



RAMAN APPLICATION NOTE RS-017

Trace Detection of Thiabendazole on Bananas

Protecting Consumer Safety with Misa

Thiabendazole (TBZ) is a broad-spectrum pesticide used both as a fungicide in fruits and vegetables and for controlling parasites in animal feed. While some individuals experience negative side effects from consuming foods which contain TBZ, overall toxicity to humans is very low. To ensure consumer safety, regulatory agencies establish maximum residue levels (MRL) for pesticide-treated crops based on their review of risk assessment studies. For bananas, which are either aurally sprayed or dipped in protectant solutions of TBZ, the US FDA reports a MRL of 3 $\mu\text{g/g}$, and the EU stipulates a MRL of 6 $\mu\text{g/g}$ by weight.

With Misa (Metrohm Instant SERS Analyzer), the rapid and sensitive detection of TBZ on bananas is demonstrated in formats easily adapted for food safety surveillance testing. SERS substrates for Misa offer unparalleled sampling flexibility—from dipping to swabbing, P-SERS can be adapted to the desired application.

INTRODUCTION

This application note describes the simple extraction and detection of TBZ residue on banana peels and in a processed banana product. Samples are applied to Silver P-SERS (Ag P-SERS) strips through both **dipping** and **swab methods**.

REFERENCE SPECTRUM AND LIBRARY CREATION

To establish a reference spectrum for TBZ, a pure standard in methanol (10 µg/mL) was analyzed using Ag P-SERS. The unique SERS spectrum shown in **Fig. 1** can be used to create a library entry for TBZ.

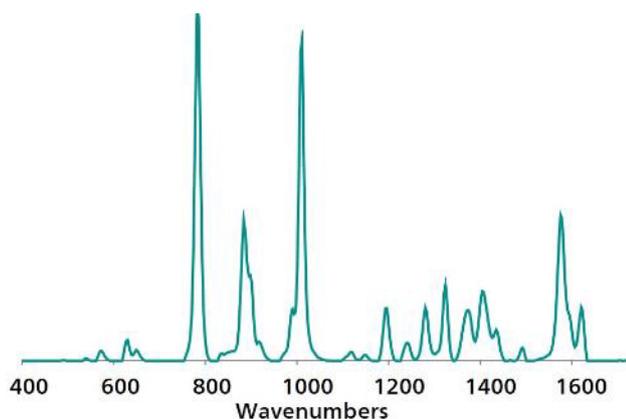


Figure 1. Standard reference Ag P-SERS spectrum of Thiabendazole.

EXPERIMENTS AND RESULTS

Detection of TBZ in Banana Chips

Dried banana chips purchased from a local grocer were ground to a fine powder and spiked with TBZ in methanol to provide a range of test samples: 100–0.1 µg/g. Samples were mixed well and dried. Afterward, 0.1 g of each sample was added to a glass vial with 1 mL of 0.1 mol/L NaOH and shaken. After settling, an Ag P-SERS strip was **dipped** into each extract, dried for 2 minutes, and immediately placed into the Misa P-SERS attachment for measurement. **Fig. 2** shows the range of detection of TBZ in ground dried banana samples from 100 µg/g to 100 ng/g.

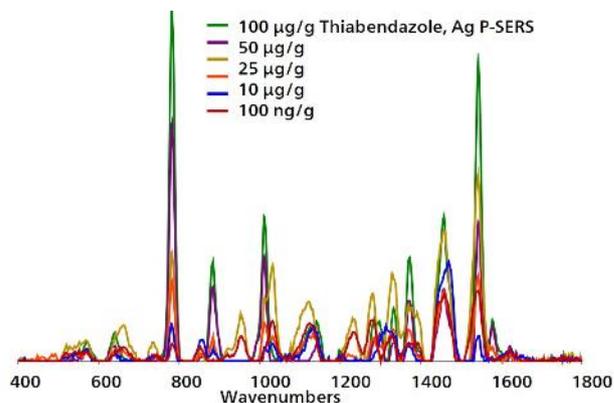


Figure 2. Overlaid baseline-corrected, dipped Ag P-SERS spectra for pulverized banana chips spiked with TBZ show detection down to 100 ng/g.

