

Enhanced Anti-Inflammatory and Antioxidant Activities of *Perna canaliculus* Oil Extract and Low Molecular Weight Fucoidan from *Undaria pinnatifida*

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Abstract : In recent years, there has been a growing recognition of the potential of marine-based functional foods and combination therapies in promoting a healthy lifestyle and exploring their effectiveness in preventing or treating diseases. The combination of marine bioactive compounds or extracts offers synergistic or enhancement effects through various mechanisms, including multi-target actions, improved bioavailability, enhanced bioactivity, and mitigation of potential adverse effects. Both the green-lipped mussel (GLM) and fucoidan derived from brown seaweed are rich in bioactivities. These two, mussel and fucoidan, have not been previously formulated together. This study aims to combine GLM oil from *Perna canaliculus* with low molecular weight fucoidan (LMWF) extracted from *Undaria pinnatifida* to investigate the unique mixture's anti-inflammatory and antioxidant properties. The cytotoxicity of individual compounds and combinations was assessed using the MTT assay in (THP-1 and RAW264.7) cell lines. The anti-inflammatory activity of mussel-fucoidan was evaluated by treating LPS-stimulated human monocyte and macrophage (THP1-1) cells. Subsequently, the inflammatory cytokines released into the supernatant of these cell lines were quantified via ELISA. Antioxidant activity was determined by using the free radical scavenging assay (DPPH). DPPH assay demonstrated that the radical scavenging activity of the combinations, particularly at concentrations exceeding 1 mg/ml, showed a significantly higher percentage of inhibition when compared to the individual component. This suggests an enhancement effect when the two compounds are combined, leading to increased antioxidant activity. In terms of immunomodulatory activity, the individual compounds exhibited distinct behaviors. GLM oil displayed a higher ability to suppress the cytokine TNF- α compared to LMWF. Interestingly, the LMWF fraction, when used individually, did not demonstrate TNF- α suppression. However, when combined with GLM, the TNF- α suppression (anti-inflammatory) activity of the combination was better than GLM or LMWF alone. This observation underscores the potential for enhancement interactions between the two components in terms of anti-inflammatory properties. This study revealed that each individual compound, LMWF, and GLM, possesses unique and notable bioactivity. The combination of these two individual compounds results in an enhancement effect, where the bioactivity of each is enhanced, creating a superior combination. This suggests that the combination of LMWF and GLM has the potential to offer a more potent and multifaceted therapeutic effect, particularly in the context of antioxidant and anti-inflammatory activities. These findings hold promise for the development of novel therapeutic interventions or supplements that harness the enhancement effects.

Keywords : combination, enhancement effect, *perna canaliculus*, *undaria pinnatifida*

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