APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

7th September 2023

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

Diversity of active metabolites in stingless bee nest materials, a path for rational discoveries in apitherapy

PREMIO MUJERES EN CIENCIA
ACADEMIA DE CIENCIAS FÍSICAS, MATEMÁTICAS Y NATURALES
Dra. Patricia Vit
2023
CIENCIAS DE LA SALUD

Patricia Vit
Apitherapy and Bioactivity,
Food Science Department,
Faculty of Pharmacy and Bioanalysis,
Universidad de Los Andes, Merida, Venezuela
Email vitolivier@gmail.com

APIBA
Apiterapia & Bioactividad

Main topics of Apitherapy, APIMONDIA 2023

- **Scientific based evidence supporting the nutritional, physiological and health claims of bee products.**
- **Preclinical research - safety, pharmacology and toxicology of bee products. Guidelines for medical applications.**
- **Clinical trials in apitherapy – doses, interactions, side effects (human and veterinary medicine). Update on the use of apitherapy in infectious diseases.**
- **Regulatory issues and clinical ethics related to the integration of apitherapy as TCM in healthcare systems.**

https://apimondia2023.com/?p=abstract

Acknowledgements

- To stingless bee keepers, entomologists (JMF Camargo†, SRM Pedro, MS Engel) who identified our stingless bees along the years, and proactive colleagues.
- To M Linkogel, QSI Bremen, for the targeted ^{1}H-NMR of SBH.
- To G Meccia for the structures of chemical compounds.
- To my family for the unconditional support in my scientific research, D Vit collected *M. favosa* honey from Paraguana Peninsula, Venezuela.
- To CDCHTA-ULA, Welcome Trust, and Prometeo for financial support in diverse projects and scholarship.

APIMONDIA
48° CONGRESO INTERNACIONAL CHILE
DE APICULTURA 4 al 8 septiembre 2023
*Desde el sur del mundo **por una apicultura sostenible***

APIBA
Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Gratitude as Invited Speaker

- **To Dr. Cristina Mateescu**

  President
  Scientific Commission on Apitherapy, APIMONDIA
  Rumania

- **To Dr. Walter Fierro**

  Local Apitherapy Commission, APIMONDIA
  Uruguay

I wish to optimize my words and slides with this precious opportunity in the Central Symposium **Value added products from Beekeeping**

APIMONDIA
48°CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

I dedicate this talk to the memory of the Manuka honey scientist ***Peter Molan****, from Waikato University, Hamilton, New Zealand, for his contributions in the UMF so important for microbial bee science*

Compared to *Apis mellifera* therapy

Apitherapy with stingless bees lack APITOXIN

but have a BIODIVERSITY of 605 species of bees

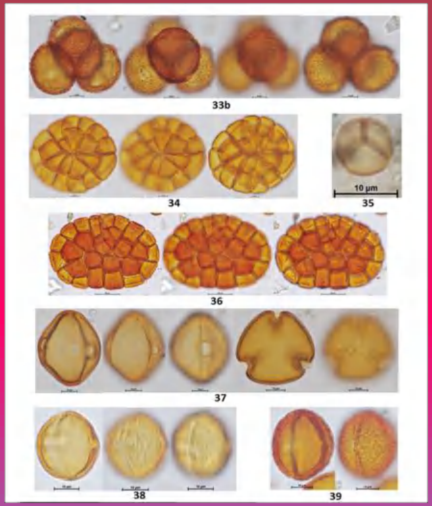
and air types of their nests…

https://www.ecocolmena.org/breathe-the-air-of-the-hive/

IDs of stingless bee nest metabolites

Botanical



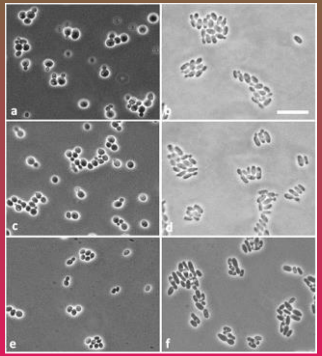


AIMS 2023; 8, 804-831

Entomological

JAR 2020; 60, 143-156

Microbial


Interciencia 2022; 47, 416-425
Int J Syst Evol Microbiol 2018; 2675

"Man has known the curative properties of honey from the earliest times. We may have forgotten, in latter years, just what medicinal benefits the golden harvest of the hive can bring. Perhaps with bacteria ever more resistant to antibiotics and viruses that seemingly defeat the medical world it is time to look once again to one of nature's own medicines that has a scientifically proven track record".

International Bee Research Association
"Honey and healing: from the hive to the hospital"
Cardiff University
7 October 2000

Rationale for discoveries in apitherapy

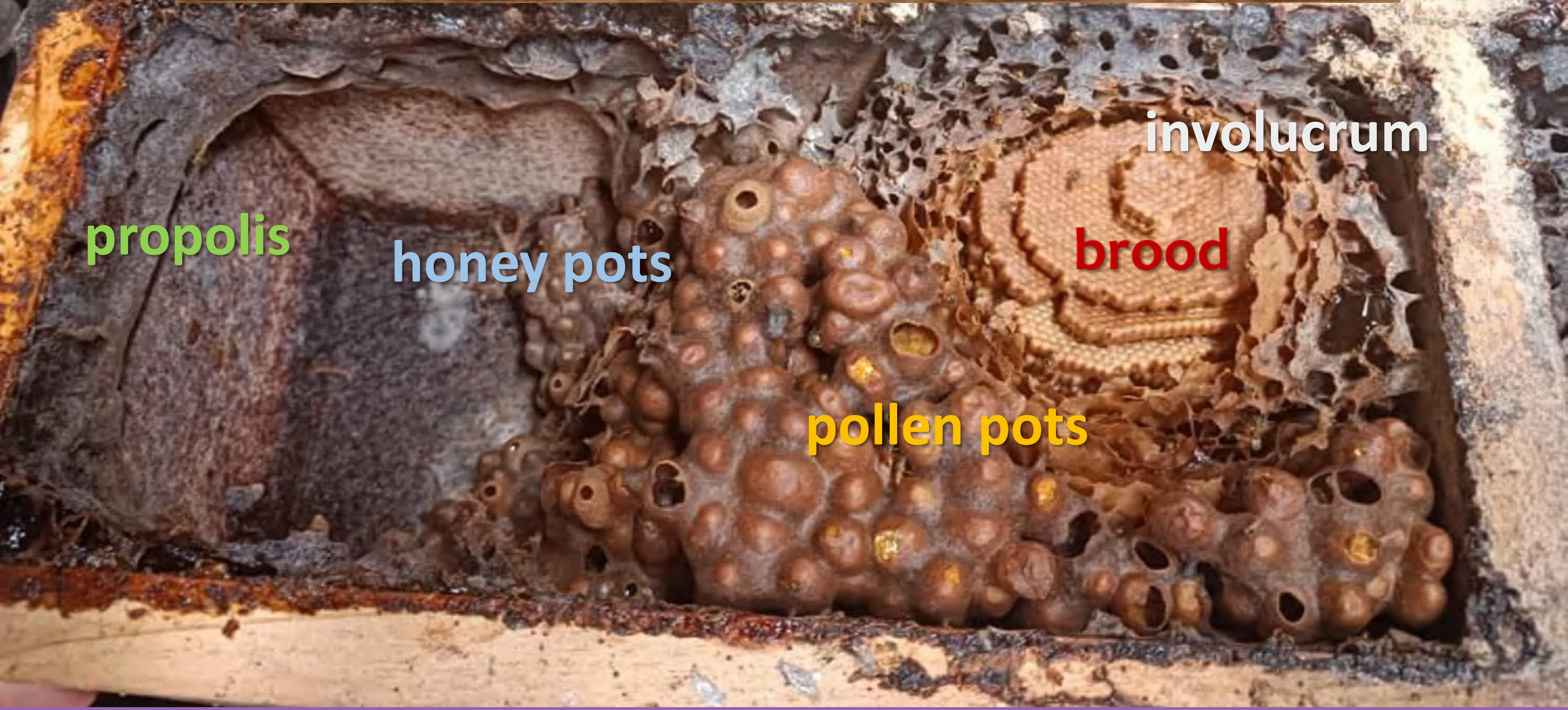
- Significance to focus on a research, targetted or not
- What gaps the research intends to fill
- Synthesis of most bioactive metabolites for pharmaceutical applications

Slowly grow

- Talent and dedication
- Multidisciplinary effort
- Ability of responsible team work

Have fun investing some of your family time in science

Tetragonisca angustula nest

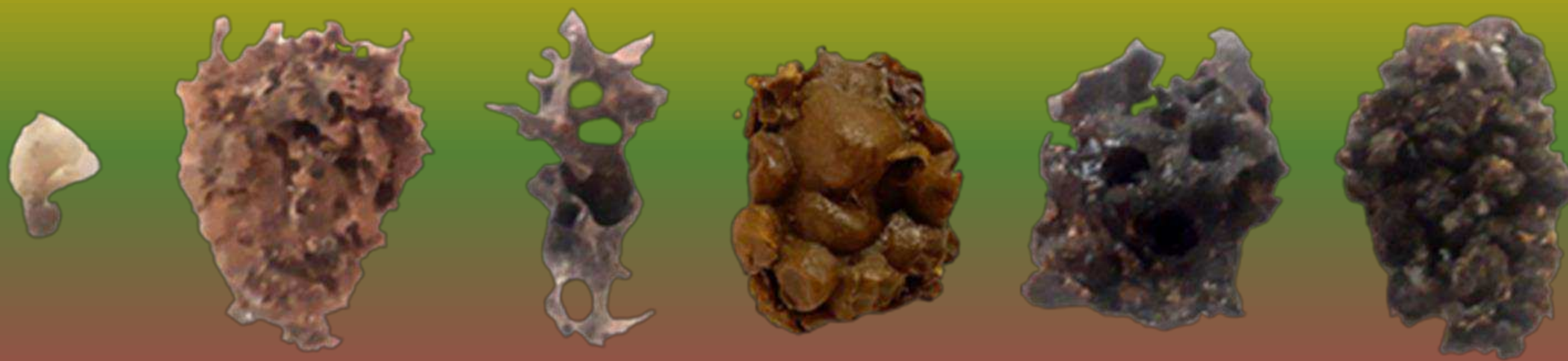


Diverse nest materials have different chemical composition and added values on bioactive properties for pharmaceutical design

Chapter 24. *Stingless bee cerumen and propolis*. 2023. Springer Nature; Cham, Switzerland. In press.

