Effect of blend of natural essential oils addition in the drinking water on productivity, carcass yield and meat quality of broiler

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Abstract. Essential oils is known as feed additives to increase poultry production. They have antibacterial properties against parasites that effect the modulation of gut microflora and health. The aim of the study was to evaluate the influence of essential oils blend from nine plant extracts on meat quality and carcass yield of broiler. The essential oils blend was given in the drinking water from day 10 to 35 (1 ml/liter). In total, 60 male day-old broiler chicks were randomly allotted in two treatments, six replicates and 5 birds per replicate. Supplementation of essential oils blend has no effect on the body weight, feed intake, feed conversion ratio and slaughter weight. Birds supplemented with essential oils blend had significant effect in carcass yield (1652 vs 1490 g). The slaughter weight and carcass percentage showed no difference between treatments. Cooking loss (22.60 vs 16.14%), tenderness (5.40 vs 3.93%), and water holding capacity (33.27 vs 26.60 mg H_2O) increased (p<0.05) when birds supplemented with essential oils blend compared with control. Moisture (77.74 vs 79.54%) and pH of carcass (6.20 vs 6.18) were not significantly different. Essential oils blend supplementation increased carcass yield, cooking loss, tenderness, and water holding capacity.

1. Introduction
Herb contents, especially essential oils have been evaluated as feed additives to increase poultry production. Essential oil supplementation improves the performance of broiler [1, 2]. Essential oils have antibacterial properties against E. Coli [3], C. perfringens [4] and control coccidian infection [5] that effected the modulation of gut microflora and improves health. Supplementation of essential oil was reported to increase nutrient utilization by increasing caeca villus surface area [6, 7]. Anise oil supplementation in broiler diets had positive effects on carcass performance and organoleptic characteristics of meat [8].

Others studies report that essential oils did not affect broiler production [9]. of the difference of essential oil effects in other studies may be related with different component content of essential oil, sources of herbs, diet type, microbial environment and animal age [10]. Essential oils blend is a mixture several types of essential oils that expected to have more beneficial properties and effective functions as
feed additive for broiler. The aim of the present study is to evaluate the effect of essential oils blend addition in drinking water on productivity, carcass yield and meat quality of broiler chickens.

2. Materials and methods

2.1. Blend of natural essential oils
The natural essential oils blend consisted of essential oils derived from 9 various herbs: Pine oil, Gardenia jasminoides, Cocos nucifera, Eucalyptus globules, Herba Origani, Gummi Myrrha, Gummi Boswellii, Cymbopogon citrates and Carrot seed oil.

2.2. Experimental design
One day old male Lohman MB 202 broiler chicks were obtained from a commercial hatchery (PT. Japfa Comfeed Indonesia Tbk.) and placed under continuous light with feed and water available ad libitum until they were 10 days old. On d 10, a total of 60 birds were individually weighed and assigned to pens in stainless steel batteries (90x50x45 cm$^2$) until d 35. A completely randomized design was used 6 pen replicates of 5 chicks assigned to each of two treatment. The chicks were monitored daily for signs of mortality.

### Table 1. Chemical composition of diets for the broiler (d 1 to 35)

| Item                  | Level          |
|-----------------------|----------------|
| ME (kcal/kg)**        | 3000.00        |
| Dry matter (DM)*      | 87.90          |
| Crude protein (CP)**  | 21.50          |
| Crude fibber*         | 2.48           |
| Fat*                  | 2.44           |
| Ash*                  | 11.25          |
| Calcium**             | 0.90-1.20      |
| Phosphor**            | 0.70-0.90      |

*Laboratory analysis;  ** Company information

The broilers were fed with commercial feed which composition is in Table 1. The experiment evaluated the effect of natural essential oils blend which were given in the drinking water from day 10 to 35 (1 ml/liter water) compared with control. At the end of treatment (d 35), the experiment was evaluated by measuring final body weight, feed intake, feed conversion ratio, carcass yield and meat quality.

2.3. Carcass yield and meat quality evaluation
At day 35, twelve chickens (6 birds per treatment group) were randomly sampled, slaughtered and weighed for carcass yield measurement. All 12 breast meat samples were collected in plastic trays for meat quality evaluation. The pH value of the meat samples was determined using a pH meter (Hanna Checker 1 pH Taster, Hanna Instruments, Ann Arbor, Michigan, USA). The pH meter was calibrated at pH 4.0 and 7.0, at ambient temperature.

The meat samples were weighed for 25 g, placed in plastic bag and cooked in a water bath at 90°C for 30 min, left under running water for 15 min and then left equilibrating, at room temperature. The samples were weighed again, in order to estimate the percentage of cooking loss (%). Shear force was evaluated, meat samples cut perpendicularly to the fiber direction using warner-bratzler shear force (Salter 235, G-R Manufacturing Co., Collins LN, Manhattan, Kansas, USA), peak force values in kg/cm$^2$ were recorded.
Water holding capacity (WHC) of 1 g thigh meat sample was measured by centrifuging at 1500 g for four min and drying at 70˚C. Moisture of the samples was measured for 12-16 hours after weighing 1 g of each sample and drying it in oven at 80˚C.

2.4. Statistical analysis
Data were analyzed using two-tailed $t$-test. All comparisons were done at 5% level of significance.

3. Results and discussion
The effect of blend of natural essential oil salt as feed additive on body weight growth showed in Figure 1.

Result showed that there is no significant difference between both groups. The blend of natural essential oils did not affect increase body weight ($P>0.05$), however natural essential oils blend had higher body weight trend of body weight increased in every week. In the end of experiment, body weight of broiler which supplemented by blend of natural essential oil 70 g (3.5%) higher than control.

The effect of natural essential oils blend as feed additive on feed intake and feed conversion ration showed in Table 2. Result showed that natural essential oils blend did not influence the feed intake and feed conversion ratio ($P>0.05$); however, feed intake of broiler that was supplemented by the natural essential oils blend was 38 g lower compared to control. Feed conversion ratio decreased by 9.26% in blend of natural essential oil.

![Figure 1. Effect of blend of natural essential oil as feed additive in drinking water on broiler body weight (g) (35)](image)

This study showed that supplementation natural essential oil blend had no significant effect on body weight, feed intake, and feed conversion ratio. Supplementation of essential oil from *Cinnamomum zeylanicum* and Rosemary did not affect body weight of broiler [11, 12]. Soybean, rapeseed and camelina oil supplement did not affect the body weight of broiler. Essential oil as feed additive did not affect the feed intake and feed conversion ratio in broiler [6, 13, 14].

| Treatment Day | Feed intake (g) | 14 | 21 | 28 | 35 |
|---------------|-----------------|----|----|----|----|
| T0            | 200             | 799 | 1672 | 2541 |
| T1            | 180             | 801 | 1637 | 2503 |

Table 2. Effect of blend of natural essential oil addition in drinking water on broiler feed intake and feed conversion ration

| Treatment | Feed conversion ratio |
|-----------|-----------------------|
| T0        | 1.19 1.32 1.47 1.77   |
| T1        | 1.09 1.25 1.42 1.62   |
The effect of essential oils blend on yield and meat quality are presented in Table 3. The essential oils blend supplementation in drinking water did not effect on body weight and carcass percentage (P>0.05). However, there were significant differences in the value of carcass (P<0.05), broiler carcass weight that supplemented by the blend of essential oils was higher compared with control.

The pH and moisture did not influence by the blend of essential oil supplementation. The essential oils blend supplementation significantly increased value of cooking loss, shear force and water holding capacity (P<0.05).

This study showed that supplementation of essential oils blend did not affect slaughter weight and carcass percentage. The blend of essential oils significantly increased carcass yield by 10.87%, compared with control. Supplementation of essential oils blend from basil, caraway, laurel, lemon, oregano, sage, tea, thyme and combination increased carcass yield [15, 16].

