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Daily activities of the Klanceng bee (*Tetragonula laeviceps*, Smith 1857) and bee-pollen feed diversity and composition of propolis bioactive compounds from Turi, Sleman, Yogyakarta

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ABSTRACT. An alternative medicine that is currently developing in Indonesia is propolis from the bee *Tetragonula laeviceps*. Factors that affect the content, physical and chemical properties of propolis are the types of pollen and the daily activities of bees. Daily activities of bees can indicate the existence of a food source and the state of the biological environment around the hive. Therefore, this study aims to study the diversity of feed sources based on the daily activity of *T. laeviceps* bees, to determine the diversity of pollen and the composition of propolis bioactive compounds of *T. laeviceps* bees in the Turi region. The relationship between *T. laeviceps* bee activity in and out of the hive with environmental factors using a quadratic model. Multiple linear regression analysis using the line function. 1Identification of pollen diversity by acetolysis method. Identification of propolis composition using GC-18 MS. The morphometric measurement of bee samples used a microscope and digital microscope Supereyes, while the identification of bee samples used journal references. The peak of bee activity occurs in the morning and evening because the temperature and humidity in the hive are normal. The dominating pollen comes from annual plants including Arecaceae, Asteraceae, and Malvaceae. The dominating class of bioactive compounds in *T. laeviceps* bee propolis are alkaloids (70%), phenolics (20%), and terpenoids (5%). The location of a plant will affect the content and composition of bioactive compounds in the plant and the bioactive compounds taken by bees will affect the propolis content. The results of measuring the morphometric characters of *T. laeviceps* bees in Sleman, Yogyakarta and Pandeglang, Banten have the same characteristics pattern because they have the same geographic location

Keywords: bioactive compounds; daily activities of bees; propolis; *Tetragonula laeviceps*; type of pollen

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INTRODUCTION

Indonesia is a country that has abundant natural resources and its flora and fauna biodiversity is widely used by the people of Indonesia because it has many benefits for human life, one of which can be used as an alternative medicine. Currently, the use of alternative medicine is increasing because it can be used to increase the body's defense or immunity and guard against various diseases at relatively low prices. Bees are one of the insects that are widely cultivated by the people of Indonesia because of their abundant properties, especially as a defense or immune system. The type of bee that is commonly cultivated in Indonesia is *Tetragonula laeviceps* or commonly called the Klanceng bee. This bee is a type of stingless bee that acts as a pollinator in pollination, thus these bees are often found in flowering plants (Pribadi, 2020).

The daily activity of *T. laeviceps* bees is flight out of the hive that has a nearby food source. Bees fly out of the hive to gather their food sources in the form of pollen and nectar (Abou-Shaara *et al*., 2013). In addition, the activity of *T. laeviceps* bees in and out of the nest also aims to protect the nest from predator attacks and to clean the dirt in the nest (Agussalim *et al*., 2015). Generally, the activity of flying out of the hive is carried out by worker bees. Plants that are often used as food sources by bees are *Impatiens balsamina, Carica papaya, Ageratum houstoniaum, Psidium guajava, Helianthus* sp., *Acacia* sp., *Caliandra brevipes, Mimosa pudica, Capsicum* sp., and *Cocos nucifera*. In addition, there are several other types of flowering plants, namely *Leucas aspera*, *Ocimum sanctum*, and *Tridax procumbents* (Kumar *et al*. 2012). The daily flying activity of bees in search of food sources can be influenced by several environmental factors including the distance of the feed source, air temperature, and light intensity (Shaara, 2014).

