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Optimasi Pakan Rendah Protein dengan Penambahan Essentials Oils dan Sodium Butirat untuk Mempertahankan Produktivitas dan Integritas Usus Ayam Petelur
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OPTIMASI PAKAN RENDAH PROTEIN DENGAN PENAMBAHAN *ESSENTIAL OILS* DAN SODIUM BUTIRAT UNTUK MENINGKATKAN PRODUKTIVITAS DAN INTEGRITAS USUS AYAM PETELUR

INTISARI

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Penelitian ini bertujuan mengevaluasi pengaruh *essential oils* (EOs) yang terdiri dari cengkeh, sereh, dan timi serta sodium butirat (SB) terhadap produktivitas, kualitas telur, morfologi saluran pencernaan, histomorfologi jejunum, serta ekspresi gen *tight junction*, sitokin inflamasi, dan antioksidan pada ayam petelur yang diberi pakan rendah protein (LCP). Sebanyak 150 ekor ayam petelur ISA Brown berumur 58 minggu dibagi ke dalam lima perlakuan, dengan enam ulangan per perlakuan dan lima ekor ayam per ulangan. Perlakuan terdiri atas pakan protein standar (SCP), pakan rendah protein (LCP), LCP + 750 mg/kg *essential oils* (EOs), LCP + 750 mg/kg sodium butirat (SB), dan LCP + 750 mg/kg EOs + 750 mg/kg SB (EOs+SB). Hasil penelitian menunjukkan bahwa perlakuan pakan tidak berpengaruh nyata terhadap produktivitas ayam petelur ($P > 0,05$), meskipun terdapat perbedaan rasio konversi pakan (FCR) pada minggu ke-58–61 ($P = 0,010$). Pemberian LCP tidak berpengaruh nyata terhadap kualitas eksternal telur dan kerabang ($P > 0,05$), namun secara signifikan menurunkan tinggi albumen dan Haugh unit ($P < 0,05$). Pemberian LCP mengubah perkembangan saluran gastrointestinal dan morfologi jejunum, yang ditandai dengan peningkatan kedalaman kripta dan penurunan rasio vili terhadap kedalaman kripta (VH:CD). Pakan LCP juga menurunkan ekspresi gen *tight junction* (*ZO-1* dan *OCLN*), antiinflamasi (*IL-10* dan *IL-13*), antioksidan (*SOD-1* dan *GPx-1*), serta meningkatkan ekspresi gen proinflamasi (*TNF-α* dan *IL-18*) ($P < 0,001$). Suplementasi EOs signifikan meningkatkan bobot albumen, menurunkan kedalaman kripta, meningkatkan rasio VH:CD, serta menekan ekspresi gen proinflamasi dan meningkatkan ekspresi gen *IL-10*. Sodium butirat signifikan meningkatkan ekspresi *ZO-1* dan *IL-13* serta menurunkan ekspresi gen *TNF-α* dan *IL-18*. Kombinasi EOs + SB secara signifikan meningkatkan tinggi albumen dan Haugh unit. Selain itu, kombinasi secara signifikan meningkatkan rasio VH:CD, meningkatkan ekspresi gen *CLDN-1*, *ZO-1*, *SOD-1* serta menurunkan ekspresi gen *TNF-α* dan *IL-18* ($P < 0,001$). Sebagai kesimpulan, penurunan protein kasar pakan sebesar 2,23% mampu mempertahankan performa produksi ayam petelur, tetapi menurunkan kualitas internal telur dan ekspresi gen yang berkaitan dengan integritas usus, sedangkan suplementasi kombinasi EOs dan SB berpotensi memitigasi respons LCP pada ayam petelur fase pasca puncak produksi.

Kata kunci: Ayam Petelur, *Essential Oils*, Integritas Usus, Pakan Rendah Protein, Sodium Butirat, Berkelanjutan

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OPTIMIZATION OF LOW-PROTEIN DIETS SUPPLEMENTED WITH ESSENTIAL OILS AND SODIUM BUTYRATE TO IMPROVE PRODUCTIVITY AND INTESTINAL INTEGRITY IN LAYING HENS

ABSTRACT

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This study aimed to evaluate the effects of essential oils (EOs) consisting of clove, lemongrass, and thyme, as well as sodium butyrate (SB), on productive performance, egg quality, gastrointestinal tract morphology, jejunal histomorphology, and the expression of tight junction, inflammatory cytokine, and antioxidant-related genes in laying hens fed a low-crude-protein (LCP) diet. A total of 150 ISA Brown laying hens aged 58 weeks were allocated to five dietary treatments, with six replicates per treatment and five hens per replicate. The treatments consisted of a standard crude protein diet (SCP), a low-crude-protein diet (LCP), LCP + 750 mg/kg essential oils (EOs), LCP + 750 mg/kg sodium butyrate (SB), and LCP + 750 mg/kg EOs + 750 mg/kg SB (EOs+SB). The results showed that dietary treatments had no significant effect on overall laying performance ($P > 0.05$), although feed conversion ratio (FCR) differed during weeks 58–61 ($P = 0.010$). The LCP diet had no significant effect on external egg and eggshell quality ($P > 0.05$), but significantly reduced albumen height and Haugh unit ($P < 0.05$). The LCP diet altered gastrointestinal development and jejunal morphology, as indicated by increased crypt depth and a reduced villus height-to-crypt depth ratio (VH). The LCP diet also downregulated the expression of tight junction-related genes (*ZO-1* and *OCLN*), anti-inflammatory cytokines (*IL-10* and *IL-13*), and antioxidant-related genes (*SOD-1* and *GPx-1*), while upregulating the expression of pro-inflammatory genes (*TNF-α* and *IL-18*) ($P < 0.001$). EOs supplementation significantly increased albumen weight, reduced crypt depth, increased the VH ratio, suppressed pro-inflammatory gene expression, and increased *IL-10* expression. Sodium butyrate significantly increased *ZO-1* and *IL-13* expression while reducing *TNF-α* and *IL-18* expression. The combination of EOs + SB significantly increased albumen height and Haugh unit. In addition, the combined supplementation significantly increased the VH ratio and the expression of *CLDN-1*, *ZO-1*, and *SOD-1*, while reducing *TNF-α* and *IL-18* expression ($P < 0.001$). In conclusion, reducing dietary crude protein by 2.23 percentage points maintained the productive performance of laying hens but impaired internal egg quality and the expression of genes associated with intestinal integrity, whereas combined supplementation with EOs and SB may mitigate the adverse responses to an LCP diet in post-peak laying hens.

Keywords: Laying Hens, Essential Oils, Intestinal Integrity, Low-Protein Diet, Sodium Butyrate, Sustainability