Determination of the Optical Properties of Rat Tissue

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INTRODUCTION: Non-invasive methods offer a great advantage over more conventional medical methods but many studies need to be done before such methods become easily accessible and usable. Many of these non-invasive methods are dependant on the interaction of light with tissue. Such interaction is influenced by the optical properties such as the absorption (u_a) and reduced scattering (u_s') coefficients of the tissue. When consulting the literature however one finds there exists a huge discrepancy between measurements and an extensive database of optical properties is not available. Furthermore measurement of the *in vivo* tissue optical properties still poses some difficulty, however the Integrating Sphere (IS) system is one method which can be used to measure the optical properties of bulk tissue *in vitro*. This study thus involved investigating the optical properties of some tissue samples from rats. Some of the results are presented here.

METHODS: The setup currently has a 7.4 mW He-Ne laser (λ=632.8 nm, JDS Uniphase laser) as the light source and is described in more detail in [1]. Tissue samples from Wistar rat (non-pigmented) were sandwiched between two microscope slides and held in place using parafilm and tape. Measurements of the total and diffuse transmission as well as the diffuse reflectance were taken in triplicates. Freshly excised, a day old, fridge and frozen samples were evaluated.

RESULTS: Figures 1 and 2 refer to the optical properties obtained from measurements on rat heart tissue samples using the experimental data and the multiple polynomial regression method [2]. The suffix 3 and 4 for both u_a and u_s' refer to the order of polynomial used in extracting the results, a and b refer to the different sides of the tissue. In this particular instance there did appear to be a difference in the side of the tissue measured, which is consistent with the results obtained for the rat skin (to be published) but it is possible it may not always be true for all tissue types. u_a of the fresh sample and the same sample a day later shows a slight decrease. Furthermore the frozen samples show u_a to have decreased from 3 to 1.5 cm^{-1}. There is a small increase in u_s' from 7 to 11cm^{-1} for the fresh sample after a day while u_s' for the frozen samples is 3 cm^{-1}.

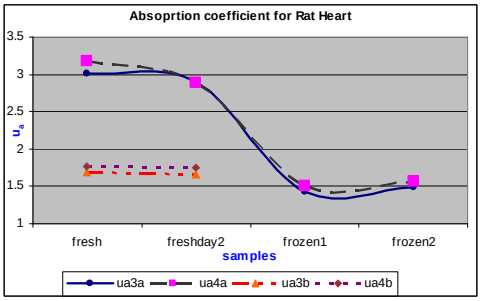

Fig. 1: u_a for different samples of rat heart

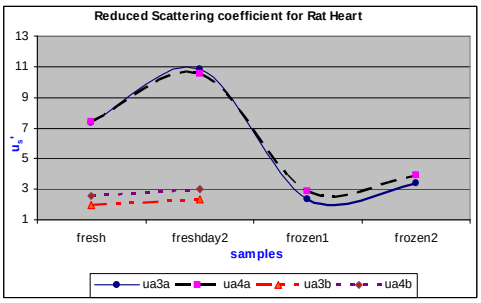

Fig. 2: u_s' for different samples of rat heart

DISCUSSION & CONCLUSIONS: No literature values could be found against which to compare the extracted optical properties. However the change in u_a is expected due to the blood loss that occurs. The increase in u_s' could possibly be due to the disintegration occurring in the tissue that increases the scattering properties, while the low u_s' maybe a consequence of the freezing down process. These are preliminary results which will be investigated for a wider spectrum range. However it is evident that the state of a sample may influence the optical properties of some tissue.

REFERENCES: [1] A Singh, A E Karsten and J S Dam, (October 19-22 2008), *Proceedings of the International Conference of the World Association of Laser Therapy, Sun City, South Africa*, 165-169 ISBN 978-88-7587-471-1) [2] J. S. Dam, T Dalgaard, et al (2000) *Appl. Opt* **39** 1202-1209

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