

Ethnic differences in skin hydration and barrier function, as illustrated by facial mapping

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Introduction

Large differences in hydration of the stratum corneum (SC) and transepidermal water loss (TEWL) have been observed on different body sites, especially on different regions of the face. However, visualization of gradients of hydration and barrier function of the entire face have not been shown. Thus, the purpose of this study was to create detailed color maps of these properties and to illustrate them in subjects of different skin ethnicities.

Material & Methods

SC capacitance (Corneometer CM825) and TEWL (Aquaflux AF-200) were measured on 30 pre-defined sites of the face (Figure 1) of subjects of four different ethnicities: Chinese, Caucasians, Indians and Black Africans. As the measurements are highly time consuming we had to enrol a limited number of subjects (four subjects per ethnicity). However, in order to limit the biological heterogeneity we chose young female subjects (21.8±1.1 years) who self-classified as having normal skin, without visual signs of photoaging and all living in the same city (Pretoria, South Africa).

To reduce an inter-individual variation of the measurements a template was used to ensure the same set of facial sites was measured on each occasion. Capacitance and TEWL maps were generated by combining digital images from Visia-CR and the bio-instrumental data. An algorithm was developed which automatically detects skin pixels and interpolates a measured value for each of them after superimposing the native Corneometer and Aquaflux data on the images. This results in full, continuous color maps of SC capacitance and TEWL on the face of the subjects.

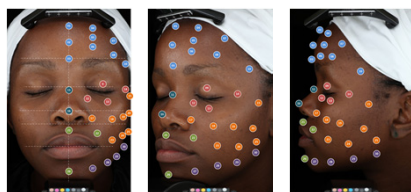


Figure 1: Anterior, oblique and lateral images of 30 predefined measuring points, shown on one selected subject.

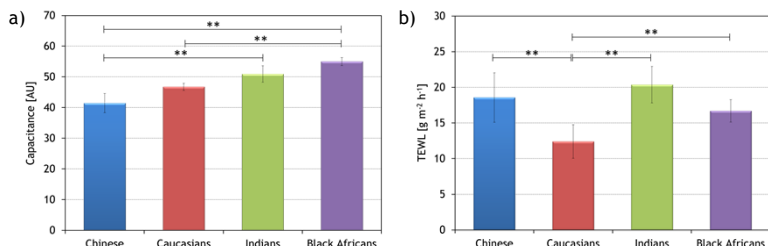


Figure 3: Comparison of overall capacitance (a) and TEWL values (b) for the four ethnic groups. Results represent mean ± SEM, n = 4 per group, ** p < 0.01.

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Acknowledgements

This study was financially supported by DSM Nutritional Products Ltd., Basel, Switzerland. We would like to thank Lebogang Kgatuke, Marlize Lategan, Caroline Moeletsi and Lee-Ann Raaff of the Photobiology Laboratory, Sefako Makgatho University, Medunsa, South Africa for their enthusiasm in conducting the study.



2015 Annual SID Meeting, Atlanta



Results & Discussion

The complexity of facial SC hydration and barrier properties in these ethnic groups is clearly visible in these unique images (Figure 2). On different areas of the face, subtle differences were found but in others there were steep particular gradients within short distances. There seemed to be a good correlation with poor hydration and barrier properties around the nasolabial fold area in all four ethnic groups but TEWL values were high in the eye area of the Black African, Indian and Chinese groups despite having normal skin hydration values. Conversely, barrier properties were normal in the lower cheek areas yet skin hydration values were low in all ethnic groups. When considering the overall ethnicity and overall SC barrier properties (Figure 3), TEWL values (g m⁻² h⁻¹) were greatest for: Indians > Chinese > Black Africans > Caucasians with the Chinese group showing the most complexity. However, overall skin hydration values, shown as Corneometer readings (AU) were greatest for: Black Africans > Indians > Caucasians > Chinese. Highest capacitance levels were observed for the eye lids, under eye regions and chin, whereas lowest levels were found for the top of the nasolabial sulcus and lower cheek.

