**A colorimetric based sensor for detection of the chemical injuries using urinary metabolites**

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Mustard gas is one of the chemical compounds used in the chemical warfare whose blistering properties were recorded in 1860 [1]. People who were exposed to this gas suffered lung, eye and skin damages. Long-term respiratory effects caused by inhaling mustard gas have caused the death of thousands of innocent people [2]. Currently, the diagnosis of lung disorders are performed using pulmonary function tests, high-resolution computed tomography and bronchoscopy [2]. Of course, the best detection method is Lung biopsy, which is an invasive method but the possibility of lung damage is very high. For this reason, most of the injured people refuse to undergo a biopsy, thus, it is difficult to accurately detect these persons [2]. As above limitations, it is necessary to use non-invasive methods to identify individuals injured by mustard gas. This study presents a colorimetric sensor consisting of a copper-silver nanozyme functionalized with dopamine combined with 12 organic dyes, separately. Based on the sensing mechanism, nanozyme catalyzes oxidation, dehydrogenation and hydrolysis reactions of volatile organic compounds. The product of the reaction can either change the color of indicators duo to turning the concentration of hydronium ions in the reaction media or creating a complex with organic dyes through Nucleophilic/electrophilic and H-bonding interactions. This sensor was used to analyze the metabolites in the urine samples of 152 volunteers including 38 controls and 114 chemical victims. The severity of the disease of injured people was defined in three states: mild, moderate and severe. The analysis was performed for 90 minutes at 75°C. Changes in the response of the sensor array are visible but the color responses were analyzed using an image analysis software. A unique recognition pattern was obtained for each sample. The statistical results show that the discrimination of control and injured species is done with a total accuracy of 81.1%. Also, the color changes of some sensing elements can have a good correlation with the severity of the disease with Pearson's coefficient of 0.987 and P\_value < 0.001. The response of the sensor is independent of the metabolic changes caused by the age of the participants and other parameters such as diet, other diseases, etc. This sensor can replace current methods as a non-invasive method for identifying the chemical victims.

**Keywords**: Colorimetric detection, Chemical warfare, Nanotechnology, Catalytic reaction, Metabolites

**References**:

[1] Kadivar, H. and S.C. Adams, Treatment of chemical and biological warfare injuries: insights derived from the 1984 Iraqi attack on Majnoon Island. Military Medicine, 1991. 156(4): p. 171-177.

[2] Tang, F.R. and Loke, W.K., Sulfur mustard and respiratory diseases, Critical Reviews in Toxicology, 2012; 42(8): 688–702.