Raman Spectroscopy as a Novel Autonomous Machine Learning and Chemical Imaging System Used to Distinguish Quantitative Abnormalities in MCF-7, MDA-MB-231, and MCF10-A Cells for the Early Detection of Basal and Epithelial Breast Cancer through Inelastic Scattering and Spectroscopic Analysis in an in vitro Model

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Breast cancer is the most prominent cancer found in women. In the US, one in every eight women will develop invasive breast cancer in their lifetime. The current annual rate of women dying from breast cancer hasn't changed significantly since 1999. Therefore, in the past twenty years, there has yet to be an effective solution to detect nor treat it. In this project, different types of breast cancer cells were developed and tested under a Raman Spectrometer. The research question posed was whether Raman Spectroscopy, a method of inelastic light scattering, would be a successful chemical imaging system to detect breast cancer cells, quantitatively distinguish between breast cancer types, and provide ample data to use in a machine learning program to group these cell types. Three types of breast cancer cells were developed: ER+ PR+ Epithelial type, ER- PR- Basal type, and normal benign control cells. The Raman Spectrometer does accurately detect breast cancer in cells, as the peaks do correlate with CH3 and CC in luteinizing hormone and tyrosine respectively, which are biomarkers of breast cancer. The differences in the points at the peaks 934.0670, and 1460.538 show the differences between basal and epithelial types of breast cancer. A decision tree machine learning model was written in R and had approximately 92% accuracy when distinguishing between basal, epithelial, and normal cells and was therefore successful. In conclusion, all three questions posed were successfully answered.

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