Products from *T. laeviceps* beehive that are nutritious for the body and economically viable are propolis, bee pollen, honey, beeswax, bee venom, and royal jelly. *T. laeviceps* produces less honey than honey bee species or other bee species. However, these bees produce more propolis than honey bees or other species because it balances the stinger of the *T. laeviceps* bee (Abduh *et al*., 2020). The popularity of propolis has also increased rapidly in recent years due to its abundant health benefits. Propolis is a resin collected by worker bees from plant parts such as young leaves, tree shoots, or sweet-smelling liquid from plants (Nelky *et al*., 2017). The dominant bioactive compounds in propolis are flavonoids and phenolics. Besides that, propolis also contains terpenoid compounds, steroids, and amino acids so that it can be efficacious as an anti-bacterial, anti-fungal, anti-inflammatory, and prevent various diseases such as cancer, heart disease, and diabetes (Eliza *et al*., 2012). Propolis from *T. laeviceps* bees has several advantages over propolis from other types of bees, namely high-value raw propolis and the production of propolis from *T. laeviceps* bees is more because it is used as a bee's self-defense mechanism and protects from nuisance organisms such as bacteria, fungi, and viruses (Bankova *et al*., 2014).

In addition to propolis, the main product produced by worker bees and contains a complete composition of nutrients and dietary supplements that are efficacious for human health is bee pollen. This product is derived from the male gametophyte in seed plants produced in the anthers of Angiosperms. The morphological characteristics of bee-pollen can be divided into several characteristics, namely pollen unit, pollen symmetry, pollen shape, type of aperture, and axin ornamentation (Ibrahim *et al*., 2012). The more varieties of plants that grow around the bee hive, the more morphological characters of bee pollen will be (Dahlia *et al*., 2019).

It is necessary to conduct further research on the daily activities of *T. laeviceps* bees with environmental factors that influence it and the diversity of bee pollen as a reference for plant species as a source of food for *T. laeviceps* bees and the content of propolis bioactive compounds in *T. laeviceps* bees to determine the potential use of propolis bioactive compounds in supporting public health.

MATERIALS AND METHODS

Pollen and propolis samples were taken from the nest of the *T. laeviceps* bee in Wonokerto Village, Yogyakarta. Pollen preparations were made and observed at the Laboratory of Plant Structure and Development, Faculty of Biology, Universitas Gadjah Mada. The content of propolis bioactive chemical compounds was observed at the Integrated Research and Testing Laboratory (LPPT) Universitas Gadjah Mada. The morphological identification of bees was observed at the Laboratory of Entomology, Universitas Gadjah Mada. Observations of the daily activity of bees were carried out in Giwangan, Yogyakarta.

Collection of pollen and propolis from the bee colony. Pollen samples that have been taken from the nest are stored using oil paper. Meanwhile, the propolis sample was taken from the *T. laeviceps* beehive using an iron spoon and then put into oil paper and then squeezed to separate the propolis from the honey using a filter and funnel.

Bee daily activities. Observation of daily activity in and out of the beehive of *T. laeviceps* was carried out at 05.00-18.00 WIB. Observations lasted for three days, every hour for ten min. The activity observed in the flying activity of *T. laeviceps* was by counting the number of work bees leaving and entering the hive and the number of visits by *T. laeviceps* bees to feed sources.

Preparation and identification of bee pollen. Pollen identification was carried out by using various acetolysis methods. The first step was pollen dilution by means of 4.4 g of pollen samples taken from pollen pots in one beehive. Then put into a beaker and add 100 ml of distilled water and then heated using a hotplate with a temperature of 105°C. The mixture of pollen and debris in a beaker was transferred to a glass centrifuge tube and 7 ml of distilled water was added. Separation of debris from pollen was carried out by filtering 2 times. The filtered pollen was then heated in a water bath at 100°C for 30 min. After that, the pollen was centrifuged at a speed of 1700 rpm for 5 min. Pollen put in the refrigerator for 24 h. After being allowed to stand for 24 h, the supernatant was discarded so that the pellet only left pollen and some organic matter, then 3 ml of 25% HCl solution was added and then vortexed until the ingredients were mixed. After that, it was heated with a water bath at 100°C for 5 min, then the supernatant was discarded. Next, 3 ml of 10% KOH solution was added to the pellet and then vortexed so that the ingredients were well mixed. After that, the pellet was put into an eppendorf tube to be centrifuged at 1700 rpm for 5 min. After the pellet was centrifuged, the supernatant was discarded so that the pellet only consisted of pollen (Sudaryadi *et al*., 2020).

