ANTIHYPERTENSIVE, ANTIOXIDATIVE, ANTIDIABETIC PROPERTIES OF JACK BEAN PEPTIDES PRODUCED UNDER ENZYMATIC MEMBRANE REACTOR

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FACULTY OF ENGINEERING AND TECHNOLOGY
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Bogor, April 2026

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RINGKASAN

ROSE ULI RUTH CECILIA. Sifat Antihipertensi, Antioksidatif, dan Antidiabetik Peptida Kacang Koro Pedang Yang Diproduksi dengan Reaktor Membran Enzimatis. Dibimbing oleh AZIS BOING SITANGGANG dan ENDANG PRANGDIMURTI.

Peningkatan minat masyarakat terhadap pangan fungsional berakar dari pemahaman yang menguat terkait hubungan nutrisi dari makanan yang dikonsumsi terhadap efek kesehatan, sejalan dengan peningkatan minat terhadap peptida bioaktif karena bioaktivitasnya yang terbukti bermanfaat bagi kesehatan. Dalam penelitian ini, peptida bioaktif yang memiliki aktivitas antioksidan, aktivitas penghambatan DPP-IV, dan ACE diperoleh dari isolat protein kacang koro pedang (*Canavalia ensiformis*) menggunakan sistem proteolisis kontinu dengan kombinasi enzim alkalase dan neutrase. Penelitian ini terdiri dari dua tahap utama: (1) persiapan isolat protein kacang koro pedang dan (2) hidrolisis enzimatik kontinu yang berfokus pada pengaruh *[E]/[S]*, pH, dan waktu tinggal (τ). Membran PES 5 kDa digunakan karena kemampuannya dalam menahan molekul enzim sepenuhnya di dalam reaktor. Ketika reaksi penentuan parameter rasio *[E]/[S]* optimal, aktivitas penghambatan DPP-IV yang diperoleh kecil dan tidak signifikan, sehingga tidak dilakukan analisis untuk parameter lainnya. Kondisi operasi optimal dari seluruh parameter, diperoleh pada perlakuan *[E]/[S]* = 5%, pH = 7,5, dan τ = 12 jam. Dalam kondisi ini, kadar peptida, kapasitas antioksidan, dan penghambatan ACE dalam permeat masing-masing adalah 0,6143 mg SE/mL, 0,0454 mg TEAC/mL, dan 92,18%. Jika dibandingkan dengan substrat yang tidak dihidrolisis dan disaring (SUF), terjadi peningkatan kadar peptida dan penghambatan ACE serta penurunan kapasitas antioksidan pada permeat. Tren peningkatan ini disebabkan oleh produksi peptida dengan bioaktivitas, sedangkan tren penurunan disebabkan oleh penolakan senyawa fenolik oleh membran. Selain itu, selama proses filtrasi kontinu jangka panjang selama 48 jam, kadar peptida dan kapasitas antioksidan meningkat sementara aktivitas penghambatan ACE menurun. Nilai IC_{50} yang diperoleh untuk kapasitas antioksidan dan penghambatan ACE masing-masing adalah 34,93 mg peptida/mL dan 36,62 µg peptida/mL. Hasil ini menunjukkan bahwa isolat protein kacang koro pedang merupakan substrat yang potensial untuk menghasilkan peptida bioaktif. Penelitian ini dapat dijadikan panduan untuk produksi bahan pangan fungsional yang menjanjikan dan berkelanjutan dari kacang-kacangan yang masih belum dimanfaatkan secara maksimal menggunakan teknologi bioproses kontinu.

Kata kunci: alkalase, kacang koro pedang, neutrase, peptida bioaktif, reaktor membran enzimatis

SUMMARY

ROSE ULI RUTH CECILIA. Antihypertensive, Antioxidative, Antidiabetic Properties of Jack Bean Peptides Produced Under Enzymatic Membrane Reactor. Supervised by AZIS BOING SITANGGANG and ENDANG PRANGDIMURTI.

Rising consumer interest in functional foods stems from heightened understanding of nutrition-wellness connections, where bioactive peptides have gained considerable recognition due to their proven health-beneficial properties. This research focused on generating bioactive peptides with antioxidant, DPP-IV inhibitory, and ACE inhibitory activities from *Canavalia ensiformis* protein isolate through continuous proteolysis employing combined alcalase and neutrase enzymes. The investigation encompassed two primary phases: (1) jack bean protein isolate preparation and (2) sustained enzymatic hydrolysis examining [E]/[S] ratios, pH levels, and residence time (τ) impacts. A 5 kDa PES membrane was selected for its complete enzyme molecule retention capability within the reactor system. When the reaction to determine the optimal [E]/[S] ratio parameters was carried out, the DPP-IV inhibitory activity obtained was small and insignificant, so no analysis was carried out for other parameters. Optimal operational parameters were established at [E]/[S] = 5%, pH = 7.5, and τ = 12 h. These conditions yielded permeate results of 0.6143 mg SE/mL peptide content, 0.0454 mg TEAC/mL antioxidant capacity, and 92.18% ACE inhibition. Compared to unprocessed filtered substrate, peptide content and ACE inhibition showed enhancement while antioxidant capacity declined. This upward pattern resulted from bioactive peptide generation, whereas the downward trend occurred due to membrane rejection of phenolic compounds. Throughout 48-hour continuous filtration, peptide content and antioxidant capacity rose while ACE inhibition activity diminished. Antioxidant activity and ACE inhibition demonstrated IC50 values of 34.93 mg peptide/mL and 36.62 µg peptide/mL, respectively. These findings validate jack bean protein isolate as an effective source for producing multifunctional bioactive peptides. The research establishes groundwork for commercially viable and environmentally sustainable functional food ingredient manufacturing from lesser-utilized legumes via continuous bioprocessing technology.

Keywords: alcalase, bioactive peptides, enzymatic membrane reactor, jack bean, neutrase

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Bogor, April 2026

Rose Uli Ruth Cecilia

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