SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Temporal Effects of Commercial Deodorants on Underarm Skin pH: A Comparative Analysis

By Yuna Ha

AUTHOR BIOGRAPHY

Yuna Ha is a rising senior in Palos Verdes Peninsula High School. Her major is Biochemistry, and she is interested in more in-depth lab research as well. Outside of academics, Yuna enjoys spending time with her friends and playing video games together.

ABSTRACT

The natural pH of axillary (underarm) skin ranges from 4.5 to 5.5, creating an acidic barrier that regulates the skin microbiome. Modern deodorants often utilize specific pH levels to control odor, yet the efficacy and longevity of these products under different physiological conditions remain understudied. This study evaluated through single-participant comparative analysis how commercial deodorants with varying pH levels alter axillary skin pH over time in both resting and perspiring states. Five stick and cream deodorants ranging from highly acidic to alkaline (pH 3.14 to 6.70) were applied to a single participant in separate trials. Axillary pH was measured before, 30 minutes after, and 60 minutes after application under two distinct conditions: a "non-sweaty" environment and a "sweaty" environment induced by a 15-minute cardio session. In non-sweaty conditions, four out of five deodorants significantly altered skin pH relative to the control at 30 and 60 minutes ($p < 0.05$). Acidic deodorants lowered skin pH, while the alkaline cream raised it. Strong, significant positive correlations were observed between deodorant pH and post-application skin pH in both non-sweaty ($R^2 = 0.9376$\$, $p = 0.0185$) and sweaty conditions ($R^2 = 0.9161$, $p = 0.0289$). However, perspiration notably reduced longevity; acidic formulations showed a distinct trend toward returning to baseline pH by the 60-minute mark, whereas the alkaline cream maintained its effect. Deodorant pH strongly predicts immediate skin pH alterations. However, perspiration significantly diminishes the longevity of acidic stick deodorants compared to alkaline cream formulations.

Keywords: *Axillary skin pH, commercial deodorants, perspiration, alkaline deodorants, acidic deodorants, skin barrier function, deodorant longevity, odor-producing bacteria.*

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

INTRODUCTION

The pH of the skin plays a critical role in maintaining overall skin health and function. Healthy human skin is naturally slightly acidic (less than 7 on a 1 to 14 scale), typically within an optimal range of about 4.5 to 5.5 (Bs & Lio, 2024). This acidity forms what is known as the acid mantle, a thin protective layer on the skin's surface that is essential for regulating the skin microbiome, preserving structural integrity, and controlling inflammation (Brooks et al., 2024).

Maintaining this acidic environment is crucial for the integrity of the epidermal barrier. When the skin pH remains within its normal range, it helps prevent excessive transepidermal water loss, which supports moisture retention, and protects against harmful microorganisms (*Urology & Continence Care Today - Article: Skin pH and Barrier Function*, n.d.). In contrast, a basic shift in skin pH can disrupt the skin barrier, making the skin more vulnerable to irritation, infection, and inflammatory conditions such as acne and atopic dermatitis (Cherney, 2022).

Skin pH is especially important in the context of cosmetic and personal care products. Even though factors like age, genetics, diet, and lifestyle can influence skin pH, products like deodorants, soaps, and body washes can have a significant impact on skin pH as well (Ultee, 2021). Many cosmetic products are acidified in order to combat problems with bacteria on the skin, such as acne causing bacteria in the case of acne medications (like those containing Benzoyl Peroxide & Salicylic Acid)(CeraVe, 2024), or odor causing bacteria in the case of deodorants (such as those containing Mandelic Acid)(Lazic, 2026).

The pH of the underarm region is particularly important because it directly influences the composition of the skin microbiome and body odor production. Compared to most areas of the body, the axillary region generally has a slightly higher pH of approximately 5.5 to 6.5. This less acidic environment supports the growth of odor-causing bacteria, primarily species of *Corynebacterium* and *Staphylococcus*. These microorganisms metabolize components of sweat and convert them into volatile compounds, including thioalcohols, that are responsible for characteristic body odor (Teerasumran et al., 2023). Because bacterial growth is strongly influenced by pH, even small changes in the level of the skin can affect how easily bacteria can thrive. Lowering the pH creates an environment that is less favorable for odor-causing bacteria, reducing the production of malodorous compounds and helping to control body odor (Khanna, 2021).

