

## Urea and Starch Detection on a Paper-Based Microfluidic Device Enabled on a Smartphone

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**Abstract :** Milk is one of the basic and primary sources of food and energy as we start consuming milk from birth. Hence, milk quality and purity and checking the concentration of its constituents become necessary steps. Considering the importance of the purity of milk for human health, the following study has been carried out to simultaneously detect and quantify the different adulterants like urea and starch in milk with the help of a paper-based microfluidic device integrated with a smartphone. The detection of the concentration of urea and starch is based on the principle of colorimetry. In contrast, the fluid flow in the device is based on the capillary action of porous media. The microfluidic channel proposed in the study is equipped with a specialized detection zone, and it employs a colorimetric indicator undergoing a visible color change when the milk gets in touch or reacts with a set of reagents which confirms the presence of different adulterants in the milk. In our proposed work, we have used iodine to detect the percentage of starch in the milk, whereas, in the case of urea, we have used the p-DMAB. A direct correlation has been found between the color change intensity and the concentration of adulterants. A calibration curve was constructed to find color intensity and subsequent starch and urea concentration. The device has low-cost production and easy disposability, which make it highly suitable for widespread adoption, especially in resource-constrained settings. Moreover, a smartphone application has been developed to detect, capture, and analyze the change in color intensity due to the presence of adulterants in the milk. The low-cost nature of the smartphone-integrated paper-based sensor, coupled with its integration with smartphones, makes it an attractive solution for widespread use. They are affordable, simple to use, and do not require specialized training, making them ideal tools for regulatory bodies and concerned consumers.

**Keywords :** paper based microfluidic device, milk adulteration, urea detection, starch detection, smartphone application

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