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Natural Ingredients in Skincare and Their Effects on the Skin

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Abstract

Natural and organic compounds are increasingly used in dermatology and cosmetics to enhance the skin, making it healthier, more resistant to alcoholism, and delaying aging. Recent studies in the beauty industry suggest that peptides, hyaluronic acid, plant derivatives, humectants, and oils high in lipids alter cell communication, enhance the water penetration in the skin, and epidermal and dermal regeneration. The skincare range features these healthy ingredients, combined to offer your skin an array of benefits, including better tone and structure, barrier repair, free-radical protection, and anti-aging properties.

This white paper provides a closer examination of the natural ingredients in the product system, including the Peptide Cleanser, Peptide Serum, Peptide Moisturizer, RENO Anti-Aging Moisturizer, and. The contemporary peer-reviewed medical and pharmaceutical literature is applied to explain the biological mechanisms of the important ingredients in hyaluronic acid, peptides, niacinamide, herbal oils, and plant-derived vitamins. Their safety and efficacy are compared to those of ordinary chemically manufactured skin care constituents. This demonstrates differences in tolerance, barrier repair capacity, and long-term skin health outcomes. On the whole, this research provides an opportunity to compare contemporary cosmetic products and to summarize existing scientific data to demonstrate the protective power of natural, bioactive skin care products.

Keywords: natural skincare; peptides; hyaluronic acidl; niacinamide; botanical extracts; barrier repair; cosmeceuticals; antioxidant therapy; skin aging; dermatological efficacy

Introduction

The skin serves as the body's primary protective barrier, safeguarding against environmental insults while maintaining hydration, supporting immune surveillance, and facilitating sensory interaction with the external environment. Preservation and restoration of the skin barrier, protection against oxidative stress, and enhancement of the skin's intrinsic repair mechanisms remain central therapeutic objectives in contemporary dermatologic and cosmetic research. Emerging evidence supports the use of bioactive natural compounds in cosmetic dermatology, including peptides, hyaluronic acid, niacinamide, botanical oils, and plant-derived extracts, which exert measurable biological effects at both cellular and molecular levels (Bagińska & Szymańska, 2025; Madnani et al., 2024).

These ingredients contribute to barrier integrity, modulation of inflammation, collagen support, and hydration homeostasis. Modern skincare formulations increasingly incorporate natural humectants, peptides, vitamins, and phytonutrients to optimize moisture retention, enhance dermal resilience, mitigate oxidative damage, and support healthy aging. This research evaluates the compositions of Peptide Cleanser, Peptide Serum, Peptide Moisturizer, and RENO Anti-Aging Moisturizer, comparing their ingredient profiles and functional mechanisms with conventional synthetic skincare formulations.

Peptide Cleanser: Natural Cleansing and Barrier Preservation

The Peptide Cleanser formulation integrates plant-derived surfactants, bioactive peptides, humectants, botanical extracts, and barrier-supportive lipids to achieve effective cleansing while preserving epidermal integrity. The surfactant system composed of decyl glucoside, coco glucoside, and cocamidopropyl betaine (CAPB) is derived primarily from plant sugars and coconut sources. These non-ionic and amphoteric surfactants provide efficient removal of environmental debris, excess sebum, and particulate pollutants while exhibiting lower irritation potential compared to traditional anionic surfactants. Their milder cleansing profile reduces disruption of intercellular lipids within the stratum corneum, thereby supporting barrier stability and minimizing increases in transepidermal water loss (TEWL).

Vegetable glycerin functions as a humectant, attracting and retaining water within the stratum corneum to maintain hydration during and after cleansing. Butylene glycol further enhances moisture retention while improving ingredient penetration and formulation stability. Panthenol (pro-vitamin B5) contributes to barrier repair by supporting epidermal differentiation and reducing inflammation, while also improving softness and elasticity. Cannabis sativa (hemp seed oil) provides a lipid profile rich in essential fatty acids, including linoleic acid, which supports restoration of the skin barrier and modulation of inflammatory signaling. Similarly, Nigella sativa (black cumin seed) contains thymoquinone and other bioactive compounds associated with antioxidant and anti-inflammatory activity. Calendula officinalis (calendula extract), Arctium lappa (burdock root extract), and Urtica dioica (nettle leaf extract) contribute additional polyphenols and flavonoids that help reduce oxidative stress, soothe irritation, and support microbiome balance.

