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Niacinamide-incorporated micellar water: A next-generation facial cleanser with barrier-supportive benefits

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Abstract
Micellar water is a widely accepted dermatological cleansing preparation due to its mild, non-irritant, and effective removal of dirt, sebum, and makeup without the need for rinsing. The present study aims to formulate and evaluate a micellar water preparation enriched with niacinamide (vitamin B3), which not only cleanses the skin but also provides additional dermatological benefits such as barrier repair, hydration, and anti-inflammatory effects. The micellar water was formulated using a combination of mild non-ionic and amphoteric surfactants to form stable micelles capable of entrapping impurities. Niacinamide was incorporated as an active pharmaceutical ingredient to enhance skin health. The formulation was evaluated for physical appearance, pH, clarity, viscosity, cleansing efficacy, stability, and skin irritation potential. The results demonstrated that the prepared micellar water was clear, stable, skin-friendly, and effective in removing dirt and makeup, while maintaining an acceptable pH for topical application. The inclusion of niacinamide makes the formulation multifunctional, suitable for daily facial cleansing. This study concludes that the developed micellar water formulation is safe, effective, and cosmetically acceptable.

Keywords: Micellar water, Niacinamide, Facial cleanser, Surfactants, Skin care formulation

Introduction

Skin plays a vital role as the primary protective barrier of the human body, shielding internal organs from environmental pollutants, microorganisms, ultraviolet radiation, and chemical irritants [1]. Maintenance of skin hygiene is therefore essential to preserve its physiological functions and overall health. Facial skin, in particular, is continuously exposed to dust, sweat, excess sebum, cosmetic products, and environmental contaminants. If these impurities are not adequately removed, they may lead to clogged pores, acne, irritation, premature ageing, and disruption of the skin barrier [2]. Hence, an effective yet gentle cleansing regimen is considered a cornerstone of dermatological care.

Traditional cleansing agents such as soaps and detergent-based face washes have been widely used for facial cleansing. However, these products often contain harsh surfactants with alkaline pH that can strip the skin of its natural lipids. This disruption of the stratum corneum may result in dryness, irritation, increased transepidermal water loss, and heightened sensitivity, particularly in individuals with sensitive or acne-prone skin. The growing awareness regarding skin barrier protection has shifted consumer preference toward milder cleansing systems that provide effective cleansing without compromising skin integrity [3, 4].

In this context, micellar water has gained significant popularity in cosmetic and dermatological applications. Micellar water is an aqueous-based cleansing formulation containing surfactant molecules that self-assemble into micelles when present above a critical micelle concentration. These micelles possess a unique amphiphilic structure, with a hydrophobic core that attracts oil-soluble impurities such as sebum, makeup, and pollutants, and a hydrophilic outer shell that allows easy removal of these impurities from the skin surface [5, 6, 7]. This mechanism enables micellar water to cleanse the skin efficiently without the need for excessive rubbing or rinsing.

One of the key advantages of micellar water over conventional cleansers is its high skin tolerability [8]. Micellar formulations are generally free from alcohol and soap, exhibit a pH close to that of the skin, and utilise mild non-ionic or amphoteric surfactants. As a result, micellar water is suitable for all skin types, including sensitive, dry, and acne-prone skin [9]. Furthermore, micellar cleansing minimises mechanical friction and reduces the risk of irritation, making it ideal for daily use and for individuals undergoing dermatological treatments.

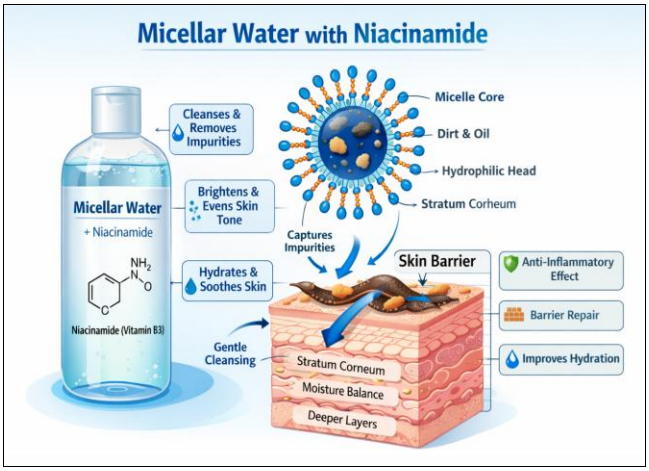

Fig 1: Micellar water with niacinamide benefits

In recent years, cosmetic formulations have evolved from single-function products to multifunctional systems that offer additional therapeutic benefits. The incorporation of

active ingredients into cleansing formulations has become an important strategy to enhance skin health while maintaining hygiene. Niacinamide, also known as nicotinamide or vitamin B3, is one such multifunctional ingredient that has gained considerable attention in dermatology and cosmetology [10, 11]. Niacinamide is a water-soluble vitamin known for its wide range of skin benefits, including enhancement of epidermal barrier function, reduction of transepidermal water loss, regulation of sebum production, anti-inflammatory activity, and improvement of skin texture and tone [12, 13].

