Food Control 130 (2021) 108335

Contents lists available at ScienceDirect

Food Control

journal homepage: www.elsevier.com/locate/foodcont

Detecting fumonisin B_1 in black beans (*Phaseolus vulgaris* L.) by near-infrared spectroscopy (NIRS)

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ARTICLE INFO

Keywords:
Mycotoxins
Pulses
Optical method

ABSTRACT

Mycotoxins are secondary metabolites produced by filamentous fungi that can affect both human and animal health. Because of this, their detection is of vital importance to avoid their consumption. To reduce time and costs, alternatives to laborious conventional laboratory tests are sought. However, these efforts have been made mainly for cereals, where near-infrared spectroscopy (NIRS) techniques have been studied. Little importance has been given to other groups, such as pulses, to which beans belong, to develop rapid detection techniques. Therefore, in this study, we evaluated the feasibility of detecting fumonisin B_1 (FB_1) in beans using NIRS. To achieve this, controlled contamination with standard solutions of the mycotoxin (0, 0.5, 1, 2.5, 5, and 10 mg kg^{-1}) was conducted using two application methods (spread and submersion, n = 18 for each method). Subsequently, bulk samples composed of 24 individually contaminated beans, both milled or whole, were analyzed in the spectrometer, in the wavelength range of 680–2,500 nm. A better linear adjustment was obtained with the spread contamination method ($R^2 = 0.99$). Moreover, different calibration models were applied using both types of contamination methods and sample types (milled or whole), by a partial least square regression (PLSR). The best result was obtained using the spread contamination method and grinding the sample ($R^2 = 0.92$ and RMSE = 0.77). The regression coefficients of this model show that the wavelengths 1,273, 1,282, 1,374, and 1,870 nm have a great influence on the variability of the model, which could be associated to changes due to the presence of FB_1.