BTMPS: An Industrial Additive in the Illicit Drug Supply

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S&T CSAC SUMMARY

- BTMPS spread quickly through the U.S. drug supply, from Jun to Dec 2024; it went from initial detection to all but 3 states reporting detection.[1]
- Unlike other adulterants commonly found in the U.S. drug market, BTMPS is likely coming from Mexico and not an adulterant added to the drug supply in the U.S.[2]
- BTMPS is being used to replace other precursor chemicals because fentanyl analogues derived from it are being detected.[3]
- U.S. news media reports on the presence of BTMPS in the illicit drug supply informed the cartels that their synthesis was not working properly. This would have given them notice to adjust their synthetic processes, resulting in the new analogues.

WHAT DO WE KNOW ABOUT BTMPS?

- Bis(tetramethylpiperidinyl) sebacate (Bis(2,2,6,6-tetramethyl-4-piperidinyl) sebacate or BTMPS, Chemical Abstracts Service Registry Number 52829-07-9), is a hindered amine light stabilizer (HALS), often sold commercially as Tinuvin® 770. BTMPS is primarily used in exterior industrial applications as an ultra-violet (UV) light stabilizer in plastics, adhesives, films, and coatings.[4–6]
- BTMPS was detected in the illicit drug supply beginning in June 2024[7,8] and has been observed in at least 22 states, including IL,[9] NC, NY, WI, ME, FL, MI, OR, PA, CO, CA, NM, VA, WA and OH.[8]

PHYSICAL PROPERTIES OF BTMPS

- BMTPS freebase is a white crystalline solid at room temperature, has a melting point of 82–85 °C, is relatively insoluble in water (18.8 mg/L)[10], and has a very low vapor pressure (1.3 x 10^{-8} Pa) at 20 °C.[11] The freebase is soluble in acetone (19% by weight), chloroform (45% by weight), and methanol (38% by weight).[11]
- BTMPS freebase loses mass when heated: 0.7% at 150 °C; 2.5% at 225 °C, and 19.8% at 275 °C.[10]
- BTMPS·2HCl (BTMPS dihydrochloride, sometimes called BTMPS chloride), a white solid, is more soluble than the freebase and has been found in the illicit drug supply.[12] Solubility values for BTMPS·2HCl were not found.
- BTMPS·2HCl has been reported to melt in several stages starting at about 118 °C with visible solid still present until it decomposed to a brown material at 255 °C.[12]
- Accounts from drug users about the taste and odor of BTMPS describe a strong, pervasive odor resembling bug spray[7] or plastic;[7] also, a rubbery or synthetic,[13] fishy smell.[7]

TOXICITY OF BTMPS

- Too few published studies are available to make human toxicity estimates.
- Inhalation lethal concentration$_{50}$ (LC_{50}) in rats is 500 mg/m^3 (4 hours).[4,14]
- Oral lethal dose (LD_{50}) in rats is 3,700 mg/kg.[14]
- Dermal LD_{50} in rats is > 3,170 mg/kg.[14]
- Inhalation LC_{50} is >960 mg/m^3 air (4-hour dust exposure), all particles >10 microns. No mortalities occurred, but salivation, lacrimation, and changes in activity were seen.[15] (Unknown animal model).
- Tinuvin 770, freebase form, was a primary skin irritant when applied neat; sensitization was seen in 2 of 50 human subjects. However, Tinuvin 770 was "not a sensitizer in maximization tests or optimization tests with guinea pigs".[15] Skin sensitizing effects were not observed in animal studies. Human data do not fully exclude skin sensitizing potential.[16] Contact allergies to items that contain BTMPS have been reported.[17,18]
- The personal protective equipment recommended for BTMPS is tightly fitting safety goggles, impervious gloves, protective clothing, filter type P2 for respiratory protection, and appropriate engineering controls.[5]

IN VITRO AND IN VIVO STUDIES OF BTMPS

- BTMPS is an L-type Ca^{2+}-channel blocker.[19] Calcium channel blockers affect muscle cells, reduce heart rates, and lower blood pressure. They may also cause vasodilation which also lowers blood pressure.[19,20]
- BTMPS has been studied in rats that were addicted to cocaine[21] and morphine.[22]

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- BTMPS damages the outer membrane of heart cells and causes excessive contraction in heart cells from adult rats. When tested in living rats, BTMPS led to areas of heart cell breakdown, extreme cell contractions, and changes in the heart tissue that are similar to damage caused by high levels of stress hormones in the heart of rats.[23,24]
- BTMPS caused acute hemodynamic alterations in dogs that had been intravenously anaesthetized and respirated. The dogs weighed 24 kg; when 100 mg (4.1 mg/kg) of BTMPS was injected, 82% of the dogs died.[25]
- BTMPS inhibits nicotinic acetylcholine receptors.[26] This inhibition could cause muscle weakness up to paralysis and would affect the nervous system causing dizziness, confusion, or altered perception.[26,27]
- BTMPS has antimicrobial properties against *Escherichia coli, Staphylococcus aureus* (methicillin-resistant and -sensitive strains) with >99.99% reduction in viable bacteria, and the yeast *Candida albicans*, with 99.3% reduction in viable colonies.[28]

CHEMISTRY AND SYNTHESIS

- BTMPS is made from 4-(2,2,6,6-tetramethyl) piperidinol and sebacic acid.[16] BTMPS·2HCl is made by dissolving BTMPS in acetone and adding a solution of hydrochloric acid in isopropanol, then isolating the product.[29]
- BTMPS may be used in a multi-step process to synthesize 2,2,6,6-tetramethylfentanyl (TMF).[30]
- Tests of drug materials show detection of precursors for TMF. Tetramethyl-4-piperidinol was first detected in August 2024; tetramethyl-4-AP and tetramethylnorfentanyl were first detected in April 2025. Only trace quantities of a substance suspected of being TMF has been observed in conjunction with the precursors.[3]

