

## SUPPLEMENTARY DATA

# ANTIOXIDANT ACTIVITY OF *APIS MELLIFERA* BEE PROPOLIS: A REVIEW

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### Abstract

**Background** Propolis is a natural product manufactured by bees from balsamic materials collected from plants that surround the hive, undergoing subsequent modification by the enzymes of these insects. It has several functions in the hive, such as sealing cracks and antimicrobial action. Folk medicine worldwide has used this resin in their health practices, and modern research turns its eyes to natural materials to become sources of new molecules to treat the most diverse ailments.

**Aims** This work collected information on studies that test the antioxidant activity of propolis, produced by *Apis mellifera* bees, using different antioxidant methods available.

**Methods** The search for this review was carried out in the following databases: SciELO, Google Scholar, PubMed, MEDLINE, Catalog of Dissertations and Theses of CAPES, BVS, CRD, Embase, Science Direct, Scopus and Cochrane Library. Publications in Portuguese, English and Spanish in the last decade were included.

**Results** The 173 articles chosen showed quantitative and qualitative data about the potential of this natural product in the area of interest. Propolis extracts reached amazing values in antioxidant tests; they were as active as isolated substances already recognized as standard patterns. Many studies have brought information about the antioxidant mechanisms of propolis, such as free radical scavenging, metal chelation, and electron donation.

**Conclusión** This review brings scientific evidence, *in vitro* and *in vivo*, that supports the idea that propolis is a good candidate for producing new antioxidant pharmaceutical and food formulations in the future.

**Keywords:** *Apis mellifera*; propolis; antioxidant activity

## INTRODUCTION

## Supplementary material

Table S1: Search strategy in each database chosen for this literature review.

Database	Search	Results
Scholar Google: English	" <i>Apis mellifera</i> " AND "propolis" AND "antioxidant activity"	1000
Scholar Google: Portuguese	" <i>Apis mellifera</i> " AND "propolis" AND "atividade antioxidante"	440
PubMed: English	((("bees"[ <i>MESH</i> Terms] OR "bees"[All Fields] OR "apis"[All Fields]) AND "mellifera"[All Fields] AND ("propolis"[ <i>MESH</i> Terms] OR "propolis"[All Fields]) AND ("antioxidants"[Pharmacological Action] OR "antioxidants"[ <i>MESH</i> Terms] OR "antioxidants"[All Fields] OR ("antioxidant"[All Fields] AND "activity"[All Fields]) OR "antioxidant activity"[All Fields])) AND (2011:2021[pdat]))	17
PubMed: Portuguese	((("bees"[ <i>MESH</i> Terms] OR "bees"[All Fields] OR "apis"[All Fields]) AND "mellifera"[All Fields] AND ("propolis"[ <i>MESH</i> Terms] OR "propolis"[All Fields]) AND (("atividade"[All Fields] OR "atividades"[All Fields]) AND ("antioxidante"[All Fields] OR "antioxidantes"[All Fields])))	0
SciELO: English	( <i>Apis mellifera</i> ) AND (propolis) AND (antioxidant activity)	12
SciELO: Portuguese	( <i>Apis mellifera</i> ) AND (propolis) AND (atividade antioxidante)	0
Cochrane Library: English	<i>Apis mellifera</i> in Title Abstract Keyword AND propolis in Title Abstract Keyword AND antioxidant activity in Title Abstract Keyword - (Word variations have been searched)	0
Cochrane Library: Portuguese	<i>Apis mellifera</i> in Title Abstract Keyword AND propolis in Title Abstract Keyword AND atividade antioxidante in Title Abstract Keyword - (Word variations have been searched)	0
BVS: English	( <i>Apis mellifera</i> ) AND (propolis) AND (antioxidant activity) AND (year_cluster:[2011 TO 2021])	21
BVS: Portuguese	(( <i>Apis mellifera</i> ) AND (propolis) AND (atividade antioxidante) AND (year_cluster:[2011 TO 2021]))	02
CAPES: English	" <i>Apis mellifera</i> " AND "propolis" AND "antioxidant activity"	14
CAPES: Portuguese	" <i>Apis mellifera</i> " AND "propolis" AND "atividade antioxidante"	13
Scopus: English	( TITLE-ABS-KEY ( " <i>Apis mellifera</i> " ) AND TITLE-ABS-KEY ( propolis ) AND TITLE-ABS-KEY ( "antioxidant activity" ) ) AND PUBYEAR > 2010 AND PUBYEAR < 2022	56

Scopus: Portuguese	( TITLE-ABS-KEY ( " <i>Apis mellifera</i> " ) AND TITLE-ABS-KEY ( propolis ) AND TITLE-ABS-KEY ( "atividade antioxidante" ) ) AND PUBYEAR > 2010 AND PUBYEAR < 2022	0
CRD: English	(( <i>Apis mellifera</i> ) AND (propolis) AND (antioxidant activity)) and ((Systematic review:ZDT and Bibliographic:ZPS) OR (Systematic review:ZDT and Abstract:ZPS) OR (Cochrane review:ZDT) OR (Cochrane related review record:ZDT) OR (Economic evaluation:ZDT and Bibliographic:ZPS) OR (Economic evaluation:ZDT and Abstract:ZPS) OR Project record:ZDT OR Full publication record:ZDT) IN DARE, NHSEED, HTA FROM 2011 TO 2021	0
CRD: Portuguese	(( <i>Apis mellifera</i> ) AND (propolis) AND (atividade antioxidante)) and ((Systematic review:ZDT and Bibliographic:ZPS) OR (Systematic review:ZDT and Abstract:ZPS) OR (Cochrane review:ZDT) OR (Cochrane related review record:ZDT) OR (Economic evaluation:ZDT and Bibliographic:ZPS) OR (Economic evaluation:ZDT and Abstract:ZPS) OR Project record:ZDT OR Full publication record:ZDT) IN DARE, NHSEED, HTA FROM 2011 TO 2021	0
Embase: English	' <i>Apis mellifera</i> ' AND propolis AND 'antioxidant activity' AND [2011-2021]/py	29
Embase: Portuguese	' <i>Apis mellifera</i> ' AND propolis AND 'atividade antioxidante' AND [2011-2021]/py	0
Science Direct: English	" <i>Apis mellifera</i> " AND "propolis" AND "antioxidant activity"	161
Science Direct: Portuguese	" <i>Apis mellifera</i> " AND "propolis" AND "atividade antioxidante"	0

**Table S2** | Data on the collection methodology and information on samples of the 173 materials used in this literature review.

