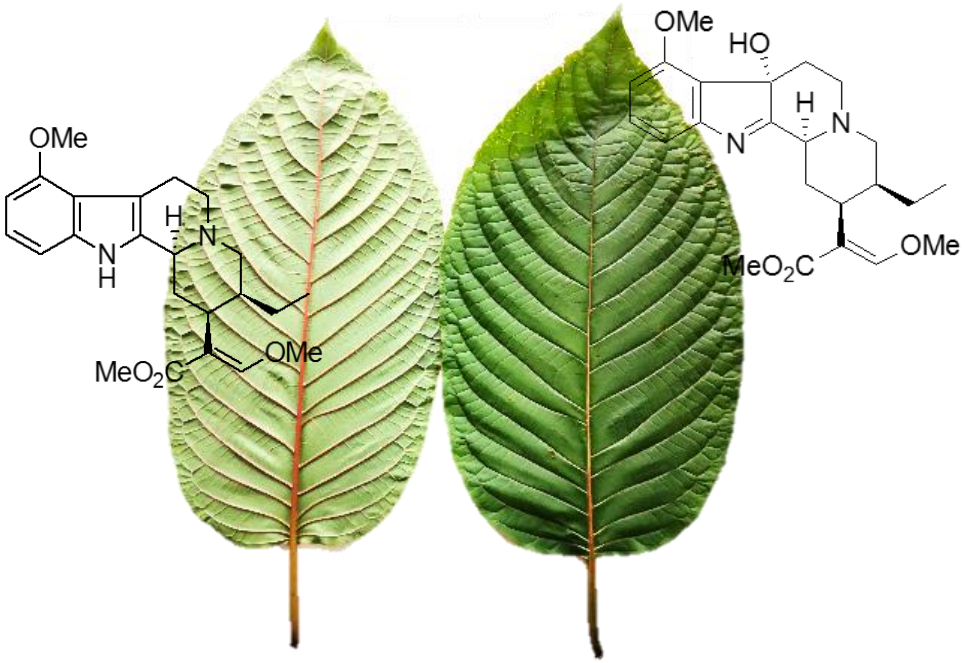
Pharmaceutical Sciences

JW Kratom Rx



รศ.ดร.ภญ.จุไรทิพย์ หวังสินทวีกุล

สาขาวิชาเภสัชเวทและเภสัชพฤกษศาสตร์

คณะเภสัชศาสตร์

มหาวิทยาลัยสงขลานครินทร์

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KRATOM COMPOUND ANALYSIS

and the importance of reference material

29th October 2021 | 1:00 P.M. - 3:00 P.M. | Zoom Platform

การบรรยายในหัวข้อ

- การเลือกใช้สารมาตราฐานสำหรับงานการวิเคราะห์สารสำคัญในกระท่อม
- การเตรียมตัวอย่าง การสกัดสารสำคัญในพืชกระท่อม และการวิเคราะห์สารสำคัญในพืชกระท่อม

speaker

Assoc. Prof. Juraithip Wungsintaweekul

Faculty of Pharmaceutical Sciences,

Prince of Songkla University

scan to register

พฤกษเคมีของกระท่อม และ วิธีวิเคราะห์

- สายพันธุ์ของกระท่อม
- ลักษณะทางมหภาค และ ลักษณะทางจุลภาค
- สารเคมีที่พบ (primary & secondary metabolites)
- การตรวจกระท่อมด้วยวิธีทางเคมี
  - ❑ Thin Layer Chromatography
  - ❑ High Performance Liquid Chromatography

สุพัตรา ลิ่มสุวรรณโชติ และ จุไรทิพย์ หวังสินทวีกุล (2562) การตรวจและการวิเคราะห์สารสำคัญในพืชกระท่อม ในเอกสารวิชาการ พืชกระท่อม: การใช้ประโยชน์จากองค์ความรู้ชุมชนและงานวิจัยเกี่ยวกับพืชกระท่อม เพื่อกำหนดนโยบายการแก้ไขปัญหาพืชกระท่อมของประเทศไทย. สถาบันสำรวจและติดตามการปลูกพืชเสพติด สำนักงาน ป.ป.ส.

Mitragyna spp. distribute in India, S.E.Asia and Africa

- 7 Species found in Asia
  - *Mitragyna speciosa* (Korth.)Havil.
  - *M. tubulosa* (Arn.)Havil.
  - *M. parvifolia* (Roxb.)Korth.
  - *M. hirsuta* Havil.
  - *M. diversifolia* (Wall ex G.Don)Havil.
  - *M. rotundifolia* (Roxb.)O. Kuntz.
  - *M. javanica* Koord. & Valeton.
- 3 Species found in West Africa
  - *M. inermis* (Willd.) O. Kuntze
  - *M. ciliata* Aubrev. and Pellegr.
  - *M. stipulosa* (D.C.) O. Kuntze
- 1 species found in East Africa
  - *M. rubrostipulata* Havil.

Source: https://de.wikipedia.org/wiki/Mitragyna_inermis

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Gong et al. (2012) Phytopharmacology 3(2):263-272

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Botanical characteristics of kratom

What Are The Different Types of Kratom?

What is a strain?

Whereas a species is a genetically unique plant with its own species name, a strain refers to the offspring of a plant **that shares the same genetic makeup but differences in physical or chemical profiles**. All kratom is the same species (*Mitragyna speciosa*), but there are many different *strains* within that species — such as Red Kali, Green Hulu, White Dragon, and many more.

There are three main categories for the different kratom strains based on the **color of the leaf** veins — red, white, and green.

While there's a lot of variability within each category, it serves as a fairly reliable way of cataloging the different effects we can expect from each leaf type.

ที่มา: Kratom.org

KRATOM ONLINE

http://kratomonline.org/

KRATOM GUIDE

MAENG DA | BORNEO | VIETNAM | MALAY | RED THAI | RED BALI | INDO | 15X EXTRACT

MORE STIMULATING — MORE RELAXING

Red Bali Kratom

Stimulating:
Mood Enhancing:
Pain Relieving:

VIEW PRICES →

Maeng Da Kratom

Stimulating:
Mood Enhancing:
Pain Relieving:

VIEW PRICES →

Red Thai Kratom

Stimulating:
Mood Enhancing:
Pain Relieving:

VIEW PRICES →

Green Malay Kratom

Stimulating:
Mood Enhancing:
Pain Relieving:

Ultra E. Indo Kratom

Stimulating:
Mood Enhancing:
Pain Relieving:

15X Kratom Extract

Stimulating:
Mood Enhancing:
Pain Relieving:

Kratom Powders

Maeng Da Kratom

VIEW PRICES →

Red Thai Kratom

VIEW PRICES →

Red Bali Kratom

VIEW PRICES →

Green Malay Kratom

VIEW PRICES →

Green Borneo Kratom

VIEW PRICES →

White Borneo Kratom

VIEW PRICES →

Premium Indo Kratom

VIEW PRICES →

Ultra Enhanced Indo

VIEW PRICES →

KRATOM

SHOP NOW

Kratom Strains: Red, Green & White Vein Kratom

There are many different *types* of kratom — which are referred to as *strains*. Each strain has a different set of effects — some are powerful sedatives and painkillers; others are better for boosting mood or energy.

Kratom Strains Chart

Source: http://kratom.org

Name	Energy	Mood	Pain Relief	Sedation	Anxiety-Relief
Red Thai Kratom	4	2	6	10	8
Green Sumatra Kratom	6	6	5	4	6
Green Thai Kratom	7	6	5	6	5
White Sumatra Kratom	9	9	4	1	6
White Thai Kratom	4	6	4	3	6

Kratom *Mitragyna speciosa* (Korth.)Havil.

Rubiaceae

Red-veined kratom

Green-veined kratom

Green-veined kratom:: Serrate apex

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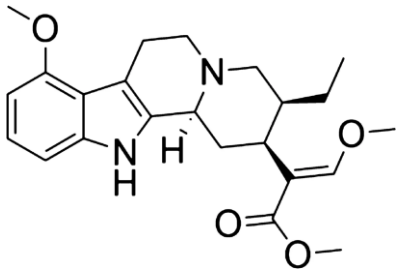
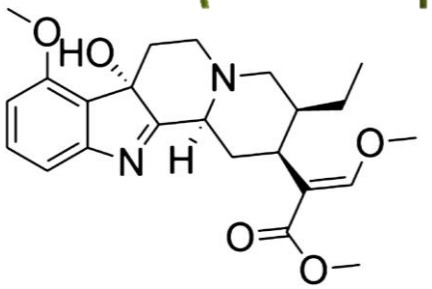
Source: Namphu subdistrict; Bannasarn district; Suratthani

พืชกระท่อม *Mitragyna speciosa* (Korth.) Havil. [Rubiaceae]

ก้านแดง
ก้านเขียว
แตงกวา
แมงดา
หางกั้ง
ยักษ์ใหญ่
เหรียญทอง
โพธิ์ทอง
ขาวปทุม



mitragynine



7α-hydroxy-*7H*-mitragynine

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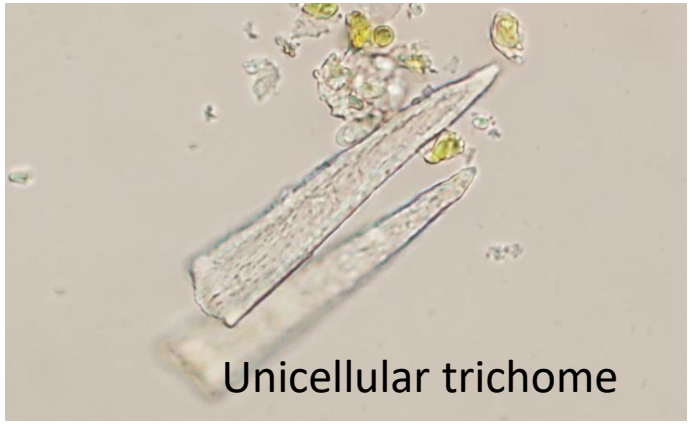
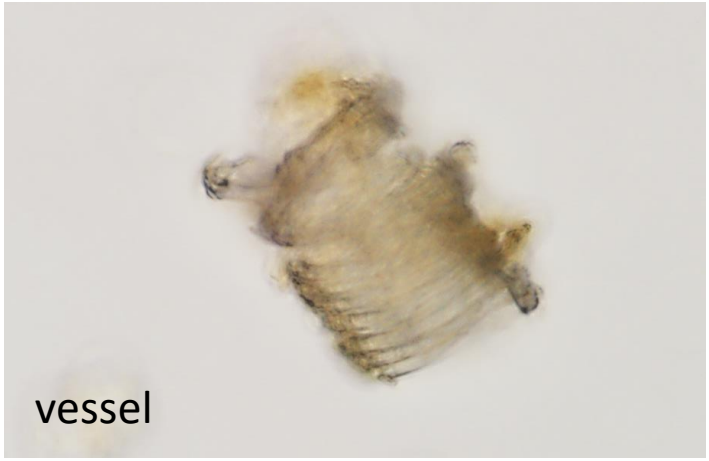
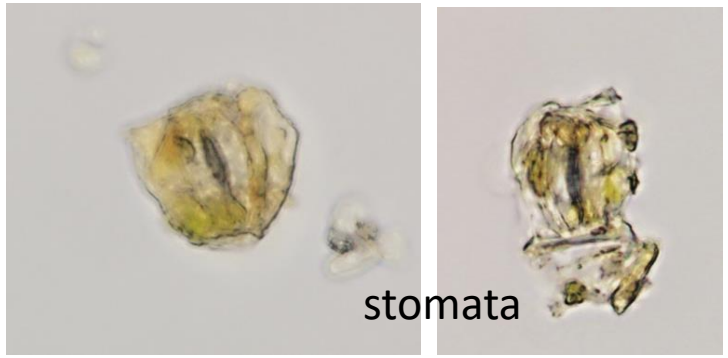
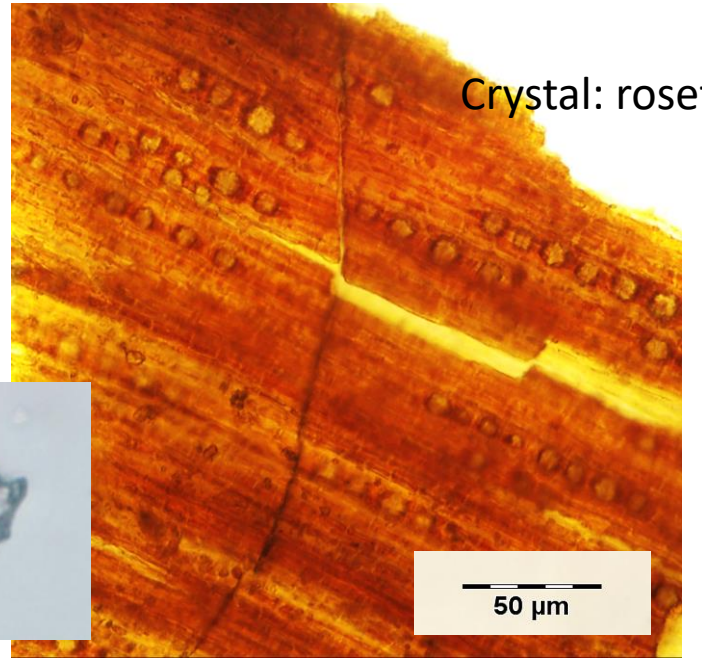
ลักษณะทางจุลภาค: ตรวจสอบลักษณะเซลล์ภายใต้กล้องจุลทรรศน์

