AB-FUBINACA and AMB FUBINACA:

Report to the Expert Advisory Committee on Drugs

Prepared by the Ministry of Health

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# SUMMARY

## 1a. Purpose

This report provides an overview of the synthetic cannabinoids AB-FUBINACA and AMB-FUBINACA. Recently there have been a number of reports of erratic behaviour, hospitalisations and deaths in New Zealand linked to the use of synthetic cannabis. Testing by Environmental Science and Research (ESR) indicated that AMB-FUBINACA was one of the synthetic cannabinoids present.

The status of information about the synthetic cannabinoids AB-FUBINACA and AMB-FUBINACA is summed up in the following.

* AB-FUBINACA and AMB-FUBINACA have psychoactive properties.
* There is evidence that AB-FUBINACA and AMB-FUBINACA are being imported into the country and being made available illegally.
* They have high potential for abuse.
* There is a lack of safety information for the use of AB-FUBINACA and AMB-FUBINACA.
* There is a lack of information on the safe and toxic dose levels of AB-FUBINACA and AMB-FUBINACA.
* There are no currently accepted medical or industrial uses for AB-FUBINACA or AMB-FUBINACA.
* There is evidence that individuals are taking AB-FUBINACA or AMB-FUBINACA in amounts sufficient to create a hazard to their health or to the safety of other individuals or of the community.
* There is evidence that the use of AB-FUBINACA and AMB-FUBINACA have resulted in adverse effects including trance-like states, hospitalisations and deaths. At least 20 deaths were reported to be associated with AMB-FUBINACA in this country alone.

## 1b. Why these substances are being considered

AB-FUBINACA and AMB-FUBINACA do not have the classical cannabinoid structure, and therefore are not controlled under the Misuse of Drugs Act 1975 (MoDA). As they are capable of producing a psychoactive effect, they can be captured under the Psychoactive Substances Act 2013 when used for this purpose.

AB-FUBINACA and AMB-FUBINACA in particular are described as being ultra-potent synthetic cannabinoids, the “crack of synth noids” (Reddit Research Chemicals user forum). The seriousness of the adverse effects indicates that it may be appropriate to schedule these synthetic cannabinoids as Controlled Drugs under MoDA.

In this paper, ‘synthetic cannabis’ refers to a dried herb or plant material sprayed with one or more synthetic cannabinoids, with the aim being to imitate the effects of Δ9-tetrahydrocannabinol (THC) in natural cannabis.

# SUBSTANCE IDENTIFICATION AND CHEMISTRY

## 2a. Identification

AB-FUBINACA and AMB-FUBINACA are synthetic cannabinoids of the class of substituted indazole-3-carboxamides.

 

|  |  |
| --- | --- |
| (ChemId, AB-FUBINACA) | * AB-FUBINACA

Synonym* AB-FUB

IUPAC name* N-[(2S)-1-amino-3-methyl-1-oxobutan-2-yl]-1-[(4-fluorophenyl)methyl]-1H-indazole-3-carboxamide

CAS Number: 1185282-01-2Molecular weight: 368.4099 g/molMolecular formula: C20H21FN4O2Physical descriptionWhite crystalline solid.AB-FUBINACA contains a chiral centre at the C-2 carbon of the 1-amino-3-methyl-1-oxobutan-2-yl side chain. This means that the substance also exists as the *R*-AB-FUBINACA enantiomer. |
| (ChemId, AMB-FUBINACA) | * AMB-FUBINACA

Synonyms* N-[[1-[(4-fluorophenyl)methyl]-1H-indazol-3-yl]carbonyl]-L-valine, methyl ester
* FUB-AMB
* FUB-MMB
* MMB-FUBINACA
* AK-47 24 Carat Gold
* Train Wreck2

IUPAC name* methyl (2S)-2-[[1-[(4-fluorophenyl)methyl]indazole-3-carbonyl]amino]-3-methylbutanoate

CAS Number 1971007-92-7Molecular weight: 383.4208 g/molMolecular formula: C21H22FN3O3Physical descriptionWhite to yellowish powder, slightly sweetish to the taste, with a sweet somewhat pleasant aroma.AMB-FUBINACA contains a chiral centre at the C-2 carbon of the valinate sidechain. This means that the substance also exists as the *R*-AMB-FUBINACA enantiomer.  |

## 2b. Similarities to other substances

AB-FUBINACA is classified as an indazole. AB-FUBINACA is based on an indazole core structure where the 1- and 3-positions of the indazole ring system are substituted. The 1-position of AB-FUBINACA is substituted with a para-fluorobenzyl group. The 3-position is substituted with an amide linker, and the nitrogen atom (N) of this linker is further substituted with an acyclic alkyl amide, named 1-amino-3-methyl-1-oxobutan-2-yl.

AMB-FUBINACA is the methyl ester analogue of AB-FUBINACA, where the terminal amide group of the 1-amino-3-methyl-1-oxobutan-2-yl is replaced with a methyl ester group. It is reported to be 75-85 times more powerful at CB1 than THC, and 50 times more potent than JWH-018. It was first reported in Louisiana in 2014, in a synthetic cannabis product called ‘Train Wreck 2’. It came to prominence in 2016, when there were a number of cases of “zombie-like” behaviour amongst users in New York City (The Drug Classroom, 2016; New York Times, December 2016; Bautista 2016; Adams et al, 2017). It was first reported in New Zealand in 2017 in association with similar occurrences (Stuff website, September 2017a).

Both substances are structurally related to AB-PINACA, ADB-PINACA, AB-CHMINACA, 5-fluoro AMP, and MDMB-FUBINACA, all of which are also synthetic cannabinoids.

## 2c. Background and history of use

AB-FUBINACA was marketed in New Zealand as a “legal” synthetic cannabis in the early 2010s. Interim product approvals were granted under the Psychoactive Substances Act 2013 until these were revoked on grounds that these posed more than a low risk of harm under Section 40 of that Act. AMB- FUBINACA does not appear to have been available in New Zealand prior to late 2016 or early 2017.

## 2d. Methods and ease of manufacturing

The synthesis of AB-FUBINACA is described in a 2009 patent by Pfizer Inc. on Indazole Derivatives, in which AMB-FUBINACA is a derivative. The patent is publicly accessible on the Google Patents website (Google.com).

The methods and ease of manufacturing synthetic cannabis can be found in the accompanying Synthetic Cannabinoids report prepared for the EACD.

# RISK OF HARM

## 3a. Likelihood or Evidence of Abuse

While no deaths appear to be associated with AB-FUBINACA, there are reports of erratic behaviour and hospitalisations from use of the substance (Brenneman et al, 2016).

AMB-FUBINACA has been associated with a number of deaths which are currently the subject of a coronial investigation (Stuff website, September 2017a; New Zealand Police, September 2017).

## 3b. Specific Effects

Effects on humans are said to be ‘euphoric, stimulating high, increases creativity and appetite, also short term memory deficits, similar to Cannabis’ (PsychonautWiki).

## 3b. i. Pharmacology

AB-FUBINACA remains orally active when dissolved in a lipid, which can increase the duration significantly.

It is presumed from structural analysis that AB-FUBINACA has a similar binding profile to that of other synthetic cannabinoids and therefore has many of the *in vivo* properties of THC.

While THC is a partial agonist of the CB1 and CB2 receptors (inducing only partial efficacy), both AB-FUBINACA and AMB-FUBINACA exhibit their range of effects via full agonism of both the CB1 and CB2 receptors, with a lesser selectivity for CB2, therefore inducing a much stronger biological response (Mackie 2008). AB-FUBINACA exerts potent cannabimimetic effects (ie, having similar pharmacological effects to those of cannabis) on locomotion, body temperature, heart rate, and nociception in mice and rats, as well as substituting for THC in drug discrimination assays (Banister et al 2015, Gatch and Forster 2015).

Banister et al (2015, 2016) have shown that both AB-FUBINACA and AMB-FUBINACA have cannabimimetic activity (ie, similar pharmacological effects to cannabis) both *in vivo* and *in vitro*. Both acted as potent, highly efficacious agonists at CB1 and CB2 receptors in a fluorometric assay of membrane potential, with a general preference for CB1 activation:

|  |  |
| --- | --- |
|  | EC50 |
| CB1 receptor | CB2 receptor |
| AB-FUBINACA (Banister et al, 2015) | 1.8 nM | 3.2 nM |
| AMB-FUBINACA (Banister et al, 2016) | 2.0 nM | 18 nM |

AB-FUBINACA exerts potent effects on locomotion, body temperature, heart rate, and nociception in mice and rats, as well as substituting for THC in drug discrimination assays (Banister et al 2015, Gatch and Forster 2015).