Author	Collection location	Bee species	Propolis	Collection period	Extraction	Vegetation/Possible Botanical Origin
Abubaker, and Fageer, 2017 (157)	Darfur and Kosti - Sudan	<i>A. mellifera</i>	-	-	MEP (1:3) Methanol 40% Dynamic maceration (room temperature) – 5 hours	-
Aguiar, 2015 (10)	Alagoas - Brazil	<i>A. mellifera</i> L.	Red	June (2006)	EEP Ethanol 95% Maceration – 14 days	<i>Dalbergia ecastapillum</i>
Al Naggat <i>et al.</i> , 2016 (42)	Saskatchewan, Ontario and British Columbia - Canada	<i>A. mellifera</i>	-	2015	EEP (1:10) Ethanol 70% Maceration (room temperature) – 72 hours	-
Alves, 2018 (5)	Rio Grande do Sul – Brazil	<i>A. mellifera</i> (Africanized)	Type 02	November (2015)	EEP (1:10) Ethanol 80% Dynamic maceration (room temperature) - 24 hours (microcapsule)	-
Andrade <i>et al.</i> , 2017 (43)	Alagoas and Sergipe – Brazil	<i>A. mellifera</i>	Brown, Green, and Red	January and July (2016)	EEP (2:15) Ethanol 70% Ultrasound (35°C) - 1 hour	<i>Baccharis dracunculifolia</i>
Andrade <i>et al.</i> , 2018 (36)	Sergipe and Bahia – Brazil	<i>A. mellifera</i> L.	Brown, Green, and Red	July (2016)	EEP (2:15) Ethanol 70% Ultrasound - 1 hour (microparticles)	-
Aranguena Salazar, 2019 (44)	Andahuaylas - Peru	<i>A. mellifera</i>	-	-	EEP (3:10) Ethanol 96° Dynamic maceration	-

					(room temperature) - 48 hours	
Araújo <i>et al.</i> , 2020 (45)	Pará - Brazil	<i>A. mellifera</i>	-	-	Hexane Maceration - 48 hours (3x)	-
Arslan <i>et al.</i> , 2021 (47)	Ardahan and Erzurum - Turkey	<i>A. mellifera caucasica</i>	-	October (2016)	EEP (1:50) Ethanol 70% Ultrasound - 30 minutes	-
Arruda, 2019 (46)	Alagoas - Brazil	<i>A. mellifera</i>	Red	March (2011) to February (2012)	EEP (1:15) Ethanol 80% Maceration (3x)	<i>Dalbergia ecastapillum</i>
Augusto-Obara <i>et al.</i> , 2019 (48)	Minas Gerais - Brazil	<i>A. mellifera</i> (Africanized)	Green	April (2015)	EEP (2:25) Ethanol 70% Dynamic maceration (45 °C) - 20 minutes	<i>Baccharis dracunculifolia</i>
Bakkaloglu, Arici, and Karasu, 2021 (49)	Yeşilova-Denizli - Turkey	<i>A. mellifera</i>	-	-	Several (1:10) Ethanol 70%, Distilled water, DMSO, and propylene glycol. Ultrasound (30, 45 and 60 °C) - 1, 2 and 3 minutes and Dynamic maceration (20°C) - 24 hours	-
Béji-Srairi <i>et al.</i> , 2020 (50)	Tebourba, Ain Haroun , Uthina and Djebel Boukornine - Tunisia	<i>A. mellifera</i>	-	December to March - End of the rainy season	EEP (1:2) Absolute ethanol Maceration (4°C) – 72 hours	-

Bhargava <i>et al.</i> , 2014 (51)	Bangalore and Karnataka - India	<i>A. mellifera</i>	-	-	EEP Ethanol 95% Dynamic maceration (37°C) - 4 days	-
Bhuyan <i>et al.</i> , 2021 (52)	Young, NSW, and Kangaroo Island - Australia, in addition to Brazil and China	<i>A. mellifera</i>	-	-	EEP (1:2) Absolute ethanol Ultrasound (50°C) - 1 hour (2x)	-
Bonamigo <i>et al.</i> , 2017 (4)	Mato Grosso do Sul - Brazil	<i>A. mellifera</i>	-	Various seasons of 2015	EEP (2:9) Ethanol 80% Maceration (70 °C)	-
Boufadi <i>et al.</i> , 2014 (53)	Tigzirt, Ouled ali, Ain El Arba, Yennarou, Ain ouassara and Ksar el hirane - Algeria	<i>A. mellifica</i> <i>intermissa</i> and <i>A. mellifica</i> <i>sahariensis</i>	-	Spring (2011)	EEP (1:10) Ethanol 95% Ultrasound - 1,5 hours (3x)	-
Boulechfar <i>et al.</i> , 2019 (165)	Grarem - Algeria	<i>A. mellifera</i>	-	April (2015)	MEP (1:10) Methanol 80% Maceration - 72 hours (3x) and Essential oil Hydrodistillation (Clevenger) - 3 hours	-
Cabral <i>et al.</i> , 2012 (54)	Bahia and Minas Gerais - Brazil	<i>A. mellifera</i>	Type 6 and Type 12	January and February (2008)	EEP (2:15) Ethanol 80% Maceration (70°C) - 30 minutes (2x)	<i>Baccharis dracunculifolia</i>

Calegari <i>et al.</i> , 2017 (3)	Paraná - Brazil	<i>A. mellifera</i> (Africanized)	-	March to June (2013) and March (2015)	EEP (2:25) Ethanol 80% Maceration (70°C) - 45 minutes	-
Calegari, 2018 (26)	Paraná and Santa Catarina - Brazil	<i>A. mellifera</i>	-	-	EEP (2:25) Ethanol 80% Maceration (45°C) - 45 minutes	-
Cao <i>et al.</i> , 2017 (7)	Shandong - China	<i>A. mellifera</i>	Poplar	Summer (2010)	EEP Ethanol 95% Ultrasound (40°C) - 3 hours (3 times)	<i>Populus</i> spp.
Capucho <i>et al.</i> , 2012 (190)	São Paulo - Brazil	<i>A. mellifera</i> L.	Green	February (2010)	WEP (3:10) Distilled water Dynamic maceration (room temperature) - 7 days	<i>Baccharis dracunculifolia</i>
Castro <i>et al.</i> , 2014 (34)	Santiago - Chile	<i>A. mellifera</i>	-	Spring (2011)	EEP (4:10000) Ethanol 90% Maceration (70°C) - 30 minutes (multiple repetitions)	-
Cavalaro, 2017 <sup>1*</sup> (29)	Minas Gerais - Brazil	<i>A. mellifera</i> (Africanized)	Green	November (2015)	EEP (1:10 a 1:30) Ethanol 0 to 99% Ultrasound (25°C) - 5 to 45 minutes	<i>Baccharis dracunculifolia</i>
Cavalaro, 2017 <sup>2*</sup> (29)	Minas Gerais - Brazil	<i>A. mellifera</i> (Africanized)	Green	November (2015)	WEP and EEP (1:20 to 1:50) Ethanol 14,4; 49,5; 84,6; 99% Ultrasound - 20 minutes (emulsion)	<i>Baccharis dracunculifolia</i>

