

## **Supporting Information**

### **Insights into Bioactive Peptides in Cosmetics**

Le Thi Nhu Ngoc<sup>1</sup>, Ju-Young Moon<sup>2,\*</sup>, Young-Chul Lee<sup>3,\*</sup>

<sup>1</sup>Department of Nano Science and Technology Convergence, Gachon University, 1342 Seongnam-Daero, Sujeong-gu, Seongnam-si 13120, Gyeonggi-do, Republic of Korea

<sup>2</sup>Department of Beauty Design Management, Han-sung University, 116 Samseongyoro-16gil, Seoul 02876, Republic of Korea

<sup>3</sup>Department of BioNano Technology, Gachon University, 1342 Seongnam-daero, Sujeong-gu, Seongnam-si, Gyeonggi-do 13120, Republic of Korea

\*Correspondences:

dreamdbs@gachon.ac.kr (Y.-C. L.), Tel: +82-31-750-8751, Fax: +82-31-776-2864

bora7033@naver.com (J.-Y.M.); Tel: +82-31-776-2863; Fax: +82-31-776-2864

**Table S1. Classification of cosmetic peptides**

Type of peptide	Site of action	Name of peptide	Mechanism of action	Cosmetic functionality	
Signal peptide	Modulator of dermal extracellular matrix	Pal-KTTKS	Increases the synthesis of fibronectin and collagen type I/III, glycosaminoglycan and elastin production	Anti-wrinkle Anti-aging	
		Pal-GHK or Pal tripeptide 1	Provides a retionic acid-like activity	Anti-aging	
		Collagen modulators		Stimulates the synthesis of collagen and glycosaminoglycan	Skin moisturizer Firming agent
			Trifluoroacetyl Tripeptide-2	Stimulates extracellular matrix via inhibiting MMP-1, 3, 9 Acts as elastase inhibitors	Anti-aging Anti-wrinkle
			Palmitoyl tripeptide-3/5	Mimics thrombospondin 1 tripeptide sequence and collagen synthesis via TGF- $\beta$	Firming agent Skin moisturizer Improve stretch marks
	Tripeptide-10	Promotes the formation of collagen fibers	Anti-aging Firming agent		

		Mimics the decorin sequences bound with collagen fibrils	Photoprotection
	Peptamide-6 or phe-val-ala-pro-phe-pro	Mimics the action of TGF- $\beta$ which facilitates maturation of adipocyte precursor cells into contractile fibroblast Prevents the differentiation of adipocytes	Skin firming agent in treatment of cellulite Anti-aging
	Oligopeptide Tyr-Tyr-Arg-Ala-asp-Ala	Inhibits procollagen-C enzyme which converts procollagen to collagen	Anti-wrinkle Firming agent
	Acetyl tetrapeptide-9/11	Stimulates the synthesis of syndecan, lumican, and collagen type I	Anti-wrinkle Firming agent Anti-aging
	Acetyl tetrapeptide-5	Reduces edema by inhibiting angiotensin-converting enzyme and collagen crosslinking Inhibits glycation thereby preventing the abnormal cross-linking of collagen fibers	Dermatochalasis or baggy eye lids
Elastin modulators	Dipeptide-2/(valyl-tryptophane)	Lymph drainage via ACE inhibition	Baggy eyelids

	Hexapeptide Val-Gly-Val-Ala-Pro-Gly	Downregulates elastin	Firming agent
		Stimulates skin fibrous cells to form vessels and endothelial cell migration	Anti-wrinkle
	Palmitoyl oligopeptide	Increases collagen and hyaluronic acid	Anti-aging
Keratinocytes/epidermal cells	Aquaporin	Increase the thickness of the stratum corneum	Skin moisturizer
			Anti-wrinkles
			Anti-aging
	Growth factors	Inhibits keratinocyte growth,	Anti-wrinkles
	Transforming growth factor (TGFs)	Chemotactic for macrophages and fibroblasts	Post-skin resurfacing
	Hepatocyte growth factors (HGFs)	Promotes neovascularization Promotes cell growth and keratinocyte migration	Photoaging
	Keratinocyte growth factor and insulin-like growth factor		
	Heat shock protein 70	Prevents cells against apoptosis, aging, and UV damage	Anti-wrinkles
			Anti-aging

