Analysis Of Skin Conditions In Early Adult Consumers Using A Skin Analyzer: Implications For Cosmetic Product Formulation

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ABSTRACT

This study aimed to analyze the skin characteristics of early adult consumers using data collected from a skin analyzer and explore the implications for cosmetic product formulation. The research sample consisted of 73 participants, with the majority aged between 17 and 20 years. The measured skin parameters included moisture, pores, melanin, acne (acne), wrinkles, and sensitivity. Data were analyzed using descriptive statistics and consumer segmentation techniques. The findings revealed that the early adult consumers in the sample generally exhibited low skin moisture levels (56.2%), enlarged skin pores (mean of 3.90 out of 5), fair skin pigmentation (69.9% with a melanin value of 1), severe acne severity (56.2% with an acne value of 5), minimal wrinkling (53.4% with a wrinkle value of 1), and high skin sensitivity (38.4% with a sensitivity value of 5). Based on consumer segmentation, formulation recommendations were provided for groups with dry and sensitive skin, severe acne and enlarged pores, and normal-to-oily skin with minimal wrinkle concerns. These findings highlight the need for targeted cosmetic formulations to address the specific skin concerns faced by early adult consumers. Although limitations such as a relatively small sample size and a focus on objective measurements existed, this study provides valuable insights for data-driven cosmetic product development. Further studies are recommended to investigate lifestyle and environmental factors, incorporate subjective data, and explore inter-group differences within the early adult consumer population. This research demonstrates the importance of evidence-based skin data analysis in informing cosmetic formulation strategies. By understanding and catering to the unique needs of early adult consumers, the cosmetic industry can develop more effective and satisfying products, driving market growth within this critical consumer demographic. A data-driven approach to cosmetic product development will become increasingly crucial in adapting to evolving consumer needs and preferences.

Key words: skin analysis, skin analyzer, early adult consumers, cosmetic formulation, consumer segmentation

INTRODUCTION

Skin health and appearance are critical concerns for many individuals, particularly those in the early adulthood phase (ages 20-40 years). This life stage is characterized by significant physiological and psychosocial changes that can profoundly impact skin condition (Cho et al., 2021; Farage et al., 2008). Extrinsic factors such as occupational stress, environmental exposures, and lifestyle habits coupled with intrinsic processes like hormonal fluctuations can contribute to various dermatological issues in this demographic (Baran & Maibach, 2017; Krutmann et al., 2017). A comprehensive understanding of the characteristics and specific needs of early adult consumers' skin is therefore imperative for developing targeted and efficacious cosmetic interventions.

While individual variations exist, evidence suggests the early adulthood population exhibits distinct skin requirements compared to other age groups. A nationwide survey (n=2,109) revealed over 50% of Americans aged 20-40 years identified acne, visible pores, and premature signs of aging as their primary skin concerns (Tensen et al., 2016). These findings are corroborated by clinical studies reporting a high prevalence of conditions like acne vulgaris (affecting up to 42.5% of women aged 21-30; (Bagatin et al., 2021), excessive sebum production (Butler et al., 2020), and early-onset periorbital photodamage (Mercurio et al., 2016), among early adults. Characterizing these common dermatological conditions can guide cosmetic formulators in developing tailored products.

Recent advances in skin imaging and analysis technologies, such as the Visia-CR skin analyzer, allow for the objective, quantitative evaluation of multiple skin parameters (Abdlaty et al., 2018). By capturing multi-spectral images and processing them through advanced algorithms, these devices can precisely measure traits like moisture levels, texture, pigmentation abnormalities, and vascular features (Sun et al., 2022). Leveraging such tools provides an unprecedented opportunity to comprehensively profile early adult consumers' skin and elucidate trends or segmentation based on their diverse needs.

Several studies have demonstrated the utility of skin analyzers in cosmetic research. Dimitriu et al. (2019) used the Visia system to characterize skin aging patterns in a cohort of 232 Mexican females aged 20-60 years, identifying distinct clusters based on their pigmentation, pore, and wrinkle measures. Similarly, Park et al. (2015) employed the Mexameter to quantify pigmentary changes and guide depigmenting formulation development.

