

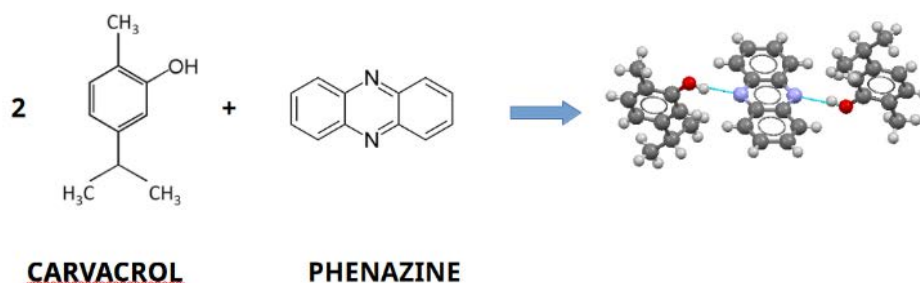
# Terpene based co-crystals for the protection from biodeteriogens in archives and libraries

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Until recently, paper was one of the most used media for the conservation of written knowledge. Fungi, as biological agents, are the major paper biodeteriogens, and several strategies have been tested to reduce their action.[1] We have proposed and tested phenazine-based cocrystals of thymol, carvacrol and eugenol (terpenes that can be found in aromatic plants such as thyme, oregano and cloves) as a new tool for the control of paper-degrading agents by indirect contact . [2,3] In cocrystals, the release of the active molecules, being controlled by the intermolecular forces within the cocrystal, is moderate respect to the terpenes in their pure phases, allowing for a prolonged efficacy of the treatment. The phenazine:carvacrol cocrystal (Figure 1) with a molar ratio 2:1 was the most active when tested *in vitro* [3] and it was able to prevent fungi growth inside a book prototype made of Whatman and Kraft paper inoculated with a mix of fungal species. [4] The treatment with the cocrystal did not show any treatment-induced paper degradation. [4] The effectiveness of the treatment was also tested inside a compactus type shelving unit.



**Figure 1.** Schematic representations of the phenazine carvacrol cocrystal

[1] Sequeira, S., Cabrita, E.J., Macedo, M.F., (2012) *Int. Biodeterior. Biodegrad.* 74, 67–86.

[2] Mazzeo, P. P., Carraro, C., Monica, A., Capucci, D., Pelagatti, P., Bianchi, F., Agazzi, S., Careri, M., Raio, A., Carta, M., Menicucci, F., Belli, M., Michelozzi, M., & Bacchi, A. (2019). *ACS Sustainable Chemistry & Engineering*, 7(21), 17929–17940.

[3] Menicucci, F., Palagano, E., Michelozzi, M., Cencetti, G., Raio, A., Bacchi, A., Mazzeo, P. P., Cuzman, O. A., Sidoti, A., Guarino, S., Basile, S., Riccobono, O., Peri, E., Vizza, F., & Ienco, A. (2022). *Int. Biodeterior. Biodegrad.*, 174, 105469.

[4] Menicucci, F., Pizzo, B., Salvadori, B., Chelazzi, L., Ienco, A., & Palagano, E. (2024). *Int. Biodeterior. Biodegrad.* 195, 105894.

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