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Overview of Acne, their Biochemical Relevance and Roles in Skin Health

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Abstract
Acne is a chronic inflammatory skin disorder that impacts both physical appearance and mental health in people of all ages. Niacinamide, or vitamin B3, has drawn interest recently as a potential supplementary or alternative treatment for acne because of its anti-inflammatory, antioxidant, and sebum-regulating qualities. This review's objective is to assess niacinamide's efficacy in treating acne by examining clinical research, its mode of action, and its safety profile. Several studies have shown that topical niacinamide can enhance skin barrier function, lessen inflammation, and lessen the severity of acne lesions without causing the irritation that more severe therapies do. Niacinamide is also a possible treatment for post-inflammatory hyperpigmentation because it has been demonstrated to improve skin repair. The data currently in favor of using niacinamide to treat acne is summarized in this review.
Keywords: Acne vulgaris, Niacinamide, Nicotinamide, inflammation, treatment, acne lesions, hyperpigmentation.

Introduction

Acne, The most prevalent skin condition that affects people worldwide is acne, a chronic inflammatory illness of the pilosebaceous units of the face, neck, chest, and back that is thought to affect 70–87% of people. Both noninflammatory (comedones) and inflammatory (papules, pustules, nodules) lesions are indicative of this pleomorphic illness. Acne grading is necessary to choose the best course of treatment. The quality of life of an individual can be significantly enhanced by effective treatment.

Most people agree that Propionibacterium acnes, or P. acnes, contributes to inflammatory acne. Systemic antibiotics have been used to lower P. acnes populations for a number of years. Due to its less interactions and adverse effects than oral antibiotics, topical antibiotics have gained popularity over the past ten years for the treatment of inflammatory acne vulgaris. Concerns regarding microorganism resistance are being raised by the widespread use of these agents, which is increasingly linked to the emergence of resistant infections. This underscores the necessity for alternative non-antimicrobial medicines to treat acne.

Niacinamide

Niacinamide belongs to the vitamin B group and is also known as nicotinamide, nicotinic acid amide, and 3-pyridinecarboxamide. Nicotinic acid, from which it is derived in vivo, possesses the same vitamin action as its amide. Nicotinic acidamide has also been referred to as vitamin PP or PP factor since its "pellagra-preventing" properties were discovered.

It comes in two different forms: colorless crystals and white crystalline powder. It has a salty, harsh flavor and no smell. The melting point is 128–131 °C, the pH is 6.0–7.5 (β = 5 g/100 ml H_2O), and the pKa value is 3.3 (20 °C). The vitamin niacinamide is soluble in water. It weighs 122.12 g/mol molar.

The recently authorized anti-acne medication niacinamide has a strong anti-inflammatory impact. One important anti-acne treatment mechanism is the reduction of inflammation. Recent research has shown that topical niacinamide is very well tolerated by facial skin and has a number of positive benefits on lowering sebum production. The effectiveness and safety of topical 4% niacinamide gel for mild to moderate acne vulgaris were examined in this study.