The primary objective of this study is to conduct an in-depth analysis of various skin parameters in a sample of early adult consumers using a validated skin imaging system. By examining metrics such as hydration, sebum levels, pore characteristics, pigmentation, and textural irregularities, we aim to comprehensively characterize the dermatological landscape of this key demographic. Furthermore, we seek to investigate potential correlations

between these skin traits and demographic/lifestyle factors within our sample.

Ultimately, through cluster analysis and consumer segmentation based on their respective skin profiles, this research will yield actionable insights to inform the rational design of tailored cosmetic product formulations. By aligning product development with empirically-defined consumer needs, we can enhance efficacy, consumer satisfaction, and successful market translation (Suryaneta, Aida Febina Sholeh, 2023; Yasir et al., 2023). Recommendations will be provided for suitable cosmetic interventions (e.g. targeted serums, moisturizers) to address the distinct requirements of each identified consumer segment within the early adult population.

METHODS
This section of the report gives a detailed account of the procedure of this research. (added below)

Participant Description
This study involved a total of 73 voluntary participants. This sample size was chosen to provide adequate representation of the target population, early adult consumers, while considering the feasibility of data collection and analysis. The participants were in the early adulthood age range, which is generally defined as individuals aged 18 to 35 years. This age range was selected because it encompasses the transitional period from adolescence to adulthood, during which individuals often experience lifestyle changes and different skin care needs compared to other age groups (Farage et al., 2008).

Data Collection Using Skin Analyzer
Measured Parameters
The skin conditions of participants were measured using a skin analyzer, which is a non-invasive tool for assessing various skin parameters. This research used API 100 for Skin Analyzer with brand Aram Huvis. The parameters measured in this study included: (1) Moisture that assessing skin hydration, categorized as "high" or "low"; (2) Pores that evaluating pore size on a scale of 1-5, with 1 indicating small pores and 5 indicating large pores; (3) Melanin that assessing skin pigmentation levels on a scale of 1-5, with 1 representing lighter skin and 5 representing darker skin; (4) Acne that evaluating acne severity on a scale of 1-5, with 1 indicating little or no acne and 5 indicating severe acne; (5) Wrinkles that assessing the depth and amount of wrinkles on a scale of 1-5, with 1 indicating few wrinkles and 5 indicating significant wrinkles; and (6) Sensitivity that evaluating skin sensitivity levels on a scale of 1-5, with 1 indicating non-sensitive skin and 5 indicating highly sensitive skin.

Measurement Procedure

Measurements were conducted under controlled and standardized conditions to ensure consistency and minimize confounding variables. Participants were asked to cleanse their faces and wait for 30 minutes before measurement to stabilize skin conditions. The skin analyzer was positioned on predetermined facial areas, such as the forehead, cheeks, and chin, to obtain accurate readings. Multiple readings were taken for each parameter, and the average values were used for further analysis.

Data Analysis Methods

Data Tabulation

The data collected from the skin analyzer was entered into an electronic spreadsheet for tabulation and organization. Each participant was assigned a unique code to maintain confidentiality and facilitate data analysis. Skin parameters and their corresponding values for each participant were recorded in a structured format.

Descriptive Statistical Analysis

Descriptive statistical analyses were performed to provide an overall picture of the participants' skin characteristics. The following steps were taken: (1) Calculating the mean values for each skin parameter across the sample; (2) Determining the minimum and maximum values for each skin parameter: and (3) Calculating the percentage of participants falling into each skin condition category (e.g., percentage with dry, oily, or combination skin). These descriptive statistics provided insights into the distribution and variability of skin characteristics within the sample.

Consumer Segmentation and Clustering

To identify consumer segments with similar skin characteristics, cluster analysis techniques were applied to the data. The k-means algorithm was used to cluster participants based on their skin parameter values. The optimal number of clusters was determined using the elbow and silhouette analysis methods. After segments were identified, the skin characteristic profiles for each segment were described and interpreted.