The pellet washing process and coloring. The first step is to take the diluted pellet which is then put into a glass centrifuge tube and then mixed with distilled water and then vortexed until the solution is mixed. Then the pellet was added with distilled water up to half an eppendorf tube and then centrifuged at 1700 rpm for 5 min. The washing process was repeated 5 times until the supernatant color became clear. The coloring was conducted by the addition of 3 drops of safranin dye. Then the pellets were allowed to stand for 24 h at room temperature. After 24 h, pellets containing pollen were removed using a brush. The pollen is placed on a glass object using a toothpick and then the glycerin solution is added. After that, the object glass was closed using a cover glass. The morphological characters of pollen were observed under a light microscope with an eyepiece magnification of 10× and an objective lens of 100× connected to Optilab 3.0 software on a laptop (Anderson *et al*., 2014).

Analysis of the content of propolis bioactive compounds from bees. The extraction method used is the maceration method. The first step is to take a sample of propolis in a beehive. The sample was heated with distilled water to remove the remaining honey. Then the sample was cut into small pieces and air-dried. After the sample was dry, the sample was ground until smooth and weighed 2.2 g. After that, the sample was extracted with MeOH solution in a ratio of 1:1. Then centrifuged at 900 rpm for 5 min. The next step is to identify the bioactive compounds in the extracted propolis samples. This research was conducted at the Integrated Research and Testing Laboratory (LPPT) Universitas Gadjah Mada. At this stage, gas chromatography was injected with the results in the form of a compound chromatographic profile. A total of 1.6 ml of the solution was injected into the gas chromatograph (Shimadzu, GCMS-QP2010S) with an initial temperature of 50°C and a final temperature of 240°C. The type of column used is Aglient HP 1MS, while the type of detector used is FID with a temperature of 300°C and the carrier gas is helium (Bittencourt *et al*., 2015; Czyżewska *et al*., 2015).

Bee identification and morphometry. A total of 5 samples of *T. laeviceps* worker bees collected from the hive were caught through the hive door into a flacon bottle filled with 70% alcohol. Then the samples that have been captured will be taken to the laboratory. The bee identification process uses several journals. The process of measuring bee morphometry using a digital microscope Supereyes tool that is connected to the Supereyes 3.0 software with a magnification of 100×. The digital microscope Supereyes instrument was installed first and then calibrated using millimeter block paper. After calibration, one bee sample was placed on a petri dish that had been installed in the Supereyes Digital Microscope, then observed using a laptop that was connected to the Supereyes 3.0 software application, thus the sample could be seen more clearly. Then begin to measure the characteristics needed for observation. This work step was also carried out on other bee samples (Tej *et al*., 2017).

Data analysis. The relationship between the activity of the bee *T. laeviceps* in and out of the hive with environmental factors is known by using a quadratic curve model. Identification of pollen using journal references presented descriptively. The GC-MS results used references to the WILEY229.LIB and NIST62 libraries to see the possible compounds contained in the samples presented using a compound chromatographic profile table. The identification and morphometry of bees are presented with a morphometric table with units of mm.

RESULTS AND DISCUSSION

Bee daily activities. Observations of the daily activities of bees in and out of the hive and visits to flowers were carried out for ± three days every one hour from 05.00 to 18.00 WIB with an observation time of 10 min as seen in Fig. 1. The environmental parameters measured were air temperature and air humidity. In addition, the available food sources around the hive also affect the daily activities of the bees.

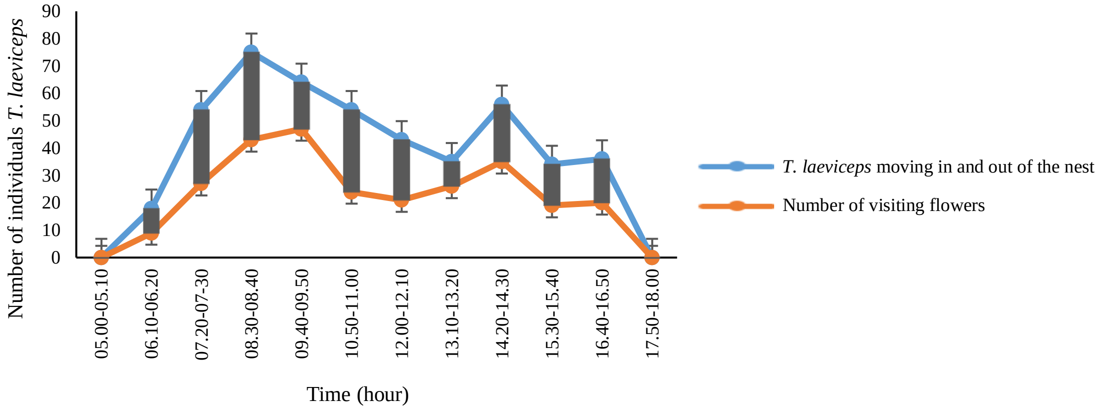

Fig. 1. Daily activities of *Tetragonula laeviceps* bees moving in and out of the hive and visiting *Carica papaya* flowers

The peak of activity in and out of *T. laeviceps* beehives is in the morning and evening. The morning occurred at 08.30-08.40 WIB with an average nest air temperature of 25°C and an average nest air humidity of 78% (Fig. 1). This is in accordance with the statement of (Simioni *et al*., 2015) that the peak activity of bees collecting pollen occurs in the morning around 08.00-10.00 WIB because the temperature and humidity are very supportive. Activity in and out of the nest increased again at 14.20-14.30 WIB with an average air temperature of 35°C and an average air humidity of 75%. Likewise, the number of visits by *T. laeviceps* bees to *Carica papaya* flowers with peak activity at 09.40-09.50 WIB was 47 individuals and the visits increased again in the afternoon at 14.20-14.30 WIB as many as 35 individuals. This is in accordance with the theory which states that the availability of nectar in plants is abundant in the mid-morning and late afternoon so that bees often visit at that time.

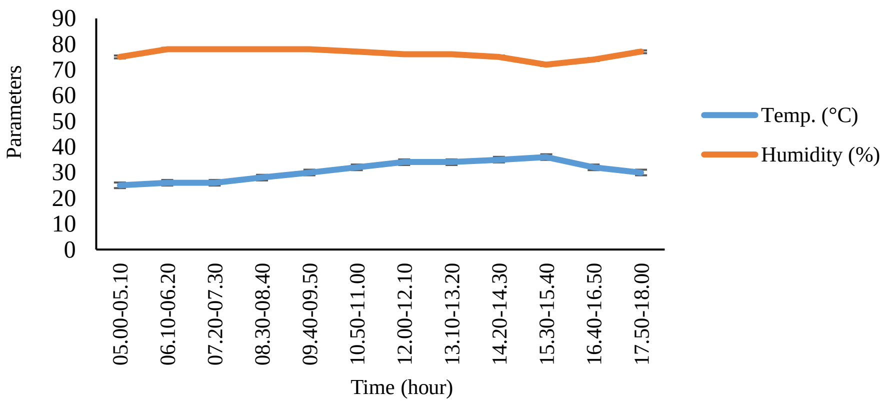

Fig. 3. The results of the average temperature and air humidity measurement for three days of observation in the maintenance box

C. papaya is a tree that grows in the tropics. *Papaya* plants are dioecious or hermaphroditic, producing only male, female or bisexual (hermaphroditic) flowers. A male papaya is distinguished by the smaller flowers borne on long stalks. Female flowers of papaya were pear- shaped, when unopened whereas, bisexual flowers are cylindrical. The compounds contained in papaya include alkaloids, caprine, flavonoids, tannins, saponins, and nicotinic acid. So that papaya can function as an anti-inflammatory, anti-oxidant, anti-cancer, anti-fungal, anti-malarial, and anti-diabetic (Diah *et al*., 2021). Apart from *Carica papaya*, bees also take food sources from the plants *Salacca* sp., *Magnifera indica, Psidium guajava, Averrhoa carambola, Citrus* sp., and *Spondias dulcis*.

