海洋酵母 *Debaryomyces hansenii* 對於幾丁聚醣基質薄膜的抗真菌及物化性質之影響

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2025/9/20

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摘要

隨著消費者對健康與保存期常食品的需求提升，促使創新的保存方式不斷被積極開發。幾丁聚醣是一種具良好成膜性與抗菌性的天然生物聚合物，並可作為微生物拮抗劑的載體。本研究評估將海洋酵母 *Debaryomyces hansenii* 添加至幾丁聚醣薄膜後，對於酵母存活性、對 *Penicillium italicum* 病原菌抑制效果以及薄膜理化特性的影響。結果顯示，含酵母的 1.5% 幾丁聚醣薄膜能夠抑制 55%菌絲生長與 45%孢子形成。此外，在 0.5% 與 1.0% 幾丁聚醣濃度下，*D. hansenii* 存活率可維持 9 天，而在 1.5% 濃度下則於第 6 天其族群動態受到顯著影響。理化性質測試發現，薄膜厚度主要受幾丁聚醣濃度影響，酵母的添加僅在 1.0% 幾丁聚醣濃度時對色澤參數造成影響，亮度及不透明度不受酵母存在的影響。酵母的加入顯著提升薄膜的斷裂強度與楊氏模數。綜合而言，幾丁聚醣結合 *D. hansenii* 可同時維持拮抗菌活性並增強薄膜的抗真菌與機械特性，展現其作為柑橘類水果包裝材料的潛在應用價值。然而，仍需進一步於柑橘水果實際應用之試驗，以驗證其防治 *P. italicum* 的效能。

關鍵字：生物防治潛力、幾丁聚醣薄膜、義大利青黴菌

參考文獻

Abdollahzadeh, E., Nematollahi, A., & Hosseini, H. (2021). Composition of antimicrobial edible films and methods for assessing their antimicrobial activity: A review. Trends in Food Science & Technology, 110, 291–303. https://doi.org/10.1016/j.tifs.2021.01.084

Aloui, H., Khwaldia, K., Sánchez-González, L., Muneret, L., Jeandel, C., Hamdi, M., & Desobry, S. (2014). Alginate coatings containing grapefruit essential oil or grapefruit seed extract for grapes preservation. International Journal of Food Science & Technology, 49(4), 952-959.

Aloui, H., Licciardello, F., Khwaldia, K., Hamdi, M., & Restuccia, C. (2015). Physical properties and antifungal activity of bioactive films containing Wickerhamomyces anomalus killer yeast and their application for preservation of oranges and control of postharvest green mold caused by *Penicillium digitatum*. International Journal of Food Microbiology, 200, 22–30. https://doi.org/10.1016/j.ijfoodmicro.2015.01.015

ASTMD882-01;Standard Test Method for Tensile Properties of Thin Plastic Sheeting. American Society for Testing Materials: Philadelphia, PA, USA, 2001.

Chakravartula, S. S. N., Soccio, M., Lotti, N., Balestra, F., Dalla Rosa, M., & Siracusa, V. (2019). Characterization of Composite Edible Films Based on Pectin/Alginate/Whey Protein Concentrate. Materials, 12(15), 2454. https://doi.org/10.3390/ma12152454

Chen, O., Yi, L., Deng, L., Ruan, C., & Zeng, K. (2020). Screening antagonistic yeasts against citrus green mold and the possible biocontrol mechanisms of Pichia galeiformis (BAF03). Journal of the Science of Food and Agriculture, 100(10), 3812–3821. https://doi.org/10.1002/jsfa.10407

Chen, P. H., Chen, R. Y., & Chou, J. Y. (2018). Screening and Evaluation of Yeast Antagonists for Biological Control of Botrytis cinerea on Strawberry Fruits. Mycobiology, 46(1), 33–46. https://doi.org/10.1080/12298093.2018.1454013 Guimarães, A., Abrunhosa, L., Pastrana, L. M., & Cerqueira, M. A. (2018).

EFSA Panel on Biological Hazards (BIOHAZ). (2012). Scientific opinion on the maintenance of the list of QPS biological agents intentionally added to food and feed (2012 update). EFSA J. 10 (12), 3020.