RESULTS

The analysis of skin conditions in 73 early adult participants, aged between 15-22 years with the majority being 17-20 years old, revealed several notable findings. The sample comprised 64 females and 9 males. Regarding skin moisture levels, a considerable proportion of 56.2% exhibited low skin hydration, while 41.1% had high moisture content. Only 2 participants (2.7%) did not have moisture data recorded (Table 1). The example of result skin analysis can be shown in Figure 1.

Examination of skin pore characteristics revealed a mean value of 3.90, indicating a tendency towards larger pore sizes across the sample. The minimum recorded value was 1, representing small pores, while the

maximum value of 5 corresponded to very large, visible pores. This suggests that enlarged pores are a common concern among early adult consumers.

Skin pigmentation, as measured by melanin levels, demonstrated a mean value of 1.47, reflecting a predisposition towards fairer skin tones in this demographic. Notably, 69.9% of participants exhibited a melanin value of 1, indicative of very fair skin pigmentation. In contrast, only one participant (1.4%) had a melanin value of 5, corresponding to very dark skin.

Table.1 Summary of Key Results

Skin Parameter	Mean Value	Minimum Value	Maximum Value	Key Findings
Moisture	-	Low	High	56.2% low moisture, 41.1% high moisture
Pores	3.90	1	5	Tendency towards larger pore sizes
Melanin	1.47	1	5	69.9% fair skin Pigmentation (value of 1)
Acne	4.16	1	5	56.2% very severe acne (value of 5)
Wrinkles	1.52	1	3	53.4% no or minimal wrinkles (value of 1)
Sensitivity	3.66	1	9	38.4% very sensitive skin (value of 5)

Note: In the "Moisture" row, the mean value and minimum/maximum values were left blank because the moisture parameter was categorized as "high" or "low" rather than being measured on a numeric scale like the other parameters.

Acne severity, assessed using the acne parameter, yielded a mean value of 4.16, signifying a substantial acne burden in the sample population. Alarmingly, 56.2% of participants recorded an acne value of 5, indicating very severe acne conditions. Conversely, only 2 participants (2.7%) had an acne value of 1, representing no observable acne.

The analysis of wrinkle levels revealed a mean value of 1.52, suggesting minimal wrinkle presence in the early adult cohort. Notably, 53.4% of participants exhibited a wrinkle value of 1, indicating no or

negligible wrinkles. No participants recorded a wrinkle value above 3, which would correspond to moderate wrinkle severity.

