Characterisation of Bowel Cancer using Vibrational Spectroscopy

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Background: As part of the digestive system, the bowel is crucial for functions like nutrient and water absorption and defecation. Bowel or colorectal cancer [CRC] is atypical of regular cancer growth meaning it has slow proliferation rates, leading to prolonged development stemming from adenomatous polyps in the mucosa lining to eventual metastasis to other organs through lymph nodes and blood vessels. Current diagnostic techniques range in cost and effectiveness with no universal test existing for the three subtypes. Currently, it is the third most diagnosed cancer and accounts for 10% of worldwide cancer cases.

Aims: This project aims to identify biochemical and molecular differences between the two cell lines represented by human epithelial colorectal adenocarcinoma, CACO2 and human colorectal adenocarcinoma, HCA7. The results could give rise to better understandings of potential metabolic activity through the inferred structural relationships therefore it could ultimately demonstrate appropriate framework to guide clinicians for more tailored chemotherapy choices.

Methodologies: The cells are cultured in supplemented Dulbecco's Modified Eagle Medium (DMEM) in normal cell culture conditions. Once the cells reach confluency of approximately 70-80%, the cells are spun using a cytospin onto calcium fluoride slides. The cells are mapped using Raman and the data is processed using orange, a Java toolkit.

Results: Both cell lines have similar overall architecture such as the presence of NHOH bonds and aliphatic regions. Principle Component Analysis (PCA) showed two and three distinct groups for CACO2 and HCA7 respectively indicating different cell sizes. Further PCA analysis showed both cell lines formed distinctive groups. The corresponding loading plot showed 4 regions of variance at wavenumber 1000 to 1250; 2300 to 2700; 2800 to 2900 and 3000 to 3500cm^{-1}.

Conclusions: The results are suggestive of differing NH and OH functional groups, methyl orientations and carbon skeleton proteins. The demonstrated methodology is suitable to distinguish similar bowel cancer cell lines and can be a successful diagnostic method in conjunction with histopathological identification. The regions of variance do warrant further

investigation to isolate and characterise these specific differences. Furthermore, better understanding of the similar regions could provide better insights into treatment development and drug responses.

Key words: Colorectal cancer, diagnostics, biochemical, CACO2, HCA7, Raman, vibrational spectroscopy.