Modern deodorants employ several different mechanisms to reduce odor, where many of them involve altering the pH of the underarm environment. Traditional deodorants often rely on antimicrobial ingredients and fragrances to suppress bacterial growth and mask odor, while newer deodorants are mostly acidified or "pH-balanced" that are specifically formulated to match the natural acidity of the skin and avoid disrupting the

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

skin barrier (Team, 2023). Products such as Lume use mandelic acid, an alpha-hydroxy acid commonly used in dermatologic applications (Lewis & Lewis, 2024b). Mandelic acid lowers the pH of the underarm and creates a condition that are unfavorable for bacteria, a strategy marketed as "pH optimization" (Lewis & Lewis, 2024). Similar approaches have also incorporated other acids, such as glycolic acid, to acidify the skin and inhibit bacterial growth. By maintaining a slightly acidic underarm environment, these deodorants not only target odor-producing microorganisms but may be associated with more alkaline formulations (Ellman, 2022).

This study focuses on how underarm skin pH changes over time following the application of deodorants, with particular attention to differences between dry and sweaty underarm conditions, and different types of deodorants. Because sweat production, moisture, and bacterial activity can all influence skin acidity, the underarm provides a unique environment to observe pH differentiation after product use. Although this study is limited to a single participant, by measuring pH at multiple time intervals, the effectiveness of deodorants are recorded.

MATERIALS AND METHODS

Experimental Design

To conduct a simple comparative analysis of how effective pH-controlling deodorants are at controlling skin pH and for how long in one individual, five underarm deodorants were chosen at varying pH levels for this experiment: Old Spice Fiji (pH 3.14), Saltair (pH 3.25), Lume (pH 3.37), Secret (pH 4.38), and Lavilin Underarm cream (pH 6.7). These were selected based on their popularity (available at most supermarkets or publicized on social media), and for their range in pH values. Lavilin, the more alkaline deodorant, was selected primarily as an example or control to compare to the acidic brands. These were also primarily all stick (solid) deodorants (except for the Lavilin brand which came as a cream) so that it would be easier to directly compare results between the acidic deodorants.

Different deodorants were applied to one underarm in three individual trials (on different days but on only one individual participant) and pH measurements were collected from the underarm skin using a skin pH measuring tool (Hanna Instruments, Skin & Scalp pH Tester). Measurements were recorded and averaged before graphing and calculating statistics. Measurements were just before, 30-minutes after, and 60-minutes after deodorant application, or in the case of the control, they were taken at similar intervals but without the deodorant application. Data was first collected in a "non-sweaty" condition to ensure that the majority of the deodorant was still present 30 or 60 minutes after application. In the "sweaty" condition, the participant went for a run outside for at least 15 minutes after the application and prior to pH measurements.

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Statistical Methods

To determine statistical significance between groups, two-tailed t-tests were conducted and p-values calculated comparing the control and each individual deodorant. Comparisons were only made between similar time points, so for example, the 30-minute control results was compared to the 30-minute Secret brand results. P-values less than 0.05 were considered significant.

To determine if there was a positive or negative correlation between the pH of the deodorant and its efficacy after application, underarm pH measurements were averaged across trials and graphed in relation to the starting pH of the deodorant itself. This was only done for data taken at the 30-minute time point because that was where the most consistent significant results were observed. The Pearson's correlation coefficient was calculated using an online calculator (https://www.statskingdom.com/correlation-calculator.html) which provided the coefficient, R^2, and p-values, for both the non-sweaty and sweaty conditions.

Consent of Human Subject

This study was conducted on a single participant, the author of this study. Consent was given by the participant and they were made aware of any risks of the study by a Scientific Review Committee.

RESULTS

In order to determine how effective pH-controlling deodorants are at controlling skin pH and for how long in our pilot study, five underarm deodorants were chosen at varying pH levels for this experiment (**Table 1**). The normal pH range of the underarm skin is 4.5-5.5 (Tan & Lio, 2025). Therefore, the majority of the deodorants were acidic pH compared to normal skin except for the Lavilin brand which was more alkaline (**Table 1**). They were also all stick (solid) deodorants except for the Lavilin brand (cream)(**Table 1**).

Table 1.

