



RAMAN APPLICATION NOTE RS-022

# Trace Detection of Carbendazim on Strawberries

## Protecting Consumer Safety with Misa

Carbendazim (MBC) is a common fungicide approved for regulated use in agriculture globally, outside of the EU. Most MBC is found on fruits as surface contamination, the result of sprays applied prior to harvest. The US EPA has determined that concentrations below 80  $\mu\text{g}/\text{mL}$  in orange juice are not a health risk, while the EU restricts MBC levels to 10  $\text{ng}/\text{g}$  (from imported produce) in foods intended for baby food production. Outside of this wide range of acceptance, it is agreed that MBC interrupts hormone production and can damage the testes in males. In the US, strawberries are the most common whole fruit to be contaminated with MBC, as determined by the USDA with GC/MS and LC/MS.

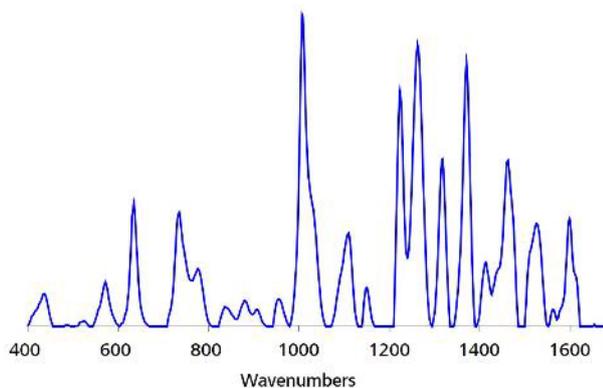
This Application Note describes a very simple test for surface MBC and provides library spectra demonstrating the sensitive detection of MBC with Misa (Metrohm Instant SERS Analyzer).

## INTRODUCTION

The most common agricultural use of MBC is a 500 µg/mL spray applied in the field, 2–3 weeks preharvest. Detection of surface contamination is a very quick and easy assay, ideal for on-site testing with Misa.

## REFERENCE SPECTRUM AND LIBRARY CREATION

To establish a reference spectrum for MBC, a pure standard in methanol is analyzed using gold nanoparticles (Au NPs). The unique SERS spectrum presented in **Fig. 1** can be used to create a library entry for MBC.



**Figure 1.** Standard SERS Au NP carbendazim reference spectrum.

## EXPERIMENT

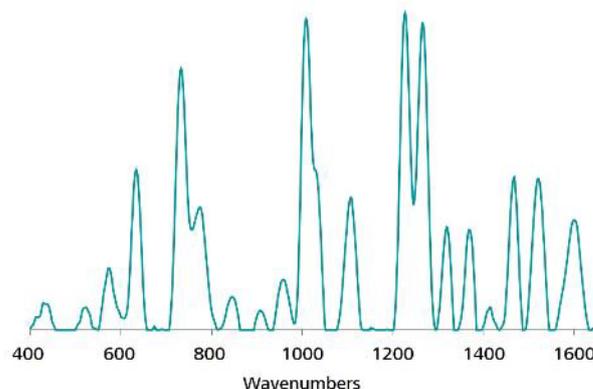
Purchased strawberries were washed with water prior to testing. A solution of 100 mg/L MBC in ethanol was sprayed onto whole strawberries to mimic a typical farm application. Once dry, each strawberry was rinsed with 4 mL of ethanol. The rinse volume was collected and concentrated to 1 mL by evaporation of solvent on a lab hot plate. Misa samples were prepared by adding 100 µL of sample to 800 µL of Au NP and 100 µL 500 mmol/L NaCl.

**Table 1.** Experimental Parameters

Instrument		Acquisition	
Firmware	0.9.33	Laser Power	5
Software	Misa Cal V1.0.15	Int. Time	1 s
Misa Vial Attachment	6.07505.040	Averages	10
ID Kit - Au NP	6.07506.440	Raster	ON

## RESULTS

A baseline-corrected spectrum acquired from whole strawberries sprayed with a 100 mg/L solution of MBC, then rinsed with ethanol agrees with the obtained MBC standard reference spectrum (**Fig. 2**).



**Figure 2.** Detection of 100 mg/L MBC with Misa.



## FIELD TEST PROTOCOL

Detection of carbendazim in the field.

**Table 2.** Requirements for Field Test Protocol

<b>ID Kit - Au NP</b>	<b>6.07506.440</b>
<b>Includes:</b>	Gold Nanoparticles (Au NP)
	Scoop
	Disposable Pipettes
	2 mL Glass Vials
<b>Reagents</b>	
Ethanol	
NaCl Solution	3 g NaCl in 100 mL water
<b>Glassware</b>	
50–250 mL beaker	
<b>Test Settings</b>	Use ID Kit OP on Misa

Place a whole fruit (e.g., strawberry, orange) into a glass beaker just large enough to contain it. Rinse with 4–6 pipettes full of ethanol. Remove fruit and reduce ethanol volume, by means of evaporation on a hot plate, to ~1 mL. Fill a *clean vial* halfway full with Au NPs. Using pipettes, add 2 drops each of reduced ethanol solution and NaCl solution to Au NPs, cap and shake the vial gently to mix. Insert into vial attachment on Misa for measurement.

<b>Analyte:</b>	Herbicides, fungicides, pesticides
<b>Matrix:</b>	Food – additives
<b>Method:</b>	Spectroscopy (NIRS/Raman)
<b>Industry:</b>	Food & beverage

## CONCLUSION

Following adept detection of MBC on whole fruits, it is clear that Misa is an excellent solution for analysis of surface contamination of produce in any setting: at the farm, at the market, or at the processing plant. Want to confirm «organic» status? Pesticides, fungicides, and herbicides are all possible targets for Misa's powerful on-site analysis.