

1 Introduction

Global Diabetes Crisis

- Glucose monitoring is crucial for preventing complications caused by diabetes. It is estimated that more than 195 million people globally suffer from diabetes at present. Its figure is expected to surpass 330 million by 2030 [1].

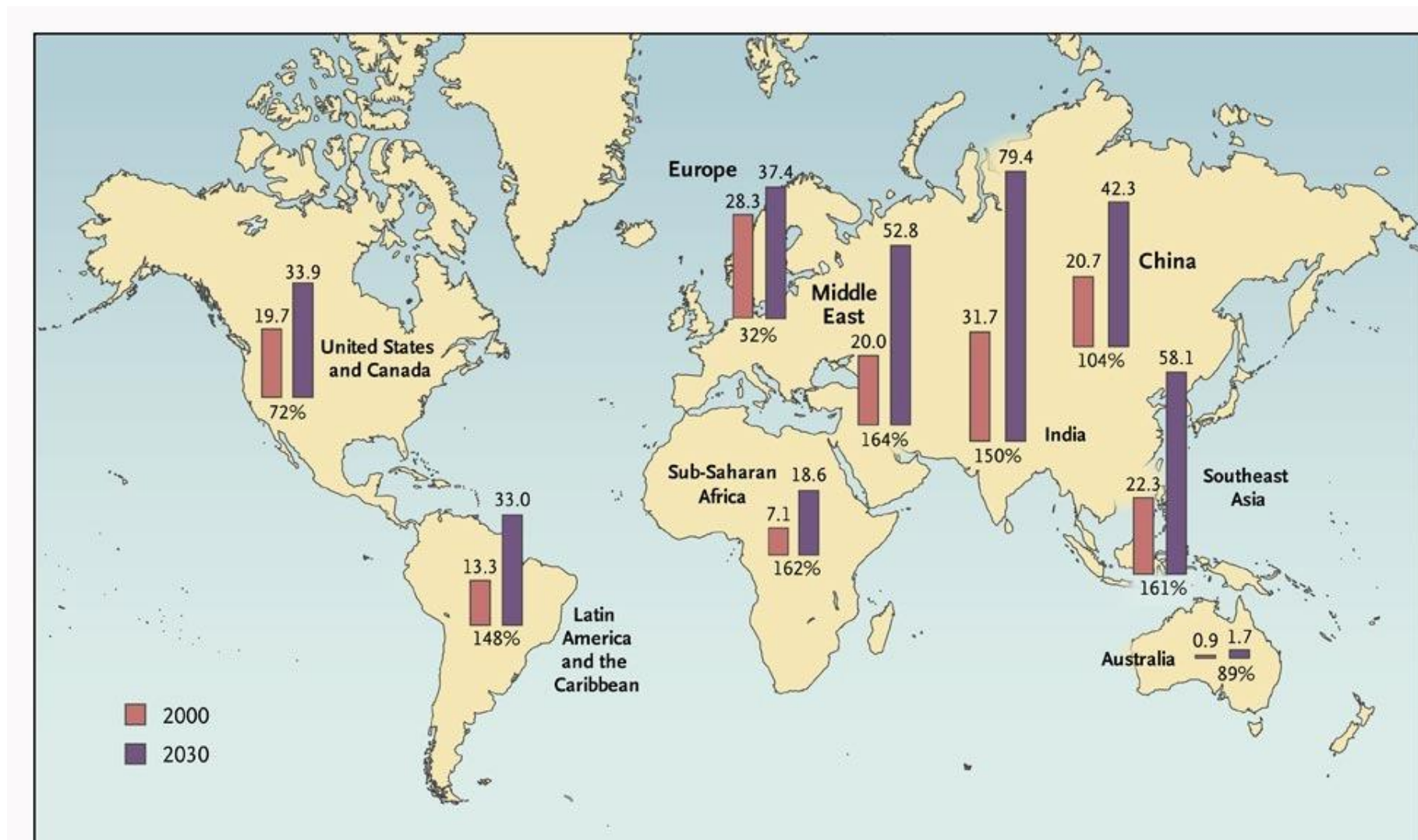


Figure 1. Millions of Cases of Diabetes in 2000 and Projections for 2030 [2]

- Traditional glucose monitoring methods** can be invasive and painful, making non-invasive and user-friendly techniques more appealing.



