Developing a Sensitive, Papain-Based Hydrogel Film That Colorimetrically Detects Glucose

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Several glucometer methods are available for patient-guided glycemic control to reduce the onset of diabetic complications. However, dipstick urine glucose tests using horseradish peroxidase (HRP) have limitations, including cost, stability, and preparation procedures. Papain, a protease found in Carica papaya, displays high selectivity and HRP-like activity but lacks sensitivity to be incorporated into existing glucometer devices. This study aimed to improve the sensitivity of the papain-based glucometer method by catalyzing papain's oxidation under varying reaction conditions. The study also investigated the viability of using papain-based hydrogel films to detect sweat glucose and provide a colorimetric indicator of blood glucose level. To do this, this study performed glucose oxidase-mediated glucose oxidation and papain-mediated TMB oxidation under varying sample conditions and spontaneously coupled them, both under microtube and hydrogel film conditions. This research confirmed that glucose oxidase quantitatively produces H2O2, whose presence catalyzes papain-mediated production of a colorimetric signal. When two oxidation reactions were coupled, this study identified that the sensitivity of papain’s glucose detection increased ten-fold with a high correlation compared to the previous studies. The hydrogel films presented a quantifiable visual correlation with high glucose absorptivity and reagent incorporation. Hence, this study presents foundational advances in the development of a patch-based glucometer device with high sensitivity to detect variations in sweat glucose and colorimetrically infer blood glucose levels. Furthermore, the minimization of invasiveness, ease of interpretation, and economic efficiency of the prototyped hydrogel film are highlighted.

Awards Won:
Second Award of $2,000