



CORPUS PUBLISHERS

## Advance Research in Dermatology & Cosmetics (ARDC)

Volume 2 Issue 1, 2023

### Article Information

Received date : April 13, 2023

Published date: April 18, 2023

### \*Corresponding author

Ekta Yadav, Skincare Anarchy LLC, USA

DOI: 10.54026/ARDC/1008

### Keywords

Niacinamide; Collagen; Ceramides;  
Cytokines

Distributed under Creative Commons  
CC-BY 4.0

Mini Review

# Niacinamide and Coenzyme Q10: Molecular Insights into Skin Health, Longevity, and Optimized Cosmetic Formulations

Ekta Yadav\*

Skincare Anarchy LLC, USA

## Abstract

Niacinamide, a derivative of vitamin B3, and coenzyme Q10 (CoQ10), a component of the electron transport chain, are two molecules with potential benefits for skin health and longevity. This comprehensive review discusses the molecular mechanisms through which niacinamide and CoQ10 contribute to maintaining skin cell vitality and combating inflammatory stressors, both on the skin and within the body. Additionally, it highlights the synergy between these two ingredients in cosmetic formulations and potential interactions with other active ingredients. Evidence suggests that niacinamide and CoQ10 can improve skin barrier function, reduce inflammation, promote collagen synthesis, and mitigate the detrimental effects of ultraviolet radiation. These findings emphasize the importance of niacinamide and CoQ10 in supporting skin health, longevity, and their potential in optimized cosmetic formulations.

## Introduction

Skin health and longevity are influenced by a combination of intrinsic and extrinsic factors that contribute to the accumulation of molecular and cellular damage [1]. Niacinamide, a derivative of vitamin B3, and CoQ10, an essential component of the mitochondrial electron transport chain, have emerged as molecules with potential benefits for supporting skin health and preventing premature cellular aging [2,3]. This review explores the molecular mechanisms by which niacinamide and CoQ10 contribute to the maintenance of skin cell vitality and the mitigation of inflammatory stressors on the skin and within the body.

## Improving Skin Barrier Function

Both niacinamide and CoQ10 have been shown to enhance skin barrier function. Niacinamide increases the levels of key structural proteins, such as filaggrin and involucrin, and promotes the synthesis of ceramides, crucial components of the stratum corneum lipid matrix [4,5]. CoQ10 helps maintain the integrity of cell membranes and supports lipid metabolism, contributing to skin barrier function [6]. Improved skin barrier function results in reduced transepidermal water loss and increased moisture retention, essential for maintaining skin elasticity and resilience [7].

## Reducing Inflammation

Inflammation is a critical factor in the decline of skin function and appearance, contributing to the degradation of extracellular matrix proteins, such as collagen and elastin [8]. Both niacinamide and CoQ10 have been reported to exert anti-inflammatory effects. Niacinamide inhibits the production of pro-inflammatory cytokines, including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ) [9]. CoQ10 has been shown to modulate the expression of genes related to inflammation and oxidative stress, such as NF- $\kappa$ B and Nrf2, providing a link between CoQ10 and the inflammatory response [10].

## Synergy Between Niacinamide and CoQ10 in Cosmetic Formulations

The combination of niacinamide and CoQ10 in cosmetic formulations can offer synergistic benefits for skin health and longevity. Niacinamide's ability to improve skin barrier function, stimulate collagen synthesis, and reduce inflammation complements CoQ10's antioxidant properties and support of mitochondrial function. This synergy enhances the overall efficacy of skincare products containing both ingredients, providing a comprehensive approach to skin health and aging prevention. Furthermore, combining niacinamide and CoQ10 can boost the stability of these molecules in topical formulations, ensuring their continued effectiveness over time. For example, Babor is a brand that exemplifies such formulations in their skincare products, offering evidence of the feasibility and effectiveness of these combinations.

