Інше

UDC 613.495

Hrebeniuk Oksana

Expert in the art of makeup and esthetics at Eva Beauty Bar LLC

TECHNIQUES FOR CREATING MAKE-UP ADAPTED TO VARIOUS CLIMATIC CONDITIONS

Summary. *The article focuses on the features of creating makeup adapted to different climatic conditions. The relevance of the topic is due to the wide variety of climatic zones and their different effects on the barrier properties of the skin and the durability of decorative products. The novelty of the work lies in the generalization of data on the mechanisms of epidermal balance involving filaggrin and NMF, as well as in demonstrating the practical effect of humidity and temperature on the durability of makeup. The study examined literary sources touching on the physiological aspects of transepidermal water loss, the reaction of lipid-protein structures of the skin and the features of applying decorative compositions in high heat, cold and variable humidity. The possibilities of adjusting color techniques (light and shade) are studied, allowing for the leveling out of visual imperfections in extreme climates. Particular attention is paid to the methods of combining photoprotection and decorative functions. The article sets the task of determining the mechanisms of adaptation of decorative products to climate fluctuations. Comparative analysis, data synthesis and market capacity assessment were used. The final conclusions will be useful for specialists in the cosmetics industry, makeup artists and scientists.*

Key words: *makeup, climate, humidity, temperature, pH, filaggrin, transepidermal water loss, photoprotection, decorative products, adaptation.*

Introduction. The issue of selecting appropriate makeup techniques for different climatic conditions is gaining increasing interest due to the expanding range of cosmetic products and growing demands for their durability. Hot and dry regions, high humidity, and extreme cold each impose specific limitations that affect the skin and the behavior of decorative coatings.

The aim of this study is to examine the mechanisms of makeup adaptation to fluctuations in temperature and humidity, drawing on research related to transepidermal water loss and filaggrin activity.

To achieve this goal, the following objectives have been set:

- Analyze publications on the impact of extreme climatic conditions on the structure and function of the epidermis.
- Describe technical methods that enhance makeup longevity in hot, cold, and variably humid conditions.
- Systematize recommendations for combining photoprotection with decorative effects to maintain the skin's barrier properties.

The novelty of this study lies in the integrating physiological mechanisms (filaggrin, NMF, pH) with practical application techniques and the analyzing makeup durability under different climatic conditions.

Materials and Methods. The study was based on the following sources: I.O. Gorbunova [2] provided insights into the effects of light and shadow in creating volumetric coverage and discussed techniques for correcting facial texture in hot conditions. L. Cau, V. Pendaries, E. Lhuillier, P.R. Thompson, G. Serre, H. Takahara, M.C. Méchin and M. Simon [4] demonstrated the importance of external humidity in the control of human filaggrin metabolism, and suggested that deimination plays a major role in this regulation. J.S. Lee [5] and K. Kwon [6] explored the selection of climate-adaptive cosmetic products using artificial intelligence methodologies and discussed pH-dependent processes in the skin. Milet [7] and Kim [3] analyzed climatic specifics and industry development

prospects across different continents. Asfary Labellab [1] investigated ingredient selection considering humidity and temperature.

Additionally, the Sun Care Products Market report [8] presents statistics on photoprotective products and marketing trends.

A comparative method was applied, involving the correlation of data on barrier function and decorative cosmetics across various climates. The study included a textual analysis and a review of publications, with the results systematically categorized based on temperature and humidity conditions and the examined makeup formulations.

Results. Various sources indicate that climate has a heterogeneous impact on the skin and decorative coatings. An analysis of publications has identified several key findings related to changes in air humidity, ambient temperature, ultraviolet exposure, ingredient selection for makeup, and adjustments in application techniques.

Certain reviews highlight the increased vulnerability of the skin under extreme heat conditions. An increase in dryness and acne occurrence has been observed, particularly in regions where high temperatures persist for extended periods and relative humidity fluctuates [6]. In such areas, there is a demand for cosmetics that reduce perspiration and minimize pore congestion, including formulations with lightweight pigments and long-lasting binding components. Researchers have documented adaptations in cosmetic products designed for sports and active lifestyles, where resistance to moisture and sweat is a critical factor [7].

