BIOAKTIVITAS EKSTRAK DAN NANOPARTIKEL PERAK *Curcuma sumatrana* SEBAGAI INHIBITOR ENZIM α-AMILASE, α-GLUKOSIDASE, DAN LIPASE SECARA *IN VITRO* DAN *IN SILICO*

SKRIPSI SARJANA BIOLOGI

OLEH:

FARAS ANNISA SYAHADA

NIM. 2210422036

PEMBIMBING:

1. **Dr. PUTRA SANTOSO**
2. **M. SYUKRI FADIL, M.Si**

DEPARTEMEN BIOLOGI

FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

UNIVERSITAS ANDALAS

2026

ABSTRAK

Diabetes melitus dan obesitas merupakan gangguan metabolik yang saling berkaitan dan menjadi masalah kesehatan global akibat peningkatan prevalensinya. Peningkatan kadar glukosa darah postprandial pada diabetes melitus tipe 2 dipengaruhi oleh aktivitas enzim α-amilase dan α-glukosidase yang menghidrolisis karbohidrat menjadi glukosa, sedangkan akumulasi lemak tubuh pada obesitas dipengaruhi oleh aktivitas enzim lipase yang menghidrolisis trigliserida menjadi asam lemak. *Curcuma sumatrana* merupakan tanaman rimpang endemik yang memiliki berbagai senyawa bioaktif yang berpotensi sebagai inhibitor enzim metabolisme tersebut. Penelitian ini bertujuan untuk mengevaluasi aktivitas inhibisi ekstrak etanol *C. sumatrana* dan nanopartikel perak berbasis ekstrak tersebut terhadap enzim α-amilase, α-glukosidase, dan lipase secara in vitro dan in silico. Nanopartikel perak disintesis melalui metode *green synthesis* menggunakan ekstrak *C. sumatrana* sebagai agen pereduksi dan penstabil. Uji aktivitas inhibisi α-amilase dilakukan dengan metode DNS (3,5-*dinitrosalicylic acid*), α-glukosidase dengan metode pNPG (p-nitrofenil-α-D-glukopiranosida), dan lipase dengan metode pNPP (p-nitrophenyl palmitate), menggunakan akarbosa dan orlistat sebagai kontrol positif. Prediksi aktivitas biologis senyawa dilakukan menggunakan PASS *Online*, dilanjutkan dengan analisis *molecular docking* terhadap protein target α-amilase (PDB ID: 4W93), α-glukosidase (PDB ID: 3A4A), dan lipase (PDB ID: 1LPB). Hasil penelitian menunjukkan bahwa ekstrak *sumatrana* memiliki aktivitas inhibisi yang lebih baik dibandingkan nanopartikel perak berbasis ekstrak pada ketiga enzim uji. Terhadap α-amilase, ekstrak etanol menunjukkan IC_{50} sebesar 73,90 µg/mL (kategori kuat), sedangkan nanopartikel perak sebesar 177,60 µg/mL (kategori lemah). Terhadap α-glukosidase, ekstrak etanol menunjukkan IC_{50} sebesar 89,13 µg/mL, sedangkan nanopartikel perak sebesar 99,85 µg/mL, keduanya dalam kategori kuat. Terhadap lipase, ekstrak etanol menunjukkan IC_{50} sebesar 65,34 µg/mL (kategori kuat), sedangkan nanopartikel perak sebesar 141,38 µg/mL (kategori sedang). Hasil *molecular docking* menunjukkan senyawa 9,10-Epoxy-12-octadecenoate memiliki afinitas pengikatan tertinggi terhadap α-amilase (-7,04 kcal/mol) dan α-glukosidase (-7,43 kcal/mol), sedangkan Desacetylcinobufotalin menunjukkan afinitas tertinggi terhadap lipase (-6,84 kcal/mol), meskipun ketiga nilai tersebut masih lebih rendah dibandingkan kontrol positif akarbosa dan orlistat.

Kata Kunci: Diabetes, Obesitas, *Curcuma sumatrana*, Nanopartikel Perak, Inhibisi Enzim, Molecular Docking.

ABSTRACT

Diabetes mellitus and obesity are interrelated metabolic disorders that have become a global health problem due to their increasing prevalence. Elevated postprandial blood glucose levels in type 2 diabetes mellitus are influenced by the activity of the enzymes α-amylase and α-glucosidase, which hydrolyse carbohydrates into glucose, whilst the accumulation of body fat in obesity is influenced by the activity of the enzyme lipase, which hydrolyses triglycerides into fatty acids. Curcuma sumatrana is an endemic rhizome plant containing various bioactive compounds with potential as inhibitors of these metabolic enzymes. This study aims to evaluate the inhibitory activity of C. sumatrana ethanol extract and silver nanoparticles based on this extract against the enzymes α-amylase, α-glucosidase and lipase, both in vitro and in silico. The silver nanoparticles were synthesised via a green synthesis method using C. sumatrana extract as a reducing agent and stabiliser. The α-amylase inhibitory activity assay was performed using the DNS (3,5-dinitrosalicylic acid) method, the α-glucosidase assay using the pNPG (p-nitrophenyl-α-D-glucopyranoside) method, and the lipase assay using the pNPP (p-nitrophenyl palmitate) method, with acarbose and orlistat as positive controls. Predictions of the compounds' biological activity were carried out using PASS Online, followed by molecular docking analysis against the target proteins α-amylase (PDB ID: 4W93), α-glucosidase (PDB ID: 3A4A), and lipase (PDB ID: 1LPB). The results of the study showed that the Sumatrana extract exhibited better inhibitory activity than the extract-based silver nanoparticles against all three test enzymes. Against α-amylase, the ethanol extract exhibited an IC_{50} of 73.90 µg/mL (strong category), whilst the silver nanoparticles exhibited an IC_{50} of 177.60 µg/mL (weak category). Against α-glucosidase, the ethanol extract exhibited an IC_{50} of 89.13 µg/mL, whilst the silver nanoparticles exhibited an IC_{50} of 99.85 µg/mL; both fall into the strong category. Against lipase, the ethanol extract exhibited an IC_{50} of 65.34 µg/mL (strong category), whilst silver nanoparticles exhibited an IC_{50} of 141.38 µg/mL (moderate category). Molecular docking results showed that the compound 9,10-Epoxy-12-octadecenoate had the highest binding affinity for α-amylase (-7,04 kcal/mol) and α-glucosidase (-7,43 kcal/mol), whilst desacetylcinobufotalin exhibited the highest affinity for lipase (-6,84 kcal/mol), although all three values were still lower than those of the positive controls, acarbose and orlistat.

Kata Kunci: Diabetes, Obesity, Curcuma sumatrana, Silver Nanoparticles, Enzyme Inhibition, Molecular Docking