

# Kratom consumption can be addictive and have adverse health effects

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**Received:** 6 July 2022 **Revised:** 4 August 2022 **Accepted:** 10 August 2022 **e-Published:** 18 August 2022

## Abstract

Kratom, also known as herbal speed, is the powdered leaves of the Asian kratom tree (*Mitragyna speciosa* Korth). The consumption of kratom powder or kratom tea for diarrhea, inflammation, fever, and pain, but also for anxiety and depression is based on traditional experiences from East Asian herbal medicine.

Pharmacologically, kratom is an intoxicant or narcotic. In low doses, the leaves have a stimulating effect, in high doses, they are depressant and psychoactive like opioids. There is a steadily increasing popularity of the herbal drug kratom and its psychoactive compounds mitragynine and 7-hydroxymitragynine around the world. To date, no randomized controlled human intervention study has evaluated the safety and efficacy of kratom ingestion. In addition, there are increasing reports of kratom-associated adverse effects including herb-induced liver toxicity and nephrotoxicity, cardiovascular and neurological symptoms, and withdrawal syndrome.

The still unsatisfactory lack of regulatory control and easy availability via internet providers will continue to increase kratom use in many countries. Clinicians should be aware that kratom use can be addictive and have potentially serious side effects. It is important to determine the consumption of dietary and herbal supplements when taking the patient's medical history.

**Keywords:** Kratom, Mitragynine, Adverse effects, Herbal drug.

## Introduction

Kratom, also known as herbal speed, is the powdered leaves of the Kratom tree (*Mitragyna speciosa* Korth.) that grows in Southeast Asia countries such as Thailand, Malaysia, Indonesia, Philippines, Papua New Guinea, and Vietnam.<sup>1</sup> Other names for this plant-based substance, which belongs to the Rubiaceae family, are biak-biak, ketum, ithang, thom, maeng da, or mambog. The Kratom tree grows to a height of about 4-16 m and has green, oval leaves, and yellow flowers. The leaves of the plant are offered as tea, powder, extracts, liquids, and capsules mainly via the internet. Exotic "health-promoting" plants in food supplements are booming and lead to an uncritical consumption of such products by consumers. But "natural" does not necessarily mean "safe"! No matter how natural they appear: Plants and plant extracts can contain harmful substances. Only a few important plants have been scientifically evaluated for their harmfulness.<sup>2</sup>

## Kratom background

The consumption of kratom powder or kratom tea for diarrhea, inflammation, fever, and pain, but also for anxiety and depression is based on traditional experiences from East Asian herbal medicine.<sup>3</sup> Some strains are said to have a euphoric effect. Pharmacologically, kratom is an intoxicant or narcotic. In low doses (1–5 g), the leaves are said to have a stimulating effect (similar to coca), in high doses, about 5–15 g of dried leaves, they are depressant and psychoactive like opioids.<sup>4</sup> The effects of chewing or smoking kratom kick in after just 5-10 minutes. There is a risk of physical and psychological dependency (risk of addiction) with regular use at a higher dose.<sup>5</sup> To date, no randomized controlled human intervention study has evaluated the safety and efficacy of kratom ingestion.<sup>2,6</sup> The kratom seller or manufacturer alone is responsible for safety. But when he's abroad, it's difficult to hold him accountable. Regardless of its use in Asia, kratom has

become increasingly popular over the past two decades in America, Europe, and Australia.<sup>2</sup> It is estimated that there are at least 10 to 16 million regular kratom users in the United States.<sup>3,7</sup> In addition, reports of kratom abuse among adolescents have been published.<sup>8</sup>