APIMONDIA
48°CONGRESO INTERNACIONAL DE APICULTURA 4 al 8 septiembre CHILE 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

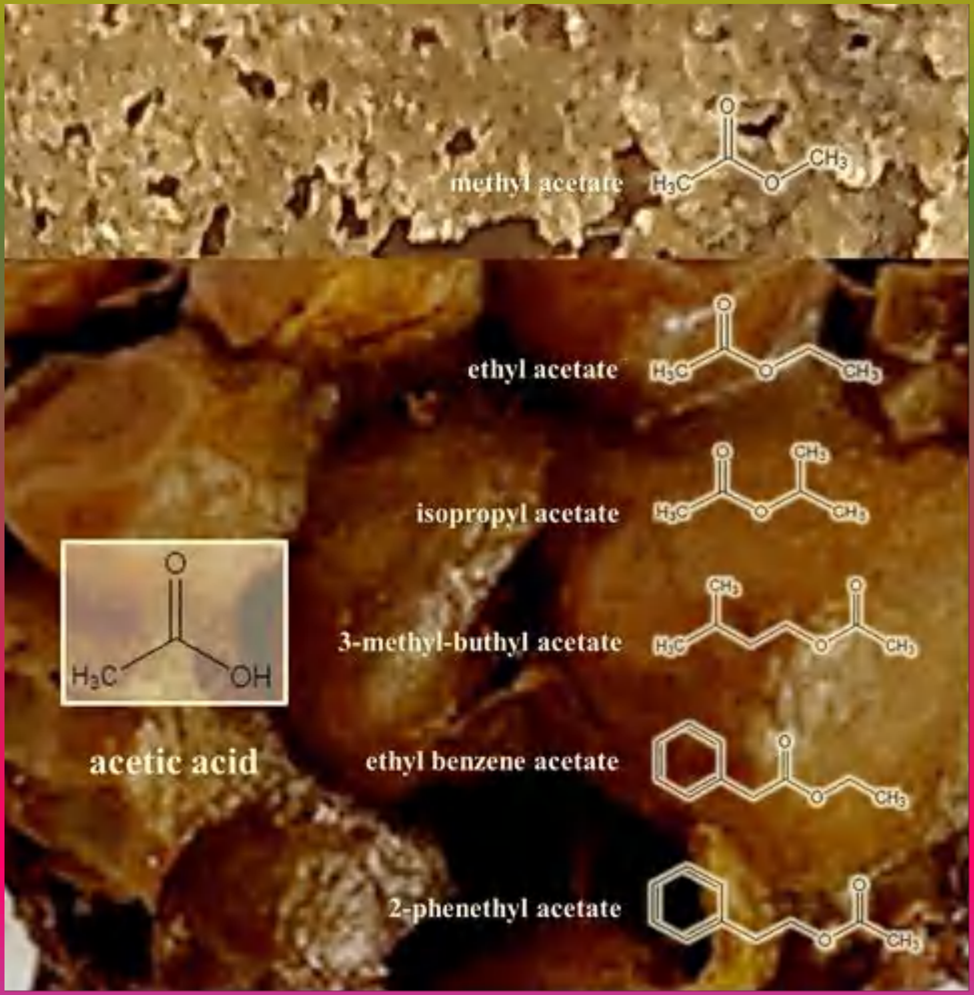


Diversity of **95 volatile organic compounds VOCs** detected and identified by HS-SPME/GC-MS. Nine chemical classes: 1. Acids (11), 2. Alcohols (16), 3. Aldehydes (7), 4. Esters (16), 5. Ketones (8), 6. Monoterpenes (17), 7. Oxides (5), 8. Sesquiterpenes (11), and 9. Others (4).

64	88	89	86	91	83
Entrance tube	**Involucrum of the brood**	**Pillars**	**Empty honey pots**	**Plant resin deposit**	**Indoor cover propolis**

Diverse nest materials have different chemical composition and added values on bioactive properties for pharmaceutical design

Chapter 24. *Stingless bee cerumen and propolis*. 2023. Springer Nature; Cham, Switzerland. In press.



Entrance tube

Empty honey pots

Acetic acid was accumulated in the cerumen of empty honey pots.
It was esterified into methyl acetate in the entrance tube, and five acetates in the honey pots

APIMONDIA 48° CONGRESO INTERNACIONAL DE APICULTURA CHILE 2023 4 al 8 septiembre
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad | UNIVERSIDAD DE LOS ANDES VENEZUELA

2015

Research Article

Rapid Communications in Mass Spectrometry

Received: 22 January 2015 | Revised: 12 February 2015 | Accepted: 25 February 2015 | Published online in Wiley Online Library

Rapid Commun. Mass Spectrom. **2015**, *29*, 948–954
(wileyonlinelibrary.com) DOI: 10.1002/rcm.7184

Determination of interglycosidic linkages in *O*-glycosyl flavones by high-performance liquid chromatography/photodiode-array detection coupled to electrospray ionization ion trap mass spectrometry. Its application to *Tetragonula carbonaria* honey from Australia

Pilar Truchado[1], Patricia Vit[2,3,4], Tim A. Heard[5], Francisco A. Tomás-Barberán[1] and Federico Ferreres[1*]

[1]Research Group on Quality, Safety and Bioactivity of Plant Foods, CEBAS-CSIC, P.O. Box 164, Espinardo 30100, Murcia, Spain
[2]Universidad Técnica de Machala, Provincia El Oro, Ecuador
[3]Faculty of Pharmacy, Universidad de Los Andes, Mérida, Venezuela
[4]University of Sydney, Lidcombe, NSW, Australia
[5]CSIRO Entomology, Long Pocket Lab, Indooroopilly, Queensland, Australia

2011

Journal of Chromatography A, 1218 (2011) 7601–7607

ELSEVIER

Contents lists available at ScienceDirect

Journal of Chromatography A

journal homepage: www.elsevier.com/locate/chroma

Liquid chromatography–tandem mass spectrometry analysis allows the simultaneous characterization of *C*-glycosyl and *O*-glycosyl flavonoids in stingless bee honeys

Pilar Truchado[a], Patricia Vit[b], Federico Ferreres[a], Francisco Tomas-Barberan[a,*]

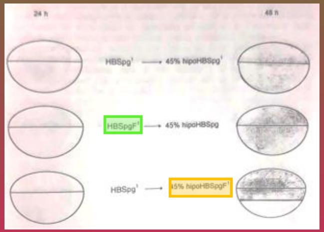
[a] Research Group on Quality, Safety and Bioactivity of Plant Foods, Department of Food Science and Technology, CEBAS-CSIC, P.O. Box 164, 30100, Campus Espinardo, Murcia, Spain
[b] Bioactividad, Departamento Ciencia de Los Alimentos, Facultad de Farmacia y Bioanálisis, Universidad de los Andes, Merida, Venezuela

Flavonoid *C*-glycoside and *O*-glycosides in *Melipona favosa* Honeys from Venezuela.[a]

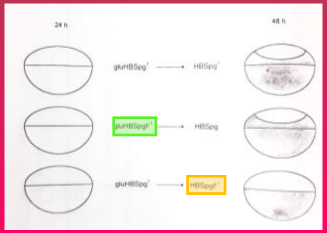
Honey samples												
Flavonoids	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
Flavone C-glycosides												
1	75.7	68.7	89.5	110.4	173.0	121.6	70.5	109.0	35.6	122.3	164.5	209.3
2	148.4	125.9	140.6	176.7	171.0	157.7	91.8	152.2	14.8	160.4	169.8	203.4
3 + 4	340.6	228.1	271.1	277.3	252.5	250.6	104.2	244.3	173.5	343.2	223.3	328.9
5	223.4	194.5	295.3	375.4	450.1	496.7	118.4	289.5	58.5	310.0	437.3	545.5
6	161.9	129.1	193.7	300.2	337.1	280.7	116.6	219.3	91.3	247.3	308.0	424.2
Total C-glyc	950.0	746.3	990.3	1240.1	1383.7	1307.4	501.6	1014.3	373.7	1183.3	1302.9	1711.3
Flavonol O-glycosides												
7	27.5	tr	26.6	21.4	16.6	tr	58.9	21.1	61.5	19.6	tr	20.8
8	52.1	nd	nd	nd	nd	1655.9	38.9	nd	227.9	252.5	50.3	87.6
9	314.7	50.3	43.7	tr	tr	9933.0	tr	tr	829.6	1208.3	229.0	443.3
10 + 11 + 12	97.9	202.4	56.0	74.9	61.3	1383.0	44.6	70.9	190.8	194.5	62.3	116.2
13	47.0	17.2	23.0	57.5	32.0	nd	22.5	29.4	nd	34.3	nd	24.2
14 + 15	48.8	135.4	35.2	nd	13.8	362.3	196.6	46.7	136.3	69.8	62.0	32.5
16	20.0	nd	nd	30.0	13.8	nd	21.4	16.0	31.5	12.3	nd	24.1
Total O-glyc	608.0	405.2	184.5	183.8	137.4	13334.2	382.9	184.1	1477.6	1791.2	403.7	748.7
Total glycosides	1558.0	1151.6	1174.8	1423.9	1521.09	14641.6	884.4	1198.4	1851.3	2974.6	1706.6	2459.9

Ovine lens diagrams in equatorial view showed different opacification patterns according to the culture media causing osmotic stress.

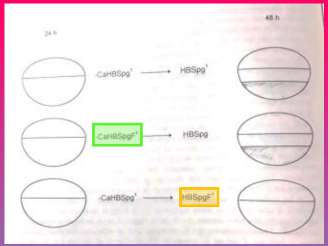
REGIONALIZED PROTECTION of tetramethyl ether luteolin applied **before** or **after** 24 h stress exposure, measured at 48 h.



