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Peptidomic Profiling of Collagen Hydrolysates Derived from Ultrasound-treated Chicken Skin and Head-feet Blends

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Abstract

Poultry processing by-products represent highly promising source of collagen (Lalthanmawii et al., 2024). Effective valorisation of this underexploited fraction supports sustainable waste management as well as generation of high-value functional ingredients (Govindaih et al., 2026). The present study aims to investigate the effectiveness of ultrasound-assisted pre-treatment followed by enzymatic hydrolysis using collagenase type I and protease in generating bioactive peptides from chicken skin and head-feet blend collagen. An untargeted LC–MS/MS-based peptidomic approach was employed to comprehensively profile the generated peptides, followed by evaluation of their antioxidant, angiotensin-converting enzyme (ACE) inhibitory, and pancreatic lipase inhibitory activities. Ultrasound pre-treatment (250 W, 39 kHz ± 1 kHz for 1 h) combined with enzyme hydrolysis (collagenase and protease) significantly enhanced degree of hydrolysis (%) and bioactivities ($P < 0.05$), with DPPH• radical scavenging activity reaching 50.97 % (protease) and 49.73 % (collagenase) in skin hydrolysates. Similarly, $ABTS^{\bullet+}$ scavenging activity approached near-maximal levels, while FRAP values increased up to 71.08 % in skin hydrolysates, confirming strong reducing power. The hydrolysates also exhibited potent antihypertensive (72.29 % and 86.15 % in protease-head–feet and collagenase-skin and 72.29 % in and anti-obesity properties, with ACE inhibitory activity reaching 86.15 % in collagenase-treated skin and 72.29 % in protease-treated head–feet samples, and pancreatic lipase inhibition ranging from 51.09 % to 55.90 % in head–feet blend hydrolysates. LC-MS/MS-based peptidomic analysis revealed a diverse pool of peptides enriched with bioactive motifs, particularly Gly-Pro-rich sequences and peptides containing hydrophobic and positively charged residues, which are known to enhance antioxidant, ACE inhibitory, and lipase inhibitory activities (Schmidt et al., 2020). The identification of sequence features such as C-terminal aromatic residues and N-terminal hydrophobic amino acids further supports the strong correlation between peptide structure and function observed in this study (Uno et al., 2020). Overall, the results demonstrate that ultrasound-assisted protease and collagenase hydrolysis effectively modulate peptide profiles and bioactivities, with protease showing slightly superior performance than collagenase. This work highlights the potential of chicken skin and head-feet by-products as sustainable sources of high-value bioactive peptides and provides a scientific basis for their application as functional ingredients. Importantly, the study contributes to advancing green processing technologies while promoting circular bioeconomy approaches for poultry waste valorization.

Keywords: Ultrasound-assisted hydrolysis, Chicken collagen, Bioactive peptides, Pancreatic lipase inhibition

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