Cavalaro, Fabricio, and Vieira, 2020 (55)	Minas Gerais - Brazil	<i>A. mellifera</i> (Africanized)	Green	March (2018) - Flowering season	EEP (1:35) Ethanol 99% Ultrasound (25°C) - 20 minutes	<i>Baccharis dracunculifolia</i>
Cécere <i>et al.</i> , 2021 (56)	Santa Catarina - Brazil	<i>A. mellifera</i>	-	-	WEP (1:100) Distilled water Ultrasound - 3 hours, followed by Maceration - 3 hours	-
Ceylan, and Halime, 2020 (57)	Anatolia - Turkey	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 96% Maceration (37°C) - 5 days	-
Coelho, 2013 (58)	Paraná, Rio Grande do Sul, Santa Catarina and Minas Gerais - Brazil	<i>A. mellifera</i>	Green	2010 and 2011	EEP Ethanol 80% Dynamic maceration (70°C) - 1 hour (2x)	<i>Baccharis dracunculifolia</i>
Coelho <i>et al.</i> , 2017 (20)	Minas Gerais, Paraná, Santa Catarina and Rio Grande do Sul - Brazil	<i>A. mellifera</i>	Green	2010 and 2011	EEP (1:10) Ethanol 80% Maceration (70°C) - 1 hour (2x)	<i>Baccharis dracunculifolia</i>
Correa <i>et al.</i> , 2016 (59)	Minas Gerais - Brazil	<i>A. mellifera</i>	Green	-	EEP Absolute ethanol Maceration (30°C) (1x and 2x)	<i>Baccharis dracunculifolia</i> , <i>Schinus terebenthifolius</i>
Cottica <i>et al.</i> , 2011 (60)	Paraná - Brazil	<i>A. mellifera</i>	Organic	-	EEP (5% e 30%) Ethanol 60 and 96% Turbo extraction - 15	-



					minutes (spray dryer): Patent PI 0605768-3	
Cruz, 2011 (61)	Beira Interior - Portugal	<i>A. mellifera L.</i>	-	August (2010)	EEP Absolute ethanol Dynamic maceration (room temperature) (3x)	-
Da Cruz Almeida <i>et al.</i> , 2017 (62)	Alagoas - Brazil	<i>A. mellifera</i>	Red	April (2012)	EEP (5:12) Ethanol 80% Maceration (3x) (microcapsules)	-
Da Cunha, 2017 (166)	Minas Gerais - Brazil	<i>A. mellifera</i>	Green	-	EEP (3:10) Ethanol 80% Dynamic maceration (50°C) - 30 minutes	<i>Baccharis dracunculifolia</i>
Da Graça Miguel <i>et al.</i> , 2014 (63)	Fez-Boulemane, Taza, East, Khenifra, Rabat, Gharb, Tanger, Agadir - Morocco	<i>A. mellifera</i>	-	-	EEP (1:30) Ethanol 70% Dynamic maceration (37°C) - 96 hours	-
Dărăban <i>et al.</i> , 2019 (64)	Arad and Bihor - Romania	<i>A. mellifera L.</i>	-	-	EEP (1:10) Ethanol 70% Maceration - 48 hours	-
Da Silva <i>et al.</i> , 2013 (65)	São Paulo - Brazil	<i>A. mellifera</i>	Green	-	EEP (3:10) Ethanol 80°GL Dynamic maceration (50°C) - 30 minutes (added to carrier systems)	-
Da Silva <i>et al.</i> , 2018 (66)	Paraná - Brazil	<i>A. mellifera</i>	-	-	EEP (2:25) Ethanol 80% Maceration (70°C) - 45 minutes	-

Da Silveira <i>et al.</i> , 2016 (188)	Mato Grosso do Sul - Brazil	<i>A. mellifera</i>	Yellow	January (2011)	EEP (1:10) Absolute ethanol Dynamic maceration (room temperature) - 24 hours	-
De Almeida, 2017 (67)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	EEP (2:7) Ethanol 93% Maceration - 48 hours (2x) (microcapsules)	<i>Dalbergia ecastapillum</i>
De Francisco <i>et al.</i> , 2018 (30)	Paraná - Brazil	<i>A. mellifera</i> L.	-	-	EEP (3:7) Absolute ethanol Turbo extraction (100°C)	<i>Pinus sp.</i> , <i>Araucaria heterophylla</i> , <i>Eucalyptus sp.</i> , <i>Baccharis dracunculifolia</i>
De Lima <i>et al.</i> , 2019a (25)	Minas Gerais – Brazil	<i>A. mellifera</i> L.	Brown	June (2017)	Essential oil Hydrodistillation (Clevenger) - 3 hours	-
De Lima <i>et al.</i> , 2019b (68)	Santa Catarina - Brazil	<i>A. mellifera</i>	Green	-	Essential oil (1:5) Ethanol 96° Soxhlet - 5 hours	<i>Baccharis dracunculifolia</i>
Del Río Del Rosal <i>et al.</i> , 2017 (167)	Andalusia – Spain and Třeboň - Czech Republic	<i>A. mellifera</i>	-	August (2012), May and December (2015), February and May (2016)	EEP (3:10) Absolute ethanol Dynamic maceration (room temperature) - 10 days	-
De-Melo <i>et al.</i> , 2014 (16)	Bahia, Rio Grande do Norte, Maranhão,	<i>A. mellifera</i> L.	-	2003 to 2005	MEP (1:50) Absolute ethanol Dynamic maceration (60°C) - 1 hour (2x)	Solanaceae, <i>Borreria verticillata</i> , Arecaceae, Sapindaceae, <i>Mimosa</i>

	Paraíba, Minas Gerais, São Paulo, Rio de Janeiro, Paraná, Santa Catarina, Rio Grande do Sul, Mato Grosso do Sul - Brazil					<i>verrucosa, Eucalyptus, Asteraceae</i>
De Mendonça, 2014 (69)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	EEP (5:12) Ethanol 80% Dynamic maceration - 48 hours (natrosol gel)	<i>Dalbergia ecastapillum</i>
De Moraes <i>et al.</i> , 2021 (154)	Alagoas - Brazil	<i>A. mellifera L.</i>	Red	-	EEP (1:100) Ethanol 60, 75 and 90% Dynamic maceration (30, 55 and 80°C) - 30, 60 and 90 minutes	<i>Dalbergia ecastapillum e Symphonia globulifera</i>
De Oliveira, 2015 (182)	Northen zones, Center and , Terceira Island of the Azores Terceira Island of the Azores - Portugal	<i>A. mellifera L.</i>	-	-	EEP (1:5) Absolute ethanol Dynamic maceration (24°C) - 24 hours (2x)	-
De Oliveira, and Andolfatto, 2014 (70)	Paraná - Brazil	<i>A. mellifera</i> genetically modified	-	2013	EEP Ethanol 50, 65 and 80% Maceration (30, 50 and 70°C) - 15,30 and 45 minutes	-