45% Hypotonic



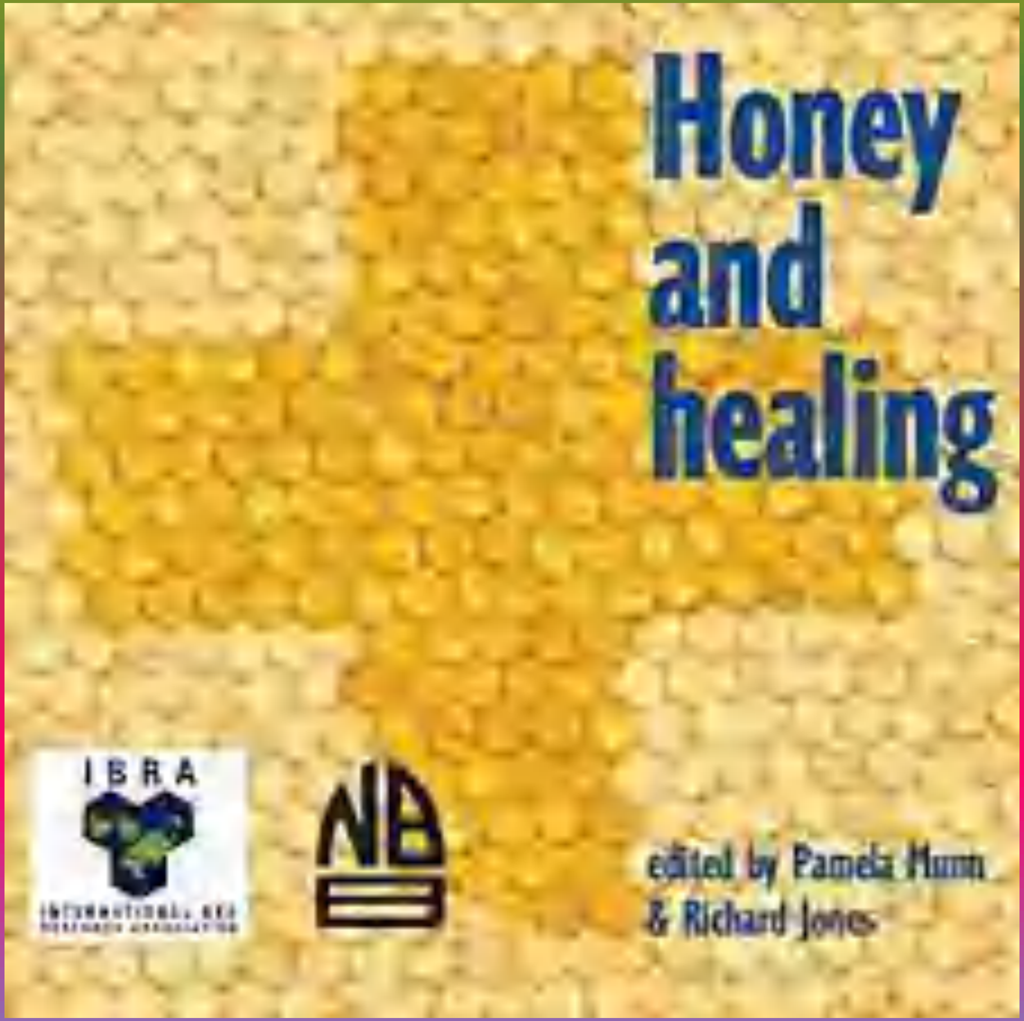
Hyperglycemic



Hypocalcemic

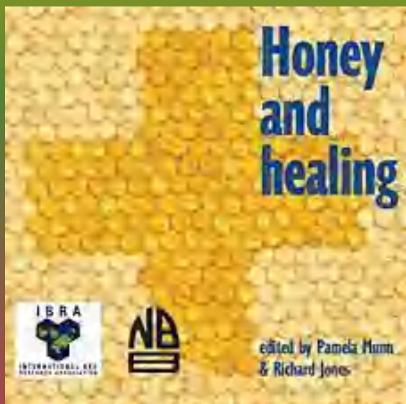
Vit P
1997
Cataratas y mieles terapéuticas.
Consejo de Desarrrollo Científico, Humanístico y Tecnológico, Universidad de Los Andes.
Mérida, Venezuela. 79 pp.

2001



This book was derived from papers given at the meeting organised by the International Bee Research Association entitled: "**Honey and healing: from the hive to the hospital**" which was held at the University of Cardiff on 7 October 2000. The programme for the meeting stated: "**Man has known the curative properties of honey from the earliest times**.

The book was originally published in 2001, but has been out of print for a number of years. Sadly, **Peter Molan**, who contributed two chapters, **died in 2015**.



Vit P
2004
Stingless bee honey and the treatment of cataracts.
International Bee Research Association. Cardiff, UK.
pp. 37-40

APIMONDIA
48°CONGRESO INTERNACIONAL CHILE DE APICULTURA 4 al 8 septiembre 2023
Desde el sur del mundo ***por una apicultura sostenible***

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Apiservices

Quality of the beehive for apitherapy 2000

Visita

Inicio | Articulos | Mercado int. miel | Bases de datos | Fotos | Contacto | Login/out

https://www.apiservices.biz/es/articulos/ordenar-por-popularidad/966-curso-calidad-colmena-para-apiterapia

Curso Calidad de la colmena para la apiterapia (2000)

Curso "Calidad de la colmena para la apiterapia" - VII Congreso nacional de ciencias farmacéuticas

Patricia Vit
Coordinadora APIVA
Apiterapia y Vigilancia Ambiental
Facultad de Farmacia, Universidad de Los Andes, Mérida, Venezuela
vitpat@cantv.net

30-31 Marzo 2000

Este curso se organizó para enfatizar el concepto de autocalidad en el mundo apícola. Los cuidados de la colmena y de sus alrededores se reflejan en los productos de las abejas utilizados con fines terapéuticos. Visitamos el apiario "La Casita de la Miel" y la empresa de productos naturales "Vitaplant".

APITERAPIA EN EL DEPARTAMENTO CIENCIA DE LOS ALIMENTOS.

Isbelia González

, Patricia Vit

Laboratorio Apiterapia y Vigilancia Ambiental, Departamento Ciencia de los Alimentos, Facultad de Farmacia, Universidad de Los Andes, Mérida.

El Departamento Ciencia de los Alimentos cumple funciones de docencia, investigación, extensión, producción y servicios. La apiterapia, entendida como tratamiento a base de productos de la colmena, sólo nos ocupa en labores de investigación. Además de haber organizado este curso sobre Calidad de la Colmena para la Apiterapia, en este VII Congreso Nacional de Ciencias Farmacéuticas, inauguraremos el primer laboratorio de investigación de nuestro departamento, APIVA (Apiterapia y Vigilancia Ambiental). En un espacio reducido, se han diseñado tres áreas para disponer de un bioterio experimental con temperatura controlada, un ambiente estéril para cultivo de órganos y el espacio para preparación y análisis de muestras. ¿Por qué apiterapia en un departamento de ciencia de los alimentos?. En 1985 se inició la investigación sobre calidad de mieles comerciales venezolanas, basada en las normas COVENIN del CT10 para alimentos. Posteriormente se orientó hacia el estudio de las mieles producidas por abejas sin aguijón. Las relaciones con instituciones especializadas en otras ciudades y en otros países, permitó avanzar con análisis que aun no figuran en las normas COVENIN para miel de abejas (Métodos de ensayo 2136-84 y Requisitos 2191-84), como la melitopalinología, el contenido de flavonoides, la evaluación sensorial y la actividad antibacteriana. Luego de haber evaluado el aspecto bromatológico de las mieles venezolanas, el siguiente paso era apuntar hacia la aplicación del conocimiento adquirido. La investigación en apiterapia es una de las avenidas que decidimos explorar. Nuestro primer objetivo ha sido explorar el vínculo tradicional entre miel de abejas y cataratas oculares, el cual ha recibido financiamiento regional, nacional e internacional y ha generado un título doctoral, diversas publicaciones y un libro especializado. Esperamos poder diversificarnos con el estudio de otras enfermedades y de los demás productos de la colmena. Así continuaremos la filosofía socrática de la medicina que nutre y el alimento que cura.

Palabras clave

alimentos, apiterapia, miel

2008

Journal of Health Science 54, 196-202

Putative Anticataract Properties of Honey Studied by the Action of Flavonoids on a Lens Culture Model

Patricia Vit*[,a] and Tim John Jacob[b]

[a]Apiterapy and Bioactivity (APIBA), Food Science Department, Faculty of Pharmacy and Bioanalysis, University of The Andes, Mérida 5101, Venezuela and [b]School of Biosciences, Cardiff University, Cardiff CF10 3US, U.K.

Table 2. Effect of Flavonoids 10^{-5} M in Cataract Model

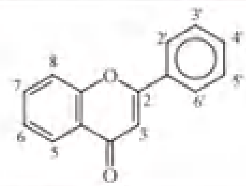
Treatments		Grey scale[a]	Treatments		Grey scale[a]
Isotonic HBS	control	90.87 ± 0.39** (90.10 – 91.40) [0.75]	Acacetin		142.95 ± 5.15 (137.80 – 148.10) [5.09]
Luteolin 4'-O-α-glucoside		116.00 ± 1.57* (113.70 – 119.00) [2.34]	Apigenin 7-O-α-glucoside		144.90 ± 5.10 (139.80 – 150.00) [4.98]
Luteolin 3'-7-O-α-diglucoside		117.20 ± 1.20* (116.00 – 119.60) [1.77]	Quercetin 3,7,3',4'-tetramethylether		145.53 ± 2.13 (142.70 – 149.70) [2.54]
Luteolin tetramethylether		120.13 ± 1.87* (116.5 – 122.70) [2.69]	Hyperoside		145.67 ± 2.34 (141.00 – 148.40) [2.79]
Orientin		121.60 ± 7.92* (107.20 – 134.50) [11.28]	45% hypotonic HBS	osmotic cataract	145.83 ± 2.84 (142.80 – 151.50) [3.37]
Isoquercitrin		136.13 ± 3.20 (130.00 – 140.80) [4.08]	Avicularin		146.17 ± 2.59 (142.60 – 151.20) [3.06]
Kaempferol		139.45 ± 5.35 (134.10 – 144.80) [5.51]	Luteolin 7-O-α-glucoside		148.05 ± 1.85 (146.20 – 149.90) [1.77]
Luteolin		140.15 ± 9.95 (130.20 – 150.10) [10.04]	Acacetin 7-O-α-rutinoside		148.55 ± 3.35 (145.20 – 151.90) [3.19]
Quercetin 3-O-β-D-glucopyranosyl-6'-acetate		141.33 ± 4.96 (134.90 – 151.10) [6.09]	Peltatoside		151.33 ± 7.05 (138.90 – 163.30) [8.07]
Kaempferol 3-O-α-robinoside-7-O-α-rhamnoside		141.45 ± 2.65 (138.80 – 144.10) [2.65]	Apigenin		152.90 ± 1.90 (151.00 – 154.80) [1.76]
Homorientin		142.40 ± 6.35 (134.20 – 154.90) [7.73]	Quercetin		154.73 ± 9.42 (143.20 – 173.40) [10.54]

a) Values are grey scale mean ± SEM, (ranges) and [cv]. The grey scale varies between 0 (black) and 255 (white) ** different from other treatments ($p < 0.050$) * different from isotonic HBS and 45% hypotonic HBS ($p < 0.050$) after *t*-student test.

