

Case Reports

Analysis of illicit carfentanil: Emergence of the death dragon



John F. Casale*, Jennifer R. Mallette, Elizabeth M. Guest

U.S. Drug Enforcement Administration, Special Testing and Research Laboratory, Dulles, VA 20166, USA

ARTICLE INFO

Article history:

Received 8 December 2016

Available online 16 February 2017

Keywords:

Carfentanil

Analysis

Chromatography

Spectroscopy

Spectrometry

Forensic chemistry

ABSTRACT

The United States is currently in the midst of an unprecedented illicit fentanyl crisis. In the last year alone there have been more recent fentanyl-related overdose deaths than in the previous 60 years. The current crisis is multi-faceted and involves a global supply of fentanyl and related substances being smuggled into the United States. Illicit carfentanil hydrochloride has recently entered the drug market causing multiple overdoses and deaths across the U.S. To date, over 400 confirmed carfentanil cases have been identified. Carfentanil is approximately 100 times more potent than fentanyl with only 20 µg of material required to produce a lethal dose. Due to a lack of published spectra for carfentanil HCl, analytical profiles are provided for three recent carfentanil submissions to our laboratory which include infrared spectroscopy, nuclear magnetic resonance spectroscopy, gas chromatography-mass spectrometry, isotope ratio mass spectrometry, and quantitative determination via gas chromatography-flame ionization detection. The three submissions were determined to contain 0.62%, 1.87%, and 0.31% carfentanil HCl, respectively. Each exhibit also contained a fentanyl-related substance (fentanyl or 2-furanylfentanyl). Acetylcarfentanil was characterized as an impurity in two exhibits. Isotopic analyses of two exhibits suggest they are intimately related.

Published by Elsevier B.V.

1. Introduction

Over the past 40 years there have been three significant fentanyl-related epidemics within the United States. The first epidemic began in the late 1970s and was dubbed “China White” due to the nature, purity, and color of the fentanyl and fentanyl-related compounds (FFRCs). The FFRCs were determined to be of Chinese origin and caused hundreds of overdose deaths. Many of the FFRCs were new compounds not previously seen by the forensic community, and extensive research was conducted to characterize and identify these new substances [1–3]. These FFRCs were a major influence in the implementation of the Controlled Substance Analogue Enforcement Act of 1986, which controlled drug analogs of listed Schedule I and II drugs. A second wave of over 1000 fatal overdoses from illicit fentanyl occurred during the 2005–2007 time frame. Illicit fentanyl was determined to be originating from a clandestine laboratory in Mexico. Our laboratory was tasked with providing “chemical intelligence” on seized fentanyl exhibits. A fentanyl signature profiling research project was established to determine the clandestine synthetic routes and link seized sam-

ples. Two profiling methods were developed, one of which was published [4]. In that work, 40 synthetic markers were identified; 12 were Janssen route-specific, 7 were Siegfried route-specific, and 21 were non route-specific. The markers were significant in determining relationships between samples.

The current outbreak of FFRCs began in late 2013 and accounted for over 5000 overdose deaths within the U.S. during 2014, as reported by the Center for Disease Control (CDC) [5,6]. A compilation of FFRC overdose deaths in 2015 is not yet available, but Ohio has reported over 1100 for that state alone. The only 2016 data available at this time is for New Hampshire with 200 opiate/opioid deaths in the first 8 months. However, the National Forensic Laboratory Information System (NFLIS) has tracked a dramatic increase in fentanyl submissions to local, state, and federal laboratories over the last 4 years (CY 2013 = 934, CY 2014 = 7864, CY 2015 = 13,059, and CY 2016 through September = 16,263). If the relationship of NFLIS sample submissions to CDC overdose deaths is consistent between 2014 and 2016, there could well be over 10,000 overdose deaths during CY 2016. Recently, the extremely potent FFRC, carfentanil (Fig. 1) (10,000× more potent than morphine, 100× more potent than fentanyl) has been detected in seizures and overdose death toxicology samples. Carfentanil was implicated in 125 deaths that occurred during the Moscow Theatre Siege of 2002 [7]. A lethal dose of carfentanil is estimated at only 20 micrograms (20 one-millionths of a gram) and is barely visible to the naked eye.

* Corresponding author at: Special Testing and Research Laboratory, U.S. Drug Enforcement Administration, 22624 Dulles Summit Court, Dulles, VA 20166-9509, USA.

E-mail address: John.f.casale@usdoj.gov (J.F. Casale).

