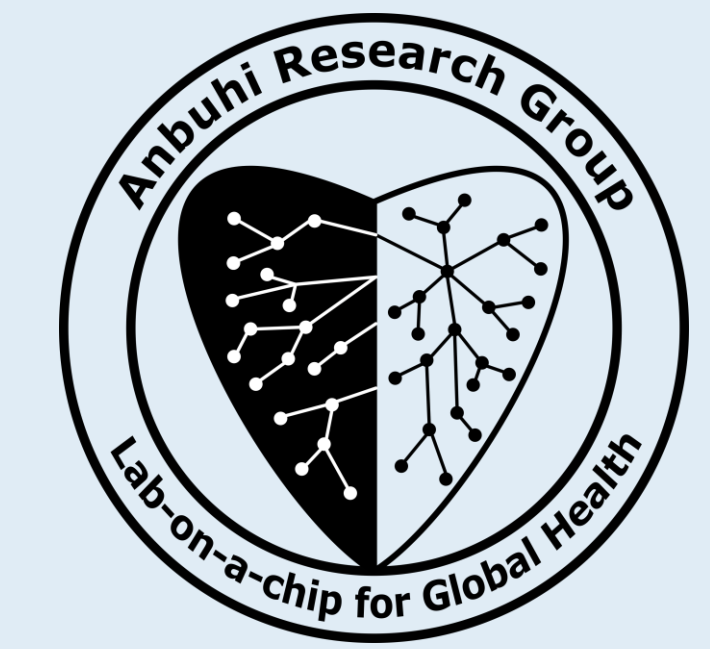


Low-cost Tablet-based Sensor for On-site Detection of Nitrite in Water

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Introduction

- Nitrite is widely used in agriculture and industry as a food additive or corrosion inhibitor. Extensive use of nitrite and its discharge through wastewater can result in excess amount of nitrite in water bodies [1, 2].
- High intake of nitrite can irreversibly convert blood hemoglobin to methemoglobin that, in turn, will result in impairment of oxygen carrying capacity of blood. Also, high nitrite concentrations can cause serious cancers such as gastric cancer, accidental abortions, birth defects, and even death. In aquatic ecosystem, elevated nitrite levels affect the growth and development of aquatic organisms and even cause mass death [1-3]. Thus, timely detection of nitrite is of utmost importance to prevent such detrimental effects.
- According to Health Canada, the maximum acceptable concentration of nitrite in drinking water is 3 mg/L [4], while the Environmental Protection Agency (EPA) of U.S has set a limit of 1 mg/L for nitrite [5]. For aquatic organisms, concentrations of above 0.02 mg/L have been reported to be detrimental [3].
- In this poster, we propose a novel tablet-based method for point-of-use detection of nitrite. Nitrite assay will be produced in the form of small portable tablets that are easy-to-use and low-cost that can make nitrite assay accessible for anyone and prevent nitrite's harmful effects.

Materials & methods

Detection mechanism:

- For the nitrite detection, Griess assay is used [6]. Under acidic conditions, sulfanilamide reacts with nitrite to form the diazonium cation. The cation then reacts with n-(1-naphthyl)ethylenediamine (NED) to form a purple-magenta azo dye (Fig. 1).

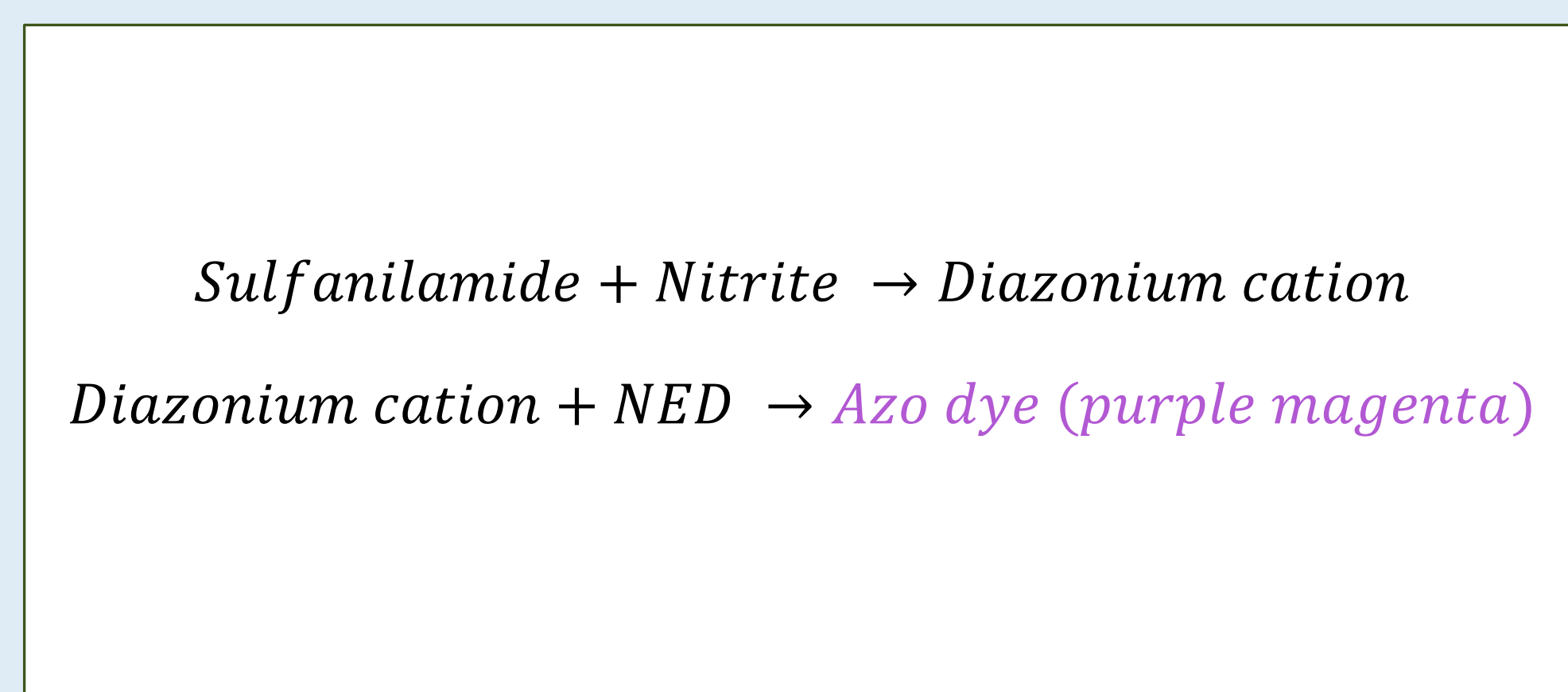


Fig. 1. Illustration of the Griess assay reactions for the detection of nitrite.

Tablet formulation:

- Sulfanilamide
 - N-(1-naphthyl)ethylenediamine
 - Mannitol (bulking agent)
 - Polyethylene glycol (PEG, lubricant)
 - Polyvinylpyrrolidone (PVP, binder)
- For the fabrication of tablets, first the powders were weighted and mixed together. Then, the mixture was poured into the pressing die, and the powder mixture was pressed with a hydraulic press machine. Finally, the created tablet was taken out of the die and stored in a glass vial covered with an aluminium foil to protect the chemicals from light (Fig. 2).

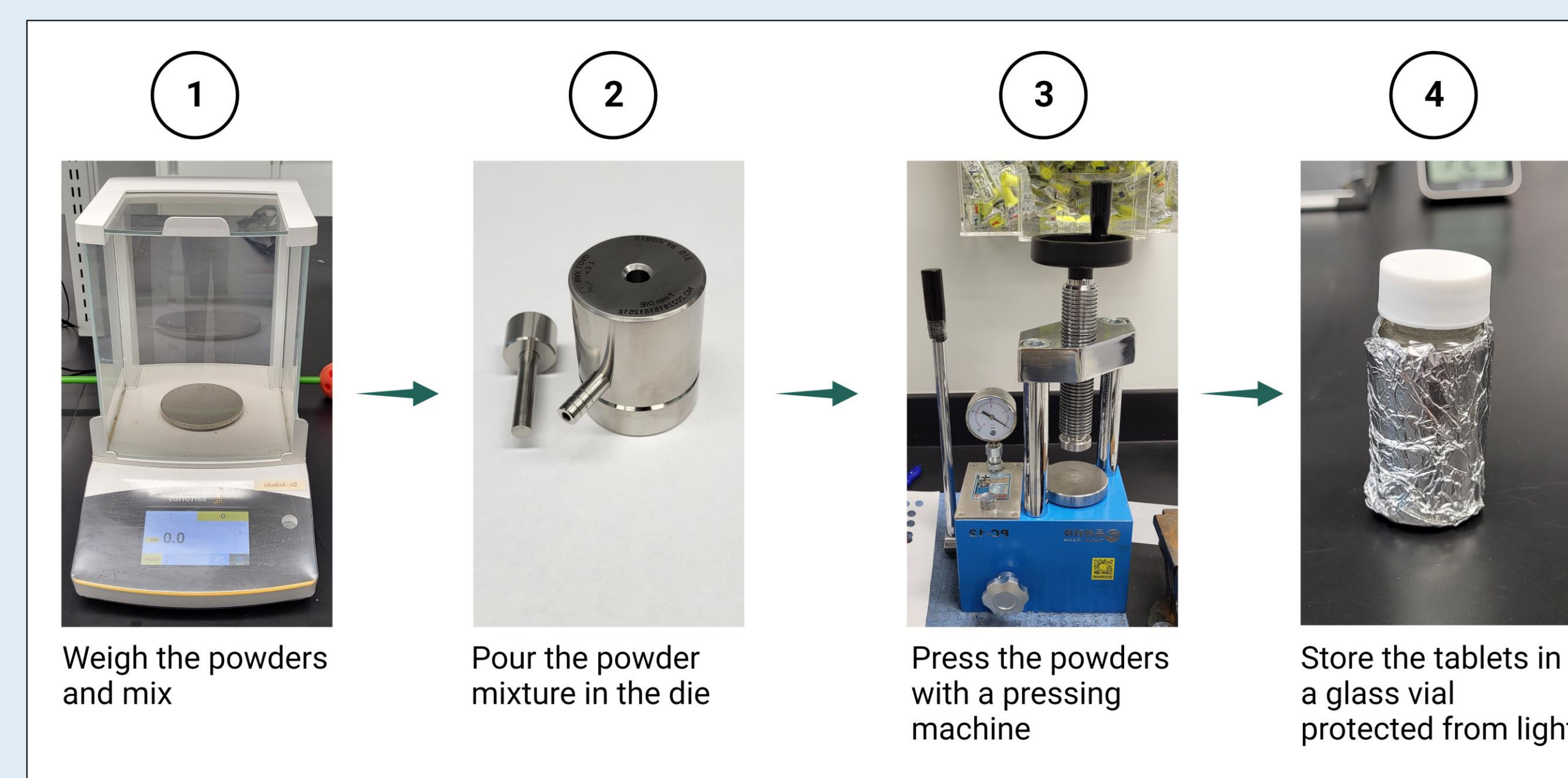


Fig. 2. Procedure for the fabrication of the tablet sensors.

Detection workflow:

- For the detection of nitrite in water samples, first, a certain amount of water is added to the test tube pre-loaded with buffer. Then, one tablet sensor is added to the test tube, and the tube is shaken well for 1-2 minutes. After 5 minutes, if nitrite is present in the sample, the solution will change color to purple-magenta corresponding to nitrite concentration (Fig. 3).

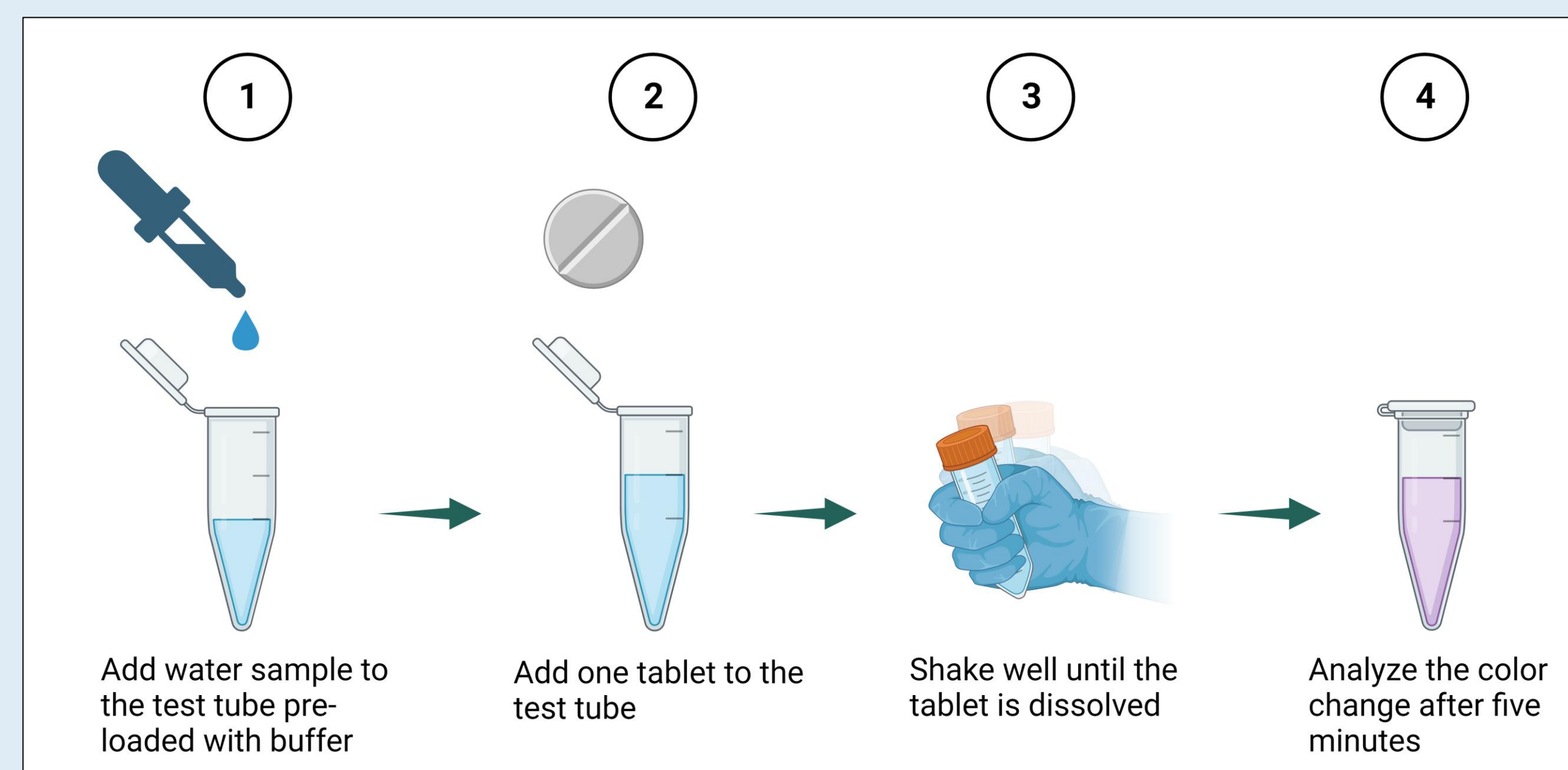


Fig. 3. Workflow of nitrite detection in water using tablet sensors.

Results

- Preliminary results demonstrated that the tablet sensors successfully detected nitrite in water with concentrations as low as 0.1 mg/L which is below the Canadian and U.S limitations for maximum acceptable concentration of nitrite in drinking water (Fig. 4)..



Fig. 4. Preliminary results of the tablet sensor for nitrite detection in water.

Conclusions

- In this poster, we proposed tablet-based sensors as a novel platform for the detection of nitrite in water.
- The proposed tablet is easy-to-use, portable, and highly sensitive that can be used by anyone anywhere.
- Such a simple and portable assay for nitrite detection can significantly increase the accessibility of nitrite assay to prevent the detrimental effects of nitrite in water both for humans and aquatic organisms.

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