The inclusion of salicylic acid offers gentle keratolytic activity, promoting desquamation of excess corneocytes and assisting in pore clarification without excessive stripping when used within a balanced formulation. Citric acid aids in pH optimization, maintaining the cleanser within the skin's physiological range to support acid mantle function. Bioactive peptides, including palmitoyl oligopeptide (palmitoyl hexapeptide-12) and palmitoyl tetrapeptide-7, contribute to cellular communication within the epidermis and dermis. These peptides are associated with supporting collagen integrity, modulating inflammatory mediators, and enhancing extracellular matrix resilience. While traditionally used in leave-on formulations, their inclusion in cleansing systems may provide short-contact signaling benefits that complement downstream skincare steps.

Carbomer and polysorbate 20 contribute to formulation stability and uniform ingredient dispersion, while benzyl alcohol and sorbic acid serve as preservation agents to maintain microbial safety.

In contrast to synthetic surfactants such as sodium lauryl sulfate (SLS) and sodium laureth sulfate (SLES), which have been associated with lipid extraction and barrier compromise in susceptible individuals, plant-derived surfactant systems demonstrate improved tolerability and reduced barrier disruption. By combining mild cleansing agents with humectants, barrier-supportive lipids, peptides, and antioxidant botanicals, this formulation aims to cleanse effectively while maintaining structural integrity, hydration homeostasis, and inflammatory balance within the skin (Bagińska & Szymańska, 2025; Madnani et al., 2024).

Peptide Serum: Bioactive Hydration and Regenerative Therapy

The Serum formulation incorporates botanical extracts, amino acids, sodium lactate, sodium PCA, jojoba oil, and plant-derived phenolic compounds to support hydration, barrier integrity, and oxidative defense. These constituents closely align with the skin's intrinsic Natural Moisturizing Factor (NMF), a complex mixture of amino acids, lactates, pyrrolidone carboxylic acid (PCA), and other hygroscopic molecules derived from filaggrin degradation within the stratum corneum. By supplying exogenous components that

biochemically resemble endogenous NMF, the serum enhances water-binding capacity within the corneocyte matrix, improving hydration, elasticity, and overall barrier resilience.

Sodium PCA and sodium lactate function as highly effective humectants, attracting and retaining water within the epidermis while contributing to maintenance of the skin's slightly acidic pH. Proper pH regulation supports enzymatic processes involved in lipid synthesis and desquamation, thereby reinforcing the structural organization of the stratum corneum and reducing transepidermal water loss (TEWL). The inclusion of amino acids further supports NMF replenishment, contributes to osmotic balance, and aids in maintaining epidermal flexibility and softness. Jojoba oil, a liquid wax ester structurally similar to human sebum, provides emollient properties without occlusion. Its lipid profile assists in restoring barrier function, improving suppleness, and supporting balanced sebum regulation. Due to its biomimetic properties, jojoba oil enhances compatibility with the skin while minimizing comedogenic potential.

Botanical extracts and plant-derived phenolic acids contribute antioxidant and anti-inflammatory effects by neutralizing reactive oxygen species (ROS) generated through environmental stressors such as UV radiation and pollution. These phytonutrients may modulate inflammatory signaling pathways and support collagen preservation, thereby promoting dermal integrity and mitigating premature aging. Collectively, the serum's composition is designed to reinforce hydration homeostasis, enhance barrier protection, and provide biochemical support at both the epidermal and dermal levels. By integrating NMF-mimicking compounds with lipid-supportive and antioxidant ingredients, the formulation addresses both immediate moisture needs and longer-term structural resilience of the skin.