Figure 2. Finger-stick blood glucose testing [3]



Figure 3. Venous blood glucose testing [4]

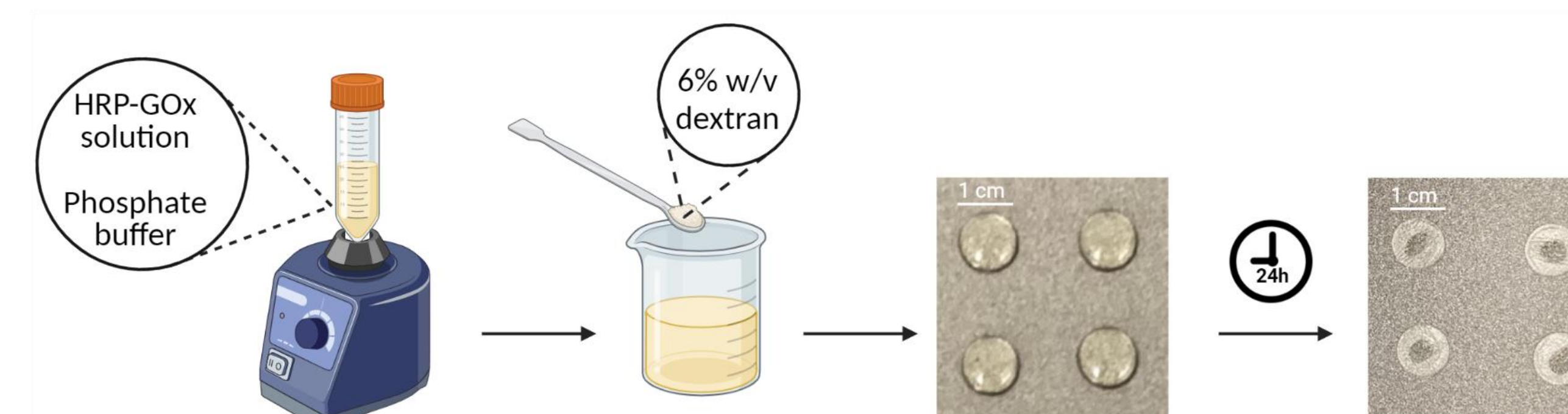
Non-invasive Point-of-care Alternative:

- Glucose detection in urine can provide insightful information about an individual's diabetes status. **Enzymatic detection methods** are widely used in POC devices, with glucose oxidase (GOx) and horseradish peroxidase (HRP) commonly used in urine glucose detection assays. However, enzymes are sensitive to temperature, and humidity, leading to rapid loss of activity and reduced assay reliability.

- In this study, we developed a stable POC assay for glucose detection in urine by encapsulating GOx and HRP with dextran in the form of a tablet. 3,3',5,5'-Tetramethylbenzidine (TMB) is used as the chromogenic agent, turning the system blue in the presence of glucose. Our tablets will provide a low-cost, stable, and convenient method for glucose monitoring, which will be especially useful in resource-limited settings.

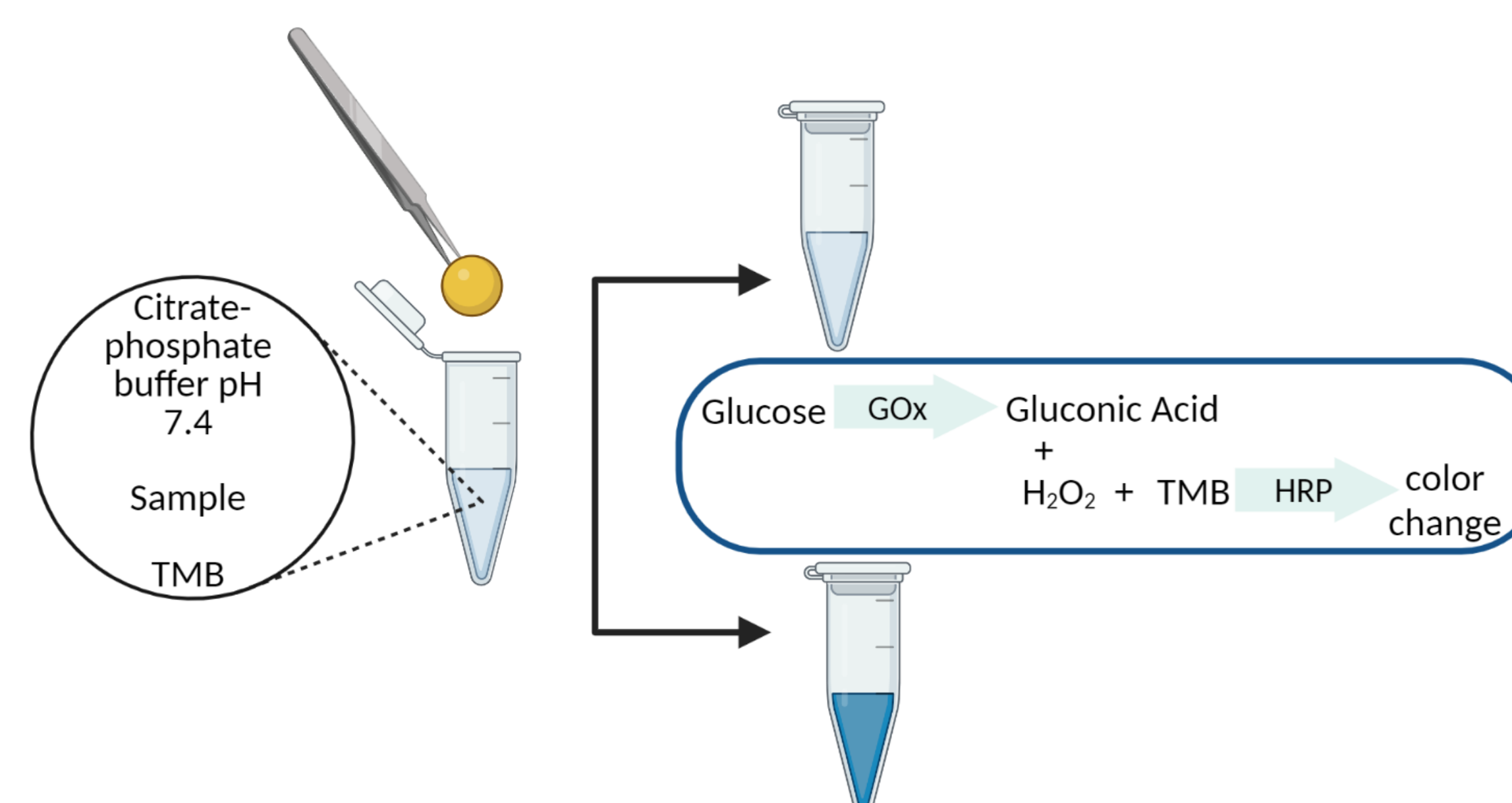
2 Methods and Materials

Tablet Fabrication



The resulting tablet solution is pipetted onto an iron-coated tray and allowed to dry for 24 hours in room temperature.

Detection Method



The system changes color in the presence of glucose. The resulting color can be analyzed by a UV-vis spectrometer or a smartphone.

3 Results and Discussion

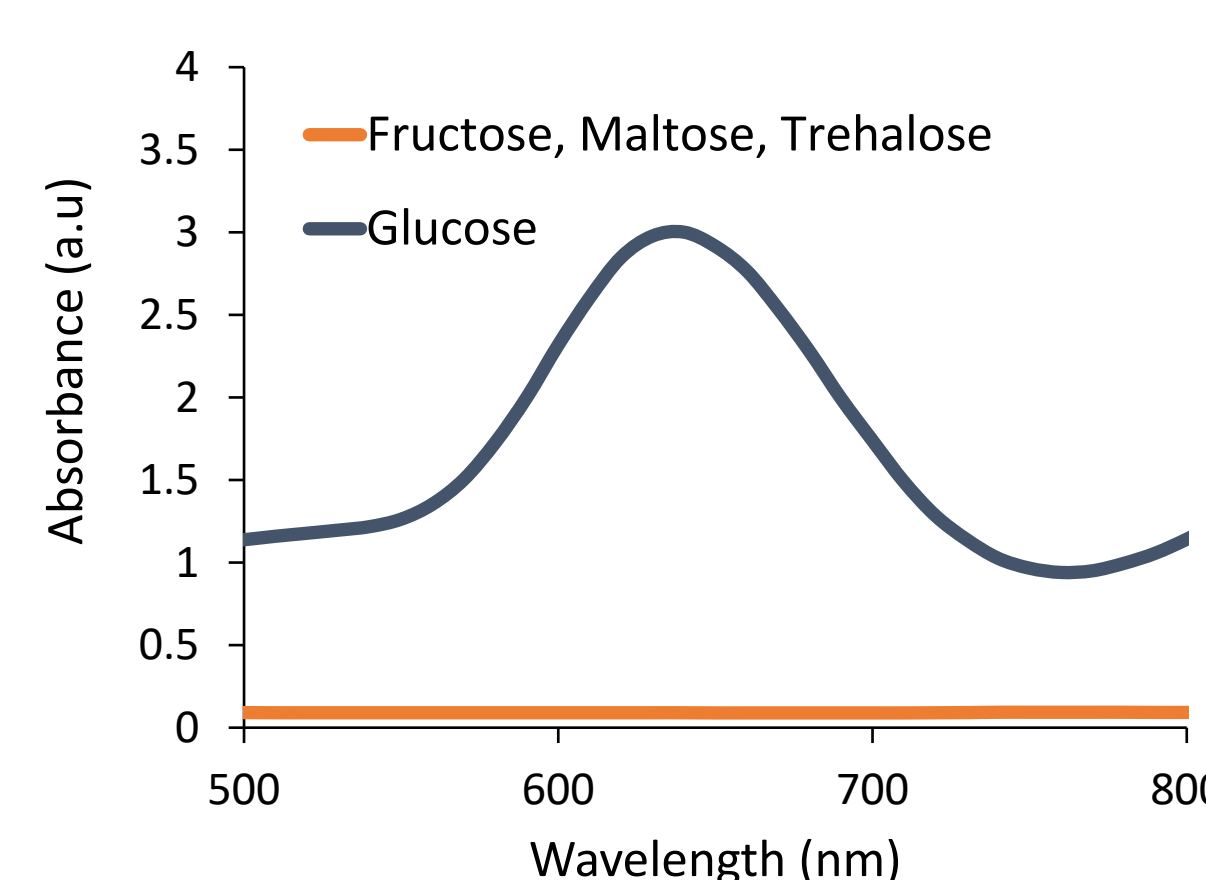


Figure 6. Selectivity test for different kinds of sugar

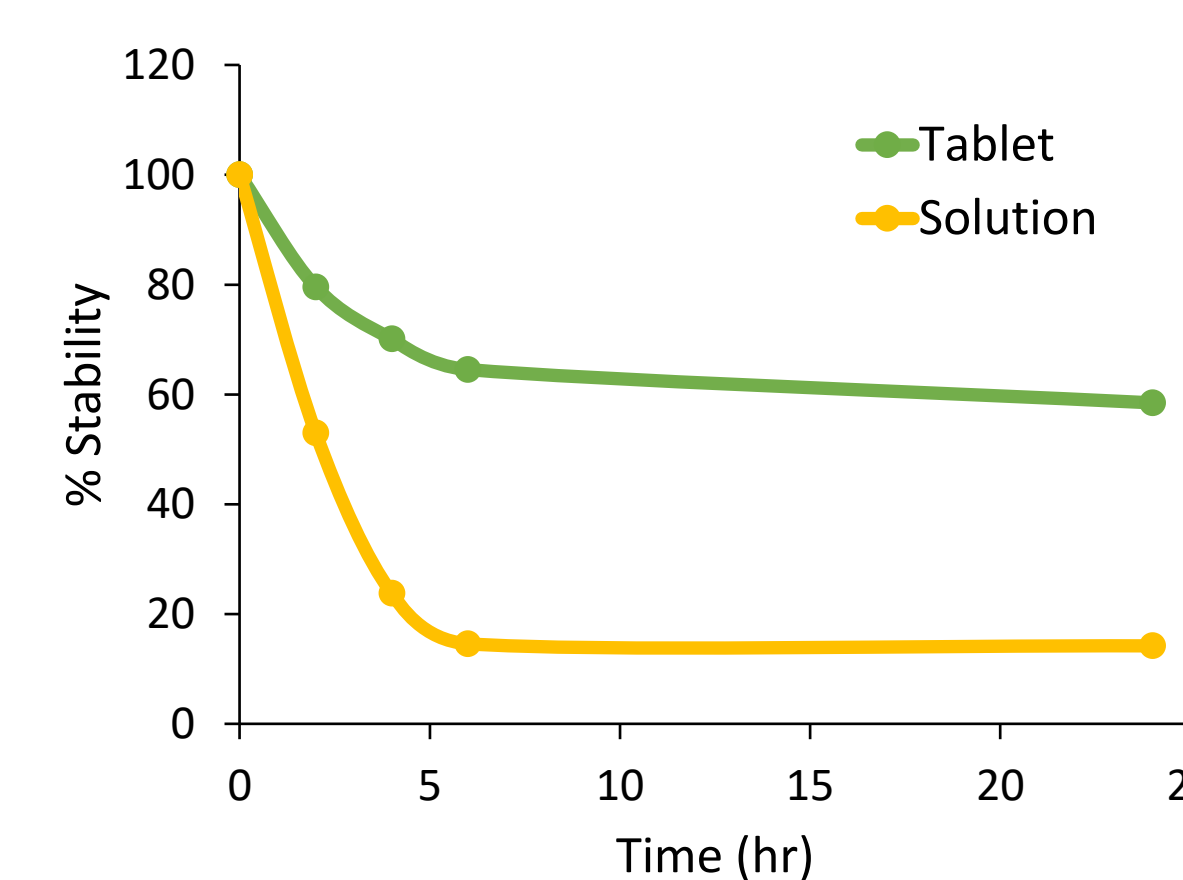


Figure 7. Thermal stability test

The system exhibited high specificity towards glucose, with no interference detected from other sugars such as fructose, maltose, and trehalose during testing of the tablets.

Comparison of tablet and tablet solution stability at 60°C showed that the solution lost 86% enzyme activity after 24 hours, while tablets only lost 42% activity.

