The Prospective Use of Essential Oil from Herbs as Feed Additive for Laying Poultry: A Review

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Abstract. Entering the era of AGP replacer has made researchers to find alternative products which are comparable to AGP. Some attempts have been made, but it seems the use of herb essential oil (EO) to be very prospective. Some commonly used herbs products evaluated are for example cinnamon, aniseed, olive and oregano. The products are often used in the form of essential oil mixture (EOM) rather than single product. This paper aimed to review the utilization of herb EO and ground herb containing EO toward poultry laying performance. The mechanism of action related to antimicrobial action assessed toward the possible improvement in laying performance. It is concluded that the use of herb EO and ground herb containing EO might replace the use of AGP, but it should be carefully done, because the success in improving laying performance is influenced by the type and dose of herb EO and ground herb containing EO used in the feed.

1. Introduction
Demand of animal protein has significantly increased to support the world human population. Increase income of people also contributes to demand of animal protein, especially if considering the relatively cheap price of poultry meat and egg. In term of laying poultry, increase egg production and quality becomes priority. Therefore, entering new era of policy in Indonesia which banned the use of Antibiotic Growth Promoter (AGP) has stimulated development on the use of antibiotic replacers.

Among antibiotic replacers, the use of essential oils (EO) is prospective. It might be used simply by using ground herb or could be extracted from different parts of plants and resulted some aromatic oils. EO has been reported to play a role as antibacterial, antifungal, antioxidant, digestive enhancer, and heat stress alleviation. Elaborative research emphasizing on antimicrobial effect of herb EO had been summarized by Krisnan and Narang [1], and specific for clove oil had been reported by Ayoola et al [2]. The effects of some EO and ground herb containing EO as AGP replacer and its effect on laying performance of poultry is summarized and reviewed in this paper.

2. Essential oil (EO)
The term of essential oil (EO) explains mixture of volatile substances obtained from plant or plant parts by the use of steam or destillation [3]. The composition of EO could be analyzed by using gas chromatography and mass spectrometry. However, the composition are quite diverse among different plant containing EO. The contents of essential oils could be mixture of hidrocarbons (terpenes,
sesquiterpenes, etc.) and oxygenated compounds (alcohol, esters, aldehydes, ketone, etc). The two or three compounds are usually dominant and present at fairly high concentration (up to 85%) in a specific ground herb or EO product. This information was summarized by Brenes and Roura [4]. In fact, unlike the ground herb or plant part or the commercial product of EO is sometime sold as mixture of two or more different EO sources.

3. Properties of essential oil (EO)
Related to laying productive traits, EO or EO containing herb or plant part has been widely known to exert antibacterial, antioxidant, digestive enhancer, lipid metabolism, etc. The current review only discusses about the antimicrobial properties of EO. It is believed that the main factors that could influence production of laying poultry is related to antimicrobial effect of EO. This oil is able to partly or totally kill pathogenic bacteria, for example an essential oil from cinnamon plant known as cinnamaldehyde was reported to strongly inhibit Clostridium perfringens and Bacteroides fragilis [5]. The mechanism by which essential oil kill pathogenic bacteria is not clearly understood. It might involve several mechanisms and its effectiveness seem to depend on pH, chemical structure of active substance(s), concentration, population and type of affected intestinal microorganism [1]. The antimicrobial inhibition activities, for example coumarin and alkaloids, might include disruption of cell membrane by terpenoids, phenolics, metal chelation by phenol and flavonoid [6]. EO beside limit or kill pathogenic bacteria, might also stimulate beneficial non-pathogenic microflora in poultry [7]. Loss of pathogenic bacteria would enhance absorption of nutrient from the intestine. In addition, population of non-pathogenic bacteria would also increase resulted better digestion and absorption of nutrient from the intestine. Such a mechanism would cause an increase in poultry production. Due to the work of EO might be support by low pH condition, low dose of EO combined with sodium butyrate effectively control Salmonella in broiler [8].