## 3b. ii. Psychoactivity

Users have reported they experienced a very fast onset of action for AB-FUBINACA (within a minute), lasting up to about 45 minutes. User reports talked of ‘trippy’, ‘stoned’, ‘feeling heavy’, ‘feeling glowy’, euphoria and visuals. One user reported paranoia and incoherency. Effects are described as being mild to moderate for AB-FUBINACA at different dosages (see the dosage table in the Dosage section below), and very high doses elicit a stronger effect (Erowid.org website).

For AMB-FUBINACA, onset of action was reported to occur with a ‘THC-like high’ within 10-15 seconds, followed by a psychedelic and dissociative experience lasting up to 20 minutes, with a ‘come-down’ to a relaxed high starting from about 30 minutes until back to baseline at about 45-60 minutes (Reddit FUB-AMB/AMB-FUBINACA Report). Typical dosages have not been reported.

## 3b. iii. Toxicology

The following adverse effects for AB-FUBINACA and AMB-FUBINACA are published on the New Zealand Drug Foundation website and the US Department of Justice (Drug Enforcement Division) website.

Non-serious adverse reactions

Many users report experiences not usually associated with cannabis including:

* fast or irregular heartbeat
* high blood pressure
* nausea
* vomiting
* tremors
* racing thoughts
* dizziness
* weight loss

These were reported to last a few hours, with a strong desire to keep using the drug, followed with a comedown which can last up to several days. This can include feeling anxious, struggling to concentrate, being irritable, or difficulty sleeping (NZ Drug Foundation).

Serious adverse reactions

Some types of synthetic cannabis were linked to heart attacks, strokes, kidney problems and psychosis. Using synthetic cannabis can induce psychosis and extreme distress, which is a higher risk for people with pre-existing mental illness. AMB-FUBINACA is reported to be linked to acute ST-segment elevation myocardial infarction requiring percutaneous coronary intervention (Hamilton et al, 2017).

Other serious adverse effects are reported to include

* aggression
* difficulty breathing
* suicidal feelings
* harmful thoughts
* psychotic episodes
* paranoia, anxiety and panic attacks
* hallucinations
* aggression
* seizures
* death

These more severe adverse effects are thought to be due to the fact that AB-FUBINACA and AMB-FUBINACA are full agonists of the CB1 and CB2 receptors compared to THC. The latter is only a partial agonist (Pertwee, 2008). Withdrawal symptoms have been reported when users stop using AB-FUBINACA and AMB-FUBINACA.

## 3b. iv. Dosage/ LD50 and amount for supply

The substances have not been studied in any scientific context, and effective and toxic dosages are unknown or unverified.

|  |  |
| --- | --- |
| **AB-FUBINACA dose** | **Oral and vapourised dose** |
| Light | 0.25-0.5 mg |
| Common | 0.5-1.5 mg |
| Strong | 1.5-3 mg |
| Heavy | 3+ mg |

(from Tripsit website)

|  |  |  |
| --- | --- | --- |
| **AB-FUBINACA effect duration** | **Vapourised route** | **Oral route** |
| Onset | 1-5 minutes | 30-240 minutes |
| Duration | 1-2 hours | 5-15 hours |
| After-effects | 1-2 hours | 2-10 hours |

(from Tripsit website)

User reports indicate that for AMB-FUBINACA, effects begin to occur with doses as low as 7 micrograms (Reddit Research Chemicals user forum). Further information was not found.

|  |  |  |
| --- | --- | --- |
| **AMB-FUBINACA effect duration** | **Vapourised route** | **Oral route** |
| Onset | 10-15 seconds  | no information |
| Duration | 30-45 minutes | no information |
| After-effects | 45 minutes-1 hour | no information |

(from Reddit Research Chemicals user forum)

## 3c. Risks to Public Health

As synthetic cannabinoids are relatively cheap to buy, making synthetic cannabis requires less time and effort than growing cannabis. Synthetic cannabinoids are increasingly being imported/smuggled into New Zealand. In June 2017, Customs intercepted over a kilogram of AMB-FUBINACA. In August 2017, Waitemata police seized 2 kg of AMB-FUBINACA and more than 11 kg of other synthetic drugs. The 3 kg was estimated to be sufficient to manufacture 150 kg of synthetic cannabis, worth a street value of $1.5 million (Newshub August 2017).

