EFIKASI NANOEMULSI MINYAK ATSIRI TEMU KUNCI SEBAGAI ADITIF AIR MINUM TERHADAP KESEHATAN ORGAN DALAM, KINERJA PRODUKSI, DAN KUALITAS TELUR AYAM *LAYER*

INTISARI

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Tujuan penelitian adalah untuk mengetahui formulasi dan karakterisasi nanoemulsi minyak atsiri temu kunci (NMATK) sebagai agen antimikroba serta mengevaluasi secara *in vivo* pengaruh pemberian NMATK terhadap kesehatan organ dalam, kinerja produksi, dan kualitas telur ayam *layer*. Penelitian tahap pertama adalah uji formulasi, optimasi, dan karakterisasi dari *self-nanoemulsifying drug delivery system* (SNEDDS) NMATK. Materi yang digunakan adalah minyak atsiri temu kunci, Tween 80, polyethylene glycol (PEG) 400, dan *virgin coconut oil* (VCO). Metode yang digunakan adalah *trial* dari D-optimasi Design Expert. Analisis statistik menggunakan t-test. Penelitian tahap kedua adalah uji daya hambat NMATK terhadap mikroba secara *in vitro*. Materi yang digunakan adalah NMATK, media nutrien agar, de man's rogosa sharpe agar (MRSA) dan broth (MRSB), inokulan *Lactobacillus sp*., *Escherichia coli*, *Salmonella enteritidis*, Tetracycline. Metode yang digunakan adalah teknik Kirby-Bauer Disk Diffusion. Analisis statistik menggunakan rancangan acak lengkap (RAL) pola searah. Penelitian tahap ketiga adalah uji efikasi NMATK untuk meningkatkan kesehatan organ dalam serta kualitas fisik dan kualitas kimiawi telur. Materi penelitian tahap ketiga adalah ayam *layer* strain Isa Brown 180 ekor, pakan basal, dan NMATK. Analisis menggunakan RAL pola searah. Setiap ayam penelitian tahap ketiga mendapatkan satu dari 5 perlakuan: air minum tanpa aditif (kontrol negatif; P0), air minum + 45 mg/L antibiotik Tetracycline (kontrol positif; P1), air minum + 2,5 mL/L NMATK (P2), air minum + 3,5 mL/L NMATK (P3), air minum + 4,5 mL/L NMATK (P4). Formula optimum NMATK memiliki komposisi VCO : minyak atsiri temu kunci : Tween 80 : PEG 400 adalah 12,61 : 12,61 : 53,65 : 21,12%. Pengamatan dan pengujian menggunakan TEM, uji partikel size, dan uji termodinamika menunjukkan bahwa SNEDDS NMATK memiliki karakter homogen, ukuran partikel rata-rata 22,92 nm, pH 5,80, serta memiliki karakter stabil tanpa endapan. Uji indeks polidispersitas (PdI) menunjukkan sebaran partikel berada pada angka 0,40 sehingga partikel NMATK bersifat homogen dengan nilai uji zeta potensial -20,6, yang menunjukkan karakter partikel stabil dan kuat. Uji viskositas merujuk pada nilai 330 cP menunjukkan NMATK tidak terlalu kental. Hasil uji Kirby-Bauer menunjukkan NMATK memiliki daya hambat patogen pada nilai 3,6 - 7,2 mL/L. Suplementasi NMATK mampu memperbaiki kesehatan organ dalam jejunum usus halus dengan menurunkan ($P<0,05$) jumlah coliform tanpa mengganggu fungsi organ pencernaan dan kinerja produksi ayam *layer*. Suplementasi NMATK memperbaiki kualitas telur dengan meningkatkan indeks telur, asam miristat ($P<0,05$), warna kuning telur, tebal kerabang telur, protein telur, dan asam nervonat serta menurunkan kolesterol telur ($P<0,01$). Level suplementasi terbaik dari NMATK adalah 4,5 mL/L dalam air minum mampu meningkatkan kesehatan organ dalam serta kualitas fisik dan kimiawi telur.

Kata kunci: Ayam *layer*, Kinerja produksi, Kualitas telur, Nanoemulsi Minyak atsiri, Temu kunci.

EFFICACY OF FINGERROOT ESSENTIAL OIL NANOEMULSION AS A DRINKING WATER ADDITIVE ON VISCERAL ORGAN HEALTH, PRODUCTION PERFORMANCE, AND EGG QUALITY IN LAYER CHICKENS

ABSTRACT

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The purpose of this research was to determine formulation and characterization of fingerroot essential oil nanoemulsion (NMATK) as an antimicrobial agent and to evaluate the *in vivo* effects of NMATK on visceral organ health, production performance, and egg quality in laying hens. The first stage of this research involved testing the formulation, optimization, and characterization of the self-nanoemulsifying drug delivery system (SNEDDS) NMATK. The materials used were fingerroot essential oil, Tween 80, polyethylene glycol (PEG) 400, and virgin coconut oil (VCO). The method employed was a trial using D-optimization in Design Expert. Statistical analysis was conducted using a t-test. The second stage of the research was an *in vitro* antimicrobial inhibition test of NMATK. The materials used were NMATK, nutrient agar media, de Man Rogosa Sharpe agar (MRSA), and broth (MRSB), inoculants of *Lactobacillus sp*., *Escherichia coli*, *Salmonella enteritidis*, Tetracycline. The method used was the Kirby-Bauer disk diffusion technique. Statistical analysis was performed using a completely randomized design (CRD) with a one-way pattern. The third stage of the research was efficacy test of NMATK to improve visceral organ health and the physical and chemical quality of eggs. The materials used in this stage included 180 Isa Brown Strain layer chickens, basal feed, and NMATK. The analysis used a one-way CRD pattern. Each laying hen in this phase of the research received one of five treatments: drinking water without additives (negative control; P0), drinking water with 45 mg/L Tetracycline antibiotic (positive control; P1), drinking water with 2.5 mL/L NMATK (P2), drinking water with 3.5 mL/L NMATK (P3), and drinking water with 4.5 mL/L NMATK (P4). The optimum formula of NMATK had a composition of VCO: fingerroots essential oil: Tween 80: PEG 400 was 12.61: 12.61: 53.65: 21.12%. Observations and tests using TEM, particle size analysis, and thermodynamic testing indicated that SNEDDS NMATK had homogeneous characteristics, an average particle size of 22.92 nm, a pH of 5.80, and demonstrated stable properties without sedimentation. The polydispersity index (PdI) test showed that particle distribution was 0.40, indicating that NMATK particles were homogeneous. Zeta potential test value was -20.6, which signified stable and strong particle characteristics. The viscosity test indicated a value of 330 cP, suggesting that NMATK is not too thick. The results of the Kirby-Bauer test showed that NMATK had pathogen inhibition power at concentrations of 3.6 - 7.2 ml/l. NMATK was able to improve visceral organ health, particularly in the jejunum of the small intestine, by significantly reducing ($P<0.05$) the number of coliforms without affecting the function of the digestive organs or the production performance of the laying hens. NMATK also improved egg quality by increasing egg index ($P<0.05$), myristate acid, shell thickness, yolk color, egg protein content, DHA, and nervonate acid while reducing egg cholesterol ($P<0.01$). The optimal

supplementation level of NMATK in drinking water was found to be 4.5 mL/L, based on its ability to improve visceral organ health as well as the physical and chemical quality of eggs.

Keywords: Egg quality, Essential oil nanoemulsion, Fingerroot, Laying hens, Productivity