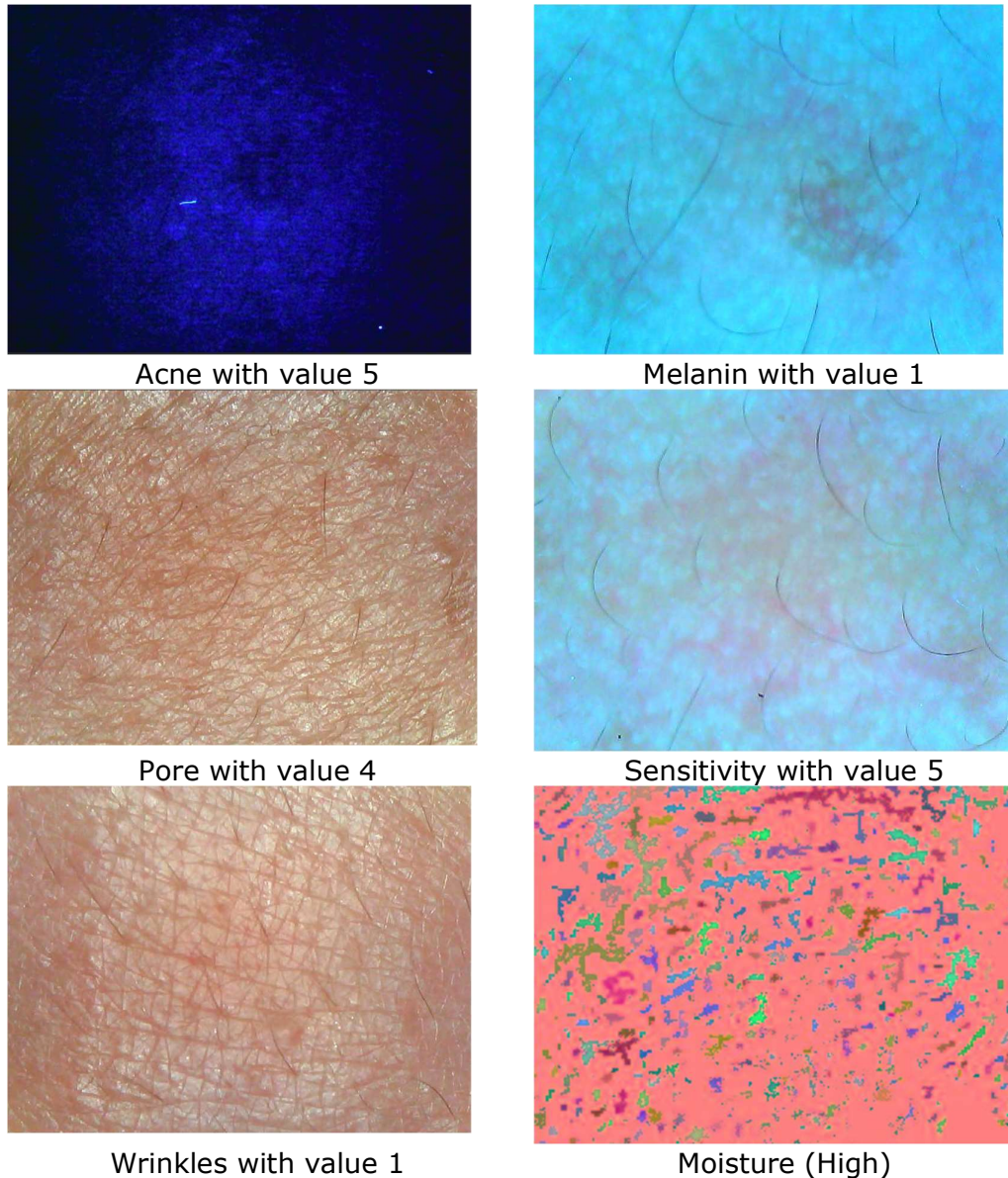|	
Acne with value 5	Melanin with value 1
Pore with value 4	Sensitivity with value 5
Wrinkles with value 1	Moisture (High)

Figure 1. Skin Analysis Result Pictures

Skin sensitivity emerged as a significant factor, with a mean value of 3.66 across the sample, implying a general tendency towards sensitive skin conditions. Remarkably, 38.4% of participants had a sensitivity value of 5, indicating very sensitive skin. However, one participant displayed an outlier sensitivity value of 9, which may be attributable to a data entry error.

These findings underscore the unique skin characteristics and concerns prevalent among early adult consumers. Low moisture levels, enlarged pores, fair skin tones, severe acne, minimal wrinkles, and heightened skin sensitivity appear to be defining features of this demographic. Consequently, cosmetic formulations tailored to address these specific needs, such as enhancing hydration, minimizing pore appearance, combating acne, and protecting sensitive skin, would be highly beneficial for this consumer segment.

DISCUSSION

The analysis of data from this study highlights several salient skin characteristics among early adult consumers that have significant implications for cosmetic product formulation. Firstly, the finding that the majority of participants (56.2%) exhibited low skin moisture levels underscores the need for formulations focused on enhancing hydration. Adequate skin hydration is crucial for maintaining overall skin health and appearance (Lichterfeld-Kottner et al., 2020). Cosmetic interventions incorporating humectants, emollients, and occlusives could effectively address this prevalent dryness concern in the early adult demographic (Purnamawati et al., 2017).

