


Bioactive Peptides in Skincare: Applications and Efficacy



This article provides an overview of mainstream peptide-based skincare products, which are categorized into four types according to their functions and mechanisms: anti-wrinkle and firming, brightening and spot-fading, soothing and anti-irritation, and specialized treatments. It explains how these peptides interact with the skin at a molecular level and includes a detailed categorization and analysis of specific ingredient formulations available on the market.

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With advancements in biomedicine and skin science, bioactive peptides, as a class of molecular compounds with specific physiological functions, have demonstrated significant application value in the field of skincare and cosmetics. These biologically active substances, formed by amino acids linked via peptide bonds, are increasingly becoming a key focus in the development of functional skincare products due to their low molecular weight, highly designable structures, and precise targeting mechanisms.

Peptide molecules regulate skin physiological processes through multiple pathways. They can act as signaling molecules to activate or inhibit specific cellular pathways, or intervene in key biological reactions through competitive binding and enzyme modulation. This multi-target and multi-layered regulatory capability gives peptides unique advantages in areas such as skin anti-aging, barrier repair, and pigmentation metabolism regulation.

The production of bioactive peptides has evolved from early natural extraction to include chemical synthesis, genetic recombination, and other technological approaches. Natural peptides play an important role in basic functions such as antioxidant defense and soothing repair, while synthetically designed peptides further enhance targeting and bioactivity through structural modification and functional optimization. As a result, the applications of peptides have expanded from anti-aging and repair to include whitening and brightening, barrier strengthening, and inflammation soothing, meeting a wider range of skin physiological needs. Additionally, advancements in molecular modification and carrier delivery technologies have effectively addressed challenges such as the hydrophilicity and

transdermal absorption efficiency of peptides, enhancing their bioavailability and stability in deeper skin layers.

The potential of bioactive peptides in skincare and cosmetics has been well demonstrated. In response to evolving market demands, peptide-based skincare products are moving toward personalized and customized solutions, aiming to achieve more precise efficacy matching and intervention across different skin types and environments. This trend will drive the development of safer and more effective peptide-based skincare products, providing more scientific solutions for skin health management and injecting new momentum into the beauty and skincare industry. Currently, widely used peptide-based skincare products can be categorized into four main types based on their mechanisms and efficacy: anti-wrinkle and firming, whitening and spot-reducing, soothing and anti-irritation, and special functions. These peptides intervene in skin physiological processes through specific molecular mechanisms, demonstrating remarkable efficacy in their respective areas. The following section will provide a detailed classification and application overview of mainstream cosmetic peptides currently on the market.

1. Anti-Wrinkle & Firming, Anti-Aging & Repair

Peptide	Function	Mechanism of Action
Palmitoyl Pentapeptide-4	Prevents fine lines caused by repeated facial movements; anti-aging, anti-wrinkle, eye care	Activates TGF- β pathway, stimulates type I/II collagen synthesis
Acetyl Hexapeptide-8	Reduces dynamic wrinkles, anti-wrinkle, instant wrinkle reduction	Inhibits SNARE complex formation, blocks neuromuscular signals, reduces acetylcholine (Ach) release
Palmitoyl Hexapeptide-12	Anti-aging, reduces fine lines, improves skin elasticity	Inhibits IL-6 release, stimulates cell communication, promotes secretion and diffusion of collagen, elastin, and hyaluronic acid; improves skin hydration, increases dermal thickness

Peptide	Function	Mechanism of Action
Palmitoyl Tripeptide-5	Anti-aging, inhibits skin inflammation, firms and moisturizes skin	Promotes lumican and type I collagen production, enhances dermal remodeling, increases collagen via TGF- β stimulation, helps repair ECM damage and inhibits inflammation
Hexapeptide-11	Firms skin, reduces fine lines, brightens complexion	Promotes syndecan-1 and type XVII collagen production, improves epidermal adhesion
Acetyl Tetrapeptide-11	Anti-wrinkle and anti-aging for face and body	Scavenges free radicals, promotes cell growth, syndecan-1, and type XVII collagen synthesis
Carnosine	Anti-aging for eye and facial areas, inhibits glycation	Prevents collagen cross-linking, significantly inhibits lipid oxidation caused by free radicals and metal ions, effectively scavenges reactive carbonyl species (RCS)
Hexapeptide-9	Significantly reduces wrinkles, skin repair	Promotes extracellular matrix (ECM), type I and III collagen synthesis, regeneration of dermal-epidermal junction, and skin differentiation
Tripeptide-1	Improves overall skin appearance and health, reduces signs of aging	Promotes ECM, type I and III collagen production; interacts with copper in the skin to repair age- and sun-induced damage, aids in rebuilding damaged areas; promotes fibroblast development, new cell growth, and stimulates collagen production
Palmitoyl Tripeptide-1	Reduces wrinkle length and depth, improves skin roughness, brightens skin tone	Inhibits collagenase-3, stimulates laminin and type IV collagen production
Dipeptide Diaminobutyroyl Benzylamide Diacetate	Instant wrinkle reduction, smoothes skin	Acts as a muscle acetylcholine receptor antagonist, inhibits muscle contraction
Acetyl Octapeptide-3	Instant wrinkle	Inhibits SNARE complex formation, reduces