De Souza <i>et al.</i> , 2018 (71)	Pará - Brazil	<i>A. mellifera</i>	-	-	Essential oil Hydrodistillation (Clevenger) - 3 hours and EEP Absolute ethanol Maceration (25°C) - 24 hours (3x)	-
Devequi-Nunes <i>et al.</i> , 2018 (72)	Bahia - Brazil	<i>A. mellifera</i> L.	Green, Brown and Red	-	EEP (2:15) Ethanol 80% Dynamic maceration (70°C) - 30 minutes (2x) and Supercritical CO <sub>2</sub> extraction with co- solvent: Ethanol 1% (50°C) - 1 hour	<i>Baccharis dracunculifolia</i> , <i>Dalbergia ecastopillum</i> (L.) <i>Taub.</i> (Fabaceae), <i>Copaifera</i> spp.
Ding <i>et al.</i> , 2021 (73)	Heilongjiang, Henan - China	<i>A. mellifera</i>	-	April, June, and August	EEP (1:20) Ethanol 95% Ultrasound - 30 minutes (3x) and Conventional extraction under the same conditions	-
Do Nascimento <i>et al.</i> , 2016 (74)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	EEP (5:12) Ethanol 80% Dynamic maceration - 48 hours (nanoparticles); after discarding the wax, 600	-

					mL of Ethanol 80% was added (shaking - 24 hours) (nanoparticles)	
Do Nascimento <i>et al.</i> , 2019 (75)	Alagoas - Brazil	<i>A. mellifera</i> (africanized)	Red	-	EEP (3:10) Absolute ethanol (99°GL ) Maceration (room temperature) - 48 hours (3x - 7 days) (microcapsules)	<i>Dalbergia ecastopillum</i>
Duca <i>et al.</i> , 2019 (76)	Bihor, Caras-Severin, Arad, Satu Mare, Timis - Romania	<i>A. mellifera</i>	-	2015 and 2016	EEP (1:20) Ethanol 60% Dynamic maceration (room temperature) - 1 hour	-
El-Guendouz <i>et al.</i> , 2016 (187)	Different regions of Morocco	<i>A. mellifera</i>	-	-	EEP (1:30) Ethanol 70% Dynamic maceration (37°C) - 7 days	-
El Meniiy <i>et al.</i> , 2021 (77)	Different regions of Morocco	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 70% Dynamic maceration (room temperature) - 7 days	-
El Sohaimi, and Masry, 2014 (78)	Middle delta region – Egypt; and Anhui - China	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 90% Dynamic maceration (room temperature) - 24 hours	-

Ertürk <i>et al.</i> , 2016 (158)	Rize - Turkey	<i>A. mellifera</i>	-	October and November (2006)	EEP (1:5) Ethanol 95% Maceration (4°C) - 7 days	-
Ezzat <i>et al.</i> , 2019 (79)	Giza - Egypt	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 70% Maceration (room temperature) – 14 days	-
Falcão, 2013 <sup>1*</sup> (13)	Several regions of mainland Portugal, Azores Archipelago, and Madeira Island	<i>A. mellifera L.</i>	-	-	EEP Ethanol 80%	-
Falcão, 2013 <sup>2*</sup> (13)	Northeast of Portugal	<i>A. mellifera L.</i>	-	Autumn (2007)	Methanol	<i>Populus x canadenses</i> , <i>Cistus ladanifer</i> , <i>Origanum</i> spp.
Falcão, 2013 <sup>3*</sup> (13)	Different regions of Portugal	<i>A. mellifera L.</i>	-	July to September (2007 - 2009)	Essential oil Hydrodistillation Cleavenger - 3 hours	<i>Populus x canadenses</i> , <i>Cistus ladanifer</i>
Falcão, 2013 <sup>4*</sup> (13)	Bragança - Portugal	<i>A. mellifera</i>	-	Spring	Absolute ethanol	<i>Populus x canadenses</i> , <i>Cistus ladanifer</i>
Fangio <i>et al.</i> , 2019 (80)	Buenos Aires - Argentina	<i>A.mellifera L.</i>	-	-	EEP (3:7) Ethanol 70% Maceration (22–25°C) - 7 days	-
Farias Azevedo <i>et al.</i> , 2018 (81)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	EEP (5:12) Ethanol 80% Dynamic maceration - 48 hours (3x) (nanoparticles)	-

Ferreira <i>et al.</i> , 2017 (83)	Rio Grande do Norte - Brazil	<i>A. mellifera</i> L. (africanized)	-	June and July (2013) and February (2014) - Prolonged drought period	Essential oil (1:15) Absolute ethanol Soxhlet - 6 hours	<i>Mimosa tenuiflora</i>
Ferreira, 2015 (2)	Rio Grande do Norte - Brazil	<i>A. mellifera</i> L. (africanized)	-	June (2013) to February (2014)	Essential oil (1:15) Absolute ethanol Soxhlet - 6 hours (2x)	-
Ferreira, 2017 (6)	Rio Grande do Sul, Alagoas and Minas Gerais - Brazil	<i>A. mellifera</i> (africanized)	Amber, Green and Red	March (2014) and September (2015)	EEP (1:10) Absolute ethanol Dynamic maceration (room temperature) - 7 days	<i>Baccharis dracunculifolia</i> , <i>Dalbergia ecastapillum</i> , <i>Eucalyptus sp.</i>
Ferreira, 2019 (82)	Rio Grande do Norte - Brazil	<i>A. mellifera</i> L.	Green	February (2014) and June/July (2013) – Prolonged drought	Essential oil (1:15) Absolute ethanol Soxhlet - 6 hours	<i>Mimosa tenuiflora</i>
Fianco, 2014 (8)	Minas Gerais - Brazil	<i>A. mellifera</i>	Green and Red	November (2011)	Supercritical extraction with CO <sub>2</sub> and EEP (1:1) Ethanol 70% Maceration (25° C) - 14 days (3x)	<i>Baccharis dracunculifolia</i> , <i>Dalbergia ecastapillum</i>
Galeotti <i>et al.</i> , 2017 (84)	Zhejiang - China	<i>A. mellifera</i>	-	-	EEP (1:100) Absolute ethanol -30% Ultrasound (10 minutes) and later Dynamic	-

					maceration (70°C) - 2 hours	
Gargouri <i>et al.</i> , 2019 (168)	Kasserine, Béja, El Kef and Monastir - Tunisia	<i>A. mellifera</i> L.	-	-	Essential oil (1:50) Ethanol 80% Glass reactor (40°C) - 3 hours and EEP (2:15) Ethanol 80% Ultrasound - 20 minutes (3x)	-
Gokduman, 2019 (159)	Central Anatolia - Turkey	<i>A. mellifera</i> L.	-	-	EEP (1:20) Absolute ethanol Dynamic maceration (60°C) - 24 hours	-
Gonçalves, Santos, and Srebernich, 2011 (9)	Minas gerais - Brazil	<i>A. mellifera</i>	Green	-	Essential oil (1:20) Absolute ethanol Soxhlet - 24 hours	-
Graikou <i>et al.</i> , 2016 (178)	Various regions of Greece, Aegean Islands, Cyprus, Croatia, and Algeria	<i>A. mellifera</i> L.	-	Spring to Summer (2008 to 2011)	EEP (1:10) Ethanol 70% Maceration (room temperature) - 24 hours	<i>Pinus</i> sp., <i>Cupressus sempervirens</i> , <i>Populus nigra</i>
Guo <i>et al.</i> , 2011 (85)	Various regions of China	<i>A. mellifera</i> L.	-	-	WEP (1:5) Distilled water Maceration (60°C) - 7 hours (2x)	-
Hames-Kocabas <i>et al.</i> , 2013 (86)	North East of Anatolia - Turkey	<i>A. mellifera</i> L.	-	Spring (2011)	EEP (1:5) Ethanol 96% Dynamic maceration	-



