Available online at www.sciencedirect.com
ScienceDirect
Food Chemistry 108 (2008) 593–599
Food Chemistry
www.elsevier.com/locate/foodchem

Survey: Ochratoxin A in European special wines

Ana Valero, Sonia Marín, Antonio J. Ramos, Vicente Sanchis *

Food Technology Department, University of Lleida, UTPV-CeRTA, Av. Alcalde Rovira Roure 191, 25198 Lleida, Spain

Received 13 August 2007; received in revised form 26 September 2007; accepted 7 November 2007

Abstract

The occurrence of Ochratoxin A (OTA) was examined in 121 special wines made using different winemaking techniques and from many European origins. The wine groups with the highest OTA content and occurrence, above 90%, were those were the must was fortified before fermentation (mean: 4.48 μg/l) and those made from grapes dried by means of sun exposure (mean: 2.77 μg/l). Fortified wines with long aging in wooden casks were about 50% contaminated, with OTA levels below 1.00 μg/l. Wines affected by noble rot, late harvest wines and ice wines did not contain OTA. Overall, 19.8% of the wines studied contained OTA levels above the maximum permissible limit for the European Union (2 μg/kg) in wine (excluding liqueur wines).

Keywords: Ochratoxin A; Dessert wines; Winemaking; European wines

1. Introduction

Ochratoxin A (OTA) is a fungal metabolite with toxic properties, produced by species belonging to the genera *Aspergillus* and *Penicillium* (Ueno et al., 1991; van der Merwe, Steyn, & Fourie, 1965). It has been considered the cause of Balkan endemic nephropathy (BEN) (Marquardt & Frolich, 1992) and it has also been classified by the International Agency for Research on Cancer (IARC, 1993) as a possible human carcinogen (group 2B).

OTA has been found in foodstuffs such as cereals, coffee, cocoa (Pardo, Marín, Ramos, & Sanchis, 2004; Rafai, Bata, & Jakab, 2000; van Egmond & Speijers, 1994), grapes (Abrunhosa, Paterson, Kozakiewicz, Lima, & Venâncio, 2001) and in dried vine fruits (MacDonald et al., 1999; Ostry, Ruprich, & Skarkova, 2002). OTA is present at high levels in red wine (EU Report, 2002), possibly due to the maceration of the must with grape skins, which might favour OTA extraction from skins (Blesa, Soriano, Moltó, & Mañes, 2006). In the case of sweet or special wines, oenological practices are very diverse and may result in different final OTA concentrations (Chiodini, Scherpenisse, & Bergwerff, 2006; Gambuti et al., 2005; Leong, Hocking, & Varelis, 2006; Ratola, Abade, Simões, Venâncio, & Alves, 2005), which are usually higher than those in dry wines (Burdaspal & Legarda, 1999; Pietri, Bertuzzi, Pallaroni, & Piva, 2001; Zimmerli & Dick, 1996). There are several types of sweet wines, defined by their winemaking procedures. Fortified musts (mistelle, Muscat) and fortified wines (Sherry, Port wine) are those in which fermentation is prevented or stopped by adding alcohol to the must or wine, respectively (fortification). Among fortified wines, Fino and Manzanilla (Spain), undergo a secondary fermentation while aging in wooden barrels. The fermentation is achieved by floating yeasts that are alcohol resistant, called Flor yeasts.

Wines from overripe grapes are non-fortified dessert wines. While none of the winemaking processes involves adding grape spirit to halt the fermentation process artificially, all of them require the premature cessation of the fermentation process, leaving behind varying residual sugar levels. The most common cause of fermentation cessation in non-fortified dessert wines is the high sugar content of the fermenting grapes, which naturally drives the alcohol level above 15% by volume. Grapes can be made overripe

* Corresponding author. Tel.: +34 973702535; fax: +34 973702596.
E-mail address: vsanchis@tecal.udl.es (V. Sanchis).

0308-8146/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodchem.2007.11.040

by different techniques, such as by exposure to sunlight (Málaga, Pedro Ximenez, Passito), dehydration in closed chambers of hot or fresh air (Vin de Paille, Vin Santo, Recioto), by the colonisation of grapes by fungus *Botrytis cinerea,* causing noble rot (Sauternes, Montbazillac, Alsace, Loire, Trockenbeerenauslese, Tokaji), by leaving grapes to shrivel in the vineyard, where they may also be occasionally affected by noble rot (Vendage Tardive, Tokaji Late harvest, Spatlese), or by waiting until winter, to produce grape dehydration by ice (ice wine, Vi de Gel, Eiswein).

