

ANALISIS POTENSI *CRUDE AGARO-OLIGOSACCHARIDES* (AOS) SEBAGAI PROTEKSI APOPTOSIS SEL HDF TERINDUKSI H₂O₂

Ratnaning Agustin Angelia
23/529534/PBI/01989
Fakultas Biologi, Universitas Gadjah Mada

INTISARI

Stres oksidatif akibat peningkatan *Reactive Oxygen Species* (ROS) merupakan salah satu faktor utama yang berperan dalam penuaan kulit dan induksi apoptosis sel. Hidrogen peroksida (H₂O₂) banyak digunakan sebagai agen penginduksi stres oksidatif secara *in vitro*. *Agaro-oligosaccharides* (AOS), hasil hidrolisis enzimatis agarosa dari alga merah, diketahui memiliki aktivitas antioksidan dan berpotensi sebagai agen anti-aging. Penelitian ini bertujuan untuk menganalisis efek protektif AOS terhadap viabilitas sel, produksi ROS intraseluler, apoptosis, serta ekspresi gen p53 dan p21 pada sel *Human Dermal Fibroblast* (HDF) yang diinduksi H₂O₂. Penelitian dilakukan secara eksperimental *in vitro* menggunakan sel HDF. Uji sitotoksitas dan viabilitas sel dianalisis menggunakan metode MTT *assay*, kadar ROS intraseluler diukur dengan uji DCFH-DA, apoptosis dianalisis menggunakan pewarnaan *Annexin V*-PI, dan ekspresi gen p53 serta p21 dianalisis menggunakan RT-qPCR. Data dianalisis menggunakan uji ANOVA satu arah dengan uji lanjut Tukey. Hasil penelitian menunjukkan bahwa AOS memiliki nilai IC₅₀ sebesar 90,44 µg/mL dan tergolong toksik sedang terhadap sel HDF. Perlakuan AOS pada konsentrasi 5 µg/mL memberikan efek protektif optimal dengan meningkatkan viabilitas sel, menurunkan produksi ROS intraseluler, serta menghambat apoptosis pada sel HDF terinduksi H₂O₂. Selain itu, AOS mampu menurunkan ekspresi gen p53 dan p21 yang berperan dalam jalur respons kerusakan DNA akibat stres oksidatif. Berdasarkan hasil tersebut, AOS berpotensi dikembangkan sebagai agen anti-aging berbasis bahan alami.

Kata Kunci : Agaro-oligosakarida, Apoptosis, Anti-aging, H₂O₂, *Human Dermal Fibroblast*, p53, p21.

ANALYSIS OF APOPTOSIS PROTECTION IN H₂O₂-INDUCED HDF CELLS BY CRUDE AGARO-OLIGOSACCHARIDES (AOS)

Ratnaning Agustin Angelia
23/529534/PBI/01989
Faculty of Biology, Gadjah Mada University

ABSTRACT

Oxidative stress caused by excessive production of Reactive Oxygen Species (ROS) plays a major role in skin aging and the induction of cellular apoptosis. Hydrogen peroxide (H₂O₂) is commonly used as an in vitro oxidative stress inducer. Agaro-oligosaccharides (AOS), produced through enzymatic hydrolysis of agarose from red algae, have been reported to exhibit antioxidant activity and potential anti-aging properties. This study aimed to evaluate the protective effects of AOS on cell viability, intracellular ROS production, apoptosis, and the expression of p53 and p21 genes in H₂O₂-induced human dermal fibroblast (HDF) cells. This experimental in vitro study was conducted using HDF cells. Cytotoxicity and cell viability were assessed using the MTT assay, intracellular ROS levels were measured using the DCFH-DA assay, apoptosis was analyzed by Annexin V–PI staining, and the expression of p53 and p21 genes was quantified using RT-qPCR. Data were analyzed using one-way analysis of variance (ANOVA) followed by Tukey's post hoc test. The results showed that AOS exhibited moderate cytotoxicity toward HDF cells with an IC₅₀ value of 90.44 µg/mL. Treatment with AOS at a concentration of 5 µg/mL provided optimal protective effects by significantly increasing cell viability, reducing intracellular ROS levels, and inhibiting apoptosis in H₂O₂-induced HDF cells. Furthermore, AOS treatment downregulated the expression of p53 and p21 genes involved in DNA damage response pathways triggered by oxidative stress. In conclusion, AOS demonstrates potential as a natural anti-aging agent through its protective effects against oxidative stress–induced apoptosis in human dermal fibroblasts.

Key Words: Agaro-oligosaccharides, Anti-aging, Apoptosis, H₂O₂, Human Dermal Fibroblasts, p53, p21