					(room temperature) - 18 hours and Essential oil (HS-SPME)	
Ikeda, 2020 (87)	Paraná - Brazil	<i>A. mellifera</i> L.	Organic	-	EEP (2:25) Ethanol 80% Dynamic maceration (70°C) - 30 minutes and Essential oil Hydrodistillation (Cleavenger) - 4 hours	-
Irigoit, Yamul, and Navarro, 2021 (88)	Buenos Aires - Argentina	<i>A. mellifera</i> L.	-	-	EEP (1:9) Ethanol 96° Maceration (40°C) – 72 hours (co-crystallized powder with sucrose)	-
Jansen, 2015 (40)	Rio Grande do Sul - Brazil	<i>A. mellifera</i>	-	September to November (2013) – Spring	EEP (1:10) Ethanol 80% Dynamic maceration (room temperature) - 3 hours	-
Jeong <i>et al.</i> , 2012 (179)	Gyeongnam - Korea	<i>A. mellifera</i>	-	-	WEP (1:10) Decoction (100°C) - 2 hours	-
Jiang <i>et al.</i> , 2020 (89)	Various regions of China	<i>A. mellifera</i>	-	-	EEP (3:50) Ethanol 95% Ultrasound - 45 minutes (3x)	-
Jug, Končić, and Kosalec, 2014 (90)	Zagreb - Croatia	<i>A. mellifera</i> L.	Poplar	2010	EEP and WEP (1:5) Pure water, Ethanol 40	<i>Populus</i> sp.

					and 80% Dynamic maceration (25-50°C) - 24 hours and EEP and WEP (1:5) Pure water, Ethanol 40 and 80% Ultrasound (ice bath) - 30 minutes	
Karadal <i>et al.</i> , 2018 (195)	Central Anatolia - Turkey	<i>A. mellifera anatoliaca</i>	-	-	EEP (3:10) Ethanol 70% Maceration (70°C) – 7 days	-
Kasote <i>et al.</i> , 2017 (12)	Thirteen regions of India	<i>A. mellifera</i>	-	June to October (2016)	EEP (1:10) Absolute ethanol Maceration	-
Kiziltas; Erkan, 2020 (160)	Turkey	<i>A. mellifera caucasica</i>	-	June to October	EEP (3:50) Ethanol 98% Dynamic maceration (25°C) - 48 hours	-
Kumar <i>et al.</i> , 2011 (91)	Tamilnadu - India	<i>A. mellifera</i>	-	December (2009)	EEP (1:10) Ethanol 80% Dynamic maceration (room temperature) – 72 hours	-
Kumazawa <i>et al.</i> , 2013 (21)	Andalusia - Spain	<i>A. mellifera</i> L.	-	Spring to Winter (2006-2007)	EEP (1:30) Absolute ethanol Maceration (room temperature) - 24 hours	<i>Castanea sativa</i> , <i>Quercus</i> sp, <i>Populus</i> sp, <i>Eucalyptus</i> sp, <i>Salix</i> sp, <i>Pinus</i> sp.

Kumul <i>et al.</i> , 2020 (92)	Yucatán - Mexico	<i>A. mellifera</i>	-	-	EEP (3:10) Ethanol 95% Maceration (25°C) - 28 days	-
Kunrath <i>et al.</i> , 2017 (93)	Paraná - Brazil	<i>A. mellifera</i> L.	-	August (2014)	EEP (1:10) Ethanol 70% Turbo extraction (spray dryer)	-
Kunrath, and Savoldi, 2014 (28)	Paraná - Brazil	<i>A. mellifera</i> L.	-	-	EEP (1:9) Ethanol 70% Maceration - 48 hours, with Turbo extraction - 15 minutes, between the two extraction days (spray dryer)	-
Kurek-Górecka <i>et al.</i> , 2012 (94)	Kamianna - Poland	<i>A. mellifera</i>	-	Summer (2006)	EEP (1:10) Ethanol 35% Maceration – 14 days	-
Labyad <i>et al.</i> , 2016 (39)	Tarhona - Líbia	<i>A. mellifera</i>	-	Spring (2014)	EEP (1:5) Absolute ethanol Maceration - 7 days	-
Lacerda, 2012 (35)	Paraná and Santa Catarina - Brazil	<i>A.mellifera</i>	Organic	February and March (2011 - Summer), December and January (2012 - Summer), Autumn and Spring (2011)	EEP (2:25) Ethanol 80% Ultrasound - 15 minutes	<i>Baccharis dracunculifolia</i>

Luis-Villaroya <i>et al.</i> , 2015 (95)	Zaragoza - Spain	<i>A. mellifera</i> L.	-	-	Propylene Glycol Maceration (36°C) - 48 hours (daily supplement)	<i>Populus</i> spp., <i>Quercus</i> spp., <i>Pinus</i> spp.
Machado <i>et al.</i> , 2016 (96)	Sergipe, Alagoas, Minas Gerais, Paraná, Santa Catarina and Rio Grande do Sul - Brazil	<i>A. mellifera</i>	Green, Brown and Red	July to September (2013)	Supercritical CO <sub>2</sub> extraction with co-solvent: Ethanol 1% (50°C) - 2,5 hours and EEP (2:15) Ethanol 80% Dynamic maceration (70°C) - 30 minutes	<i>Baccharis dracunculifolia</i> , <i>Dalbergia ecastopillum</i> , <i>Copaifera</i>
Marcussi, and Gutierrez-Gonçalves, 2013 (97)	Ceará - Brazil	<i>A. mellifera</i> L.	-	-	Essential oil (4:125) Absolute ethanol Soxhlet	-
Masek <i>et al.</i> , 2019 (98)	Various regions of Poland	<i>A. mellifera</i> L.	-	2016	EEP (1:5) Ethanol 70% Dynamic maceration (room temperature) - 7 days	-
Mello, and Hubinger, 2012 (99)	São Paulo - Brazil	<i>A. mellifera</i>	Green	-	EEP and WEP (1:8) Ethanol 80% and Deionized water Maceration (room temperature) - 2 hours, 1 - 10 days (pH 2,0-8,0)	<i>Baccharis dracunculifolia</i>