Because synthetic cannabis is relatively cheap to buy, vulnerable populations such as homeless people are more likely to be affected by these substances.

As the substances are illegal, it is impossible for the user to know which cannabinoid is involved, how strong it is, or how much is contained in the synthetic cannabis purchased. Because there is no quality control, there may be large variations in which chemicals and how much, are present. Different users will react differently to different batches of the purported same synthetic cannabis.

## 3d. Therapeutic Value

AB-FUBINACA was originally developed by Pfizer in 2009 as an analgesic. It was first reported in synthetic cannabis in Japan in 2012. It was found in Spice/K2-type herbal blends.

Neither AB-FUBINACA nor AMB-FUBINACA are approved for medical use anywhere in the world, and are not formulated or available for clinical use.

## 3e. Potential to Cause Death

A number of hospitalisations and deaths were reported to be linked to synthetic cannabis in the past year in the Auckland region alone (New Zealand Police, July 2017).

AB-FUBINACA is reported to have caused a number of poisonings at Wesleyan University in Connecticut in 2015 (The Conversation, November 2015).

According to the New Zealand Drug Foundation, at least 20 deaths are likely to be linked to AMB-FUBINACA (Matters of Substance, October 2017). Tested products were reported to have contained between 32 mg/g and 400 mg/g of the active ingredient, being between 2 to 25 times stronger than the mass casualty event reported in New York a year earlier (Stuff website, September 2017b; Stuff website September 2017c).

## 3f. Potential for Physical or Physiological Dependence

The chronic use of AB-FUBINACA is considered moderately addictive, with a high potential for abuse and psychological dependence. Both AB-FUBINACA and AMB-FUBINACA have pharmacological profiles similar to other psychoactive cannabinoids. It is reasonable to assume that they also possess physiological and psychological dependence liability. As they are full agonists of the CB1 receptor, it is possible that they may also exert a stronger effect. However, no actual studies were found regarding psychological or physiological dependence on either AB-FUBINACA or AMB-FUBINACA.

## 3g. Any other matters considered relevant

According to Psychonaut Wiki, tolerance to AB-FUBINACA develops with prolonged and repeated use. This results in users having to administer increasingly large doses to achieve the same effects. On stopping use, it takes about 3 - 7 days for the tolerance to be reduced to half and 1-2 weeks to be back at baseline. AB-FUBINACA presents cross-tolerance with all cannabinoids, meaning that after the consumption of AB-FUBINACA, all cannabinoids will have a reduced effect (Psychonaut Wiki website).

There are no industrial uses identified for either AB-FUBINACA or AMB-FUBINACA.

# CLASSIFICATION

## 4a. Classification and Regulation in New Zealand (past and present)

Neither AB-FUBINACA nor AMB-FUBINACA are scheduled medicines in Schedule 1 of the Medicines Regulations 1984 or are controlled drugs under the Misuse of Drugs Act 1975.

Under section 9 of the Psychoactive Substances Act 2013, a psychoactive substance is defined as a substance, mixture, preparation, article, device, or thing that is capable of inducing a psychoactive effect (by any means) in an individual who uses the psychoactive substance.

Both AB-FUBINACA and AMB-FUBINACA are considered capable of inducing a psychoactive effect, and would be unapproved psychoactive substances if used for this purpose.

## 4b. International Classification and Experience in Other Jurisdictions

See the accompanying Synthetic Cannabinoids report prepared for the EACD, for information on the classification of AB-FUBINACA and AMB-FUBINACA in Australia, Canada and the UK.

**Germany**

Since 2016, all substances belonging to the group of synthetic cannabinoids are illegal.

**USA**

In 2012, the Synthetic Drug Abuse Prevention Act was signed into law, banning synthetic compounds found in synthetic marijuana and placing them into Schedule I of the Controlled Substances Act 1970. Thus, AB-FUBINACA and AMB-FUBINACA are caught in Schedule 1.

**China**

As of October 2015, AB-FUBINACA is a controlled substance.

**UN Classification**

AB-FUBINACA and AMB-FUBINACA have not been considered by the ECDD or CND.

# OTHER RELEVANT INFORMATION

## 5a. Anticipated future trends

The 2017 Global Drug Survey (covering 50 countries) reported on the percentage of emergency ward visits caused by the various types of ‘recreational’ drugs. Synthetic cannabis was found to be the second highest risk category after methamphetamines, causing up to 3.2% of all visits to hospitals. In the UK, one in 10 users sought EMT help in 2017. Over 65% of users experienced withdrawal symptoms. The most common method of use was in tobacco (joint).

