Diagnosis of human brain metastasis by infrared microspectroscopy

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Metastatic brain tumors are an important clinical problem because the signs and symptoms of intracranial metastases are undistinguishable from those of primary brain tumors. In some cases the site of the origin of the metastasis cannot be determined histopathologically. As metastatic brain tumors contain the molecular information of the tissue of the primary tumor, IR spectroscopy has great potential for determining the origin of the metastasis by evaluating their spectroscopic parameters. The variances in IR spectral maps of tissue sections caused by their heterogeneity might lead to misclassification. To overcome this problem, we studied samples from cultured cells as model systems. Cell lines are expected to offer advantages in homogeneity, reproducibility and availability. We analyzed cultured cells of 5 human tumor types by IR microspectroscopic mapping and compared the results with spectral maps of tissue sections of brain metastases of 31 patients.

Data collection was done by measuring IR microspectroscopic images in transmission mode using the FTIR spectrometers Nicolet 5 PC equipped with a MCT detector and the Bruker Hyperion equipped with a FPA detector (64 x 64 pixel), both connected to an IR microscope. To determine the origin of a brain metastasis, several methods of multivariate analyses were tested. PCA (Principal Component Analysis) and SIMCA (soft indeperndet modeling of class analogy) were used to evaluate and to compare the spectroscopic parameters of the metastases and the cell cultures of their primary tumors.

By using PCA and SIMCA algorithm, it is possible to assign the spectra of brain metastases of colon carcinoma, mamma carcinoma and melanoma correctly to the models of cell cultures of their primary tumors.