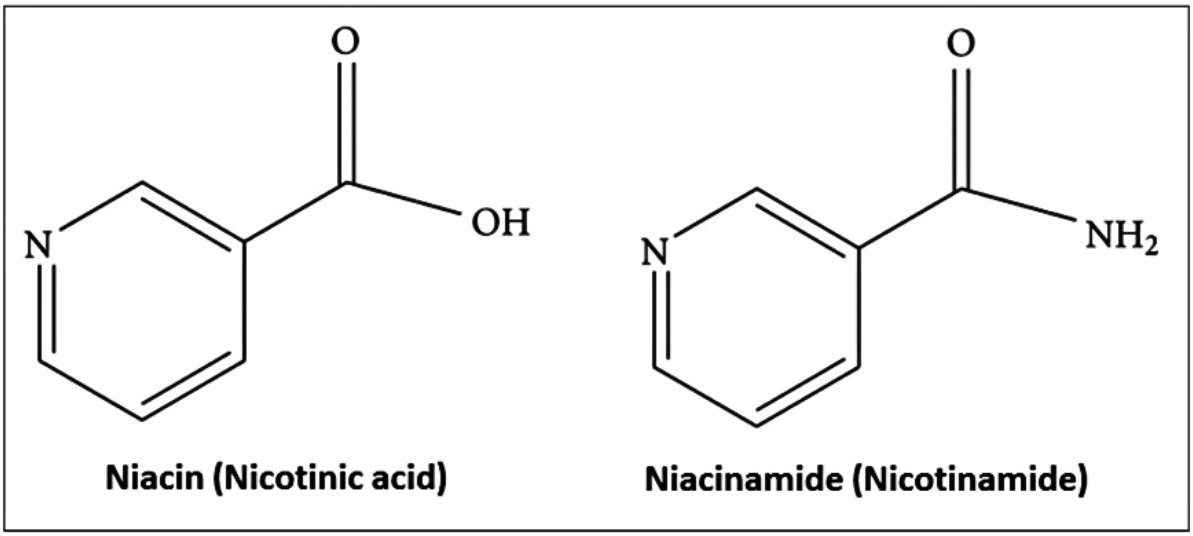

Figure 1: Chemical structure of Niacin and Niacinamide

Active Ingredient

A variety of foods, including meat, nuts, wholegrains, legumes, and yeast, contain vitamin B3. Of course, the pure vitamin can be found in a number of commercial sources. Topical skin care products have utilized three main types of vitamin B3: nicotinamide, also known as niacinamide, nicotinic acid, and nicotinate esters, such as myristoyl and benzyl nicotinate. The majority of published clinical and in vitro research demonstrating skin benefits has used topical niacinamide (see below). Nicotinic acid and the majority of nicotinate esters have not been the subject of clinical skin benefit trials due to concerns about skin irritation (see the section on potential side effects below). Clinical studies using myristoyl nicotinate have been reported, and the results show effects on aging skin.

How Can Niacinamide Help Acne?

- Anti-inflammatory Effects: Inflammation, which causes redness, swelling, and irritation, is frequently linked to acne. Niacinamide's potent anti-inflammatory qualities aid in calming the skin, lowering redness, and stopping the inflammatory reaction that exacerbates acne.
- Regulating Sebum Production: The development of acne is largely influenced by excessive oil production, which can plug pores and foster the growth of germs. In order to avoid acne outbreaks caused by excess oil, niacinamide helps control sebum production.
- Strengthening the Skin Barrier: To keep contaminants, bacteria, and irritants out of the skin, a strong skin barrier is essential. Because niacinamide helps to fortify this barrier, the skin is less susceptible to the things that can cause acne.
- Antibacterial and Antioxidant Effects: Niacinamide contains mild antibacterial qualities that may help lessen acne-causing germs on the skin's surface, even if it isn't as effective as some other acne treatments. Its antioxidant properties also shield the skin from harm brought on by external stresses.

- Reducing Hyperpigmentation and Redness: Acne lesions may leave behind dark spots (post-inflammatory hyperpigmentation) after they heal. Over time, niacinamide helps remove dark spots and encourage a more uniform skin tone by preventing the synthesis of melanin, the pigment that causes them.

Marketed dosage forms

- **Topical Creams/Gels:** Creams and gels that carry doses of 2% to 10% are common formulations for niacinamide. These are immediately applied to the skin to Reduce breakouts and hyperkeratosis, Maintains sebum balance, Unclogs & tightens pores, Promotes anti-microbial activity against acne causing bacteria, Reduce acne inflammation & redness. Eg. Figure 2. Salicylic Acid 2% Niacinamide 6% Oil-Free Gel. Eg-Figure 2.

Figure 2. Salicylic Acid 2% Niacinamide 6% Oil-Free Gel.

Compared to ointments, gels have greater potential as a drug delivery system since they are stable, non-sticky, take less energy to formulate, and have aesthetic value. Compared to semi-solid formulations, gels typically have a smoother, more elegant, non-greasy impact and greater drug release.

- **Topical Lotions:** Lighter in consistency than creams, lotions are designed to treat acne and contain niacinamide in concentrations between 2% and 5%. Eg-Figure 3.

Figure 3. Bodywise 10% Niacinamide Body Lotion.

- **Topical Serums:** Serums containing 5% to 10% niacinamide are popular because of their lightweight texture and ability to be applied directly to regions afflicted by acne. Eg-Figure 4.

Figure 4. Minimalist Niacinamide 10% face serum.

- **Topical Sprays:** Niacinamide is available from certain brands as a spray or mist for easy application and hydration. Eg-Figure 5.

Figure 5. Lab & herb Anti Acne Body Spray with 2% Niacinamide and 2% Salicylic Acid.

- **Face masks:** A Niacinamide Acne face masks work by reducing inflammation, controlling oil production, and encouraging better skin.Sometimes, sheet masks or wash-off masks designed for skin prone to acne contain niacinamide. Eg-Figure 6.

Figure 6. Twasa 10% Niacinamide +Zinc PCA Acne Mask & Blemish Skin.

- **Cleansers:** Niacinamide is used in several face cleansers, usually at lower doses (1%–5%), to gently wash the skin while providing its anti-inflammatory properties. Eg-Figure 7.

Figure 7. Ant-acne face wash 2% Niacinamide, 2% Salicylic Acid & Matcha Tea.