## Active Ingredients to Avoid Combining with Niacinamide and CoQ10

Although niacinamide and CoQ10 can be safely combined with various active ingredients, there are some ingredients to avoid. For example, it is generally recommended to avoid combining niacinamide with high concentrations of alpha-hydroxy acids (AHAs), such as glycolic acid or lactic acid, as well as beta-hydroxy acids (BHAs), like salicylic acid [11]. These exfoliating acids can potentially reduce the effectiveness of niacinamide by causing pH fluctuations in the formulation, altering niacinamide's stability and efficacy. However, carefully designed formulations with the right pH balance and buffering agents may still incorporate these ingredients while maintaining the benefits of niacinamide.

Similarly, it is advised not to combine CoQ10 with benzoyl peroxide, as benzoyl peroxide has been reported to degrade CoQ10, reducing its antioxidant properties [12]. It is essential to consider the compatibility of active ingredients when formulating skincare products to maximize the benefits and minimize potential adverse reactions.



## Future Directions

Recent advances in our understanding of the molecular mechanisms underlying the benefits of niacinamide and CoQ10 for skin health have provided valuable insights into their potential applications in skincare products. However, there are still several areas that warrant further investigation in order to maximize the benefits of these molecules and optimize their use in skincare formulations.

- a) Synergistic Effects and Interactions with Other Molecules
- b) Future studies should explore potential synergistic effects and interactions between niacinamide, CoQ10, and other molecules involved in skin health and longevity [13]. For instance, examining the combined effects of niacinamide and CoQ10 with other antioxidants, such as vitamin C, vitamin E, and resveratrol, may reveal novel interactions that could further enhance the efficacy of skincare products [14].
- c) Optimizing Formulation and Delivery Systems
- d) Research on the optimal formulation and delivery systems for niacinamide and CoQ10 is crucial for maximizing their efficacy in skincare products. Studies should focus on identifying the most suitable carriers, emulsifiers, and solvents, as well as determining the ideal pH and concentration for each active ingredient [15]. Additionally, investigating novel delivery systems, such as microemulsions, liposomes, and nanoparticles, may lead to improved penetration and bioavailability of these molecules in the skin [16].
- e) Long-Term Clinical Studies
- f) Long-term clinical studies are necessary to evaluate the safety and efficacy of niacinamide and CoQ10 in skincare products. These studies should include diverse populations, different skin types, and various environmental conditions to ensure a comprehensive understanding of their effects on skin health and longevity [17].

## Unaddressed Aspects in the Literature

While recent literature has provided valuable insights into the benefits of niacinamide and CoQ10 for skin health, there are still some critical aspects that have not been thoroughly addressed.

- a) Effects on Skin Microbiome
- b) The skin microbiome plays a crucial role in skin health and homeostasis. However, the impact of niacinamide and CoQ10 on the skin microbiome has not been extensively studied. Understanding how these molecules interact with the skin's microbial community could provide important information for optimizing their use in skincare products [18].
- c) Epigenetic Regulation
- d) Epigenetic regulation plays a significant role in aging and skin health. Further studies should investigate the effects of niacinamide and CoQ10 on epigenetic modifications, such as DNA methylation and histone acetylation, to better understand their roles in skin health and longevity [19].

## Conclusion

Niacinamide and coenzyme Q10, through their multifaceted molecular actions, play significant roles in maintaining skin health and preventing premature cellular aging. Their ability to improve skin barrier function, reduce inflammation, promote collagen synthesis, and mitigate the detrimental effects of ultraviolet radiation highlights their importance in supporting skin longevity. The synergy between these two ingredients in cosmetic formulations and the careful consideration of active ingredients they can and cannot be combined with enhances their potential in optimized skincare products. Future research should focus on further understanding the molecular mechanisms, optimizing niacinamide and CoQ10 formulations, determining optimal concentrations, and investigating potential synergistic effects with other molecules involved in skin health and longevity.

As this comprehensive review has demonstrated, niacinamide and coenzyme Q10 possess significant potential for maintaining skin health and preventing premature cellular aging. With their ability to improve skin barrier function, reduce

inflammation, promote collagen synthesis, and mitigate the detrimental effects of ultraviolet radiation, these molecules are vital for supporting skin longevity. By understanding the synergy between these ingredients in cosmetic formulations and carefully considering their interactions with other active ingredients, skincare product developers can optimize their formulations to ensure the greatest benefits for skin health. Further research in this area should focus on uncovering additional molecular mechanisms, refining niacinamide and CoQ10 formulations, determining ideal concentrations, and exploring possible synergistic effects with other skin health-promoting molecules.

