

Effect of water activity and temperature on growth of *Aspergillus carbonarius* and *Aspergillus tubingensis* and their interactions on ochratoxin A production

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RESEARCH ARTICLE

Abstract

Aspergillus section *Nigri* are described as the main source of ochratoxin A (OTA) contamination in grapes and wine worldwide. The grape-growing area in Argentina has a wide latitudinal extension with ecological variations that allow the classification of well-demarcated regions. The aims of this study were: to determine the effect of eco-physiological parameters on growth of *Aspergillus tubingensis* and *Aspergillus carbonarius* and to evaluate the interaction between these species on OTA production in synthetic grape juice medium under different water activity (a_w) and temperature conditions. The results showed that optimal growth conditions for *A. tubingensis* and *A. carbonarius* were 0.980 a_w and 28 °C, however *A. tubingensis* grew faster than *A. carbonarius* at all temperatures and a_w tested. OTA production by *A. carbonarius* was favoured at 20 °C and 0.950-0.965 a_w , during 14 days of incubation. The effect of *A. tubingensis* on OTA production by *A. carbonarius* was mainly dependent on temperature. At 35 °C, *A. tubingensis* reduced the OTA production while this effect was not observed at 20 °C. More OTA could be produced as a defence reaction against fungal competitors to maintain niche colonisation, but in this study no effects by a related species were observed.

Keywords: *Aspergillus* section *Nigri*, SGM medium, fungal interaction, eco-physiological conditions

1. Introduction

Aspergillus section *Nigri* are commonly isolated from vineyards and include species such as *Aspergillus carbonarius* and *Aspergillus niger* aggregate, responsible for ochratoxin A (OTA) contamination of grapes and wines (Visconti *et al.*, 2008). The presence of this toxin in foods and beverages results in a health risk to consumers since OTA is classified as a possible carcinogen to humans (group 2B) by the International Agency for Research On Cancer (IARC, 1993). Knowledge of the factors affecting grape contamination by species within this section and OTA production is essential to be able to reduce their presence, not only to improve wine quality, but also from the point of view of its safety.

Temperature and water availability are the key factors determining fungal colonisation and OTA contamination

in grapes and by-products (Astoreca *et al.*, 2010a; Battilani *et al.*, 2006). Several studies have evaluated the influence of these factors on growth of *Aspergillus* section *Nigri* species and OTA production on different culture media. It was shown that the optimal growth rate for *Aspergillus* section *Nigri* species was between 0.95-0.99 water activity (a_w) and 30-37 °C and the optimal OTA production between 0.95-0.99 a_w and 15-20 °C (Astoreca *et al.*, 2007, 2009, 2010b; Belli *et al.*, 2004, 2005a,b, 2006, 2007; Esteban *et al.*, 2004; Mitchell *et al.*, 2003, 2004). Other studies have also shown that fungal interactions could affect OTA levels produced by species within *Aspergillus* section *Nigri*. Valero *et al.* (2006, 2007) studied the effect on OTA production by *A. carbonarius* and *A. niger* aggregate at different temperatures and a_w under co-inoculation with other fungal species. A reduction in OTA levels was observed when *A. carbonarius* was co-inoculated with either competing fungi or OTA producing and non-producing *A. niger* aggregate strains.