5 Effective Structural Modification of Cosmetic Peptides

Summary:
Peptides have been receiving increasing attention in the industry in recent years due to their anti aging, whitening, antioxidant, and acne removing properties. However, unmodified natural peptides have poor transdermal permeability and are difficult to fully exert their biological activity. The limiting factors are mainly reflected in:

1. The molecular weight is usually greater than the lower limit of the ideal molecular weight of permeable skin substances (i.e. 500 Da);
The logarithm (log P) of the octanol water partition coefficient is usually smaller than the ideal range for permeable skin substances;
3. Due to the presence of its side chain groups, it usually has charge at physiological pH values;
4. It is susceptible to degradation by skin proteolytic enzymes.

Due to various limitations of natural peptides themselves, structural modifications are needed to improve skin permeability and biological activity. This article reviews the structural modification strategies of peptides in recent years, providing direction and ideas for the design and development of new cosmetic peptide raw materials.

The Structure of the Skin

The skin is composed of the epidermis, dermis, subcutaneous tissue and its appendages, hair, sweat glands, etc. The stratum corneum is the main barrier that affects transdermal absorption, formed by the accumulation of 15-20 layers of keratinocytes into a dense "brick wall structure". The stratum corneum exhibits strong lipophilicity, allowing only a certain molecular weight of lipophilic molecules to passively penetrate.
The barrier function of the skin stratum corneum is also reflected in biological enzymatic reactions, colonization of skin microbiota, mediation of immune signals, low pH values,

antioxidants, and natural moisturizing factors, all of which may affect the effectiveness of peptide molecules.

The skin plays a barrier role in resisting damage and stimulation from external environmental factors, but it also limits the penetration of active ingredients in cosmetics, limiting the full utilization of its efficacy. Especially for peptides with strong polarity and hydrophilicity, the stratum corneum is considered the main speed limiting barrier.

Factors Affecting The Transdermal Permeability of Peptides

The main factors affecting the percutaneous absorption of peptide components in cosmetics include skin microcirculation, hydration degree of the stratum corneum, lipophilicity of the components, and molecular weight.

According to the principle of similarity compatibility, non polar active substances mainly utilize lipid rich intercellular channels for absorption, while polar active substances mainly utilize intracellular channels for absorption.

Molecules with ideal transdermal absorption are generally considered to have log P values of 1-3 and molecular weights less than 500 Da. The highly lipophilic stratum corneum limits the transdermal transport of high molecular weight, hydrophilic or charged natural peptides, thereby affecting their biological activity. Therefore, structural modifications are needed to improve the transdermal absorption of cosmetic peptides. you can click Omizzur custom peptide synthesis companies to learn more about cosmetic peptide & **peptide synthesis** knowledge.

5 Strategies for Structural Modification of Cosmetic Peptides

Natural peptide molecules are mostly endogenous substances of organisms, with strong affinity for receptors on the cell surface, clear targeting and precise mechanisms of action. However, direct application in prototypes can lead to issues such as poor transdermal permeability and susceptibility to enzymatic hydrolysis.

Reasonable optimization and modification of the structure of peptides can improve their hydrophilicity and charge carrying properties to enhance transdermal absorption, enhance their anti enzymatic ability to extend the action time, and enhance the affinity between peptide molecules and receptors to enhance their activity.

At present, the strategies for peptide structural modification mainly include chemical group modification, transdermal peptide coupling, metal ion complexation, cyclization modification, and special amino acid substitution.

1.Chemical Peptide Modification

Chemical modification of fatty acid groups is a common method for modifying the structure of cosmetic peptides, which has great potential in improving the transdermal permeability and stability of peptides. Among them, palmitoyl group modification is the most common modification method.

Peptides modified with palmitoyl groups include palmitoyl tripeptide-1, palmitoyl tripeptide-8, palmitoyl tripeptide-5, etc. After being modified by fatty acid groups, the formed lipopeptides can form amphiphilic molecules, forming aggregates with specific structures through self-assembly, which have the advantages of good biocompatibility and high stability.

Palmitoyl modification is not applicable to all peptides, and the ion charge at the N-terminus of certain peptides directly affects their affinity with the target, resulting in a decrease in their activity after modification After modification of carnosine to palmitoyl carnosine, its antioxidant activity is converted into prooxidant activity.

2.Cell Penetrating Peptides

Cell penetrating peptides, also known as Trojan peptides, can promote the penetration of substances such as nucleic acids, peptides, and proteins. Cellular transmembrane peptides are usually short peptides composed of 5-30 amino acids, which can be divided into three types structurally: polycationic, amphiphilic, and hydrophobic

The mechanism of action of cell penetrating peptides may be the interaction with proteins and the induction of intercellular lipid flow. Cell penetrating peptides have certain application prospects in increasing the skin permeability of peptides.

3. Metal ion complexation

A complex is a type of compound composed of metal ions and organic ligands through coordination bonds. Some special structured peptides such as tripeptide-1 and carnosine can form coordination bonds with metal ions, resulting in a corresponding increase in skin permeability.

Tripeptide-1 copper was first discovered in human plasma, which can accelerate wound healing, promote vascular growth, and has cosmetic effects such as repair, anti-aging, and promoting hair growth.

4 Peptide Cyclization Modification

The cyclization of peptides is a common method to improve their stability, which can enhance their anti enzymatic ability, obtain stable biological conformation, and exhibit better biological activity.

The main cyclization methods of peptides include: head tail linked cyclic peptides, side chain and side chain linked cyclic peptides, side chain and end group linked cyclic peptides, cyclic peptides containing disulfide bonds, and cyclic peptides containing other bridging structures.

The first case of peptide cyclization modification applied to cosmetics is the cyclotetrapeptide-24 aminocyclohexane formate.

5. Special Amino Acid Substitution

All endogenous proteins in the human body are natural amino acids in the L-configuration, and peptidases in the body can only recognize and degrade natural amino acids. Therefore, using certain special amino acids as substitutes in peptide sequences is an effective strategy to protect them from degradation and enhance the activity of cosmetic peptides.

The histidine residues in tripeptide-1 are composed of special amino acids imidazopyridine acid (L-spinacin) and L-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid (L-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid. After acid substitution, it showed more stable anti enzymatic ability and did not show significant degradation within 3 hours.

FAQs: What Are Cosmetic Peptides?

Cosmetic peptides are a type of peptide composed of a small number of amino acids arranged in a small amount, which have different effects such as anti wrinkle, anti-aging, and promoting hair growth etc.

Representative cosmetic peptide products include acetyl hexapeptide-3, acetyl octapeptide-1, pentapeptide-3, dipeptide snake venom, and pentapeptide-3, among which acetyl hexapeptide-3 is the most widely used.