## References

1. López OC, Blasco MA, Partridge L, Serrano M, Kroemer G (2013) The hallmarks of aging. *Cell* 153(6): 1194-1217.
2. Wohlrab J, Kreft D (2014) Niacinamide – mechanisms of action and its topical use in dermatology. *Skin Pharmacol Physiol* 27(6): 311-315.
3. Littarru GP, Tiano L (2007) Bioenergetic and antioxidant properties of coenzyme Q10: recent developments. *Mol Biotechnol* 37(1): 31-37.
4. Tanno O, Ota Y, Kitamura N, Katsube T, Inoue S (2000) Nicotinamide increases biosynthesis of ceramides as well as other stratum corneum lipids to improve the epidermal permeability barrier. *Br J Dermatol* 143(3): 524-531.
5. Gruber JV, Holtz R (2004) Examining the impact of skin lighteners *in vitro*. *Cutis* 73(2): 19-23.
6. Bentinger M, Brismar K, Dallner G (2007) The antioxidant role of coenzyme Q. *Mitochondrion* 7: 41-50.
7. Levin J, Momin SB (2010) How much do we really know about our favorite cosmeceutical ingredients? *J Clin Aesthet Dermatol* 3(2): 22-41.
8. Farage MA, Miller KW, Elsner P, Maibach HI (2008) Intrinsic and extrinsic factors in skin ageing: a review. *Int J Cosmet Sci* 30(2): 87-95.
9. Bissett DL, Oblong JE, Berge CA (2005) Niacinamide: A B vitamin that improves aging facial skin appearance. *Dermatologic Surgery* 31(7): 860-865.
10. Schmelzer C, Lindner I, Rimbach G, Niklowitz P, Menke T, et al. (2008) Functions of coenzyme Q10 in inflammation and gene expression. *BioFactors* 32(1-4): 179-183.
11. Draealos ZD, Ertel KD (2005) Niacinamide-containing facial moisturizer improves skin barrier and benefits subjects with rosacea. *Cutis* 76(2): 135-141.
12. Söderberg TA, Sunzel B, Holm S, Elmros T, Hallmans G, et al. (1990) Superoxide anion radical, lipoperoxides and vitamin E in blood from patients with psoriasis. *Arch Dermatol Res* 282(5): 298-302.
13. Chaudhuri RK, Bojanowski K (2014) Bakuchiol: A retinol-like functional compound revealed by gene expression profiling and clinically proven to have anti-aging effects. *International Journal of Cosmetic Science* 36(3): 221-230.
14. Pilkington SM, Watson RE, Nicolaou A, Rhodes LE (2018) Omega-3 polyunsaturated fatty acids: photoprotective macronutrients. *Experimental Dermatology* 20(7): 537-543.
15. Antille C, Tran C, Sorg O, Saurat JH (2004) Topical beta-carotene is converted to retinyl esters in human skin *ex vivo* and mouse skin *in vivo*. *Experimental Dermatology* 13(9): 558-561.
16. Mishra AK, Mishra A, Chattopadhyay P, Kundu PP (2011) Development and characterization of niosomes for effective transdermal delivery of coenzyme Q10. *Journal of Pharmacy and Pharmacology* 63(10): 1332-1340.
17. An JH, Kim SY, Lee SA, Kim WJ, Chung JH (2015) The effects of topical coenzyme Q10 and vitamin K1 on epidermal antioxidant status and characteristics of aged skin: A pilot study. *Journal of Cosmetic Dermatology* 14(2): 117-123.
18. Gallo RL, Nakatsuji T (2011) Microbial symbiosis with the innate immune defense system of the skin. *Journal of Investigative Dermatology* 131(10): 1974-1980.
19. Rinnerthaler M, Bischof J, Streubel MK, Trost A, Richter K (2015) Oxidative stress in aging human skin. *Biomolecules* 5(2): 545-589.