Some data suggest that regions with significant weather fluctuations and temperature shifts require a multi-step approach to product selection and application methods. In such cases, combined textures are used, incorporating gentle primers and correctors layered with water-resistant mineral-based coatings [5]. Cosmetic companies are expanding their product lines to accommodate varying daytime and evening conditions with different levels of solar exposure.

Marketing analysis indicates high consumer interest in foundation products and blushes that include UVB and UVA filters. Additionally, survey results reveal a growing preference for makeup that protects not only against ultraviolet radiation but also against infrared and visible light spectrums, reflecting increased awareness of photoinduced aging [1].

Insufficient adaptation of cosmetic formulations leads to irritation and uneven makeup distribution in fluctuating humidity conditions. Preventive mechanisms against flaking focus on moisture retention through the inclusion of NMF components (natural moisturizing factor), ceramides, and lipid-restoring agents. This trend aligns with studies on the composition of the stratum corneum in extreme environments, where excessive dryness or high humidity disrupts the skin barrier and increases transepidermal water loss (TEWL) [4].

Dry air has been shown to accelerate transepidermal water loss, particularly at an epidermal pH below 6.5. When the skin's surface pH drops below this threshold, enzyme activity responsible for breaking down filaggrin into free amino acids decreases. The formation of free amino acids, essential for maintaining skin hydration, is weakened, leading to increased vulnerability of the stratum corneum (see Fig. 1).

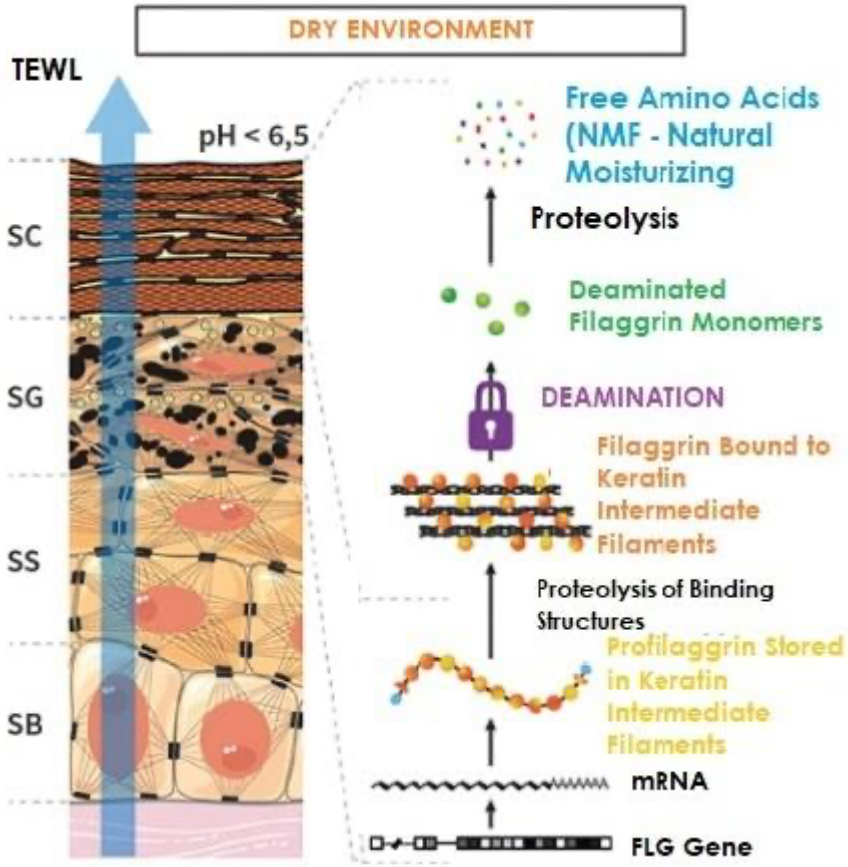

Fig. 1. The effect of a dry environment on filaggrin metabolism and skin barrier function (SC - stratum corneum, SG - granular layer, SS - spinous layer, SB - basal layer) [4]

The retention of NMF in the epidermis increases under high humidity, leading to a reduction in TEWL and a more even distribution of amino acids. When pH exceeds 6.5, filaggrin proteolysis becomes more active, resulting in the formation of monomers that support hydration (see Fig. 2).