Clinical efficacy after topical application

For a considerable amount of time, topical niacinamide has been used frequently, primarily through cosmetic preparations, and is thought to be safe up to a 4% concentration. However, given there is a dearth of clinical data and the limited significance of the data that is available, it is impossible to definitively verify the practical applicability of the effects detailed here. Furthermore, the information and publications that are now accessible frequently fail to specify the galenic principle upon which the preparations were founded, as well as whether and to what extent the cutaneous bioavailability of niacinamide in the target compartment has been confirmed. However, the information offers the dermatologist some intriguing insights into topical treatment.

Studies on the anti-inflammatory effects of psoriasis, rosacea, acne vulgaris, and atopic dermatitis are available. These are pilot trials, thus their design and clinical outcomes are insufficient to demonstrate the therapeutic efficacy of the corresponding formulations. Following an 8-week course of treatment with a formulation containing 2% niacinamide, Soma et al. found that transepidermal water loss was reduced in a research including 28 individuals with atopic dermatitis. Additionally, Draelos et al. may demonstrate barrier-protective effects in a trial involving fifty rosacea patients. Data from a multicenter study involving acne patients published by Shalita et al. demonstrated that a preparation containing 4% niacinamide was more effective than 1% clindamycin gel. A subsequent investigation, however, was unable to demonstrate any additive effects for 1% clindamycin and 4% niacinamide. In a separate clinical context, Draelos et al. demonstrated how a preparation containing 2% niacinamide inhibited the production of sebum on the face. Clinical evidence supporting the hypothesized antipruritic effect is lacking. Preparations containing up to 5% niacinamide have been used to cure hyperpigmentation. Research conducted on Asian participants has demonstrated clinically significant skin lightening effects following eight weeks of twice-daily use of a formulation containing 5% niacinamide. In a double-blind, randomized research, Kimball et al. might also demonstrate a reduction in facial hyperpigmentation. There is no scientific evidence to support the effectiveness of niacinamide in treating infections that are pertinent to the skin. Moloney et al. The number of actinic keratoses over a 6-month period was examined in relation to the effectiveness of a 1% niacinamide preparation vs a vehicle, but no significant changes were found. In experiments using recall antigen tests, Gensler may demonstrate in vivo that niacinamide lessens immunosuppression brought on by UV light. There is no additional research on photocarcinogenesis or photoprotection.

Conclusion

Niacinamide is affordable, readily accessible, and has a well-established safety profile. Because of its ability to reduce inflammation, regulate sebum, and build the skin barrier, niacinamide shows great promise as an acne treatment. Because it is less likely to cause irritation than other acne treatments, niacinamide is appropriate for sensitive skin. Although its potency may not match that of prescription medications like oral antibiotics or retinoids, its adaptability and low side effects make it a useful supplement or substitute for acne treatment. The best concentrations for treating acne and its long-term advantages require more investigation.

References

1. Katsambas AD, Stefanaki C, Cunliffe WJ. Guidelines for treating acne. Clin Dermatol 2004; 22: 439-444.
2. Healy E, Simpson N. Acne vulgaris. BMJ 1994, 308, 831-833.
3. Khanna NV. Topical clindamycin hydrochloride 1% in acne vulgaris. Indian J Dermatol Venereol Leprol 1990; 56: 337-380.
4. Cunliffe WJ, Simpson NB. Disorders of the sebaceous glands. In: Textbook of Dermatology. Oxford: Blackwell Science Ltd, 1998; 1927-1984.
5. Eady EA, Jones CE, Tipper JL et al. Antibiotic resistant propionibacteria in acne: need for policies to modify antibiotic usage. BMJ 1993; 306: 555-556.
6. Bissett DL, Oblong JE, Berge CA. Niacinamide: A B Vitamin that improves aging facial skin appearance. Dermatol Surg 2005; 31: 860-865.
7. Draelos ZA, Matsubara A, Smiles K. The effect of 2% niacinamide on facial sebum production. J Cosmet Laser Ther 2006; 8: 96-101.
8. Burgess C: Topical vitamins. J Drugs Dermatol 2008; 7(suppl 7):s2–s6.
9. Larm NE, Geme G: Understanding the chemistry of the reaction between nicotinamide and trichloroacetic acid. Abstr Am Chem Soc 2009, p 237.
10. Yang J, Klaidman LK, Adams JD: Medicinal chemistry of nicotinamide in the treatment of ischemia and reperfusion. Mini Rev MedChem 2002; 2: 125–134.
11. DiPalma JR, Thayer WS: Use of niacin as a drug. Annu Rev Nutr 1991; 11: 169–187.
12. Bains P, Kaur M, Kaur J, Sharma S. Nicotinamide: Mechanism of action and indications in dermatology. Indian journal of dermatology, venereology and leprology. 2018 Mar 1;84:234.
13. Berson DS, Osborne R, Oblong JE, Hakozaki T, Johnson MB, Bissett DL. Niacinamide. Cosmeceuticals and cosmetic practice. 2013 Dec 27:103-12.
14. Hammar H: Epidermal nicotinamide adenine dinucleotides in psoriasis and neurodermatitis (lichen simplex hypertrophicus). Arch Dermatol Forsch 1975;252:217227.
15. Beningo KE, Scott DW, Miller WH Jr, Rothstein E: Observations on the use of tetracycline and niacinamide as antipruritic agents in atopic dogs. Can Vet J 1999;40: 268–270.
16. Hammar H: Epidermal nicotinamide adenine dinucleotides in psoriasis during treatment with dithranol. Arch Dermatol Forsch 1975; 252:229–236.
17. Levine D, Even-Chen Z, Lipets I, Pritulo OA, Svyatenko TV, Andrashko Y, Lebwohl M, Gottlieb A: Pilot, multicenter, double-blind, randomized placebo-controlled bilateral comparative study of a combination of calcipotriene and nicotinamide for the treatment of psoriasis. J Am Acad Dermatol 2010;63: 775–781.
18. Kademian M, Bechtel M, Zirwas M: Case reports: new onset flushing due to unauthorized substitution of niacin for nicotinamide. J Drugs Dermatol 2007;6:1220–1221.
19. Draelos ZD, Ertel K, Berge C: Niacinamide containing facial moisturizer improves skin barrier and benefits subjects with rosacea. Cutis 2005;76:135–141.
20. Shalita AR, Smith JG, Parish LC, Sofman MS, Chalker DK: Topical nicotinamide compared with clindamycin gel in the treatment of inflammatory acne vulgaris. Int J Dermatol 1995;34:434–437.

