

POTENSI GARAM FUNGSIONAL DARI MAKROALGA *Ulva lactuca* UNTUK PENCEGAHAN HIPERTENSI

INTISARI

Konsumsi natrium berlebih dapat memicu hipertensi, sehingga diperlukan alternatif garam rendah natrium berbasis bahan alami. Makroalga *Ulva lactuca* berpotensi dikembangkan sebagai garam fungsional karena secara alami kaya akan mineral dan senyawa bioaktif. Penelitian ini bertujuan untuk mengevaluasi potensi *Ulva lactuca* sebagai garam fungsional dalam pencegahan hipertensi. Metode ekstraksi berbantuan ultrasonik (UAE) digunakan dengan variasi suhu (35, 50, dan 65 °C) dan waktu (10 dan 30 menit), dilanjutkan dengan pengeringan beku (*freeze-drying*). Parameter uji meliputi sifat fisikokimia, fenolik total, dan flavonoid total. Selanjutnya, aktivitas antihipertensi serta profil ADMET dan sitotoksitas dievaluasi secara *in silico*. Hasil penelitian menunjukkan kondisi ekstraksi optimal pada suhu 65 °C selama 30 menit, menghasilkan kadar kalium tertinggi (0,33%), rasio Na:K yang ideal (28,99%) dan fenolik total tertinggi (8,34 mg GAE/g). Analisis GC-MS mengidentifikasi delapan senyawa dominan. Uji *in silico* memvalidasi bahwa senyawa 3H-indazol-3-one, 1,2-dihydro-5-nitro-, memiliki afinitas pengikatan terkuat (-8,81 kcal/mol), sementara 2-Furancarboxylic acid, anhydride, berpotensi memiliki spesifisitas tinggi dalam menghambat ACE melalui interaksi dengan residu katalitik. Prediksi ADMET menunjukkan profil farmakokinetik ligan yang baik, ditandai oleh absorpsi usus yang optimal, distribusi yang seimbang, serta waktu paruh yang singkat. Namun, aspek toksisitas belum sepenuhnya aman karena beberapa ligan menunjukkan risiko cedera hati serta potensi karsinogenitas pada senyawa toluena dan 1,2-pentadiene, 4-methoxy-4-methyl, sehingga memerlukan modifikasi struktur (*lead optimization*) sebelum dikembangkan lebih lanjut. Berdasarkan hasil penelitian, sinergi antara rasio mineral, senyawa bioaktif, dan efektivitas penghambatan molekuler ini mengukuhkan potensi pengembangan makroalga *Ulva lactuca* sebagai kandidat garam fungsional untuk mencegah hipertensi.

Kata Kunci: antihipertensi, *in silico*, UAE, *Ulva lactuca*, garam fungsional.

THE POTENTIAL OF FUNCTIONAL SALT FROM THE MACROALGA *Ulva lactuca* IN PREVENTING HYPERTENSION

ABSTRACT

*Excessive sodium intake can trigger hypertension, necessitating the development of natural-based, low-sodium salt alternatives. The macroalga *Ulva lactuca* has potential to be developed as a functional salt because it is naturally rich in minerals and bioactive compounds. This study aims to evaluate the potential of *Ulva lactuca* as a functional salt for preventing hypertension. Ultrasonic-assisted extraction (UAE) was employed with varying temperatures (35, 50, and 65 °C) and durations (10 and 30 minutes), followed by freeze-drying. Test parameters included physicochemical properties, total phenolics, and total flavonoids. Furthermore, antihypertensive activity, ADMET profiles, and cytotoxicity were evaluated in silico. The results indicated that the optimal extraction conditions were achieved at 65 °C for 30 minutes, yielding the highest potassium content (0.33%), the ideal Na: K ratio (28.99%), and the highest total phenolic content (8.34 mg GAE/g). GC-MS analysis identified eight dominant compounds. In silico testing confirmed that the compound 3H-indazol-3-one, 1,2-dihydro-5-nitro-, exhibits the strongest binding affinity (-8.81 kcal/mol), whereas 2-Furancarboxylic acid, anhydride, has the potential for high specificity in inhibiting ACE through interaction with catalytic residues. ADMET predictions indicate a favorable pharmacokinetic profile for the ligand, characterized by optimal intestinal absorption, balanced distribution, and a short half-life. However, the toxicity profile is not yet fully established, as some ligands exhibit a risk of liver damage and potential carcinogenicity in the compounds toluene and 1,2-pentadiene, 4-methoxy-4-methyl; therefore, structural modifications (lead optimization) are required before further development. Based on the research results, the synergy among mineral ratios, bioactive compounds, and molecular inhibitory efficacy confirms the potential for developing the macroalga *Ulva lactuca* as a candidate functional salt for preventing hypertension.*

*Keywords: antihypertensive, functional salt, in silico, UAE, *Ulva lactuca*.*