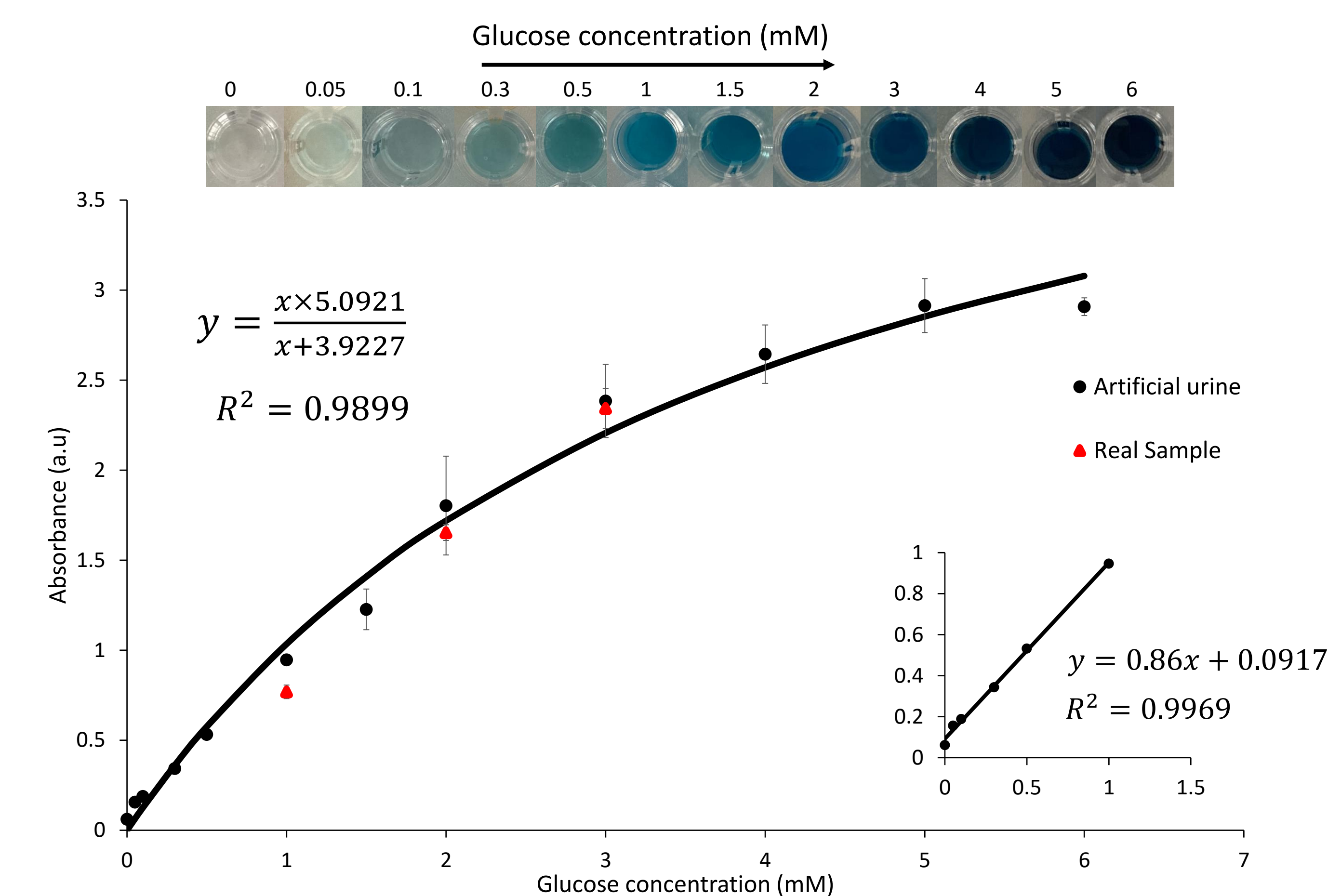


Figure 8. Calibration curve

- A calibration curve was generated by testing tablets with known concentrations of spiked artificial urine containing glucose. The device showed a working range of 0-6 mM with the limit of detection of 0.05mM. These values fit well into clinically relevant range of glucose in human urine.

4 Conclusion

- Enzymes encapsulation by dextran in tablets used with TMB as a chromogenic agent resulted in a reliable colorimetric response. The tablets are stable and can be stored at room temperature for extended periods without significant loss of activity.
- Future studies could investigate the application of this assay combined with smartphone imaging and machine learning algorithms to further improve the accessibility of the system. Also, the application of this method can be studied in other biological fluids.

5 References

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