Hyaluronic acid (HA) is a naturally occurring glycosaminoglycan widely distributed throughout connective, epithelial, and neural tissues. In the skin, it plays a central role in maintaining hydration, viscoelasticity, and structural integrity. Due to its remarkable capacity to bind and retain water up to 1,000 times its molecular weight hyaluronic acid contributes significantly to dermal turgor, suppleness, and resilience. Beyond its hydrating function, HA is actively involved in wound healing and age-related tissue repair processes (Al-Halaseh et al., 2022; Chylińska & Maciejczyk, 2025). At the cellular level, hyaluronic acid interacts with receptors such as CD44 to influence extracellular matrix (ECM) organization, fibroblast proliferation, and keratinocyte migration. These interactions support collagen synthesis, regulate inflammatory responses, and facilitate coordinated tissue remodeling (Karabat & Tuncer, 2025). HA also contributes to maintaining epidermal barrier function by promoting proper cellular turnover and supporting intercellular communication within the dermal–epidermal junction. Clinical studies further demonstrate that topical hyaluronic acid improves skin hydration, elasticity, and overall barrier recovery, particularly in aging or environmentally stressed skin. Improvements in moisture retention are often accompanied by enhanced smoothness and reduction in the appearance of fine lines, reflecting both immediate humectant effects and longer-term extracellular matrix support (Wu et al., 2025). Collectively, hyaluronic acid functions not only as a potent hydrating agent but also as a biologically active molecule that contributes to structural maintenance, repair signaling, and dermal homeostasis.

Bioactive peptides such as Palmitoyl Tetrapeptide-7 and Palmitoyl Tripeptide-5 are incorporated into the formulation to support dermal matrix integrity and modulate inflammatory signaling. Palmitoyl Tripeptide-5 is recognized for its ability to stimulate transforming growth factor-beta (TGF-β) pathways, thereby promoting collagen synthesis and enhancing extracellular matrix organization. Palmitoyl Tetrapeptide-7 has been associated with downregulation of pro-inflammatory mediators, contributing to reduced visible redness and improved dermal resilience. Collectively, these peptides function as cellular signaling molecules that encourage structural protein production, improve firmness, and support repair processes. Emerging research demonstrates that topical peptide applications can enhance wound recovery, stimulate collagen remodeling, and reduce visible markers of aging, supporting their integration into modern dermocosmetic formulations (Ash et al., 2024; Baker, 2025).

Amino acids within the formulation further reinforce skin structure and hydration. As essential components of the Natural Moisturizing Factor (NMF), amino acids help maintain osmotic balance and water retention within the stratum corneum. They also serve as substrates for the synthesis of key structural proteins, including collagen and elastin, thereby contributing to epidermal strength, elasticity, and barrier cohesion.

Botanical extracts such as Nigella sativa (black cumin seed), horsetail (Equisetum arvense), dandelion (Taraxacum officinale), and aloe vera provide additional antioxidant and anti-inflammatory support. Black cumin seed contains thymoquinone, a compound studied for its capacity to modulate oxidative stress and inflammatory pathways. Horsetail is rich in silica, which may support connective tissue integrity. Dandelion extracts provide polyphenols that contribute to free radical scavenging, while aloe vera supports soothing, hydration, and epidermal repair. Together, these phytochemicals assist in mitigating oxidative damage induced by environmental stressors and help maintain cutaneous homeostasis. Jojoba oil, structurally similar to human sebum due to its wax ester composition, enhances compatibility with the skin's lipid barrier. It functions as a biomimetic emollient, reinforcing the intercellular lipid matrix without creating occlusion or pore congestion. This lipid support aids in reducing transepidermal water loss (TEWL) and improving overall barrier integrity.

In contrast, many conventional synthetic serums rely heavily on silicones to create an immediate smoothing or "blurring" effect on the skin surface. While silicones can provide short-term sensory benefits, they do not actively engage biological repair pathways. Evidence suggests that formulations containing bioactive peptides and hyaluronic acid operate through stimulation of endogenous collagen production and enhancement of intrinsic hydration mechanisms, rather than relying solely on temporary surface-level effects (Rahim et al., 2024). By supporting the skin's natural regenerative and moisture-regulating systems, peptide- and hyaluronic acid-based serums may provide more sustained improvements in firmness, elasticity, and overall skin quality.

