H42 Synchrotron Studies of Spectrometric and Chemical Changes in Aging Bruises

Stewart Walker, PhD, Flinders University, Phys Sci, For & Analytic Chem, GPO Box 2100, Rm 304, Adelaide, South Australia 5001, AUSTRALIA; Neil E. Langlois, MD, Forensic Science SA, GPO Box 2790, Adelaide, South Australia 5001, AUSTRALIA; and Josie P. Nunn, BSc, Flinders University, GPO Box 2100, Adelaide 5001, AUSTRALIA*

The goal of this presentation is to express to the audience the trials, pitfalls, and achievements of using high-intensity, high-resolution synchrotron light to determine the spectrometric and chemical changes that occur over time in bruises.

This presentation will impact the forensic science community by highlighting the advantages of using synchrotron light to probe the changes in spectra and chemical composition due to aging in bruises. This fundamental knowledge can be applied in normal conventional laboratory instruments.

The chemistry that occurs during the formation, maturing, and fading of a bruise during its lifecycle is complex and may provide information about the age of the contusion, which may have medicolegal significance. Spectroscopy can be used to distinguish similarly colored compounds, including those known to be present in bruises: oxyhaemoglobin, deoxyhaemoglobin, methaemoglobin, biliverdin (green), bilirubin (orange-yellow), and ferritin.

Visible and near infra-red reflectance spectra were obtained using an Ultraviolet/Visible/Near-Infrared (UV-Vis-NIR) spectrophotometer with a 150nm Integrating Sphere accessory at Flinders University, Australia. Far Infrared (FIR) transmission analysis was conducted at the Australian Synchrotron to extend the investigation into the 10 cm^{-1}-1,500cm^{-1} range.

Significant differences between the spectra of bilirubin and biliverdin were found and will be presented. These investigations were carried out in solid phase samples.

Further work involving the development of novel diamond liquid cells with spacers of 5mm to 60µm was also undertaken at the Australian Synchrotron as measuring the spectra in solution would be more realistic to the biological solutions found in a bruise.

This study will present spectra from hemoglobin, biliverdin, and bilirubin as solids, in matrixes, in slurries, and in solution from 10cm^{-1} to 25.000cm^{-1} from room temperature to 78K. As water causes interferences in the spectra, a number of different solvents were tried. A balance needs to be determined in finding solvents in which the materials are soluble but do not have a spectrum that overloads the detector or interferes with the spectral information from the desired material.

The process of obtaining spectra of bruise components using a liquid cell system produced novel challenges. The development of the analytical method and the results in the fluid phase will be presented and compared with solid phase analysis. It is not intended that all forensic analysis of bruises be conducted using a synchrotron light source, but the information and knowledge that is obtained from these specialist studies can assist in the analysis of bruises using conventional laboratory equipment that is available to all.

Bruises, Synchrotron, Aging

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