A study on boiler meat did not show any pH and moisture differences between the essential oils blend supplementation and control. Dietary cinnamon oil and oregano essential oil supplementation did not effect pH of broiler meat [11,17]. The moisture content of broiler meat supplemented by thyme and orange essential oil in feed was not different when compared with the control [18]. In this study, the blend of essential oil supplementation increased the cooking loss. In line with our study, [11] found that dietary oregano essential oil was affecting cooking loss of broiler meat.

| Table 3. Effect of blend of natural essential oil on broiler carcass yield and meat quality |
|---|---|---|---|
| Parameter | T1 | T2 |
| **Carcass yield** | | |
| Slaughter weight (g) | 2032±174.57 | 2090±64.72 |
| Carcass (g) | 1490±89.24 | 1652±121.10 |
| Carcass presentation (%) | 73.50±3.20 | 79.80±6.40 |
| **Meat quality** | | |
| pH | 6.18±0.09 | 6.20±0.03 |
| Cooking loss (%) | 16.14±2.30 | 22.60±0.97 |
| Shear force (kg/cm²) | 3.93±0.62 | 5.40±0.43 |
| Water Holding Capacity (mg H₂O) | 26.60±2.65 | 33.27±2.34 |
| Moisture (%) | 79.54±0.41 | 77.74±0.65 |

ns: non significant; T1 = control; T2 = natural blend essential oil

The essential oils blend significantly increased the shear force of broiler meat. The supplementation of essential oil (400mg/kg) increased shear force of broiler meat [8]. In the current study, water holding capacity of broiler meat was increased by the blend of essential oil supplementation (P<0.05). The essential oil supplementation increased protein content of meat [19].

4. Conclusion
In conclusion, blend of essential oil addition in drinking water (1 ml/1 l) affected carcass yield, increased carcass yield, cooking loss, tenderness, and water holding capacity as parameter of broiler meat quality. Further studies are needed to expand the knowledge of natural oil supplementation, especially in industrial practice.

References
[1] Weber G M, Michalczuk M, Huyghebaert G, Juin H, Kwakernaak C and Gracia M I 2012 Poult. Sci. 91 2820–28
[2] Hong J, Steiner T, Aufy A and Lies T 2012 Livestock Sci 144 253–262
[3] Sun Q, Liu D, Guo S, Chen Y and Guo Y 2015 *J. Anim. Feed Sci. and Technol.* 207 234–244
[4] Juneja V K, Thrippareddi H and Friedman M., 2006 *J. Food Prot.* 69 1546–51
[5] Oviedo-Rondon E O, Hume M E, Hernandez C and Clemente-Hernandez S 2006 *Poult. Sci.* 85 854–60
[6] Khattak, F, Ronchi A, Castelli P and Sparks N 2014 *Poult. Sci.* 93 132–7
[7] Hafeez A, Manner K, Schieder C and Zentek J 2016 *Poult. Sci.* 95 622–9
[8] Simsek, U G, Ciftci M, Dalkilic B, Guler T and Ertas O N 2007 *Revue. Méd. Vét.* 158 514–518
[9] Cerisuelo A, Marin C, Sanchez-Vizcaino F, Gomez E A, de la Fuente J M, Duran R and Fernandez C 2014 *Anim. Feed Sci. Technol.* 134 304–15
[10] Jang I S., Ko Y H., Kang, S Y., Lee C Y. 2007. *Anim. Feed Sci. Technol.* 134: 304-315
[11] Symeon G K, Athanasiou A, Lykos N, Charismiadou M A, Goliomytis M, Demiris N, Ayoutanti A, Simitzis P E and Deligeorgis S G 2014 *Ann. Anim. Sci.* 14 883–895
[12] Brenes A and Roura E 2010 *Anim. Feed Sci. Technol.* 158 1–14
[13] Jaskiewicz T, Sagan A and Puzio I 2014 *Livestock. Sci.* 165 74–79
[14] Kirkpinar F, Ünlü H B, Serdaroglu M and Turp G Y 2014 *British. Poult. Sci.* 55 157–66
[15] Roofčhaee A, Irani M, Ebrahimzadeh M A and Akbari M R 2011 *African J. Biotech.* 10 6177–83
[16] Alçıçek A, Bozkurt M and Çabuk M 2003 *S Afr. J. Anim. Sci.* 33 89–94
[17] Symeon G K, Zintilas C, Ayoutanti A, Bizelis J A and Deligeorgis S G 2009 *Can. J. Anim. Sci.* 89 331–334
[18] Rimini S, Petracci M and Smith D P 2014 *Poult. Sci.* 93 2096–102
[19] Herkel R, Galik B, Biro D, Rolince M, Simko M, Juracek M, Arpasova H and Wilkanowska A 2016 *J of Central European Agriculture* 17 25–39