KARAKTERISASI DAN UJI AKTIVITAS RAFINAT POLISAKARIDA SULFAT ALGA SEBAGAI KANDIDAT ANTIDIABETES TIPE 2

SKRIPSI

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

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KARAKTERISASI DAN UJI AKTIVITAS RAFINAT POLISAKARIDA SULFAT ALGA SEBAGAI KANDIDAT ANTIDIABETES TIPE 2

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

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PERNYATAAN

Dengan ini saya menyatakan bahwa skripsi dengan judul **“Karakterisasi dan Uji Aktivitas Rafinat Polisakarida Sulfat Alga Sebagai Kandidat Antidiabetes Tipe 2”** ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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ABSTRAK

Spirulina platensis dan *Sargassum polycystum* merupakan jenis alga yang mengandung sejumlah senyawa bioaktif yang berpotensi sebagai kandidat obat. Pada penelitian ini dilakukan ekstraksi, karakterisasi rafinat polisakarida sulfat alga (PSP) dari *Spirulina platensis* dan *Sargassum polycystum*, serta pengujian aktivitas PSP sebagai kandidat antidiabetes tipe 2 secara *in vitro* dan *in silico*. Rafinat PSP dikarakterisasi menggunakan spektrofotometer UV-Vis dan FTIR, sedangkan aktivitas antidiabetes ditentukan dengan mengukur persen inhibisi rafinat PSP terhadap enzim α-amilase menggunakan spektrofotometer UV-Vis. Hasil analisis UV menunjukkan serapan khas polisakarida sulfat pada panjang gelombang 258 nm dan 266,5 nm untuk masing-masing rafinat PSP *Spirulina platensis* dan PSP *Sargassum polycystum* yang kemudian disebut fukoidan. Analisis spektra FTIR pada kedua rafinat menunjukkan puncak serapan khas pada bilangan gelombang 1074 dan 1033 cm^{-1} yang dikaitkan dengan vibrasi regangan C-O-C gugus-gugus gula pada struktur karbohidrat, dan puncak serapan khas pada 1246 dan 1249 cm^{-1} dikaitkan dengan regangan asimetris gugus sulfat (S=O) yang mengkonfirmasi bahwa di dalam rafinat terkandung polisakarida sulfat. Perbandingan kandungan gula menunjukkan rafinat *Sargassum polycystum* mengandung PSP 21,14% lebih tinggi dibandingkan rafinat PSP *Spirulina platensis*. Kedua rafinat menunjukkan aktivitas inhibisi terhadap α-amilase. Inhibisi tertinggi rafinat PSP *Spirulina platensis* terhadap α-amilase saliva non-diabetes dan saliva diabetes sebesar 37,13% dan 79,10%, sedangkan inhibisi tertinggi rafinat fukoidan terhadap α-amilase saliva non-diabetes dan saliva diabetes sebesar 29,03% dan 73,69%. Pengujian *in silico* dilakukan dengan menambatkan (*docking*) struktur mono-/di-/tri-/tetra-sakarida penyusun PSP terhadap α-amilase. Simulasi *molecular docking* menunjukkan adanya interaksi antara ligan PSP dengan reseptor α-amilase dengan energi afinitas yang lebih besar ditunjukkan pada struktur trisakarida PSP *Spirulina platensis* yaitu sebesar -7,8 kkal/mol dan sebesar -7,7 kkal/mol untuk ligan disakarida fukoidan. Adapun kontrol positif ligan akarbosa memiliki energi afinitas sebesar -8,3 kkal/mol. Simulasi posisi interaksi reseptor-ligan PSP menunjukkan bahwa ligan dari kedua alga menempati sisi pengikatan yang sama dengan ligan akarbosa, yang mengindikasikan mekanisme inhibisi yang terjadi adalah kompetitif. Berdasarkan hasil penelitian dapat disimpulkan bahwa rafinat polisakarida sulfat dari *Spirulina platensis* dan *Sargassum polycystum* berpotensi untuk digunakan sebagai kandidat agen terapi antidiabetes tipe 2.

Kata kunci: antidiabetes, inhibisi, *molecular docking, Sargassum polycystum, Spirulina platensis*

ABSTRACT

Spirulina platensis and *Sargassum polycystum* are member of algae that contain a number of potential bioactive compounds that can be utilized as drug candidates. In this research, extraction, characterization of polysaccharide sulfate raffinate (PSP) from *Spirulina platensis* and *Sargassum polycystum* were carried out, as well as evaluating the PSP activity as a candidate for type 2 antidiabetic through in vitro and in silico approaches. The PSP raffinate was characterized using a UV-Vis and FTIR spectrophotometer, while the antidiabetic activity was determined by measuring the percent inhibition of the PSP raffinate against α-amylase using a UV-Vis spectrophotometer. The results of UV analysis showed a typical absorption of polysaccharides sulfate at a wavelength of 258 nm and 266.5 nm for PSP *Spirulina platensis* and PSP *Sargassum polycystum* (hereafter named as fucoidan) raffinates, respectively. FTIR spectra analysis of both raffinates revealed the absorption peaks at wave numbers of 1074 and 1033 cm^{-1} which were associated with the C-O-C stretching vibrations of the sugar groups in the carbohydrate structure, and the absorption peaks at 1246 and 1249 cm^{-1} that were associated with the asymmetric stretching of the sulfate groups (S=O) which confirmed that the polysaccharides sulfate available in the raffinate. Sugar content analysis showed that *Sargassum polycystum* raffinate have 21.14% higher of PSP than that of *Spirulina platensis* PSP raffinate. Both raffinates showed inhibitory activity against α-amylase. The highest inhibition of PSP *Spirulina platensis* raffinate against non-diabetic salivary α-amylase and diabetic saliva was 37.13% and 79.10%, respectively, while the highest inhibition of fucoidan raffinate against non-diabetic salivary α-amylase and diabetic saliva was 29.03% and 73.69%. In silico testing was carried out by docking the mono-/di-/tri-/tetra-saccharide of PSP against α-amylase. Molecular docking simulations show that the interaction was occurred among the PSP ligands and the α-amylase with a greater affinity energy of -7.8 kcal/mol for trisaccharide of PSP of *Spirulina platensis* and -7.7 kcal/mol for the fucoidan disaccharide ligand. The positive control of the acarbose ligand has an affinity energy of -8.3 kcal/mol. Simulation of the position of the PSP receptor-ligand interaction showed that the ligands from both algae occupy the same binding sites as the acarbose ligands, indicating that the mechanism of inhibition that occurs is competitive. It can be concluded that the polysaccharide sulfate raffinate from *Spirulina platensis* and *Sargassum polycystum* show their potential to be used as therapeutic agents for type 2 diabetes mellitus.

Keywords: antidiabetic, inhibition, molecular docking, *Sargassum polycystum*, *Spirulina platensis*

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