

Paper-based Selective Detection of Methanol and Formaldehyde

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Methanol is widely used as an organic solvent in laboratories, chemical industries, pharmaceutical industries, fuel and paint industries, and household products. However, one cannot ignore its detrimental effect on health, the environment, and ecology. One of the most critical domains of utmost concern is “methanol poisoning or intoxication,” also termed as alcohol poisoning that develops from consuming methanol with alcoholic drinks, ultimately resulting in various adverse health outcomes, viz. dizziness, blindness, central nervous system breakdown, coma, and even death. These deleterious consequences through alcohol poisoning have caused nuisance worldwide; in particular, India being a developing country, is worst affected, predominantly where tribes, tea tribes, and daily wages reside. In the recent past, in 2021, 5 people died in Madhya Pradesh, in 2020, 111 people died in Punjab, and in 2019 more than 150 people died in Jorhat, Assam, due to methanol poisoning. Despite that, the nonexistence of a suitable on-site methanol detection kit for fast diagnosis is a matter of concern. Besides, methanol poisoning is a kinetically fast event, and quick medical intervention is essential to save lives. Hence, the demand for an on-site diagnosis report acquired through a portable kit or sensor is tremendous. At the same time, formaldehyde/formalin, the oxidation product of methanol, is considered hazardous waste and a carcinogenic agent, and its detection is also crucial. Conventionally, the analytical instruments available to detect either methanol or formaldehyde are bulky, complicated, involve tedious sample preparation procedures, and trained personnel to carry out the analysis. Owing to these bottlenecks, they are not suitable for Point-Of-Care (POC) and Point-Of-Need (PON) testing. Therefore, there is a need to develop a facile, inexpensive, rapid, and interference-free paper-based platform for the selective and colorimetric detection of methanol and formaldehyde for POC and PON testing. We exploited a chemical reaction strategy to detect methanol through a two-step process on the paper platform. The first step involves the conversion of methanol to formaldehyde using an enzyme, while the second step involves the conversion of the formaldehyde to a purple-colored product in the presence of a chromogen and basic pH condition. The methanol concentration can be calculated by measuring the pixel intensity of the developed color on the paper substrate. This lab-on-paper kit can be utilized for qualitative and quantitative detection of both methanol and formaldehyde in POC and PON locations.

