Determination of ochratoxin A content in wheat bread samples collected from the Algarve and Bragança regions, Portugal: Winter 2007

J.M.V. Bento a, A. Pena a, C.M. Lino a,⁎, J.A. Pereira b

a Group of Bromatology, Center of Pharmaceutical Studies, FCT, University of Coimbra, 3000-295, Coimbra, Portugal
b CIMO/Escola Superior Agrária, Polytechnic Institute of Bragança, Campus de Santa Apolónia, Apartado 1172, 5301-855, Bragança, Portugal

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A B S T R A C T

Ochratoxin A (OTA) is a mycotoxin produced by fungi such as Penicillium verrucosum and Aspergillus spp. and has been found to have a variety of potentially deadly toxic effects. The favoured substrate for fungal growth and OTA production appears to be cereals and flour-based products, including bread. Due to the dietary relevance of bread for the Portuguese population, it is imperative that its OTA content remains well within safe quantities. As such, bread samples collected from commercial surfaces across the Algarve region and from the city of Bragança during the winter of 2007 were tested for OTA through extraction with immunoaffinity columns and quantification by liquid chromatography coupled with fluorescence detection. Although OTA content was found to be above the limit of quantification in approximately 60% and 50% of the analysed samples from Algarve and Bragança, respectively, all samples were found to be compliant with European Commission. OTA content reached maximums of 0.49 ng/g in Algarve and 0.43 ng/g in Bragança, and was thus below the maximum limit established by European legislation for bread of 3 ng/g. The results of the present study put the estimated daily intake of OTA from bread at approximately 0.26 ng/kg bw/day in Algarve and 0.38 ng/kg bw/day in Bragança, circa 1.5% and 2.0% of the TDI established by either the EFSA or the FAO/WHO, or over 4.5% and 6.5% if we consider the FAO/WHO advised bread consumption of 250 g/day. These results seem to suggest that, in these two Portuguese regions, OTA contamination is well under control and unlikely to represent a threat to consumer health.

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1. Introduction

Despite their almost opposite geographical positioning in the country, Portugal’s Algarve—the southernmost region—and Bragança—one of the north-easternmost towns—regions (Fig. 1) are famous holiday destinations. Bragança derives much of its tourist trade from its proximity to Spain, its typical crafts and nearby natural preserve, while Algarve’s beaches fuel the tourist industry by attracting people from all over the world.

According to the Köppen–Geiger climate classification, Algarve falls under the Csa class (warm temperate, with warm dry summer) while Bragança is classified as a Csb (warm temperate, with temperate dry summer) [1].

Despite these seemingly close environments, temperature differences are quite noticeable throughout the year, with Bragança significantly cooler than Algarve. A significant part of the tourist trade, for both regions, is the typical Portuguese cuisine, which generally includes significant amounts of bread, whether as an ingredient, an entry, or a complement to the main dish. One of its possible contaminants is OTA (structure in Fig. 2).

OTA is an UV-decomposable mycotoxin produced by fungi such as Penicillium verrucosum and varied Aspergillus species, especially in cold and wet climates [2]. Production continues while the cereals are stored, especially under improper storage conditions, and processing methods are insufficient for their efficient detoxification, resulting in OTA-bearing cereal-derived products, such as contaminated bread. OTA has been proven to have a variety of toxic effects, including nephrotoxic—having been linked to the Balkan Endemic Nephropathy [3]—immunotoxic [4], carcinogenic [5] and teratogenic [6], while also being a possible genotoxic. In the last ten years some work has indicated that its mode of carcinogenicity is ‘genotoxic’ [7]. However, OTA’s genotoxicity is not certain, and recent work funded by Directorate-General (DG) XII of the EU has demonstrated that DNA binding of OTA is not detectable with sensitive analytical methods, and is unlikely to represent a mechanism for OTA-induced tumour formation [8].

The by far largest source of dietary OTA intake in Europe are cereals and their derived products, which account for around half of said intake, with wine and coffee taking a paltry second and third places, contributing about 10 and 9%, respectively [9]. To ensure the safety of the consumers, the EC has put the maximum permitted OTA level of cereals at 5 ng/g and of their derived products at 3 ng/g [10] and OTA’s Tolerable Weekly Intake (TWI) at 120 ng/kg bw/week [11].