Detection of TBZ on Banana Peel

To simulate Ag P-SERS **swab testing**, locally purchased organic bananas were washed with tap water and isopropanol/distilled water. To simulate typical application of TBZ, a 2 cm² section of peel was treated with 20 µL of methanol containing different concentrations (250, 100, 75, 50, 25, and 10 µg/mL) of TBZ. After drying, an Ag P-SERS strip wetted with methanol was used to swab the section. The strip was dried for 1 minute and placed into the Misa P-SERS attachment for measurement, with resulting spectra shown in **Fig. 3**.

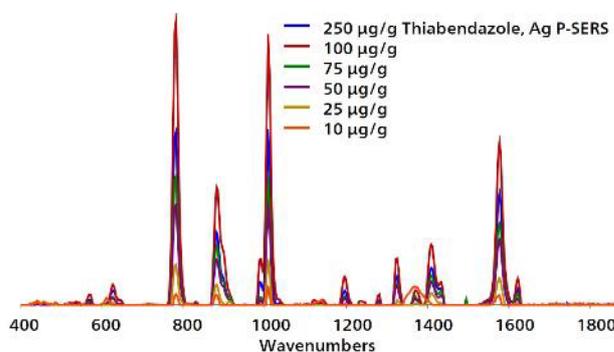


Figure 3. Overlaid baseline-corrected spectra acquired from Ag P-SERS swabs show detection of TBZ on banana peel to 100 ng/g.

Table 1. Experimental Parameters

Instrument		Acquisition	
Firmware	0.9.33	Laser Power	5
Software	Misa Cal V1.0.15	Int. Time	1 s
Misa SERS Attachment	6.07505.030	Averages	10
ID Kit - Ag P-SERS	6.07506.470	Raster	ON

Direct Test of a Store Bought Banana

In a final test, a non-organically grown unwashed banana from the grocers was **swabbed** with a methanol-moistened Ag P-SERS strip. In **Fig. 4**, detection of TBZ is confirmed by peak agreement between the spectrum from the banana swab and that of the TBZ standard.

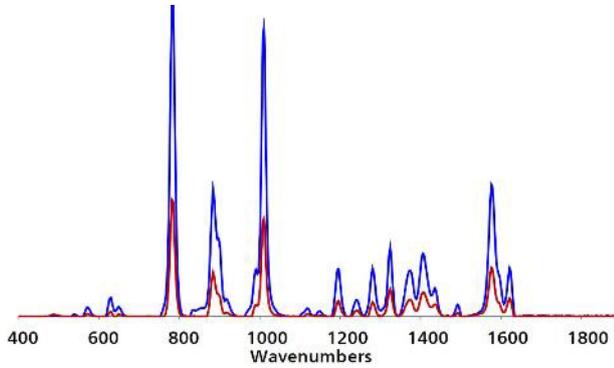


Figure 4. Direct testing of an untreated non-organic banana purchased from a grocery store returned an Ag P-SERS spectrum consistent with detection of TBZ.

CONCLUSION

After Misa’s ability to sensitively detect TBZ on bananas is demonstrated, a successive experiment confirms post-harvest treatment of bananas with TBZ. Such fast and accurate test results recommend Misa as an excellent solution for streamlined, onsite identification of chemically treated foods.



FIELD TEST PROTOCOL

Detection of thiabendazole in the field.

Table 2. Requirements for Field Test Protocol

ID Kit - Ag P-SERS	6.07506.470
Includes:	Silver P-SERS
	Scoop
	Disposable Pipettes
	2 mL Glass Vials
Reagents	
Methanol	
Test Settings	Use ID Kit OP on Misa

Using a disposable pipette, wet the printed end of a P-SERS strip with 2 drops of methanol. *Touch only the unprinted back side of the swab with your gloved hands.* Use the moistened, printed portion of the strip to swab the peel of a banana. Move the strip along the peel for at least 2 cm. After drying for 2 minutes, insert the Ag P-SERS strip, with the printed portion facing down and toward the instrument, into the P-SERS attachment for measurement.

Analytes:	Azoles; Herbicides, fungicides, pesticides
Matrix:	Food – additives
Method:	Spectroscopy (NIRS/Raman)
Industry:	Food & beverage