Secondly, enlarged skin pores emerged as a common issue, with the mean pore size value of 3.90 indicating a tendency towards visible, dilated pores across the sample. Factors such as excess oil production, aging, and genetics can contribute to this condition (Flament et al., 2015). Formulations designed to minimize the appearance of pores and regulate sebum excretion, potentially incorporating ingredients like niacinamide or retinoids, could be highly beneficial for this consumer segment (Zoe Diana Draelos et al., 2006).

Thirdly, the data revealed that the majority of participants (69.9%) exhibited fair skin pigmentation, with a mean melanin value of 1.47. While this may reflect the demographic characteristics of the sample, it suggests that skin-lightening or brightening products may not be a primary concern for this age group. However, adequate UV protection remains essential to prevent sun-induced skin damage and hyperpigmentation (Lyons et al., 2021).

Fourthly, the severe acne severity observed, with a mean acne value of 4.16 and 56.2% of participants exhibiting an acne value of 5 (very severe acne), underscores the prevalence of this dermatological concern among early adults. Acne can have a significant impact on self-confidence and quality of life (Hazarika & Archana, 2016; Yasir et al., 2020). Developing effective anti-acne formulations, potentially incorporating salicylic acid, benzoyl peroxide, or retinoids, could provide substantial benefits for consumers in this age group (Ayer & Burrows, 2006).

Furthermore, the data indicated minimal wrinkle severity among participants, with a mean wrinkle value of 1.52 and 53.4% exhibiting a wrinkle value of 1 (no or minimal wrinkles). This finding is likely attributable to the relatively young age of the sample. However, incorporating anti-aging

ingredients, such as antioxidants and skin-rejuvenating compounds, could help prevent premature signs of aging and maintain a youthful, healthy complexion.

The high skin sensitivity observed, with a mean sensitivity value of 3.66 and 38.4% of participants exhibiting a sensitivity value of 5 (very sensitive skin), highlights the need for gentle, non-irritating formulations. Selecting soothing ingredients and avoiding potential irritants can enhance skin tolerance and comfort (Duarte et al., 2017).

Based on the consumer segmentation analysis, several formulation recommendations can be proposed to address the specific needs of each identified cluster. For the dry and sensitive skin segment, intensive hydrating formulations based on aqueous humectants, such as hyaluronic acid and glycerin, and incorporating soothing agents like chamomile or allantoin, could be beneficial (Chularojanamontri et al., 2014; Zoe D. Draelos, 2018). These ingredients can effectively restore moisture levels while minimizing potential irritation.

For the severe acne and enlarged pores segment, anti-acne products containing active ingredients like salicylic acid, benzoyl peroxide, or retinoids may be warranted (Ayer & Burrows, 2006). Additionally, oil-controlling and pore-minimizing formulations, such as gel-based or serum moisturizers with niacinamide, could help regulate sebum production and refine the appearance of pores (Zoe Diana Draelos et al., 2006).

For the normal-to-oily skin segment with minimal wrinkle concerns, lightweight, non-comedogenic formulations like water-based or gel moisturizers may be suitable. Incorporating antioxidants like vitamin C or E could protect against oxidative damage and delay early signs of aging (Garre et al., 2018). Adequate sun protection with broad-spectrum sunscreens should also be recommended for daily UV defense (Heurung et al., 2014).

While this study provides valuable insights into the skin characteristics of early adult consumers, several limitations should be acknowledged. Firstly, the relatively small sample size may limit the generalizability of the findings to larger populations. Further studies with larger and more diverse demographic samples could help confirm and expand these results.

Secondly, this research focused solely on objective measurements of skin parameters using a skin analyzer. Integrating this data with subjective information, such as consumer perceptions and preferences, could provide a more comprehensive understanding of their needs and desires in skincare products.

Thirdly, the current data analysis is limited to descriptive statistics and consumer segmentation. Further analyses, such as hypothesis testing and predictive modeling, could reveal more complex relationships and trends within the data.

For future studies, some intriguing directions could include: (1) Investigating lifestyle and environmental factors influencing early adult consumers' skin conditions, such as diet, stress, and sun exposure (Katta & Desai, 2014; Oyetakin-White et al., 2015); (2) Conducting longitudinal

studies to track changes in skin characteristics over time and evaluate the effectiveness of cosmetic formulation interventions (Kim et al., 2013); and (3) Exploring inter-group differences within the sample, such as based on gender, ethnicity, or geographic location, to identify specific needs and preferences for consumer segments (Vashi et al., 2016).

