Plasma as a postharvest treatment against *Monilia* spp. on plum

Julia Wimmer[1], Andreas Schulz[2], Christian Scheer[1], Ralf T. Voegele[3]

Abstract

The genus Monilia *spp. causes brown rot as well as blossom and twig blight on stone and pome fruits. In recent years an increasing number of plums from southern Germany developed symptoms post harvest on their way to the consumer. To reduce these losses, we aspire to develop a chemical free postharvest decontamination method for plums without reducing fruit quality by applying an atmospheric microwave driven air plasma. In order to evaluate the sterilizing effects of plasma as an alternative fruit protection application in pomiculture, we inactivate conidia and mycelium of* Monilia *spp. on plums. Initially spores and mycelium of* Monilia laxa *on model substrates are treated to proof a general decontamination effect.*

Keywords: *Monilia* spp., postharvest treatment, atmospheric Plasma, model substrate

Introduction

The genus *Monilia spp.* causes brown rot as well as blossom and twig blight on stone and pome fruits (Byrde & Willets, 1977). In Europe mainly *Monilia laxa* and *Monilia fructigena* are present. Usually, infections of ripening fruits can be kept low by appropriate phytosanitary measures. However, in recent years an increasing number of plums from southern Germany developed symptoms post harvest on their way to the consumer (Fritsch, 2009). To reduce these losses, we aspire to develop a chemical free postharvest decontamination method for plums by applying an atmospheric microwave driven air plasma. Plasma is a partly ionised gas which is usually generated by an electrical field (Schulz, 2011). The field can be varied from direct-current voltage up to very high frequency electromagnetic radiation, e.g. microwaves at 2.45 GHz. It consists of ions, electrons and radicals (Leins, 2009; Leins, 2012) that can have a high decontaminating effect on microorganisms including biofilms. These effects are supported by UV irradiation that is emitted by the plasma from excited molecules. Until recently cold plasmas could only be generated under vacuum conditions. New technologies enable plasma formation under atmospheric pressure, thus allowing the treatment of fresh products and an easy industrial application. To investigate the sterilizing effects of plasma as an alternative fruit protection application in pomiculture, we inactivate conidia and mycelium of *Monilia* spp. on plums. Initially spores and mycelia of *Monilia laxa* are treated on model substrates to proof a general decontaminating effect.

Material and Methods

Monilia laxa M1D2E1 was incubated on potato-dextrose agar plates (PDA Difco™, Becton, Dickinson and Company) for 21 days at 23°C with a photoperiod of 14 hours. The mycelium was transferred to a sterile tube (15 ml) and covered with approximately 5 ml of sterile distilled water (sdH_2O). The mycelium was homogenized for 15 seconds using an Ultra Turrax (IKA-Werke GmbH & Co. KG, Staufen, Germany). The suspension was filled up to 15 ml with additional sdH_2O and filtered in three steps (cheesecloth, gauze 100 µm

[1] Competence Centre for Pomiculture, D-88213 Ravensburg, julia.wimmer@kob-bavendorf.de, scheer@kob-bavendorf.de
[2] Institute of Interfacial Process Engineering and Plasma Technology, University of Stuttgart, D-70569 Stuttgart, andreas.schulz@ipf.uni-stuttgart.de
[3] Institute of Phytomedicine, University of Hohenheim, D-70599 Stuttgart, ralf.voegele@uni-hohenheim.de

and nylon filter 40 µm pore size), to gain small and single pieces of hyphae. 20 µl of mycelial suspension were dripped on PDA plates. After drying, plates were stored at 4°C over night. Plasma treatment was conducted the following day with a microwave plasma torch under the following conditions: Φ (dry air) = 20 l/sec, P (microwave) = 1 kW, treatment time = 5 minutes. After the treatment, plates were sealed and stored at room temperature. Mycelial growth was monitored daily and mycelial diameter was measured using a ruler. Initial diameter was 0.8 cm each, indicating initial drop size.

Results and Discussion

Mycelial growth was monitored for three days after treatment. Untreated control cultures showed constant growth, beginning on day two after treatment. Whereas plasma treated cultures did not show any growth for a period of up to two weeks (Figure 1). Similar results could already be generated for *M. laxa* suspensions of higher concentration and for mycelial suspensions of *Botrytis cinerea* (data not shown). Higher concentrations of *M. laxa* and *B. cinerea* did not result in complete reduction, but in significant retardation of mycelial growth. Thus, the efficacy of plasma treatment strongly depends on the density of mycelium. This assumption is confirmed by the fact that plasma only acts on surfaces and is shadowed by hyphae directly on the surface. To show this correlation, the experiment will be repeated with serial dilutions of mycelial suspensions.

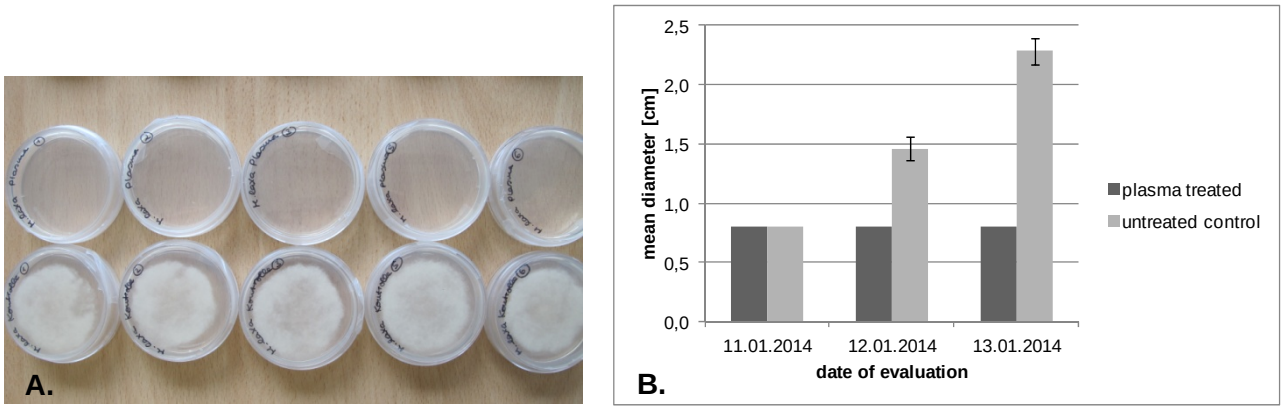

Figure 1: **A.** Cultures of *M. laxa* on PDA five days after plasma treatment. Upper row: treated cultures, lower row: untreated cultures. **B.** Mean mycelial diameter for three days after treatment. Arithmetic mean calculated for five independent replicates, bar shows standard deviation.

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