A Low-Cost Tyrosinase-Based Biosensor for Colorimetric Toxicity Screening of Water Samples

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Water pollution by phenolic compounds and heavy metals poses a significant threat to aquatic ecosystems, creating a need for rapid, low-cost methods to assess environmental toxicity. Tyrosinase, a copper-containing oxidase involved in melanin biosynthesis, is sensitive to inhibition by many common toxins, making it a useful biological indicator of pollution. In this study, a low-cost tyrosinase-based colorimetric test strip was evaluated for its ability to quantify enzyme inhibition using kojic acid as a model inhibitor and was compared to a standard enzyme assay. Both methods demonstrated a strong positive correlation between kojic acid concentration and tyrosinase inhibition, with the enzyme assay showing slightly higher consistency than the test strip. Although the test strips exhibited a higher baseline inhibition and greater variability, their inhibition trends closely matched those of the conventional assay. Short-term freezing of the test strips for up to 72 hours did not significantly affect S-values ($p = 0.3998$), indicating stability during storage. Overall, the tyrosinase test strips reliably reflected kojic acid–induced inhibition and provide a rapid, practical, and cost-effective alternative to traditional enzyme assays for short-term environmental toxicity screening.

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