Osmotic cataracts were induced by incubating ovine lenses in 45% hypotonic HBS for 24 h to test the anticataract action of 20 synthetic flavonoids 10^{-5} M concentration.

Luteolin tetramethyl ether, lutelin-4'-glucoside, luteolin-3'- 7-diglucoside, and orientin significantly inhibited onset of induced cataracts. Preliminary evidence of SBH anticataract properties.

Table 1. Structures of Flavonoids Tested in Cataract Model

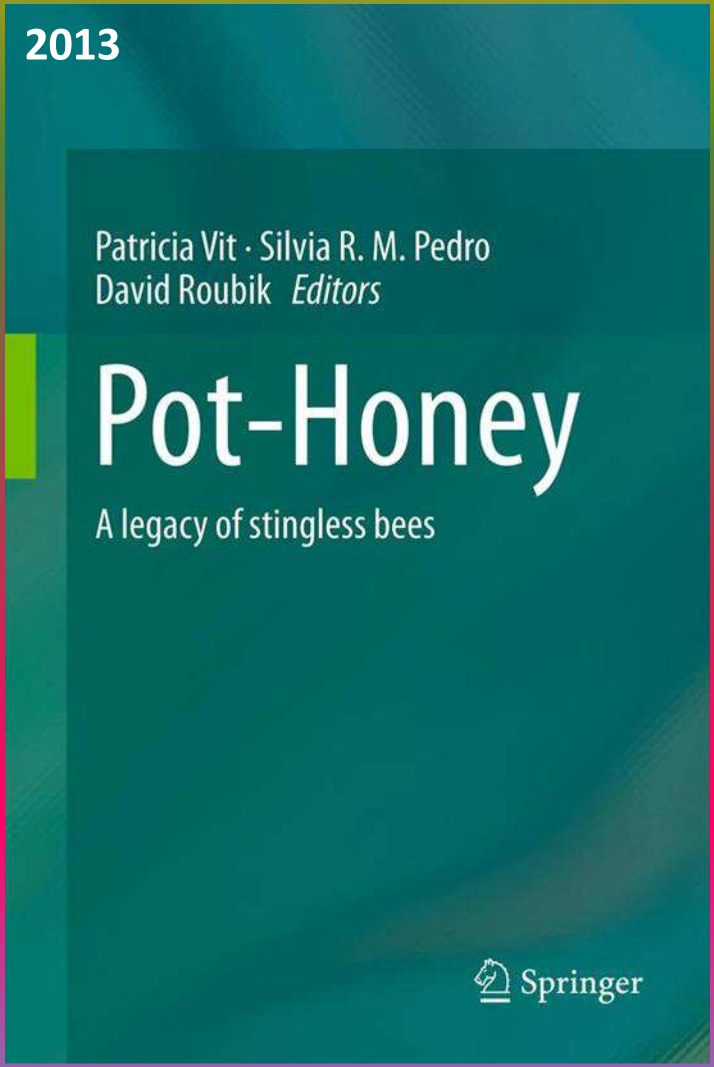


Flavonoids	Abbreviation	substituents						
		R_3	R_5	R_6	R_7	R_8	$R_{3'}$	$R_{4'}$
Acacetin	aca	H	OH	H	OH	H	H	OCH_3
Acacetin 7-O-α-rutinoside	aca7R	H	OH	H	Orut	H	H	OCH_3
Apigenin	api	H	OH	H	OH	H	OH	H
Apigenin 7-O-α-glucoside	api7G	H	OH	H	Oglu	H	OH	H
Kaempferol	kae	OH	OH	H	OH	H	H	OH
Kaempferol 3-O-α-robinoside-7-O-α-rhamnoside	kae3R7H	Orob	Orha	H	OH	H	H	OH
Luteolin	lut	H	OH	H	OH	H	OH	OH
Luteolin tetramethylether	lutMe4	H	OCH_3	H	OCH_3	H	OCH_3	OCH_3
Luteolin 6-C-glucoside (homorientin)	lut6G	H	OH	Cglu	OH	H	OH	OH
Luteolin 8-C-glucoside (orientin)	lut8G	H	OH	H	OH	Cglu	OH	OH
Luteolin 3′,7-O-α-diglucoside	lut3′G7G	H	OH	H	Oglu	H	Oglu	OH
Luteolin 4′-O-α-glucoside	lut4′G	H	OH	H	OH	H	OH	O-glu
Luteolin 7-O-α-glucoside	lut7G	H	OH	H	Oglu	H	OH	OH
Quercetin	que	OH	OH	H	OH	H	OH	OH
Quercetin-3-O-α-arabinoside (avicularin)	que3A	Oara	OH	H	OH	H	OH	OH
Quercetin-3-O-α-arabinoglucoside (peltatoside)	que3AG	Oara/glu	OH	H	OH	H	OH	OH
Quercetin-3-O-α-galactoside (hyperoside)	que3L	Ogal	OH	H	OH	H	OH	OH
Quercetin 3-O-α-glucoside (isoquercitrin)	que3G	Oglu	OH	H	OH	H	OH	OH
Quercetin 3-O-β-D-glucopyranosyl-6″-acetate	que3GAc	Oglu/Ac	OH	H	OH	H	OH	OH
Quercetin 3,7,3′,4′-tetramethylether	queMe4	OCH_3	OH	H	OCH_3	H	OCH_3	OCH_3

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA 4 al 8 septiembre CHILE 2023
Desde el sur del mundo ***por una apicultura sostenible***

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

2013



Chapter 35
Use of Honey in Cancer Prevention and Therapy

Patricia Vit, Jun Qing Yu, and Fazlul Huq

This chapter is dedicated to cancer sufferers and survivors, and researchers engaged in its prevention and therapy

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo ***por una apicultura sostenible***

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Pot-honey cytotoxicity in human ovarian cancer cell model *in vitro*

Biodiversity of **13** species of stingless bee honeys from **4** countries

Australia
Brazil
Mexico
Venezuela

488 P. Vit et al.

Table 35.1 IC_{50} values of pot-honeys in the human ovarian cancer cell lines

Geographical origin, city, country	Cisplatin (control) / Pot-honey bee species	Ovarian cancer cell lines: A2780 IC_{50}	A2780^{cisR} IC_{50}	A2780^{cisR} RF	A2780^{ZD0473R} IC_{50}	A2780^{ZD0473R} RF
	Cisplatin (control)	0.88	3.55	4.42	3.44	3.91
Chetumal, Mexico	*Melipona beecheii*	4.24	3.35	0.79	4.14	0.98
El Revenón, Mexico	*Melipona fasciata*	6.17	4.72	0.77	4.28	0.69
Mosra, Brazil	*Melipona fasciculata*	6.18	5.83	0.94	5.89	0.95
Tabocas, Brazil	*Melipona fasciculata*	8.00	3.97	0.50	5.15	0.64
Preazinho, Brazil	*Melipona fasciculata*	13.56	6.69	0.49	7.69	0.57
Mucuy, Venezuela	*Melipona favosa*	16.50	4.2[illegible]	**0.26**	12.8[illegible]	0.78
Mucuy, Venezuela	*Melipona favosa*	3.39	3.68	1.08	3.65	1.08
Belém, Brazil	*Melipona rufiventris*	5.10	4.68	0.92	3.80	0.74
João Pessoa, Brazil	*Melipona scutellaris*	**24.37**	**25.72**	1.06	**27.64**	1.31
Chiapas, Mexico	*Melipona solani*	**2.74**	1.66	0.61	**0.79**	**0.29**
Natal, Brazil	*Melipona subnitida*	17.54	27.60	**1.57**	[illegible]	**1.96**
El Revenón, Mexico	*Scaptotrigona hellwegeri*	4.19	4.59	1.10	4.10	0.98
Cuetzalan, Mexico	*Scaptotrigona mexicana*	7.71	4.43	0.57	5.62	0.73
Xingu, Brazil	*Scaptotrigona polysticta*	3.60	**1.54**	0.43	1.36	0.38
Brisbane, Australia	*Tetragonula carbonaria*	8.96	[illegible]	0.53	4.54	0.51
Guerrero, Mexico	*Frieseomelitta nigra*	4.58	4.72	1.03	4.19	0.92

IC_{50} honey (mg/mL), cisplatin (µM). *RF* resistance factor as the ratio IC_{50} resistant cell line/IC_{50} parent cell line

IC_{50} mg honey/mL
µM cysplatin

RF Resistance Factor
IC_{50} **resistant** cell lines/
IC_{50} **parent** cell line

A2780

Cis R
ZD0473R
resistant cell lines

2013
Open Acces

Chapter 8
Systematic reviews on interventions with honey in cancer.
Vit P, Huq F

Chapter 10
Antioxidant activity of nest products of *Tetragonisca angustula* from Mérida, Venezuela.
Pérez-Pérez EM, Suárez E, Peña-Vera MJ, González AC, Vit P

Chapter 20
Cosmetic properties of honey. 1. Antioxidant activity
Isla M, Cordero A, Díaz L, Pérez-Pérez EM, Vit P

http://www.saber.ula.ve/handle/123456789/35292

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

"Fermented pot-honey is not a defect, but microbial associations with stingless bees preserving their wet honey with active metabolites"
Patricia Vit, EuroFoodChem-Food for Future, Copenhagen, Denmark (2009).

2011
Revista del Instituto Nacional de Higiene Rafael Rangel 12, 58-63

Presencia de ácido láctico y otros compuestos semivolátiles en mieles de Meliponini

Patricia Vit[1], Luis B Rojas[2], Alfredo Usubillaga[2], Rosa Aparicio[2], Gina Meccia[2], Miguel A Fernández Muiño[3], María Teresa Sancho[3]

1 Apiterapia y Bioactividad, Departamento Ciencia de los Alimentos, Facultad de Farmacia y Bioanalisis, Universidad de Los Andes, Merida,Venezuela.

