EFEK PENGHAMBATAN *AGARO-OLIGOSACCHARIDES* (AOS) TERHADAP EKSPRESI GEN *MMP-1* DAN *MMP-9* PADA *HUMAN DERMAL FIBROBLAST* TERINDUKSI UVA

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INTISARI

Paparan sinar ultraviolet (UV) adalah faktor lingkungan utama yang bertanggung jawab atas 80-90% penuaan kulit, terutama melalui akumulasi *reactive oxygen species* (ROS) dan peningkatan ekspresi *matrix metalloproteinase* (*MMP*) yang mendegradasi matriks ekstraseluler. *Agaro-oligosaccharides* (AOS), hasil hidrolisis agarose alga merah (Rhodophyta), menunjukkan bioaktivitas *anti-aging*, antiinflamasi dan antioksidan. Namun, informasi tentang potensi anti-*photoaging* AOS hasil hidrolisis α-agarase masih terbatas. Penelitian ini bertujuan untuk menganalisis efek penghambatan AOS terhadap ekspresi gen *MMP-1* dan *MMP-9* pada HDF pasca induksi UVA. Sitotoksisitas terhadap HDF dianalisis dengan MTT *Assay*, lalu viabilitas sel dievaluasi setelah induksi UVA 2 J/cm² (Genstar) dan perlakuan AOS. Kadar ROS intraseluler dan ekspresi *MMP-1* dan *MMP-9* diperiksa lebih lanjut dengan DCFHDA dan RT-qPCR. Hasil analisis membuktikan bahwa AOS hasil hidrolisis α-agarase tidak bersifat sitotoksik terhadap HDF. AOS terbukti meningkatkan viabilitas HDF terinduksi UVA hingga 92,62 ± 0,06 dan 93,09 ± 0,02% pada konsentrasi 25 dan 50 µg/mL. Lebih jauh, terdapat penurunan akumulasi ROS intraseluler dengan rata-rata intensitas DCF dari 11,37 ± 0,74 (kontrol negatif) menjadi 8,25 ± 0,79; 6,41 ± 0,60; dan 4,94 ± 0,30 pada konsentrasi 12,5; 25; dan 50 µg/mL. AOS juga mengurangi jumlah sel teroksidatif dari 85,71% menjadi 74,61% pada dosis 25 µg/mL. Selain itu, AOS konsentrasi 25 µg/mL mampu menekan ekspresi *MMP-1* dan *MMP-9* secara optimal hingga 3,41 dan 6 kali lipat lebih rendah dibanding kontrol negatif. Penelitian ini mengindikasikan bahwa AOS hasil hidrolisis α-agarase memiliki aktivitas anti-*photoaging* pada HDF pasca induksi UVA, sehingga berpotensi dikembangkan sebagai bahan bioaktif dalam formulasi produk perawatan kulit.

Kata kunci: *Agaro-oligosaccharides*, antioksidan, *human dermal fibrolast*, *MMP-1*, *MMP-9*

INHIBITION EFFECT OF AGARO-OLIGOSACCHARIDES (AOS) AGAINST *MMP-1* AND *MMP-9* GENES EXPRESSION IN UVA-INDUCED HUMAN DERMAL FIBROBLAST

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ABSTRACT

Ultraviolet (UV) exposure is the main environmental factor responsible for 80-90% of skin aging, mainly through UVA-induced accumulation of reactive oxygen species (ROS) and upregulation of matrix metalloproteinases (*MMPs*) that degrade the extracellular matrix. Agaro-oligosaccharides (AOS), a hydrolysis product of red algae (Rhodophyta) agarose, exhibits anti-aging, anti-inflammatory, and antioxidant properties. However, its anti-photoaging potential from α-agarase hydrolysis remains unclear. This study investigated the inhibition effect of AOS against *MMP-1* and *9* expression in UVA-induced human dermal fibroblasts (HDF). Cytotoxicity was evaluated using the MTT Assay, followed by UVA irradiation (2 J/cm^2) and cell viability assay. Intracellular ROS levels were measured using DCFHDA and *MMP* expression were analyzed using RT-qPCR. The results demonstrated that AOS was non-cytotoxic to HDF and improved cell viability to 92.62 ± 0.06 and 93.09 ± 0.02% at concentrations of 25 and 50 µg/mL, respectively. AOS significantly reduced intracellular ROS accumulation, as indicated by a decreased mean DCF intensity from 11.37 ± 0.74 (negative control) to 4.94 ± 0.30 at concentration of 50 µg/mL. AOS also reduced the number of oxidized cells from 85.71% to 74.61% at a dose of 25 µg/mL. Moreover, AOS at the same concentration suppressed *MMP-1* and *MMP-9* expression, reducing them by 3.41 and 6 times lower than the negative control. These findings indicate that AOS produced by α-agarase hydrolysis show anti-photoaging activity in UVA-induced HDF, suggesting its potential as a bioactive ingredient for skincare product formulation.

Keywords: Agaro-oligosaccharides, antioxidant, human dermal fibroblast, *MMP-1*, *MMP-9*