Developing an Ethylene Scavenging Polyurethane Foam Packaging Material That Delays the Ripening Process of Climacteric Produce

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Ethylene gas is a plant hormone that induces the ripening process in fruits and vegetables. The incorporation of ethylene scavengers into sachets or directly into plastic packaging have succeeded in reducing ethylene concentration and extending produce shelf-life, but there has been little exploration into other materials. This project demonstrates the viability of low-density polyurethane foam as a medium for ethylene scavengers. The ethylene scavenger Zeolite-$KMnO_4$ was synthesized and mixed into a low-density polyurethane foam mix at ratios of 2.5 (Foam A) and 5 (Foam B) w/w%. The resulting foams were cut into sheets and placed into containers with unripe Cavendish bananas/Envy apples. The containers packaged with Foam A were referred to as Group A, those with Foam B as Group B, and those without foam as the control group. Over the course of 9 days, the ethylene concentration (ppm) in each container was collected daily with an ethylene gas detector and gas sampling pump. The results were analyzed using 2-sample t-tests with an alpha of 0.1. For the apples, the ethylene levels of Group A and Group B were lower than the control group from days 6-10 ($p = 0.0061, 0.0061, 0.0808, 0.0341, 0.0031$) and days 5-9 ($p = 0.0657, <0.0001, 0.0007, 0.0179, 0.0039, <0.0001$) respectively, and Group B was lower than Group A from days 8-10 ($p = 0.0705, 0.0031, 0.001$). For the bananas, the effects of the foam can most clearly be seen in the timing of peak ethylene production. The peak of the control group fell later than that of Group A ($p = 0.0352$), which fell later than that of Group B ($p = 0.0890$). The incorporation of foam provides benefits such as impact absorption and scalability compared to previous forms of ethylene control, and this study opens the door for future development.

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