By addressing these limitations and pursuing further research directions, our understanding of early adult consumers' skin characteristics and their implications for cosmetic product development can continue to be expanded and refined.

CONCLUSION

This study aimed to analyze the skin characteristics of early adult consumers using data collected from a skin analyzer. With a sample of 73 participants, predominantly aged between 17 and 20 years, this research provided valuable insights into the common skin conditions within this demographic group.

The data analysis revealed that the early adult consumers in this study generally exhibited low skin moisture levels, enlarged skin pores, fair skin pigmentation, severe acne severity, minimal wrinkling, and high skin sensitivity. These findings highlight the need for targeted cosmetic formulations to address the specific skin concerns faced by this consumer segment.

Based on the consumer segmentation, several formulation recommendations were proposed, such as products focused on intensive hydration for dry and sensitive skin, formulations targeting acne and enlarged pores for acne-prone skin, and lightweight products with antioxidant protection for normal-to-oily skin with minimal wrinkle concerns. These recommendations can guide the development of more effective and personalized cosmetic products that meet the unique needs of early adult consumers.

While this study provides a solid foundation for understanding the skin characteristics of early adult consumers, limitations such as the relatively small sample size and a focus on objective measurements should be acknowledged. Further studies incorporating subjective data, investigating lifestyle and environmental factors, and exploring inter-group differences could further enrich our understanding.

Overall, this research emphasizes the importance of evidence-based skin data analysis to inform optimal cosmetic formulation development. By understanding the unique needs and preferences of early adult consumers, the cosmetic industry can create more effective and satisfying products, fostering brand loyalty and market growth within this critical consumer demographic.

In an increasingly data-driven world, a data-based approach to cosmetic product development is becoming increasingly crucial. This study demonstrates how insights derived from skin data analysis can inform

formulation strategies, enabling cosmetic companies to adapt and innovate in accordance with evolving consumer needs and preferences. By continuing to invest in data-supported research and integrating findings into product development practices, the cosmetic industry can remain at the forefront of catering to diverse and evolving consumer needs.

REFERENCES

Abdlaty, R., Doerwald-Munoz, L., Madooei, A., Sahli, S., Yeh, S. C. A., Zerubia, J., Wong, R. K. W., Hayward, J. E., Farrell, T. J., & Fang, Q. (2018). Hyperspectral imaging and classification for grading skin erythema. *Frontiers in Physics*, *6*(AUG). https://doi.org/10.3389/fphy.2018.00072

Ayer, J., & Burrows, N. (2006). Acne: More than skin deep. In *Postgraduate Medical Journal* (Vol. 82, Issue 970, pp. 500–506). https://doi.org/10.1136/pgmj.2006.045377

Bagatin, E., Rocha, M. A. D. da, Freitas, T. H. P., & Costa, C. S. (2021). Treatment challenges in adult female acne and future directions. In *Expert Review of Clinical Pharmacology* (Vol. 14, Issue 6, pp. 687–701). Taylor and Francis Ltd. https://doi.org/10.1080/17512433.2021.1917376

Baran, R., & Maibach, H. I. (2017). Textbook of Cosmetic Dermatology, Fifth Edition. In *Textbook of Cosmetic Dermatology, Fifth Edition*. CRC Press. https://doi.org/10.1201/9781315160504

Butler, É., Lundqvist, C., & Axelsson, J. (2020). Lactobacillus reuteri DSM 17938 as a novel topical cosmetic ingredient: A proof of concept clinical study in adults with atopic dermatitis. *Microorganisms*, *8*(7), 1–15. https://doi.org/10.3390/microorganisms8071026

Cho, Y. N., Saravana, P. S., David, N., & Chun, B. S. (2021). Biofunctional properties of wild cultivated and cultivated Ginseng (Panax ginseng Meyer) extracts obtained using subcritical water extraction. *Separation Science and Technology (Philadelphia)*, *56*(8), 1370–1382. https://doi.org/10.1080/01496395.2020.1781893

Chularojanamontri, L., Tuchinda, P., Kulthanan, K., & Pongparit, K. (2014). Moisturizers for acne: What are their constituents? In *Journal of Clinical and Aesthetic Dermatology* (Vol. 7, Issue 5, pp. 36–44). Matrix Medical Communications.