4. Effects of essential oil in laying poultry
Table 1. summarized the effect of different EO on laying poultry. The result indicates that effect of EO on laying performance varies among the experiments, so it has to be carefully justified before implementing the result into practice. The use of cinnamon oil, bergamot oil, myrtle oil, clove oil and some EOM seem to be promising to replace the use of AGP in poultry. Though the result indicates improvement in HDP for example, it still needs to be tested in commercial scale.

| Type of Poultry | Level of inclusion | Effect | Reference |
|-----------------|--------------------|--------|-----------|
| Laying Chicken  | From 0 to 600 ppm EOM | Egg mass, egg weight and egg shell strength improved, but had no effect on body weight, feed intake and FCR | Olgun [9] |
| Laying Chicken  | EOM 36 ppm with or without addition of 2 g organic acid | No effect on feed intake, FCR, egg production and egg weight. Immune responses were also not significantly different. | Özek et al., [10] |
| Laying Chicken  | Cinnamon oil 40 ppm | No effect on feed intake and BWG but improved HDP, egg weight, egg mass and FCR under cold stress condition | Torki et al., [11] |
| Laying Chicken  | Nigella sativa oil 1 to 3 ppm | No effect on feed intake, FCR, HDP and egg weight and quality, but with significant reduction of E coli in feces | Bölükbaş et al., [12] |
| Laying Chicken  | Bergamot oil 1 to 3 ppm | No effect on feed intake, but significantly increased FCR, HDP and egg weight and egg breaking strength | Bölükbaş et al., [13] |
Laying Chicken
EOM 24 g
No effect on HDP, egg weight and FCR, but significantly improved egg shell weight and oxidative stability of stored egg significantly improved by the use of 200 ppm Cinnamon oil. All treatments significantly improved fertility, but not hatchability.
Bozkurt et al., [14]

Laying Chicken
EOM 24 g
No effect on feed intake and FCR, but significantly improved egg weight and HDP
Bozkurt et al., [15]

Laying Quail
EOM 24 g
No effect on feed intake, egg weight, but significantly improved HDP and FCR
Çabuk et al., [16]

Laying Quail
Cinnamon oil 200 ppm, Rosemary oil 200 ppm or combination of Cinnamon and Rosemary oils of 100 ppm each
No effect on feed intake and egg weight, but HDP and FCR improved significantly by the use of 200 ppm Cinnamon oil. All treatments significantly improved fertility, but not hatchability.
Şimşek et al., [17]

Laying Quail
Myrtle oil from 500 to 5000 ppm
HDP significantly improved with up to 1000 ppm myrtle oil added, but at highest level (5000 ppm) FCR decreased significantly. No significant effect on fertility and hatchability
Bulbul et al., [18]

Laying Quail
0-600 ppm EO mixture
No effect on BWG, feed intake, FCR, egg production, fertility and hatchability, but with 50 ppm EO improved egg breaking streng without impairing shell thickness
Olgun and Yıldız [19]

Laying Quail
Oregano oil 5%
No effect on feed intake, FCR, egg weight
Cetingul et al., [20]

Laying Quail
Oregano oil 200 ppm, Rosemary oil 200 ppm, combination of Oregano and Rosemary oil
Significantly increased feed intake and FCR, improved HDP, but had no effect on egg weight if Oregano and Rosemary oil is combined in feed
Yesilbag et al., [21]

Laying Duck
Clove oil 200 ppm
Improved HDP, FCR and IOFC, but had no effect on feed intake and digestibility of nutrients
Widodo, et al., [22]

Note: EOM: essential oil mixture without information on ratio of each EO used

In this review, ground herbs which contains EO might affect laying performance of poultry is also summarized in Table 2. The current result indicates that leaves of anise, oregano, olive and their mixture might improve poultry laying performance, but again it has to be tested at commercial level before being commercialized.

| Type of Poultry | Doses | Effect | Reference |
|-----------------|-------|--------|-----------|
| Laying chicken  | 1 – 3% Olive ground leaf | No effect on HDP, egg weight and quality, but significantly improved yolk colour | Cayan and Erener [23] |
| Laying quail    | Until 5% ground aniseed | No effect on egg production and egg quality, but increased feed intake and FCR. Immune response improved with increasing level of inclusion. Suggestion level was 4% | Baryam et al., [24] |

Table 2. Summary of results on the effect of ground herb on laying poultry
5. Conclusion

It might be concluded that some EO and ground herb might be used as alternative for AGP, but it should take into account effective dose and careful justification of implementing the result in commercial poultry farm. The hygiene and more stable condition of poultry house and other means which could prevent outbreak of diseases should be important consideration of antibiotic removal policy from poultry farm.

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