### Psychoactive kratom alkaloids

Kratom contains over 45 plant alkaloids in very different concentrations, there are no standardized compositions of kratom preparations, so the effect is uncontrollable. The psychoactive compounds mitragynine, 7-hydroxymitragynine, speciociliatine, speciogynine, and paynantheine which act on mu, delta, and kappa opioid human receptors, represent the largest proportion in terms of quantity. In addition, these major indole alkaloids also activate adrenergic (alpha1 and alpha2 receptors), serotonergic (5-HT1A and 5-HT2A receptors), and dopaminergic (D1 and D2 receptors) neurotransmitters in the brain, even at low doses.<sup>1,5,7</sup> Both main kratom alkaloids, mitragynine, and 7-hydroxymitragynine, have also been shown to inhibit P-glycoprotein-mediated efflux transporters, suggesting the potential for drug-drug interactions with the transporter substrates.<sup>1</sup> Because of its psychoactive effects, kratom is also often advertised as a natural, safe, effective, and legal opioid substitute for methadone and buprenorphine.<sup>5</sup> Under no circumstances should consumers forego necessary medical treatments - even if it is claimed that a botanical preparation such as kratom could replace them. It is important to talk to a doctor first so as not to take any unnecessary risks. In addition, there is a lack of scientifically valid data on dose-response relationships or the effects of long-term kratom use.<sup>2</sup>

### Kratom-drug interactions

Furthermore, clinically serious drug interactions of kratom and alcohol, opioids, benzodiazepines, and others should not be underestimated by consumers and medical professionals. Kratom alkaloids stimulate the toxicity of pharmacologically active substances via modulation of drug-metabolizing enzymes, in particular cytochrome P450 (e.g. CYP2D6 inhibition), P-glycoprotein, and uridine diphosphate glucuronosyltransferase.<sup>3,5,9</sup> For

example, kratom in combination with high doses of caffeine can lead to high blood pressure. And the combination with alcohol increases the calming effect, even to the point of shortness of breath. Consumers should generally exercise caution when using plants and plant preparations if they are chronically ill and/or need to take medication regularly. There is still far too little information about the interaction of kratom products with other pharmaceuticals.

### Kratom-associated adverse events

Reports of kratom-associated adverse effects including constipation, loss of appetite, herb-induced liver toxicity and nephrotoxicity, cardiovascular and neurological symptoms, and withdrawal syndrome are increasing worldwide (Table 1).<sup>2,3</sup> And numerous kratom-related deaths have even been reported.<sup>7,36</sup> In addition, kratom products with massive disease-causing multiple serotypes of salmonella contamination (such as Thompson, Okatie, Heidelberg, Weltevreden, and Javiana) have been found again and again in recent months.<sup>37</sup> Some products also contained potentially hazardous high levels of the toxic heavy metals nickel (0.73–7.4 µg/g raw kratom product), lead (0.25–1.6 µg/g), iron (187–850 µg/g), and chromium (0.21–5.7 µg/g). Trace levels of other nephrotoxic metals such as arsenic, cadmium, and mercury were also detectable in kratom supplements.<sup>38-40</sup> Recently, Fleming et al. found in commercially available kratom tea samples manganese levels up to 20 times higher than the tolerable upper intake of 11 mg/day, and as is well known, a longer-term overexposure to manganese can lead to Parkinsonian symptoms (“manganism”).<sup>41</sup> Kratom is a potent drug with serious side effects but without regulatory safety testing and permits.

### Legal position

In various countries such as Australia, Denmark, Finland, Italy, Israel, Latvia, Lithuania, New Zealand, Poland, Romania, Russia, Sweden, Switzerland, Turkey, United Kingdom, and in some US states (e.g. Alabama, Arkansas, Indiana, Rhode Island, Tennessee, Vermont, and Wisconsin) kratom is one of the substances to be controlled, so it is not a legal food supplement or

possessing kratom is strictly illegal.<sup>3,4,37,39</sup> In 2021, for example, U.S. Marshals on behalf of the U.S. Food and Drug Administration (FDA) seized and destroyed over 34 tons of kratom powder and 207,000 packages of dietary supplements containing kratom from Florida manufacturers.<sup>42</sup>

