DETECTION OF BIOMARKERS FROM HUMAN RESPIRATION, USING GAS CHROMATOGRAPHY AND PHOTOACOUSTIC TECHNIQUE

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Biomarkers are chemical compounds present in an organism that can be measured and assessed as indicators of pharmacological responses to the use of medicines, pathological and healthy biological processes. In order to diagnose and monitor diseases in a non-invasive manner, breath analysis is becoming a promising field in biomedicine. One in eleven people in the world has diabetes. One third of these people can develop chronic kidney disease (CKD), which has already reached 10% of the world’s population. Acetone ($C_3H_6O$), a well-established biomarker for mellitus diabetes types one and two, can be found in the range of concentration from 0.39 to 1.09 ppmv in the air exhaled by a healthy person. Higher values indicate the presence of diabetes. Ammonia ($NH_3$), a well-established biomarker for chronic kidney disease can be found in the range of concentration from 0.20 to 0.25 ppmv in the air exhaled by a healthy person. Higher values indicate a person with CKD. This study proposes the detection of both biomarkers through two analytical techniques. The first one will be gas chromatography - FID, a conventional and well-known technique regarding the separation of compounds present in gaseous mixtures. And the second one will be the photoacoustic technique, which is non-conventional for this type of study. The photoacoustic technique consists in detecting an acoustical signal generated by the gas present inside of a closed cell. Due to the absorption of a modulated (or pulsed) radiation, emitted by a Quantum Cascade Laser (QCL), the molecules of a gas, held in the photoacoustic cell, transition to an excited state, and then heat is generated as consequence of the molecules dropping back to a lower energy level. This heat is transformed into mechanical energy in the form of pressure waves. With the modulation of the excitation light in a specific frequency, the pressure waves (sound) can be detected by a microphone connected to a Lock-in amplifier. Considering that the intensity of the generated signal is linearly dependent of the number of molecules that absorb the radiation, by choosing the specific wavelength for a molecule its concentration can be identified (determined) in trace levels in a mixture of gases. The importance of the quantification of such biomarkers in trace level is that this type of analysis allows an early diagnosis, which makes possible to establish an effective therapy, avoiding the progression of such diseases and eventual deaths.