As ‘vaping’ becomes more commonplace, there is the possibility that synthetic cannabinoids will become more available in a liquid form, allowing these to be ‘vaped’. This has the potential to adversely affect the Government’s Smokefree 2020 programme, by linking legitimate nicotine vaping with illegal synthetic cannabinoid vaping.

Police data provided to the Ministry of Health, on seizures of unapproved controlled drug or psychoactive substances shows that the quantity of AB-FUBINACA seized has decreased in the last five years (from a high of 78 kg in 2014 down to 1.2 kg in 2017). However, the quantity of AMB-FUBINACA seized has remained constant at about 4 kg during the last two years (New Zealand Police, 2018). This trend is likely to continue over the next several years.

# CLASSIFICATION OPTIONS

Options for the scheduling of AMB-FUBINACA and AB-FUBINACA are presented in the accompanying Synthetic Cannabinoids report prepared for the Expert Advisory Committee on Drugs.

# REFERENCES

Adams AJ, Banister SD, Irizarry L, Trecki J, Schwartz M, Gerona R. (2017). “Zombie” Outbreak Caused by the Synthetic Cannabinoid AMB-FUBINACA in New York. New England Journal of Medicine 376:235-242. <http://www.nejm.org/doi/full/10.1056/NEJMoa1610300>

Banister SD, Moir M, Stuart J, Kevin RC, Wood KE, Longworth M, Wilkinson SM, Beinat C, Buchanan AS, Glass M, Connor M, McGregor IS, Kassiou M. (2015). Pharmacology of indole and indazole synthetic cannabinoid designer drugs AB-FUBINACA, ADB-FUBINACA, AB-PINACA, ADB-PINACA, 5F-AB-PINACA, 5F-ADB-PINACA, ADBICA, and 5F-ADBICA. ACS Chemical Neuroscience 6:1546–1559.

Banister SD, Longworth M, Kevin R, Sachdev S, Santiago M, Stuart J, Mack JBC, Glass M, McGregor IS, Connor M, Kassiou M. (2016). Pharmacology of Valinate and tert-Leucinate Synthetic Cannabinoids 5F-AMBICA, 5F-AMB, 5F-ADB, AMB-FUBINACA, MDMB-FUBINACA, MDMB-CHMICA, and Their Analogues. ACS Chemical Neuroscience 7(9):1241-1254. <https://pubs.acs.org/doi/10.1021/acschemneuro.6b00137>

Bautista C. DNAinfo. (2016). Marijuana: Study. <https://www.dnainfo.com/new-york/20161215/bed-stuy/brooklyn-k2-outbreak-synthetic-marijuana-ak-47-24-karat-gold>

Brenneman R, Papsun D, Logan B, Neavyn M. (2016). Hartford HealthCare. A Death-like Slumber. Toxic Outbreak of AB-FUBINACA. <https://www.acmt.net/_Library/2016_ASM_Posters/Abstract_108.pdf>

Chen MH-H, Dip A, Ahmed M, Tan ML, Walterscheid JP, Sun H, Teng B-B, Mozayani A. (2016). Detection and Characterization of the Effect of AB‐FUBINACA and Its Metabolites in a Rat Model. Journal of Cellular Biochemistry 117:1033-1043 <https://onlinelibrary.wiley.com/doi/full/10.1002/jcb.25421>

Erowid.org website. AB-FUBINACA. <https://erowid.org/experiences/exp.php?ID=105231> (accessed 19 February 2018).

Gatch MB, Forster MJ. (2015). Δ9-Tetrahydrocannabinol-Like Effects of Novel Synthetic Cannabinoids Found on the Gray Market. Behavioural Pharmacology 16(5):460-468. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4497846/>

Global Drug Survey (2017). Global overview and highlights. <https://www.globaldrugsurvey.com/wp-content/themes/globaldrugsurvey/results/GDS2017_key-findings-report_final.pdf>

Google Patents website. Pfizer Inc. (2009). Indazole derivatives. <https://patents.google.com/patent/WO2009106982A1>

Hamilton RJ, Keyfes V, Banka SS. (2017). Journal of Emergency Medicine 52(4):496-498. [http://www.jem-journal.com/article/S0736-4679(16)30797-1/fulltext](http://www.jem-journal.com/article/S0736-4679%2816%2930797-1/fulltext)

Mackie K. 2008. Cannabinoid receptors: where they are and what they do. 2008. Journal of Neuroendocrinology 20 (suppl 1.): 10-14.