2 Grupo de Productos Naturales y Quimica Medicinal, Instituto de Investigaciones, Facultad de Farmacia y Bioanalisis, Universidad de Los Andes, Merida, Venezuela.

3 Nutricion y Bromatologia, Facultad de Ciencias, Universidad de Burgos, Burgos, Espana. Autor principal: Tlf. 0274-2403565 (of) Fax 0274-2711802 vit@ula.ve .

Lactic acid was found in the honey produced by four species of stingless bees.
Other compounds were identified:
2-ethyl-hydroxy-propanoic acid in ***Melipona favosa***, ***Tetragonisca angustula*** honeys,
5-(hydroxymethyl)-2-furancarboxaldehyde and α-phenylmethyl benzene ethanol in ***Scaptotrigona mexicana*** honey,
2-butanol, heneicosane and heptacosane in ***Tetragonula carbonaria*** honey.

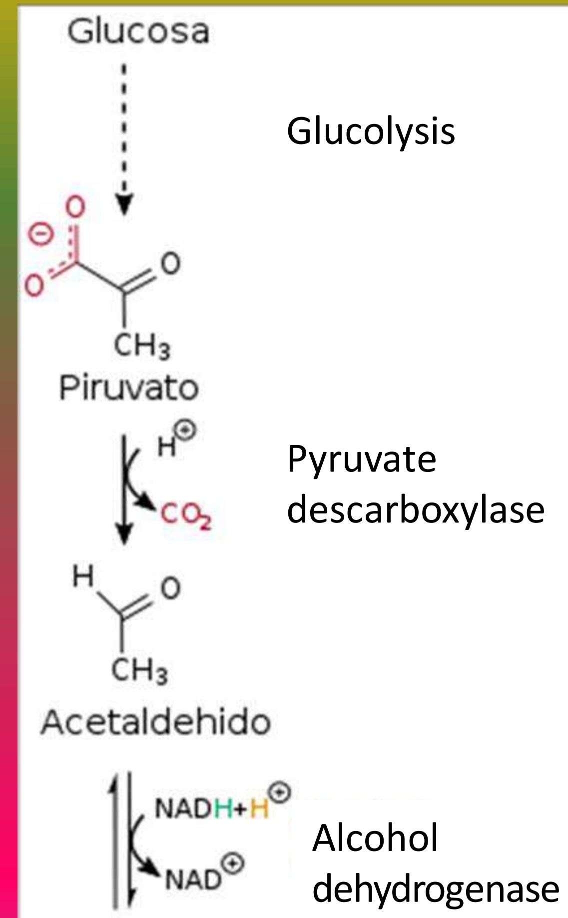
2004 Bee World 85, 2-5

Alcoholic Fermentation *Yeasts*

Etymology

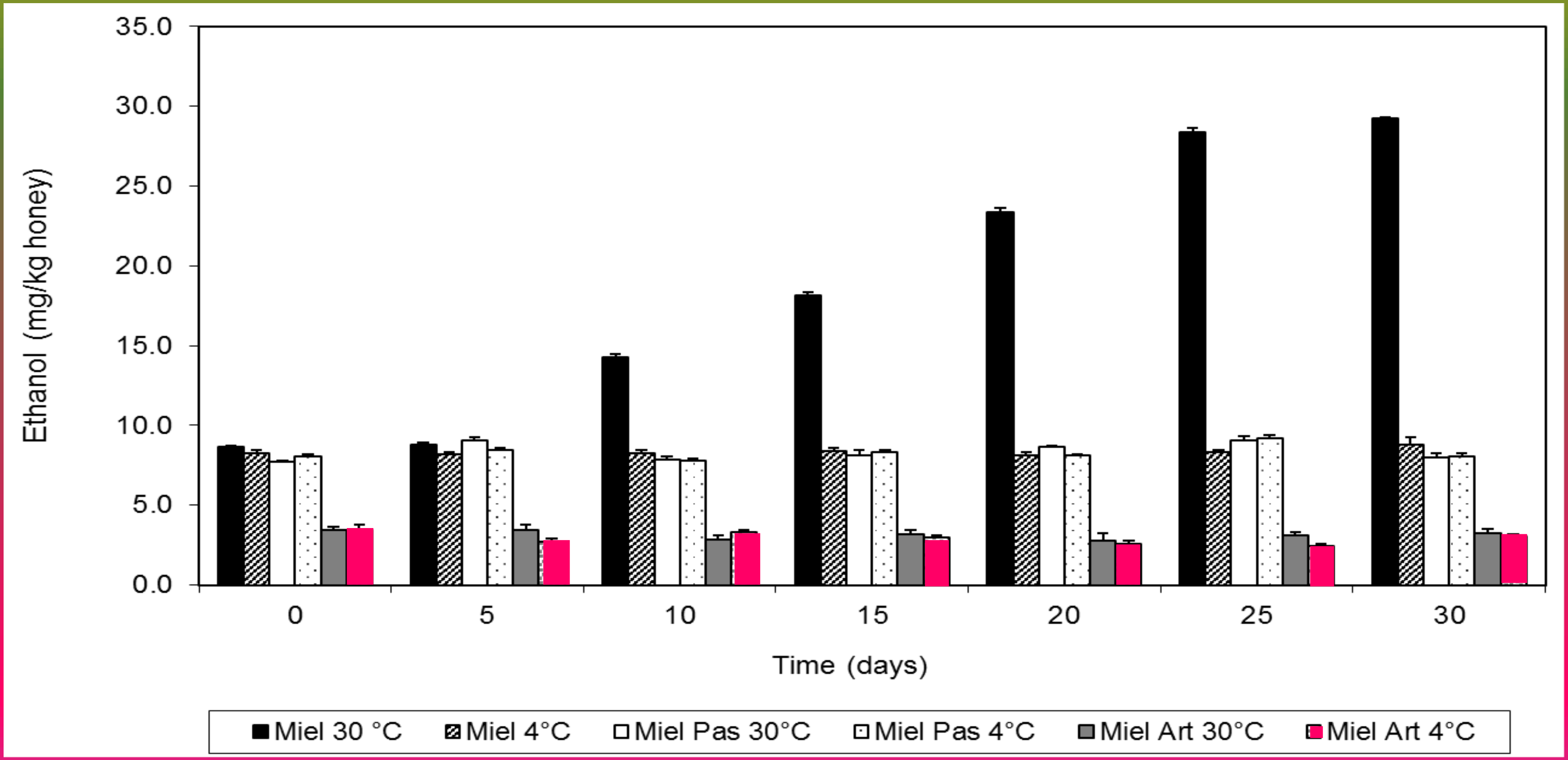
Fermentation Latin *fervere*, boiling forming bubbles

Scaptotrigona mexicana
pot-honey
fermentation prior to bottling, Sierra Norte de Puebla, Mexico.



Ethanol

2007 BioTecnología 10, 14-22



Effect of storage temperature (30°C and 4°C) for one month on ethanol content of raw and pasteurized *Tetragonisca angustula* (Ta) honey, compared to artificial honey

2004 Bee World 85, 2-5

TABLE 2. Medicinal uses of stingless bee honey.

Species	Medicinal uses
Melipona beecheii	Digestive disorders, eye diseases, respiratory infections, wound healing, post-birth recovery, fatigue, casts for fractures, skin ulcers
Melipona favosa favosa	Delivery enhancer
Melipona paraensis	Post-birth recovery
Melipona trinitatis	Gastritis
Scaptotrigona mexicana	Respiratory infections
Nannotrigona perilampoides	Cataract and pterygion treatment, stomach aches, bruises
Plebeia jatiformis	Cataract, pterygion, external injuries on the head, stomach aches
Trigona (Tetragonisca) angustula	Stomach disorders, cataract and pterygion, respiratory infections, wound healing

This was the first proposal of standards for SBH

2004 Bee World 85, 2-5

Do we need them for apitherapy?

TABLE 3. Suggested standards for stingless bee honeys, compared with official Codex Allimentarius Commission standards for *Apis mellifera* honey.

Honey composition	Standards *Apis mellifera*	*Melipona*	*Scaptotrigona*	*Trigona*
Water content (g/100g)	max 20.0	max 30.0	max 30.0	max 30.0
Reducing sugars (g/100g)	min 65.0	min 50.0	min 50.0	min 50.0
Sucrose (g/100g)	max 5.0	max 6.0	max 2.0	max 6.0
Acidity (meq/100g)	max 40.0	max 70.0	max 85.0	max 75.0
Ash (g/100g)	max 0.5	max 0.5	max 0.5	max 0.5
HMF (mg/kg)	max 40.0	max 40.0	max 40.0	max 40.0
Diastase activity (DN)	min 8.0	min 3.0	min 3.0	min 7.0

APIMONDIA 48°CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023

Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad | UNIVERSIDAD DE LOS ANDES VENEZUELA

This was the second proposal of standards for SBH, expanded

2023 Interciencia 48, 2-5

Yes, we need them for apitherapy

Chemical quality factors	*Apis mellifera*	Neotropical stingless bee genera				Paleotropical stingless bee genera: Indo-Malayan [b]		Paleotropical stingless bee genera: Australasian [c]
	Honey standards [e]	Suggested honey standards [d]			New suggested honey standards [a]	New suggested honey standards		
		Melipona	*Scaptotrigona*	*Trigona*	*Tetragonisca*	*Geniotrigona thoracica*	*Heterotrigona itama*	*Tetragonula carbonaria*
Water (g/100g honey)	Maximum 20.0	Maximum 30.0	Maximum 30.0	Maximum 30.0	Maximum 30.0	Maximum 30.0	Maximum 30.0	Maximum 30.0
Reducing sugars (g/100g honey)	Minimum 65.0	Minimum 50.0	Minimum 50.0	Minimum 50.0	Minimum 50.0	Minimum 50.0	Minimum 50.0	Minimum 50.0
Sucrose (g/100g honey)	Maximum 5.0	Maximum 6.0	Maximum 2.0	Maximum 6.0	Maximum 5.0	ND	ND	Maximum 2.0
Free acidity (meq/100g honey)	Maximum 40.0	Maximum 70.0	Maximum 85.0	Maximum 75.0	Maximum 70.0	Maximum 300.0	Maximum 300.0	Maximum 150.0
Ash (g/100g honey)	Maximum 0.5	Maximum 0.5	Maximum 0.5	Maximum 0.5	Maximum 0.5	Maximum 0.2	Maximum 0.2	Maximum 0.5
Hydroxymethylfurfural (mg/kg honey)	Maximum 40.0	Maximum 40.0	Maximum 40.0	Maximum 40.0	Maximum 40.0	Maximum 20.0 [f]	Maximum 20.0 [f]	Maximum 20.0
Diastase activity (DN)	Minimum 8.0	Minimum 3.0	Minimum 3.0	Minimum 7.0	Minimum 8.0	-	Minimum 15.0 [f]	Minimum 0.1

ND: not detected. Source: [a] Vit (2023a,b); [b] Zawawi *et al.* (2022); [c] Persano-Oddo *et al.* (2008); [d] Vit *et al.* (2004); [e] Codex Stan (2019); [f] (Suhana Ahmad, personal communication).

