Rapa Whelk (*Rapana venosa*) Protein Concentrates and Hydrolysates Extraction and Characterization for Nanomaterial Production

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Abstract:

This study presents the valorization of *Rapana venosa*, an ecologically invasive marine gastropod in the Black Sea, as a novel source of protein for the development of nanomaterials. Firstly, Rapa whelks collected from different stations of Black Sea coast and their amino acid profile were revealed by High-performance liquid chromatography (HPLC). Then, protein concentrates and hydrolysates were extracted using pH-shift precipitation and enzymatic hydrolysis with Alkalase, respectively. The whelk homogenate powder contained 6.54 ± 0.07% moisture, 7.22 ± 0.94% ash, and 57.48 ± 1.57% protein. A nitrogen solubility profile was generated to identify the optimal pH for protein extraction, showing minimal solubility at pH 5.0 (isoelectric point) and maximal solubility at pH 11.0. However, pH 7.0 was selected as the maximum solubility value for industrial relevance due to its lower chemical usage and cost efficiency. Furthermore, the nutritional profiles of the concentrates were determined, and both protein types were thoroughly characterized in terms of nucleic acid content. Thermal properties assessed by differential scanning calorimetry (DSC) are indicated. FTIR spectroscopy confirmed molecular integrity and secondary structural variations in extracts. HPLC identified distinct peptide compositions, including sequences with known antioxidant properties. Antioxidant assays

were also demonstrated to find radical-scavenging capacity in extracts. Electrospinning trials were optimized to fabricate nanomaterial from both protein concentrates and hydrolysates. Scanning electron microscopy (SEM) revealed differences in morphology and diameter distributions between concentrate- and hydrolysate-based samples, highlighting the influence of peptide chain length and solubility. Collectively, the findings suggest that *Rapana venosa* protein-derived nanomaterials hold significant promise as bioactive films for food packaging. This study introduces an innovative marine biopolymer source, contributing to the sustainable management of an ecologically disruptive species.

Keywords:

Rapana venosa, aquatic protein, amino acid profile, enzymatic hydrolysate.