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A New Look at Skin Cell Turnover

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Introduction

Skin cell turnover is the process where epidermal cells mature and slough off the skin surface. It is often considered the "holy grail" of healthy skin, and stimulation of cell turnover is one of the major benefits of the most effective skincare products from facial peels to retinol treatment. Several methods for evaluating the stratum corneum cell turnover rate have been proposed over the past few decades(1-5). The current industry standard mostly relies on a clinical grading based danysl chloride staining method. This method requires expert graders to evaluate the level of dansyl chloride left on the skin over the time to determine the cell turnover time. It typically takes several weeks and numerous visits from study participants, therefore it is expensive and time consuming. More importantly, this method may not be always accurate, because many factors can influence the relatively subjective determination of the exact time when all stain disappears. Here, our study was intended to develop an objective and quantitative cell turnover method that is faster and more accurate.

Methods

A clinical study was conducted using a new quantitative study design. At the beginning of the test, patches with 5% dansyl chloride in petrolatum were applied to three sites on the upper arms of twelve participants. Two sites were then treated with 5% lactic acid and an exfoliation cream, respectively, twice a day and the third site was used as an untreated control. An *in vivo* spectrophotometer (SkinSkan, Horiba) was used to quantify the amount of dansyl chloride fluorescence (Figure 1A). The wavelengths used were 335 nm for excitation and 460 nm for emission, as determined by the dansyl chloride spectral analysis (Figure 1C, 1D). An imaging booth (VISIA CR, Canfield Scientific) was also used to take dansyl chloride fluorescence photos under UV light (Figure 1B). Study continued for each participant until no dansyl chloride was visible or detectable.

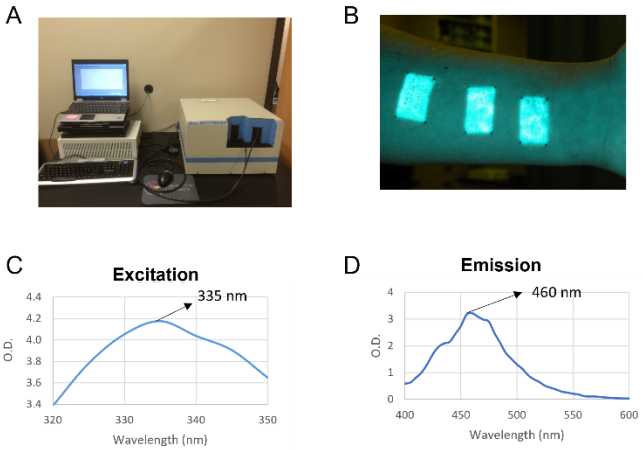

Figure 1: Instrumentation. (A) spectrophotometer; (B) florescence images under UV; (C, D) spectral analysis of maximum excitation and emission for dansyl chloride.

A parallel study was also conducted on a panel of thirty-one participants using the conventional expert grading based dansyl chloride method.

Results and Discussion

The dansyl chloride fluorescence levels on the three test sites in the first study were quantified over the course of about three weeks. The temporal profiles of dansyl chloride fluorescence intensity matched the corresponding photos captured at the same time (Figure 2). A new parameter $T_{0.05}$ was proposed to calculate the time when 5% stain is left, which we believe can be more accurately measured than T_0, the often loosely determined end point of the cell turnover process.

The results from the first study also demonstrated that the new method can well differentiate the performance of different products, in this case between the 5% lactic acid and the milder exfoliating cream (Figure 2B).

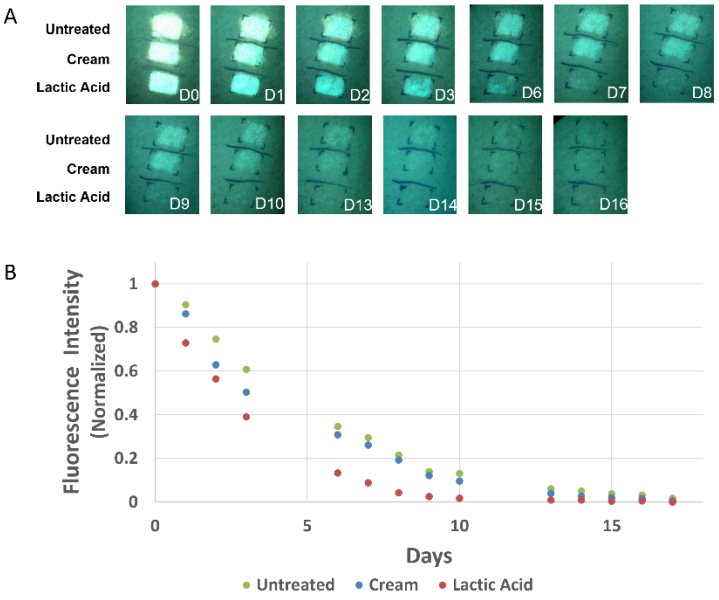

Figure 2: Dansyl chloride intensity on two treated and one untreated sites during the course of study. (A) florescence images under UV; (B) dansyl chloride fluorescence detected by the spectrophotometer.

It's also worth noting that the rate of cell turnover can be calculated on as early as the fourth day of the study, a fraction of the typical 2-3 week time frame required for the expert grading method. This can significantly speed up the turnaround time of a cell turnover study, and is especially beneficial in situations where a fast read is required. One example is the rapid efficacy testing when multiple rounds of formula revisions are necessary.

The results from the study were also compared to the data from the parallel expert grading. While the cell turnover time points were defined slightly differently, the improvement of cell turnover after the exfoliating cream treatment was well captured in both studies (Table 1).

Table 1: Cell turnover times determined by the instrument based and expert grading based studies

	SC Turnover Time $T_{0.05}$ (Day) (Instrument)	SC Turnover Time T_0 (Day) (Expert Grading)
Untreated	13.9	17.7
Cream	11.6*	15.7*

$T_{0.05}$: cell turnover time defined as 5% dansyl chloride is left; T_0: cell turnover time defined as no dansyl chloride is left. *: Statistically different from untreated sites ($p<0.05$)

Finally, the growing data collected using this method can potentially provide us with an unprecedented opportunity to study skin cell turnover. For instance, questions like how aging impacts stratum corneum cell turnover (2, 6) can now be better answered when many more reliable data points are generated using this new cell turnover method. It can also benefit the medical field on skin conditions related to abnormal cell turnover.

Conclusion

A quantitative method to study skin cell turnover was developed. This method has provided an objective way of study cell turnover with the assistance of instrumental measurement. This method has been used for formulation development and claims substantiation with better accuracy and a small fraction of time and cost compared with the conventional method. This method has also demonstrated its potential in advancing our understanding of skin cell turnover, an important concept for skin care industry.

References

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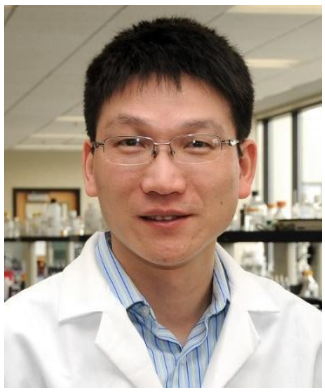
About the speaker



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