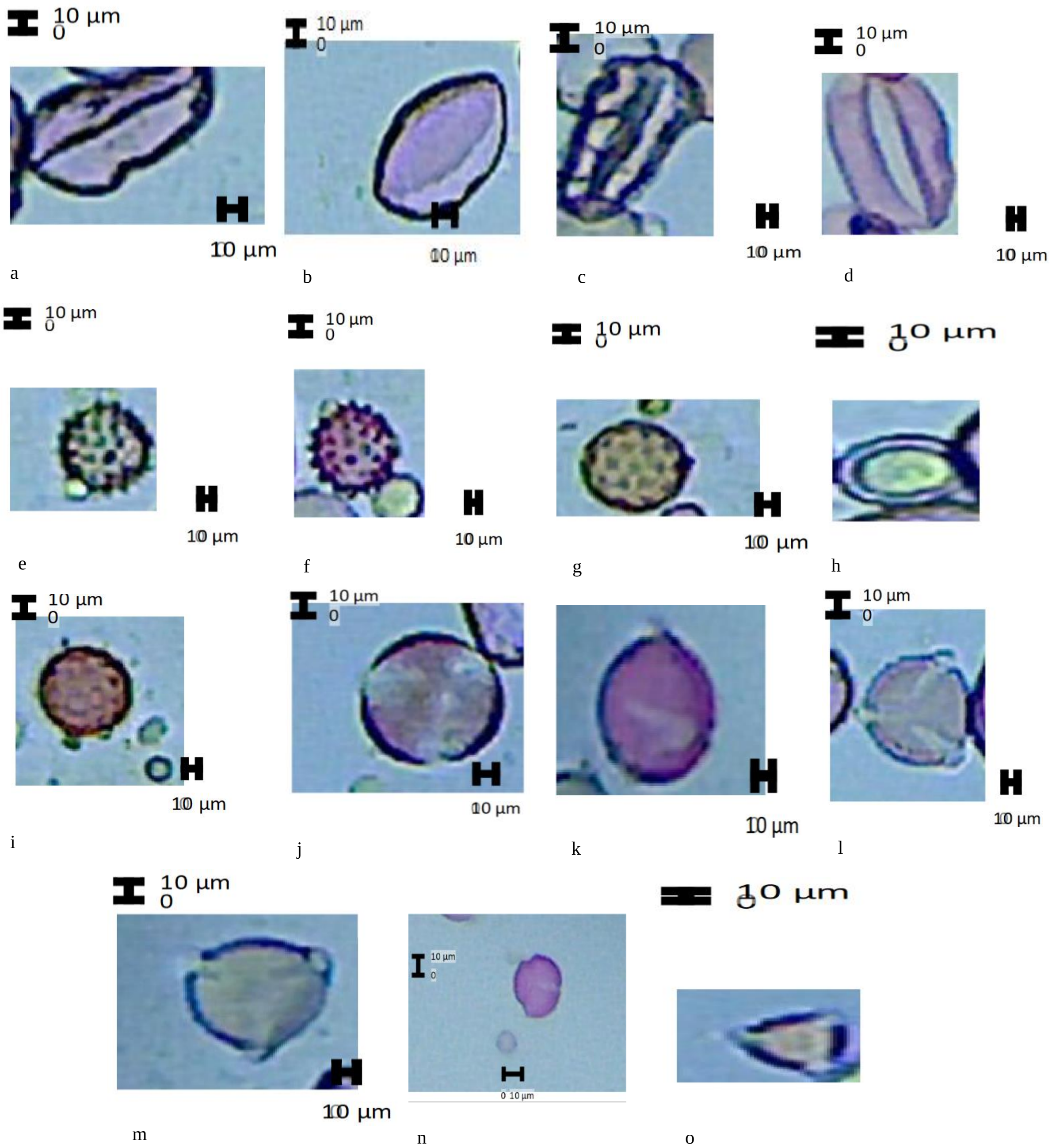

Fig. 4. Diversity of pollen as feed for *Tetragonula laeviceps* bees in Turi, