SESSION 4:

FOOD SAFETY, TOXICOLOGY AND UTILIZATION OF MYCOTOXIN-CONTAMINATED GRAIN

Chairperson: Dave Kendra

PREDICTING WHEAT MYCOTOXIN CONTENT USING NEAR INFRARED REFLECTANCE SPECTROSCOPY

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ABSTRACT

Among the limiting factors for wheat production in Southern Brazil, are wet and warm springs in some years, that favor the occurrence of Fusarium head blight (FHB) outbreaks. *Fusarium graminearum*, the main FHB causal agent in the region, is able to produce different mycotoxins such as deoxynivalenol (DON), nivalenol (NIV) and zearalenone (ZON), which are considered the most important ones because of their widespread occurrence and toxicity. Among the methods available for the rapid screening of contaminated samples, Near Infrared Reflectance Spectroscopy (NIRs), which is based on the absorption of near-infrared light by organic compounds, presents promising results. The aim of this study was to verify the presence of mycotoxins in different wheat samples using reference chromatographic methods and to adjust and validate a NIR-based method for quick screening of these contaminants, as well as genotype evaluation in breeding programs. A total of 196 and 120 wheat samples were analysed for DON and for ZON content, respectively. Wheat samples were obtained from commercial fields naturally infected by *Fusarium graminearum* and from breeding trials conducted by Embrapa in 2008 and 2009 growing seasons. The procedure required, firstly, the whole kernel wheat samples (125 g each), to be scanned by NIR. Secondly, the same samples were milled and homogenized, resulting in particles with less than 1.0 mm in diameter, and they were scanned again by NIR. Finally, the milled samples were sent to a reference laboratory for chemical analyses using liquid chromatography-tandem mass spectrometry (LCMS/MS) equipment. The NIR instrument used was a FOSS XDS – RCA (FOSS NIRSystems, Hoganas, Sweden), coupled with the module XDS Monochromator double detection system (Silicon 400–1100 nm) and (Lead Sulphide 1100–2500 nm). The accuracy of each calibration model was tested by using cross-validation in groups and selected based on the highest coefficient of determination of calibration (r^2) and the lowest standard error of cross validation (SECV). The calibrations were performed by partial least square (PLS) and modified partial least square (MPLS). Spectral outliers (standardized H>3) were removed and samples with large residuals ($T \geq 2.5$) were omitted from the population. In our study, the r^2 obtained for DON content in wheat kernel was 0.89 and SECV 612.05 μg kg^{-1} and in milled wheat r^2 was 0.91 and SECV 578.33 μg kg^{-1}, indicating a very good prediction using the NIR calibration model MPLS and PLS, respectively. Furthermore, a r^2: 0.86 with SECV 254.29 μg kg^{-1} and r^2: 0.87 with SECV 231.85 μg kg^{-1} obtained in wheat kernel and milled wheat, respectively, represented an acceptable prediction of ZON content by NIR using MPLS calibration models. These results indicated reasonable prediction for both DON and ZON content, in unprocessed wheat. Further tests will demonstrate the potential to incorporate this methodology for quick screening of contaminated commercial samples as well as early generation breeding samples.

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STABILITY OF THE TRICHOTHECENE, DEOXYNIVALENOL IN PROCESSED FOODS AND WHEAT FLAKE CEREAL

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ABSTRACT

Deoxynivalenol (DON) is a trichothecene mycotoxin produced by Fusarium species, principally F. graminearum and F. culmorum. These fungi are natural contaminants of wheat, barley and corn and, consequently, DON is found in cereal-based foods. The effect of thermal processing on DON is variable: some methods have been shown to reduce DON concentrations whereas others have had little effect. To determine if DON is stable during the production of selected foods, its concentrations in flour, wheat and processed food items prepared using commercially relevant conditions were compared using a gas-chromatographic method. The mean DON concentrations (n=9/item) in cookies, crackers, and pretzels were 61% (cookies) to 111% (pretzels) that of the unprocessed flour (100% = 0.46 ppm). Lower concentrations were found in donuts and bread. Their respective DON concentrations were 44% and 30%, respectively, that of flour. Mass balance estimations indicated that the total amount of DON (ppm flour equivalents) remaining in the flour-based products was as low as 50% (bread, 0.23 ppm flour equivalents) and as high as 120 % (donuts). This suggests that dilution of the flour by other ingredients significantly contributed to reducing DON concentrations in the bread and accounted for the entire reduction found in donuts. The mass balance results for the other flour products were in the range of 76% to 107%. The concentration of DON was higher in cereal flakes (0.55 ppm) than in the wheat (0.40 ppm) Likewise, the total amount of DON remaining in the finished flakes (mass balance result = 0.58 ppm) was also higher. In summary, DON concentrations were reduced ≥50% in only in bread and donuts and evidence for "loss" of DON through decomposition, interaction with food matrix components or other mechanisms was obtained only for bread. The findings for this series of products are consistent with earlier reports and provide additional evidence that DON is generally stable during the preparation of heat processed foods made from flour or whole wheat.