

# Nicotine in food – What does smoking have to do with it?

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## Introduction

Nicotine is a natural alkaloid produced by plants of the nightshade family. While cultivated tobacco contains the highest levels (0.5 - 3%) potatoes, tomatoes and eggplants reportedly contain only traces (2-7 µg/kg). Nicotine has been widely used as an insecticide both in plant and animal production. Tobacco extracts have been commonly used in organic farming. Nowadays, nicotine is not any more approved within the EU and the default MRL of 0.01 mg/kg applies to most commodities. Some temporary exceptions were however established for products with frequent findings such as wild fungi, spices, herbs and tea. Residues of nicotine are not only found in the abovementioned products but occasionally also in fresh produce. The encountered levels are typically low but MRL violations also occur.

## Application or Contamination?

Since 2017 356 samples of fresh fruits and vegetables (excl. fresh herbs) were analyzed by the QuPPE method at the CVUA Stuttgart and found to contain nicotine levels exceeding a trigger value of ~0.003 mg/kg. These samples were thereafter re-analyzed by an alkaline version of QuEChERS. In 43 cases (12 %) the legal MRL was exceeded. Taking measurement uncertainty (50%) into account, 13 of the 43 samples were considered as exceeding the MRL beyond reasonable doubt. Positive findings and MRL-exceedances concerned a very broad range of crops.

Tab. 1 Nicotine Findings in Fresh (CVUA Stuttgart 2017- May 2020) (excluding fresh herbs, which have other MRLs than 0.01 mg/kg)

Origin of Samples	Samples analyzed	Nicotine Results (MRL = 0.01 mg/kg)		
		≤ MRL	> MRL and ≤ 2 x MRL	> 2 x MRL*
Germany	149	124 (83%)	18 (12%)	7 (5%)
EU (excl. DE)	101	92 (91%)	5 (5%)	4 (4%)
Non-EU	74	68 (92%)	4 (5%)	2 (3%)
Unknown	32	29 (91%)	3 (9%)	0
<b>Total</b>	<b>356</b>	<b>313 (88%)</b>	<b>30 (8%)</b>	<b>13 (4%)</b>

\* MRL-exceeded even after deducting the measurement uncertainty of 50%.

The measured amounts of nicotine don't tell how the insecticide ended up in the sample...

- was a nicotine-containing PPP applied?
- was it contaminated in the field or during processing?
- did the plant produce nicotine itself?

There is some discussion as to whether nicotine naturally occurs in some plants, such as porcini mushrooms and tea, but no scientific evidence has been provided thus far. More likely is a contamination from nearby tobacco fields, or tobacco processing plants, or from contaminated soil due to a tobacco cultivation history. Contamination through the hands of pickers or packers has also been under discussion. But how does our food get contaminated in daily life?

## Analysis

Nicotine can be analyzed by various methods:

### For screening:

- QuPPE or CEN-QuEChERS without ILIS

### For quantitative analysis:

- QuPPE with ILIS (mainly corrects for Matrix Effects)
- CEN-QuEChERS with ILIS (corrects for recovery and MEs)
- Alkaline QuEChERS (matrix-matched calibr. and/or ILIS)

ILIS: e.g. D<sub>4</sub> or D<sub>3</sub> Nicotine

**Alkaline QuEChERS** involves addition of 5N NaOH (0.3 mL) to 10 g sample, addition of acetonitrile (10 mL), shaking, partitioning via shaking after addition of 1g NaCl/4g MgSO<sub>4</sub>, centrifugation, dSPE with PSA (optional), and analysis via LC-MS/MS or GC-MS/MS. Using ILIS for recovery correction also the CEN-QuEChERS approach can be used.

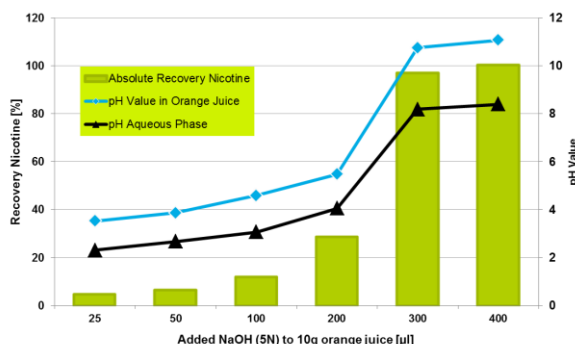


Figure I Impact of pH on nicotine recovery in QuEChERS

## Simulated Contamination Experiment

Imagine a customer smoking a cigarette just before his weekly shopping trip. Once in the shop he picks up a head of lettuce, turning it over in his hands to see if it's the best one available. CVUA Stuttgart reconstructed this situation with lettuce, apples and peaches, testing the food items thereafter for nicotine residues. After having smoked a cigarette, the tester alternatively took dry or wet products into his hand.

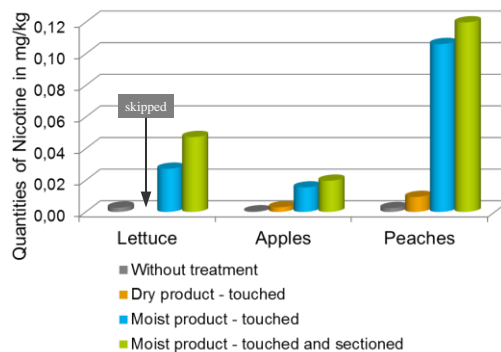


Figure II Nicotine amounts in lettuce, apples and peaches, before and after contact with a smoker's hands



## Result

While no or comparatively little nicotine was transferred when the food surface was dry, large amounts were transferred when it was moist. Being a very polar pesticide, nicotine is easily dissolved in water. In all three cases of contact with a wet product the nicotine MRL of 0.01 mg/kg was exceeded. Intensive contact via touching and cutting of the moist lettuce and peaches yielded even higher levels. This would simulate the situation in the lab if a smoker does not wash his hands or does not wear gloves prior to handling samples.

## Summary

Even though the test conducted at CVUA Stuttgart was just a model experiment, it shows that relevant amounts of nicotine can certainly be transferred to food after smoking a cigarette. So the rule still holds: wash your hands before coming in contact with food.



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