National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Development of Photodynamically Treated Process to Enhance Shelf life of Dragon Fruit (Hylocereus undatus) Using a Novel Curcumin Mediated Photosensitizer
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Venue	: CH-113 (Department of Food Process Engineering)
Date and Time	: 24 Sep 2025 (16.45 hr)
Abstract	: Dragon fruit (*Hylocereus* species) is a nutrient-rich exotic fruit cultivated throughout the arid regions, especially in Asia. However, it is highly perishable with short postharvest shelf life due to rapid weight loss, increased ripening, and high respiration rates, leading to shrivelling and spoilage. Fresh-cut fruits, including dragon fruit (DF), are increasingly popular for their health benefits, convenience, and nutritional value, boosting global consumption and research interest. However, improper handling and storage can cause microbial contamination, posing risks of foodborne illnesses and outbreaks. Thus, the current research applies Photodynamic Inactivation (PDI) technology with blue visible light to activate a hydrothermally synthesized curcumin&ndashD(+) trehalose dihydrate (CUR-TRE) complex, as a novel photosensitizer, generating ROS that inactivate microbes, enhance bioactive compounds, and ultimately extending the shelf life of DF. Initially, turmeric powder (TP) was treated using atmospheric cold plasma (ACP) for the extraction of curcumin (CUR) and other bioactive compounds. Treatment at 30 kV for 10 min yielded maximum CUR (46.49 mg/g), increased phenols, flavonoids, and antioxidants, and caused visible cell lysis. CUR was isolated via silica gel chromatography and recrystallization, then combined with trehalose (TRE) through a hydrothermal method to form the CUR&ndashTRE complex. Characterization (NMR, HRMS, FTIR, FESEM, XRD, DRS) of CUR-TRE complex confirmed its formation, showing improved stability, crystallinity, and photoluminescence (543 nm). The complex exhibited faster photobleaching and higher ROS generation than CUR alone. At 100 µM, CUR&ndashTRE achieved a 6.52-log reduction of *E. coli* O157:H7 within 30 min and >3.47-log reduction on inoculated fresh-cut DF under blue visible light. Moreover, CUR&ndashTRE mediated PDI preserved the visual quality, color, and vitamin C of fresh-cut dragon fruit during 20 days at 25°C, reduced weight loss to 33.08% (vs. 87.69% control), and significantly inhibited PPO and POD activities. Further, PDI-treated DF juice stored at 4 ± 1 °C for 28 days showed higher retention of phenols, flavonoids, and DPPH activity compared to atmospheric cold plasma-treated juice, along with increased soluble solids and reduced pH. Finally, the CUR-TRE complex powder is converted into a value added product like stretchable hydrogel, which was applied as a protective shield on the outer surface of DF to inhibit microbial growth and thereby extending its shelf life for 25 days.