EDAD: Early Diagnosis of Alzheimer's Disease Utilizing Low-Cost Plasma Peptide Extraction, Atmospheric Pressure Mass Spectrometer, and Support Vector Machine-Based Classification of Amyloid-Beta Species

Manuel, Charly David (School: Alaminos City National High School)
Quiam, Rey Alfred (School: Alaminos City National High School)
Bubos, Klein Gunneries (School: Alaminos City National High School)

Conventional methods for Alzheimer's Disease (AD) early diagnosis are often considered not cost-effective and sometimes invasive. Although recent AD studies focus on blood biomarker-based methods, a less expensive and non-invasive way, these methods still require high clinical expertise. To address these limitations, this study aimed to develop EDAD, a diagnostic device to automatically detect, quantify, and classify blood biomarkers, specifically amyloid-beta species, to predict AD prognosis in patients assisted by support vector machines (SVMs). The device was tested in-silico using COMSOL Multiphysics to determine the capability of the inner casing to retain its particle velocity and denoise mass spectra using its novel rotating annular cylinder mechanism. A biuret test of the peptide binding assay (PBA) and calibration test of the amyloid-beta species-specific quadrupole mass spectrometer (QMS) was done to determine its ability to extract proteins and to prepare for actual testing. The rotating mechanism resulted in an x-axis mean free path after 10 seconds at 300 RPM, and the inner casing constriction resulted in an increased velocity for the ions. In its actual testing, EDAD analyzed 48 plasma samples from four (4) different population groups based on their AD prognosis. EDAD classified forty-seven (47) samples correctly, showing a specificity of 92.3% and sensitivity of 100%, significantly higher than conventional screening tests such as Amyloid-PET scan and ELISA kits. Additionally, the cost analysis shows that EDAD is significantly more cost-effective than Amyloid PET scan and ELISA Kits, making it a more cost-effective and efficient alternative for early AD diagnosis.

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