

紫草素智慧型包裝材料之應用

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一、前言

二、紫草素和蜂膠結合明膠/鹿角菜膠基顏色指示劑薄膜應用於智慧食品包裝

三、具有高機械強度和疏水特性的智慧型感測薄膜，應用於蝦子和豬肉的新鮮度監測

四、由幾丁聚醣和聚乙烯醇製備的智慧型包裝膜，應用於蝦的新鮮度監測

五、結論

摘要

智慧型包裝能夠透過顏色變化即時監控包裝食品的品質及狀況，近年來，花青素、薑黃素及紫草素等多種天然著色劑因其智慧顏色感測及其他功能特性而備受關注。紫草素(Shikonin)為一種常見於紫草科的萘醌化合物，具有抗癌、抗發炎、傷口癒合等多種藥理作用，由於其 pH 值敏感特性適合作為智慧型包裝之永續材料。因此本研究將探討紫草素做為顏色指示劑以監測食品新鮮度，並結合其他活性成分包括明膠/鹿角菜膠(Gel/Carr)、蜂膠(Propolis)、幾丁聚醣/聚乙烯醇(CS/PVA)及纖維素來提高食品安全性，製備活性智慧包裝膜並進行各性能研究分析。以 Propolis 及紫草素加入 Gel/Carr 基以製備多功能智慧複合膜，Propolis 及紫草素均勻的分散在 Gel/Carr 中，並明顯改善紫外線遮光功能，Gel/Carr/Shikonin/Propolis 複合膜也顯示出抗菌及抗氧化活性，在 pH 2-12 範圍內表現出顏色變化，能夠有效監控包裝牛奶的新鮮度。以纖維素作為基質製備含有紫草素複合膜。在紫草素的加入下改善了疏水性、拉伸強度、熱穩定性及防水性能，並能夠在 20、4 和 -20°C 下監測蝦子及豬肉的新鮮度。以 CS/PVA 基質中加入紫草素製備成複合膜，增強了機械強度、疏水性及水蒸氣阻隔性，並且具有抗菌及抗氧化性能，在不同溫度下監測蝦的新鮮度也能顯示出顏色變化。綜合上述三篇文章顯示，紫草素表現出優異的顏色感測功能以即時監控食品的新鮮度，未來能夠進一步應用於實際食品系統。

Application of Shikonin in Smart Packaging

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1.Introduction

2. Preparation of Gelatin/Carrageenan-Based Color-Indicator Film Integrated with Shikonin and Propolis for Smart Food Packaging Applications.

3. Smart colorimetric sensing films with high mechanical strength and hydrophobic properties for visual monitoring of shrimp and pork freshness.

4.Smart colorimetric indicator films prepared from chitosan and polyvinyl alcohol with high mechanical strength and hydrophobic properties for monitoring shrimp freshness.

5.Conclusion

Abstract

Smart packaging can monitor the quality and condition of packaged food in real-time through color changes. In recent years, various natural colorants such as anthocyanin, curcumin, and shikonin have garnered attention for their smart color-sensing and other functional properties. Shikonin, a naphthoquinone compound commonly found in the Boraginaceae family, has pharmacological properties such as anti-cancer, anti-inflammatory, and wound healing. Due to its pH-sensitive properties, shikonin is suitable as a sustainable material for smart packaging. This study explores the use of shikonin as a color indicator to monitor food freshness and combines it with other active ingredients, including gelatin/carrageenan (Gel/Carr), propolis, chitosan/polyvinyl alcohol (CS/PVA), and cellulose to enhance food safety. Active smart packaging films are prepared, and their performance is analyzed. A multifunctional smart composite film was prepared by incorporating propolis and shikonin into a Gel/Carr-based film. Propolis and shikonin were evenly distributed in the Gel/Carr matrix, significantly improving UV light-blocking functions. The Gel/Carr/Shikonin/Propolis composite film also exhibited antibacterial and antioxidant activities. It showed color changes in the pH range of 2–12 and effectively monitored the freshness of packaged milk. A cellulose-based composite film containing shikonin was prepared. The addition of shikonin improved the film's hydrophobicity, tensile strength, thermal stability, and water resistance, and it was able to monitor the freshness of shrimp and pork at 20, 4, and -20°C. A composite film was also prepared using a CS/PVA matrix with added shikonin, which enhanced mechanical strength, hydrophobicity, and water vapor barrier properties. The film exhibited antibacterial and antioxidant activities, and its color changed when monitoring shrimp freshness at different temperatures. In summary, the three studies demonstrate that shikonin shows excellent color-sensing properties for real-time monitoring of food freshness, with potential for further application in practical food systems.

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