

The Emerging Issue in Food Safety

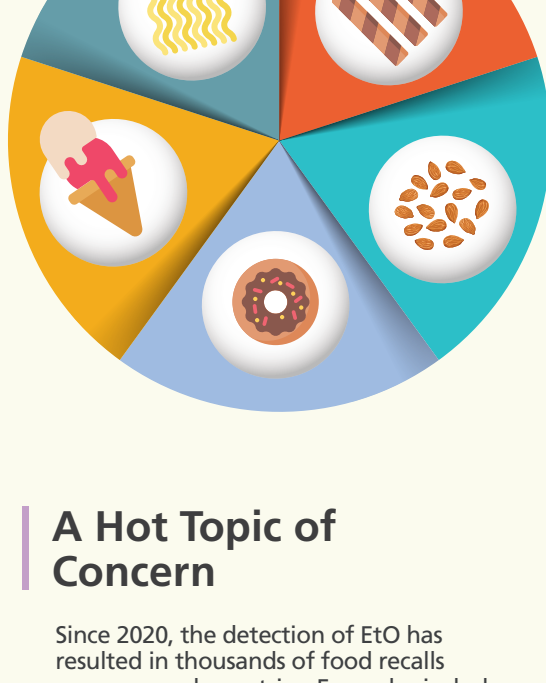
ETHYLENE OXIDE

What is Ethylene Oxide?

Ethylene oxide (EtO) is extremely effective in the disinfection or disinfestation of dry food commodities.

In some countries, EtO fumigation has been implemented to reduce the risk of sesame seed contamination with *Salmonella* and other fecal bacteria.

However, it is highly carcinogenic, mutagenic, and genotoxic to living beings.

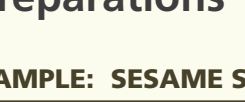


A Hot Topic of Concern

Since 2020, the detection of EtO has resulted in thousands of food recalls across several countries. Examples include noodles, confectionery, nuts, bakery products, and ice cream. In fact, the EtO incident is one of the biggest food recall operations in EU history.

The Solution: Liquid Injection or Dynamic Headspace Injection?

Once EtO is in contact with the food, it undergoes reactions within the matrix and produces various reaction products.



The most prominent reaction product of EtO is 2-CE. Due to the limited removal during aeration, the EtO, 2-CE, and their reaction products can be used as markers in EtO fumigations.

Herein we present the end-to-end workflow analysis of EtO and 2-CE using GC-MS analysis via dynamic headspace injection method and liquid injection method, respectively.

Sample Preparations

SAMPLE: SESAME SEEDS

LIQUID INJECTION

5000 mg of sesame seeds sample + 10000 µL of diluent (Acetonitrile), mix well and vortex for 15 minutes

Centrifuge for 5 min at 5000 rpm at 10 °C

Remove 5000 µL of supernatant from above solution, transfer it into 15 mL of Tarson tube

Add cleanup reagent and vortex for 5 minutes

Centrifuge for 5 min at 5000 rpm at 10 °C

Remove supernatant from above solution (matrix blank) and proceed for analysis

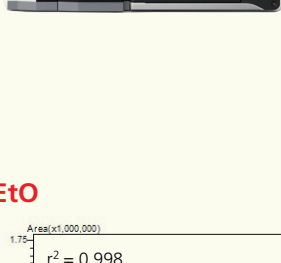
DYNAMIC HEADSPACE INJECTION

1000 mg of sesame seeds sample + 1000 µL of diluent (Acetonitrile), mix well and vortex for 15 minutes

Centrifuge for 5 min at 5000 rpm at 10 °C

Remove 100 µL from above solution, transfer it into 20 mL HS vial and proceed for analysis

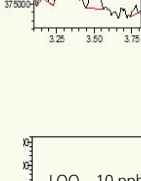
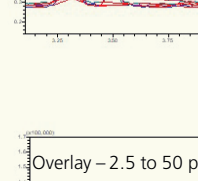
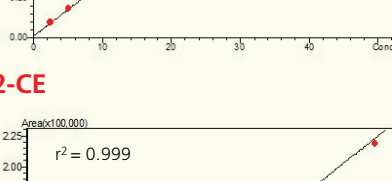
Validation Results For Liquid Injection GC-MS