Peptide Moisturizer: Barrier Repair and Antioxidant Protection

The Peptide Moisturizer formulation integrates barrier-replenishing lipids, bioactive peptides, humectants, botanical antioxidants, and skin-soothing compounds to support structural integrity, hydration homeostasis, and dermal resilience. Plant-derived oils including Helianthus annuus (organic sunflower seed oil), Persea gratissima (avocado oil), and Simmondsia chinensis (organic jojoba seed oil) provide essential fatty acids that are critical for restoration of the stratum corneum lipid matrix. Linoleic acid, abundant in sunflower oil, plays a particularly important role in ceramide synthesis and barrier repair. Avocado oil contributes oleic acid, phytosterols, and fat-soluble antioxidants that enhance skin elasticity and barrier fluidity. Jojoba oil, composed primarily of wax esters structurally similar to human sebum, functions as a biomimetic lipid that supports barrier compatibility and reduces transepidermal water loss (TEWL) without occlusive heaviness. Caprylic/capric triglyceride further enhances emolliency while improving spreadability and reducing moisture evaporation.

Butyrospermum parkii (organic shea butter) provides triglycerides and unsaponifiable fractions rich in triterpenes and phytosterols, which support lipid replenishment, soften corneocytes, and contribute to anti-inflammatory effects. Together, these lipid components assist in rebuilding the intercellular lamellar structure of the epidermis, strengthening the barrier and improving tolerance in compromised or dry skin conditions. Barrier-repair formulations have been shown to significantly improve skin firmness, hydration, and symptoms associated with impaired barrier function (Madnani et al., 2024). Humectants such as plant-derived glycerin and butylene glycol enhance water retention within the stratum corneum by attracting and binding moisture. Aloe barbadensis (organic aloe vera juice) further supports hydration while delivering polysaccharides that soothe irritation and promote epidermal repair. Panthenol (pro-vitamin B5) enhances barrier recovery by stimulating epidermal differentiation, reducing inflammation, and improving softness and elasticity. The peptide complex Palmitoyl Oligopeptide and Palmitoyl Tetrapeptide-7 functions as a signaling system within the dermal matrix. These peptides are associated with stimulation of collagen synthesis and modulation of inflammatory mediators, contributing to improved firmness and reduction in visible signs of aging. Unlike conventional moisturizers that primarily provide occlusion, peptide-containing formulations actively engage cellular repair pathways to support extracellular matrix integrity.

Antioxidant protection is provided through tocopherol (vitamin E), Camellia sinensis (organic green tea leaf extract), and Nigella sativa (black cumin seed). Vitamin E acts as a lipid-phase antioxidant, protecting cellular membranes from oxidative damage induced by UV radiation and environmental pollutants. Green tea extract contains catechins, particularly epigallocatechin gallate (EGCG), which have demonstrated anti-inflammatory and free radical–scavenging properties. Black cumin seed provides thymoquinone, which contributes additional antioxidant and inflammatory modulation support. Collectively, these phytochemicals mitigate oxidative stress that

accelerates collagen degradation and barrier dysfunction. Structuring agents such as stearic acid and carbomer stabilize the formulation and contribute to emulsion integrity, while phenoxyethanol and ethylhexylglycerin maintain microbial safety.

In contrast, many conventional lotions rely heavily on mineral oil and petrolatum to create occlusive layers that reduce water loss but do not actively support biological repair processes. While occlusives can temporarily decrease TEWL, they do not stimulate collagen production, enhance lipid synthesis, or modulate inflammatory pathways (Karabat & Tuncer, 2025). Botanical lipid systems and peptide-based formulations, by comparison, aim to both protect and biologically reinforce the skin barrier through structural and signaling mechanisms. Overall, this moisturizer is designed not only to prevent moisture loss but also to restore lipid architecture, enhance collagen support, provide antioxidant defense, and promote long-term barrier resilience through integrated biochemical and structural pathways.

RENO Anti-Aging Moisturizer: Marine and Botanical Bioactives

The RENO Anti-Aging Moisturizer is formulated with a combination of marine-derived bioactives, botanical extracts, structured lipids, and humectants designed to support dermal hydration, antioxidant defense, and cellular resilience. The phytoplankton complex including *Nannochloropsis gaditana*, *Isochrysis galbana*, *Phaeodactylum tricornutum*, *Tetraselmis chuii*, and *Dunaliella salina* provides a diverse array of marine-derived antioxidants, carotenoids, polyunsaturated fatty acids, amino acids, and trace minerals. Marine microalgae are particularly rich in compounds such as beta-carotene, fucoxanthin, chlorophyll derivatives, and omega fatty acids, which have been studied for their capacity to reduce oxidative stress, support mitochondrial energy metabolism, and protect against photoaging. These bioactives may enhance cellular self-defense systems by modulating reactive oxygen species (ROS) and supporting extracellular matrix stability. Through these mechanisms, marine extracts contribute to improved skin vitality and environmental stress tolerance.

