

Skin Brightness and Hydration Improvement Analysis

Objective

This analysis was to evaluate the efficacy of a **test skincare product** in improving:

- **Skin brightness** (measured using **Spectrophotometer** via **L*** values)
- **Skin hydration** (measured using **Corneometer** values)

Subjects/Humans were assessed over **four visits**:

1. **Visit 1 - Baseline** (before product application)
2. **Visit 1 - Timm** (20 mins post-application)
3. **Visit 2** (7 days of regular use)
4. **Visit 3** (14 days of regular use)

Data Preparation & Cleaning

- **Separate datasets** for hydration (Corneometer) and brightness (Spectrophotometer L*, a*, b* values) were imported and cleaned.
- Columns were renamed for clarity and converted to **2 decimal places**.
- Missing and irrelevant data points were removed.

Improvement Calculations

For each subject:

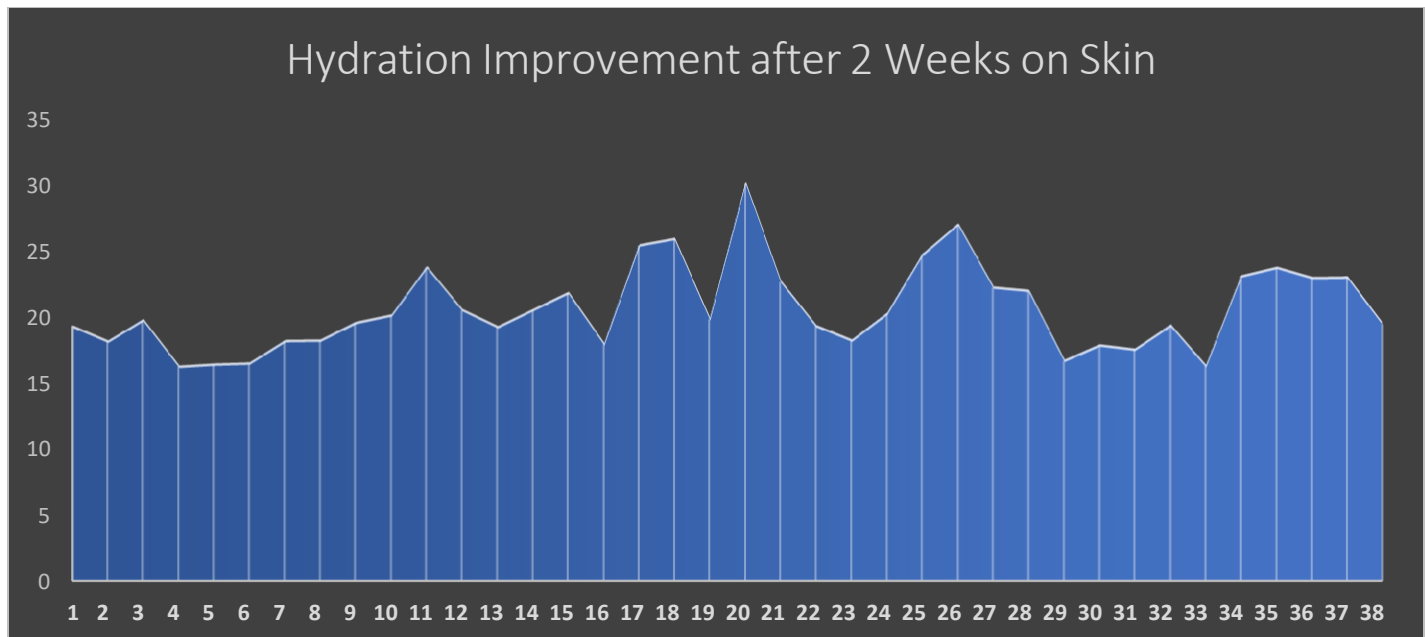
- **Hydration Improvement:**
 - **1st Time:** After 7 Days – After 20 min
 - **2nd Time:** After 14 Days – After 7 Days
 - **Final:** After 14 Days – Baseline
- **Brightness Improvement:**
 - Changes in **L*** over time.

Hydration Improvement Over Time

- Plots showed steady improvement in hydration for most subjects.
- Shaded areas captured variability.
- Select data labels highlighted key time points.

Inference:

- Most subjects showed continuous increase in hydration from baseline to Day 14.
- The rate of improvement varied, suggesting individual skin response differences.



Distribution of Improvement

- Bar charts with KDE lines visualized the **distribution of % improvement** across subjects.
- Helped identify whether improvements were **skewed** (only a few responders) or **balanced**.

Inference:

- Hydration showed a **right-skewed curve**, indicating that **many subjects benefited significantly**.
- Brightness improvements were more **evenly spread**.

Box Plots by Cluster

- Box plots displayed **hydration** and **brightness (L^* , a^*)** levels across **3 identified clusters**.

Cluster	Hydration (Visit 3)	Brightness (L*) (Visit 3)	Redness (a*) (Visit 3)
Cluster 0: High Responders	Highest hydration (~65–70)	Brightest skin (~60–65)	Lowest redness (~10–11)
Cluster 1: Moderate Responders	Moderate hydration (~60–67)	Lower brightness (~50–53)	Slightly higher redness (~12+)
Cluster 2: Low/Non-Responders	Lowest hydration (~55–60)	Moderate brightness (~57–60)	Higher redness (~12+)

The plots confirmed:

- **Cluster 0** showed best skin response in both hydration and brightness.
- **Cluster 2** showed minimal improvement.

Clustering & PCA Scatter Plot

- Applied **KMeans clustering** to group subjects into:
 - **Cluster 0: High Responders** (>20% improvement both metrics)
 - **Cluster 1: Moderate Responders** (10–20% improvement)
 - **Cluster 2: Low/Non-Responders** (<10% improvement)
- PCA was used to visualize clusters.
- Axes were renamed for clarity:
“Overall Skin Improvement Index” and “Skin Response Pattern Difference”.

Recommendations

- Consider **targeting High Responders** with promotional claims.
 - Further investigate **why Low Responders** show minimal changes.
 - Use these insights to refine **product positioning**.
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Correlation Between Skin Hydration and Brightness Improvements

Pearson correlation analysis was conducted.

- **Correlation coefficient (r):** 0.07
- **p-value:** 0.6881

Inference:

- The correlation is **very weak and statistically insignificant**.
- This indicates that **hydration and brightness improvements do not strongly influence each other** in this study.
- Subjects may experience **benefits in one parameter without necessarily seeing the same level of improvement in the other**.

The test product thus appears to act **independently on hydration and brightness**.

Conclusion

Hydration:

- Significant improvement for most subjects by Day 14.
- Strong responders clearly identified through visual and statistical analysis.

Brightness (L*):

- Similar positive trend, especially in Cluster 0.

Clustering:

- Clear stratification into **High, Moderate, and Low** responders.
- This segmentation can help in **targeted skincare recommendations**.

Skin Tone (a*):

- Improvements in **redness (a*)** and **even skin tone** observed, especially in Cluster 0