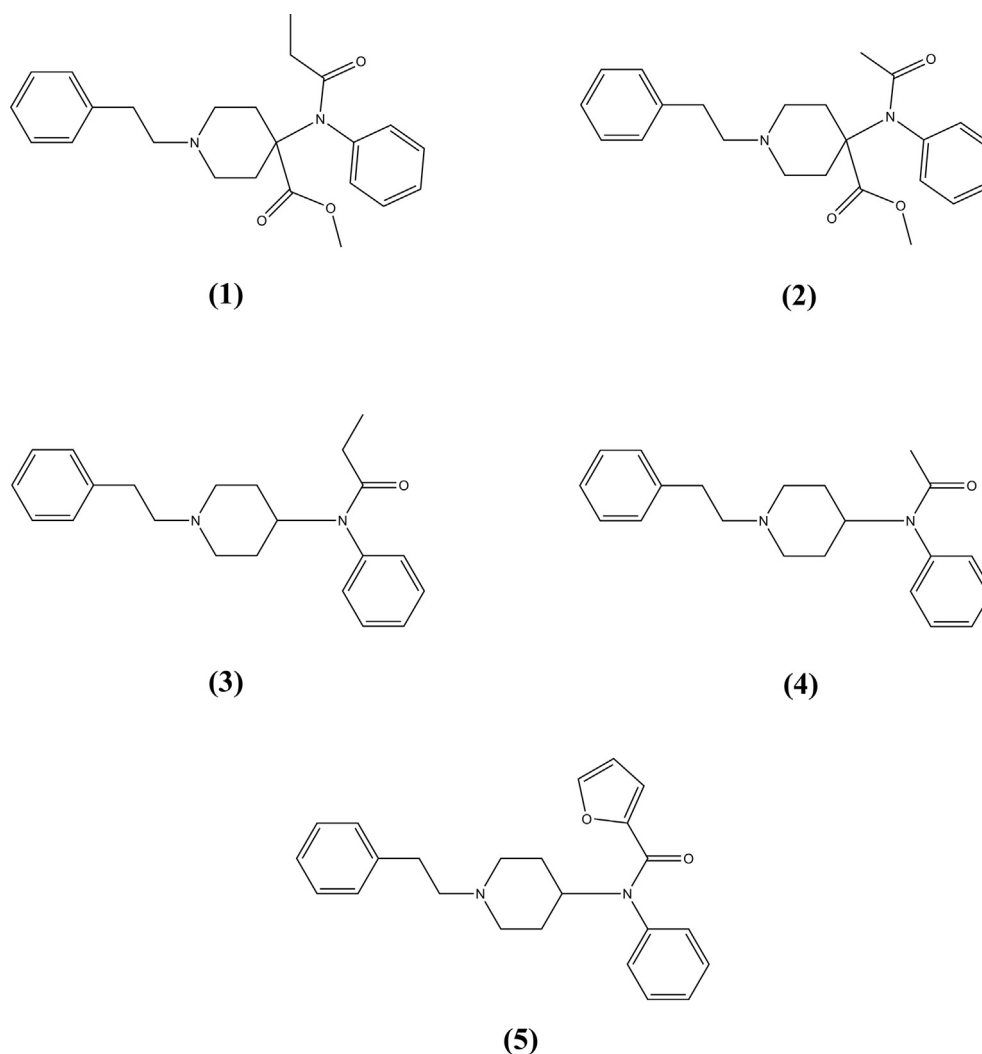


Fig. 1. Structures of carfentanil (1), acetylcarfentanil (2), fentanyl (3), acetylfentanyl (4), and 2-furanylfentanyl (5).

During CY 2016, this laboratory has been notified of over 400 confirmed carfentanil cases within the U.S., with the overwhelming majority (84%) occurring in Ohio (Table 1). Herein, we report analytical data for illicit carfentanil from three case exhibits which include infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR), gas chromatography–mass spectrometry (GC/MS), isotope ratio mass spectrometry (IRMS), and quantitative determination via gas chromatography–flame ionization detection (GC–FID).

2. Cases

Exemplars of two cases comprised of three total exhibits were submitted to this laboratory for in-depth analysis. Specific details for each exhibit cannot be disclosed due to current and active enforcement investigations; however, the following non-sensitive information is provided:

Case #1: Two separate exhibits (1A and 1B) of white powder seized in the central U.S. weighing approximately 2 and 20 g,

Table 1
Confirmed carfentanil cases examined by local, state, and federal forensic laboratories during 2016.^a

Reported drug with carfentanil	OH	MI	FL	KY	IL	RI	GA	IN	Total
Carfentanil only	48	1	8	7	0	0	3	0	67
Fentanyl	3	0	0	0	0	0	0	2	5
Furanylfentanyl	4	0	0	0	0	4	0	0	8
Heroin	20	0	2	5	0	0	0	0	27
Heroin/fentanyl	8	0	0	3	1	0	0	0	12
Heroin/furanylfentanyl	1	0	0	0	0	0	0	0	1
Heroin/fentanyl/furanylfentanyl	1	3	0	0	0	0	0	0	4
Other controlled substances ^b	8	1	1	0	0	0	0	0	10
No detailed reporting	250	0	23	0	0	0	0	0	273
Total	343	5	34	15	1	4	3	2	407

^a Data compiled by DEA Special Testing and Research Laboratory as of October 26, 2016.

^b Includes mixtures containing cocaine, FUB-AMB, U47700, methamphetamine, and cannabinoids.

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