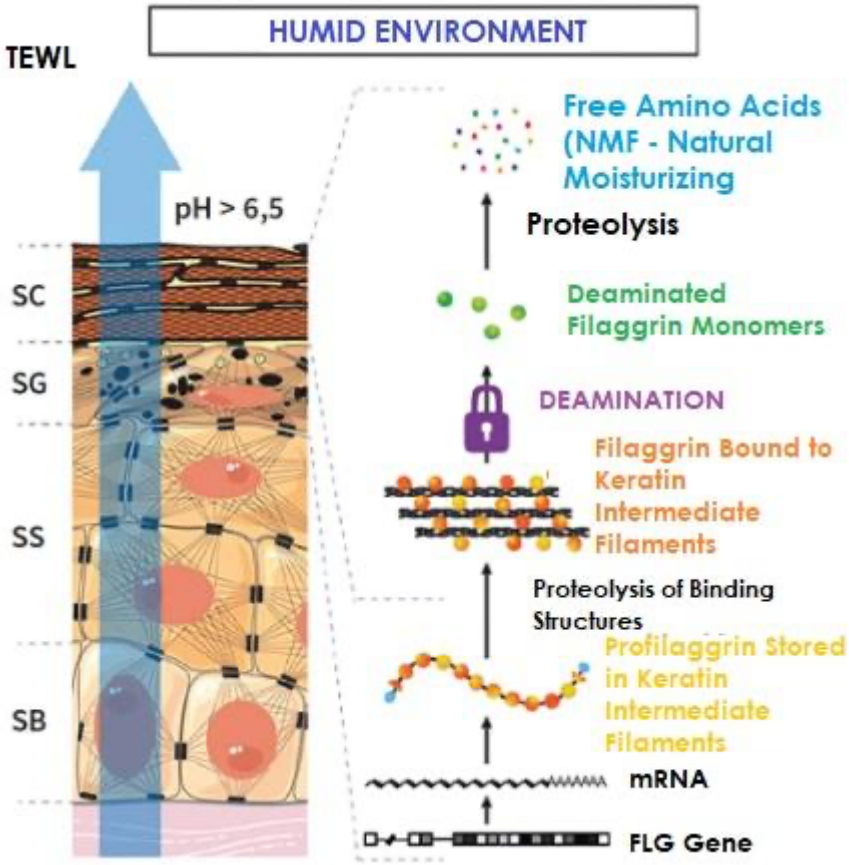

Fig. 2. The effect of a humid environment on filaggrin metabolism and skin barrier function (SC - stratum corneum, SG - granular layer, SS - spinous layer, SB - basal layer) [4]

Publications on sun protection cosmetics describe growing interest in combining decorative properties with photoprotection [7]. Statistical reports indicate an increasing demand for moisturizing products with high SPF, pigmented formulations for lip and eye makeup enriched with antioxidants, vitamins, and enzymes that enhance resistance to external factors [8]. Some reviews provide a digital assessment of the sun care cosmetics market, highlighting sales growth and the development of formulations designed for daily wear without overburdening the skin [3].

A comparative analysis of makeup adaptations for hot and cold climates has revealed key differences in priorities. In warmer environments, lightweight formulas are preferred as they are less likely to clog pores and better withstand

perspiration [6]. In low-temperature conditions, denser cream-based foundations are favored to create an additional layer that helps prevent epidermal dehydration. In tropical regions, mattifying products that prevent excessive shine and account for increased sebum production are gaining popularity [1].

Significant temperature fluctuations, humidity shifts, and cold air can lead to cracking of makeup layers. In tropical climates, there is a higher risk of smudging and decreased longevity of cosmetic products, while in hot and dry regions, foundation adhesion to the skin deteriorates. In Arctic conditions, there is a likelihood of texture freezing and moisture condensation, which affects the smoothness of application (see Fig. 3).

