Detection of Serotonin and microRNA-1202 Using Molecularly Imprinted Polymers and Four-Way-Junction Sensor and Biosensor Toward Mental Disorder Diagnosis

Calvo-Chumbimuni, Angela (School: Oviedo High School)

About 1 in 7 individuals experience a mental disorder during their adolescence. Currently, the primary method for the diagnosis of these conditions is through clinical tools (online assessments or questionnaires). This project proposes the development of a novel sensor and biosensor for the detection of two biomarkers that could facilitate mental disorder diagnosis: serotonin (5-HT) and microRNA-1202, respectively. To develop the 5-HT sensor, molecularly imprinted polymers (MIPs) will be used based on o-phenylenediamine (OPD). The MIPs will be synthesized on a glassy carbon electrode's surface, containing OPD monomer and 5-HT template. Subsequent washing will allow cavity formation for selective 5-HT recognition. To develop the microRNA biosensor, the four-way-junction (4WJ) technology was applied for the first time in the recognition of microRNA-1202. The 4WJ is composed of a DNA stem-loop probe (SL) attached to a gold electrode for target recognition (microRNA-1202). Strands m and f—each of which contains half of the SL and microRNA-1202 complementary sequences—are used to provide selectivity and aid in the hybridization process. The 5-HT sensor reached a limit of detection (LOD) of 3.2 μM, and the microRNA-1202 reached an LOD of 0.5 nanomolar. Both had high reproducibility (10% or less), selectivity, and sensitivity. The 5-HT sensor was validated using the HPLC reference method and sample recovery for the microRNA-1202 biosensor. Future work involves the application of these sensors to biological samples, such as blood and saliva.

Awards Won: