Is FTIR-ATR a Sensitive Tool for Determination of Aflatoxins?

Sir:

An article presented a method for rapid and accurate determination of aflatoxins in groundnut and groundnut cake based on FTIR with attenuated total reflectance (FTIR-ATR) (1).

The study reported four mid-IR spectra and attributed them to aflatoxins B_1, B_2, G_1, and G_2, respectively (Fig. 1).

At first glance, one might speculate that relatively complex organic compounds such as aflatoxins should have exhibited much more complex spectra than those in Figure 1. Figure 2 depicts the reference aflatoxin B_1 spectrum in its fingerprint region reproduced from the Chemexper Chemical Directory (2). As can be seen, it includes nearly 20 absorption bands. In contrast, the spectra reported by Mirghani *et al.* (1) include only 4, and they clearly lack many of the expected characteristic absorption bands related to the stretching and/or bending vibrations of aflatoxin (3,4).

A closer look at Figure 1 reveals that these spectra show similar spectroscopic patterns. According to the article, these spectra exhibit absorption bands at wavenumber ranges 3004–2969, 1744–1720, 1364–1369, 1217–1220, and 1035–1037 cm^{-1}, which are similar to the wavenumber ranges characteristic of the absorption bands of acetone (Fig. 3). Apart from this similarity, we believe these spectra represent acetone rather than aflatoxins, based on the following observations.

The standard cleaning method for the ATR crystal is by washing with acetone, and this is frequently done during the course of analysis by FTIR-ATR. Very possibly, chances exist for a background to be collected while a small amount of acetone is left undried on the surface of the crystal.

Figure 4 shows how acetone can leave its impression on the background. If a background spectrum is to be taken under such conditions, the contamination (i.e., characteristic acetone absorption bands) will enter all subsequent spectra calculated.

Mirghani *et al.* (1) obtained their spectra after subtracting the solvent spectra from the toxin-spiked solvent spectra. The negative absorption bands in Figure 1 are the result of differences in the minuend and subtrahend spectra, which in turn seem to be caused by differing degrees of solvent evaporation at the time the spectra were collected. This could be considered a source of error in the study unless some measures were adopted to minimize the variations in solvent evaporation.

In similar experiments conducted in our laboratory, we could unfortunately not detect aflatoxin B_1 at concentrations as high as *ca.* 1500 ppb (well above the maximum concentration Mirghani *et al.* used for their calibration).

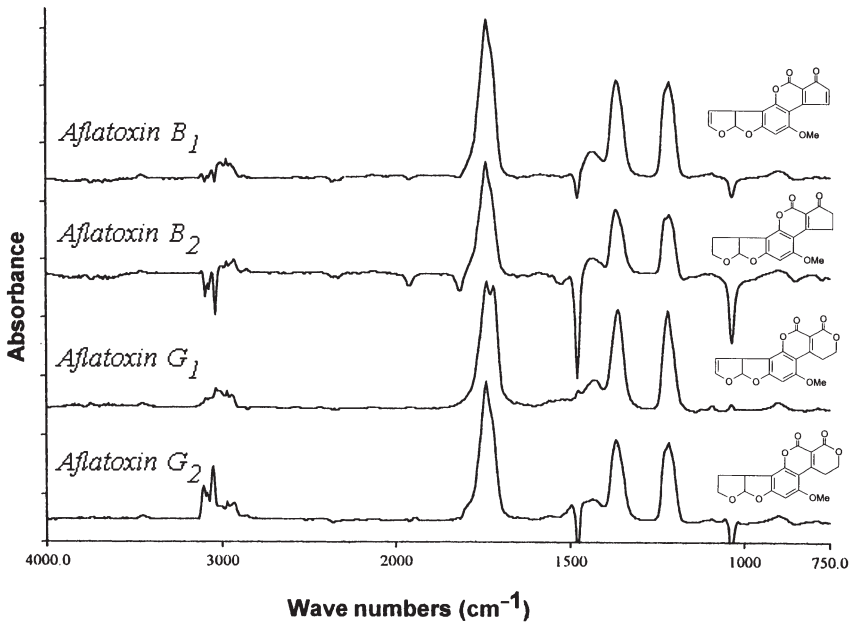

FIG. 1. IR spectra and structures of aflatoxins B_1, B_2, G_1, and G_2 (figure reprinted from Mirghani *et al.,* Ref. 1).

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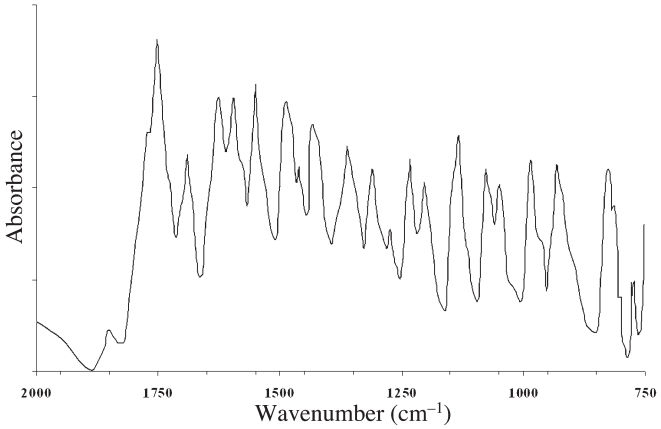

FIG. 2. IR spectrum of aflatoxin B_1 (figure reproduced from the Chemexper Chemical Directory, Ref. 2).

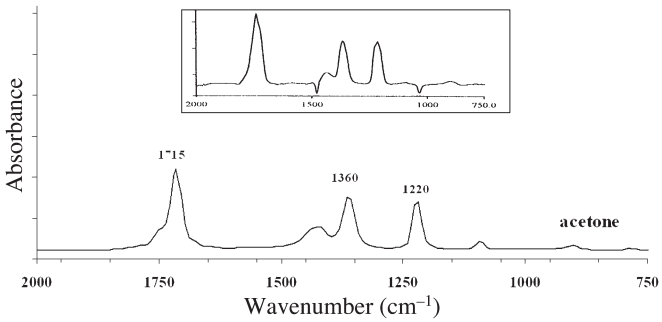

FIG. 3. Similarity between the IR spectrum of acetone and that introduced by Mirghani *et al.* (1) as aflatoxin B_1 (top inset).

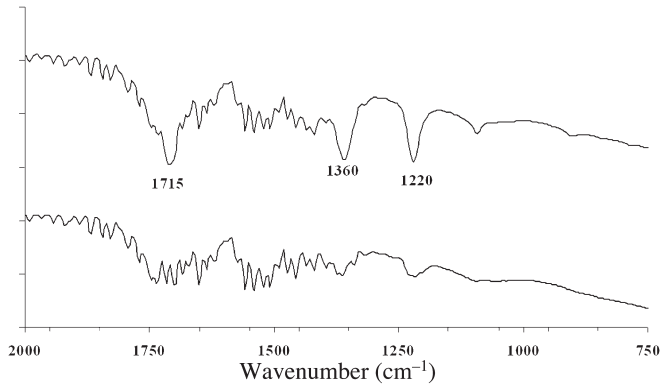

FIG. 4. Top: background spectrum taken from an acetone-stained crystal. Bottom: background spectrum taken from a dried crystal.

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