Preparasi Elektroda Carbon Foam dan Studi Aplikasinya untuk Deteksi COVID-19 = Carbon Foam Electrode Preparation and Its Application Study for COVID-19 Detection

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Abstrak

SARS-CoV-2 merupakan virus RNA envelop dengan rantai untai tunggal positif yang menyebabkan COVID-19. Sejak awal teridentifikasi, SARS-CoV-2 menyebar secara luas dan cepat di seluruh dunia, sehingga WHO pada 11 Maret 2020 menyatakan COVID-19 sebagai suatu pandemi. SARS-CoV-2 mampu menginfeksi sel inang melalui proses pengikatan spike glikoprotein terhadap ACE2. Hingga saat ini, metode deteksi RT-PCR menjadi metode terbaik dalam deteksi COVID-19, namun penggunaannya dibatasi oleh reagen dan instrumentasi yang mahal. Oleh karena itu metode alternatif deteksi COVID-19 dapat menjadi solusi, salah satunya adalah sensor elektrokimia. Umifenovir (arbidol) merupakan senyawa elektroaktif yang dapat berinteraksi dengan spike glikoprotein SARS-CoV-2. Simulasi penambatan molekul menggunakan Molecular Operating Environment (MOE) memprediksi interaksi umifenovir-spike glikoprotein S2 SARS-CoV-2 terjadi secara optimum pada pH 7.4 dan temperatur 300K dengan G binding -7.8414 kcal mol-1. Interaksi dimediasi oleh residu asam amino asam glutamat (Glu780) pada chain A. Uji interferensi menunjukkan kompleks umifenovir-HA H1N1 memberikan nilai G binding -7.5822 kcal mol-1, namun tidak cukup kompetitif untuk mengganggu kompleks umifenovir-spike glikoprotein S2 SARS-CoV-2. Hasil studi komputasi kemudian menjadi acuan dalam pengukuran elektrokimia. Pada penelitian ini, perilaku elektrokimia umifenovir dipelajari menggunakan elektroda carbon foam (CF) yang dipreparasi secara hidrotermal-karbonisasi dan dikarakterisasi menggunakan instrumentasi XRD, FTIR, Raman, dan SEM-EDS. Elektroda carbon foam memiliki struktur berpori 3D dengan luas permukaan besar yang menyediakan situs reaksi reduksi-oksidasi bagi umifenovir. Melalui teknik cyclic voltammetry (CV) dan amperometri, ditemukan bahwa keberadaan spike glikoprotein S2 SARS-COV-2 menyebabkan penurunan respon arus umifenovir dengan waktu kontak optimum yaitu 5 menit. Pada konsentrasi yang sama, HA H1N1 dan spike glikoprotein S2 SARS-CoV-2 menyebabkan munculnya efek gabungan yang menurunkan respon arus umifenovir secara signifikan. Hasil tersebut mengindikasikan sensor elektrokimia umifenovir bersifat kurang selektif terhadap senyawa interferensi.

.....SARS-CoV-2 is a positive single-stranded RNA envelope virus that causes COVID-19. Since its initial identification, SARS-CoV-2 has spread widely and rapidly throughout the world, so the WHO on March 11, 2020 declared COVID-19 as a pandemic. SARS-CoV-2 is able to infect host cells through the binding process of spike glycoprotein to ACE2. Until now, the RT-PCR detection method has been the best method for detecting COVID-19, but its use is limited by expensive reagents and instrumentation. Therefore, an alternative method of detecting COVID-19 can be a solution, one of which is an electrochemical sensor. Umifenovir (arbidol) is an electroactive compound that can interact with the SARS-CoV-2 spike glycoprotein. Molecular docking simulation using Molecular Operating Environment (MOE) predicts the umifenovir-spike glycoprotein S2 SARS-CoV-2 interaction will occur optimally at pH 7.4 and temperature 300K with G binding -7.8414 kcal mol-1. The interaction is mediated by the amino acid residue of glutamic acid (Glu780) in chain A. The interference test showed the umifenovir-HA H1N1 complex gave G binding

value of -7.5822 kcal mol-1, but was not competitive enough to interfere with the umifenovir-spike glycoprotein S2 complex of SARS-CoV. -2. The results of computational studies then become a reference in electrochemical measurements. In this study, the electrochemical behavior of umifenovir was studied using carbon foam (CF) electrodes prepared by hydrothermal carbonization and characterized using XRD, FTIR, Raman, and SEM-EDS instrumentation. The carbon foam electrode has a 3D porous structure with a large surface area that provides an oxidation-reduction reaction site for umifenovir. Through cyclic voltammetry (CV) and amperometry techniques, it was found that the presence of the SARS-COV-2 spike glycoprotein S2 caused a decrease in the current response of umifenovir with an optimum contact time of 5 minutes. At the same concentration, HA H1N1 and spike glycoprotein S2 SARS-CoV-2 caused a combined effect that significantly decreased the current response of umifenovir. These results indicate that the umifenovir electrochemical sensor is less selective for interfering compounds.