NICOTINE ANALYSIS OF COMMERCIAL FOOD PRODUCTS USING GC-MS-MS AND LC-MS-MS

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Introduction

Tobacco, tomatoes, peppers, and eggplant are all a part of the Solanaceae plant family and contain nicotine at different levels. If consumer products use these vegetables as main ingredients, do these products also contain nicotine? Two methods were used in this study to measure possible low levels of nicotine in consumer foods and beverages containing these ingredients.

Vegetable	Nicotine Present (ng/g)[1]
	181.9
	74.1
	174.3

Table 1. Native nicotine levels in tomatoes, green peppers and eggplant.[1]

Sample Extraction

Samples evaluated for nicotine were the following: two vegetable juices, tomato juice, tomato soup, baba ghanoush, and Darjeeling black tea. The tea was used based on previous research stating 300 ppb in Darjeeling teas.[2] Previous samples considered for evaluation were excluded to either simplify the experimental design or was based on sample extraction complexities.

Each sample was extracted in duplicate with an additional two extractions per sample with 500 ng of nicotine spiked onto the sample before extraction to judge extraction efficiency.

Sample Extraction continued

10 mL of liquid samples were pH adjusted to be above pH 10 with NH_4OH or 1 gram of solid/pasty samples were extracted with 10 mL of pH 10 NH_4OH water. Samples were shaken on a wrist action shaker for 60 minutes. pH was also taken after extraction and an additional 200 µL of NH_4OH was added to each sample.

The extracted sample mixtures were centrifuged at 2500g for 30 minutes.

Solutions were decanted on a 500 mg Waters HLB Solid Phase Extraction (SPE) column conditioned with pH 10.0 NH_4OH water. The tea samples required a filtering step before the SPE cartridge due to the many small leaves.

After the samples were passed through the SPE cartridges, the column was eluted with 500 ppb d_3-nicotine methanol solution. Some samples required further filtering due to particulate matter. Samples were run on both GC-MS-MS and LC-MS-MS systems to confirm low level nicotine presence.

Analytical Methodology

GC-MS-MS Parameters

MRM Monitoring of 162-84 Da and 165-85 Da.

EI Multiple Reaction Monitoring

LC-MS-MS Parameters

MRM Monitoring of 163-130 Da and 166-85 Da.

Positive Mode Electrospray Ionization

Results

	Average Native Nicotine per serving	
Sample	LC Nicotine Quant	GC Nicotine Quant
Vegetable Juice 1	1.8 µg/1 can serving	3.1 µg/1 can serving
Vegetable Juice 2	1.5 µg/1 can serving	1.5 µg/1 can serving
Tomato Juice	1.5 µg/1 can serving	1.4 µg/1 can serving
Tomato Soup Concentrate	17 µg per serving or 44 µg per can	21 µg per serving or 52 µg per can
Baba Ganoush	12 µg per serving or 93 µg per container	16 µg per serving or 127 µg per container
Darjeeling Tea	0.3 µg/bag	0.4 µg/bag

Table 2. Nicotine native levels in various food and beverages.

Samples showed microgram levels of nicotine and good recovery in samples based on the spike values not shown. Possible causes for higher-than-expected variability between methods may be due to technical GC issues, extended time at room temperature, and possible unknown matrix issue with sample storage.

Conclusion

When using tomatoes, green peppers and eggplant to make beverages or food, native levels of nicotine remain in the final product. The results showed nicotine values ranging from 0.3 µg to 21 µg per serving.

Samples with the lowest nicotine (about 1.4 µg) were more processed beverages while the foods like tomato soup and baba ghanoush had nicotine levels roughly 10X higher than the beverages. Darjeeling tea was used as a comparator based on a literature reference and had about 0.3 µg per tea bag.[2]

Future research will be done to test additional products and to assess the impact of different sample preparation techniques.

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