Deodorant Brands for Experimentation and their respective pH/characteristics.

Deodorant type/brand name	**Deodorant pH**	**application method**
Old Spice Fiji	3.14	stick
Saltair	3.25	stick

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

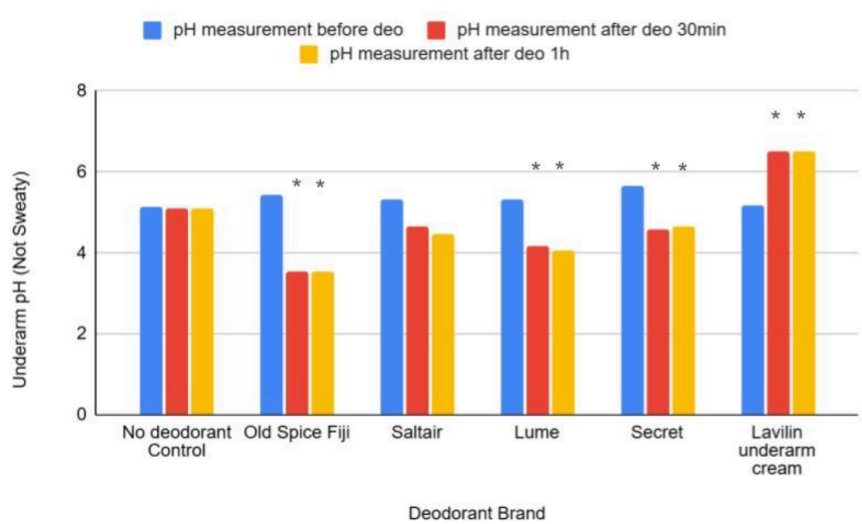
FALL 2026

Lume	3.37	stick
Secret	4.38	stick
Lavilin underarm cream	6.7	cream

Next, the different deodorants were applied to the underarm in individual trials (on different days, but on the same person) and pH measurements of the underarm skin were taken before, 30-minutes after, and 60-minutes after application (**Figure 1**). Data was first collected in a "non-sweaty" condition to ensure that the majority of the deodorant was still present 30 or 60 minutes after application. Measurements for the control group, where no deodorant was applied, fluctuated very little over time, and were taken before each deodorant was applied. Compared to the control groups, four out of the five deodorants resulted in a decrease in the pH level of the underarm 30 minutes after application (p-values < 0.05 by a two-tailed t-test). Interestingly, Saltair did not result in a change in pH after application by a two-tailed t-test. Furthermore, the results after the 60-minutes stayed relatively consistent across all brands (p-values < 0.05 by a two-tailed t-test)(**Figure 1)**. As expected, the deodorants with more acidic pH level lowered the underarm's pH level, and Lavilin underarm cream, which is more alkaline, brought the pH level up in our study.

Figure 1.

pH Measurements from deodorants applied on the underarm over time.



SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

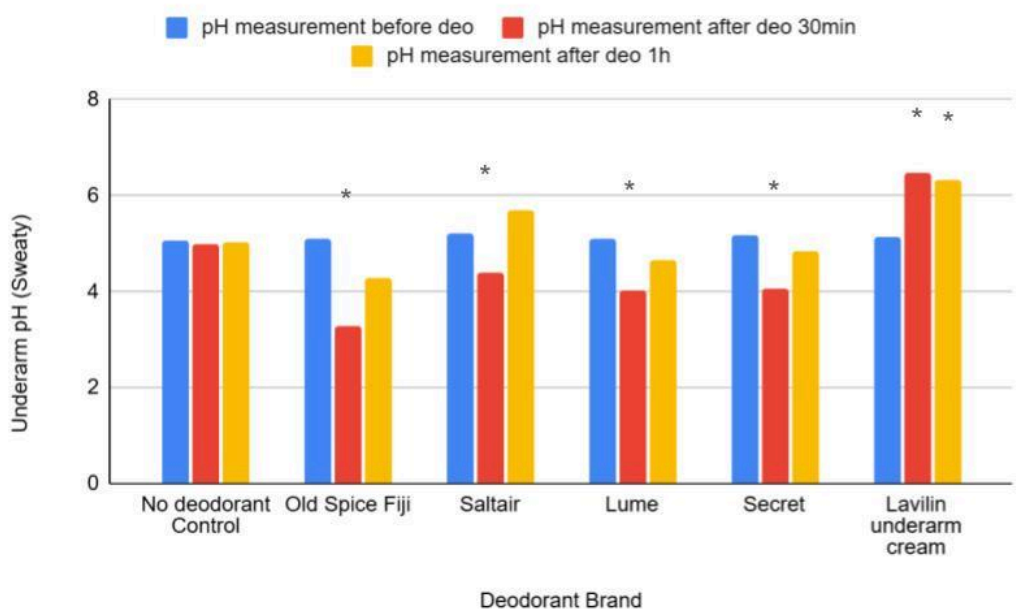
E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Note. Average pH measurements were taken 30 minutes before (blue), 30 minutes after (red), and 1 hour after (yellow) application of 5 different deodorant types listed on the x-axis. Measurements were also taken in a no deodorant control. Averages are based on three separate measurements taken on different days from the same individual participant. Asterisks indicate statistical significance between this bar and the corresponding no deodorant control bar (p-values < 0.05 by a two-tailed t-test). Created by author, 2026.

In order to test whether changes in skin pH of our participant was affected by perspiration, different deodorants were applied to the underarms in sweaty conditions as well (**Figure 2**). The control group, where no deodorant was applied, showed little to no change in its pH level 30 or 60 minutes after application. Similar to above, acidic deodorant brands lowered the underarm pH level of the participant after 30-minutes (p-values < 0.05 by a two-tailed t-test), but all of them showed a trend of the pH level going back up to normal by 60 minutes after application. Meanwhile, Lavilin, the more alkaline deodorant, kept the pH level of the underarm alkaline after both 30 minutes and after 60-minutes (p-values < 0.05 by a two-tailed t-test)(**Figure 2**).

Figure 2. *pH Measurements from deodorants applied on a sweaty underarm over time.*



Note. Average pH measurements were taken 30 minutes before (blue), 30 minutes after (red), and 1 hour after (yellow) application of 5 different deodorant types listed on the x-axis. Measurements were also taken in a no

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

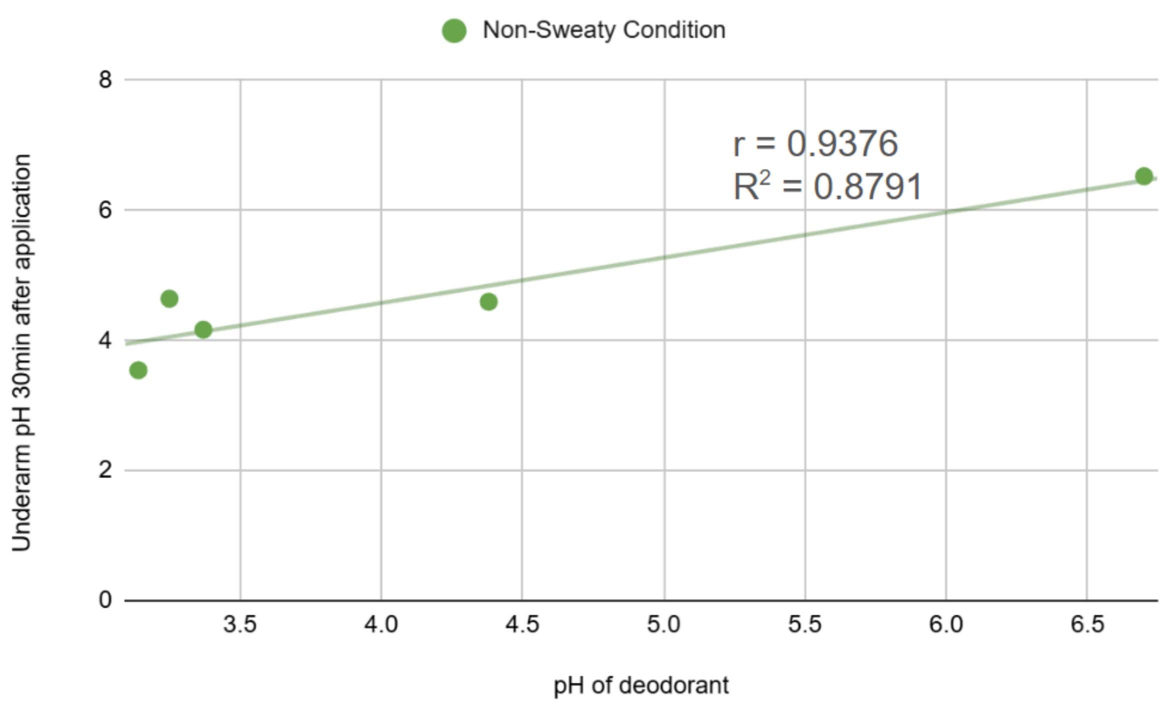
E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

