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Impedance spectroscopy for the non-destructive evaluation of *in vitro* epidermal models

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Reconstructed human epidermis (RHE) is standardly used for the risk assessment of chemical compounds. However, analysis is dependent on invasive methods such as histological processing or 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) staining. As an alternative to these methods, impedance spectroscopy can be performed as a nondestructive technology to analyze the integrity of epidermal equivalents. Therefore, RHEs were generated and impedance spectra were recorded during culture time and under different culture conditions. From these spectra, we extrapolated electrical characteristics such as the capacitance and the Ohmic resistance. Furthermore, the measurable electrical parameters were used to quantify the effects of mechanical and chemical disruption of the epidermal integrity. A fully matured RHE exhibits typical impedance spectra in a frequency ranging between 1 Hz and 100 kHz, which is comparable to the spectra of freshly isolated human epidermal biopsies. We could show that, during RHE maturation, these characteristics change significantly. Thus, capacitance and ohmic resistance can be employed as a criterion for the quality control of skin equivalents. Additionally, our application of impedance spectroscopy reveals sufficient sensitivity to detect a transient decreased ohmic resistance caused by 2-propanol, which is classified as a non-irritant by MTT assays. These results indicate that impedance spectroscopy can be employed as a non-destructive complementary method to assess mild irritative effects, which is currently not possible. Besides testing for irritative potential of substances, mechanical wounding and subsequent wound healing by re-epithelialization can be monitored non-invasively demonstrating the feasibility of the method for the assessment of re-epithelialization.

Biography

Lisa Engelhardt has studied Life Science Engineering and graduated from Friedrich-Alexander University Erlangen-Nuremberg, Germany, in 2015. She is now working on her PhD at the Department Tissue Engineering and Regenerative Medicine at the University Hospital of Wuerzburg, Germany/Translational Center "Regenerative Therapies for Oncology and Musculoskeletal Diseases", Fraunhofer Institute for Interfacial Engineering IGB and Biotechnology in Wuerzburg, Germany. The study focuses on the development of vascularized skin models, the design of bioreactors for tissue engineering, 3D bioprinting, and impedance spectroscopy.

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