Elsabee, M. Z., & Abdou, E. S. (2013). Chitosan based edible films and coatings: A review. Materials Science and Engineering: C, 33(4), 1819–1841. https://doi.org/10.1016/j.msec.2013.01.010

Estrada, R. R. G., Valle, F. D. J. A., Sánchez, J. A. R., & Santoyo, M. C. (2017). Use of a marine yeast as a biocontrol agent of the novel pathogen *Penicillium citrinum* on Persian lime. Emirates Journal of Food and Agriculture, 29(2), 114-122.

García, M. A., Pérez, L., Paz, N. de la, González, J., Rapado, M., & Casariego, A. (2015). Effect of molecular weight reduction by gamma irradiation on chitosan film properties. Materials Science and Engineering: C, 55, 174–180. https://doi.org/10.1016/j.msec.2015.05.009

González-Estrada, R., Calderón-Santoyo, M., Carvajal-Millan, E., Valle, F. D. J. A., Ragazzo-Sánchez, J. A., Brown-Bojorquez, F., & Rascón-Chu, A. (2015). Covalently Cross-Linked Arabinoxylans Films for Debaryomyces hansenii Entrapment. Molecules, 20(6), 11373–11386. https://doi.org/10.3390/molecules200611373

González-Estrada, R. R., Carvajal-Millán, E., Ragazzo-Sánchez, J. A., Bautista-Rosales,

P. U., & Calderón-Santoyo, M. (2017). Control of blue mold decay on Persian lime: Application of covalently cross-linked arabinoxylans bioactive coatings with antagonistic yeast entrapped. LWT - Food Science and Technology, 85, 187–196. https://doi.org/10.1016/j.lwt.2017.07.019

Guimarães, A., Abrunhosa, L., Pastrana, L. M., & Cerqueira, M. A. (2018). Edible Films and Coatings as Carriers of Living Microorganisms: A New Strategy Towards Biopreservation and Healthier Foods. Comprehensive reviews in food science and food safety, 17(3), 594–614. https://doi.org/10.1111/1541-4337.12345

Homez-Jara, A., Daza, L. D., Aguirre, D. M., Muñoz, J. A., Solanilla, J. F., & Váquiro, H. A. (2018). Characterization of chitosan edible films obtained with various polymer concentrations and drying temperatures. International Journal of Biological Macromolecules, 113, 1233–1240. https://doi.org/10.1016/j.ijbiomac.2018.03.057

Kanashiro, A. M., Akiyama, D. Y., Kupper, K. C., & Fill, T. P. (2020). *Penicillium italicum*: An Underexplored Postharvest Pathogen. Frontiers in microbiology, 11, 606852. https://doi.org/10.3389/fmicb.2020.606852

Marín, A., Atarés, L., & Chiralt, A. (2017). Improving function of biocontrol agents incorporated in antifungal fruit coatings: A review. Biocontrol Science and Technology, 27(10), 1220–1241. https://doi.org/10.1080/09583157.2017.1390068

Pop, O. L., Pop, C. R., Dufrechou, M., Vodnar, D. C., Socaci, S. A., Dulf, F. V., Minervini, F., & Suharoschi, R. (2020). Edible Films and Coatings Functionalization by Probiotic Incorporation: A Review. Polymers, 12(1). https://doi.org/10.3390/polym12010012

Wang, F., Deng, J., Jiao, J., Lu, Y., Yang, L., & Shi, Z. (2019). The combined effects of Carboxymethyl chitosan and Cryptococcus laurentii treatment on postharvest blue mold caused by *Penicillium italicum* in grapefruit fruit. Scientia Horticulturae, 253, 35–41. https://doi.org/10.1016/j.scienta.2019.04.031

Wang, Z., Li, J., Liu, J., Tian, X., Zhang, D., & Wang, Q. (2021). Management of blue mold (Penicillium italicum) on mandarin fruit with a combination of the yeast, Meyerozyma guilliermondii and an alginate oligosaccharide. Biological Control, 152, 104451. https://doi.org/10.1016/j.biocontrol.2020.104451