

ABSTRAK

EFEKTIVITAS SEDIAAN NANOEMULSI BAWANG MERAH (*Allium cepa* L.) TERHADAP FUNGSI GINJAL DAN GAMBARAN HISTOPATOLOGI GINJAL TIKUS PUTIH GALUR WISTAR (*Rattus norvegicus*) YANG MENGALAMI OBESITAS

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Latar Belakang: Obesitas memicu akumulasi lipid ektopik pada ginjal (*renal lipotoxicity*), peningkatan stres oksidatif, dan inflamasi kronis yang berisiko menyebabkan kerusakan struktur serta penurunan fungsi filtrasi ginjal. Bawang merah (*Allium cepa* L.) kaya akan senyawa flavonoid (quercetin) yang memiliki efek antioksidan dan nefroprotektif, namun bioavailabilitasnya rendah pada sediaan konvensional. Formulasi nanoemulsi dikembangkan untuk mengoptimalkan absorpsi senyawa aktif ke jaringan target.

Tujuan: Mengetahui efektivitas sediaan nanoemulsi bawang merah (*Allium cepa* L.) dalam melindungi atau memperbaiki fungsi filtrasi ginjal (kadar ureum dan kreatinin) serta struktur histopatologi ginjal pada tikus putih galur wistar yang mengalami obesitas.

Metodologi: Penelitian ini merupakan eksperimental laboratorium (*true experiment*) dengan rancangan *post-test with control group design*. Sampel terdiri atas 25 ekor tikus jantan galur wistar yang dibagi acak ke dalam 5 kelompok (n=5): Kontrol Negatif (K-), Kontrol Positif (K+; diinduksi kuning telur puyuh tanpa terapi), Perlakuan 1 (P1; nanoemulsi dosis 50 mg/kgBB), Perlakuan 2 (P2; dosis 100 mg/kgBB), dan Perlakuan 3 (P3; dosis 200 mg/kgBB). Induksi diet tinggi lemak dilakukan selama 14 hari untuk mencapai kondisi obesitas berdasarkan parameter Indeks Lee. Sediaan nanoemulsi diberikan secara oral selama 14 hari berikutnya (H14 hingga H28). Parameter fungsi ginjal diukur melalui kadar ureum dan kreatinin darah. Struktur histopatologi ginjal (nekrosis, degenerasi hidrofik, degenerasi lemak) dianalisis menggunakan mikroskop cahaya perbesaran 400x. Data dianalisis secara statistik menggunakan uji ANOVA dan *Least Significant Difference* (LSD).

Hasil: Induksi diet tinggi lemak berhasil memicu obesitas yang ditandai dengan peningkatan Indeks Lee secara signifikan pada kelompok K+ ($324,25 \pm 10,91$) serta peningkatan kadar ureum dan kreatinin. Pemberian nanoemulsi bawang merah selama 14 hari (H28) berhasil menurunkan Indeks Lee dan memperbaiki parameter fungsi ginjal. Kadar ureum akhir secara signifikan menurun pada kelompok terapi: P1 ($18,96 \pm 1,28$ mg/dL), P2 ($17,28 \pm 1,43$ mg/dL), dan P3 ($15,96 \pm 0,52$ mg/dL) dibandingkan dengan K+ ($37,02 \pm 1,46$ mg/dL) ($p < 0,05$). Kadar kreatinin sediaan akhir juga mengalami penurunan bermakna, di mana dosis optimal ditunjukkan oleh kelompok P3 ($0,35 \pm 0,11$ mg/dL) dibandingkan K+ ($1,69 \pm 0,13$ mg/dL) ($p < 0,05$). Pengamatan histopatologi ginjal menunjukkan perbaikan nyata pada arsitektur tubulus dan glomerulus, ditandai dengan berkurangnya skor degenerasi seluler dan nekrosis seiring peningkatan dosis.

Kesimpulan: Sediaan nanoemulsi bawang merah (*Allium cepa* L.) terbukti efektif dalam memperbaiki fungsi filtrasi ginjal dan memulihkan kerusakan struktur histopatologi ginjal tikus wistar akibat obesitas, dengan efektivitas paling optimal pada dosis 200 mg/kgBB.

Kata Kunci: *Allium cepa* L., Nanoemulsi, Obesitas, Fungsi Ginjal, Histopatologi Ginjal.

ABSTRACT

THE EFFECTIVENESS OF SHALOT (*Allium cepa* L.) NANOEMULSION ON RENAL FUNCTION AND RENAL HISTOPATHOLOGICAL PROFILE IN OBESE WISTAR RATS (*Rattus norvegicus*)

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Background: Obesity triggers ectopic lipid accumulation in the kidneys (renal lipotoxicity), which induces oxidative stress and chronic inflammation, leading to structural damage and impaired filtration function. Shallot (*Allium cepa* L.) is rich in flavonoid compounds, particularly quercetin, which possesses potent antioxidant and nephroprotective properties. However, its bioavailability is low in conventional formulations. Nanoemulsion technology was developed to enhance the absorption and targeted delivery of these bioactive compounds to renal tissues.

Objective: This study aimed to evaluate the effectiveness of shallot (*Allium cepa* L.) nanoemulsion in protecting or restoring renal filtration parameters (blood urea and creatinine levels) and renal histopathological structures in obese Wistar rats.

Methodology: This study was a laboratory experimental research (*true experiment*) utilizing a post-test only with control group design. A total of 25 male Wistar rats were randomly assigned into 5 groups (n=5): Negative Control (K-), Positive Control (K+; induced with a high-fat diet using quail egg yolks without treatment), Treatment 1 (P1; nanoemulsion at 50 mg/kg BW), Treatment 2 (P2; nanoemulsion at 100 mg/kg BW), and Treatment 3 (P3; nanoemulsion at 200 mg/kg BW). Obesity was induced via a high-fat diet for 14 days, confirmed by the Lee Index. The nanoemulsion treatments were administered orally for the subsequent 14 days (Day 14 to Day 28). Renal function parameters were determined by measuring serum blood urea and creatinine levels. Structural alterations in the kidney (necrosis, hydropic degeneration, and fatty degeneration) were analyzed via light microscopy at 400x magnification. Data were statistically analyzed using ANOVA followed by the Least Significant Difference (LSD) test.

Results: High-fat diet induction successfully induced obesity, characterized by a significant increase in the Lee Index in the K+ group (324.25 ± 10.91), along with elevated urea and creatinine levels. The administration of shallot nanoemulsion for 14 days significantly reduced the Lee Index and restored renal function parameters. Final blood urea levels decreased significantly in the treatment groups: P1 (18.96 ± 1.28 mg/dL), P2 (17.28 ± 1.43 mg/dL), and P3 (15.96 ± 0.52 mg/dL) compared to the K+ group (37.02 ± 1.46 mg/dL) ($p < 0.05$). Final serum creatinine levels also demonstrated a significant reduction, where the optimal dose was observed in the P3 group (0.35 ± 0.11 mg/dL) compared to the K+ group (1.69 ± 0.13 mg/dL) ($p < 0.05$). Histopathological examination of the kidney showed marked improvements in tubular and glomerular architecture, indicated by decreased cell degeneration and necrosis scores corresponding to the increasing doses.

Conclusion: Shallot (*Allium cepa* L.) nanoemulsion is highly effective in improving renal filtration function and recovering structural damage in renal histopathology caused by obesity, with the most optimal efficacy demonstrated at a dose of 200 mg/kg BW.

Keywords: *Allium cepa* L., Nanoemulsion, Obesity, Renal Function, Renal Histopathology.