Kratom is also illegal in most Asian countries. In Brunei, Cambodia, Indonesia, Japan, Laos, Malaysia, Myanmar, Philippines, Singapore, South Korea, and Vietnam it is illegal to possess, buy or sell kratom.<sup>4,39</sup> In the native country of Thailand, possession, and consumption had been banned since 1943. Since August 2021 there has been a separate law for the use and control of kratom. It is now

legal to grow kratom, and sell and consume the leaves. However, the sale and consumption of concentrates made from the leaves are still illegal. Sale to persons under the age of 18 and pregnant women, online, in schools, and parks is prohibited.

In October 2021, the Expert Committee on Drug Dependence (EDCC) of the World Health Organization (WHO) evaluated kratom's health and adverse effects but did not include it in the United Nations list of internationally controlled substances. However, kratom remains on the list of substances under surveillance by the WHO ECDD.<sup>43</sup>

**Table 1.** Recent documented reports of adverse effects associated with kratom use

Adverse events and toxicities	References
Liver injury	Aldyab et al. 2019, <sup>10</sup> Fernandes et al. 2019, <sup>11</sup> Ahmad et al. 2021, <sup>12</sup> Botejue et al. 2021 <sup>13</sup>
Kidney injury	Antony et al. 2019, <sup>14</sup> Khan et al. 2021, <sup>15</sup> Sangani et al. 2021, <sup>16</sup> Jasim et al. 2022, <sup>17</sup> Tobarran et al. 2022 <sup>18</sup>
Hyperkalemia	Sangani et al. 2021, <sup>16</sup> Maria-Rios et al. 2022, <sup>19</sup> Torres-Ortiz et al. 2022 <sup>20</sup>
Tachycardia	Eggleston et al. 2019, <sup>21</sup> Post et al. 2019, <sup>22</sup> Davidson et al. 2021, <sup>23</sup> Leong Bin Abdullah et al. 2021 <sup>24</sup>
Hypertension	Post et al. 2019, <sup>22</sup> Davidson et al. 2021, <sup>23</sup> Leong Bin Abdullah et al. 2021 <sup>24</sup>
Cardiac arrest	Abdullah et al. 2019, <sup>25</sup> Eggleston et al. 2019, <sup>21</sup> Wolfer et al. 2020, <sup>26</sup> Sheikh et al. 2021 <sup>27</sup>
Seizures	Eggleston et al. 2019, <sup>21</sup> Demick et al. 2020, <sup>28</sup> Burke et al. 2021, <sup>29</sup> Halim et al. 2021, <sup>30</sup> Hartley C 2nd et al. 2022 <sup>5</sup>
Coma	Eggleston et al. 2019 <sup>21</sup>
Agitation/irritability	Eggleston et al. 2019, <sup>21</sup> Post et al. 2019, <sup>22</sup> Davidson et al. 2021 <sup>23</sup>
Drowsiness/lethargy	Eggleston et al. 2019, <sup>21</sup> Davidson et al. 2021 <sup>23</sup>
Vomiting	Eggleston et al. 2019, <sup>21</sup> Zuberi et al. 2019, <sup>31</sup> Singh et al. 2020 <sup>32</sup>
Withdrawal symptoms	Eggleston et al. 2019, <sup>21</sup> Stanciu et al. 2019, <sup>33</sup> Wright et al. 2021, <sup>34</sup> Smith et al. 2022 <sup>35</sup>
Neonatal Abstinence Syndrome	Wright et al. 2021 <sup>34</sup>