A wine's origin seems also to be a determinant of its final OTA content (Ottender & Majerus, 2000). Different climatic conditions, due to the latitude and also to variables in local weather, may affect OTA-producing fungi distribution (Battilani et al., 2006; Serra, Lourenço, Alípio, & Venâncio, 2006) and final OTA concentration (López de Cerain, Gónzalez-Peñas, Jiménez, & Bello, 2002).

Despite many surveys on wines from different sources, such as Italy, Spain, Greece, etc (Bellí, Marín, Duaigües, Ramos, & Sanchis, 2004; Pietri et al., 2001; Soufleros, Tricard, & Bouloumpasi, 2003), there is no intensive study on OTA occurrence in sweet or special wines, including wines made from overripe and botrytised grapes.

Currently, several countries have specific regulations for OTA in various commodities, 2 μg OTA/kg being the maximum level allowed for wine, grape must and grapes in the European Union (Commission Regulation (EC) No.1881/2006).

The aim of this study was to assess OTA occurrence in special wines from Europe made using different winemaking techniques.

2. Material and methods

2.1. Samples

One hundred and twenty one representative special wines from Europe were purchased from Spanish and Portuguese markets and from Italian and Spanish distributors. Wine from all wine-growing zones, according to European regulations, A, B, CI, CII and CIII (Council Regulation (CE) No 1493/1999; Corrigendum (CE) No 1512/2005), which are based on production conditions, soil, region and climate, have been sampled (Fig. 1). Classification of the assayed wines is summarised in Table 1.

2.2. Sugar content in wine

Into an Erlenmeyer flask 10 ml of 0.168 M cupric solution (Gab System, Olérdola, Spain), 5 ml of 0.886 M alkaline solution (potassium sodium tartrate, $KNaC_4H_4O_6 \cdot 4H_2O$. Gab System), a small pumice stone and 2 ml of wine,

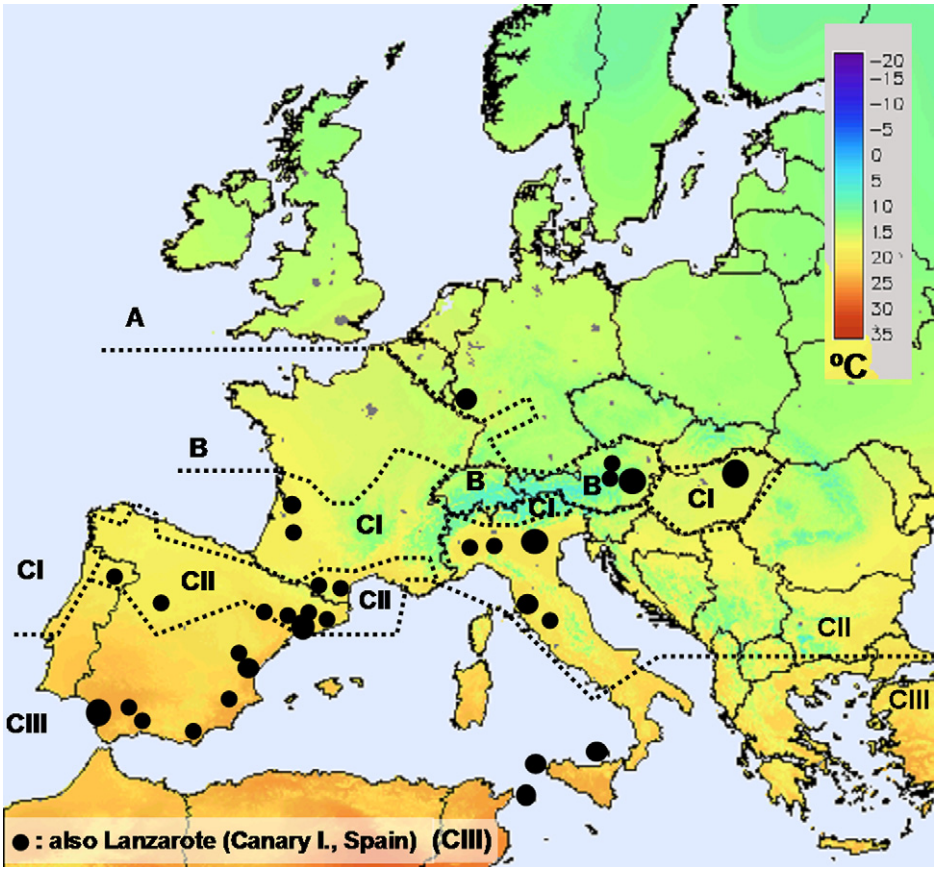

Fig. 1. Map of Europe showing the average temperatures in September and divided by dotted lines into wine-growing zones (A, B, CI, CII and CIII). Black points represent the origin of samples.