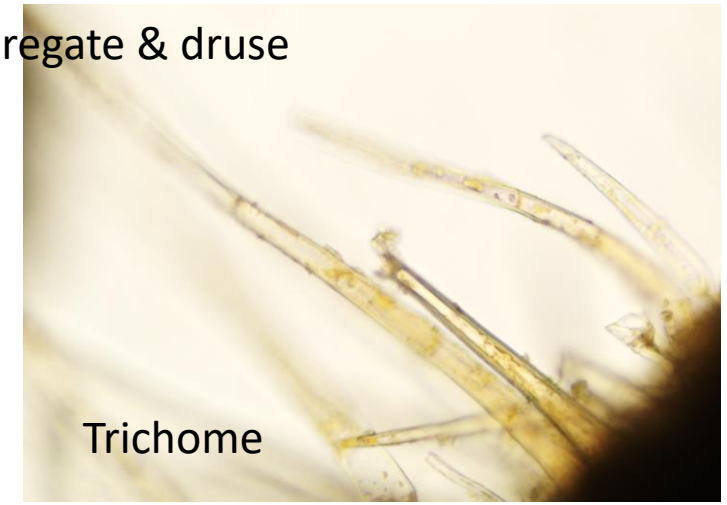
ก้านแดง

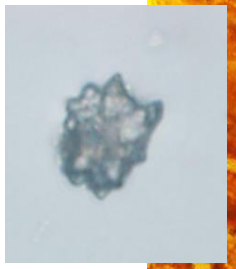












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Credit: Dr. Tidarat PUANGPAIROTE

องค์ประกอบทางเคมีของกระท่อม

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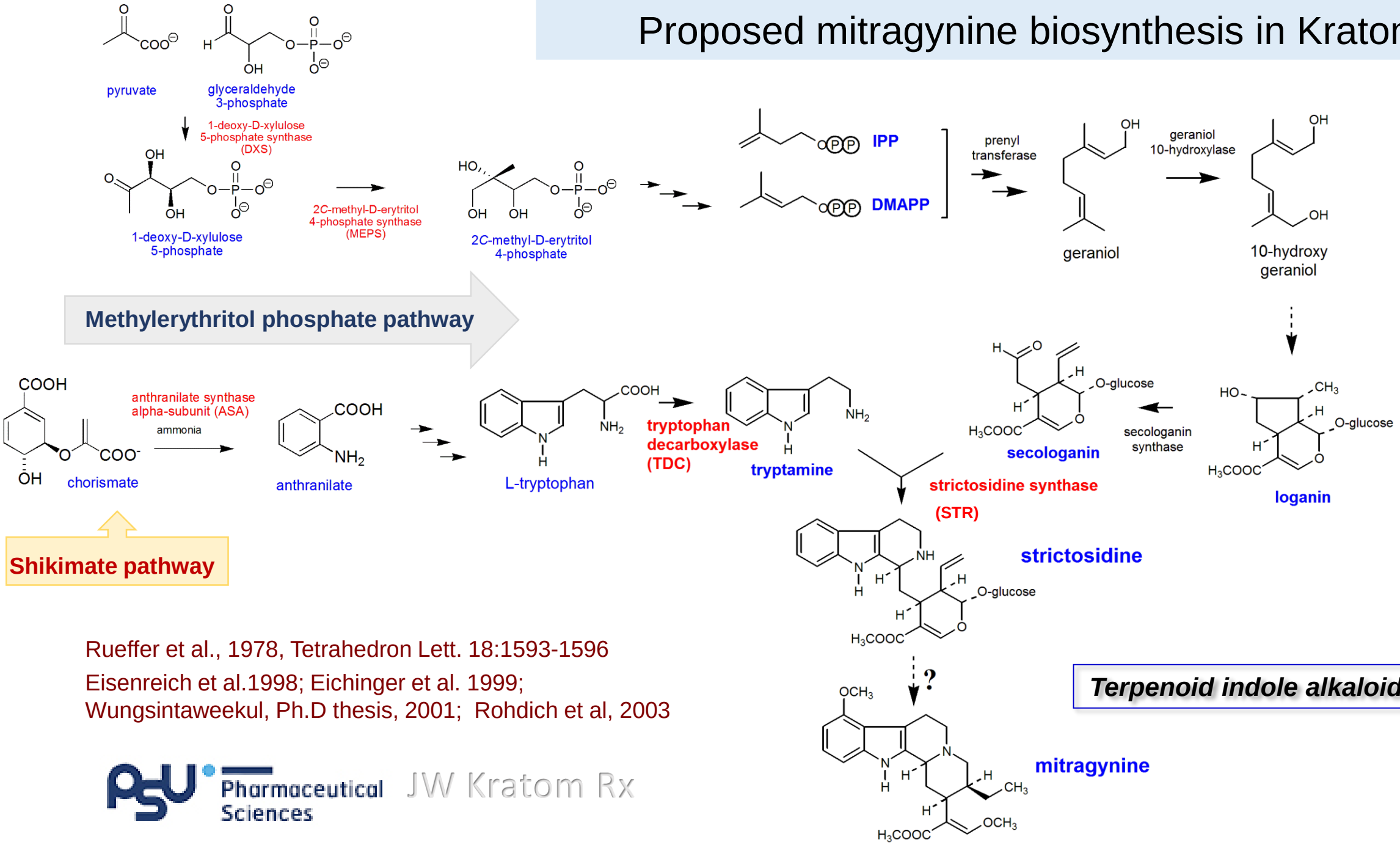
Proposed mitragynine biosynthesis in Kratom



Rueffer et al., 1978, Tetrahedron Lett. 18:1593-1596

Eisenreich et al.1998; Eichinger et al. 1999;
Wungsintaweekul, Ph.D thesis, 2001; Rohdich et al, 2003

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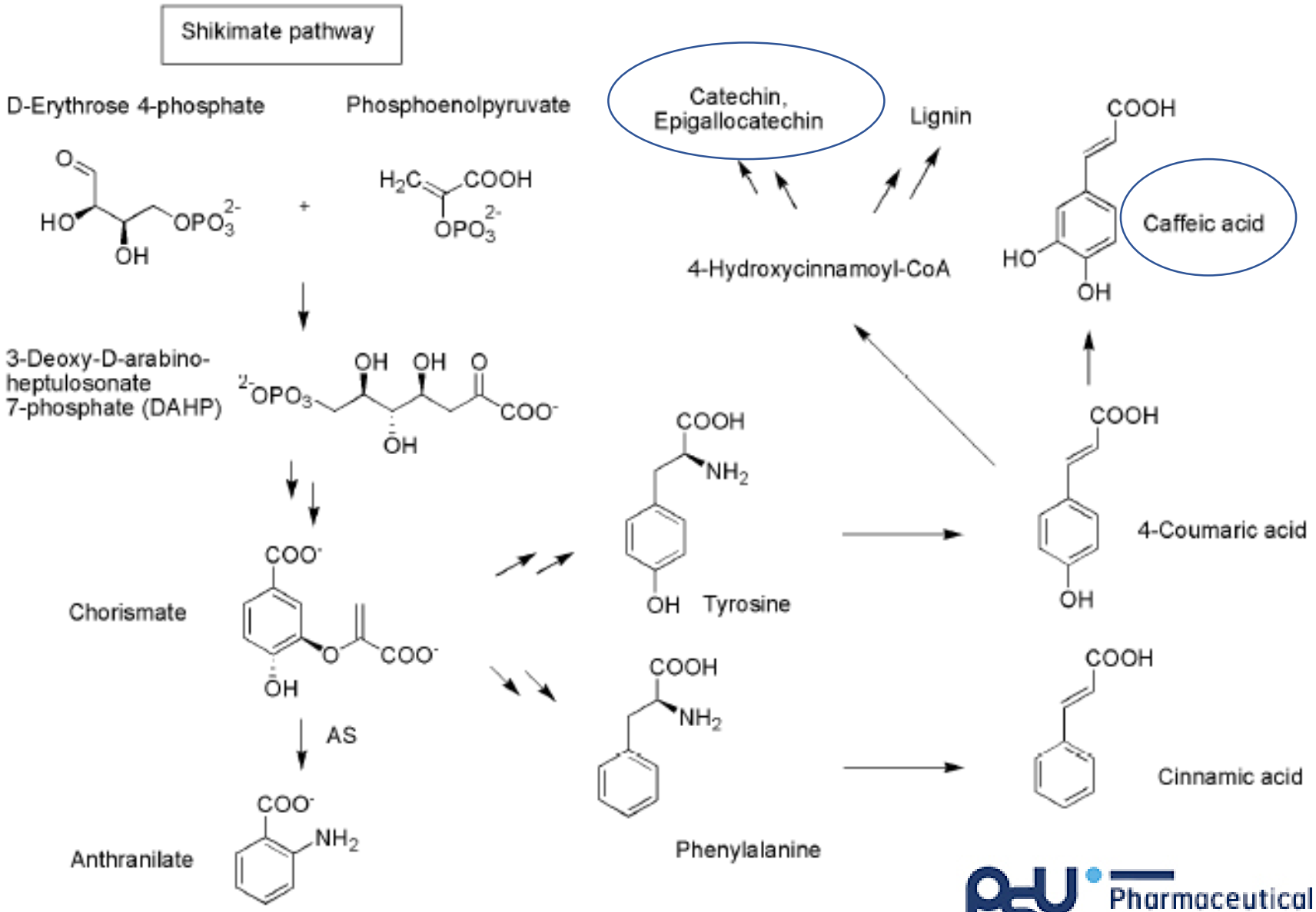

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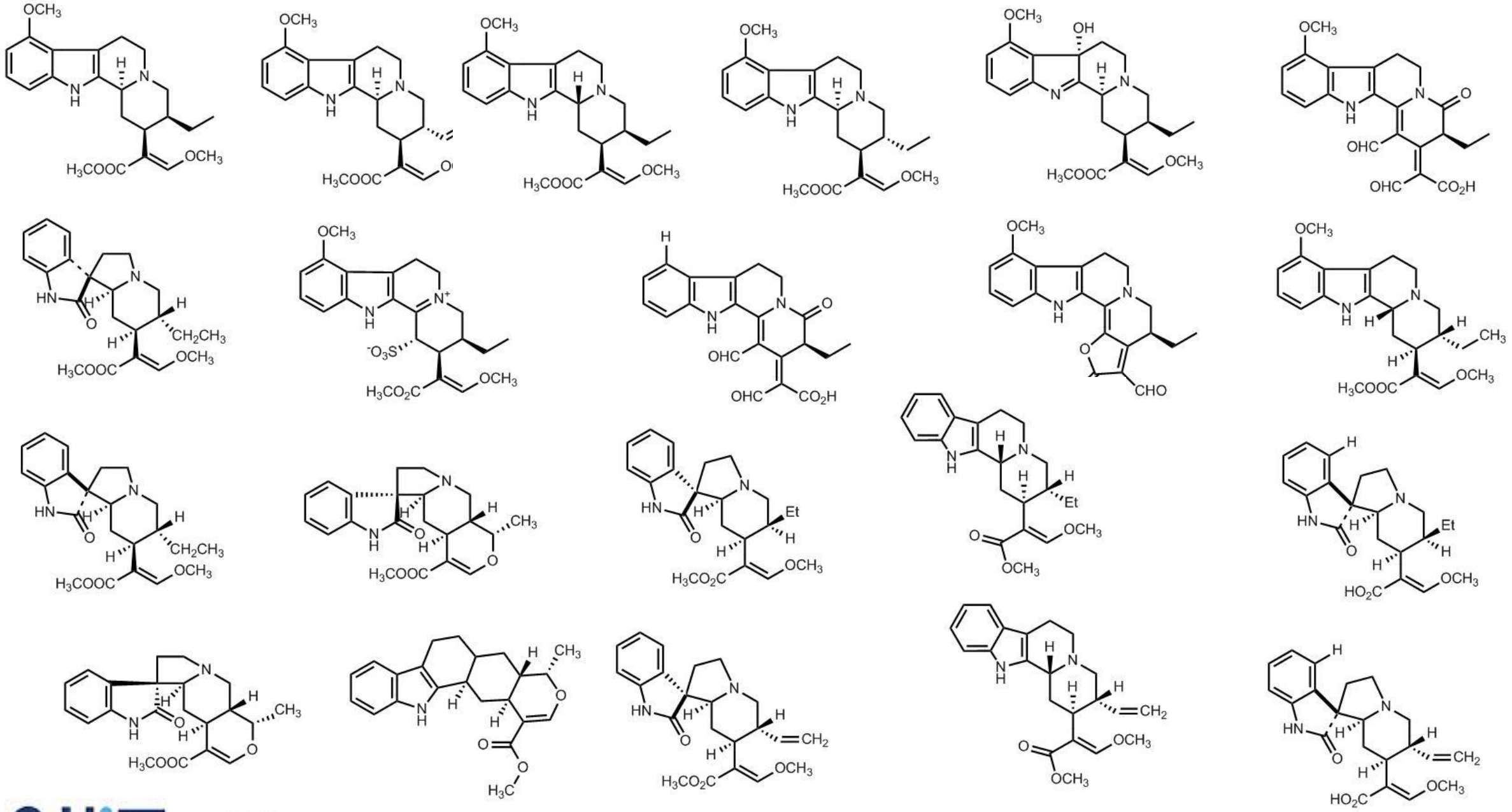
Charoonratana et al. (2013) Z. Naturforsch 68C: 394-405



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Alkaloids found in Kratom leaf and bark

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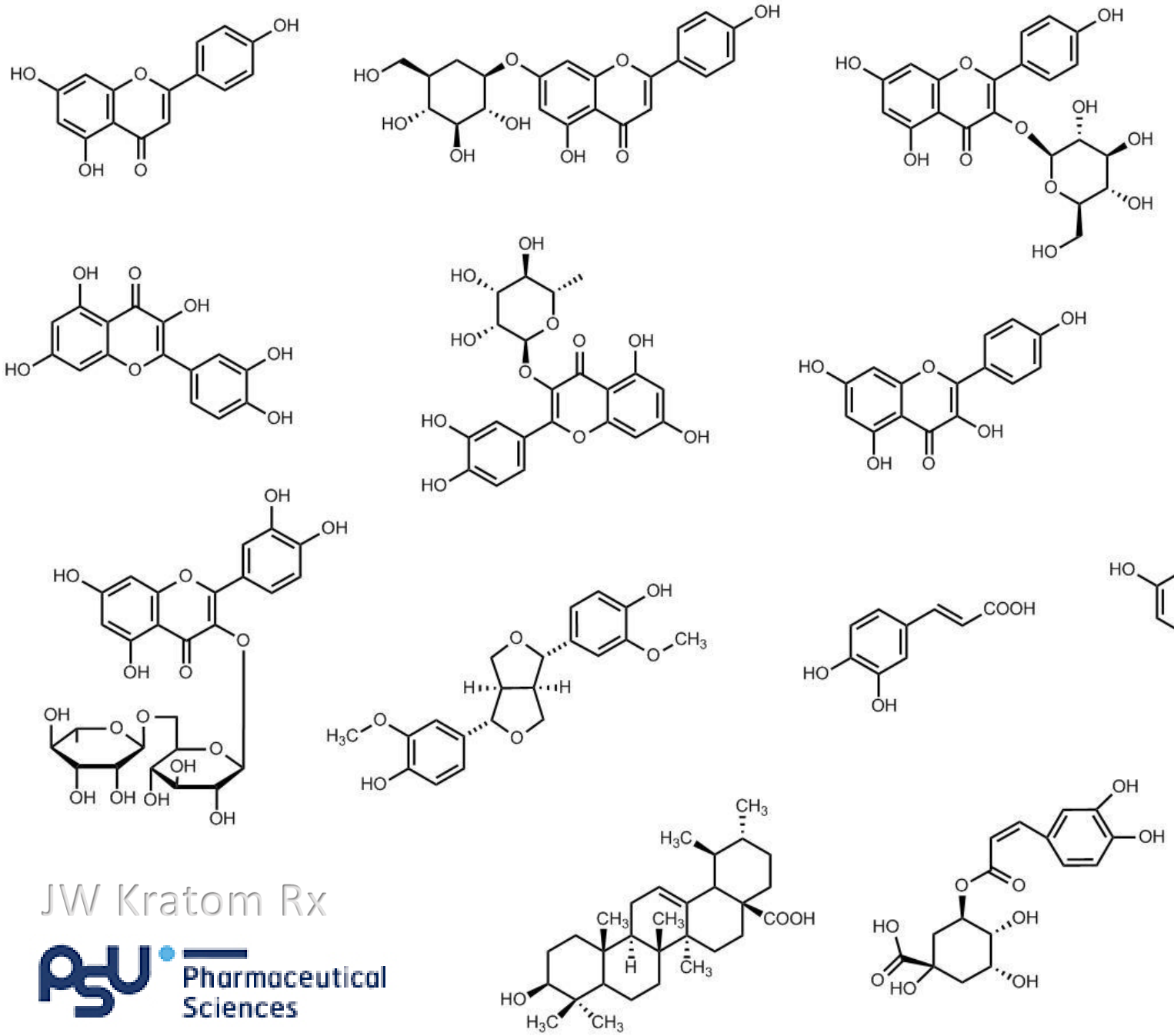

Flavonoids, Tannins, Lignans, Terpenoids in Kratom leaf

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ส่วนของพืช	ชื่อสารเคมี
ใบ	กลุ่มสาร: แอลคาลอยด์ ajmalicine; akuammigine; angustine; corynantheidine; corynantheidaline; corynantheidalinic acid; corynoxeine; corynoxine; corynoxine B; hirsutine; hirsuteine; isocorynoxeine; isomitraphylline; isomitrafoline; isospeciofoline; isorhynchophylline; isocorynantheidine; javaphylline; mitraciliatine; mitrafoline; mitragynalinic acid; mitragynine oxindole mitrajavine; mitraphylline; mitrasulgynine; mitragynaline; mitragynine; mitralactonal; paynantheine; speciociliatine; speciofoline; speciogynine; 3-isoajmalicine; 3,4,5,6-tetradehydromitragynine; 7α-hydroxy-7H-mitragynine; 3-dehydro-mitragynine[4-12] กลุ่มสาร: ฟลาโวนอยด์ apigenin; apigenin-7-O- rhamnoglucoside; astragalin; cosmosiin; hyperoside; kaempferol; quercetin; quercitrin; quercetin-3-galactoside-7-rhamnoside; rutin; (-)-epicatechin[9,13] กลุ่มสาร: เฟนิลโพรพานอยด์ caffeic acid; chlorogenic acid[13] กลุ่มสาร: ลิกแนน (+)-pinoresinol[14] กลุ่มสาร: ไตรเทอร์ปีนอยด์ ursolic acid; oleanolic acid[15]
เปลือกต้น	กลุ่มสาร: แอลคาลอยด์ ciliaphylline; isomitraphylline; isorhynchophylline; isospecionoxeine; javaphylline; mitraciliatine; mitragynine oxindole A; mitragynine oxindole B; mitraphylline; rhynchociline; rhynchophylline; speciogynine; speciociliatine; specionoxeine[7,8]
เปลือกราก	กลุ่มสาร: แอลคาลอยด์ ciliaphylline; corynoxeine; isocorynoxeine; isomitraphylline; isorhynchophylline; isospecionoxeine; mitraciliatine; mitraphylline; rhynchociline; rhynchophylline; speciociliatine; speciogynine; specionoxeine[8,16]
ผล	กลุ่มสาร: แอลคาลอยด์ 7α-hydroxyspeciociliatine[17]
หมักด้วยแบคทีเรีย	กลุ่มสาร: แอลคาลอยด์ mitragynine pseudoindoxyl; hydroxylmitragynine pseudoindoxyl[18]

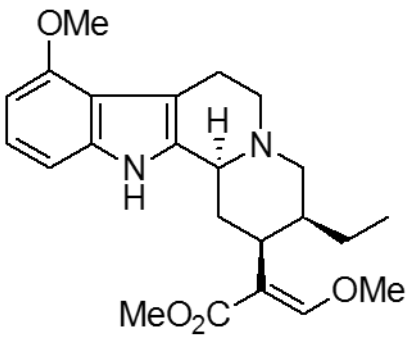
NAPRALERT
[http://www.napralert.org]

จุไรทิพย์ หวังสินทวีกุล และ นิวัติ แก้วประดับ (2562) ชีววิทยา พฤกษเคมี ของพืชกระท่อม. สพส. ป.ป.ส.

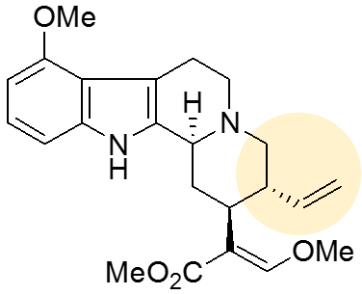
Alkaloid profile of *Mitragyna speciosa* Korth. The percentage is the estimated content in the alkaloid extracts.

Alkaloid	Percentage (%)
Mitragynine	66
Paynantheine	9
Speciogynine	7
7-hydroxymitragynine	2
Speciociliatine	1
Mitraphylline	<1
Isomitraphylline	<1
Speciophylline	<1
Rhynchophylline	<1
Isorhynchophylline	<1
Ajmalicine	<1
Corynantheidine	<1
Corynoxine A	<1
Corynoxine B	<1

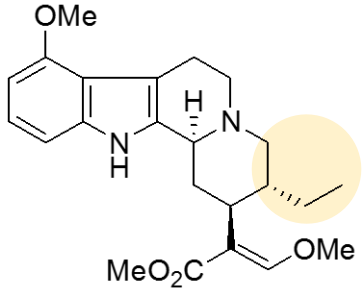
Hassan et al. (2013) Neurosci. Biobehav. Rev. 37(2): 138-151.



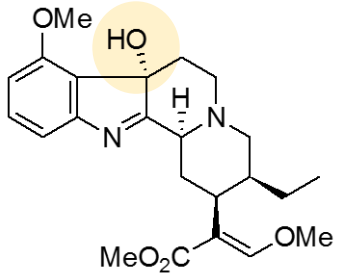
mitragynine



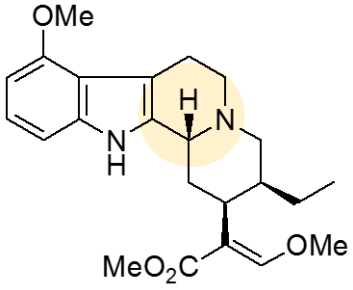
paynantheine



speciogynine



7α-hydroxy-7H-mitragynine



speciociliatine

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IN-HOUSE isolation of mitragynine and other alkaloids

Kratom leaves powder (1.1 kg DW)

↓ macerated with basified MeOH (pH 9)

Crude MeOH extract (198 g)

↓ acid-base extraction

Crude alkaloid extract (7.62 g, 0.7%)

↓ SiO_2 column
Hexane: $CHCl_3$, $CHCl_3$, $CHCl_3$: MeOH

F-1

Sephadex® LH-20

Mitragynine
(2.21 g, 29% dry wt)

F-2

SiO_2 column
Hexane: EtOAc

Semi-preparative HPLC

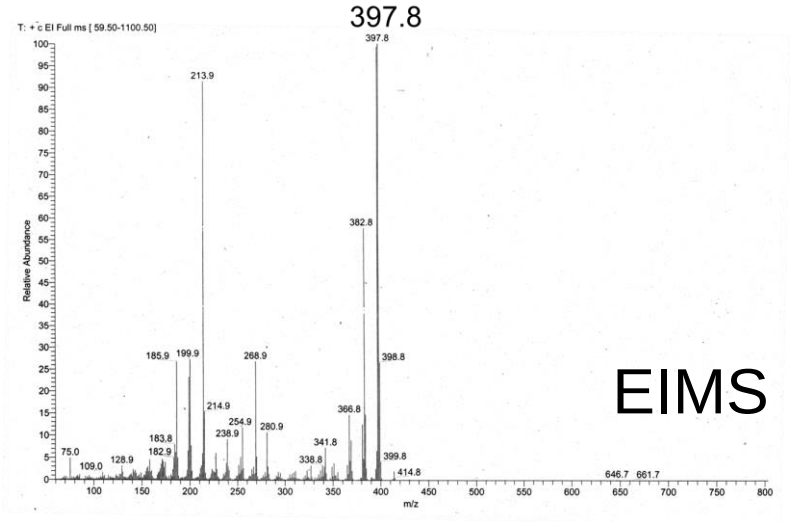
Paynantheine
(20.4 mg, 0.27% dry wt)

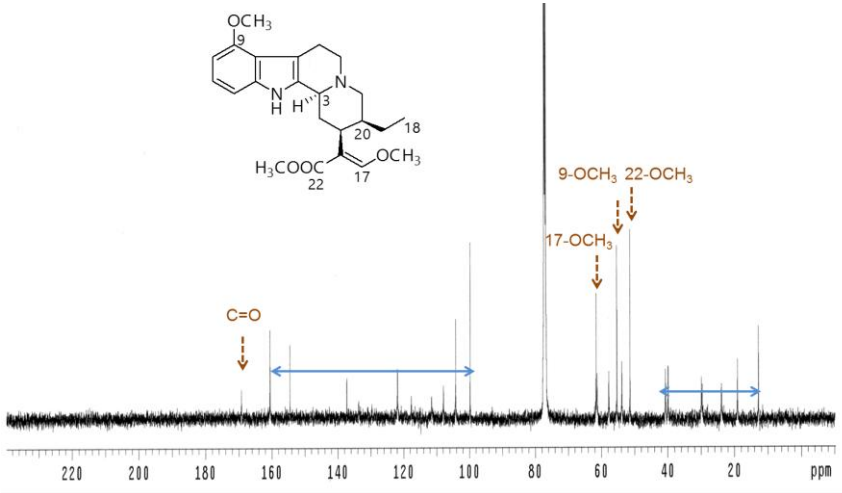
F-3

SiO_2 column
Hexane: EtOAc, EtOAc
EtOAc: MeOH

Speciogynine
(47.9 mg, 0.63% dry wt)

Keawpradub N (1990); Limsuwanchote S (2014)





^{13}C-NMR in $CDCl_3$ (125 MHz)

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JW Kratom Rx

Quantification methods for mitragynine, its metabolites and related alkaloids

Identification of kratom and kratom products
'mitragynine'

- Botanical approach
- Microscopic examination
- Chemical reaction
- Thin layer chromatography
- HPLC/HPLC-DAD/HPLC-UV
- GC/GC-FID/GC-MS
- DNA fingerprint

Determination of mitragynine and related metabolites
'plasma and urine'

- HPLC-UV
- UHPLC-MS-DAD
- LC-MS
- LC-MS-MS
- GC-MS

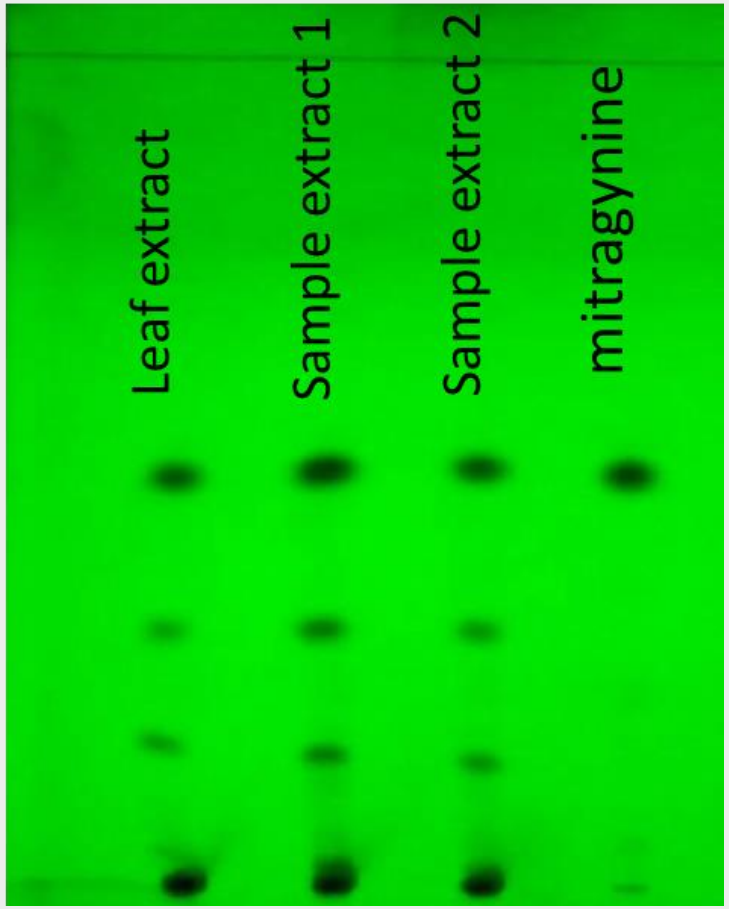
Thin Layer Chromatography: การตรวจสอบสารมิตรากัยนิน

Stationary phase	Mobile phase	Ratio	Spraying reagent	Rf-value	References
Silica gel 60 F254 TLC	$CHCl_3$: MeOH	9:1	iodoplatinate	0.91	Scott et al. 2014
Silica gel HPTLC	EtOAc: hexane	4:1	Dragendorff-H_2SO_4	0.92	Parthasarathy et al. 2009
Silica gel 60 G254 HPTLC	EtOAc: hexane	2:8	Iodine, Dragendorff	0.82	Beng et al. 2011
Silica gel 60 F254 TLC	EtOAc: hexane: 25% NH_3	15:30:1	-	0.49	Kowalczuk et al. 2013
Silica gel 60 F254 TLC	EtOAc: $CHCl_3$	1:1	Fast Black k salt	0.67	วราพงษ์ เสนะวีระกุล และคณะ, 2018
	EtOAc: hexane	4:6	Fast Black k salt	0.59	

การตรวจหาสารมิตรากัยนีนในพืชกระท่อม

ตรวจในพืช

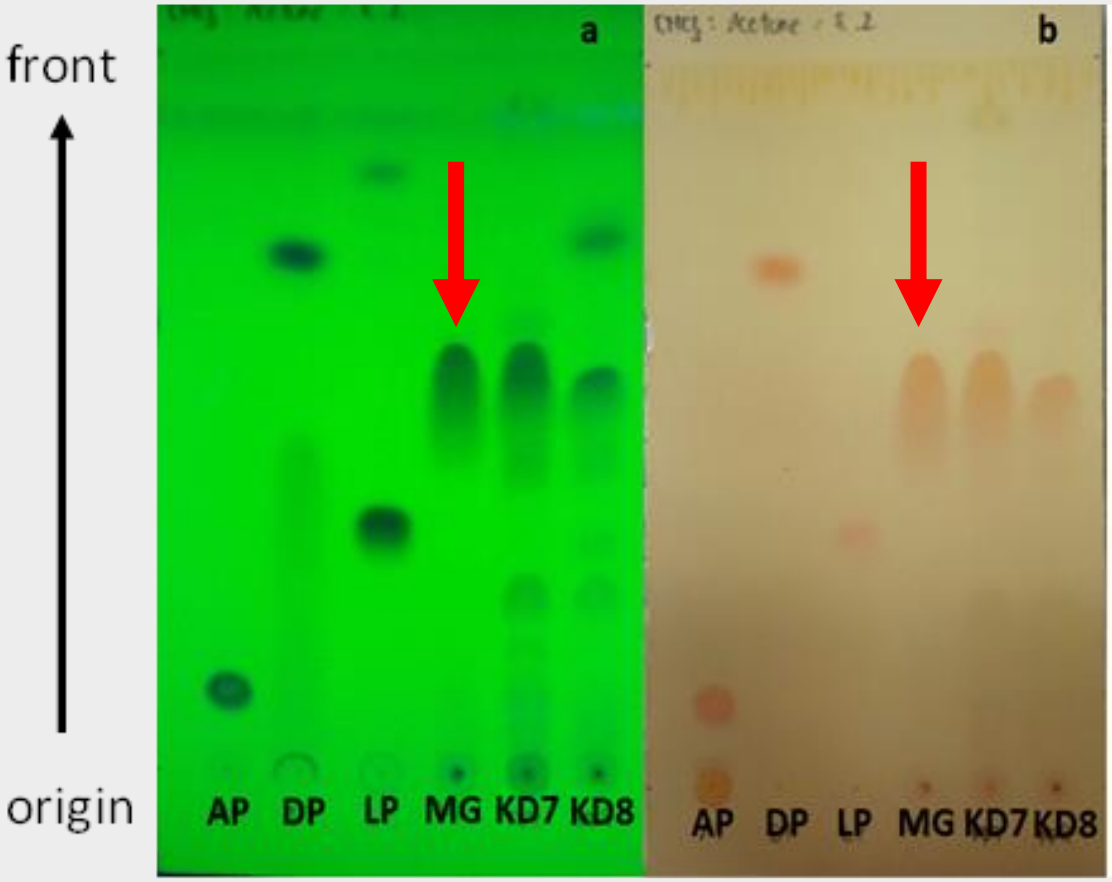
TLC plate: Silica gel GF254



แผ่นรงคเลขผิวบาง

น้ำต้ม 4 x 100

mobile phase: $CHCl_3$: acetone; 8:2



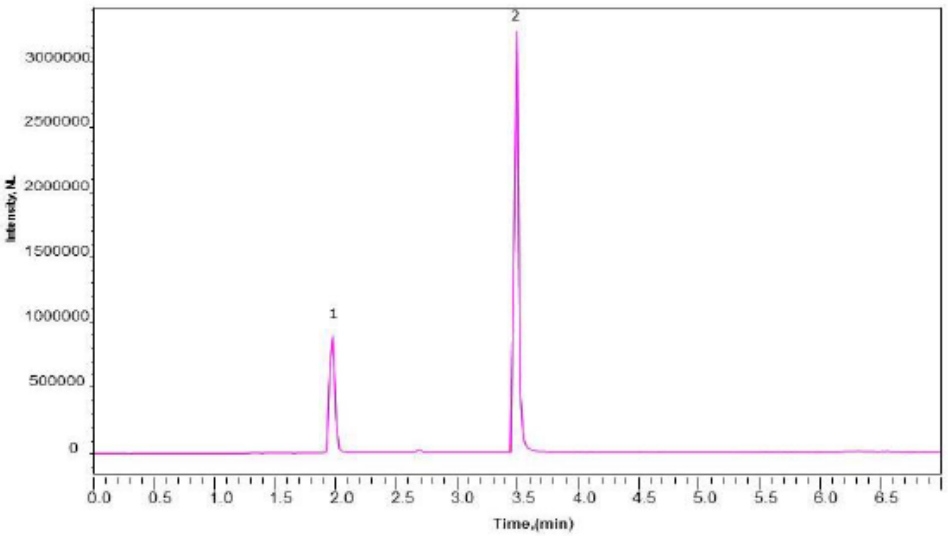
Unpublished result

Quantification of kratom alkaloids using chromatographic methods

Technique	Target alkaloid	Sample/Specimen	Sensitivity	References
HPLC-UV	mitragynine	rat serum	LOD: 0.03 µg/mL LOQ: 0.1 µg/mL	Janchawee et al., 2007
	mitragynine	rat plasma	LOD: 0.025 µg/mL LOQ: 0.050 µg/mL	Parthasarathy et al., 2010
HPLC-DAD	mitragynine	kratom cocktail	LOD: 1.0 µg/mL LOQ: 3.0µg/mL	Chittrakarn et al., 2012
	mitragynine	kratom plant	LOD 0.25 µg/mL LOQ: 0.50 µg/mL	Parthasarathy et al., 2013
LC-MS	mitragynine,	kratom plant	Linearity: 1.0-10.0 µg/mL	Kikura-Hanajiri et
	7-hydroxymitragynine	kratom commercial products	Linearity: 0.01-1 µg/mL	al., 2009
LC-MS-MS	mitragynine	human urine	LOD: 0.02 ng/mL	Lu et al., 2009
			LOQ: 0.1 ng/mL	
	mitragynine	rat plasma	LOQ: 0.2 ng/mL	de Moraes et al., 2009
	mitragynine	human urine	LOD: 2 ng/mL	Arndt et al., 2011
			LOQ: 50 ng/mL	
GC-MS	mitragynine	kratom plant	-	Chan et al., 2005
	mitragynine, paynantheine, speciogynine, speciociliatine	rat plasma and urine	LOD: 100 ng/mL	Philipp et al., 2011
ELISA	mitragynine	Kratom plant	LOD: 32.5 µg/mL LOQ: 32.9 µg/mL	Limsuwanchote et al., 2014

LOD: limit of detection; LOQ: limit of quantification

UHPLC/MS Analysis of Kratom and its Metabolite on Ascentis® Express C18, 2 µm



Peak Number	Compound	Concentration µg/mL
1	7-OH Mitragynine	5
2	Mitragynine	5

Conditions:

column: Ascentis® Express C18, 5 cm x 2.1 mm I.D., 2 µm

mobile phase: [A] Water (0.1% (v/v) Formic Acid) ; [B] Acetonitrile (0.1% (v/v) Formic Acid)

gradient: 10% B to 95% B in 4 min; hold at 95% for 1 min.; 95% B to 10% B in 0.1 min; hold at 10% B for 2 min

flow rate: 0.4 mL/min

column temp.: 25 °C

detector: MSD, ESI-(+)

injection: 2 µL

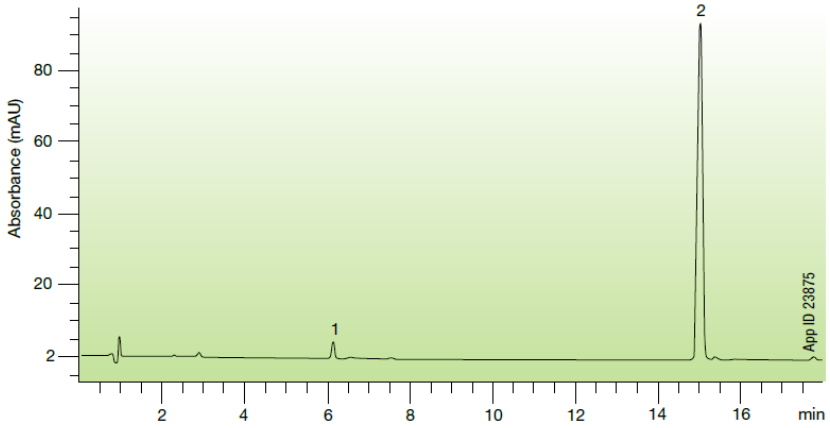
sample: Kratom compounds, varied concentration, 95:5 Acetonitrile:Water

Determination of Mitragynine in *Mitragyna speciosa* Raw Materials and Finished Products by Liquid Chromatography with UV Detection: Single-Laboratory Validation

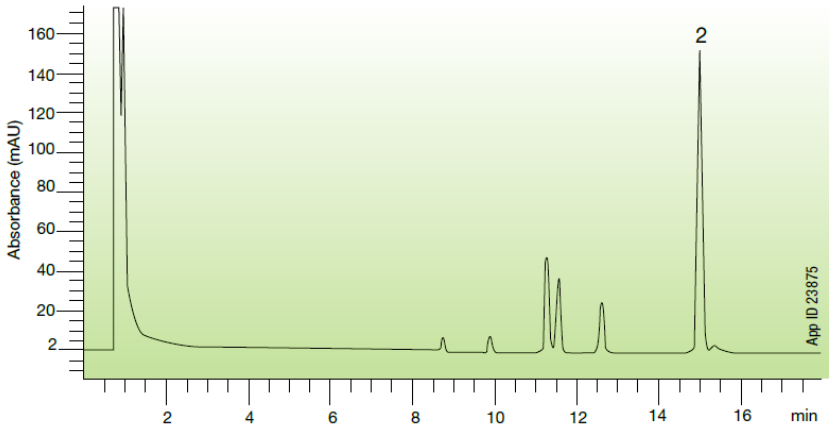
Elizabeth M. Mudge and Paula N. Brown

JOURNAL OF AOAC INTERNATIONAL VOL. 100, NO. 1, 2017

Mitragynine and 7-OH mitragynine alkaloids in a standard mixture[1].



Mitragynine alkaloids in raw materials[1].



Agilent 1200 Series Liquid Chromatograph

HPLC Conditions

(a) *Analytical column.*—Kinetex 5 µm EVO C18 100Å (Phenomenex, Torrance, CA), 150 × 4.6 mm, 5 µm particle size.

(b) *Column temperature.*—25°C.

(c) *Detector conditions.*—Monitor at 226 nm (4 nm bandwidth), no reference.

(d) *Flow rate.*—1.5 mL/min.

(e) *Run time.*—18 min, plus 4 min column re-equilibration time.

(f) *Injection volume.*—5 µL.

(g) *Gradient conditions.*—*See* Table 1.

Kratom compounds analysis: leaves and products

Kikura-Hanajiri et al. (2009) Simultaneous analysis of mitragynine, 7-hydroxymitragynine, and other alkaloids in the psychotropic plant “kratom” (*Mitragyna speciosa*) by LC-ESI-MS. Forensic Toxicology 27:67–74.

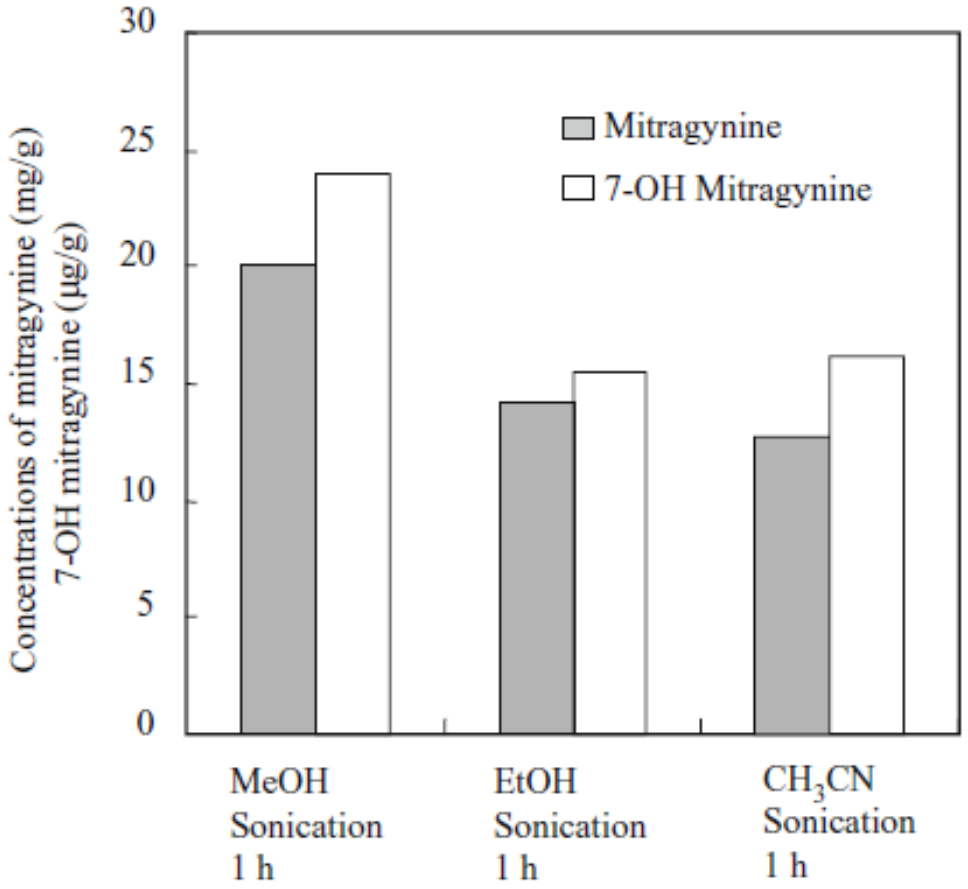


Fig. 3 Concentrations of mitragynine and 7-OH-mitragynine from product No. 4 using different organic solvents for extraction

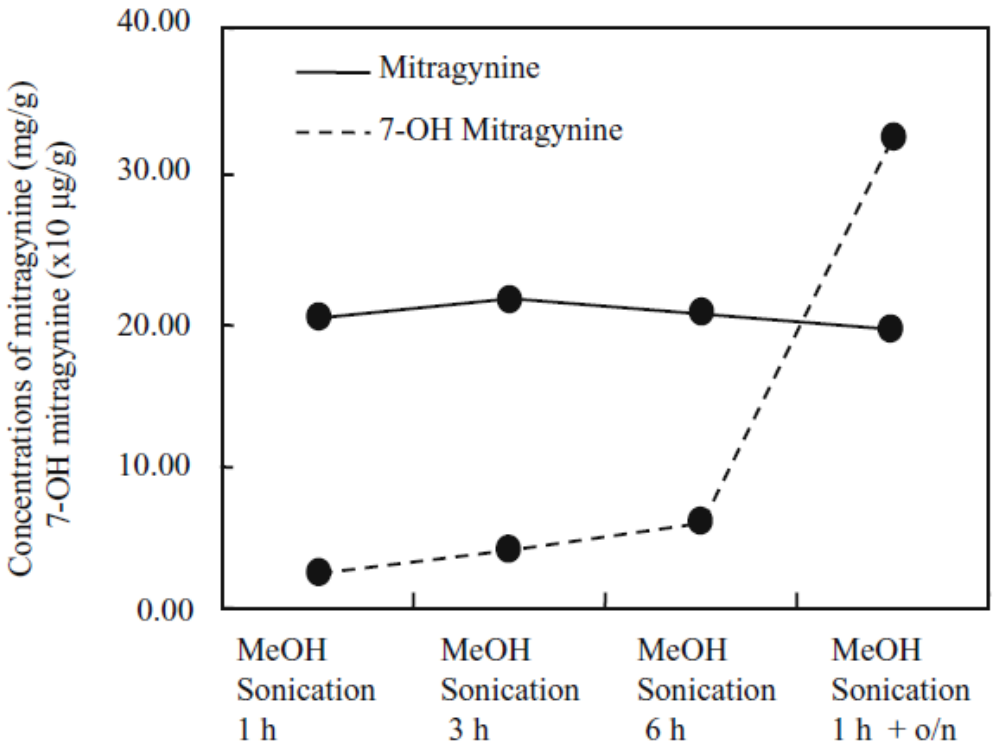


Fig. 4 Concentrations of mitragynine and 7-OH mitragynine from product No. 4 as a function of extraction time using methanol. *o/n*, Overnight storage at room temperature

Powdered sample (10–50 mg) was extracted with 10 ml of 80% methanol aqueous by ultrasonication for 1 h.

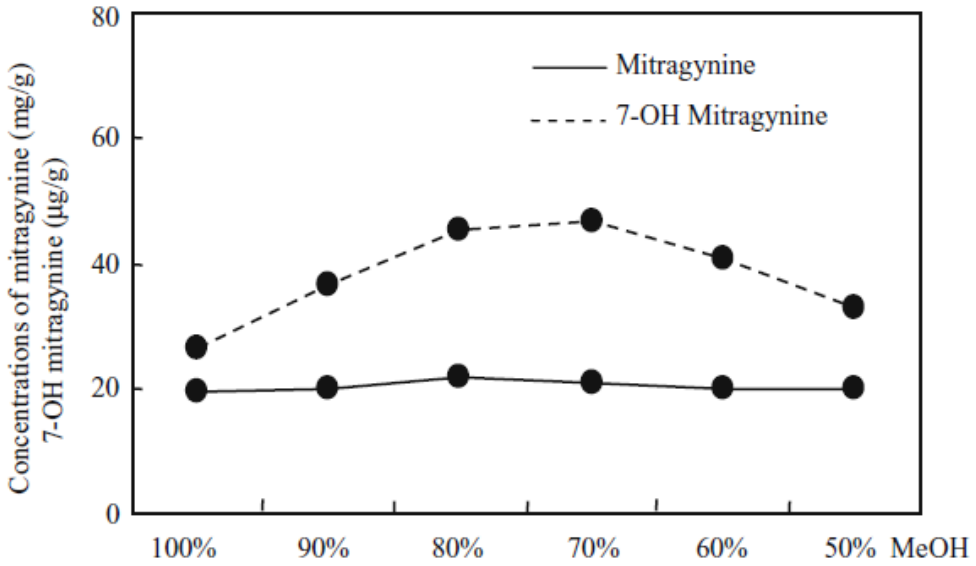


Fig. 5 Concentrations of mitragynine and 7-OH-mitragynine from product No. 4 as a function of different concentrations of methanol for extraction

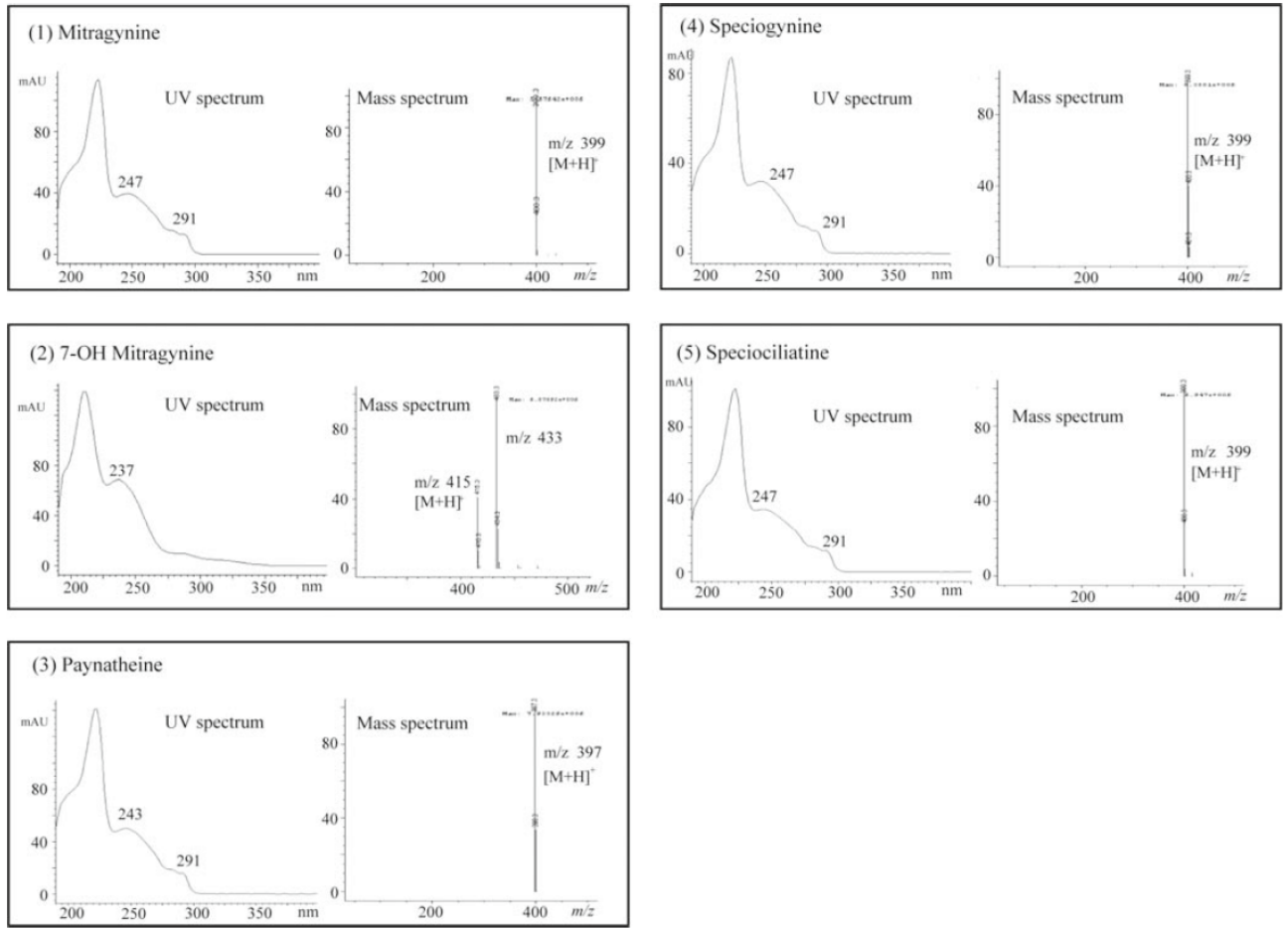


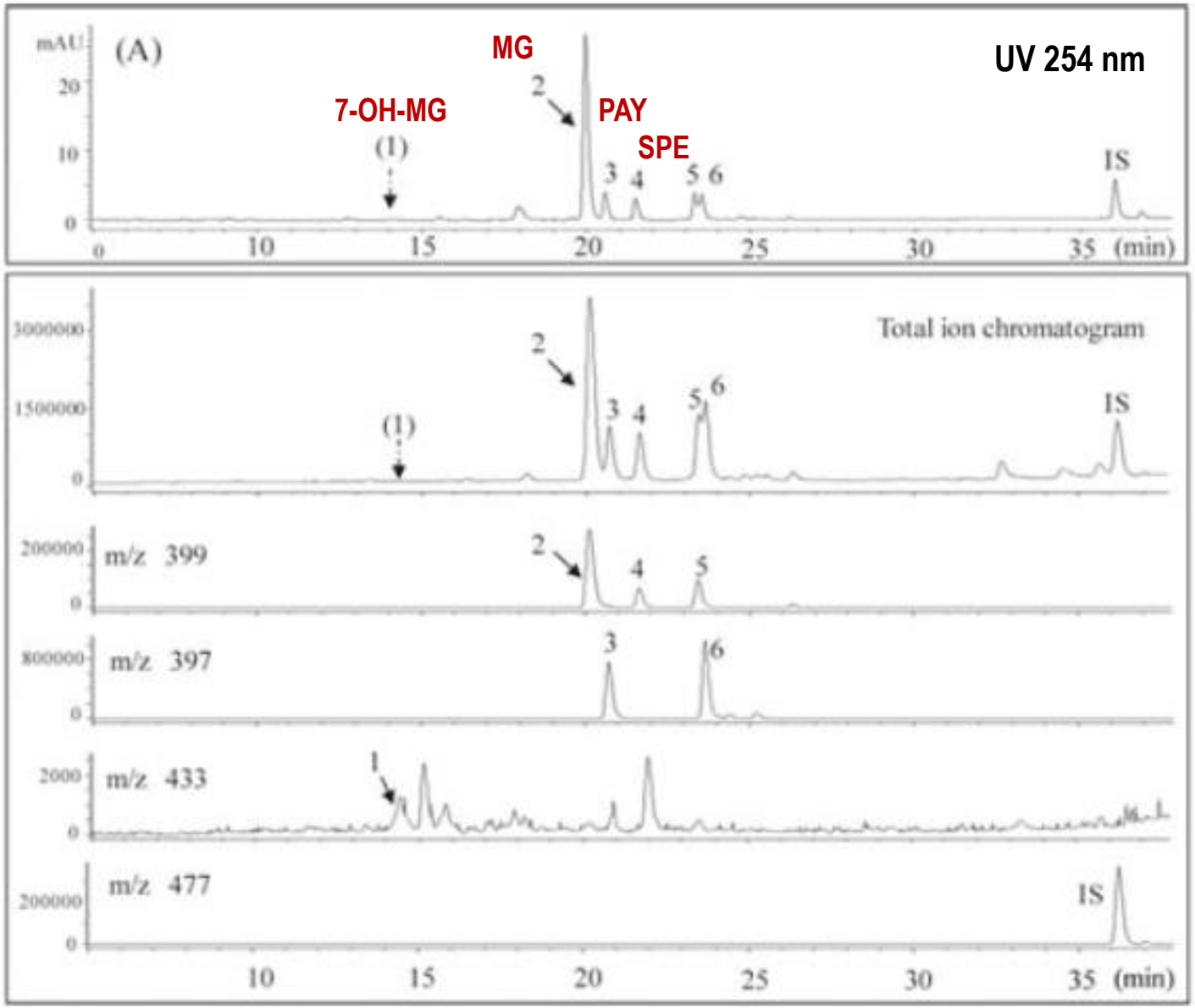
Fig. 2 Ultraviolet (UV) and mass spectra of the standard compounds of five alkaloids in *M. speciosa.* The retention times of mitragynine, 7-OH-mitragynine, paynantheine, speciogynine, and speciociliatine were 19.9, 21.5, 20.5, 19.9, and 23.3 min, respectively

Kikura-Hanajiri et al. (2009) Forensic Toxicology 27:67–74.

Agilent 1100 Series HPLC 1100 Series LC/MSD SL
Column: Atlantis dC18 column at 40°C.
Mobile phase:
A. 10 mM ammonium formate, pH 3.5
B. methanol
Elution: gradient mode;
Total run time 35 min
Injection volume: 1 μL
PDA detector [190-400 nm; 254 nm]

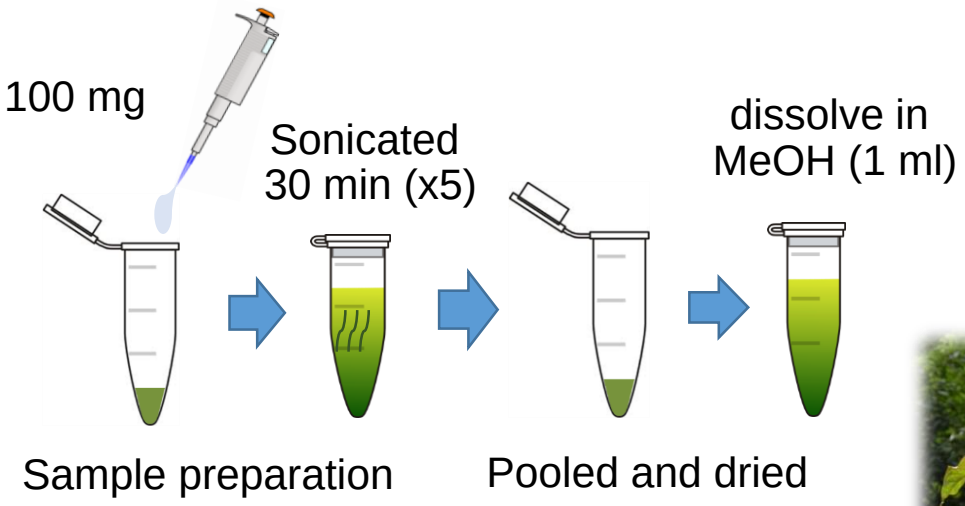
Fig. 6A UV chromatograms, total ion chromatograms, and mass chromatograms of the extracts from
A. a reference raw material of *M. speciosa* (big leaves)
1: 7-OH-mitragynine; 2: mitragynine;
3: paynantheine; 4: speciogynine;
5: speciociliatine; 6: unidentified

Raw material of *M. speciosa* (big leaves)



Kikura-Hanajiri et al. (2009) Forensic Toxicology 27:67–74.

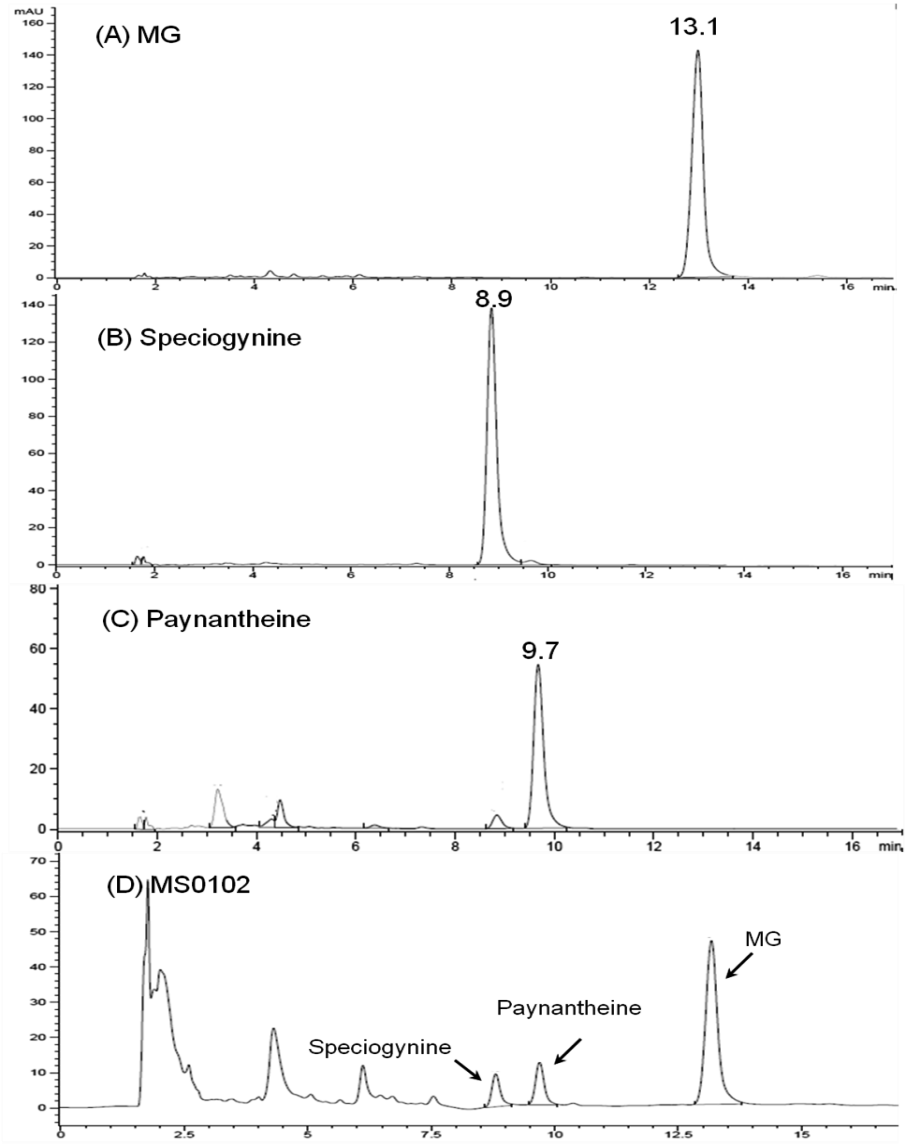
Quantification of MG in kratom leave samples



HPLC Analysis

Model	:	Agilent 1100 series
Detector	:	DAD-detector, 225 nm
Column	:	Verticep™ UPS C_{18} (4.6 x 250 mm, 5 µm)
Mobile phase:		20 mM ammonium acetate (pH 6.0) : ACN (35:65)
Injection volume:		20 µl
Flow rate:		1.0 ml/min

Wungsintaweekul et al. (2012) Biotechnology Letters 34:1945–1950



Pharmaceutical Sciences

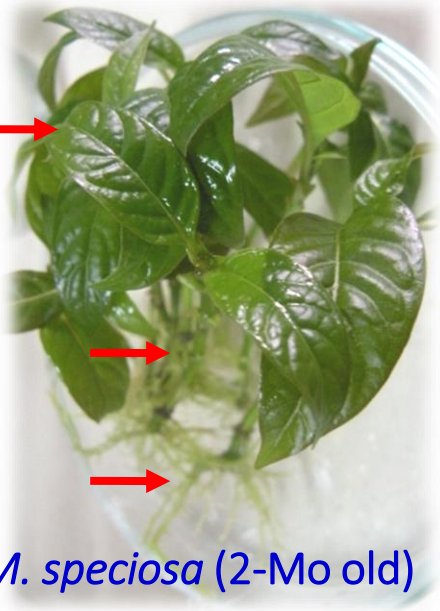
JW Kratom Rx

HPLC - based metabolites analysis

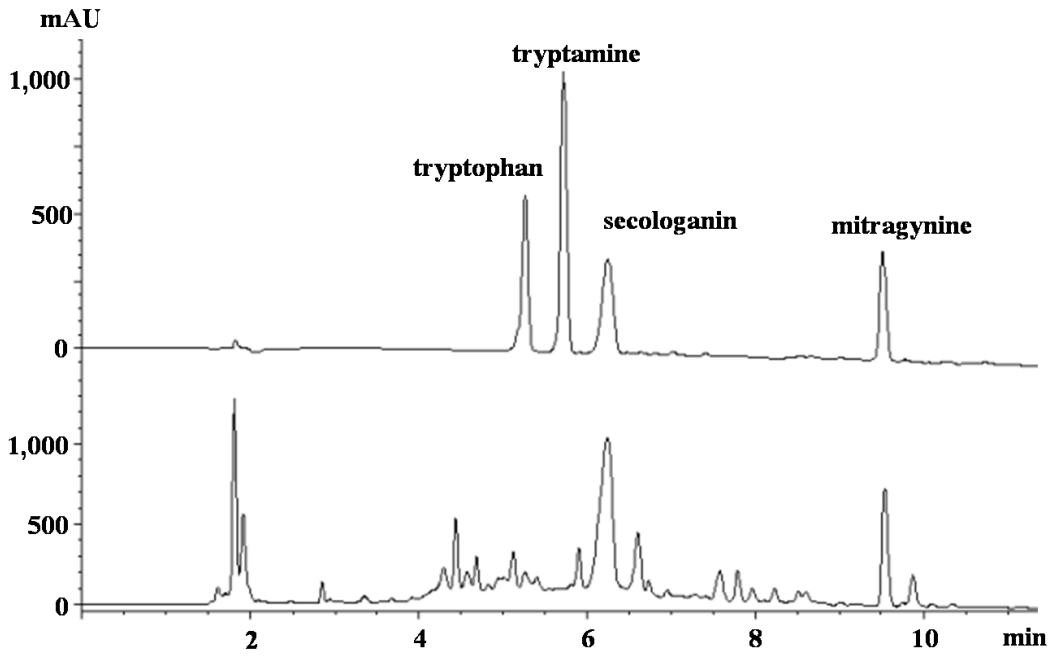
Leaf

Stem

Root



In vitro M. speciosa (2-Mo old)



(AOAC guideline, 2002)

Linearity 0.9996-0.9999
Limit of quantification 2 µg/ml

Methanolic extract from leaves

50 mg of lyophilized powder

- reflux with methanol at 70 °C for 1 hour.
- wash pigment out by partition with petroleum ether (2x)
- pooled methanol fractions; evaporated
- HPLC analysis

Agilent 1100 series HPLC-DAD-FLD

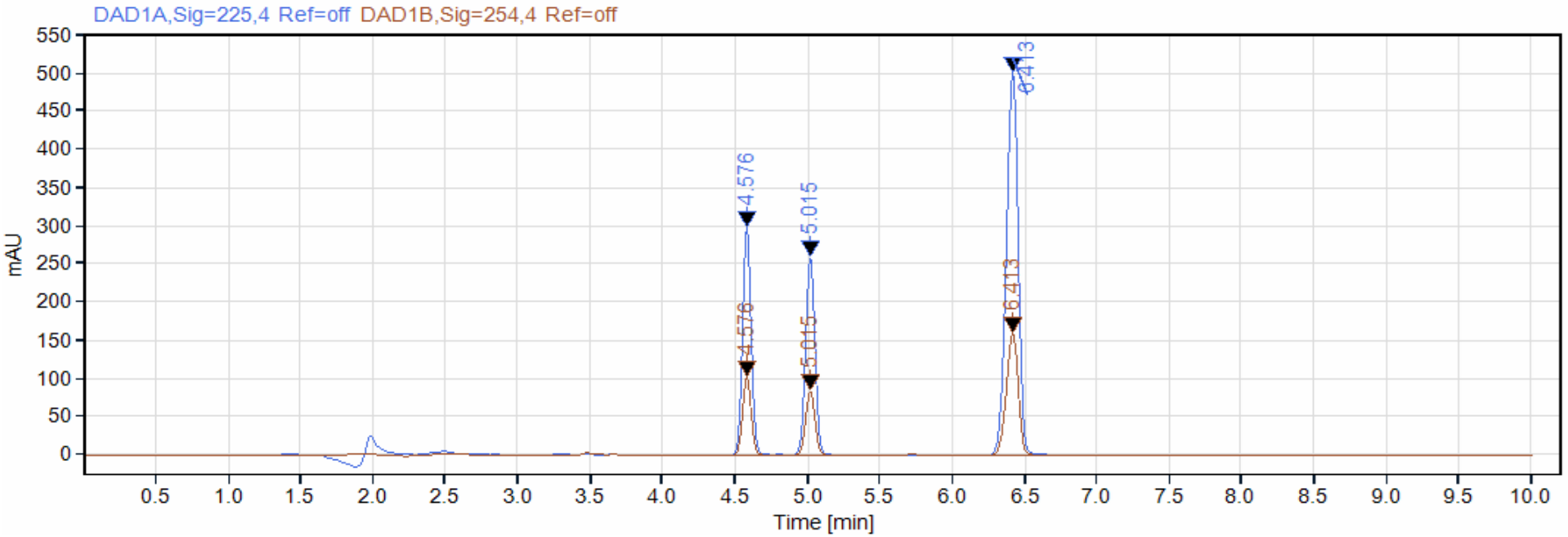
Column: VertiSep™ UPS C18 (250 mm x 4.6 mm i.d., 5 µM)
Mobile phase: 100 mM H_3PO_4 pH 2.4/H_2O: acetonitrile;
(10:90 → 90:10 ; 15 min)
Detector: UV 225; 238 nm for mitragynine, secologanin
fluorescence excite 270 nm; emission 370 nm for tryptophan, tryptamine

Charoonratana et al. (2013) Z. Naturforsch 68C: 394-405

Condition
HPLC (Agilent 1260)
Column : Kinetex 2.6 µm. EVO C18 (250 x 4.6 mm)
Mobile phase : 20 mM Ammonium acetate pH 6 : acetonitrile
Isocratic elution: 40:60
Flow rate : 1 mL/min
Inject volume : 10 µL
Run time : 10 min
UV-PDA detector

Pharmaceutical Sciences

JW Kratom Rx



Limsuwanchote et al. (2014) Forensic Science International 244: 70-77.

Boffa et al. (2018) Alkaloid Profiles and activity in different *Mitragyna speciosa* Strains. Natural Product Communications. 13(9): 1111-1116.

Plant material: The leaves of three red vein strains of *M. speciosa* (K.) H., from Thailand (Red Thai), Malaysia (Red Malay) and Bali (Red Bali), a white vein strain from Borneo (White Borneo) and a green vein strain from Malaysia (Green Malay) were all provided by Herba Invest S.R.O. (Bratislava, Slovakia).

HPLC-DAD analyses: MG standard and alkaloid extract solutions were prepared via dissolution in ethanol and 1 to 10 dilution in a mixture of H_2O/CH_3CN 2:1 (TFA 0.1%). The solutions were filtered through a 0.45 µm syringe filter and analyzed by HPLC on an XTerra MS C8 column (4.6 x 150 mm, 5 µm, Waters). The PDA detector was. The analyses were carried out on a Waters 1525 Binary HPLC pump equipped with 2998 PDA, using a flow rate of 1 mL/min and an injected volume of 20 µL. The quantification of the MG standard and all the alkaloids in the extracts was performed at 222 nm. 0.1% TFA aqueous solution (A), and acetonitrile, with 0.1% TFA (B), were used as the mobile phases accordingly to the following gradient profile: (time, B%) 0.01, 20; 7.5, 20; 15, 30; 26, 60; 39.5, 100; 44, 100.

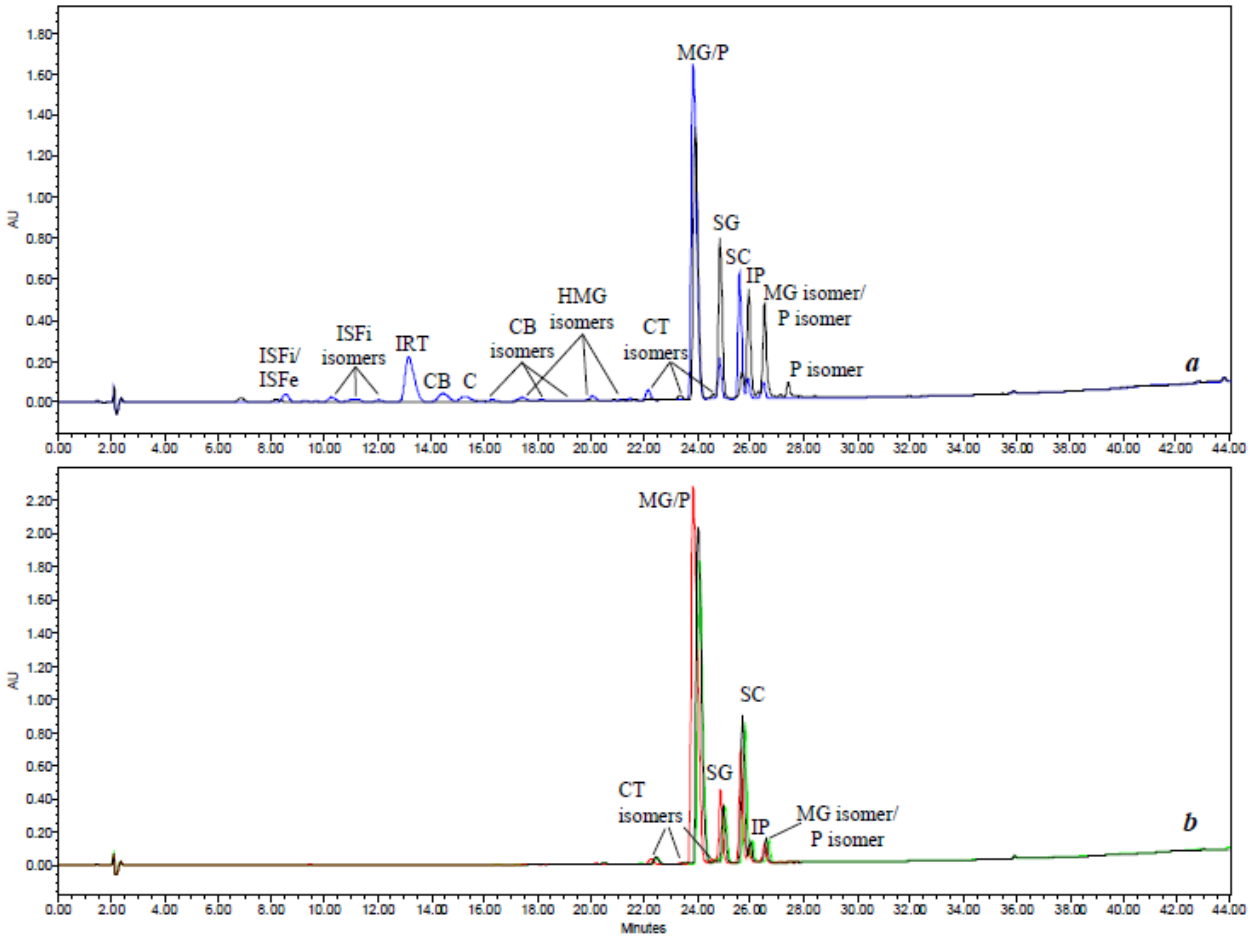
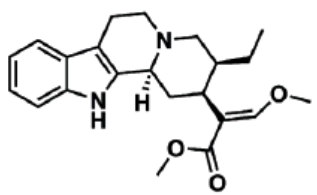
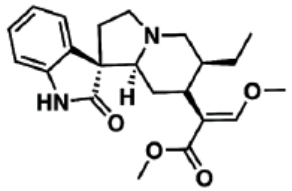
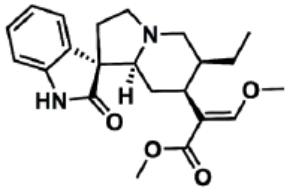
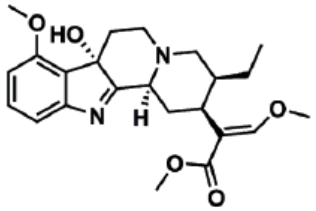


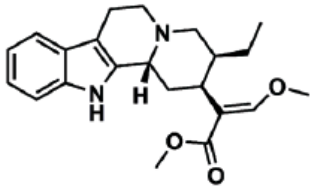
Figure 2: Comparison between HPLC-DAD chromatograms of Red Bali and Red Malay (*a*) and Red Thai/White Borneo/Green Malay (*b*).