APIMONDIA 48°CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Cytotoxicity of Ecuadorian Stingless Bee Honey

WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES

SJIF Impact Factor 7.632

Volume 10, Issue 9, 115-134 Research Article ISSN 2278 – 4357

CYTOTOXICITY OF *GEOTRIGONA*, *MELIPONA* AND *SCAPTOTRIGONA* ECUADORIAN POT-HONEYS IN HUMAN OVARIAN CANCER CELL MODEL

Fazlul Huq[1], Jun Qing Yu[1], Silvia RM Pedro[2], Elizabeth Pérez-Pérez[3], Favian Maza[4], Patricia Vit[5,6]*

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

Cytotoxicity of 3 genera of Ecuadorian Stingless Bee Honeys

IC_{50} values and resistance factors (RF) for honey and cisplatin as applied to A2780 and $A2780^{cisR}$ human ovarian cancer cell lines

Cell lines	Stingless bee species IC_{50} (mg mL^{-1} honey)			Reference drug IC_{50} (µM)
	Geotrigona leucogastra	*Melipona grandis*	*Scaptotrigona* sp.	Cisplatin
A2780	19.28 ± 1.93	0.15 ± 0.02	4.25 ± 0.26	0.88 ± 0.05
$A2780^{cisR}$	22.67 ± 2.27	0.05 ± 0.002	4.29 ± 0.39	3.90 ± 0.50
RF	1.18	0.32	1.01	4.43

Cell survival fraction as IC_{50} values were calculated in response to pot-honey dilutions. Resistance factor (RF) is the ratio of the IC_{50} value in the resistant cell line to that in the parental cell line. Data are expressed as means ± SE (n = 3).

Pot-honey harvest from a *Melipona grandis nest* in Puyo, Pastaza province, Ecuador

Cytotoxicity of Ecuadorian Stingless Bee Honeys

Antioxidant activity and biochemical components of honey produced by three species of stingless bees did not explain the highest cytotoxicity of *M. grandis* in the ovarian cancer cell model

Honey parameters	Stingless bee species		
	Geotrigona leucogastra	*Melipona grandis*	*Scaptotrigona* sp.
Antioxidant activity			
AOA (mM UAE /100 g)	1.0 ± 0.1	1.1 ± 0.0	1.1 ± 0.0
HR (% inhibition HR)	85.8 ± 0.9	88.4 ± 0.9	87.5 ± 0.2
TAA (µmoles TE/100g)	148.8 ± 6.5	125.1 ± 1.5	170.1 ± 0.5
Biochemical components			
Flavonoids (mg QE/100 g)	80.0 ± 8.2	67.3 ± 2.2	122.0 ± 17.4
Polyphenols (mg GAE/100 g)	1444.2 ± 105.0	890.4 ± 163.7	1340.7 ± 29.7
Proteins (mg proteins/ 100 g)	593.4 ± 124.7	1097.1 ± 82.8	1374.9 ± 56.0

UAE uric acid equivalents, HR hydroxyl radical, TE Trolox equivalents, QE quercetin equivalents, GAE gallic acid equivalents. Data are expressed as means ± SE (n = 3).

APIMONDIA
48°CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

Contents lists available at ScienceDirect

Current Research in Food Science

journal homepage: www.sciencedirect.com/journal/current-research-in-food-science

ELSEVIER

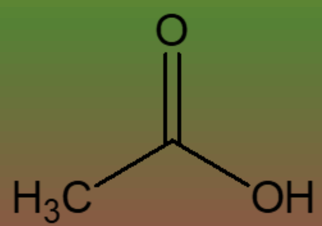
Research Paper

Impact of genus (*Geotrigona*, *Melipona*, *Scaptotrigona*) in the targeted ^{1}H-NMR organic profile and authenticity test by interphase emulsion of honey processed in cerumen pots by stingless bees in Ecuador

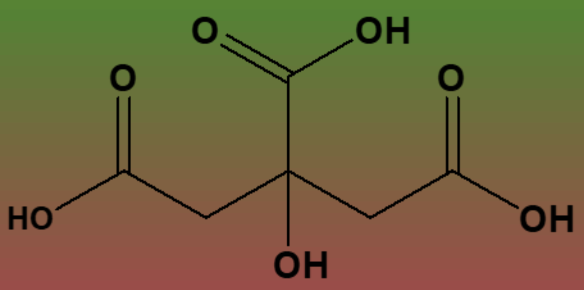
Patricia Vit[a,*], Jane van der Meulen[b], Maria Diaz[b], Silvia R.M. Pedro[c], Isabelle Esperança[d], Rahimah Zakaria[e], Gudrun Beckh[b], Favian Maza[f], Gina Meccia[g], Michael S. Engel[h,i]

Supplement with 41 chemical structures of honey metabolites

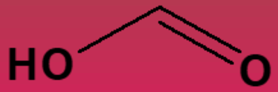
Aliphatic Organic Acids (AOA)



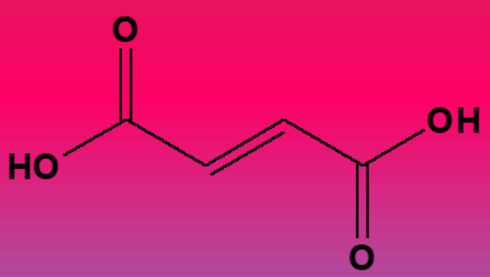
Acetic acid



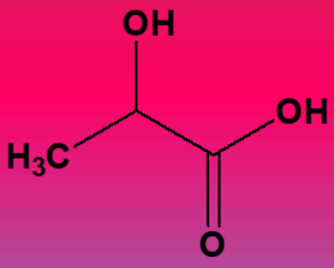
Citric acid



Formic acid



Fumaric acid

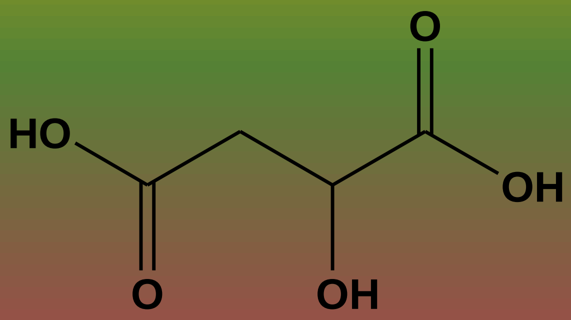


Lactic acid

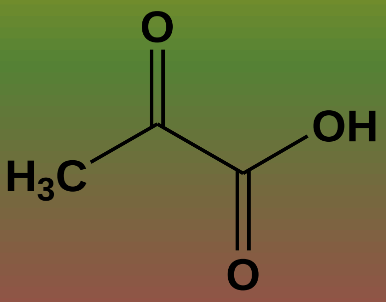
APIMONDIA
48°CONGRESO INTERNACIONAL CHILE
DE APICULTURA 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

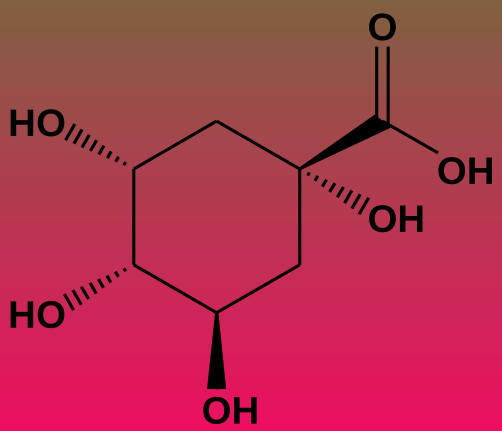
Aliphatic Organic Acids (AOA)



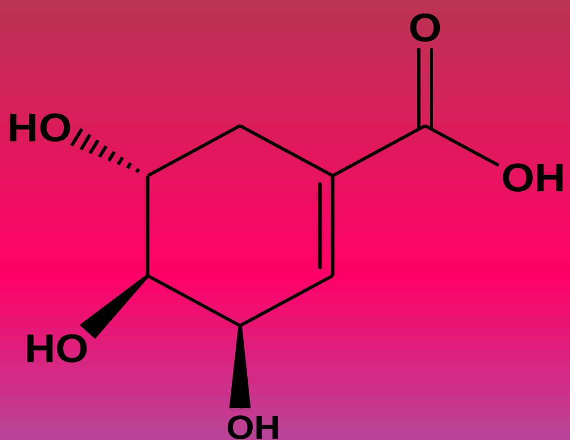
Malic acid



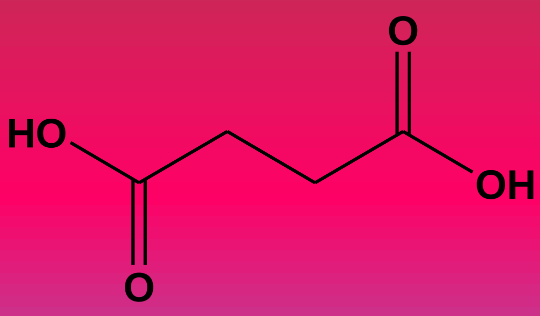
Piruvic acid



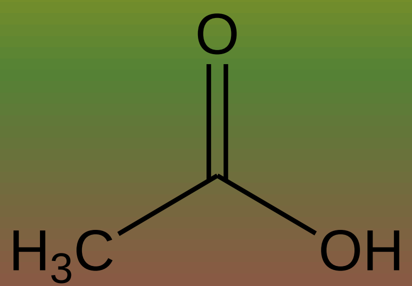
Quinic acid



Shikimic acid



Succinic acid

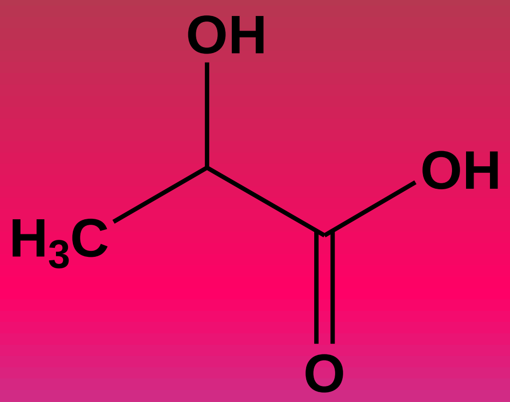


Acetic acid

Acetic Fermentation

Acetobacter

$$CH_3CH_2OH + O_2 \rightarrow CH_3COOH + H_2O + 348\ kJ$$



Lactic acid

Lactic Fermentation

Lactic Acid Bacteria LAB

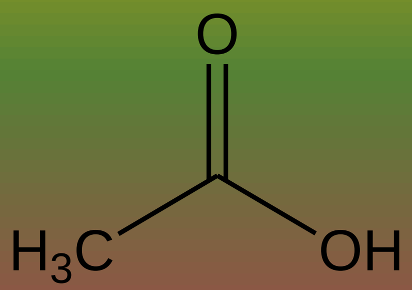
$$C_6H_{12}O_6 + 2\ NAD^+ + 2\ ADP + 2\ P_i \rightarrow 2\ ATP + 2\ NADH + 4\ H^+ + 2\ H_2O + 2\ CH_3COCOO^-$$