## Conclusion for the clinical practice

Currently, the FDA, Centers for Disease Control and Prevention (CDC), National Institute on Drug Abuse (NIDA), and Drug Enforcement Administration (DEA) in the United States, as well as the European Food Safety Authority (EFSA), are actively evaluating all available scientific information on this international health concern and continue to caution consumers against using products containing kratom or its psychoactive compounds mitragynine and 7-hydroxymitragynine.<sup>2</sup> The still unsatisfactory lack of regulatory control and easy availability via internet providers will continue to increase kratom use in many countries.<sup>2,6</sup> Extensive pharmaceutical

law necessary studies on the safety and dosage of kratom products are missing (not to mention the missing standardized compositions of kratom preparations). Therefore, based on the available evidence, this supposed "miracle herb" should also not be recommended by clinicians for pain patients to use as an analgesic or to treat psychiatric comorbidities.<sup>44</sup>

Clinicians should be aware that kratom use can be addictive and have potentially adverse health effects. It is fundamentally very important to determine the consumption of dietary and herbal supplements when taking the patient's medical history - preferably at every doctor's appointment.

**Acknowledgment**

None.

**Competing interests**

The author declares that he has no competing interests.

**Abbreviations**

None applicable.

**Author contribution**

The author read and approved the final manuscript. The author takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Funding**

None.

**Availability of data and materials**

None applicable.

**Ethics approval and consent to participate**

None.

**Consent for publication**

By submitting this document, the author declares his consent for the final accepted version of the manuscript to be considered for publication.

