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EXPLORING ANTIMICROBIAL PEPTIDES: A NEW FRONTIER IN CANCER TREATMENT INNOVATION

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Introduction

Antimicrobial peptides (AMPs) have emerged as promising candidates for the development of alternative cancer therapies. These naturally occurring peptides are produced by a wide array of living organisms, including plants, vertebrates, invertebrates, bacteria, and fungi[1,2,3]. Most AMPs possess amphiphilic structures and positive charges. Cationic AMPs are capable of killing bacteria by specifically disrupting their membranes. However, cationic cell-penetrating peptides (CPPs) can enter bacterial cells without damaging the membrane and target intracellular components, demonstrating their antimicrobial capabilities.

Materials and Methods

For the bibliometric study, we searched articles published in PubMed, ScienceDirect, and Web of Science, Clarivate, in the last two decades [1,2,3,4,5,6,7,8].

Results and discussions

The mechanisms of cell-penetrating of AMPs with dual effects may be used either on their own or as part of combination therapy (for example, with antibiotics). These AMPs represent an alternative platform of therapeutic agents that can be used to treat intracellular infections (Figure 1)[1,2,3,4,5,6,7,8,9].

Data was collected about the use of peptides as antibacterial agents, antitumoural substances, and vaccines (Table 1). The bibliometric study illustrates the increasing significance of anticancer peptides in the treatment of cancer during the past two decades. Membrane-active peptides encompass categories of antimicrobial peptides and cell-penetrating peptides (CPPs). One significant obstacle in cancer treatment is the unfavorable outlook, particularly for pancreatic cancer, glioma, and lymph metastases.

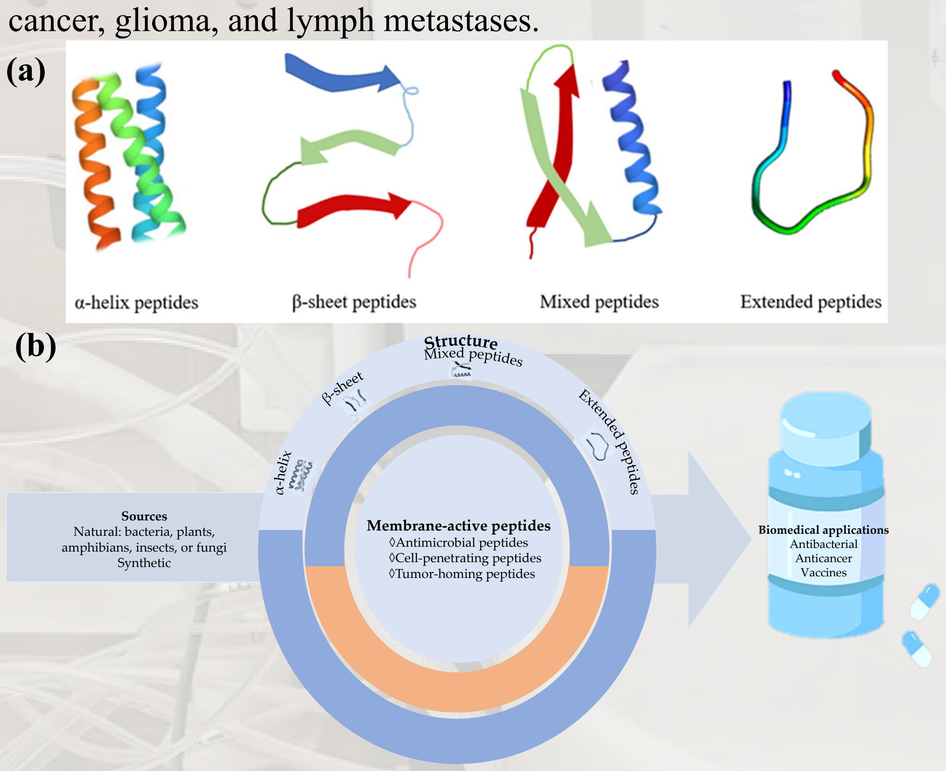

Figure 1. (a) 3D structures of different classes of AMPs. (b) Schematic information on peptides' origin and potential biomedical applications.

Table 1. Peptides with applications in medicine [8].

Peptide	Commercial Drug Name	Applications	Trial Phase
		Antibacterial	
Gramicidin	Neosporin®	Treating bacterial conjunctivitis	Admitted to the market
Vancomycin	Vancocin®HCl	Treatment of Gram-positive bacterial infections	Admitted to the market
Daptomycin	Cubicin®	Treatment for skin infections and *Staphylococcus aureus* infections	Admitted to the market
Telavancin	Orbactiv®	Treatment of Gram-positive bacterial infections	Admitted to the market
Nisin	Nisaplin®, Chrisin® and Delvo®Nis	Biopreservative	Admitted to the market
Streptococcus salivarius K12	BLIS K12	Protection against oral pathogenic bacteria in humans	Admitted to the market
		Antitumoral	
Microcin E492	-	Cervical adenocarcinoma, acute T-cell leukemia, Burkitt's lymphoma, B-lymphoblastoid cells	Preclinical
Colicin A and E1	-	Breast carcinoma, osteosarcoma, leiomyosarcoma, fibrosarcoma	Preclinical
Azurin-Derived Peptide p28	-	Breast cancer	Phase I of clinical trials
Nisin A	-	Head and neck squamous cell carcinoma, breast adenocarcinoma, liver hepatocellular carcinoma, acute T-cell leukemia	Preclinical
Pediocin CP2	-	Mammary gland adenocarcinoma, hepatocarcinoma, cervical adenocarcinoma	Preclinical
Peptide	Commercial Drug Name	Used for	Trial Phase
		Vaccines	
Combination of 25 amino acids from several immune mutations of the repetitive region of MUC1 combined with immunoadjuvant monophosphoryl lipid A	Liposomal BLP-25	Anticancer	Phase III of clinical trials
Combination of 16 peptides	ISA101	HPV immunization	Phase II of clinical trials
Combination of nucleoprotein, matrix 1, and both B- and T-cell linear epitopes from HA into a single recombinantly synthesized polypeptide	Multimeric-001	Influenza and HIV-1 immunization	Phase I of clinical trials
Synthesized peptide immunogens of the SARS-CoV-2 S protein conjugated to a carrier protein and absorbed on aluminum hydroxide	EpiVacCorona	Coronavirus disease 19 (COVID-19) immunization	Phase II of clinical trials
Short C-terminal fragments of Aβ40 and an aluminum hydroxide adjuvant	ABvac40	Treatment for Alzheimer's disease	Phase II of clinical trials

Conclusions

Peptide-based treatments have revolutionized drug delivery and enhanced clinical outcomes in cancer treatment through the utilization of cutting-edge peptide-based assembly techniques. They exhibit anti-cancer effects via disrupting cell membranes and by processes that do not disturb cell membranes. These mechanisms include inducing necrosis or apoptosis in cancer cells, inhibiting the growth of new blood vessels (angiogenesis), attracting immune cells, and activating specific regulatory proteins. Similar to many typical polymeric compositions, these macromolecules have the potential to significantly reduce the rate of drug release. Peptides, unlike other polymeric formulations, can be precisely tailored to a specific sequence through the use of genetic engineering. This renders them a compelling alternative to conventional formulations. Combinations of peptide-based strategies and conventional therapies are being investigated for their potential synergistic effects in developing anticancer drugs.

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