

**PENGARUH ESSENTIAL OILS DALAM PAKAN RENDAH PROTEIN  
TERHADAP PRODUKTIVITAS, KARAKTERISTIK KARKAS,  
HISTOMORFOLOGI USUS, DAN EKSPRESI GEN  
BARRIER FUNCTION PADA BROILER**

**INTISARI**

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Penelitian ini bertujuan untuk mengetahui pengaruh penambahan kombinasi *essential oils* (EO, terdiri dari serai, timi, dan cengkih) yang disaponifikasi dalam pakan rendah protein (*low protein diet*, LPD) terhadap produktivitas, karakteristik karkas, histomorfologi usus dan ekspresi gen *tight junctions* serta inflamasi pada broiler. Penelitian ini menggunakan 360 ekor *day old chick* (DOC) strain Ross 308 dengan enam perlakuan dalam rancangan faktorial 2 x 3, terdiri dari 2 level protein, yaitu *standard protein diet* (SPD) 19,5% dan *low protein diet* (LPD) 18,0%, serta 3 level EO (0, 300, dan 600 mg/kg pakan). Setiap perlakuan terdiri dari enam ulangan dengan 10 ekor ayam per ulangan. Perlakuan diberikan pada umur 21-34 hari (fase *finisher*). Hasil penelitian menunjukkan bahwa level protein tidak berpengaruh signifikan terhadap produktivitas ( $P > 0,05$ ). Suplementasi EO dengan dosis 300 mg/kg menghasilkan FCR yang terbaik, meskipun tidak berbeda signifikan dibandingkan kontrol. Level protein dan EO tidak berpengaruh signifikan terhadap persentase karkas, dada, sayap, atau paha ( $P > 0,05$ ). Suplementasi EO meningkatkan persentase lemak abdominal ( $P < 0,05$ ). Terdapat interaksi signifikan antara SPD dan 300 mg/kg EO yang menghasilkan persentase lemak abdominal tertinggi. Level protein tidak berpengaruh signifikan terhadap histomorfologi usus ( $P > 0,05$ ). Namun, penambahan EO menghasilkan kedalaman kripta yang rendah ( $P < 0,001$ ) dan nilai rasio panjang vili terhadap kripta yang tinggi ( $P < 0,05$ ). Terdapat interaksi antara LPD dengan EO 300 atau 600 mg/kg yang menghasilkan kedalaman kripta yang rendah ( $P < 0,05$ ) dan nilai rasio vili terhadap kripta yang tinggi ( $P < 0,05$ ). Level protein dan EO tidak berpengaruh signifikan terhadap ekspresi gen CLDN-1 ( $P > 0,05$ ). Level protein tidak berpengaruh signifikan terhadap ekspresi gen ZO-1, tetapi meningkat ( $P < 0,001$ ) dengan penambahan EO 300 dan 600 mg/kg. Pemberian LPD meningkatkan ekspresi gen proinflamasi TNF- $\alpha$  dan IL-18 ( $P < 0,001$ ). Suplementasi EO meningkatkan ekspresi gen antiinflamasi IL-10 ( $P < 0,001$ ) dan IL-13 ( $P < 0,05$ ), serta menurunkan gen IL-18 ( $P < 0,001$ ). Terdapat interaksi signifikan antara LPD yang ditambah 300 atau 600 mg/kg yang menghasilkan IL-10 yang lebih tinggi dibandingkan dengan perlakuan lain. Berdasarkan penelitian dapat disimpulkan bahwa penambahan EO dalam pakan rendah protein dapat memperbaiki morfologi usus dan memodulasi ekspresi gen inflamasi dan *tight junctions*. Suplementasi ini mendukung homeostasis imun, sehingga berkontribusi dalam mempertahankan produktivitas ayam broiler di bawah kondisi pembatasan protein.

Kata kunci: *Low protein diet*, *Essential oils*, Histomorfologi usus, *Tight junctions*, Inflamasi.

## **EFFECTS OF ESSENTIAL OILS IN LOW PROTEIN DIETS ON THE PRODUCTIVITY, CARCASS CHARACTERISTICS, INTESTINAL HISTOMORPHOLOGY, AND BARRIER FUNCTION GENE EXPRESSION OF BROILER CHICKENS**

### **ABSTRACT**

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This study aimed to evaluate the effects of adding a combination of essential oils (EOs, consisting of lemongrass, thyme, and clove) that were saponified into a low-protein diet (LPD) on productivity, carcass characteristics, intestinal histomorphology, and the expression of tight junction and inflammatory genes in broiler chickens. A total of 360 day-old chicks (DOC) of the Ross 308 strain were used in a 2 × 3 factorial design comprising six treatments: two protein levels, standard protein diet (SPD) at 19.5% and low protein diet (LPD) at 18% and three EO levels (0, 300, and 600 mg/kg of feed). Each treatment was replicated six times with 10 birds per replicate. Treatments were administered from days 21 to 34 (finisher phase). The results showed that dietary protein level had no significant effect on broiler performance ( $P > 0.05$ ). Supplementation with 300 mg/kg EO resulted in a better FCR, although it was not significantly different from the control. Dietary CP and EO levels had no significant effect on the percentage of carcass, breast, wing, or thigh ( $P > 0.05$ ). Supplementation with EO increased the abdominal fat percentage ( $P < 0.05$ ). A significant interaction was observed between SPD and 300 mg/kg EO, resulting in the highest abdominal fat percentage. Dietary protein levels had no significant effect on intestinal histomorphology ( $P > 0.05$ ). However, EO supplementation decreased crypt depth (CD) ( $P < 0.001$ ) and increased the villus to crypt ratio (VH: CD) ratio ( $P < 0.05$ ). There was significant interaction between LPD with 300 or 600 mg/kg EO that exhibited lower CD and higher VH: CD ratio. Dietary protein and EO levels had no significant effect on CLDN-1 gene expression ( $P > 0.05$ ). Dietary protein level had no significant effect on ZO-1 gene expression; however, its expression was significantly upregulated ( $P < 0.001$ ) with the addition of 300 and 600 mg/kg EO. Dietary LPD increased the expression of pro-inflammatory genes TNF- $\alpha$  and IL-18 ( $P < 0.001$ ). supplementation of EO upregulated the expression of anti-inflammatory genes IL-10 ( $P < 0.001$ ) and IL-13 ( $P < 0.05$ ), while downregulating IL-18 ( $P < 0.001$ ). A significant interaction was observed, where LPD combined with 300 or 600 mg/kg EO resulted in higher IL-10 expression compared to other treatments. In conclusion, supplementation of essential oils in low-protein diets improved intestinal morphology and modulated inflammatory and tight junction-related genes. It supported immune homeostasis, contributing to the maintenance of broiler productivity under protein-restricted conditions.

**Keywords:** Low protein diet, Essential oils, Intestinal histomorphology, Tight junctions, Inflammation.