deodorant control. Averages are based on three separate measurements taken on different days from the same individual participant after a 15-minute cardio session to create a sweaty underarm environment. Asterisks indicate statistical significance between this bar and the corresponding no deodorant control bar (p-values < 0.05 by a two-tailed t-test). Created by author, 2026.

To determine if there was an observed correlation between the pH of the deodorant and its efficacy 30 minutes after application, the underarm pH measurements taken 30 minutes after application were averaged across trials and graphed in a non-sweaty (**Figure 3**) or sweaty (**Figure 4**) condition. The correlation coefficient was then calculated and a significant positive correlation was observed in both the non-sweaty (R^2 = 0.9376, p = 0.01853) and sweaty conditions (R^2 = 0.9161, p = 0.02886) for our participant.

Figure 3.
Correlation between deodorant pH and underarm pH 30 minutes after application in nonsweaty conditions.



Note. The relationship between pH of deodorant (x-axis) and average underarm pH 30 minutes after application in nonsweaty condition (y-axis) is shown as individual data points. Averages are based on three separate measurements taken on different days from the same individual participant. The trendline indicates the

SCHOLARLY REVIEW

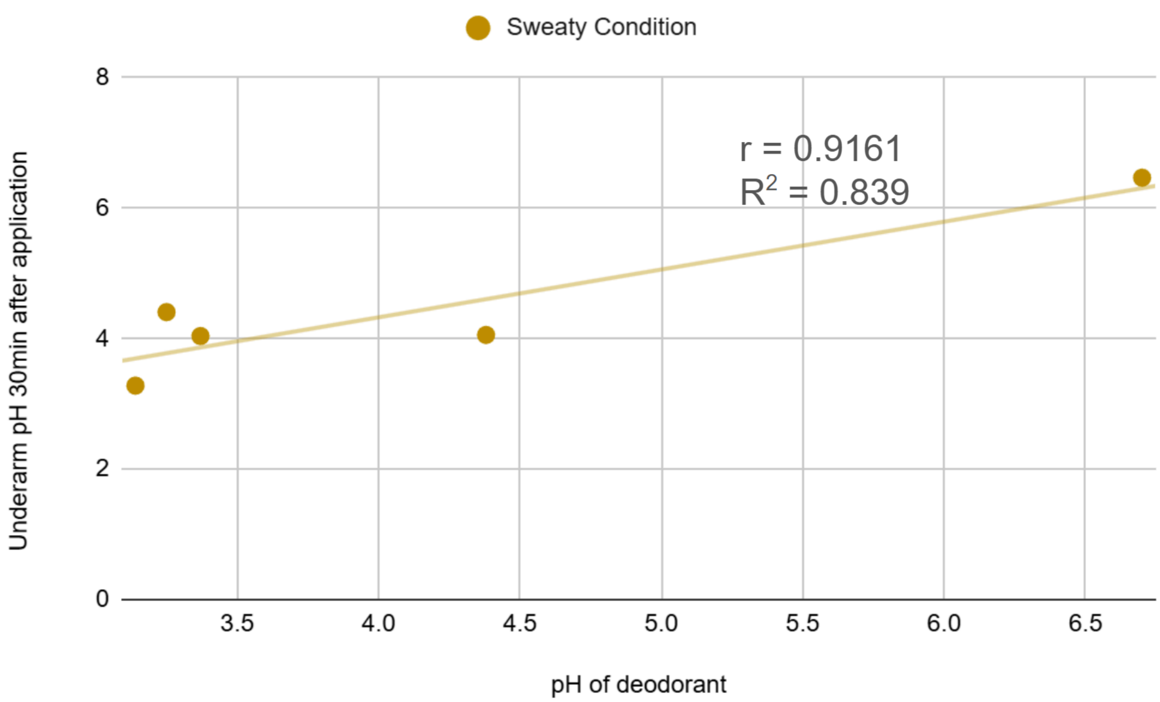
SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Pearson's correlation where $R^2 = 0.8791$ which is statistically significant (p = 0.01853). Created by author, 2026.