Newshub, 10 August (2017). Police seize over 10kg of synthetic drugs. <http://www.newshub.co.nz/home/new-zealand/2017/08/police-seize-over-10kg-of-synthetic-drugs.html>

New York Times website. December (2016). Drug 85 times as potent as marijuana caused a ‘zombielike’ state in Brooklyn. <https://www.nytimes.com/2016/12/14/nyregion/zombielike-state-was-caused-by-synthetic-marijuana.html> (accessed 16 February 2018).

New Zealand Drug Foundation, (2017). Matters of Substance, October 2017. We Should Have Known. <https://www.drugfoundation.org.nz/matters-of-substance/october-2017/we-should-have-known/>

New Zealand Police. (July 2017). Joint statement from the Chief Coroner's office and Police on the significant number of synthetic cannabis related deaths in Auckland. Friday 21 July 2017. <http://www.police.govt.nz/news/release/joint-statement-chief-coroners-office-and-police-significant-number-synthetic-cannabis> (accessed 19 February 2018).

New Zealand Police. (September 2017). Police and Chief Coroner reinforce synthetic drug warning. 14 September 2017. <http://www.police.govt.nz/news/release/police-and-chief-coroner-reinforce-synthetic-drug-warning> (accessed 19 February 2018).

New Zealand Police. (2018). Police seizure data (private communication).

Pertwee RG. (2008). The diverse CB1 and CB2 receptor pharmacology of three plant cannabinoids: Δ9-tetrahydrocannabinol, cannabidiol and Δ9-tetrahydrocannabivarin. British Journal of Pharmacology 153(2):199-215. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2219532/>

PsychonautWiki website. AB-FUBINACA. <https://psychonautwiki.org/wiki/AB-FUBINACA> (accessed 15 February 2018).

Reddit Research Chemicals FUB-AMB/AMB-FUBINACA Report. <https://www.reddit.com/r/researchchemicals/comments/5xcw82/fubamb_ambfubinaca_report/> (accessed 21 February 2018).

Stuff website. (2017a). September 14, 2017. The ‘ultrapotent’, ‘zombie’ drug AMB-FUBINACA has come to town. <https://www.stuff.co.nz/national/health/96860356/the-ultrapotent-zombie-drug-ambfubinaca-has-come-to-town> (accessed 19 February 2018).

Stuff website, (2017b). Killer Chemicals. Part One. Inside NZ’s synthetic cannabis crisis. <https://interactives.stuff.co.nz/2017/09/killer-chemicals/index.html> (accessed 19 February 2018).

Stuff website, (2017c). September 18, 2017. Worsening synthetic drug crisis demands action. <https://www.stuff.co.nz/national/96932967/worsening-synthetic-drug-crisis-demands-action> (accessed 19 February 2018).

The Conversation, November 2015. Labs make new, dangerous synthetic cannabinoid drugs faster than we can ban them. <https://theconversation.com/labs-make-new-dangerous-synthetic-cannabinoid-drugs-faster-than-we-can-ban-them-47896> (accessed 19 February 2018).

The Drug Classroom. (2016). Overview: String of Overdoses from AMB-FUBINACA in New York. <https://thedrugclassroom.com/overview-string-overdoses-amb-fubinaca-new-york/> (accessed 19 February 2018).

Tripsit website. AB-FUBINACA. <http://drugs.tripsit.me/ab-fubinaca> (accessed 19 February 2018).

US Department of Justice website. Drug Enforcement Administration. 21 CFR Part 1308 [Docket No. DEA-433]. Schedules of Controlled Substances: Placement of PB-22, 5F-PB-22, AB-FUBINACA and ADB-PINACA into Schedule I. <https://www.deadiversion.usdoj.gov/fed_regs/rules/2016/fr0205.htm> (accessed 19 February 2018).

Wikipedia. Synthetic cannabinoids. <https://en.wikipedia.org/wiki/Synthetic_cannabinoids> (accessed 21 February 2018).

Wikipedia. AB-FUBINACA. <https://en.wikipedia.org/wiki/AB-FUBINACA> (accessed 26 March 2018).