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Advances in Peptide Synthesis & Purification: Technologies and Future Challenges

Peptides are key bioactive molecules widely used in pharmaceuticals, food, cosmetics and agriculture. As demand grows, peptide synthesis and purification technologies have advanced rapidly, though challenges remain in efficiency, green production and scale-up.

1. Research Background

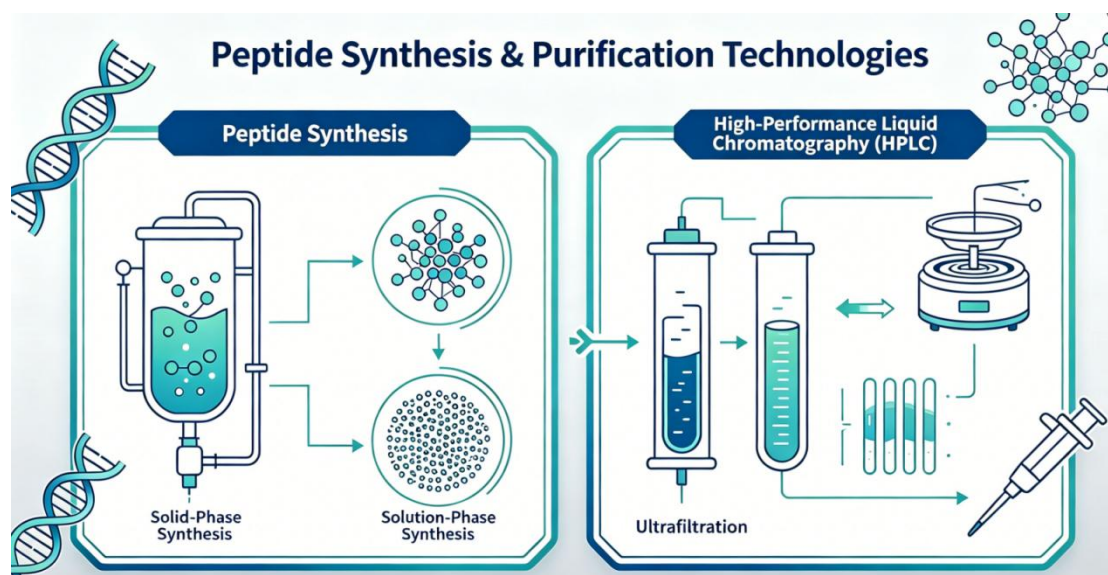
Peptides regulate physiological functions with high bioactivity. Chemical synthesis dominates for short-to-medium peptides, while biological methods are common for large-scale production. However, traditional synthesis faces limitations in chain length, yield and purity; purification often relies on HPLC, which is costly and complex. Developing efficient, eco-friendly synthesis and purification is essential for industrialization.

2. Research Purpose and Significance

This review summarizes mainstream peptide synthesis (solid-phase, liquid-phase, enzymatic, recombinant) and purification technologies (HPLC, ultrafiltration, electrophoresis), analyzes their strengths and

limitations, and discusses future directions. It aims to guide technology optimization, improve production efficiency, reduce costs, and promote the industrial application of high-quality peptides.

3. Research Content



Synthesis technologies: Solid-phase synthesis (SPPS) is mature and automated but limited in chain length. Liquid-phase synthesis suits long peptides with higher yield. Enzymatic and recombinant methods are eco-friendly and scalable. Purification technologies: Reversed-phase HPLC achieves high purity (over 96%). Ultrafiltration and HPCE offer fast, cost-effective options. Combined strategies are often used for complex samples.

4. Conclusion and Outlook

Current peptide synthesis and purification technologies support diverse applications but still face challenges in green chemistry, cost control and large-scale production. Future development will focus on green synthesis strategies, high-efficiency purification, automated processes and

new analytical methods, driving the peptide industry toward sustainable, large-scale and high-quality development.