**References**

- Hanapi NA, Chear NJ, Azizi J, Yusof SR. Kratom Alkaloids: Interactions with Enzymes, Receptors, and Cellular Barriers. *Front Pharmacol.* 2021;12:751656 doi:10.3389/fphar.2021.751656 PMID:34867362 PMCID:PMC8637859
- Papadi G, Bakhiya N, Ildico Hirsch-Ernst K. Assessment of the possible health risks associated with the consumption of botanical preparations of *Mitragyna speciosa* (kratom). *EFSA J.* 2022;20(Suppl 1):e200415. doi:10.2903/j.efsa.2022.e200415 PMID:35634550 PMCID:PMC9131591
- Swogger MT, Smith KE, Garcia-Romeu A, Grundmann O, Veltri CA, Henningfield JE, et al. Understanding Kratom Use: A Guide for Healthcare Providers. *Front Pharmacol.* 2022;13:801855 doi:10.3389/fphar.2022.801855 PMID:35308216 PMCID:PMC8924421
- Warner ML, Kaufman NC, Grundmann O. The pharmacology and toxicology of kratom: from traditional herb to drug of abuse. *Int J Legal Med.* 2016;130(1):127-38. doi:10.1007/s00414-015-1279-y PMID:26511390
- Hartley C 2nd, Bulloch M, Penzak SR. Clinical Pharmacology of the Dietary Supplement Kratom (*Mitragyna speciosa*). *J Clin Pharmacol.* 2022;62(5):577-93. doi:10.1002/jcph.2001 PMID:34775626
- Shah K, Tankersley W, Mekala H. Kratom: An Emerging Issue and Need for Regulations in the United States. *Prim Care Companion*
- CNS Disord. 2021;23(1):20r02770 doi:10.4088/PCC.20r02770
- Henningfield JE, Wang DW, Huestis MA. Kratom Abuse Potential 2021: An Updated Eight Factor Analysis. *Front Pharmacol.* 2022; 12: 775073. doi:10.3389/fphar.2021.775073 PMID:35197848 PMCID:PMC8860177
- Sharma V, Cottler LB, Bares CB, Lopez-Quintero C. Kratom Use Among U.S. Adolescents: Analyses of the 2019 National Survey on Drug Use and Health. *J Adolesc Health.* 2022;70(4):677-81 doi:10.1016/j.jadohealth.2021.10.009 PMID:34836801 PMCID:PMC9328154
- Tanna RS, Tian DD, Cech NB, Oberlies NH, Rettie AE, Thummel KE, et al. Refined Prediction of Pharmacokinetic Kratom-Drug Interactions: Time-Dependent Inhibition Considerations. *J Pharmacol Exp Ther.* 2021;376(1):64-73 doi:10.1124/jpet.120.000270 PMID:33093187 PMCID:PMC7745086
- Aldyab M, Ells PF, Bui R, Chapman TD, Lee H. Kratom-Induced Cholestatic Liver Injury Mimicking Anti-Mitochondrial Antibody-Negative Primary Biliary Cholangitis: A Case Report and Review of Literature. *Gastroenterol Res.* 2019;12(4):211-15 doi:10.14740/gr1204 PMID:31523332 PMCID:PMC6731044
- Fernandes CT, Iqbal U, Tighe SP, Ahmed A. Kratom-Induced Cholestatic Liver Injury and Its Conservative Management. *J Investig Med High Impact Case Rep.* 2019;7:2324709619836138 doi:10.1177/2324709619836138 PMID:30920318 PMCID:PMC6440031
- Ahmad J, Odin JA, Hayashi PH, Fontana RJ, Conjeevaram H, Avula B, et al. Liver injury associated with kratom, a popular opioid-like product: Experience from the U.S. drug induced liver injury network and a review of the literature. *Drug Alcohol Depend.* 2021; 218: 108426. doi:10.1016/j.drugalcdep.2020.108426 PMID:33257199 PMCID:PMC8113016
- Botejue M, Walia G, Shahin O, Sharma J, Zackria R. Kratom-Induced Liver Injury: A Case Series and Clinical Implications. *Cureus.* 2021;13(4):e14679. doi:10.7759/cureus.14679
- Antony A, Lee TP. Herb-Induced Liver Injury With Cholestasis and Renal Injury Secondary to Short-Term Use of Kratom (*Mitragyna speciosa*). *Am J Ther.* 2019;26(4):e546-47 doi:10.1097/MJT.0000000000000802 PMID:29927773
- Khan MZ, Saleh MA, Alkhayyat M, Roberts DE, Lindenmeyer CC. Multiorgan Dysfunction Related to Kratom Ingestion. *ACG Case Rep J.* 2021;8(8):e00647 doi:10.14309/crj.0000000000000647 PMID:34476274 PMCID:PMC8389947
- Sangani V, Sunnoqrot N, Gargis K, Ranabhotu A, Mubasher A, Pokal M. Unusual Presentation of Kratom Overdose With Rhabdomyolysis, Transient Hearing Loss, and Heart Failure. *J Investig Med High Impact Case Rep.* 2021; 9: 23247096211005069. doi:10.1177/23247096211005069 PMID:33764201 PMCID:PMC8767650
- Jasim RK, Hassan Z, Singh D, Boyer E, Gam LH. Characterization of urinary protein profile in regular kratom (*Mitragyna speciosa* korth.) users in Malaysia. *J Addict Dis.* 2022; 40(2):235-46. doi:10.1080/10550887.2021.1981122 PMID:34747343
- Tobarran N, Wolf C, Cumpston KL, Wills BK. Pressure Necrosis Requiring Fasciotomy After Kratom Overdose. *J Addict Med.* 2022; 16(2):252-53. doi:10.1097/ADM.0000000000000873 PMID:34001773
- Maria-Rios JC, Darrabie M, Martin A. Severe Rhabdomyolysis Complicated with Compartment Syndrome Likely Associated to Recent Kratom Use. *Am J Respir Crit Care Med.* 2022; 205: A1578. doi:10.1164/ajrccm-conference.2022.205.1\_MeetingAbstracts.A1578
- Torres-Ortiz A, Al Zein S, Alqudsi M. A Case of Hyperkalemia

- Induced by Kratom (*Mitragyna speciosa*). *Cureus*. 2022; 14 (4): e24036. doi:10.7759/cureus.24036
21. Eggleston W, Stoppacher R, Suen K, Marraffa JM, Nelson LS. Kratom Use and Toxicities in the United States. *Pharmacotherapy*. 2019;39(7):775-77. doi:10.1002/phar.2280 PMID:31099038
  22. Post S, Spiller HA, Chounthirath T, Smith GA. Kratom exposures reported to United States poison control centers: 2011-2017. *Clin Toxicol (Phila)*. 2019;57(10):847-54. doi:10.1080/15563650.2019.1569236 PMID:30786220
  23. Davidson C, Cao D, King T, Weiss ST, Wongvisavakorn S, Ratprasert N, et al. A comparative analysis of kratom exposure cases in Thailand and the United States from 2010-2017. *Am J Drug Alcohol Abus*. 2021;47(1):74-83 doi:10.1080/00952990.2020.1836185 PMID:33232183
  24. Leong Bin Abdullah MFI, Singh D. The Adverse Cardiovascular Effects and Cardiotoxicity of Kratom (*Mitragyna speciosa* Korth.): A Comprehensive Review. *Front Pharmacol*. 2021; 12: 726003. doi:10.3389/fphar.2021.726003 PMID:34646135 PMCid:PMC8504575
  25. Abdullah HMA, Haq I, Lamfers R. Cardiac arrest in a young healthy male patient secondary to kratom ingestion: is this 'legal high' substance more dangerous than initially thought? *BMJ Case Rep*. 2019;12(7):e229778. doi:10.1136/bcr-2019-229778 PMID:31326902 PMCid:PMC6663180
  26. Wolfer H, Gerona R, Blumenberg A. Evidence of a potential mechanism for Kratom-related cardiac arrest. *Clin Toxicol (Phila)*. 2020;58(8):851-52. doi:10.1080/15563650.2019.1687907 PMID:31718341
  27. Sheikh M, Ahmed N, Gandhi H, Chen O. Report of ventricular fibrillation in a 44-year-old man using kratom. *BMJ Case Rep*. 2021;14(3):e237837. doi:10.1136/bcr-2020-237837 PMID:33758039 PMCid:PMC7993157
  28. Demick DS, Lee TT, Summers AT, El-Mallakh RS. Kratom: A growing substance of abuse in the United States. *Ann Clin Psychiatry*. 2020;32(4):275-80. doi:10.12788/acp.0012 PMID:32722734
  29. Burke DJ, Mahonski SG, Van Cott AC. Breakthrough Seizure Associated With Kratom Use in Patients With Epilepsy. *Neurol Clin Pract*. 2021;11(1):78-84 doi:10.1212/CPJ.0000000000000846 PMID:33968476 PMCid:PMC8101317
  30. Halim SA, Low JH, Chee YC, Alias MR. Seizures among young adults consuming kratom beverages in Malaysia: A case series. *Epilepsy Behav*. 2021;121(Pt A):108057. doi:10.1016/j.yebeh.2021.108057 PMID:34052638
  31. Zuberi M, Guru PK, Bansal V, Diaz-Gomez J, Grieninger B, Alejos D. Undifferentiated Shock and Extreme Elevation of Procalcitonin Related to Kratom Use. *Indian J Crit Care Med*. 2019;23(5):239-41. doi:10.5005/jp-journals-10071-23170 PMID:31160844 PMCid:PMC6535991
  32. Singh V, Mulla N, Wilson JL, Umansky A, Lee J, Stead T, et al. Intractable nausea and vomiting in naïve ingestion of kratom for analgesia. *Int J Emerg Med*. 2020;13(1):42. doi:10.1186/s12245-020-00301-0 PMID:32758124 PMCid:PMC7409412
  33. Stanciu CN, Gnanasegaram SA, Ahmed S, Penders T. Kratom Withdrawal: A Systematic Review with Case Series. *J Psychoactive Drugs*. 2019;51(1):12-8 doi:10.1080/02791072.2018.1562133 PMID:30614408