Figure 4.
Correlation between deodorant pH and underarm pH 30 minutes after application in sweaty conditions.



Note. The relationship between pH of deodorant (x-axis) and average underarm pH 30 minutes after application in sweaty condition (y-axis) is shown as individual data points. Averages are based on three separate measurements taken on different days from the same individual participant after 15 minutes of cardio to create a sweaty underarm environment. The trendline indicates the Pearson's correlation where $R^2 = 0.839$ which is statistically significant (p = 0.02886). Created by author, 2026.

DISCUSSION

The goal of this study was to observe in a single-participant comparative analysis if differences in pH of deodorants alter the skin pH over time. The results of this study demonstrated that deodorant efficacy, as measured through changes in underarm pH, varied depending on both the deodorant used and the presence of sweat on our participant. Under nonsweaty conditions, all deodorants except Saltair (Old Spice Fiji, Lume,

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Secret, and Lavilin Underarm Cream) demonstrated a significant change in underarm pH after both 30 minutes and 60 minutes after application (**Figure 1**). Under sweaty conditions, all deodorants tested showed significant results after 30 minutes; however, only the Lavilin Underarm Cream stayed effective for our participant after 60 minutes (**Figure 2)**. These findings suggest that in our participant, sweat may substantially reduce the duration of deodorant efficacy and that certain deodorant formulations may be more resistant to this effect compared to others.

One possible explanation for the superior performance of Lavilin Underarm Cream is its alkaline formulation (pH 6.7). A positive correlation was observed between deodorant pH and efficacy, indicating that products with higher pH values may be more effective at altering the underarm environment under sweaty conditions. However, while the data support a relationship between deodorant pH and efficacy, correlation does not imply causation. Additional factors such as active ingredients, antimicrobial compounds, moisture resistance, and application formula may also contribute to deodorant performance.

Several limitations should be considered when interpreting these results. First, only five deodorants were tested, representing a limited range of deodorant formulations and pH values. Most deodorants included in the study were acidic, while only one deodorant, Lavilin Underarm Cream, was alkaline. This imbalance limits the ability to determine whether the alkaline pH itself contributed to increased efficacy. Also, Lavilin was the only cream-based deodorant tested, whereas the remaining products were stick formulations. As a result, differences in performance may have been caused by the application method rather than pH alone. Future studies should include a larger selection of deodorants with a wider range of pH values, particularly additional alkaline stick deodorants, to better isolate the effects of pH from formulation type.

Another limitation is the relatively short experimental duration. Measurements were collected only up to 60 minutes after application, making it difficult to determine how long the effects of each deodorant lasted. Future experiments could include additional time points beyond 60 minutes, particularly under nonsweaty conditions, to evaluate whether deodorants with different pH values have differences in long-term efficacy.

There are also other ways to measure deodorant effectiveness, here only one measurement of deodorant effectiveness was taken. In the future, additional data could be recorded such as sniff tests (to test for unpleasant odors), moisture tests (to test for perspiration blocking), and/or bacterial swabs could be taken to measure antimicrobial effects of different deodorants.

Additionally, the study was conducted using a single human subject, limiting the generalizability of the results. Individual differences in skin type, sweat production, age, gender, hygiene habits, and microbiome composition may influence deodorant efficacy. Therefore, to make the results more applicable to a wider

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

population, a more diverse sample of participants should be included in future studies to determine whether the observed trends are consistent across different populations. Increasing the number of experimental replicates would also improve the reliability and statistical power of the results.

Despite these limitations, this study provides evidence that sweat can significantly reduce deodorant efficacy over time. The findings also suggest that deodorant pH may be an important factor influencing performance and could be a useful feature for manufacturers to consider when developing or marketing products. Understanding how deodorant formulations interact with skin pH may help consumers make more informed choices and encourage further research into the mechanisms that contribute to odor control.