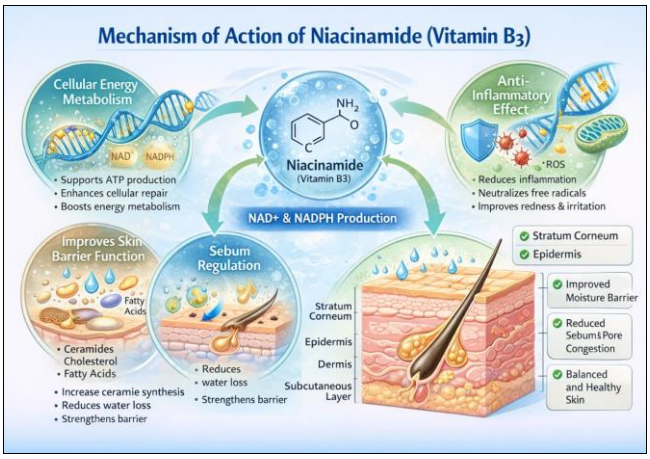

Fig 2: Niacinamide mechanism working on the human body

Several studies have demonstrated that niacinamide stimulates the synthesis of ceramides and other intercellular lipids, thereby strengthening the skin barrier and improving hydration [3]. It has also been reported to reduce erythema, hyperpigmentation, and acne-related inflammation, making it a valuable ingredient for daily skincare products [12]. Unlike many active compounds, niacinamide exhibits excellent stability in aqueous systems and shows good compatibility with a wide range of cosmetic excipients [14]. Additionally, it is non-comedogenic and well-tolerated, even at relatively higher concentrations, which supports its incorporation into facial cleansing formulations [15].

The combination of micellar cleansing technology with niacinamide offers a synergistic approach by providing effective removal of dirt and makeup along with added skin-conditioning and protective effects [16]. Such formulations are particularly beneficial for individuals seeking gentle yet multifunctional skincare solutions. Despite the widespread use of micellar waters, limited formulation-based studies have focused on the development of micellar water enriched with dermatologically active ingredients like niacinamide [17].

Therefore, the present study was undertaken to formulate and evaluate a micellar water containing niacinamide, developed by undergraduate pharmacy students. The objective of this research was to develop a stable, mild, and effective micellar cleansing formulation capable of removing dirt and cosmetic residues while simultaneously supporting skin barrier function [18]. The formulation was evaluated for physicochemical properties, cleansing efficacy, stability, and skin compatibility, making it suitable for routine facial cleansing applications.

Materials and Methods

1. Materials

The materials used for the preparation of *Hydralift Micelles (A Next-Generation Solution for Clean and Nourishing Skin)* were selected based on their safety, compatibility, and widespread use in cosmetic and dermatological formulations [11]. All ingredients were of pharmaceutical or cosmetic grade and were used without further purification.

- **Purified Water:** Used as the primary solvent and dispersion medium for the formulation
- **Tween 80 (Polysorbate 80):** used as a non-ionic surfactant for micelle formation and cleansing action [10]
- **Glycerine:** used as a humectant to provide skin hydration and moisturization
- **Propylene Glycol:** used as a humectant and co-solvent to enhance skin hydration and solubility of ingredients
- **Sodium Benzoate:** used as a preservative to prevent microbial growth [10]
- **Niacinamide (Vitamin B3):** used as an active ingredient for skin brightening and barrier improvement [11]
- **Disodium EDTA:** used as a chelating agent to enhance formulation stability by binding metal ions

2. Method of Preparation of Hydralift Micelles

The micellar water formulation was prepared using the **cold process method**, which is commonly employed for aqueous cosmetic formulations to preserve the stability of active ingredients and minimize degradation.

Initially, a measured quantity of purified water was taken in a clean, dry beaker and stirred gently using a magnetic stirrer at room temperature. Disodium EDTA was added to the purified water and stirred until it was completely dissolved. This step was carried out first to ensure chelation of any metal ions present in the aqueous medium, thereby improving the overall stability of the formulation.