Hyaluronic acid functions as a critical glycosaminoglycan within the dermal matrix, enhancing water retention, elasticity, and structural support. By binding significant amounts of water, it improves skin turgor and reduces the visible appearance of fine lines. Additionally, hyaluronic acid supports keratinocyte migration and extracellular matrix organization, contributing to barrier recovery and age-related repair processes. Cocos nucifera (coconut-derived lipids) and stearic acid provide emollient and structural lipid support. Coconut-derived components contribute medium-chain fatty acids that enhance barrier smoothness and reduce transepidermal water loss (TEWL). Stearic acid serves both as a structural fatty acid within the formulation and as a contributor to barrier reinforcement by supporting lamellar lipid organization in the stratum corneum. Glycerin, a well-established humectant, enhances hydration by attracting water into the epidermis and maintaining moisture equilibrium.

Populus tremuloides (aspen bark extract) contains naturally occurring salicylates and polyphenolic compounds that provide mild antimicrobial support while contributing antioxidant protection. These polyphenols assist in neutralizing oxidative damage and may support preservation of cellular proteins and lipids. Lonicera caprifolium (honeysuckle absolute oil) provides additional botanical antioxidant and soothing properties, contributing to microbiome balance and skin comfort. Citric acid plays a role in maintaining optimal formulation pH, supporting the skin's acid mantle and enzymatic activity involved in lipid processing and barrier renewal. Emulsifying wax ensures stable integration of aqueous and lipid components, preserving consistency and delivery of active ingredients.

In contrast to many conventional anti-aging formulations that rely heavily on synthetic retinoids or mass-produced synthetic vitamins ingredients that can cause irritation, erythema, and barrier disruption in sensitive individuals this formulation emphasizes marine and plant-derived antioxidants. While retinoids are clinically effective, they are often associated with increased sensitivity and transient barrier compromise. Marine phytoplankton extracts and botanical antioxidants offer an alternative strategy by supporting endogenous antioxidant pathways, collagen preservation, and cellular energy metabolism with improved tolerability profiles (Madnani et al., 2024). Collectively, the RENO Anti-Aging Moisturizer is structured to provide multi-layered support: enhancing hydration through humectant systems, reinforcing lipid architecture, protecting against oxidative and environmental stressors, and supporting mitochondrial and extracellular matrix function through marine bioactives. This integrative approach targets both immediate mois-

ture restoration and longer-term dermal resilience, positioning the formulation within a biologically supportive anti-aging framework.

Comparative Evaluation with Conventional Skincare Products

Conventional skincare formulations frequently rely on ingredients designed to produce immediate sensory or cosmetic effects, including silicones, mineral oils, synthetic surfactants, and high-potency exfoliating acids. Silicones such as dimethicone create a temporary smoothing or "blurring" effect by forming an occlusive film over the skin surface. Similarly, mineral oils and petrolatum reduce transepidermal water loss (TEWL) by forming a physical barrier. While these occlusives can provide short-term improvements in texture and moisture appearance, they do not actively participate in biological repair processes or stimulate endogenous regenerative pathways. Synthetic detergents and strong chemical exfoliants, often incorporated for rapid cleansing or resurfacing effects, may disrupt intercellular lipids within the stratum corneum when overused or improperly balanced.

Repeated barrier disruption can contribute to increased TEWL, irritation, altered microbiome composition, and heightened cutaneous sensitivity. Although these ingredients may enhance product performance from a cosmetic standpoint, their long-term impact on barrier resilience remains a concern, particularly in individuals with compromised or reactive skin. In contrast, formulations centered on botanical lipids, bioactive peptides, humectants, and marine or plant-derived antioxidants aim to work synergistically with the skin's natural physiology. Peptides function as signaling molecules that support collagen synthesis, extracellular matrix stability, and inflammatory modulation. Plant-derived lipids rich in essential fatty acids contribute directly to ceramide production and lamellar lipid organization, reinforcing barrier structure rather than merely occluding it. Humectants such as glycerin, sodium PCA, and hyaluronic acid enhance intrinsic water-binding capacity, supporting hydration through biomimetic mechanisms aligned with the skin's Natural Moisturizing Factor (NMF).