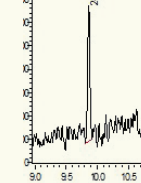
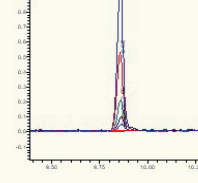
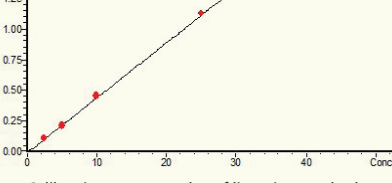
GCMS-TQ8050 NX with Liquid Sampler, AOC-20i and AOC-20s

- Backed by durable hardware, robust design, and reliable operation, Shimadzu GCMS-TQ8050 NX delivers trace-level analysis with high accuracy.
- AOC-20i and AOC-20s enable robust automated analysis with flexible sample handling of up to 150 vials.

EtO



2-CE



Calibration curve, overlay of linearity standards and chromatogram of LOQ solution

	EtO	2-CE
Reproducibility	7.7% (n=6)	9.4% (n=6)
Spiked Recovery Test at 10 ppb	73% (n=3)	85% (n=3)
Sample Preparation Time	35 - 40 min	
Cost	Cleanup Reagent / QuEChERS required	

Meeting EU-MRLs

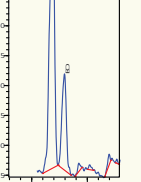
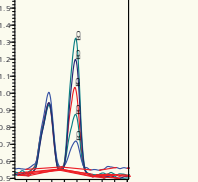
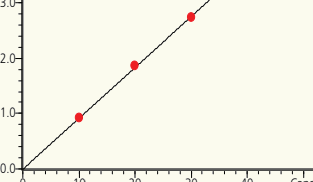
Validation Results For Dynamic Headspace Injection GC-MS

GCMS-TQ8050 NX with Headspace Sampler, HS-20 NX Trap

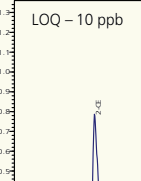
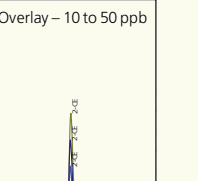
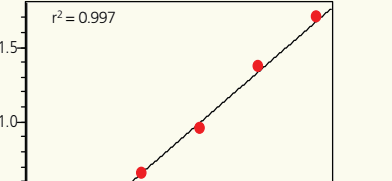
- The performance excellence, operational efficiency, and compliance ease of HS-20 NX have made it a powerful solution for volatile component analysis, whether in research or quality control laboratories.



EtO



2-CE

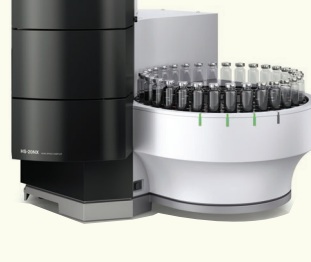


Calibration curve, overlay of linearity standards and chromatogram of LOQ solution

	EtO	2-CE
Reproducibility	2.1% (n=6)	4.9% (n=6)
Spiked Recovery Test at 10 ppb	91% (n=3)	121% (n=3)
Sample Preparation Time	20 - 25 min	
Cost	Cleanup Reagent / QuEChERS NOT required	

Meeting EU-MRLs

Benefits of Dynamic Headspace Injection



The Next Level of Analysis with HS-20 NX Trap

- Ultra-low carryover for excellent reliability
- High quality results every time
- Super short transfer line for consistent results
- Automatic overlap for high productivity

The Ultra-Fast GCMS TQ-8050 NX

- Ultra-High sensitivity with ultra-fast speed
- Proprietary UFSweeper™ technology for trace analysis
- Exceptional reliability and robustness
- Minimized contamination and maximized uptime



Evaluation of GC Injection Method

PROS AND CONS

LIQUID INJECTION

EtO and 2-CE can be measured at 10 ppb LOQ concentration

No additional accessory is required

No derivatization is required

May require sample clean up

May still introduce matrix into injection system after clean up

High matrix effect may require matrix match calibration

Matrix may have interferences when heated at high temperature in the injection port leading to false quantitation

DYNAMIC HEADSPACE INJECTION

EtO and 2-CE can be measured at 10 ppb LOQ concentration

Preferred method - More straightforward with less matrix interference

No additional clean up required

Dynamic headspace is an additional accessory



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