International Journal of Pharmacy and Pharmaceutical Sciences

Print ISSN: 2656-0097 | Online ISSN: 0975-1491 Vol 13, Issue 2, 2021

Original Article

DISTRIBUTION AND COMPOSITION OF THE MAIN ACTIVE COMPONENTS FOUND IN STINGLESS BEE PROPOLIS FROM VARIOUS REGIONS IN INDONESIA

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Received: 24 Aug 2020, Revised and Accepted: 18 Dec 2020

ABSTRACT

Objective: The aim of this study is to map out the distribution and composition of the main active components found in stingless bee propolis from various regions in Indonesia.

Methods: The stingless bee propolis used was obtained from ten different provinces in Indonesia and the active components analysis using Gas Chromatography-Mass Spectrometer (GC-MS) pyrolyzer.

Results: This study found 85 main types of active components with concentrations ≥1%. The most frequently found active component was *alpha-d-glucopyranoside*, which had an average concentration of 28.20%.

Conclusion: There were differences between the main active components found in 14 samples of stingless bee propolis obtained from 10 provinces in Indonesia, which was due to the variety of bee species and plant origin.

Keywords: Active components, Concentration, Distribution, Plant resin, Stingless bee propolis

DOI: https://dx.doi.org/10.22159/ijpps.2021v13i2.39521. Journal homepage: https://innovareacademics.in/journals/index.php/ijpps.

INTRODUCTION

Bees are one of Indonesia's fauna that can be used for many advantages. Species of bees are divided into two main types: stingless bees and sting bees. Indonesia has approximately 46 stingless bee species spread around Sumatra and Borneo [1]. The 12 species commonly found are the *Heterotrigona itama (H. itama), Geniotrigona thorasica (G. thorasica), T. apicalis, T. terminata, T. respani, T. melanocephala, T. valdezi., T. collina, T. atripes, T. canifron, T. iridepennis,* and *T. rufibasalia* [2].

Most stingless bee species have the potential to cultivate and produce high-quality propolis in large quantities, as much as 2.243 tons per 4 mo or 6.729 tons per year [3]. Propolis is a mixture of resin substances (plant sap), gum tree bark, and shoots of plants which are collected by bees, mixed with beeswax and bees saliva [4]. Propolis can strengthen the structural stability of bees hive to prevent decomposing of the inside. Currently, propolis is mainly used in the health industry as an anti-inflammatory and antibacterial treatment and also as antioxidant serum [5]. Stingless bee propolis can provide health benefits including the prevention and treatments of diseases and consumed in prescribed dosage [6, 7]. Propolis has more than 300 different active components [8], with polyphenols (flavonoid, phenolic acid, and ester) as the main active components found in propolis, which are known to have antibacterial and antioxidant activities [9].

There are plenty of unidentified active components in stingless bee propolis due to various geographic locations, plant resins, and bees species [10]. Therefore, it is essential to discover the distribution and composition of the main active components found in stingless bee propolis from different regions in Indonesia.

MATERIALS AND METHODS

Materials

The stingless bee propolis used were obtained from 10 different provinces in Indonesia, namely *Tetragonula minangkabau* and *Sundatrigona moorei* from North Sumatra, *Tetragonula laeviceps* from Banten, *Tetragonula laeviceps* from West Java, *Tetragonula laeviceps* from Central Java, *Heterotrigona itama* from West Borneo, *Heterotrigona itama* from East Borneo, *Heterotrigona itama, Geniotrigona thorasica, Tetragonula laeviceps* from South Borneo, *Wallacetrigona incisa* and *Tetragonula biroi* from South Sulawesi, *Tetragonula fuscobalteata* from West Nusa Tenggara, and *Tetragonula fuscobalteata* from North Maluku. These bees were harvested by bee farmers and delivered to Jatinangor, Sumedang. Materials for extraction and GC-MS Analysis, such as alcohol, ethanol, paraffin were obtained from Sigma-Aldrich, USA. Propylene glycol was obtained from Merck, USA.

Propolis extraction

The first step was mixing 1 kg of raw propolis (still in the process of glass transition) with ethanol 70% at a ratio of 1:2,5 (propolis: ethanol). Then, propolis was mashed into propolis pulp and filtered using a 30-mesh filter before being left for 12 h. The filtrate was separated while the rest of the propolis pulp was mixed with ethanol 70% at a ratio of 1:1,5 (propolis: ethanol), which was repeated 3 times. Afterward, the filtrate was condensed using a rotary evaporator at a maximum temperature of 50 °C, which was proceeded until the color of propolis extract turned dark brown, then it was mixed with propylene glycol and filtered using Whatmann 50 filter paper.

GC-MS analysis

This study used the GC-MS QP equipped with pyrolyzer, with the oven temperature set at 50 °C for 5 min, then raised up to 280 °C, with a pressure of 101 kPa, column flow 0,85 ml/min. MS detector was set at ion source temperature (200 °C), interface temperature 280 °C, detector temperature 280 °C, pyrolyzer temperature 300 °C. When stable,±1 µg/1 drop liquid propolis was injected into the pyrolyzer, and GC-MS started to operate for 50 min.

RESULTS AND DISCUSSION

Distribution and composition of main active components of stingless bee propolis

The study found 85 types of main active components with concentrations of≥ 1% in 14 propolis samples obtained from 10 provinces in Indonesia. Table 1 shows *alpha d-glucopyranoside* as the most frequently found substance, which was observed in 8 different propolis samples: *H. itama* from East Borneo, *H. itama, T. laeviceps*, and *G. thorasica* from South Borneo, *W. incisa* and *T. biroi* from South Sulawesi, *T. fuscobalteata* from West Nusa Tenggara, and *T. fuscobalteata* from North Maluku. This finding aligns with a previous study which found *alpha d-glucopyranoside* as the sugar component in propolis [11].

Table 1: Main active components of stingless bee propolis

No.	Name of components	Province/Species													Average	Regions
		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1	Formamide			8.26		3.11										5.69	2
2	Limonene													4.69		4.69	1
3	2,3 butanedione	1.07														1.07	1
4	2 methyl furancarboxaldehyde	5.71		15.69		3.13		4.16								7.17	4
5	Acetoin			9.84												9.84	1
6	Acetic acid	1.28		1.53												1.41	2
7	Carbamic acid						1.05							3.45		2.25	2
8	Methoxyethyl acetate											1.16				1.16	1
9	2 propanone	4.07		4.45										3.81		4.11	3
10	Propanal/Pyruvaldehyde			6.96		1.27										4.12	2
11	Propanoic acid			1.69												1.69	1
12	Butanone			2.02												2.02	1
13	2,3 Dimethylenebutane 1,4 diacetate														2.67	2.67	1
14	Cyclobutabenzene								3.49							3.49	1
15	Cyclopentanone	1.69														1.69	1
16	Cyclopentene	1.72		4.44		1.22									1.08	2.12	4
17	Cycloheptanone		1.19									2.16				1.68	2
18	Isosorbid	4.27		5.00	0.63	4.30						1.50				3.14	5
19	Hydroquinone	2.00														2.00	1
20	Cyclohexane			1.82						1.89						1.86	2
21	Methylpyrazine			1.25												1.25	1
22	Dodecane						2.64									2.64	1
23	Decanoic acid	1.57		1.44		2.17										1.73	3
24	Dodecanoic acid/lauric acid	18.55	51.62	3.94	63.29	39.77	61.12									39.72	6
25	N-(2-hydroxyethyl) dodecanamide				3.42											3.42	1
26	Tetradecanoic acid/Myristic acid	1.61	2.92	1.10				4.09	8.89			13.92				5.42	6
27	Tetracosanoic acid				3.31											3.31	1
28	Tetracontane				4.31											4.31	1
29	Octadecanoic acid	4.50	3.60								13.17					7.09	3
30	Tridecanoic acid											2.06				2.06	1
31	Pentadecanoic acid											3.02				3.02	1
32	Octanoic acid				6.65						3.99					5.32	2
33	Octadecadienoic acid/linoleic acid														1.71	1.71	1
34	Hexadecanoic acid/Palmitic acid	4.59	10.91	2.63		1.44				2.75		1.23	4.61			4.02	7
35	Hexatriacontane				1.45											1.45	1
36	Hexanoic acid butyll ester												10.98			10.98	1
37	Tricosanone	1.01												2.23		1.62	2
38	Oxalic acid		4.49													4.49	1
39	Acetol		2.02													2.02	1
40	Oxiraneundecanoic acid		6.05													6.05	1
41	1,6 anhydro beta d Glucopyranose			7.00				18.74	16.62		3.01	4.44		3.79	24.51	11.16	7
42	Nonedecane				3.37											3.37	1
43	1,4 Anhydro d mannitol					1.18										1.18	1
44	Citronella						2.93									2.93	1
45	Alpha D Glucopyranoside							34.49	22.33	18.77	40.43	36.13	12.10	8.44	52.95	28.20	8
46	Alpha D Galactopyranoside							16.07	14.83							15.45	2
47	Alpha L Galactopyranoside														1.2	1.20	1
48	Alpha D Mannofuranoside								2.43							2.43	1
49	inositol							2.85								2.85	1
50	Styrene oxide								4.09							4.09	1
51	Isopentane								5.60							5.60	1
52	Diethyl 1,2 dioxypropyldiacetate									5.18						5.18	1
53	Diethyl ester alpha methyladipic acid									5.13						5.13	1
54	1,2,4 tri acetyl di methylribitol									4.07						4.07	1
55	N Methylisobutyrthioanilide										1.48					1.48	1

56	Galacticol, 1 thiohexyl									3.24					3.24	1
57	1,1,4,4, Tetramethyl 2 hydroxy 7 ethyl tetraline									2.85					2.85	1
58	Epoxycycloheptane										2.16				2.16	1
59	Gliserol										6.45				6.45	1
60	Naphthalene										1.83	7.51			4.67	2
61	Sinularene											7.4			7.40	1
62	Octadecatrienoic acid											10.09			10.09	1
63	1 cyclohexene 1 methanol alpha 2,6,6 tetramethyl											4.79			4.79	1
64	Methyl Trans Communate											1.43			1.43	1
65	Tridecanol											2.57			2.57	1
66	2 tert-butyl-6-methyl-5-(3-methyl-butyl)-(1-3) Dioxan-4-one											2.06			2.06	1
67	Cyclopropaneoctanoic acid											3.02			3.02	1
68	d Nerolidol											2.33			2.33	1
69	3,6 Dimethylphenanthrene											5.72			5.72	1
70	Anthracene											3.11			3.11	1
71	10-octadecynoic acid methyl ester											4.12			4.12	1
72	Hexanedioic acid											2.69			2.69	1
73	Piperylene												4.47		4.47	1
74	Nonacosanol												3.33		3.33	1
75	n Docosyl acetate												2.92		2.92	1
76	n Heptacosane												4.73		4.73	1
77	Cycloeucalenol												5.38		5.38	1
78	Cycloartenol												11.41		11.41	1
79	Tetrahexacosanetriol												4.52		4.52	1
80	Hexadecanol actetate												1.57		1.57	1
81	2,6 Dimethoxyphenol										1.67				1.67	1
82	Allicin										2.50				2.50	1
83	Azulenemethanol										2.22				2.22	1
84	Epoxycycloheptane										2.16				2.16	1
85	Dimethyl 2 hydroxy, 2 methylbutane, 1,4 dioate										4.17				4.17	1
Jumlah Komponen ≥ 1%		14	8	17	8	9	4	6	8	6	7	17	16	14	6	

Details:

- Percentage of a Compound

- 1)North Sumatra *Tetragonula minangkabau,* 2)North Sumatra *Sundatrigona moorei,* 3)Banten *T. laeviceps,* 4)West Java *T. laeviceps*, 5)Central Java *T. laeviceps*, 6)East Borneo *Heterotrigona itama*, 7)West Borneo *H. itama*, 8)South Borneo *H. itama*, 9)South Borneo *T. laeviceps*, 10)South Borneo *Geniotrigona thorasica*, 11)South Sulawesi *Wallacetrigona incisa*, 12)South Sulawesi *T. biroi*, 13)West Nusa Tenggara *T. fuscobalteata*, 14)North Maluku *T. fuscobalteata.*

The second most commonly found active component was the *1,6 anhydro beta d-glucopyranose* which were observed in 7 different propolis samples: Banten, East Borneo, South Borneo, West Nusa Tenggara Barat, and North Maluku. This active component was also found in Algeria [12]. The *hexadecanoic acid/palmitic acid* came in third after being found in 7 different propolis samples obtained from West Lampung and South Lampung [13], Bursa-Orhangazi, Bartin, and Ankara-Mamak regions [14]. The fourth most frequently found component was the *dodecanoic acid (lauric acid),* found in 6 different propolis samples, and this active component was also found in Maribaya Bandung region [15]. The fifth most commonly found component was the *tetradecanoic acid (myristic acid),* found in 6 different propolis samples; this active component can also be found in Turkey (North-West Anatolia) [14].

The sixth, seventh, eighth, ninth, and tenth most active components were *isosorbid, 2 methyl furancarboxaldehyde* (HMF), *cyclopentene, octadecanoic acid,* dan *2-propanone 1-hydroxy,* which were found in 5, 4, 4, 3, and 3 different propolis samples. The active components of *isosorbid* and *2-propanone 1-hydroxy* were found in West Lampung and South Lampung [13]. The active components of *cyclopentene* and *octadecanoic acid* were found in Bursa city in Turkey (North-West Anatolia) [14].

Concentration of main active components of stingless bee propolis

Out of the 85 active components, the ten most commonly found were analyzed. Table 1 shows the *dodecanoic acid* (*lauric acid*) had the highest average component concentration of 39,72%, which was contributed by the *T. laeviceps* propolis sample from West Java (63,29%). The finding aligns with a previous study, which found the same component in Maribaya Bandung, with a concentration of 1,32% [15]. The second-highest average component concentration was *alpha d-glucopyranoside* with 28,20%, contributed by the *T. fuscobalteata* propolis sample from North Maluku (52,95%). The finding aligns with a study in Tizi Ouzou and Babor city in Algeria, with a concentration of 1,59% and 2,74%, respectively [12]. The third highest average component concentration was *alpha d-galactopyranoside* with a percentage of 15,45%, contributed by the *H. itama* propolis sample from West Borneo (16,07%). The fourth highest average component concentration was *cycloartenol* with a concentration of 11,41% found in *H. itama* propolis sample from East Borneo, and this component was also found in Pandeglang region in Banten, with a concentration of 49,91% [16]. The fifth highest average component concentration was *1,6 anhydro beta d-glucopyranoside* with a concentration of 11,16%, which was only found in *T. fuscobalteata* propolis sample from North Maluku. The sixth, seventh, eighth, ninth, and tenth-highest average component concentration were *hexanoic acid butyl ester, octadecatrienoic acid, acetoin, sinularene,* and *2 methyl furancarboxaldehyde* (HMF) with a concentration of 10,98%; 10,09%; 9,84%; 7,40%; and 7,17%, respectively. The active components *hexanoic acid butyl ester, octadecatrienoic acid,* and *sinularene* were found in *T. biroi* propolis samples from Sulawesi Selatan. The active components of *acetoin* and *2 methyl furancarboxaldehyde* (HMF) were found in *T. laeviceps* propolis samples from Banten.

Plant origin of stingless bee propolis

Every bee species has its own plant source based on its region; thus the active propolis component varies. The variety is caused by the difference in tree type, temperature, region, and harvest time [17]. Based on the variety of the active components, the propolis type with the most diverse active components was the *W. incisa* sample from South Sulawesi, which had 17 different main active components with concentrations of ≥ 1%, namely the *methoxyethyl acetate; cycloheptanone; isosorbid; tetradecanoic acid (myristic acid); tridecanoic acid; pentadecanoic acid; hexadecanoic acid (palmitic acid);*

1,6 anhydro beta d-glucopyranose; alpha d-glucopyranoside; epoxycycloheptane; gliserol; naphthalene; 2,6 dimethoxyphenol; allicin; azulenemethanol; epoxycycloheptane; and dimethyl 2 hydroxy, 2 methylbutane, 1,4 dioate. This finding aligns with a previous study, in which plant origin from South Sulawesi province was proven to contain more active components compared to other propolis plant origin [18]. There are plenty of plant origin, such as *Mangifera indica*, *Durio zibethinus*, *Cordyline fruticosa*, *Persea americana*, *Baccaurea racemosa*, *Garcinia mangostana*, etc. *H. itama* propolis from West Borneo had the lowest active component in the resin with only 4 active components: *arbamic acid, dodecane, dodecanoic acid (lauric acid),* and *citronella*. Previous study showed resin from West Borneo had fewer main active components because of the limited variation of plants in the area, with rubber plant as the dominant plant.

Table 2: Plant origin of stingless bee propolis from 10 provinces

No.	Province	Type of stingless bee	Number of active components	Plant origin
1	North Sumatra	*T. minangkabau* *S. moorei*	14 components 8 components	*Mangifera indica*, *Artocarpus heterophyllus*, *Durio zibethinus*, *Musa paradisiaca* L.
2	Banten	*T. laeviceps*	17 components	*Coffea, Anacardium occidentale*, *Durio zibethinus, Gnetum gnenom*, *Saccharum, Nephelium lappaceum, Averrhoa carambola, Artocarpus heterophyllus, Annona muricata, Cocos nucifera, Mangifera indica, Garcinia mangostana*, *Theobroma cacao, Swietenia mahagoni, Tectona grandis, Garcinia mangostana, Artocarpus heterophyllus, Amaranthus spinosus*
3	West Java	*T. laeviceps*	8 components	*Mystica Fragrans*, *Garcinia mangostana, Artocarpus heterophyllus, Swietenia mahagoni, Tectona grandis, Garcinia mangostana, Artocarpus heterophyllus*, *Amaranthus spinosus*
4	Central Java	*T. laeviceps*	9 components	*Swietenia mahagoni, Tectona grandis, Garcinia mangostana, Artocarpus heterophyllus*, *Amaranthus spinosus*
5	West Borneo	*H. itama*	4 components	*Hevea brasiliensis*
6	East Borneo	*H. itama*	6 components	*Mangifera indica*, *Artocarpus heterophyllus*, *Durio zibethinus*, *Musa paradisiaca* L.
7	South Borneo	*H. itama* *T. laeviceps* *G. thorasica*	8 components 6 components 7 components	*Mangifera indica*, *Artocarpus heterophyllus*, *Durio zibethinus*, *Musa paradisiaca* L.
8	South Sulawesi	*W. incisa* *T. biroi*	17 components 16 components	*Mangifera indica*, *Artocarpus heterophyllus*, *Durio zibethinus*, *Musa paradisiaca* L, *Cordyline fruticosa*, *Leucaena leucocephala, Michelia champaca, Albizia chinensis, Artocarpus altilis, Baccaurea racemosa, Dillenia,*
9	West Nusa Tenggara	*T. fuscobalteata*	14 components	*Manihot glaziovii, Garcinia mangostana, Mangifera indica*, *Artocarpus heterophyllus*, *Artocarpus integer, Durio zibethinus, Citrus maxima, Musa paradisiaca* L, *Ricinus communis*
10	North Maluku	*T. fuscobalteata*	6 components	*Myristica fragrans, Syzygium aromaticum, Manihot glaziovii, Tectona grandis, Garcinia mangostana, Artocarpus heterophyllus,*

Based on table 2, the most frequent plant origin found in Indonesia was from mango plant; this was due to the high flavonoid content in the plant and its bark [19]. The other plants origin were *Persea americana, Acacia, Michelia champaca, Artocarpus integer, Erythrina variegata, Agathis dammara, Ricinus communis, Archidendron pauciflorum, Citrus maxima, Citrus limon, Theobroma cacao, Hevea brasiliensis, Mangifera odorata, Manihot glaziovii, Garcinia mangostana, Cordyline fruticosa, Leucaena leucocephala, Casuarina equisetifolia, Ceiba pentandra, Gluta renghas, Vatica, Dillenia, Manihot glaziovii, Annona muricata,* etc [20]. The difference of plants origin aligns with a study which proved the active propolis components were affected by the plants origin [21]. The higher resins in the plant, the stronger biological activity in the propolis.

Biological activities of the main active components in stingless bee propolis

Active components in stingless bee propolis have the potential to be further developed in Indonesia's healthcare sector. Based on the GC-MS analysis and library, there were 16 main active components with different biological activities (table 3).

Table 3: Biological activities of the main active components in stingless bee propolis

No.	Active components	Provinces	Biological activities	Reference
1	*Alpha d-glucopyranoside*	7,8,9,10,11,12,13,14	Anti-tuberculosis	[22, 23]
			Antibiotic	[23]
			Hepato-protective	[24]
			Antifungal	[25]
			Nutritional status recovery of pulmonary tuberculosis patients	[22]
			Antiemetic	[22]
2	*1,6 anhydro-beta-d-glucopyranose*	3,7,8,10,11,	Anti-tumor and antioxidant	[26]
		13,14	Immunostimulator	[27]
			Hepatoprotective	[22]
3	*Hexadecanoic acid/Palmitic acid*	1,2,3,5,9,11,12	Anti-tumor, antioxidant, anti-inflammatory, antiscorbutic	[28]
4	*Dodecanoic acid/lauric acid*	1,2,3,4,5,6	Antibacterial	[29, 31]
5	*Tetradecanoic acid/Myristic acid*	1,2,4,7,8,11	Antimicrobial, antioxidant	[30]
6	*Isosorbid*	1,3,4,5,11	Diuretic	[13]
7	*2-methyl-furancarboxaldehyde*	1,3,5,7	Anti-diabetes	[13]
8	*Cyclopentene*	1,3,5,14	Stimulate uterine contraction during childbirth (prostaglandin → lipid containing cyclopentene rings)	[31]
9	*Octadecanoic acid*	1,2,10	Protect β-pancreatic cells	[32]
10	*2-propane-1-hydroxy*	1,3,13	Preservatives	[13]
11	*Alpha-d-galactopyranose*	7,8	Antioxidant	[33]
12	*Cycloartenol*	13	Antibacterial, antimycotic, and antiradical	[34]
13	*Hexanoic acid butyl ester*	12	-	
14	*Octadecatrienoic acid*	12	Antimicrobial	[35]
15	*Acetoin*	3	-	
16	*Sinularene*	12	Antibacterial against *S. typhimurium* and *S. aureus*	[36]

Details:

1)North Sumatra *Tetragonula minangkabau,* 2)North Sumatra *Sundatrigona moorei*, 3)Banten *T. laeviceps,* 4)West Java *T. laeviceps*, 5)Central Java *T. laeviceps*, 6)West Borneo *Heterotrigona itama*, 7)East Borneo *H. itama*, 8)South Borneo *H. itama*, 9)South Borneo *T. laeviceps*, 10)South Borneo *Geniotrigona thorasica*, 11)South Sulawesi *Wallacetrigona incisa*, 12)South Sulawesi *T. biroi*, 13) West Nusa Tenggara *T. fuscobalteata*, 14)North Maluku *T. fuscobalteata.*

Based on table 3, the biological activities of the active components found were very diverse and complex. The main active component was the glycoside derivate *alpha-D-glucopyranoside,* which is a flavonoid compound. The role of this component is to inhibit bacterial DNA synthesis [37], inhibit receptor signals, neutralize micro-toxin, and inhibit virulent factor secretion [38]. Another advantage of *alpha-D-glucopyranoside* is its ability to act as an antiemetic substance by reducing gastrointestinal hyperactivity. In a previous study, which was conducted by giving vomiting agents to chicks, flavonoid compounds showed an effect of reduction of the stomach's excessive movement [39].

One of the components which act as an immunostimulator is 1,6-Anhydro-Beta-D-Glucopyranose, which functions as an immune system inducer to increase T cells, which will release granules to hydrolyze the *Mycobacterium tuberculosis* (*M. tbc*) cell wall [27]. This component is also hepatoprotective, which means it can protect the liver from the toxic effect of antituberculosis drugs and maintain the liver's function, which in turn will result in the maintenance of appetite. The two main active components, *alpha-D-glucopyranoside* and *1,6-Anhydro-Beta-D-Glucopyranose,* act as antioxidants which can reduce the radical compound 2,2-diphenyl-1-picrylhydrazyl (DPPH) [24].

Tetradecanoic acid and *hexadecanoic acid* are long-chain fatty acid compounds, an essential oil that works by damaging bacterial cell membranes [37]. Both of these components can also reduce the radical compound 2,2-diphenyl-1-picrylhydrazyl (DPPH) [40]. The component of dodecanoic acid/lauric acid acts as an antibacterial, which has more antibacterial effects on gram-positive bacteria compared to gram-negative bacteria [29].

2-methyl-furancarboxaldehyde has the ability to be antidiabetic, which was proven in a previous study by screening 2.4 derivatives of substitution of furan for its antidiabetic activity and compared it to standard Acarbose drugs (diabetes medications). The result showed that most of the active components were equal to those of Acarbose drugs [13]. *Cycloartenol* is found in Brazilian red propolis, which has been identified as having antibacterial, antimycotic, and antiradical activities, independently of its plant origin and chemical composition. Plenty of studies have shown that propolis has antimicrobial and antioxidant activities due to the role of stingless bee in the hive, which uses these active components to protect themselves against pathogenic microorganisms and weather elements [34].

The component *octadecatrienoic acid*, the main component of *Bauhinia purpurea* leaf extract, has shown the presence of antibacterial activity against two gram-positive bacteria (*S. aureus* and *B. subtilis*) and also has the potential to be used in the treatment of infectious diseases caused by microorganisms resistant to commercial antibiotic drugs [35].

The biological activities of some active components identified, namely the *Hexanoic acid butyl ester* and *Acetoin,* has yet to be known.

CONCLUSION

In this study, each of the 14 stingless bee propolis samples from 10 provinces in Indonesia had different main active components. The differences of the propolis LTS samples were caused by the variety of bee species and plant resins. The most frequently found active component was *alpha-d-glucopyranoside,* with an average concentration of 28,20%. The component can be utilized for its antimicrobial, antibacterial, hepatoprotective, and antifungal activities.

ACKNOWLEDGEMENT

The authors express gratitude to the Faculty of Agric. Industrial Technology of Universitas Padjadjaran for facilitating the research. We are thankful to Ahmad Sulaeman and Hardinsyah for providing a method of active component stingless bee propolis using GC-MS. We are also thankful to the National Institute of Health Research and Development team, Nunung, Sunarno, and Kambang Sariadji for providing the instrumental laboratory facilities to determine plant origin and active components using GC-MS.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors declare no conflict of interest associated with this study.

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