IIT Hyderabad scientists developing mobile phone-based detectors to check for milk adulteration

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Hyderabad: Indian Institute of Technology Hyderabad Researchers are developing a Smart Phone-based sensors to detect adulteration in milk. As a first step, they have developed a detector system to measure the acidity of milk through design of an indicator paper that changes color according to the acidity of the milk. They have also developed algorithms that can be incorporated on to a mobile phone to accurately detect the color change.

The Research, undertaken by a team led by Prof Shiv Govind Singh, Department of Electrical Engineering, IIT Hyderabad and comprising Dr Soumya Jana and Dr Siva Rama Krishna Vanjari, Associate Professors in the Department of Electrical Engineering, IIT Hyderabad and others, has been published in the November 2018 issue of Food Analytical Methods journal.

Speaking about the importance of this research, Prof Shiv Govind Singh said, “While techniques such as chromatography and spectroscopy can be used to detect adulteration, such techniques generally require expensive setup and are not amenable to miniaturization into low-cost easy-to-use devices. Hence, they do not appeal to the vast majority of milk consumers in the developing world.”

Further, Prof Shiv Govind Singh added, “We need to develop simple devices that the

consumer can use to detect milk contamination. It should be possible to make milk adulteration detection failsafe by monitoring all of these parameters at the same time, without the need for expensive equipment."

As a first step, the research team has developed a sensor-chip based method for measuring pH, an indicator of the acidity. The researchers have used a process called 'electrospinning' to produce paper-like material made of nanosized (~10-9 m diameter) fibres of nylon, loaded with a combination of three dyes. The paper is "halochromic", that is, it changes color in response to changes in acidity.

The Researchers have developed a prototype smart phone-based algorithm, in which, the colours of the sensor strips after dipping in milk are captured using the camera of the phone, and the data is transformed into pH (acidity) ranges. They have used three machine-learning algorithms and compared their detection efficiencies in classifying the colour of the indicator strips. On testing with milk spiked with various combinations of contaminants, they found near-perfect classification with accuracy of 99.71%.

His Research team at IIT Hyderabad will extend the above research to study the effects of mobile phone cameras and lighting on detection efficiency. In the long run, they hope to develop sensors for other physical properties such as conductivity and refractive index, and integrate it with the pH detection unit to obtain comprehensive milk quality check systems that can be easily deployed by the consumer using mobile phones and other hand-held devices.

Adulteration of milk is a serious problem in India. A recent report by the Animal Welfare Board shows that 68.7 % of milk and milk by-products in the country are adulterated with products such as detergent, glucose, urea, caustic soda, white paint and oil. Chemicals such as formalin, hydrogen peroxide, boric acid and antibiotics could also be added to milk to increase shelf life.

The conventional way to detect adulteration in milk is to analyse the chemicals that are present in it by complex processes. Prof Shiv Govind Singh's Research Group seeks to detect contamination through sensing changes in the biophysical properties of milk as explained in in thire earlier publish work in J of Food chemistry. Some common biophysical properties that change because of addition of adulterants are acidity, electrical conductivity and refractive index (passage of light through material).

For example, addition of detergent, caustic soda or boric acid can make the milk more or less acidic than it should be. The addition of urea can change the electrical conductivity of milk. The addition of sugar, water and urea has been shown to alter the refractive index of milk.