An Improved Method for the Determination of Carbonyls in Cigarette **Smoke and Butyraldehyde Co-Elution**

Results

Abstract

Carbonyls, including formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde crotonaldehyde, and methyl ethyl ketone, are included in the FDA established list of Harmful and Potentially Harmful Constituents (HPHC) in tobacco products and tobacco smoke. CORESTA published CRM 74, "Determination of selected carbonyls in mainstream cigarette smoke by HPLC" for the determination of carbonyls in cigarette smoke. CRM 74 includes the seven aforementioned carbonyls that are HPHCs and also includes butyraldehyde, an inhalation irritant. CRM 74 was later developed into ISO 21160:2018 and ISO 23922:2020 for non-intense and intense smoking respectively. The run time of the CRM 74 and the ISO standards is long (45 min) which is not ideal for high throughput analyses. In this work, we followed the principles in CRM 74 and shortened the run time to 10 min. This method uses Ultra-High Pressure Liquid Chromatography (UHPLC) with a sub-2 µm InfinityLab Poroshell 120 Bonus-RP analytical column. Data generated with our improved method were consistent with CRM 74. All requirements for method validation were met. The repeatability for each analyte was \leq 10.7%, intermediate precision was \leq 8.6% over three days, linearity was demonstrated with a coefficient of determination of \geq 0.999 for all analytes, and recoveries were 80% to 109% for 1R6F non-intense and CM8 intense samples. This optimized method significantly reduced instrumental run time. Most importantly, our study demonstrated that butyraldehyde, as reported with the standardized methods and our method, is actually a mixture of isomers that cannot be effectively separated. Based on our validation, we suggest reporting butyraldehyde as mixture of butyraldehyde and iso-butyraldehyde when using CRM 74 and the ISO standards.

Introduction

- CORESTA Recommended Method 74 and ISO standards 21160:2018 and 23922:20202 include the analysis of eight carbonyls: formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, crotonaldehyde, methyl ethyl ketone (MEK), and butyraldehyde.¹ o These methods require derivatization with DNPH for UV detection and allows for
- chromatographic separation by reverse phase HPLC. • All of the carbonyls listed in CRM 74 except butyraldehyde are on the FDA established
- list of HPHC in tobacco products and tobacco smoke.²
- The major drawback to the traditional HPLC separation is the 45 minutes analysis time.
- The objective of this study was to develop and validate a method with a shorter run time using UHPLC-UV for carbonyls in cigarette smoke based on the CRM 74.

Methods

Parameters	Setting
DNPH trapping solution	2.0 g DNPH-HCl in 1 L of ACN:wa 2.05 M phosphoric acid
Smoke Collection	Two impingers each containing 35
Instrumentation	Waters Acquity UPLC system with
Analytical column	InfinityLab Poroshell 120 Bonus-R
Injection volume	2 µL
Column temperature	55 °C
Mobile phases	A: ACN:water (10:90, v/v), B: ACN
UV detection wavelength	365 nm
Total run time	10 min

ater (50:50, v/v) with 29 mL

mL DNPH trapping soln. UV detector

RP, 2.1 x 100 mm, 2.7 μm

I:MeOH (75:25, v/v)







>Carbonyl yields in 1R6F non-intense samples generated using the ALCS method and CORESTA method are comparable (n=3)

This scientific research is presented by Altria Client Services LLC (ALCS). ALCS affiliate companies are tobacco product manufacturers.

Carbonyl Yields in 1R6F Non-Intense – Using ALCS Method vs CRM 74

Conclusion

- laboratories.³

References

- 1.Harmful and Potentially Harmful Constituents in Tobacco Products and Tobacco Smoke: Established List. April 2012.
- 2.CORESTA Recommended Method No. 74, Determination of Selected Carbonyls in Mainstream Cigarette Smoke By HPLC.
- 3. Proficiency Testing Round CIG -2020A, measurement of smoking parameters in the 1R6F certified reference cigarette, University of Kentucky, Center for Tobacco Reference Products, July 2020.

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Retention Times of Individual Standard vs Sample Using ALCS Method



 \geq Isobutyraldehyde retention time matches sample peak.

• We identified that isobutyraldehyde co-elutes with butyraldehyde when following CRM 74, ISO 21160:2018 and ISO 23922:20202. This can result in over reporting butyraldehyde. For this reason, we suggest reporting butyraldehyde as mixture of butyraldehyde and iso-butyraldehyde when using CRM 74 and the ISO standards. • Although the ALCS method reported herein does not resolve the co-elution of isobutyraldehyde and butyraldehyde, it does offer comparable results to the aforementioned standard methods with 4-times the throughput. The data generated with our method were also comparable to results from other