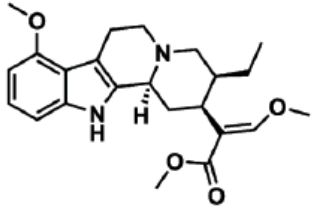


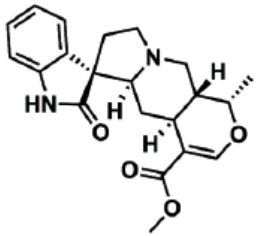


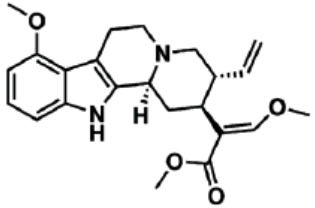


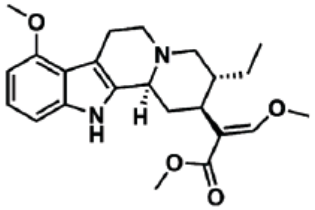


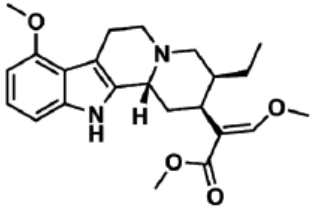








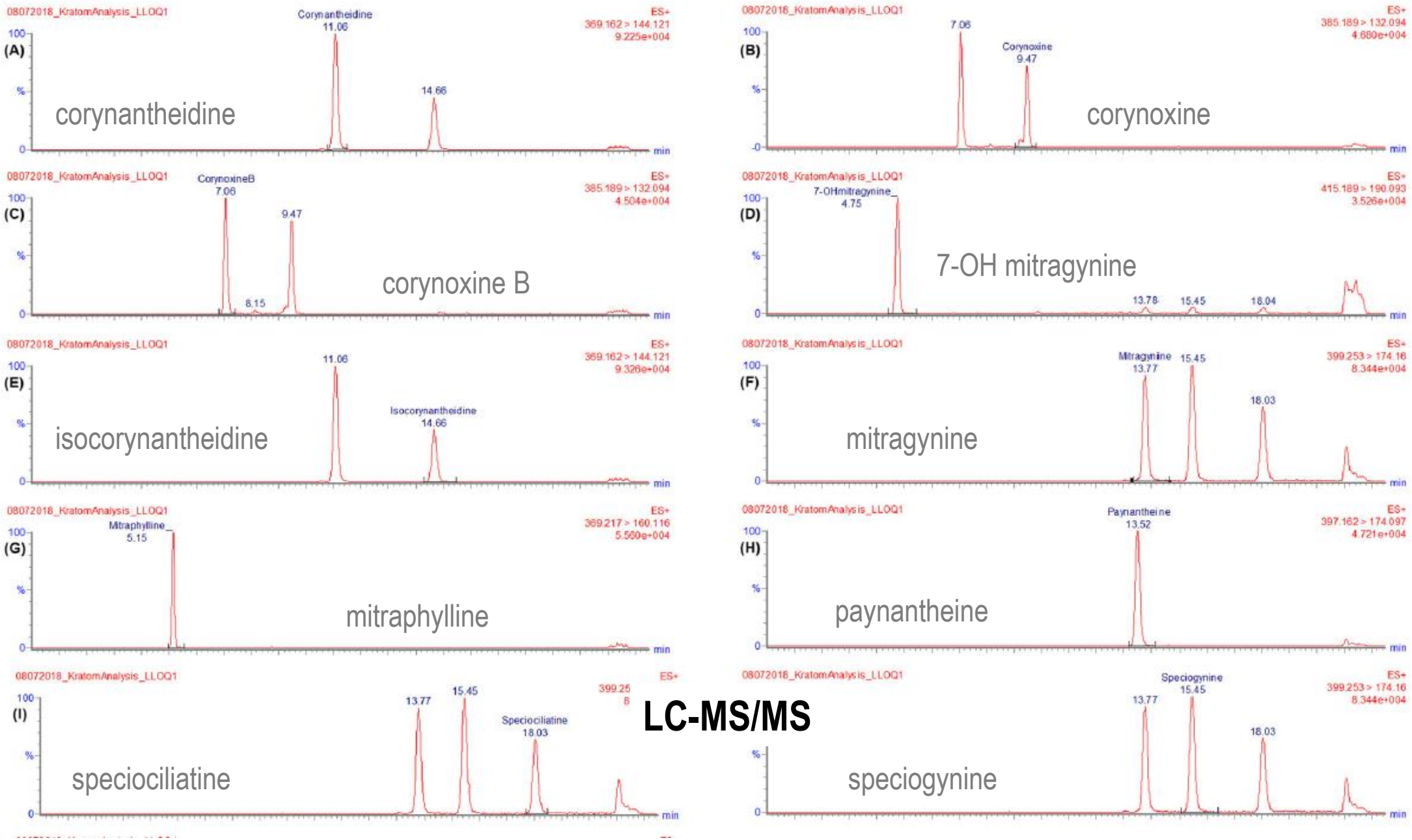




Simultaneous quantification of ten key Kratom alkaloids in *Mitragyna speciosa* leaf extracts and commercial products by ultra-performance liquid chromatography−tandem mass spectrometry

Sharma et al (2019) Drug Testing and Analysis 1-10

- A Waters Acquity Class I UPLC coupled with an XevoTQ-S Micro triple quadrupole mass spectrometer (Milford, MA, USA) was used for the quantitative analysis of kratom alkaloids.
- Chromatographic separation of kratom alkaloids sharing monoisotopic masses (M + H+, (m/z) was achieved on a Waters Acquity BEH C18 column (1.7 μm, 2.1 × 100 mm) with a slow gradient using a mobile phase consisting of aqueous ammonium acetate buffer (10 mM, pH 3.5; A) and acetonitrile (B).
- The flow rate of the mobile phase was held at 0.35 mL/min


08072018_KratomAnalysis_LLOQ1
(A)
corynantheidine
Corynantheidine
11.06
14.66
ES+
369.162 > 144.121
9.225e+004
(B)
corynoxine
7.06
Corynoxine
9.47
ES+
385.189 > 132.094
4.680e+004
(C)
corynoxine B
CorynoxineB
7.06
9.47
8.15
ES+
385.189 > 132.094
4.504e+004
(D)
7-OH mitragynine
7-OHmitragynine
4.75
13.78
15.45
18.04
ES+
415.189 > 190.093
3.526e+004
(E)
isocorynantheidine
11.06
Isocorynantheidine
14.66
ES+
369.162 > 144.121
9.326e+004
(F)
mitragynine
Mitragynine
13.77
15.45
18.03
ES+
399.253 > 174.16
8.344e+004
(G)
mitraphylline
Mitraphylline
5.15
ES+
369.217 > 160.116
5.560e+004
(H)
paynantheine
Paynantheine
13.52
ES+
397.162 > 174.097
4.721e+004
(I)
speciociliatine
13.77
15.45
Speciociliatine
18.03
ES+
speciogynine
Speciogynine
13.77
15.45
18.03
ES+
399.253 > 174.16
8.344e+004
min

LC-MS/MS

Kratom cocktail or fatal 4 x 100 formula

1. Boiled kratom leaves
2. cola drink
3. cough syrup
4. ice cube/mosquito coil/ tramadol/sedative drugs

Pre-treatment of kratom cocktail

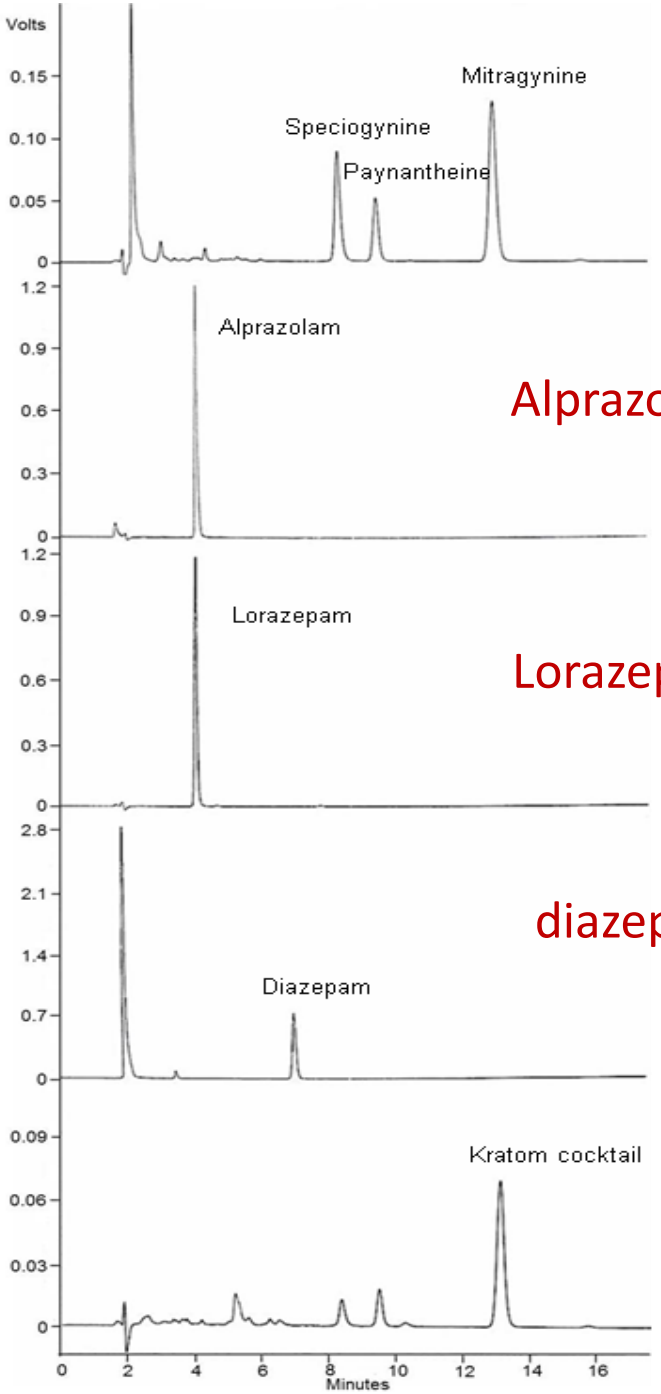
10 ml → Adjust to pH 9 using NH_4OH (28%)

↓

Partitioned with Chloroform

↓

Pooled and evaporated → HPLC



Alprazolam

Lorazepam

diazepam

Quantification of MG in kratom cocktail

HPLC analysis

The HPLC system consisted of a Shimadzu model 10 ADVP equipped with an LC-10 ADVP pump, DGU-14A degasser, SIL-10ADVP autosampler, and SPD-10AVP UV–VIS detector (Shimadzu, Kyoto, Japan). The chromatographic separation was obtained on a Verticep™ UPS C_{18} column (250 × 4.6 mm i.d., particle size 5 μm) (Nonthaburi, Thailand) using an isocratic elution of acetonitrile/20 mM ammonium acetate (pH 6) (65: 35, v/v) at flow rate 1.0 mL/min. The injection volume was 20 μL. The detection wavelength was 225 nm. Under separation conditions, the LOQs of MG, paynantheine, and speciogynine were 0.649, 0.266, and 0.236 mg/L, respectively.

Limsuwanchote et al. (2017) Forensic Toxicology 35: 167-172

MEDICAL KRATOM

Stimulant

Combat Fatigue

Pain Relief

Drugs Substitution

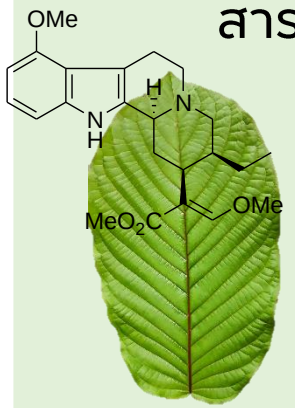
AS FOOD

AS DRUG

FOOD & DRUG INDUSTRY

ควบคุมคุณภาพ: วัตถุดิบ & สารสกัด

โมเดลสัตว์ทดลอง: ทดสอบประสิทธิภาพ & ความปลอดภัย



วิจัยและพัฒนา
สารสกัดมาตรฐาน

ปรุงตำรับ

ตำรามาตรฐานยาสมุนไพรไทย
Thai Herbal Pharmacopoeia

การทดสอบความเป็นพิษเฉียบพลัน-
กึ่งเฉียบพลัน-เรื้อรัง

การแปรรูปยาในร่างกาย

- อาหาร
- อาหารฟังก์ชัน
- ผลิตภัณฑ์สุขภาพ
- ยาสมุนไพร
- ยาแผนโบราณ
- ยาพัฒนาจากสมุนไพร

ผ่านการรับรองจาก อย. สธ.

ขึ้นทะเบียน

ศบภ.: ห้องปฏิบัติการควบคุมคุณภาพสมุนไพร

แนวทางปฏิบัติทางเกษตรที่ดี (GAP)

แนวทางปฏิบัติการเก็บเกี่ยวที่ดี (GHP)

แนวทางปฏิบัติการผลิตที่ดี (GMP)

พรีคลินิก

คลินิก เฟส 1

คลินิก เฟส 2

คลินิกเฟส 3-4

การทดสอบทางคลินิก ในมนุษย์

JW Kratom Rx

ศูนย์วิจัยและพัฒนาผลิตภัณฑ์จากพืชกระท่อม

คณะเภสัชศาสตร์

มหาวิทยาลัยสงขลานครินทร์