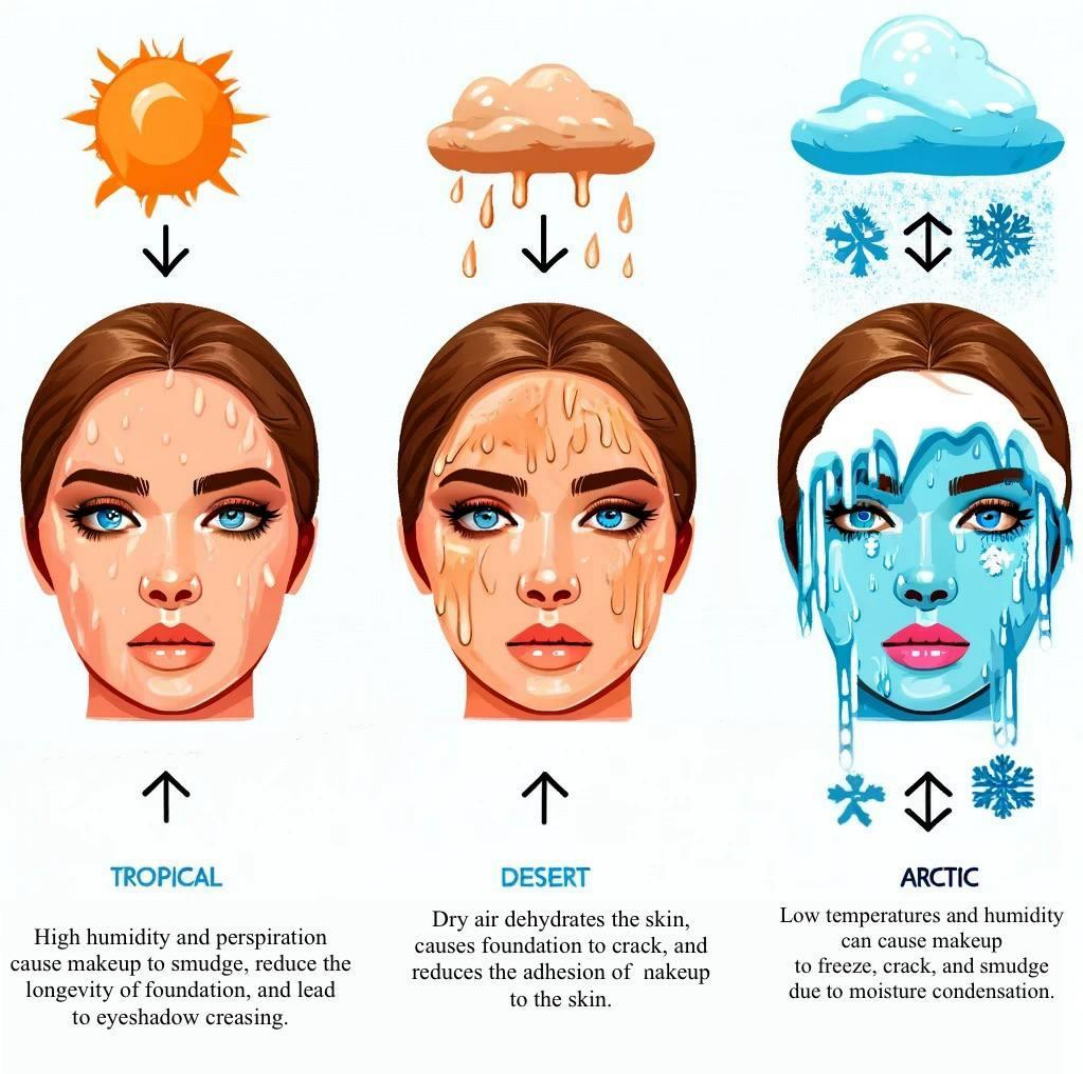

Fig. 3. Comparative analysis of climate factors affecting makeup

Source: compiled by the author based on [1]

Certain experiments highlight the benefits of cooling ingredients that can reduce the perceived temperature on the skin's surface. BB creams with a localized cooling effect of 3–5 degrees have been noted as highly demanded, as they enhance the comfort of wearing makeup [3]. Consumers associate an improved complexion with such formulations, which help maintain a fresh sensation even after multiple applications throughout the day.

Literature on light and shadow techniques discusses facial tone correction through the differentiated use of highlighter and bronzer, depending on lighting conditions and the angle of light incidence [2]. There is reported demand for translucent powders designed to accentuate specific areas, utilizing reflective particles to adjust skin texture and diminish the appearance of inflammation or dryness in hot conditions.

The collected data systematize the understanding of high consumer interest in makeup that remains resistant to wind, solar radiation, and humidity fluctuations. Many manufacturers have implemented combined methods that integrate long-wear pigments with skincare ingredients that soften and hydrate the skin. Consumers living in regions with significant weather fluctuations tend to prefer multifunctional products that, in addition to their decorative effect, support the skin's barrier function and reduce the risk of irritation.

A literature review indicates the growing popularity of hybrid formulations that simultaneously minimize UV damage, regulate thermal load, and ensure long-lasting makeup wear. Summary reports propose a technological model for developing formulations that incorporate durable pigment particles, low oil content, and additional emollients that enhance the tactile properties of cosmetics under varying humidity levels [8]. These solutions are particularly targeted at athletes, residents of hot climates, and individuals seeking makeup that provides comfort without a heavy feel.

Discussion. Previous studies have demonstrated that humidity levels, temperature fluctuations, and ultraviolet exposure directly influence the maintenance of epidermal barrier function, including the preservation of the natural moisturizing factor (NMF) associated with filaggrin metabolism. Various authors have indicated that low humidity leads to increased water loss through the stratum corneum, while excessive humidity, conversely, reduces transepidermal moisture flux. This study confirms this correlation, showing that in arid climates, the stratum corneum exhibits a rapid decline in free amino acid concentration and more pronounced barrier damage, whereas in high-humidity environments, NMF retention is greater, and filaggrin degradation occurs more gradually.

The observations obtained in comparison with the data from [4] align with conclusions that proteolytic enzyme activity is linked to local pH levels, which can fluctuate with changes in air humidity. When pH drops below 6.8, surface dryness increases, and the number of filaggrin monomers decreases, indicating a specific vulnerability of the epidermis in arid conditions. Conversely, when pH exceeds 6.8, enzymatic reactions intensify, free amino acids are formed, and the stratum corneum retains moisture more effectively. This behavior can be interpreted as an adaptive mechanism of the epidermis to environmental conditions, where a balance between filaggrin, amino acids, and barrier function plays a key role.

Beyond the physiological state of the skin, this study examined the behavior of decorative coatings under different climatic conditions. In tropical zones, excessive perspiration and high humidity accelerate the displacement of makeup textures, reducing the longevity of foundation and increasing the tendency of eyeshadows to crease. In hot, arid environments where air lacks moisture, foundation products exhibited cracking, and makeup adhesion to the skin weakened. Arctic-like conditions posed risks of cosmetic formulas freezing and condensation forming on the skin, sometimes leading to cracking of the applied

products. The level of humidity and temperature directly impacts the uniformity of application and the durability of decorative cosmetics.

A comparison with previous studies reveals a general trend: an effectively protected epidermis, characterized by stable NMF levels and a balanced pH, demonstrates greater resilience to temperature fluctuations and maintains makeup without significant structural alterations. However, some authors have noted that under extreme heat conditions, even an optimal lipid and amino acid composition does not always guarantee the preservation of the decorative layer. This indicates the need for additional testing to refine makeup formulations based on microclimatic conditions and the duration of external exposure.

Several unresolved questions remain in this area. First, there is a lack of data on the long-term effects of combined extreme humidity and high temperatures on filaggrin dynamics—most studies have focused either on heat combined with low humidity or on consistently high humidity under moderate thermal conditions. Second, there is limited understanding of how to precisely adjust cosmetic formulations to prevent component freezing under peak subzero temperatures. Third, detailed chemical analysis of filaggrin and its monomers during abrupt pH fluctuations still requires further development to reliably apply this knowledge in designing makeup for diverse climatic conditions.

This study contributes to the field by integrating data on the interaction between the epidermal barrier, humidity, and temperature with practical observations on the behavior of decorative cosmetics. Specific signs of weakened foundation adhesion and increased transepidermal water loss under low humidity conditions were identified, along with the effects of excessive moisture—such as an increased sliding effect of cosmetic products on the skin. The findings may encourage further research into developing makeup that can adapt to extreme conditions, including sudden shifts in temperature and humidity.

Thus, this study enhances the understanding of the mechanisms linking climate variations, the quality of decorative coatings, and filaggrin activity. In the

future, this could improve approaches to personalized cosmetic selection and lead to the development of formulations that account for regional and climatic conditions, ensuring stable coverage and optimal skin hydration.

Conclusion. The objectives outlined in the introduction are reflected in the final conclusions. First, the literature review established that filaggrin activity, NMF retention, and a balanced pH form the foundation for the skin's adaptation to extreme dryness, humidity, and temperature fluctuations. Second, the examined technical approaches—including multilayer application, adjustments to base formulations, and the selection of appropriate pigments—enhance makeup adhesion and support the skin barrier across various climatic conditions. Third, the study analyzed methods for integrating photoprotection with decorative coverage to ensure color stability and provide additional epidermal defense.

The findings confirm the significance of weather factors in selecting decorative products and application techniques. The results may serve as an impetus for developing innovative formulations that enable individuals across different professions and regions to create makeup that remains stable under extreme conditions without compromising skin health.

References

1. The influence of climate on the choice of ingredients for cosmetics. *Asfary Labellab.* URL: https://asfarylab.com/vlijanie-klimata-na-vybor-ingredientov-dlja-kosmetiki/ (date of access: 02/05/2025).

2. Gorbunova, O. A. Effects of light and shadow in makeup: creating volume and contrast. *Bulletin of Science*. 2023. No. 10 (67).

3. Beat the Heat: Innovations in Climate-Proof Makeup. Alibaba.com. – URL: https://reads.alibaba.com/beat-the-heat-innovations-in-climate-proof-makeup/ (access date: 05.02.2025).

4. Cau L, Pendaries V, Lhuillier E, Thompson PR, Serre G, Takahara H, Méchin MC, Simon M. Lowering relative humidity level increases epidermal

protein deimination and drives human filaggrin breakdown. J Dermatol Sci. 2017 May;86(2):106-113. doi: 10.1016/j.jdermsci.2017.02.280. Epub 2017 Feb 20. PMID: 28242341; PMCID: PMC5476296.

5. Lee, J. S., Ha, J., Shin, K., Kim, H., Cho, S. Different cosmetic habits can affect the biophysical profile of facial skin: a study of Korean and Chinese women. Ann Dermatol. 2019. Vol. 31, No. 2. P. 175-185. DOI: 10.5021/ad.2019.31.2.175. Epub 2019 Feb 28. PMID: 33911566; PMCID: PMC7992690.

6. Lee, J., Kwon, K. Skin health response to climate change: weather tailored cosmetics using artificial intelligence. Journal of Medical Artificial Intelligence. 2024. Vol. 7. URL: https://jmai.amegroups.org/article/view/9056 (date accessed: 05.02.2025).

7. Milet, K. Trends: how climate change will transform cosmetics. *Premium Beauty Media.* 2024. URL: https://www.premiumbeautynews.com/en/trends-how-climate-change-will%2C23244 (Date accessed: 05 Feb. 2025).

8. Sun Care Products Market Size, Share & Trends Analysis Report by Product, By Distribution Channel (Hypermarket & Supermarket, Pharmacy & Drug Store, Online), By Region, And Segment Forecasts, 2021–2028.