of *Salmonella* in the ceca or environmental shedding. This study highlights how the "test tube" effects of a compound can translate to some effects in the actual animal host, but these effects need to be placed in the context of the desired outcome of application.

Unfortunately, far less research has been performed in commercial turkeys compared to broilers. Bampidis et al (2006) examined the effects of dried oregano leaves on performance in turkey hens. Treatments did not impact body weights or serum cholesterol content, but did positively impact feed conversion from 43 to 84 days of age. No studies have examined the effects of essential oils on the microflora of turkeys. Certainly, more studies are necessary to determine if essential oils exert beneficial effects in commercial turkeys.

Concluding Remarks:

With such an array of different compounds classified as "essential oils" with differing levels of purity on the market, it is challenging to determine using the scientific literature which products may be suitable for use in commercial turkey production. There is no doubt from existing literature that these products hold potential for benefits – these benefits may include pathogen inhibition and increased productivity. However, claims in literature that these serve as a "replacement for antibiotics" need to be cautioned. There is simply not enough scientific

evidence to support the claims that these products will have the same broad beneficial effects that low-dose antibiotics have had for years. In search of alternative to antibiotics, essential oils should be considered as a component of this formula.

References:

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