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Title Investigating FT-NIR Spectral and Color Properties of Lysozyme-Chitosan Coated Egg Freshness during Storage
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Abstract Text

Eggs are globally an important source among the most nutritious foods consumed worldwide. However, they are highly perishable and can lose interior quality in short time depending on storage condition. Egg coating is alternatively an effective method to preserve interior quality of eggs during storage at 24°C. Various studies have been conducted on eggs such as hydrocolloids, lipid, proteins etc. Chitosan, a deacetylated form of chitin obtained from shellfish waste, provides excellent oxygen barrier film properties. Lysozyme is a peptidoglycan N-acetyl-muramoylhydrolase bacteriolytic enzyme. This study aimed to evaluate the effects of chitosan based coatings combined with lysozyme at 0, 10, 20 and 60% (w/w) with storage time of 6 weeks at 24°C on the quality characteristics of shell eggs. Spectral measurements were taken on the eggs yolk and albumen in reflectance and transmittance modes using an FT-NIR spectrometer of Bruker multi-purpose analyser that equipped with InGaAs detectors and a 20 W high-intensity tungsten-halogen NIR light source. Reflectance measurements obtained with a fibre optic probe covered the wavelengths of 780–2500 nm. The color values of shell egg, albumen and yolk samples were measured with Minolta Chroma Meter CR-400. Results were recorded as L*, a*, b* where L* describes lightness, a* redness and b* yellowness. This study investigated the effectiveness of lysozyme-chitosan coatings to maintain the quality attributes such as albumen and yolk color and spectral properties of fresh eggs during storage at 24°C for 6 weeks. Lightness and redness of egg albumens significantly increased during storage for all egg groups during storage, while b* values decreased in time. Lightness of egg yolk decreased from 65.32±0.59 to 57.27±0.84, while redness of egg albumens significantly increased during storage. FT-NIR spectroscopy system acquired diffuse reflectance spectra in the range of 833 to 2500 nm. By NIR spectroscopy, C-H, N-H and O-H bonds are induced to vibrate. NIR scanning for 800 to 2800 nm spectra was applied to analyse the effect of lysozyme-chitosan (L-C) coatings on fresh egg. The absorbance spectrum stays relatively flat around 1200-1300 nm. The 20% and 60% L-C coatings were more effective than chitosan alone and 10% L-C coating for maintaining the internal quality of fresh eggs during storage. The control egg albumen and yolk spectra were used as a base for comparison to determine changes in secondary structure of control and end of storage, instead of to show correlation between color values and NIR measurements. Studies results showed the correlation between Haugh until and NIR spectral values. Albumen becomes thinner over time, which leads to a change in the transmitted spectra while water band changes depending on the water content were clearly observed. In particular this study showed that L-C coatings could be an alternative to other coatings for maintaining the internal qualities of fresh eggs during long-term storage while FT-NIR spectroscopy could be used as a new tool for the assessment of freshness and has a potential as a rapid and non-destructive analysing technique to determine quality changes in fresh eggs during storage period.

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Keywords Lysozyme, chitosan, coating, shell egg, color, near-infrared spectroscopy.