Peptide	Function	Mechanism of Action
	smoothing, reduces wrinkles, anti-aging	acetylcholine release, suppresses muscle contraction, decreases neuronal excitability
Pentapeptide-18	Immediate wrinkle reduction, diminishes expression lines (especially forehead and eye areas)	Inhibits acetylcholine release, suppresses muscle contraction

2. Whitening & Spot-Reduction

Peptide	Function	Mechanism of Action
Glutathione	Brightens skin tone, antioxidant, prevents skin aging	Reduces eumelanin production, enhances the skin's antioxidant capacity
Carnosine	Antioxidant, anti-glycation, brightens skin tone	Natural antioxidant, inhibits intracellular peroxidation
Decarboxy Carnosine HCl	Antioxidant, anti-glycation, brightens skin tone	Scavenges hydroxyl radicals, singlet oxygen, and hydrogen peroxide radicals; inhibits lipid oxidation including non-metal ion-induced oxidation
Nonapeptide-1	Balances skin tone, controls hyperpigmentation, whitens and reduces spots	Competitive inhibitor of α -MSH, reduces tyrosinase activity in melanocytes, inhibits melanin production, improves skin tone
Tetrapeptide-30	Reduces hyperpigmentation, brightens skin tone	Inhibits α -MSH production by suppressing proopiomelanocortin (POMC) expression, thereby reducing melanin generation

3. Soothing & Anti-Irritation

Peptide	Function	Mechanism of Action
Acetyl Dipeptide-1 Cetyl Ester	Reduces pain and heat sensations, promotes skin	Inhibits CGRP (Calcitonin Gene-Related Peptide) production, stimulates β -endorphin

Peptide	Function	Mechanism of Action
	comfort and relaxation	release, elevates cutaneous heat sensitivity threshold
Palmitoyl Tripeptide-8	Prevents and reduces external irritation; alleviates itching, stinging, erythema, and edema	Suppresses inflammatory cytokines (IL-1 α , IL-8, TNF- α) to soothe skin
Palmitoyl Tetrapeptide-7	Prevents and reduces wrinkles, firms skin, inhibits inflammation and glycation damage	Inhibits interleukin-6 (IL-6) release, soothes skin, suppresses inflammatory response and glycation damage
Tetrapeptide-30	Evens skin tone, reduces inflammation	Inhibits pro-inflammatory cytokine release, reduces risk of redness and stinging in sensitive skin
Acetyl Tetrapeptide-15	Soothes sensitive skin; alleviates inflammatory, chronic, and neuropathic pain	Increases excitation threshold of μ -opioid receptor neurons via endorphin-like pathways, reduces skin hyperreactivity and discomfort from external stimuli

4. Other Functions

Peptide	Function	Mechanism of Action
Copper Peptide (GHK-Cu)	Wound healing	Upregulates MMP-2/MMP-9 activity to remove damaged proteins and scar tissue; attracts macrophages to the injury site to release growth factors and accelerate wound healing
Tripeptide-1 Copper	Hair loss prevention, antioxidant, brightening	Promotes ECM, type I/III collagen production; delays hair follicle regression; blocks ROS formation and scavenges peroxides for smoother skin
Acetyl Tetrapeptide-3	Hair growth, anti-hair loss	Mimics natural peptides to stimulate cell proliferation/differentiation, improves follicle structure, regulates growth cycle, and enhances collagen/laminin