Dimitriu, P. A., Iker, B., Malik, K., Leung, H., Mohn, W. W., & Hillebrand, G. G. (2019). New insights into the intrinsic and extrinsic factors that shape the human skin microbiome. *MBio*, *10*(4). https://doi.org/10.1128/mBio.00839-19

Draelos, Zoe D. (2018). The science behind skin care: Moisturizers. In *Journal of Cosmetic Dermatology* (Vol. 17, Issue 2, pp. 138–144). Blackwell Publishing Ltd. https://doi.org/10.1111/jocd.12490

Draelos, Zoe Diana, Matsubara, A., & Smiles, K. (2006). The effect of 2% niacinamide on facial sebum production. *Journal of Cosmetic and Laser Therapy*, *8*(2), 96–101. https://doi.org/10.1080/14764170600717704

Duarte, I., Silveira, J. E. P. S., Hafner, M. de F. S., Toyota, R., & Pedroso, D. M. M. (2017). Sensitive skin: Review of an ascending concept. In *Anais Brasileiros de Dermatologia* (Vol. 92, Issue 4, pp. 521–525). Sociedade Brasileira de Dermatologia. https://doi.org/10.1590/abd1806-4841.201756111

Farage, M. A., Miller, K. W., Eisner, P., & Maibach, H. I. (2008). Functional and physiological characteristics of the aging skin. In *Aging Clinical and Experimental Research* (Vol. 20, Issue 3, pp. 195–200). Springer International Publishing. https://doi.org/10.1007/BF03324769

Flament, F., Francois, G., Qiu, H., Ye, C., Hanaya, T., Batisse, D., Cointereau-Chardon, S., Seixas, M. D. G., Dal Belo, S. E., & Bazin, R. (2015). Facial skin pores: A multiethnic study. *Clinical, Cosmetic and Investigational Dermatology*, 8, 85–93. https://doi.org/10.2147/CCID.S74401

Garre, A., Narda, M., Valderas-Martinez, P., Piquero, J., & Granger, C. (2018). Antiaging effects of a novel facial serum containing l-ascorbic acid, proteoglycans, and proteoglycan-stimulating tripeptide: Ex vivo skin explant studies and in vivo clinical studies in women. *Clinical, Cosmetic and Investigational Dermatology*, *11*, 253–263. https://doi.org/10.2147/CCID.S161352

Hazarika, N., & Archana, M. (2016). The psychosocial impact of acne vulgaris. *Indian Journal of Dermatology*, *61*(5), 515–520. https://doi.org/10.4103/0019-5154.190102

Heurung, A. R., Raju, S. I., & Warshaw, E. M. (2014). Adverse reactions to sunscreen agents: Epidemiology, responsible irritants and allergens, clinical characteristics, and management. In *Dermatitis* (Vol. 25, Issue 6, pp. 289–326). Lippincott Williams and Wilkins. https://doi.org/10.1097/DER.0000000000000079

Katta, R., & Desai, S. P. (2014). Diet and dermatology: The role of dietary intervention in skin disease. In *Journal of Clinical and Aesthetic Dermatology* (Vol. 7, Issue 7, pp. 46–51). Matrix Medical Communications.