Conclusion

- There exist remarkable capacitance and TEWL gradients within short distances on selected areas of the face. The gradients are distinctive in the different ethnic groups.
- In contrast to other reports, we found that darkly pigmented skin does not always have a superior barrier function and skin hydration is complex.
- Moisturizing concepts, therefore, need to consider the different characteristics of various facial anatomical locations as well as the various characteristics of different skin ethnicities.
- Research has shown that we do not meet current skin moisturization needs. This approach highlights the complexity of facial skin and areas of facial skin that need special attention.

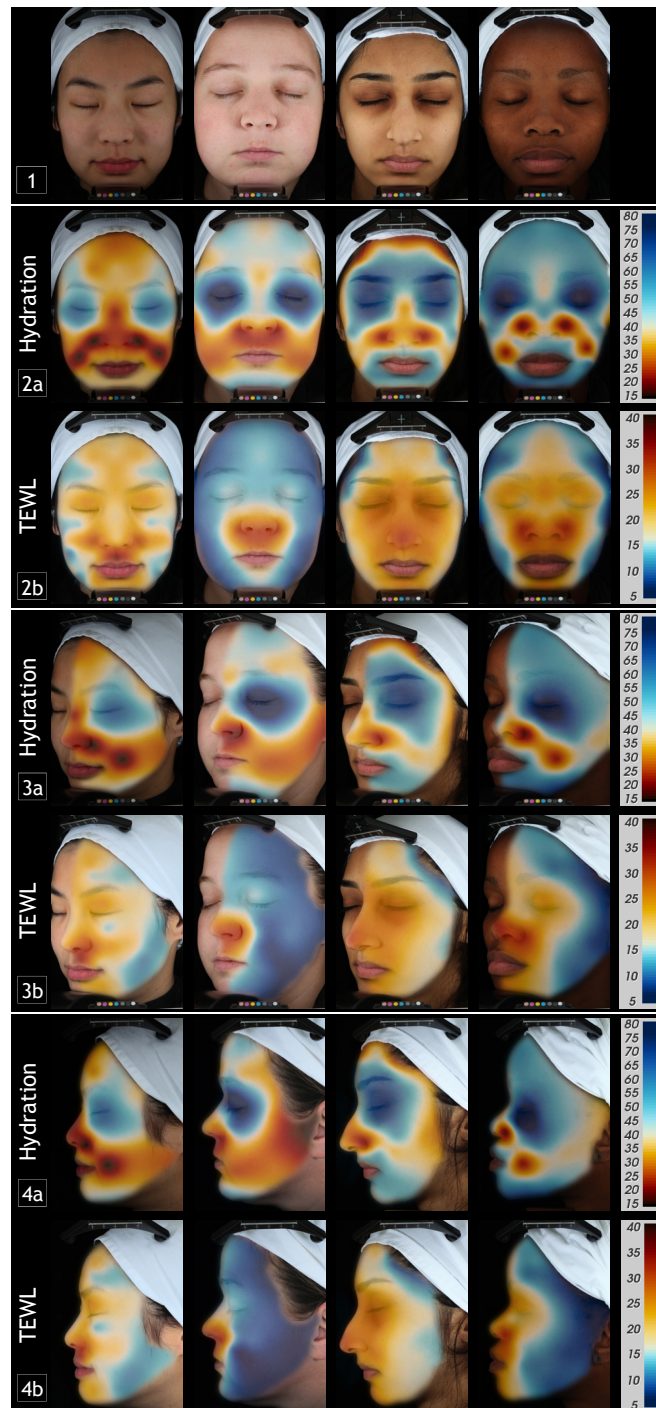


Figure 2: Continuous TEWL and capacitance color maps of one selected subject per skin ethnicity, mean values of each group, from left: Chinese, Caucasians, Indians, Blacks. Color code for Corneometer values (AU) and TEWL values (g m⁻² h⁻¹) shown on the scales on the right (blue = normal skin condition, red = impaired skin condition). 1: unmapped subjects, 2: anterior view, 3: oblique view, 4: lateral view; a: hydration data, b: TEWL data.