Subsequently, glycerine and propylene glycol were added slowly to the aqueous phase with continuous gentle stirring. These humectants were incorporated to enhance the moisturizing and hydrating properties of the formulation while maintaining skin softness and preventing dryness [13]

After complete mixing of the humectants, niacinamide was added gradually to the formulation. The mixture was stirred until niacinamide was completely dissolved, ensuring uniform distribution throughout the solution. Niacinamide was incorporated at this stage to maintain its stability and effectiveness as a skin-brightening and barrier-supporting agent [11].

Following the addition of the active ingredient, Tween 80 (Polysorbate 80) was added slowly to the formulation with gentle stirring. Care was taken to avoid excessive agitation to prevent foam formation. Tween 80 acts as a non-ionic surfactant and is responsible for the formation of micelles, which encapsulate dirt, sebum, and makeup from the skin surface [1].

Finally, sodium benzoate was added as a preservative and mixed thoroughly until a clear and homogeneous solution was obtained. The prepared formulation was allowed to stand for a short period to remove entrapped air bubbles. The final product obtained was a clear, transparent micellar solution free from particulate matter.

The prepared micellar water was filled into clean, airtight containers and stored at room temperature for further evaluation studies.

3. Evaluation Parameters

3.1 Physical Appearance and Clarity

The formulation was visually inspected for color, clarity, and presence of any particulate matter.

3.2 pH Determination

The pH of the formulation was measured using a calibrated digital pH meter at room temperature.

3.3 Viscosity

Viscosity was determined using a Brookfield viscometer at 25°C which is a standard technique for characterizing low-viscosity cosmetic liquids such as micellar water.

3.4 Cleansing Efficacy

Cleansing efficiency was evaluated by applying makeup to the skin surface and removing it using a cotton pad soaked with the micellar water. The effectiveness was assessed visually [5].

3.5 Skin Irritation Test

A patch test was carried out on healthy human volunteers to observe any signs of redness, itching, or irritation.

3.6 Stability Studies

The formulation was stored at room temperature and accelerated conditions to observe any changes in appearance, pH, or phase separation over a period of 30 days.

Results

The formulated micellar water *Hydralift Micelles* was subjected to various physicochemical, microbiological, and dermatological evaluation tests to assess its safety, stability, and performance. All tests were carried out as per standard laboratory procedures, and the results obtained were found to be satisfactory.

Table 1: Evaluation Results of Hydralift Micellar Water Formulation

Sr. No.	Evaluation Test	Method / Observation	Result	Inference
1	pH Test	pH measured using calibrated digital pH meter at room temperature	5.5 - 6.0	Skin-friendly and suitable for topical application
2	Anionic Surfactant Detection Test	No precipitate or color change observed	Anionic surfactants absent	Confirms presence of mild non-ionic surfactant; low irritation potential
3	Microbial Test	No visible microbial growth observed	Within acceptable cosmetic limits	Microbiologically safe and effective preservation
4	Skin Efficacy Test	Effective removal of dirt, oil, and makeup; skin felt clean and hydrated	Satisfactory cleansing and skin nourishment	Effective micellar cleansing with moisturizing effect
5	Skin Irritability Test	No redness, itching, or irritation observed during patch test	Non-irritant	Safe for regular topical use

1. pH Test

The pH of the prepared micellar water formulation was determined using a calibrated digital pH meter at room temperature. The pH value of the formulation was found to be within the range of 5.5 to 6.0, which closely corresponds to the natural pH of human skin. This indicates that the formulation is skin-friendly and suitable for topical application without causing irritation or disruption of the skin barrier.

2. Anionic Surfactant Detection Test

The anionic surfactant detection test was performed to confirm the absence of harsh anionic surfactants in the formulation. The test results indicated no characteristic precipitate or color change, confirming the absence of anionic surfactants. This result demonstrates that the formulation contains only mild non-ionic surfactants, which contributes to improved skin tolerability and reduced irritation potential.

3. Microbial Test

Microbial analysis of the prepared micellar water was carried out to evaluate microbial contamination and preservative effectiveness. The results showed no visible microbial growth, and the microbial load was found to be within acceptable limits as per cosmetic standards. This confirms that the preservative system used in the formulation is effective and that the product is microbiologically safe for topical use.

