

Title *Aspergillus flavus* growth response to individual and combined mixtures of cinnamon extract and sodium benzoate

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### Abstract

A wide range of natural antimicrobial sources is being evaluated. However, data on the effect of natural antimicrobials in combination with other antimicrobials are scarce. The effect of selected combinations of cinnamon extracts (CE, 50, 100, 200, 400 and 800 ppm) with sodium benzoate (NaB, 12.5, 25, 50, 100, 200, 400 and 800 ppm) on *Aspergillus flavus* growth response, inoculated in aw 0.99 – pH 3.5 or 4.5 potato-dextrose agar (PDA), were evaluated. Cinnamon sticks were ground with sufficient ethanol, filtered through cheesecloth, vacuum concentrated to dryness and dissolved in 50 mL of ethanol. PDA prepared at each pH and antimicrobial mixture, was inoculated with 2 µL of a 10<sup>6</sup> spore/mL suspension, incubated at 25 °C, and observed daily for 30 d. Minimal inhibitory concentration (MIC) was defined as the minimal required individually to inhibit growth. Fractional inhibitory concentration (FIC) were calculated from individual and inhibitory combinations; also FIC index for each antimicrobial mixture was computed. CE MICs occurred at 200 ppm and were not affected by pH, while for NaB pH reduction from 4.5 to 3.5 reduced MIC from 800 to 400 ppm. Several mixtures of CE and NaB inhibit *A. flavus* growth with lower concentration than those needed when used alone. However, FICs and FIC index show at pH 3.5 synergistic, additive or antagonistic effects depending on antimicrobial concentration in the mixture. Additive combinations with FIC index of 1.0 included 200 ppm NaB with 100 ppm CE at pH 3.5. This same combination shows synergism at pH 4.5 with a FIC index of 0.75. Mixtures of CE and NaB exhibit less pH dependence in its activity than common antimicrobial agents, which encourages further research on applications of mixtures of natural antimycotic agents. CE are promising antifungal agents for foods compatible with their flavor and odor such as baked goods, dairy and certain fruit products.