KAJIAN POTENSI EKSOPOLISAKARIDA *Dictyosphaerium chlorelloides* SEBAGAI KANDIDAT ANTIDIABETES TIPE-2 BERDASARKAN STUDI *MOLECULAR DOCKING*

SKRIPSI

diajukan untuk memenuhi sebagian dari syarat memperoleh gelar Sarjana Sains
Program Studi Kimia

Oleh

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Universitas Pendidikan Indonesia
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ABSTRAK

Dictyosphaerium chlorelloides merupakan salah satu mikroalga yang menghasilkan eksopolisakarida (EPS), suatu makromolekul linier atau bercabang yang disekresikan keluar sel. Salah satu EPS yang dilaporkan memiliki aktivitas hipoglikemia adalah xanthan. Pada penelitian ini dilakukan kajian potensi EPS sebagai kandidat antidiabetes tipe-2 melalui pendekatan *molecular docking*. Melalui simulasi ditentukan afinitas pengikatan, interaksi molekuler, dan sifat inhibisi EPS terhadap empat enzim yang berperan dalam regulasi karbohidrat, yaitu α-amilase, α-glukosidase, dipeptidil peptidase-IV (DPP-IV), dan glukosa-6-fosfat dehidrogenase (G6PD). Pembanding yang digunakan adalah akarbosa sebagai kontrol positif inhibitor α-amilase dan α-glukosidase, linagliptin sebagai kontrol positif inhibitor DPP-IV, serta polidatin sebagai kontrol positif inhibitor G6PD. Tahapan penelitian meliputi preparasi protein, validasi metode *docking*, optimasi dan preparasi ligan, proses *docking*, dan visualisasi hasil dengan menggunakan beberapa perangkat lunak diantaranya AutoDock Tools 1.5.6, AutoDock Vina 1.1.2, PyMOL 2.2.3, dan BIOVIA *Discovery Studio Visualizer* 2020. Hasil yang diperoleh menunjukan bahwa afinitas pengikatan EPS terhadap enzim α-amilase dan α-glukosidase lebih tinggi 0,3 *kkal/mol* dibandingkan akarbosa. Afinitas pengikatan EPS terhadap enzim DPP-IV lebih rendah 0,1 *kkal/mol* dibandingkan linagliptin, dan afinitas pengikatan EPS terhadap G6PD sama dengan polidatin. EPS berinteraksi dengan keempat enzim melibatkan ikatan hidrogen, interaksi hidrofobik, dan interaksi van der Waals. EPS menginhibisi keempat enzim secara kompetitif dengan menempati sisi pengikatan yang sama dengan substrat dan kontrol positif inhibitor. Berdasarkan hasil penelitian diketahui bahwa EPS menginhibisi kerja keempat enzim dan berpotensi besar dimanfaatkan sebagai kandidat alami antidiabetes tipe-2. Pengujian lanjutan secara eksperimental diperlukan untuk mendukung data simulasi yang diperoleh.

Kata Kunci: antidiabetes, eksopolisakarida, inhibitor, mikoralga, *molecular docking*.

ABSTRACT

Dictyosphaerium chlorelloides is microalgae which produces exopolysaccharide (EPS), a linear or branched macromolecule that is secreted out of the cell. Xanthan, an EPS has reported to have hypoglycemic activity. This study aims to screen activity of EPS through molecular docking approach for further applications as antidiabetic type-2 candidate. The binding affinity, molecular interactions, and EPS inhibitory properties were determined to four enzymes that play a role in carbohydrate regulation, namely α-amylase, α-glucosidase, dipeptidyl peptidase-IV (DPP-IV), and glucose-6-phosphate dehydrogenase (G6PD). Acarbose was used as positive control of α-amylase and α-glucosidase inhibitors, linagliptin as a positive control of DPP-IV inhibitor, and polydatin as a positive control of G6PD inhibitor. The step of simulation comprises of protein preparation, docking model validation, optimization and ligand preparation, docking process, and visualization using several software tools including AutoDock Tools 1.5.6, AutoDock Vina 1.1.2, PyMOL 2.2.3, and BIOVIA Discovery Studio Visualizer 2020. The results show that the binding affinity of EPS to the α-amylase and α-glucosidase was 0,3 kcal/mol higher than those of the acarbose. In contrast, the binding affinity of EPS to the DPP-IV is 0,1 kcal/mol lower compared to linagliptin, while the binding affinity of EPS to G6PD is the same as polydatin. EPS interacts with all four enzymes through hydrogen bonds, hydrophobic interactions, and van der Waals interactions. EPS inhibits the four enzymes competitively and occupies the same binding site as substrate and positive control of inhibitors. The current results show that EPS is potential to be used as a natural candidate of antidiabetic type-2. However, further experimental is essential to be carried out to support the simulation data obtained.

Keywords: antidiabetic, exopolysaccharide, inhibitor, microalgae, molecular docking.

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