Antioxidant systems derived from green tea, marine algae, black cumin seed, and vitamin E further contribute to oxidative balance by neutralizing reactive oxygen species (ROS) generated by ultraviolet radiation, pollution, and metabolic stress. By addressing oxidative damage and inflammatory signaling at the molecular level, these ingredients support long-term structural integrity rather than temporary surface correction (Bagińska & Szymańska, 2025; Rahim et al., 2024). Importantly, natural and peptide-based formulations often demonstrate improved tolerability profiles due to their biochemical compatibility with epidermal lipids and cellular signaling pathways. Reduced irritation potential and alignment with endogenous repair systems contribute to fewer adverse effects and improved long-term barrier function.

Advancements in cosmetic science continue to refine the delivery of both natural and synthetic actives. Emerging nanostructured carriers, liposomal systems, and biomimetic encapsulation technologies are being developed to enhance stability, penetration, and targeted delivery of functional ingredients. These innovations aim to bridge efficacy with safety, optimizing therapeutic outcomes while minimizing barrier compromise (Youseaf & Yousaf, 2025). Overall, the comparative distinction lies in mechanism: conventional products often prioritize immediate cosmetic enhancement through surface-level occlusion or rapid exfoliation, whereas peptide- and botanical-centered formulations are structured to support barrier repair, hydration homeostasis, antioxidant defense, and cellular communication. This biologically aligned strategy reflects a shift in modern skincare research toward long-term skin health rather than transient aesthetic effects.

Conclusion

Contemporary skincare science increasingly supports formulations that align with the skin's intrinsic biology rather than relying solely on surface-level cosmetic effects. Ingredients such as hyaluronic acid, plant-derived lipids, humectants, peptides, and antioxidant vitamins contribute to a multi-layered strategy that reinforces hydration, barrier integrity, and structural resilience. Hyaluronic acid plays a central role in maintaining dermal water balance, enhancing elasticity, and supporting wound healing and age-related repair processes. Its ability to influence extracellular matrix organization and cellular signaling underscores its value beyond simple moisture retention.

Plant oils rich in essential fatty acids help restore the lipid architecture of the stratum corneum, thereby reducing transepidermal water loss (TEWL) and strengthening barrier cohesion. Humectants such as glycerin, sodium PCA, and related compounds mimic components of the Natural Moisturizing Factor (NMF), supporting osmotic balance and sustained hydration. Antioxidant vitamins and botanical extracts provide protection against oxidative stress, a key contributor to collagen degradation, inflammation, and premature aging. Emerging evidence in dermatologic literature indicates that these naturally derived and peptide-based ingredients exert measurable cellular and molecular effects, including modulation of inflammatory pathways, stimulation of collagen synthesis, and support of epidermal repair mechanisms. Compared to many conventional synthetic formulations that emphasize occlusion or rapid resurfacing, biocompatible peptide–botanical systems are designed to work in concert with endogenous repair processes. This alignment may contribute to improved tolerability, reduced irritation potential, and enhanced long-term barrier stability.

Importantly, the integration of peptides with botanical antioxidants and lipid-replenishing systems represents a promising area of cosmetic innovation. While current data support their individual efficacy, further well-designed clinical studies are warranted to better characterize synergistic interactions, optimize delivery systems, and quantify long-term outcomes. Future research exploring peptide–phytochemical combinations, advanced encapsulation technologies, and biomimetic formulations may further refine their therapeutic potential. Overall, skincare strategies that prioritize biological compatibility, barrier repair, and molecular signaling pathways reflect a paradigm shift toward sustainable skin health. Rather than providing temporary aesthetic improvement, these formulations aim to promote structural reinforcement, hydration homeostasis, and regenerative support, contributing to both immediate and enduring improvements in skin quality.

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