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Effect of cold plasma on the control of Alternaria alternata associated with juice processing and its mycotoxins in the food industry.

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Beverage spoilage caused by filamentous fungi is a recurring problem in the food industry, causing significant economic losses. Contamination can occur in the raw material and persist during processing, leading to spoilage of the final product and health risks due to the potential production of mycotoxins by some species. Mycotoxins may be present in the raw material and are generally stable during processing. In this context, cold plasma is an emerging and sustainable technology that, through the formation of reactive oxygen and UV species, causes cellular damage to microorganisms, treating surfaces without leaving residue. Additionally, cold plasma can aid in the degradation of mycotoxins. This study aimed to evaluate the effect of cold plasma on the control of *Alternaria alternata*, a fungus associated with the deterioration of tomato juices, and on the degradation of the mycotoxins alternariol (AOH), alternariol monomethyl ether (AME) and tenuazonic acid (TeA) produced by the fungus. The effect of Dielectric Barrier Discharge (DBD) plasma on the radial growth of *A. alternata* was evaluated. The strain was inoculated in MEA medium and incubated for 15 days at 25 ºC. Then, 6 mm plugs were plasma treated for 5 to 10 min at 100 W; with an untreated control. After treatment, plugs were incubated for 14 days, and colony growth was measured daily. Radial growth rates (mm/day) were calculated by linear regression. The effect of DBD plasma on fungal cell viability was analyzed by fluorescence microscopy. For mycotoxin analysis, fungal plugs were treated with plasma for 10 min and mycotoxins were extracted with a solution of methanol:dichloromethane:ethyl acetate (1% formic acid) and analyzed by UPLC-MS/MS. A control without treatment was included to compare the results and assess the impact of plasma treatment on mycotoxin concentration. Growth rates of *A. alternata* did not differ significantly between the 5 to 9 minutes treatments and the control, although treated colonies were smaller. The fungicidal effect occurred after 10 minutes, inhibiting growth, while treatments of 6 to 9 minutes temporarily delayed the onset of growth, suggesting a fungistatic effect. Cold plasma seemed to eliminate part of the initial fungal population, and with longer exposure time, more cells were destroyed, resulting in no fungal growth after 10 minutes of treatment. Furthermore, *A. alternata* is a dematiaceous fungus, characterized by increased melanin levels in the cell wall of its hyphae and conidia, giving it greater resistance to environmental stresses, making it more difficult to treat. The results were confirmed with viability tests, since there were no viable cells after 10 minutes of exposure to plasma. A reduction of up to 69.7% in mycotoxins was also observed, with 50.2% for AOH, 55.04% for AME, and 69.7% for TeA. The oxidative environment generated by cold plasma can inactivate fungal conidia by denaturing cell wall proteins, causing loss of integrity, lipid damage, and exposure to reactive oxygen species (RONs) and UV light. These highly reactive species attack the chemical bonds of mycotoxins, resulting in the degradation of their molecular structure. In summary, DBD cold plasma proved to be a promising technology for the control of *A. alternata* and the reduction of mycotoxins, contributing significantly to food safety and reducing losses in the food sector.

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