21. Dos SK, Barbhuiya JN, Jana S, Dey SK: Comparative evaluation of clindamycin phosphate 1% and clindamycin phosphate 1% with nicotinamide gel 4% in the treatment of acne vulgaris. Indian J Dermatol Venereol Leprol 2003;69:8–9.
22. Draelos ZD, Matsubara A, Smiles K: The effect of 2% niacinamide on facial sebum production. J Cosmet Laser Ther 2006;8:96–101.
23. Chiu PC, Chan CC, Lin HM, Chiu HC: The clinical anti-aging effects of topical kinetin and niacinamide in Asians: a randomized, double-blind, placebo-controlled, split-face comparative trial. J Cosmet Dermatol 2007;6: 243–249.
24. Hakozaki T, Minwalla L, Zhuang J, Chhoa M, Matsubara A, Miyamoto K, Greatens A, Hillebrand GG, Bissett DL, Boissy RE: The effect of niacinamide on reducing cutaneous pigmentation and suppression of melanosome. transfer. Br J Dermatol 2002;147:20–31.
25. Kimball AB, Kaczvinsky JR, Li J, Robinson LR, Matts PJ, Berge CA, Miyamoto K, Bissett DL: Reduction in the appearance of facial hy-perpigmentation after use of moisturizers with a combination of topical niacinamide and N-acetyl glucosamine: results of a ran-domized, double-blind, vehicle-controlled trial. Br J Dermatol 2010;162:435–441.
26. Moloney F, Vestergaard M, Radojkovic B, Damian D: Randomized, double-blinded, placebo controlled study to assess the effect of topical 1% nicotinamide on actinic keratoses. Br J Dermatol 2010;162:1138–1139.
27. Gensler HL: Prevention of photoimmunosuppression and photocarcinogenesis by topical nicotinamide. Nutr Cancer 1997;29:157–162.
28. Chen AC, Damian DL. Nicotinamide and the skin. Australasian Journal of Dermatology. 2014 Aug;55(3):169-75.
29. Rolfe HM. A review of nicotinamide: treatment of skin diseases and potential side effects. Journal of cosmetic dermatology. 2014 Dec;13(4):324-8.
30. Milani M, Colombo F. The Rational of a Fixed Combination of Benzoyl Peroxide and Niacinamide in the Treatment of Acne Vulgaris: A Narrative Review. Dearma J Cosmetic Laser Therapy. 2024;3(1):01-3.
31. Permatasari NJ, Tan ST. Efficacy of Topical Niacinamide on Skin Hydration of Adolescents with Acne Vulgaris: An Experimental Study on the Adolescent Community in Jakarta, Indonesia. Bioscientia Medicina: Journal of Biomedicine and Translational Research. 2024 Jun 26;8(9):4987-95.
32. Tempark T, Shem A, Lueangarun S. Efficacy of ceramides and niacinamide-containing moisturizer versus hydrophilic cream in combination with topical anti-acne treatment in mild to moderate acne vulgaris: A split face, double-blinded, randomized controlled trial. Journal of Cosmetic Dermatology. 2024 May;23(5):1758-65.
33. Walocko FM, Eber AE, Keri JE, Al-harbi MA, Nouri K. The role of nicotinamide in acne treatment. Dermatologic therapy. 2017 Sep;30(5):e12481.