Predicting human epidermal melanin concentrations for different skin tones

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In the past 50 years lasers has found numerous applications in medicine. One of their advantages is their use for minimalistic or non-invasive diagnosis and treatment. Often that means light penetration through skin and the correct dose required relies on accurate information regarding the skin's optical properties. Light absorption in the epidermal layer is a major factor in determining the laser light fluence that reaches the deeper skin levels. Darker skin has an epidermal melanin volume fraction about twice that of lighter skin. Due to melanin absorption, less laser light reaches the deeper skin layers in dark skin tones. Laser-tissue interaction modelling software can correct for this by adapting the dose applied to the skin. To correctly apply such software it is important to characterise the skin in terms of skin tone with an easy and reliable method. Measuring the melanin content of the skin is the best method, but it needs to be done non-invasively. However, access to samples of all skin types is often limited and skin-like phantoms are used instead. The objective of this study is to compare experimentally measured absorption features of liquid skin-like phantoms representing Skin Types I to VI with computational simulated skin from the Realistic Skin Model (RSM) part of the ASAP® software from Breault Research. Skin-like phantoms were prepared by adding Intralipid (20% fat emulsion) to samples of increasing melanin concentration at pH ~ 7. UV-VIS transmittance spectra of the samples were measured over the wavelength range 370 to 900 nm and compared to simulated results from ASAP® using the same optical parameters. Experimental and computational results indicated that at shorter wavelengths melanin absorption displayed non-monotonic features that may allow for more accurate ways of determining melanin concentration and therefore the expected absorption through the epidermal layer. This suggests that the phantoms may be able to represent optical characteristics of real skin.