Peptide	Function	Mechanism of Action
		production for stronger hair
Biotinoyl Tripeptide-1	Prevents hair loss	Promotes type IV collagen and laminin-5 synthesis around follicles to anchor hair firmly within the dermis
Myristoyl Pentapeptide-17	Eyelash growth enhancement	Activates keratin genes and acts on lash papilla cells to increase lash density
Palmitoyl Tetrapeptide-20	Reverses hair graying	Stimulates α -MSH expression to promote melanogenesis and darken hair
Dipeptide-2	Reduces under-eye puffiness	Inhibits angiotensin-converting enzyme (ACE), improves lymphatic drainage, reduces fluid retention to diminish puffiness
Acetyl Tetrapeptide-5	Reduces edema and under-eye bags	ACE inhibitor that diminishes puffiness and dark circles; improves skin elasticity and smoothness
Hexapeptide-3	Lip care	Promotes tissue repair, wound healing, and cell adhesion; enhances lip smoothness and hydration for a plumper, softer effect
Pentapeptide-25	Reduces cellulite and fat	Limits lipid accumulation and reduces the size/volume of lipid vesicles in adipocytes for slimming effects

Peptide Applications in Anti-Wrinkle and Firming Skincare

Peptides have seen extensive and mature application in the anti-wrinkle and firming sector. A number of leading international brands — such as Estée Lauder, Lancôme, L'Oréal, Chanel, Dior, SK-II, OLAY, and Decorté — as well as domestic emerging brands like Beast Code, Biohyalux, Medrepair, HBN, and Dr. Alva, have actively expanded into peptide-based skincare, with serums forming the core of their product offerings.

Dipeptide Diaminobutyryl Benzylamide Diacetate is a commonly used anti-wrinkle ingredient that effectively reduces the appearance of wrinkles even at low concentrations. It has been incorporated into products such as L'Oréal's Revitalift

Laser X3 Eye Cream, SPA Treatment Snake Toxin Eye Mask, and Filorga Time-Filler Eyes.

Furthermore, many brands adopt multi-peptide complexes with diverse mechanisms of action to achieve targeted anti-aging benefits. For instance, DR.HEPROA has introduced a Multi-Peptide Firming Elastic Serum based on the concept of “six-dimensional wrinkle reduction,” which synergistically combines Acetyl Hexapeptide-8 to relax dynamic wrinkles, Dipeptide-2 to reduce expression lines, Pentapeptide-3 to stimulate collagen regeneration, and Tetrapeptide-21 to improve lymphatic circulation and inhibit collagen degradation — offering a multi-pathway approach to wrinkle mitigation. Proya’s Ruby Cream, another notable example, is well-regarded for incorporating ingredients such as Acetyl Hexapeptide-1, Palmitoyl Tripeptide-5, and retinol, delivering high-performance wrinkle reduction while reinforcing skin elasticity. Other representative products include Diary’s Acetyl Hexapeptide-8 Anti-Wrinkle Lifting and Firming Facial Serum, as well as Bloomage Biotech’s Quadi GABA Peptide Hyaluronic Acid Booster, which features Palmitoyl Pentapeptide-4, Acetyl Hexapeptide-8, and Palmitoyl Tripeptide-1.

Whitening and Spot Reduction: A New Frontier for Peptide Cosmetics

Several brands have already launched related products in this category. For example, Dr. Alva’s Brightening Essence uses carnosine as its core ingredient, focusing on antioxidant and brightening effects. BIOMONT and Jours Align’s whitening essences primarily incorporate glutathione, offering both brightening and moisturizing benefits. Compared to the highly competitive anti-wrinkle and firming market, peptide-based whitening and spot-reduction products still hold significant potential for market expansion.

Sensitive Skin Solutions: Peptides as a Growing Focus

With the increasing population of individuals with sensitive skin, peptide-driven soothing and anti-irritation solutions are gradually becoming a new market emphasis. Peptides can help calm the skin and reduce redness and stinging in sensitive skin by inhibiting the production of inflammatory cytokines such as IL-1 α , IL-8, and TNF- α , or by raising the skin’s sensitivity threshold. Although peptide

applications in this segment are not yet widespread, the anti-irritation and soothing market offers considerable growth prospects.

Diverse Functions and Future Development

Beyond these applications, peptides also demonstrate potential in promoting wound healing, preventing hair loss, reducing edema, and diminishing under-eye bags. However, most peptides have relatively singular mechanisms of action, making it challenging to address multiple skin concerns comprehensively. As a result, combinations of multiple peptides or integrations with other active ingredients are often used to enhance overall efficacy and market competitiveness. Advances in biochemical technology continue to drive R&D in the beauty peptide sector, leading to the development of novel bioactive functional peptides. In addition to naturally derived peptides, synthetic chemistry and peptide synthesizers now allow the preparation of peptides with richer functionalities and stronger target specificity, highlighting substantial market potential.

Looking ahead, peptides will remain a mainstream ingredient in cosmetic skincare. Meanwhile, green, clean, and environmentally friendly production processes have emerged as a forward-looking direction, promoting more sustainable progress in the industry.