In conclusion, this study found that deodorant efficacy differed among products and was strongly influenced by the presence of sweat. While several deodorants remained effective under nonsweaty conditions, only Lavilin Underarm Cream maintained a significant effect after 60 minutes in sweaty conditions. A positive relationship between deodorant pH and efficacy was observed, suggesting that pH may play a role in deodorant performance. However, additional research involving more deodorant types, longer testing periods, direct measurements of odor and bacterial activity, and larger participant groups is necessary to confirm these findings.

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

REFERENCES

Brooks, S. G., Mahmoud, R. H., Lin, R. R., Fluhr, J. W., & Yosipovitch, G. (2024). The Skin Acid Mantle: An update on skin pH. *Journal of Investigative Dermatology*, *145*(3), 509–521. https://doi.org/10.1016/j.jid.2024.07.009

Bs, I. J. T., & Lio, P. A., MD. (2024). From Discovery to Modern Understanding: The Acid Mantle in Dermatology: The acid mantle plays a significant role in the skin barrier, pH balance, and microbiome. Understanding its function has advanced holistic skincare and therapeutic potential in dermatology. *www.jintegrativederm.org*. https://doi.org/10.64550/joid.pemwha98

CeraVe. (2024, August 15). Salicylic Acid vs. Benzoyl Peroxide for Acne-Prone Skin. *Salicylic Acid Vs. Benzoyl Peroxide for Acne-Prone Skin*. Retrieved from https://www.cerave.com/skin-smarts/skin-concerns/acne/salicylic-acid-vs-benzoyl-peroxide#:~:text=Salicylic%20acid%20and%20benzoyl%20peroxide%20are%20two%20common%20active%20ingredients,that%20they%20deliver%20these%20benefits.

Cherney, K. (2022, August 25). *About skin pH and why it matters*. Healthline. Retrieved from https://www.healthline.com/health/whats-so-important-about-skin-ph#skin-p-h

Ellman, L. D. (2022, March 19). Why are there acids in deodorant? Dermatologists explain the new Skin-Care trend. *Allure*. Retrieved from https://www.allure.com/story/skin-care-acids-in-deodorant

Khanna, K., PhD. (2021, December 30). *Microbial origins of body odor*. ASM.org. Retrieved from https://asm.org/articles/2021/december/microbial-origins-of-body-odor

Lazic, E. (2026, March 27). *How mandelic acid controls body odor — the science behind acidified deodorant*. Mando. Retrieved from https://shopmando.com/blogs/mando-blog/how-mandelic-acid-controls-body-odor-the-science-behind-acidified-deodorant

Lewis, R., PhD, & Lewis, R., PhD. (2024, November 25). *How Lume whole body deodorant was inspired by a genetic disease*. DNA Science. Retrieved from https://dnascience.plos.org/2024/04/04/how-lume-whole-body-deodorant-was-inspired-by-a-genetic-disease/

Tan, J., & Lio, A. (2025). From discovery to modern Understanding: The Acid Mantle in Dermatology. *Journal of Integrative Dermatology*, *1*(1). https://doi.org/10.64550/joid.pemwha98

Team, B. (2023, June 21). *Is your deodorant pH right for your skin? (And why it matters)*. Biome. Retrieved from https://www.biome.com.au/blogs/beauty/is-your-deodorant-ph-the-best-for-your-skin?shpxid=a5abed05-e552-45b0-8a6c-bbcbcddf2f4f

Teerasumran, P., Velliou, E., Bai, S., & Cai, Q. (2023). Deodorants and antiperspirants: New trends in their active agents and testing methods. *International Journal of Cosmetic Science*, *45*(4), 426–443. https://doi.org/10.1111/ics.12852

SCHOLARLY REVIEW

SCHOLARLY REVIEW JOURNAL

E-ISSN: 2996-8380
Published by Leadership & Innovation Lab

FALL 2026

Ultee, J. (2021, April 1). *How Acidic Are Soaps And Cleansers? - Dr. Jetske Ultee blog*. Dr. Jetske Ultee Blog. Retrieved from https://www.dr-jetskeultee.com/blog/acidic-soaps-cleansers/

Urology & Continence Care Today - Article: Skin pH and barrier function. (n.d.). Retrieved from https://www.ucc-today.com/journals/issue/launch-edition/article/skin-ph-and-barrier-function