  34. Wright ME, Ginsberg C, Parkison AM, Dubose M, Sherbondy M, Shores E. Outcomes of mothers and newborns to prenatal exposure to kratom: a systematic review. *J Perinatol*. 2021;41 (6): 1236-43. doi:10.1038/s41372-021-00952-8 PMID:33589723 PMCid:PMC8225511
  35. Smith KE, Dunn KE, Rogers JM, Garcia-Romeu A, Strickland JC, Epstein DH. Assessment of Kratom Use Disorder and Withdrawal Among an Online Convenience Sample of US Adults. *J Addict Med*. 2022 doi:10.1097/ADM.0000000000000986 PMID:35220331 PMCid:PMC9402806
  36. Jittasopa W, Srisont S. The Causes of Death and Pathological Findings of Kratom Users: A 5-Year Retrospective Analysis. *Am J Forensic Med Pathol*. 2021;42(4):335-40. doi:10.1097/PAF.0000000000000691 PMID:34054017
  37. Nsubuga J, Baugher J, Dahl E, Schwensohn C, Blessington T, Aguillon R, et al. Multistate Outbreak Investigation of Salmonella Infections Linked to Kratom: A Focus on Traceback, Laboratory, and Regulatory Activities. *J Food Prot*. 2022;85(5): 747-54. doi:10.4315/JFP-21-319 PMID:35114689
  38. Prozialeck WC, Edwards JR, Lamar PC, Plotkin BJ, Sigar IM, Grundmann O, et al. Evaluation of the Mitragynine Content, Levels of Toxic Metals and the Presence of Microbes in Kratom Products Purchased in the Western Suburbs of Chicago. *Int J Environ Res Public Health*. 2020;17(15):5512 doi:10.3390/ijerph17155512 PMID:32751712 PMCid:PMC7432033
  39. Prozialeck W, Fowler A, Edwards J. Public Health Implications and Possible Sources of Lead (Pb) as a Contaminant of Poorly Regulated Kratom Products in the United States. *Toxics*. 2022; 10 (7):398. doi:10.3390/toxics10070398 PMID:35878303 PMCid:PMC9320411
  40. Sekar A, Velani S, Katzman S, O'Donnell M, Conway KS. Suspected Fanconi syndrome from cadmium toxicity exacerbated by heavy kratom use. A rare occurrence. *Clin Toxicol (Phila)*. 2022;60(7):888-89 doi:10.1080/15563650.2022.2046774 PMID:35323068
  41. Fleming J, Poklis J, Peace MR, Alves EA. The Analysis of Commercially Available Kratom Products in Richmond, Virginia. *Graduate Research Posters 2022*. Poster 142. Available at: <https://scholarscompass.vcu.edu/gradposters/142/>
  42. U.S. Food and Drug Administration (FDA). FDA announces seizure of adulterated dietary supplements containing kratom. May 21, 2021. Available at: <https://www.fda.gov/news-events/press-announcements/fda-announces-seizure-adulterated-dietary-supplements-containing-kratom>
  43. Commission on Narcotic Drugs. Summary of assessments, findings, and recommendations of the 44th World Health Organization's (WHO) Expert Committee on Drug Dependence (ECDD), 11-15 October 2021. E/CN.7/2021/CRP.12. December 2021. Available at: [https://www.unodc.org/documents/commissions/CND/CND\\_Sessions/CND\\_64Reconvened/ECN72021\\_CRP12\\_V2108992.pdf](https://www.unodc.org/documents/commissions/CND/CND_Sessions/CND_64Reconvened/ECN72021_CRP12_V2108992.pdf)
  44. Lautenschlager F, Weiss M, Feuerer S, Wodarz N. Kratom - eine kurze Übersicht für die Schmerzmedizin [Kratom - a short review for pain medicine]. *Schmerz*. 2022;36(2):128-34. doi:10.1007/s00482-021-00588-9 PMID:34533652 PMCid:PMC8447806

**Cite this article as:**

Hofmeister M. Kratom consumption can be addictive and have adverse health effects. *Novel Clin Med*. 2022; 1(4):168-172. doi: 10.22034/NCM.2022.350622.1050