APPLYING PHYTO-NANOTECHNOLOGY AND LASER IRRADIATION IN THE ENHANCEMENT OF STRAWBERRY QUALITY ATTRIBUTES

THESIS

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ABSTRACT

This research aimed to find an effective and ecological method for maintaining quality attributes, eliminating deterioration, and preserving the appearance of strawberry fruit (*Fragaria* x *ananassa*, cv. Festival) under cold storage. Laser irradiation and edible coating of chitosan nanoparticles have been used for this investigation. Biosynthesis of chitosan nanoparticles using Guava L. (*Psidium guajava* L.) extract as ecofriendly and cost effective approach has been studied. The leaves of guava are nontoxic, full of bioactive compounds, and suitable alternative to avoid chemicals used in the other techniques. Variations in extract preparation method and ratio of chitosan to leaf extract were examined to investigate the effect of these factors on the particles size. The characterizations of chitosan nanoparticles were conducted using dynamic light scattering (DLS), transmission electron microscope (TEM), Fourier transform infrared spectroscopy (FTIR), and zeta potential analysis. To prolong the shelf life and reduce senescence of strawberries, two experiments have been conducted: 1) Strawberries were irradiated by diode laser at wavelength of 450 nm and light intensity of 1.3 $mWcm^{-2}$ for 3, 6, and 12 min to identify the optimal exposure time of laser light in order to suppress fungal decay and extend the shelf life for 7 days. 2) Strawberries were treated by 0.5% chitosan coating, chitosan nanoparticles coating, and a combination of the optimal exposure time of laser and chitosan nanoparticles coating to prolong the shelf life for 12 days. For both experiments, untreated fruit were used as control, and the fruit were preserved under the same storage circumstances at 10 ^{o}C and 85-90% RH. The results showed that semi-spherical nanoparticles were formed at pH=5 with an average particle size of 21.92 nm and narrow size distribution as the polydispersity index (PDI) value was 0.471. Zeta potential was -27.1 which gives reasonable stability of the nanoparticles in suspension. The findings revealed that low exposure time of diode laser reduced weight loss and decay percentages, maintained the flesh firmness and total soluble solids, while a minor effect on external color, anthocyanin accumulation, and ascorbic acid was detected. Meanwhile, the combination of low exposure time of laser and chitosan nanoparticles coating completely suppressed the fungal decay compared to 50% decay of control sample, and reduced weight loss percentage to the lowest value of 4.68% compared to 27.35% of the control sample. Combination treatment exhibited the highest levels of anthocyanin content and vitamin C at 42 and 81.1 mg/100 g, respectively, and decreased the reduction percentage of antioxidant activity to 7.16% compared to 31.27% of untreated sample.

Key words: Strawberry fruit, chitosan nanoparticles, diode laser.