$$CH_3COCOO^- + NADH + H^+ \rightarrow NAD^+ + CH_3CHOHCOO^-$$

$$C_6H_{12}O_6 + 2\ ADP + 2\ P_i \rightarrow 2\ ATP + 2\ CH_3CHOHCOO^- + 2\ H^+ + 2\ H_2O$$

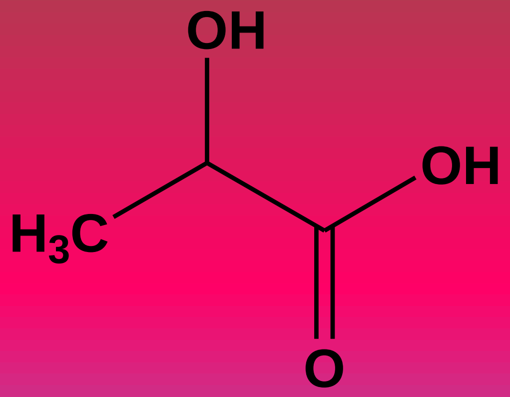
https://es.wikipedia.org/wiki/Fermentaci%C3%B3n

Acetic acid



Aliphatic organic acids (mg/kg honey)	Stingless bee genus		
	Geotrigona (n = 8)	*Melipona* (n = 4)	*Scaptotrigona* (n = 8)
Acetic acid (g/kg) Monocarboxylic acid	19.60 ± 1.45[b] [15.23–25.56]	1.33 ± 0.33[a] [0.46–2.06]	1.21 ± 0.34[a] [0.21–2.85]
Lactic acid (g/kg) Monocarboxylic acid	24.30 ± 1.65[b] [19.28–30.45]	1.56 ± 0.45[a] [0.41–2.63]	1.55 ± 0.39[a] [0.43–3.39]

Lactic acid



https://es.wikipedia.org/wiki/Fermentaci%C3%B3n

Gluconic acid is not measurable by NMR due to its 16 isomers But it was measured by HPIC-SCD high performance ion chromatography with suppressed conductivity detection in 111 SBH from Australia.

Journal of Food Composition and Analysis 122 (2023) 105466

Contents lists available at ScienceDirect

Journal of Food Composition and Analysis

journal homepage: www.elsevier.com/locate/jfca

ELSEVIER

Check for updates

Organic acid profiles of Australian stingless bee honey samples determined by ion chromatography.

Natasha L. Hungerford [a,*], Hans S.A. Yates [b], Tobias J. Smith [c], Mary T. Fletcher [a]

[a] *Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Health and Food Sciences Precinct, Coopers Plains, Qld 4108, Australia*

[b] *Forensic and Scientific Services, Queensland Health, Coopers Plains, Qld 4108, Australia*

[c] *School of Biological Sciences, The University of Queensland, St Lucia, Qld 4072, Australia*

APIMONDIA
48°CONGRESO INTERNACIONAL DE APICULTURA CHILE 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

Seminal review

- **Harmonized AOA units** available in the literature, useful to compare a set of AOA in different honey types, based on the 100 g compositional standard of food science adopted as the best way to compare nutrients in similar products.
- **Updated reference for honey AOA contents** Visualization of **AOA < 2.5% for *Apis mellifera*** honey replacing the current < 0.5%, as well as **AOA < 5.8% for pot-honey**, represented by the *Axestotrigona* genus from Tanzania in this SBH dataset.
- Chronological data (1994–2023) selected refined bibliometric support of 919 samples, **710 *Apis mellifera* honey** and **209 Meliponini pot-honey**

We eagerly anticipate a positive response from our esteemed readers networking between pot-honey experts and integrative multidisciplinary science.

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA 4 al 8 septiembre CHILE 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad
UNIVERSIDAD DE LOS ANDES VENEZUELA

antioxidants

MDPI

Article

Chemical Components and Antioxidant Activity of *Geotrigona* sp. and *Tetragonisca fiebrigi* Stingless Bee Cerumen Reduce Juglone-Induced Oxidative Stress in *Caenorhabditis elegans*

Isamara Carvalho Ferreira [1], Raíssa Cristina Darroz Côrrea [1], Sarah Lam Orué [1], Daniel Ferreira Leite [1], Paola dos Santos da Rocha [1], Claudia Andrea Lima Cardoso [2], Rosilda Mara Mussury [3], Patricia Vit [4], Kely de Picoli Souza [1], Edson Lucas dos Santos [1] and Jaqueline Ferreira Campos [1,*]

1 Research Group on Biotechnology and Bioprospecting Applied to Metabolism (GEBBAM), Federal University of Grande Dourados, Rodovia Dourados-Itahum, Km 12, Dourados 79804-970, MS, Brazil; isamara.ferreira137@academico.ufgd.edu.br (I.C.F.); raissa.correa416@academico.ufgd.edu.br (R.C.D.C.); sarah.orue005@academico.ufgd.edu.br (S.L.O.); daniel.leite059@academico.ufgd.edu.br (D.F.L.); paolasantosrocha@ufgd.edu.br (P.d.S.d.R.); kelypicoli@ufgd.edu.br (K.d.P.S.); edsonsantos@ufgd.edu.br (E.L.d.S.)
2 Course of Chemistry, State University of Mato Grosso do Sul, Rodovia Dourados-Itahum, Km 12, Dourados 79804-970, MS, Brazil; claudia@uems.br
3 Faculty of Biological and Environmental Sciences, Federal University of Grande Dourados, Rodovia Dourados-Itahum, Km 12, Dourados 79804-970, MS, Brazil; maramussury@ufgd.edu.br
4 Apitherapy and Bioactivity, Food Science Department, Faculty of Pharmacy and Bioanalysis, Universidad de Los Andes, Mérida 5101, Venezuela
* Correspondence: jaquelinefcampos@ufgd.edu.br

Phenolic compounds and fatty acids in ethanolic extracts of cerumen (mg/mL), and antioxidant activity IC_{50} (mg/mL).

Compounds	*Geotrigona* sp	*Tetragonisca fiebrigi*
Phenolic compounds		
3,4-hydroxycinnamic acid	3.040 ± 0.032	
Catechin	10.000 ± 0.044	-
Gallic acid	-	6.473 ± 0.020
Rutin	-	12.993 ± 0.022
Vanillin	4.020 ± 0.035	-
Dicarboxylic acids		
Maleic acid	1.970 ± 0.023	-
Fatty acids		
Caprylic acid	0.303 ± 0.003	0.347 ± 0.003
Capric acid	1.607 ± 0.007	1.503 ± 0.003
Lauric acid	2.590 ± 0.012	2.543 ± 0.009
DPPH	1.001 ± 0.062	1.251 ± 0.068
ABTS	0.496 ± 0.040	0.254 ± 0.023

Juglone is an organic compound generating large amounts of the radical superoxide anion, inducing oxidative stress and reducing nematode viability. EEC ameliorated juglone-induced oxidative stress during the redox imbalance. In other studies. Rutine, palmitic acid and oleic acid, increased the resistance to oxidative stress in *C. elegans* by activating DAF-16

INTERNATIONAL JOURNAL OF SYSTEMATIC AND EVOLUTIONARY MICROBIOLOGY

TAXONOMIC DESCRIPTION
Santos *et al.*, *Int J Syst Evol Microbiol*
DOI 10.1099/ijsem.0.002675

MICROBIOLOGY SOCIETY

Starmerella camargoi f.a., sp. nov., *Starmerella ilheusensis* f.a., sp. nov., *Starmerella litoralis* f.a., sp. nov., *Starmerella opuntiae* f.a., sp. nov., *Starmerella roubikii* f.a., sp. nov. and *Starmerella vitae* f.a., sp. nov., isolated from flowers and bees, and transfer of related *Candida* species to the genus *Starmerella* as new combinations

Ana Raquel O. Santos,[1] Marina P. Leon,[1] Katharina O. Barros,[1] Larissa F. D. Freitas,[1] Alice F. S. Hughes,[1] Paula B. Morais,[2] Marc-André Lachance[3] and Carlos A. Rosa[1,*]