Mendez-Pfeiffer <i>et al.</i> , 2020 (100)	Sonora - Mexico	<i>A. mellifera</i>	-	Winter (2014) to Spring (2015)	MEP (1:5) Absolute methanol Maceration – 72 hours	<i>Ambrosia deltoidea</i> , <i>Encelia farinosa</i> , <i>P. fremontii</i>
Miguel <i>et al.</i> , 2014 (101)	Algarve - Portugal	<i>A. mellifera</i> L.	-	Winter and Spring (2008 and 2009)	WEP (1:10) Maceration (80 °C) – 3 hours	-
Mohdaly <i>et al.</i> , 2015 (102)	Fayoum - Egypt	<i>A. mellifera</i>	-	-	MEP (1:10) Absolute methanol Maceration (25°C) - overnight	-
Molnár <i>et al.</i> , 2017 (103)	Debrecen Domsod, Esztergom, Szarvas, Kecskemét, Pusztaszabolcs, Berettióújfalu, Puspokladáni, Eger and Mezokovesd - Hungary	<i>A. mellifera</i>	-	-	EEP (1:5) Ethanol 80% Dynamic maceration (room temperature) - 24 hours	-
Moncayo Luján <i>et al.</i> , 2018 (104)	Coahuila and Durango - Mexico	<i>A. mellifera</i> L.	-	-	EEP (1:10) Ethanol 70% Dynamic maceration (35°C) - 48 hours and EEP (1:10) Ethanol 70% Ultrasound (30°C) - 30 minutes	-

					and EEP (4:63) Ethanol 70% Microwaves (70°C) - 17 minutes	
Mouhoubi-Tafinine, Ouchemoukh, and Tamendjari, 2016 (24)	Adekar and Oued ghir - Algeria	<i>A. mellifera</i>	-	July (2007)	Several (1:40) Water, Ethanol 50% and 85%, Methanol 50% Dynamic maceration (room temperature 25–30 °C) - 15 hours	-
Naik, and Vaidya, 2011 (105)	Maharashtra - India	<i>A. mellifera</i>	-	-	Essential oil (5:28) Hydrodistillation (Clevenger)	-
Nina <i>et al.</i> , 2015 (106)	Region of Maule - Chile	<i>A. mellifera</i>	-	2012 to 2014	MEP (1:10) Absolute methanol Ultrasound (room temperature) - 3 minutes (2x)	-
Nina <i>et al.</i> , 2016 (107)	La Paz, Cochabamba, Chuquisaca, Tarija, Santa Cruz, Okinawa - Bolivia	<i>A. mellifera</i>	-	2013 to 2014	MEP (1:10) Absolute methanol Maceration (room temperature) (3x)	-
Nori <i>et al.</i> , 2011 (108)	São Paulo - Brazil	<i>A. mellifera</i>	Type 12	-	EEP (3:10) Ethanol 80% Dynamic maceration (50°C) - 30 minutes (microcapsules)	-

Oldoni <i>et al.</i> , 2015 (109)	Paraná - Brazil	<i>A. mellifera</i> L. (Africanized)	-	March to August (2013)	EEP Ethanol 50, 65 and 80% Maceration (30, 50 and 70°C) - 15, 30 and 45 minutes	-
Osés <i>et al.</i> , 2016 (169)	Spain	<i>A. mellifera</i>	-	2014	EEP (4:15) Ethanol 90% (food grade) Dynamic maceration (room temperature) - 48 hours	-
Osés <i>et al.</i> , 2020 (170)	South of tropical areas of America and countries of southwestern and southeastern Europe	<i>A. mellifera</i>	-	2015	EEP (1:30) Ethanol 70% (food grade) Dynamic maceration (room temperature) - 24 hours (many times)	-
Ozdal <i>et al.</i> , 2018 (110)	Various regions of Turkey	<i>A. mellifera</i> L.	-	-	EEP (1:10) Ethanol 70% Ultrasound (room temperature) - 30 minutes	-
Ozdal <i>et al.</i> , 2019 (111)	Ankara, Central Anatolia, Eastern Anatolia, Western Mediterranean, and Marmara - Turkey	<i>A. mellifera</i> L.	-	April to July (2014)	EEP (1:15) Ethanol 70% Dynamic maceration (room temperature) - 24 hours	-
Özkök <i>et al.</i> , 2021 (23)	Various regions of Turkey	<i>A. mellifera</i> L.	-	End of Summer (2019)	EEP (1:30) Ethanol 70% Dynamic maceration	-

					(room temperature) - 24 hours (2x)	
Pandolfo, 2014 (1)	South of Paraná and North of Santa Catarina - Brazil	<i>A. mellifera</i>	Organic	Summer and Autumn (2012 and 2013)	EEP (2:25) Ethanol 80% Maceration (70°C) - 30 minutes	Araucaria, pine, and eucalyptus
Pazin <i>et al.</i> , 2017 (112)	Minas Gerais - Brazil	<i>A. mellifera</i> (Africanized)	Green	March (2012)	EEP (3:10) Ethanol 70% Maceration - 2 months	<i>Baccharis dracunculifolia</i>
Peixoto <i>et al.</i> , 2021 (18)	Gerês - Portugal	<i>A. mellifera</i> L.	-	August and September (2011 to 2015)	EEP (3:20) Absolute ethanol Dynamic maceration (room temperature) - 24 hours	-
Permana <i>et al.</i> , 2020 (113)	Sulawesi - Indonesia	<i>A. mellifera</i>	-	-	EEP (1:2) Ethanol 25, 50, 75 and 100% Ultrasound (room temperature) - 24 hours (nanocarrier: phytosome)	-
Prasniewski, 2015 (114)	Paraná - Brazil	<i>A. mellifera</i>	-	March to August (2013)	EEP (2:25) Ethanol 80% Maceration (70°C) - 45 minutes	-
Quintino <i>et al.</i> , 2020 (115)	Minas Gerais - Brazil	<i>A. mellifera</i> L.	Green	June (2017)	Essential oil Hydrodistillation (1:5) (Clevenger) - 3 hours	<i>Baccharis dracunculifolia</i>



Ramnath, and Venkataramgowda, 2016 (116)	Haryana, Himachal Pradesh, Uttaranchal, Punjab, Delhi, Maharashtra, Tamil Nadu, Karnataka, Kerala, and Andhra Pradesh - India	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 70% Dynamic maceration (room temperature) - overnight (3x)	-
Righi <i>et al.</i> , 2011 (117)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	Essential oil Absolute methanol Soxhlet	-
Ristivojević <i>et al.</i> , 2018 (118)	Various regions of Turkey	<i>A. mellifera</i> L.	Poplar subtypes	-	EEP (1:10) Ethanol 80% Ultrasound - 45 minutes	<i>Populus</i> spp.
Ristivojević <i>et al.</i> , 2020 (119)	Serbia, Turkey, China, and Russia	<i>A. mellifera</i> L.	Poplar	Beginning and end of Spring and beginning of Summer	EEP (1:10) Ethanol 80% Ultrasound - 30 minutes	<i>Populus nigra</i> L.
Rivera-Yañez <i>et al.</i> , 2018 (120)	Chihuahua - Mexico	<i>A. mellifera</i>	-	November (2014)	EEP (3:10) Ethanol 70% Maceration (room temperature)	-
Rocha <i>et al.</i> , 2013 (121)	Minas Gerais, São Paulo, Rio Grande do Sul, Paraná, and Santa Catarina - Brazil	<i>A. mellifera</i>	Green	-	EEP Ethanol 70% Dynamic maceration followed by percolation	<i>Baccharis dracunculifolia</i>

