



## Biophysical characterization of tears by FTIR-microspectroscopy for the research of Parkinson's disease biomarkers

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## Abstract:

In recent years, the study of tears as a source of biomarkers for the diagnosis of different pathologies and in particular for neurodegenerative diseases like Amyotrophic Lateral Sclerosis (ALS), Parkinson's (PD) and Alzheimer's, has attracted much interest. [1][2]

Recently, tears from ALS patients have been characterized by means of Fourier Transform InfraRed micro-spectroscopy (micro-FTIR) [3], a tool that provides information on the composition and structure of the sample's main biomolecules. In particular, this approach – coupled with multivariate analysis - allowed discriminating between diseased and healthy samples with a high overall performance, enabling also to disclose the spectral components responsible for the discrimination. In my thesis project, FTIR-microspectroscopy is employed to analyse tears from PD's patients and healthy controls with the aim to identify passible biomarkers for pen invasive and early diagnosis of

healthy controls with the aim to identify possible biomarkers for non-invasive and early diagnosis of the disease.

To better resolve the tear complex absorption and to assign the different components to specific biomolecules, second derivative spectra were calculated and subjected to multivariate analysis. In particular, we employ Partial Least Squares-Discriminant Analysis (PLS-DA) not only to discriminate PD-positive samples from negative controls, but also to pull out the spectral components responsible for the observed segregation.

Preliminary results highlight differences in the protein and lipid structure between tears from PD patients and healthy controls. During the research, the number of samples will be increased in order to verify the statistical significance of the obtained data.

## References:

[1] Ponzini E., Tear biomarkers. Adv Clin Chem. 2024;120:69-115.doi:10.1016/bs.acc. 2024.03.002.
[2] Edman MC, et al., Tears - more to them than meets the eye: why tears are a good source of biomarkers in Parkinson's disease. Biomark Med. 2020 Feb;14(2):151-163. doi: 10.2217/bmm-2019-0364.

[3] Ami D, et al., Tear-Based Vibrational Spectroscopy Applied to Amyotrophic Lateral Sclerosis. Anal Chem. 2021 Dec 28;93(51):16995-17002. doi: 10.1021/acs.analchem.1c02546.