



Application Note AN-RS-025

Trace Detection of Paraquat in Tea Leaves

Protecting consumer safety with Misa

Paraquat is a highly effective herbicide used to manage weeds in agricultural operations. It is also exceptionally toxic, causing debilitating health effects that can result in delayed death after exposure. In China alone, it is estimated that over 5000 deaths each year are attributed to exposure during application and production of paraquat. In recognition of paraquat's danger, the EU and several other countries have banned its use for any application. The US EPA permits limited use of paraquat by licensed

applicators. Despite tight regulation, paraquat continues to be produced and is liberally used as an herbicide in over 100 countries without regulatory oversight.

Testing for paraquat typically requires involved sample processing and analysis by trained chemists using expensive laboratory instruments such as HPLC, CE, and LC/MS. Misa achieves trace level detection of paraquat residue in tea leaves in a fully integrated, portable, smart system for easy on-site testing by non-technicians.

INTRODUCTION

This application note describes a simple procedure for trace detection of paraquat on tea leaves, based on the acquisition of SERS spectra

of paraquat in chloroform extracts using Misa and gold nanoparticles (Au NPs).

REFERENCE SPECTRUM AND LIBRARY CREATION

To establish a reference spectrum, pure paraquat standard at a concentration of 1 $\mu\text{g/g}$ in water was analyzed using Au NPs. The unique

SERS spectrum shown in **Figure 1** can be used to create a library entry for paraquat.

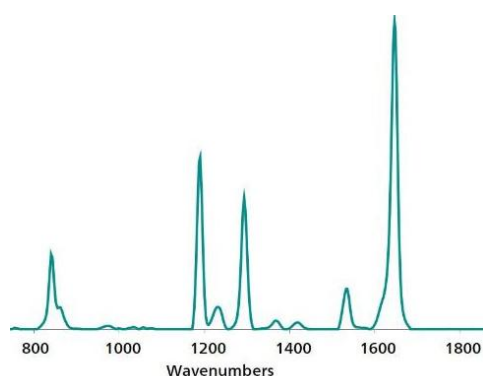


Figure 1. Standard reference SERS Au NP spectrum of paraquat.

EXPERIMENT

Serial dilutions of paraquat in water were added to 0.1 g aliquots of finely ground tea in glass vials to yield a concentration range of spiked test samples: 50, 25, 10, 5, and 1 $\mu\text{g/g}$, 100 and 50 ng/g. These samples were dried at 80 ° C, and 1 mL of chloroform was added each vial. Each sample was shaken for thorough wetting of the ground tea leaves and rested for 15 minutes to facilitate settling and extraction. After waiting the required time, 10 μL of chloroform extract was decanted to a fresh vial, dried briefly, and resuspended in 450 μL of Au NPs and 50 μL of 0.5 mol/L NaCl. Sample vials were gently shaken and immediately placed into the vial attachment on Misa for measurement.



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

Overlaid Au NP SERS spectra acquired for a range of paraquat-spiked tea samples demonstrate detection down to 1 $\mu\text{g/g}$ (Figure

2). Spectra were baseline-corrected and background-subtracted with Misa Cal software.

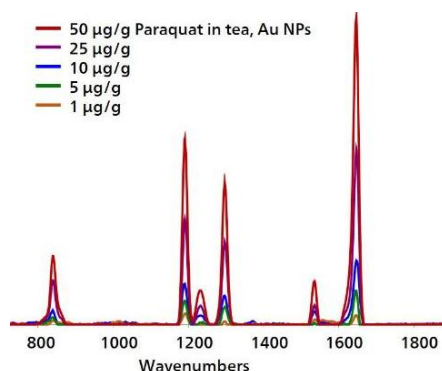


Figure 2. SERS spectra for a concentration range of paraquat in tea.

FIELD TEST PROTOCOL

Detection of paraquat in the field

If tea leaves are very large, then grind, crush, or chop them. Using the large end of the scoop, add 3–4 scoops of sample to a 2 mL vial. Add chloroform to the vial until halfway full. Cap and shake the vial gently to mix, then let sample rest for 15 minutes. Fill a clean vial ~1/2 full with Au

NPs. Using a pipette, add 2 drops of chloroform extract to a *clean vial* and remove the solvent with evaporative heating. Fill this vial halfway full with Au NP solution, add 1 drop of NaCl solution, and shake gently to mix. Insert into vial attachment on Misa for measurement.

Table 2. Requirements for field test protocol

ID Kit - Au NP	6.07506.440
includes:	Gold nanoparticles (Au NP)
	Scoop
	Disposable pipettes
	2 mL glass vials
Reagents	
Chloroform	
NaCl solution	3 g NaCl in 100 mL water
Test settings	Use ID Kit OP on MISA

CONCLUSION

The level of detection reported here for paraquat on tea leaves is significantly lower than the permissible levels of residue allowed for most vegetable, herb, and fruit crops. Sampling with Misa is simplified with onboard operating

procedures that automate acquisition parameters, sample processing, and results reporting. Misa's dedicated software, Misa Cal, can be used for spectral processing, library matches, and results sharing.

CONTACT

瑞士万通中国
北京市海淀区上地路1号院
1号楼7702
100085 北京

marketing@metrohm.com.cn

CONFIGURATION



MISA Advanced

Metrohm Instant SERS Analyzer (MISA) 是一款高性能、便携式分析系,可快速/定非法物、食品添加和微量食品染物。MISA 的特点是配了 Metrohm 独特的道光栅描 (ORS) 技的高效光。其空需求最小和并且池寿命有所延,是或移室用的理想。MISA 提供各 1 激光附件,可活取。分析可通 BlueTooth 或 USB 接行。MISA Advanced 套件是一个完整套件,其作用是用能用 Metrohms 米粒溶液和 P-SERS 条行 SERS 分析。MISA Advanced 套件包含了一个 MISA 小管附件、一个 P-SERS-附件、一个 ASTM 校正准件、一个 USB 迷、一个 USB 供元和用于行 MISA 器的 MISA Cal 件。随供了一个用来安全保管器和附件的固保箱。



ID – Au NP

ID 套件 - Au NP 包含了 Mira/Misa 用使用体金溶液行 SERS 分析所需的件。套件包含了一个一次性抹刀、一个移液管、品小瓶和一个含金体的瓶子。