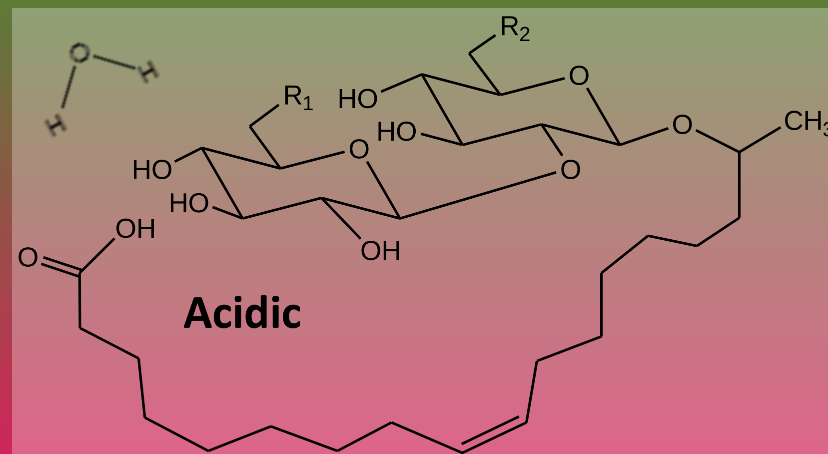
Sophorolipids

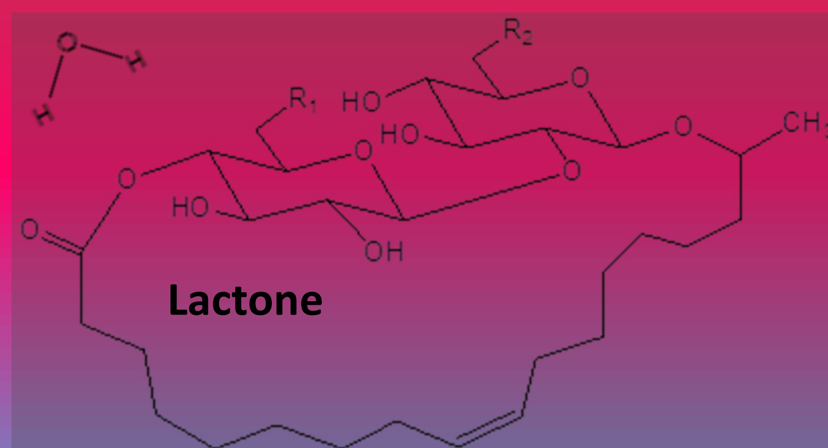
Industrial applications

- Food
- Bioreemediation
- Cosmetics
- Pharmacy
- Ecology friendly home

Biotechnological optimization of culture media for microbial origin surfactants

Scaptotrigona vitorum honey





Metabolomics Categorizations

Categories of metabolites to VISUALIZE healing power

- Chemical type
- Quantity
- Entomological origin

MANUKA HONEY was the **seminal METABOLOMIC CATEGORY** for HONEY

With the **UMF**

The worldwide pharmaceutical attribute UNIQUE MANUKA FACTOR

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA 4 al 8 septiembre CHILE 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Metabolomics Categorizations

2008 Acta Bioquímica Clínica Latinoamericana 42, 237-244

Bioquímica Clínica

Mieles checas categorizadas según su actividad antioxidante

Czech honey categorized according to their antioxidant activity

▶ Patricia Vit[1], María Gabriela Gutiérrez[2], Dalibor Titěra[3], Michael Bednař[4], Antonio Jesús Rodríguez-Malaver[5]

Categories of Antioxidant Activity

Tabla VI. *Clasificación ampliada de mieles según su AAT (µmoles equivalentes Trolox/100 g miel).*

Clases	*Categoría AAT*	*AAT µmoles equivalentes Trolox*	
		Desde	*Hasta*
1	Pro-oxidante	<1	
2	Muy baja	1	50
3	Baja	51	100
4	Moderadamente baja	101	150
5	Media	151	200
6	Moderadamente alta	201	250
7	Alta	251	300
8	Muy alta	>300	

Trehalulose

2020

SCIENTIFIC REPORTS
natureresearch
Check for updates

OPEN

Stingless bee honey, a novel source of trehalulose: a biologically active disaccharide with health benefits

Mary T. Fletcher[1], Natasha L. Hungerford[1], Dennis Webber[2], Matheus Carpinelli de Jesus[3], Jiali Zhang[1], Isobella S. J. Stone[2,3], Joanne T. Blanchfield[3] & Norhasnida Zawawi[1,4]

Trehalulose Sci. Rep. 2020

[1]Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Brisbane, QLD 4072, Australia.
[2]Biosecurity Queensland, Department of Agriculture and Fisheries, Brisbane, QLD 4108, Australia.
[3]School of Chemistry and Molecular Biosciences, The University of Queensland, Brisbane, QLD 4072, Australia.
[4]Department of Food Science, Faculty of Food Science and Technology, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

Trehalulose

2022

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

ELSEVIER

FOOD CHEMISTRY

Check for updates

Unique physicochemical properties and rare reducing sugar trehalulose mandate new international regulation for stingless bee honey

Norhasnida Zawawi [a,b,*], Jiali Zhang [b], Natasha L. Hungerford [b], Hans S.A. Yates [c], Dennis C. Webber [e], Madeleine Farrell [c], Ujang Tinggi [c], Bhesh Bhandari [d], Mary T. Fletcher [b]

[a] *Faculty of Food Science and Technology, University Putra Malaysia, 43400 UPM Serdang, Malaysia*
[b] *Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Health and Food Sciences Precinct, Coopers Plains, Qld 4108, Australia*
[c] *Forensic and Scientific Services, Queensland Health, Coopers Plains, Qld 4108, Australia*
[d] *School of Agriculture and Food Sciences, The University of Queensland, St. Lucia, Qld 4067, Australia*
[e] *Biosecurity Queensland, Department of Agriculture and Fisheries, Brisbane, QLD 4108, Australia*

Trehalulose

Table 2
Average physicochemical properties of stingless bee honey across different species.

Physicochemical properties	Malaysian Stingless Bee Species						Australian Stingless Bee Species					
	Heterotrigona itama (n = 10)			*Geniotrigona thoracica* (n = 5)			*Tetragonula carbonaria* (n = 11)			*Tetragonula hockingsi* (n = 10)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Colour (mmPfund)	230.4[ac]	111.6	107.85–450.3	148.5[a]	58.8	95.34–315.32	436.4[b]	131.5	297.83–718.11	365.7[bc]	116.2	203.72–575.26
Moisture (%)	28.16[a]	1.45	25.97–30.70	28.30[abc]	2.08	25.78–31.01	25.48[b]	0.85	23.91–26.88	25.15[bc]	1.16	23.75–27.66
pH	3.19[a]	0.15	2.86–3.42	3.07[a]	0.04	3.01–3.1	3.6[b]	0.06	3.5–3.71	3.63[b]	0.13	3.44–3.88
Free acidity (meq/kg)	211.5[a]	93	17.0–336.2	235.6[a]	95.8	95.3–315.3	167.8[a]	32.8	98.5–212.3	125.4[a]	40.9	74.1–202.0
Total Phenolic (mg GAE/kg)	358.9[a]	88.2	251.1–541.8	325.0[a]	69.5	223.4–410.4	1054.9[b]	136.2	883.4–1246.3	1044.5[b]	165.6	923.2–1321.3
Sugar (g/100 g)												
Fructose	16.23[a]	6.21	4.89–25.01	4.11[b]	2.61	0.69–7.07	17.43[a]	2.87	12.98–22.40	16.58[a]	3.39	10.48–20.60
Glucose	13.37[a]	7.22	2.12–24.88	2.90[b]	1.20	ND-4.26	12.10[a]	2.51	7.81–15.26	12.71[a]	2.91	6.30–16.91
Fructose + Glucose	29.61[a]	13.32	7.01–49.59	6.29[b]	4.3	0.69–11.32	29.54[a]	5.21	20.79–37.66	29.29[a]	6.10	17.34–36.47
Trehalulose	28.38[a]	9.05	17.81–42.30	49.08[b]	5.84	43.08–57.04	23.18[a]	4.80	18.03–35.45	24.90[a]	6.49	18.62–38.75

Categories of Trehalulose in SBH

Classes	Trehalulose Concentration ranges (g/100g SBH)	Stingless bee species
1	10.0–19.9	*Heterotrigona itama, Tetragonula carbonaria, Tetragonula hockingsi*
2	20.0–29.9	*Heterotrigona itama, Tetragonula carbonaria, Tetragonula hockingsi*
3	30.0–39.9	*Heterotrigona itama, Tetragonula carbonaria, Tetragonula hockingsi*
4	40.0–49.9	*Heterotrigona itama, Geniotrigona thoracica*
5	50.0–59.9	*Geniotrigona thoracica*

APIMONDIA
48°CONGRESO INTERNACIONAL CHILE DE APICULTURA 4 al 8 septiembre 2023
Desde el sur del mundo por una apicultura sostenible

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Valued stingless bee products sustain social projects

Review Article

Female stingless bee keepers promoting nutraceutical and health benefits of meliponine honey, pollen, cerumen, and propolis

Patricia Vit[1], Ingrid Aguilar[2], Bajaree Chuttong[3], O Monika Barth[4], Cleofas Cervancia[5], Anna Locsin[5], Jessica Baroga-Barbecho[5], Kemilla S Rebelo[6], Favio Vossler[7], Le N Thanh[8], Prakash Karmakar[9], Ujjwal Layek[10], Gina Meccia[11], Palmira Guevara[12], Favian Maza[13], Claus Rasmussen[14], Sammy Kimoloi[15], Megan Halcroft[16], Carmen Lucía Yurrita[17], Silvio Loayza[18,19], Jesús Infante [20], Alfonso Pérez[21], Amelia Nicolas[22], Alfredo Usubillaga[23], Azmi WA[24], Maria Cristina Marcucci[25], David Silva Nogueira[26], Elia Ramírez-Arriaga[27]

Single mothers' stingless bee keeper project in Terengganu, Malaysia by UMT

Conclusions

- Besides the chemical composition, the antioxidant activity and the antimicrobial activity are important overall added values for stingless bee products, to ground a medicinal approach for both nutritional and pharmaceutical applications.

- Focused targets continue developing investigations on respiratory, cardiovascular, digestive systems boosting the the immune system, protecting against cancer, COVID, and dilucidading mechanisms of action.

APIMONDIA
48° CONGRESO INTERNACIONAL DE APICULTURA CHILE 2023 4 al 8 septiembre
Desde el sur del mundo **por una apicultura sostenible**

APIBA Apiterapia & Bioactividad

UNIVERSIDAD DE LOS ANDES VENEZUELA

Muy apreciada la hospitalidad chilena en el exitoso Congreso APIMONDIA 2023

desde la línea áerea LATAM
la asistencia y recepción en el aeropuerto
la distinguida atención en el Hotel Double Tree en Vitacura
los uber taxi y los choferes de los autobuses
las recepciones con deliciosos alimentos y bebidas
la producción y gastronomía chilena
organizadores, coordinadores y asistentes
la generosidad de su gente
la miel de ulmo, de avellano y de todas sus latitudes

Te llevamos en nuestros corazones Chile

Thank you for your kind attention