			Inhibits aggregation and supports the regeneration of denatured proteins		
		Interferon alpha	Increases the concentration of dendritic cells and CD1a and HLA-DR positive cells	Anti-wrinkles	Anti-aging
		Kinetin (natural plant derived growth hormone)	Inhibits the growth of keratinocytes Delays the onset of aging features in human fibroblasts	Anti-wrinkles	Anti-aging
Modulation of melanogenesis	of	Tetrapeptide (His-D-Phe-Arg-Trp)	Analogue of $\alpha$ -MSH causes the synthesis of melanin Minimizes DNA damage by enhancing repair of DNA and scavenging ROS free radicals	Cosmetic tanning	Vitiligo
		Tripeptide (His-D-Phe-Arg)	Analogue of $\alpha$ -MSH induces melanin synthesis	Cosmetic tanning	Vitiligo
		Ser-Tyr-Ser-Nle-Glu-His-D-p-Phe-Arg-Trp-Gly-	MC1R/ $\alpha$ -MSH signaling pathway Induces melanin synthesis Anti-inflammatory	Vitiligo	

Lys-Pro-Val (Melano-Tan-1)				
Decapeptide			Derived from b-FGF, induces melanin synthesis	Vitiligo
Acetyl hexapeptide-1			Melanin increases via $\alpha$ -MSH regulation	Vitiligo Tanning Hair repigmentation
Tyr-Arg-Ser-Arg-Lys-Tyr-Ser-Ser-Trp-Tyr (decapeptide-12)			Tyrosinase inhibitor	Melasma, postinflammatory hyperpigmentation Lentigo Freckles
Nonapeptide-1			Tyrosinase activation inhibition	Melasma, post-inflammatory hyperpigmentation
Carrier peptide	Collagen and elastin synthesis	GHK-Cu glyceryl-histidyl-lysine (tripeptide 1)	Activates acute and chronic wound healing	Anti-aging Skin laxity Wrinkles

			Regenerates collagen by modulating levels of TIMP-1, TIMP-2, and MMP-2	In sunscreens and post-skin resurfacing
			Increases synthesis of dermatan sulfate and chondroitin sulfate	
			Stimulates antioxidant responses	
		Manganese tripeptide complex-1 GHK-Mn	Stimulates matrix protein growth, antioxidant reactions	Wrinkles Anti-aging
Neurotransmitter -inhibitor peptides	Moisturizing effect Stimulating collagen/elastin synthesis	Acetyl hexapeptide 3/8	Offers botox-like through inhibiting SNARE and releasing catecholamine	Firming and toning skin Skin hydration Periorbital wrinkle
	Inhibiting melanin synthesis	Pentapeptide 18	Inhibits nerve cell activity and catecholamine release Mimics the natural mechanism of enkephalins	Firming and toning skin Skin hydration Periorbital wrinkle
		Pentapeptide 3	Competitive antagonist at acetylcholine receptors	Anti-wrinkle Anti-aging

		Dipeptide diaminobutyroyl benzylamide diacetate	Mimics the effects of waglerin, a neurotoxin derived from the venom of <i>Tropidolaemus wagleri</i>  Offers botox-like via acetylcholine receptor	Anti-wrinkle  Anti-aging
Enzyme inhibitor peptide	Moisturizing effect  Stimulating collagen/elastin synthesis	Soybean amino acids	Inhibits proteinase formation, increases the length and number of hair roots	Anti-aging  Skin moisturizer  Hair promoting agent
		Rice peptides	Promotes the expression of hyaluronan synthase 2 genes	Hair conditioning agent Anti-aging
		Silk proteins derived from silkworm <i>Bombyx mori</i>	Shows antioxidant activity  Offers high affinity to chelate with copper  Inhibits the activity of lipid peroxidation and tyrosinase	Anti-aging