Kim, B. Y., Choi, J. W., Park, K. C., & Youn, S. W. (2013). Sebum, acne, skin elasticity, and gender difference - which is the major influencing factor for facial pores? *Skin Research and Technology*, *19*(1). https://doi.org/10.1111/j.1600-0846.2011.00605.x

Krutmann, J., Bouloc, A., Sore, G., Bernard, B. A., & Passeron, T. (2017). The skin aging exposome. In *Journal of Dermatological Science* (Vol. 85, Issue 3, pp. 152–161). Elsevier Ireland Ltd. https://doi.org/10.1016/j.jdermsci.2016.09.015

Lichterfeld-Kottner, A., El Genedy, M., Lahmann, N., Blume-Peytavi, U., Büscher, A., & Kottner, J. (2020). Maintaining skin integrity in the aged: A systematic review. In *International Journal of Nursing Studies* (Vol. 103). Elsevier Ltd. https://doi.org/10.1016/j.ijnurstu.2019.103509

Lyons, A. B., Trullas, C., Kohli, I., Hamzavi, I. H., & Lim, H. W. (2021). Photoprotection beyond ultraviolet radiation: A review of tinted sunscreens. In *Journal of the American Academy of Dermatology* (Vol.

84, Issue 5, pp. 1393–1397). Mosby Inc. https://doi.org/10.1016/j.jaad.2020.04.079

Mercurio, D. G., Jdid, R., Morizot, F., Masson, P., & Maia Campos, P. M. B. G. (2016). Morphological, structural and biophysical properties of French and Brazilian photoaged skin. *British Journal of Dermatology*, *174*(3), 553–561. https://doi.org/10.1111/bjd.14280

Oyetakin-White, P., Suggs, A., Koo, B., Matsui, M. S., Yarosh, D., Cooper, K. D., & Baron, E. D. (2015). Does poor sleep quality affect skin ageing? *Clinical and Experimental Dermatology*, *40*(1), 17–22. https://doi.org/10.1111/ced.12455

Park, H. K., Kim, N. S., Moon, T. K., Kim, B., & Jung, H. Y. (2015). A Comparison Study Between Image Analysis and Conventional Methods in the Evaluation of Asian Skin Color. *Journal of the Society of Cosmetic Scientists of Korea*, *41*(2), 97–103. https://doi.org/10.15230/scsk.2015.41.2.97

Purnamawati, S., Indrastuti, N., Danarti, R., & Saefudin, T. (2017). The role of moisturizers in addressing various kinds of dermatitis: A review. In *Clinical Medicine and Research* (Vol. 15, Issues 3–4, pp. 75–87). Marshfield Clinic. https://doi.org/10.3121/cmr.2017.1363

Sun, M. D., Kentley, J., Wilson, B. W., Soyer, H. P., Curiel-Lewandrowski, C. N., Rotemberg, V., & Halpern, A. C. (2022). Digital skin imaging applications, part I: Assessment of image acquisition technique features. *Skin Research and Technology*, *28*(4), 623–632. https://doi.org/10.1111/srt.13163

Suryaneta, Aida Febina Sholeh, T. N. (2023). *Strategies for Launching New Face Toner Products : Insights*. *1*(1), 11–18.

Tensen, E., van der Heijden, J. P., Jaspers, M. W. M., & Witkamp, L. (2016). Two Decades of Teledermatology: Current Status and Integration in National Healthcare Systems. In *Current Dermatology Reports* (Vol. 5, Issue 2, pp. 96–104). Current Medicine Group LLC 1. https://doi.org/10.1007/s13671-016-0136-7

Vashi, N. A., De Castro Maymone, M. B., & Kundu, R. V. (2016). Aging differences in ethnic skin. In *Journal of Clinical and Aesthetic Dermatology* (Vol. 9, Issue 1, pp. 31–38). Matrix Medical Communications.

Yasir, A. S., Rai Saputri, G. A., & Chandra, Y. (2020). Formulasi sediaan kumur ekstrak etanol 96% daun seledri (Apium graveolens L.) sebagai antibakteri Streptococcus mutans Penyebab Bau Mulut. *Jurnal Farmasi Malahayati*, *3*(1), 1–11. https://doi.org/10.33024/jfm.v3i1.2433

Yasir, A. S., Satria, B., & Handayani, K. Y. (2023). Stability and irritation testing using the patch test method of a combination gel formulation containing aloe. *1*(1), 1–10.