Rodríguez <i>et al.</i> , 2012 (122)	Sabanalarga, Galapa, Juan de Acosta and Santo Tomás - Colombia	<i>A. mellifera</i> (africanized)	-	Second Quarter (2019) - Dry Period	EEP (3:10) Ethanol 96% Maceration (room temperature) - 48 hours (3x)	-
Rodríguez Pérez <i>et al.</i> , 2020 (123)	Estado do Mexico, Michoacán, Guanajuato, Puebla, and Veracruz - Mexico	<i>A. mellifera</i>	-	November (2010), September and November (2012), April, May, and September (2013)	EEP (1:3) Ethanol 70% Ultrasound	-
Salas <i>et al.</i> , 2016 (164)	Tucuman - Argentina	<i>A. mellifera</i> L.	-	December (2012) and March (2013) – End of spring and beginning of summer	EEP (2:25) Ethanol 80% Maceration (room temperature) - 7 days	<i>Zuccagnia punctata</i>
Salas <i>et al.</i> , 2018 (171)	Tucumán - Argentina	<i>A. mellifera</i>	Type Zuccagnia	December (2012)	EEP (2:25) Ethanol 80% Maceration (room temperature) - 7 days (otological formulation)	<i>Zuccagnia punctata</i>
Salas <i>et al.</i> , 2020 (172)	Catamarca - Argentina	<i>A. mellifera</i>	Type Zuccagnia	2015 to 2018	EEP (2:25) Ethanol 80% Ultrasound - 30 minutes	<i>Z. punctata</i> , <i>Larrea</i> sp.

Saleh, 2012 (192)	Fayoum - Egypt	<i>A. mellifera carnica</i>	-	-	WEP Distilled water (gently warmed) Maceration	-
Salgueiro, 2016 (37)	Rio de Janeiro - Brazil	<i>A. mellifera</i> Lineau (Africanized)	Green	July (2010), January to November (2012)	EEP and MEP (1:25) Ethanol 95% e Methanol 95% Dynamic maceration (room temperature) - 48 hours and Essential oil (1:80) Absolute ethanol Soxhlet - 5 hours	<i>Baccharis dracunculifolia</i> L.
Salgueiro, and Castro, 2016 (124)	Rio de Janeiro - Brazil	<i>A. mellifera</i>	Green	July (2010), March to November (2012)	EEP (1:25) Ethanol 95% Dynamic maceration (room temperature) - 48 hours	-
Sánchez <i>et al.</i> , 2020 (125)	Northwest of Mexico	<i>A. mellifera</i>	-	Winter and Summer (2012 and 2013)	EEP (1:10) Absolute ethanol Dynamic maceration (room temperature - 25°C) – 72 hours	-
Sanpa <i>et al.</i> , 2017 (41)	Chiang Rai, Lamphun, Nan, Phayao, Phrae – Thailand	<i>A. mellifera</i>	-	January (2009) to January (2010)	EEP (1:10) Ethanol 70% Ultrasound (room temperature) - 30 minutes	<i>Mangifera indica</i>

Saral <i>et al.</i> , 2019 (126)	Thrace, Anatolia, and Camili - Turkey	<i>A.mellifera carnica</i> , <i>A. mellifera anatoliaca</i> , <i>A. mellifera syriaca</i> , <i>A. mellifera caucasica</i>	-	August (2017)	MEP Absolute methanol Maceration (room temperature) - 24 hours	-
Schmidt <i>et al.</i> , 2014a (127)	Paraná - Brazil	<i>A. mellifera</i>	-	January and May (2009)	EEP (1:10) Ethanol 70% Dynamic maceration (room temperature) - 100 hours	-
Schmidt <i>et al.</i> , 2014b (128)	Paraná - Brazil	<i>A. mellifera</i>	-	November (2008)	EEP and WEP (3:15) Water and Ethanol 30, 70 and 95% Dynamic maceration (room temperature) - 100 hours	-
Shahbaz <i>et al.</i> , 2021 (129)	Faisalabad - Pakistan	<i>A. mellifera L.</i>	-	-	WEP, EEP and MEP Water, methanol 65, 80 and 95% and Ethanol 65, 80 and 95% Dynamic maceration (room temperature) - 24 hours	-

Shehata <i>et al.</i> , 2020 (130)	Egypt, Brazil, Bulgaria, Oman, Saudi Arabia, and China	<i>A. mellifera</i> L.	Green and Brown	Autumn and Spring	EEP (1:10) Absolute ethanol Maceration (room temperature 23°C) - 6 hours	-
Shubharani, Mahesh, and Yogananda Murti, 2019 (131)	Haryana, Himachal Pradesh, Uttaranchal, Karnataka and Kerala - India	<i>A. mellifera</i>	-	-	EEP Ethanol 70% Maceration (nanoparticles)	-
Silva <i>et al.</i> , 2011 (155)	South of Uruguai	<i>A. mellifera</i>	-	End of Springe beginning of Summer	EEP (1:10) Ethanol 75% Dynamic maceration (50-60°C) - 30 minutes (2x)	-
Silva <i>et al.</i> , 2018 (132)	Alagoas - Brazil	<i>A. mellifera</i>	Red	-	EEP Maceration Absolute ethanol (room temperature) - 72 hours	<i>Dalbergia ecastopillum</i>
Sime <i>et al.</i> , 2015 (133)	Agarfa, Alage, Wolaita, Holeta and Gedo - Ethiopia	<i>A. mellifera</i>	-	June and July (2011)	EEP (1:5) Ethanol 70% Maceration - 20 days	-
Sousa <i>et al.</i> , 2019 (134)	Paraná - Brazil	<i>A. mellifera</i>	Brown	November (2013)	EEP (1:25) Ethanol 95% Dynamic maceration (room temperature) - 48 hours	-

