

NEWS, VIEWS, AND REVIEWS

Hypochlorous Acid: A Blast from the Past

Nikita Menta BA, Savanna I. Vidal BS, Adam Friedman MD FAAD

Department of Dermatology, George Washington University School of Medicine and Health Sciences, Washington, DC

INTRODUCTION

Hypochlorous acid (HOCl) is one of the latest skincare ingredients to gain widespread popularity on social media. Despite newfound interest by some, the use of HOCl is certainly not new; its medicinal use, as a wound disinfectant, dates back to World War I.¹ Since then, HOCl has earned FDA approval for several indications, including wound care and management of eyelid and oral infections.¹ In dermatology, specifically, several stabilized HOCl formulations are in the marketplace and have been studied for various indications.² Now, HOCl spray has made its way to social media with users incorporating it into their daily skincare routines, applying it as a post-workout disinfectant, and using it to manage acne. Herein, we review the evidence for HOCl to determine the validity behind this skincare trend.

Mechanisms of Action

HOCl is naturally produced through the body's innate immune response. It is formed through the respiratory burst pathway after myeloperoxidase-expressing cells phagocytose pathogens. Its microbicidal actions are mediated through oxidative damage to pathogens' proteins, DNA, and lipids, which can gradually lead to cytotoxicity and cell death.³ HOCl is microbicidal to many pathogens including *Methicillin-Resistant S. aureus*, *S. epidermidis*, *E. coli*, and *P. aeruginosa*.⁴ HOCl also has numerous anti-inflammatory mechanisms such as reducing the activity of histamine, leukotriene B₄ (LTB₄), and interleukin-2 (IL-2) and increasing the activity of transforming growth factor-beta.⁴

Applications in Dermatology

There are numerous dermatologic applications for HOCl, with wound care being the most common. HOCl reduces the microbial load in infected wounds in a concentration-dependent manner; at a concentration of 500 mg/L, the extent of microbial reduction is around six times greater than at 100 mg/L.^{2,5} HOCl can also directly contribute to wound healing success by increasing the percentage of epithelialization compared to other mediums such as sterile saline solution.⁶ Additionally, HOCl may have a role in reducing scarring of wounds. A study comparing HOCl gel to 100% silicone gel found that HOCl gel decreased the vascularity and height of scars to a greater degree after 16 weeks.⁷

HOCl is also effective in the treatment of atopic dermatitis (AD)-associated pruritus. In animal studies, topical HOCl reduced scratching behavior to the same extent as 0.1% betamethasone

dipropionate ointment.⁸ In human studies, topical HOCl reduced itch within three days with no serious adverse events.⁹ Another study demonstrated significantly reduced *S. aureus* colony counts within three minutes and after one week of treatment with HOCl.¹⁰ Reduction of *S. aureus* and diminished activity of histamine, IL-2, and LTB₄ have been hypothesized to be primary mechanisms by which HOCl reduces AD-associated pruritus.⁴ HOCl has both anti-inflammatory and pro-inflammatory effects, but anti-inflammatory effects predominate.⁴ Specific anti-inflammatory mechanisms, namely HOCl's effect on proteases, are concentration-dependent. At high concentrations, HOCl decreases protease activity causing anti-inflammatory effects, but at low concentrations, it increases protease activity causing the opposite effect.⁴

Finally, the role of HOCl in treating acne and seborrheic dermatitis has been previously explored. One study evaluating the efficacy of HOCl solution versus benzoyl peroxide in acne management found equivalent improvement in facial inflammatory lesions with both treatments.¹¹ Another study investigating the efficacy of HOCl gel in managing mild-to-moderate facial and scalp seborrheic dermatitis observed a 33% improvement in Investigator Global Assessment scores within 14 days.¹² More studies are needed to quantify the efficacy of HOCl in treating these conditions.

Stability of Hypochlorous Acid

While HOCl has many beneficial applications, its efficacy is highly dependent on its stability. Several variables can impact the stability of HOCl in solution, including pH and environmental factors such as sunlight, temperature, contact with air, and other compounds in solution. HOCl is stable between a pH of 3.5 and 5.5; at pH ranges above or below this, concentrations of HOCl decrease, and concentrations of reaction products increase.⁴ For example, at higher pHs, the concentration of sodium hypochlorite, which has less microbicidal activity than HOCl, increases.⁴ In addition to pH, controlling environmental factors is also essential to maintaining the stability of HOCl. One study evaluated the effect of sunlight on the shelf life of HOCl and found that chlorine reduction started on day 4 in the sun-exposed solution and by day 14 in the sun-sheltered solution, highlighting that sunlight significantly decreases the stability of HOCl.¹³ In addition to sunlight, irradiation from an ultraviolet

lamp, contact with air, temperatures greater than 25°C, and the presence of organic and inorganic compounds in solution all decrease the stability of HOCl.¹⁴ Accordingly, HOCl must be stored in cool, dark environments. Additionally, contact with air and the concentration of organic and inorganic compounds in the water used to formulate HOCl solutions must be kept to a minimum to maintain its stability.¹⁴

Over-the-Counter Hypochlorous Acid Products

Considering the very specific requirements for properly formulating and maintaining the stability of HOCl, it is crucial to carefully consider the characteristics and handling of over-the-counter (OTC) HOCl formulations. Currently, there are no guidelines for storing or handling OTC HOCl. Additionally, OTC HOCl formulations have not been studied in in-vitro or clinical studies, and, thus, we have no data on their microbicidal activity. HOCl concentrations in trending OTC sprays range between 0.012-0.02% which is on the lower end of concentrations that effectively reduce microbial density in wounds.^{5,15} Nonetheless, anecdotally, individuals with AD and acne have reported improvement in symptoms and appearance with the use of OTC HOCl sprays. While this suggests that OTC formulations have some efficacy, they likely differ in efficacy compared to stabilized, prescription formulations, due to variations in production, shipping, and handling. Even once the product reaches consumers' hands, it is vulnerable to many environmental factors; heat, in particular, is a major culprit, given that many users store it in their gym bags to use as a post-workout disinfectant.

CONCLUSION

While over-the-counter HOCl formulations increase accessibility to this multifaceted biomolecule, consistency with respect to efficacy and stability are not known due to a lack of both in-vitro and in-vivo studies evaluating these formulations. Taking into account the high susceptibility of HOCl to environmental factors and variability in the production of OTC products, we can assume that the OTC HOCl formulations have different functional properties compared to their prescription counterparts. Given that we have an array of alternative FDA-approved treatment options for both AD and acne, the use of HOCl spray in place of first-line, evidence-based treatments is not advisable. However, since HOCl has a favorable safety profile, its adjunctive use is at least unlikely to be harmful. Ultimately, more studies are needed to elucidate the stability and microbicidal activity of over-the-counter HOCl sprays.

DISCLOSURE

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AUTHOR CORRESPONDENCE

Adam Friedman MD FAAD

E-mail:..... ajfriedman@mfa.gwu.edu