4 Skin Efficacy Test

The skin efficacy of the formulated micellar water was evaluated based on its cleansing performance and skin feel after application. The formulation effectively removed dirt, oil, and makeup from the skin surface with minimal effort. Post-application observation indicated that the skin felt clean, fresh, and hydrated, without any tightness or dryness. The presence of humectants and niacinamide contributed to improved skin smoothness and overall appearance.

5. Skin Irritability Test

The skin irritability test was conducted using a patch test method on healthy human volunteers. The formulation was applied to a small area of skin and observed for any signs of redness, itching, inflammation, or discomfort over a specified period. No adverse reactions were observed during the test period, indicating that the formulation is non-irritant and safe for regular topical use.

6. Summary of Results

Overall, the results obtained from all evaluation tests confirmed that *Hydralift Micelles* is a stable, mild, and skin-compatible micellar water formulation. The formulation exhibited appropriate pH, absence of harsh surfactants, microbiological safety, effective cleansing action, and excellent skin tolerability.

Discussion

The present study was undertaken to formulate and evaluate *Hydralift Micelles*, a micellar water enriched with niacinamide, with the objective of developing a mild, effective, and skin-compatible facial cleansing formulation.

The results obtained from physicochemical, microbiological, and dermatological evaluations indicate that the developed formulation meets the essential criteria of an ideal micellar cleansing product.

The pH of a topical formulation plays a crucial role in maintaining the integrity of the skin barrier. In the present study, the pH of *Hydralift Micelles* was found to be in the range of 5.5-6.0, which is close to the physiological pH of human skin. This acidic pH range helps preserve the acid mantle of the skin, thereby reducing the risk of irritation, dryness, and microbial colonization. The skin-friendly pH of the formulation suggests that it is suitable for regular facial use and is unlikely to disrupt normal skin functions.

One of the major advantages of micellar water over conventional cleansers is the absence of harsh anionic surfactants. The anionic surfactant detection test confirmed the absence of anionic surfactants in the formulation, indicating the exclusive presence of a mild non-ionic surfactant, Tween 80. Non-ionic surfactants are known for their low irritation potential and high compatibility with the skin. The absence of anionic surfactants in *Hydralift Micelles* contributes significantly to its gentle cleansing action and improved skin tolerability, making it suitable for sensitive and acne-prone skin types.

Microbiological stability is an essential quality attribute of aqueous cosmetic formulations, as such systems are highly susceptible to microbial contamination. The microbial test results demonstrated no visible microbial growth and acceptable microbial limits, confirming the effectiveness of sodium benzoate as a preservative in the formulation. The presence of disodium EDTA further enhanced preservative efficacy by chelating metal ions that could otherwise promote microbial growth. These results indicate that the formulation is microbiologically safe for topical application and has adequate shelf stability.

Fig 3: Hydralift Micelles, display of our product

The skin efficacy test revealed that *Hydralift Micelles* effectively removed dirt, oil, and makeup from the skin surface with minimal effort. The micellar cleansing mechanism allows the hydrophobic core of micelles to solubilize oily impurities, while the hydrophilic outer layer facilitates easy removal using a cotton pad. The presence of humectants such as glycerine and propylene glycol helped maintain skin hydration after cleansing, preventing the tightness and dryness commonly associated with traditional cleansers. This observation highlights the dual functionality of the formulation, providing effective cleansing while maintaining skin moisture balance.

The skin irritability test further confirmed the safety of the developed formulation. The absence of redness, itching, or irritation during the patch test indicates excellent skin compatibility. This can be attributed to the use of mild excipients, absence of harsh surfactants, and incorporation of niacinamide, which possesses anti-inflammatory and barrier-strengthening properties. Niacinamide is known to improve skin tolerance and reduce inflammation, which further supports the non-irritant nature of the formulation.

Overall, the results obtained in the present study demonstrate that *Hydralift Micelles* successfully combines effective micellar cleansing technology with the dermatological benefits of niacinamide. The formulation exhibited appropriate pH, microbiological safety, absence of irritating surfactants, effective cleansing performance, and excellent skin tolerability. These findings suggest that the developed micellar water formulation is suitable for daily facial cleansing and offers added skin-nourishing benefits, making it a promising cosmetic product for routine use.

Conclusion

The present study successfully formulated and evaluated a micellar water containing niacinamide. The developed formulation demonstrated effective cleansing action, good stability, and excellent skin compatibility. The addition of niacinamide enhanced the dermatological value of the product. This micellar water formulation can be considered a safe and effective alternative to conventional facial cleansers.

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Conflict of Interest

The authors declare no conflict of interest.

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