

Title Environmental factors affect efficacy of some essential oils and resveratrol to control growth and ochratoxin A production by *Penicillium verrucosum* and *Aspergillus westerdijkiae* on wheat grain

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Citation Journal of Stored Products Research, Volume 44, Issue 4, 2008, Pages 341-346

Keywords Essential oils; Antioxidants; Water activity; Temperature; Ochratoxin; Fungal growth; Wheat grain; Environment

Abstract

This study determined the efficacy of three essential oils (bay, clove and cinnamon oil) and the antioxidant resveratrol ($0\text{--}500\text{ }\mu\text{g g}^{-1}$) on the control of growth and ochratoxin A (OTA) production by *Penicillium verrucosum* and *Aspergillus westerdijkiae* (= *A. ochraceus*) under different water activity (a_w , 0.90, 0.95, 0.995), and temperature (15, 25 °C) conditions on irradiated wheat grain. The most effective treatment (resveratrol) was then tested on natural grain. The ED_{50} values for growth inhibition by the oils were 200–300 $\mu\text{g g}^{-1}$ at the a_w and the temperatures tested. For resveratrol, this varied from $<50\text{ }\mu\text{g g}^{-1}$ at 0.90–0.95 a_w to >350 at 0.995 a_w at both temperatures. The ED_{50} values for the control of OTA were slightly lower than for control of growth, with approx. 200 $\mu\text{g g}^{-1}$ required for the oils and 50–100 $\mu\text{g g}^{-1}$ of the antioxidant, at 0.90/0.95 a_w and both temperatures. In wet grain (0.995 a_w), higher concentrations were required. For growth there were statistically significant effects of single-, two- and three-way interactions between treatments except for concentration \times temperature and concentration \times temperature \times essential oil/antioxidant treatment. For OTA control, statistically significant treatments were a_w , temperature \times a_w , concentration \times temperature, treatment \times concentration, and three-way interaction of concentration \times a_w \times treatment for *P. verrucosum* and *A. westerdijkiae*. Subsequent studies were done with the best treatment (resveratrol, 200 $\mu\text{g g}^{-1}$) on natural wheat grain with either *P. verrucosum* or *A. westerdijkiae* at 0.85–0.995 a_w and 15/25 °C over 28 days storage. This showed that the populations of the mycotoxigenic species and OTA contamination could be reduced by $>60\%$ by this treatment at the end of the storage period.