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휴대용 근적외 분광분석기를 이용한 피부 수분 측정법 개발

Development of Determination Method for Human Skin Moisture using New Portable Near Infrared System

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In this study, portable near infrared (NIR) system was newly integrated with a photodiode array detector, which has no moving parts and this system has been successfully applied for evaluation of human skin moisture. Human skin consists of epidermis and dermis. The softness and pliability of skin are the main characteristic factors to protect the body and assist the motion. These factors are dependent on the amount of moisture contained in the stratum corneum, which is the outermost layer of epidermis, and controlled by the barrier function that maintains adequate water content in the skin layer. The stratum corneum is about 10-40 micron thick, except on the palms and soles, and composed of partially flattened and keratinized layers. If the health condition of stratum corneum is not maintained due to environmental changes, the efficiency of barrier function and moisture maintaining function of the skin will be dropped off. As a result, the skin becomes easily dried, roughed, and even more liable to infection. Therefore, it is very important to maintain sufficient moisture in the stratum corneum for healthy skin.

Electric conductance, transepidermal water loss (TEWL), infrared spectroscopy by attenuated total reflectance (ATR) have been used as conventional skin moisture measuring devices. However, all these methods have drawbacks such as temperature sensitive and pressure sensitive. Therefore, recently, the uses of near-infrared reflectance spectroscopy related to skin moisture have been *in vitro* or *in vivo* reported.[1-3]

In our study, for portable use, new NIR system has been integrated to determine water content of skin rapidly and stably even under severe environmental conditions. In order to elucidate the relationship between water content and NIR absorbance with partial least squares (PLS) regression, separated hairless mouse skin is *in vitro* used. The good correlation between NIR absorbance and absolute water content of separated hairless mouse skin was, *in vitro*, showed depending on the water content (7.4-84.9 %) using this portable NIR system. Partial least squares (PLS) regression was used for the calibration with the 1150-1650 nm wavelength range. For the practical use for the evaluation of human skin moisture, PLS model for human skin moisture was, *in vivo*, developed using the portable NIR system based on the relative water content values of stratum corneum from the conventional capacitance method. We acquired the NIR spectra of human skin in the wavelenght range 1150-1650 nm, as shown in Figure 1. The huge band at 1450 nm in the spectrum is due to the overtone of fundamental OH band stretching of water in the IR region.

The PLS model showed a good correlation. Figure 2 shows that the calibration model with log 1/R spectra was better with SEC of 4.5 and SEP of 4.9.

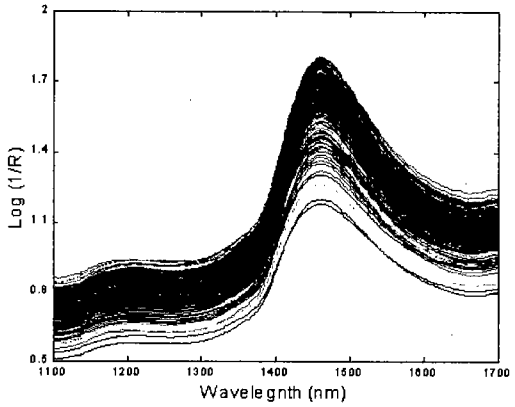

Figure 1. NIR spectra of human skin by using portable NIR system.

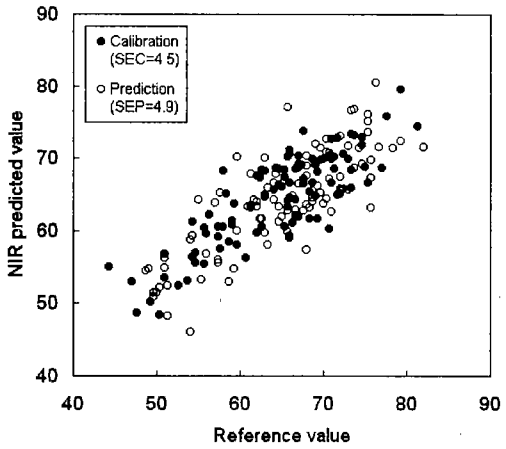

Figure 2. Scatter plot showing correlation between NIR value and reference value for water content of human skin using the 1150-1650 nm range (Portable NIR system).

Overall, these studies showed that the developed portable NIR system would be more effective and practical for calibration for human skin moisture. The portable NIR system can be applied for human skin as a rapid and non-destructive method. While the conventional method is sensitive to external environmental conditions, for example, temperature and humidity, the portable NIR system is so stable that it may be used wherever it need to be measured.

References

1. Libnau, F. O.; Kvalheim, O. M.; Christy, A. A.; Toft, J. *Vibrational Spectrosc.* **1994**, *7*, 243
2. Walling, P. L.; Dabney, J. M. *J. Soc. Cosmet. Chem.* **1989**, *40*, 151.
3. K. Martin, *Appl. Spectrosc.* **1998**, *52*, 1001.