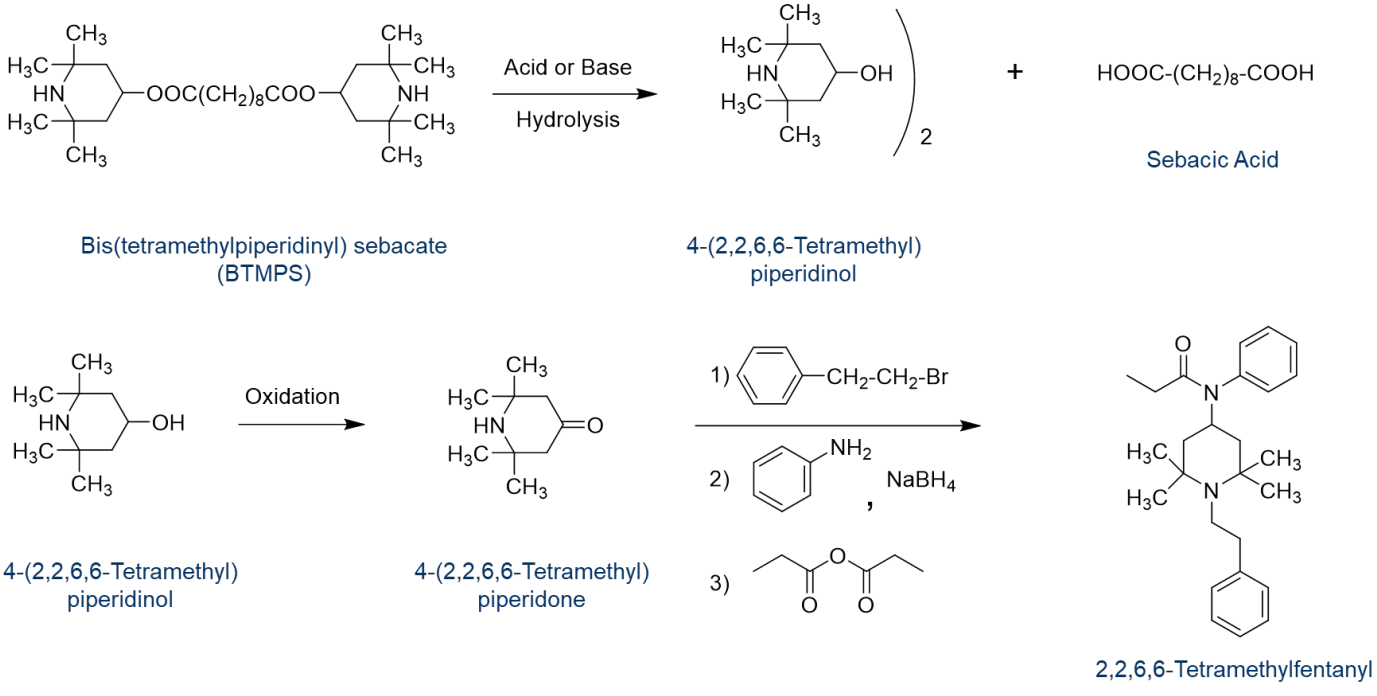

Figure 1. Potential Route for the Synthesis of 2,2,6,6-Tetramethylfentanyl from BTMPS

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DETECTION METHODS FOR BTMPS

- BTMPS may be detected using Fourier transform infrared spectroscopy.[14,31]
- BTMPS leached from laboratory and medical plastics has been detected via liquid chromatography coupled with mass spectrometry.[32,33,34]
- BTMPS leached from polymer toys with simulated saliva has been detected via liquid–liquid extraction and ultra performance liquid chromatographic analysis with ultraviolet-visible and evaporative light scattering detections.[34]

AREAS FOR FURTHER RESEARCH

- A limited number of publicly available studies of the dose and efficacy of BTMPS in laboratory animals have been performed; more studies are needed to develop human toxicity doses and establish safety guidance.
- The methods of decontamination used for BTMPS are expected to be similar to other illicit drugs and precursors.

S&T CSAC RESOURCES FOR INFORMATION ABOUT ILLICIT DRUGS

- *Fentanyl & Nitazene Analogues: Prevalence, Toxicity, and Shared Precursors Update*, CSAC 25-016, July 2025.
- *DHS Master Question List for Synthetic Opioids*, *Version 2.* https://www.dhs.gov/publication/st-master-question-list-synthetic-opioids. September 2024.
- Memorandum for the Record, Addition of Nitazenes to CBRN FY25 Risk Cycle, October 4, 2023.
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- *DHS Master Question List for Synthetic Opioids*. https://www.dhs.gov/publication/st-master-question-list-synthetic-opioids. September 2021.
- *Bulletin – Nitazene Synthesis and Reagents*, CSAC 21-004.
- *Memorandum for Record 2.1 Illicit Drug Threats*, CSAC 21-002.
- *Memorandum for Record 2.0 Illicit Drug Threats*, CSAC 20-008.
- *Nitazene Benzimidazole Quick Response Guide*, CSAC 20-007.
- *Fentanyl Synthesis Quick Reference Guide*, CSAC 20-004.
- *Synthetic Opioids Bulletin*, CSAC 17-009.

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