Sulaiman <i>et al.</i> , 2011 (135)	Baghdad, Dahuk, Mosul and Salah ad-Din - Iraq	<i>A. mellifera</i>	-	2007 to 2008	MEP (1:10) Absolute methanol Dynamic maceration (60°C) - 1 hour (3x)	<i>Cedrus libani</i> , <i>Abies cillicica</i> , <i>Betula alba</i> , <i>Robinia pseudoacacia</i> , <i>Cupressus sempervirens</i> , <i>Melia azedarach</i> , <i>Tamarix articulata</i> , <i>Acacia</i> spp., <i>Eucalyptus</i> spp., <i>Alnus</i> spp., <i>Pinus</i> spp., Poplars and oaks
Sun <i>et al.</i> , 2015 (136)	Beijing - China	<i>A. mellifera</i> L.	Poplar	-	WEP (1:20) EEP (1:20) Ethanol 5, 50, 75, 95,100% Ultrasound (40°C) - 5 hours	<i>Poppulus</i> spp.
Svečnjak <i>et al.</i> , 2020 (137)	Krk, Rab, Pag, Biševo and Korcula - Croatia	<i>A. mellifera carnica</i> Pollmann	Mediterranea n	2017	EEP (1:10) Ethanol 70% Ultrasound (40°C) - 45 minutes	<i>Cupressus</i> spp., <i>Juniperus spp.</i> , <i>Poplar</i> spp, <i>Cistus</i> spp.
Tiveron, 2015 (27)	Paraná and Santa Catarina - Brazil	<i>A. mellifera</i>	Organic	February to June, and December; (2011) and January (2012)	EEP (2:25) Ethanol 80% Maceration (70°C) - 30 minutes (microcapsules)	-
Tiveron <i>et al.</i> , 2016 (138)	Santa Catarina - Brazil	<i>A. mellifera</i>	Organic	February (2011) to January (2012)	EEP (2:25) Ethanol 80% Dynamic maceration (70°C) - 30 minutes	-
Tohamy <i>et al.</i> , 2014 (193)	Beni-Suef - Egypt	<i>A. mellifera</i>	-	-	WEP (1:250) Distilled water Dynamic maceration - 10 minutes	-

Toreti, 2011 (139)	São Paulo - Brazil	<i>A. mellifera</i>	Green	January to December (2009 to 2010)	EEP (2:25) Ethanol 80% Maceration (70°C) - 30 minutes	<i>Baccharis dracunculifolia</i>
Touzani <i>et al.</i> , 2018 (140)	Various regions of Morocco	<i>A. mellifera</i>	-	-	EEP (1:10) Ethanol 70% Dynamic maceration (room temperature) - 7 days	-
Valente <i>et al.</i> , 2011 (189)	Beira Interior - Portugal	<i>A. mellifera</i>	-	September (2007)	MEP (1:1) Absolute methanol Dynamic maceration (room temperature) - overnight	-
Vargas-Sánchez <i>et al.</i> , 2019 (141)	Northwest of Mexico	<i>A. mellifera</i>	-	-	EEP (1:10) Absolute ethanol Maceration (room temperature - 25°C) - 72 hours	-
Vargas-Sánchez; Torrescano-Urrutia; Sánchez Escalante, 2020 (142)	Sonora - Mexico	<i>A. mellifera</i>	-	Summer and Winter (2017)		-
Vargas Tapia, 2018 (156)	Tacna, Arequipa and Lambayeque - Peru	<i>A. mellifera</i>	-	November (2013)	EEP (2:25) Ethanol 80% Maceration (70°C) - 30 minutes	<i>Baccharis tricuneata, Alnus acuminata</i>
Venegas <i>et al.</i> , 2016 (143)	Biobío and Araucanía - Chile	<i>A. mellifera</i>	-	-	MEP (1:50) Absolute methanol	-
Wali <i>et al.</i> , 2016 (144)	Jammu and Kashmir - India	<i>A. mellifera</i>	-	-	EEP (1:5) Absolute ethanol Dynamic	-

					maceration (room temperature) - 24 hours (3x) and EEP (1:5) Ethanol 50% Dynamic maceration (room temperature) - 48 hours (3x) and WEP (1:5) MilliQ Water Dynamic maceration (room temperature) - 48 hours	
Wang <i>et al.</i> , 2016 (145)	South Korea, Brazil, China, and Australia	<i>A. mellifera</i> L.	-	-	EEP Absolute ethanol Maceration (room temperature) - 24 hours	-
Wiwekowati <i>et al.</i> , 2017 (146)	Central Java - Indonesia	<i>A. mellifera</i> sp	-	-	EEP Ethanol 96% Maceration - 24 hours	-
Wiwekowati <i>et al.</i> , 2020 (194)	Yogyakarta - Indonesia	<i>A. mellifera</i> sp	-	-	EEP Ethanol 96% Maceration - 24 hours	-
Xavier <i>et al.</i> , 2017 (147)	Bahia - Brazil	<i>A. mellifera</i>	-	May (2014)	EEP (2:25) Ethanol 80% Maceration (70°C) - 30 minutes	-
Yonar <i>et al.</i> , 2012 (184)	Central Anatolia - Turkey	<i>A. mellifera caucasica</i>	Poplar	-	EEP (1:10) Ethanol 70% Maceration (room temperature) - 24 hours	-



Yonar <i>et al.</i> , 2014 (191)	Central Anatolia - Turkey	<i>A. mellifera caucasica</i>	Poplar	-	EEP (1:10) Ethanol 70% Maceration (room temperature) - 24 hours	-
Yonar <i>et al.</i> , 2017 (173)	Central Anatolia - Turkey	<i>A. mellifera caucasica</i>	Poplar	-	EEP (1:10) Ethanol 70% Maceration (room temperature) - 24 hours	-
Yuan <i>et al.</i> , 2020 (148)	Brazil and China	<i>A. mellifera</i>	Poplar and Green	Summer (2017)	MEP (1:50) Absolute methanol Ultrasound - 1 hour (2x) and EEP (1:20) Ethanol 95% Ultrasound - 1 hour (2x)	Poplar, <i>Baccharis</i>
Yurteri, 2015 (149)	Ankara Mamak - Turkey	<i>A. mellifera</i>	-	August (2014)	EEP (1:20) Ethanol 70% Dynamic maceration - 10 days; the same was done again, but only for 2 days	-
Zeitoun <i>et al.</i> , 2019 (150)	Costa Sul - Líbano	<i>A. mellifera L.</i>	-	June and August (2014)	EEP (1:5) Ethanol 70% Dynamic maceration (30°C) - 7 days	-
Zhang <i>et al.</i> , 2015 (151)	Shandong - China	<i>A. mellifera</i>	Poplar	-	EEP Ethanol 95% Ultrasound (40°C) - 3 hours (3x)	<i>Poppulus sp.</i>
Zhang <i>et al.</i> , 2016 (152)	Shandong and Nanjing - China; and South Australia	<i>A. mellifera</i>	Poplar, Green, and Eucalyptus	-	EEP (1:4) Ethanol 95% Ultrasound (40°C) - 3 hours (3x)	<i>Poppulus sp.</i> , <i>Baccharis sp.</i> , Eucalipto.

Žižić <i>et al.</i> , 2013 (153)	Mrckovina, Babine, Miljevici, Jabuka, Velika Zupa, Zalug, and Kacevo - Serbia	<i>A. mellifera</i>	-	Summer (2011)	EEP (1:20) Ethanol 96% Dynamic maceration (room temperature) - 24 hours	-
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\*Thesis with several internal works.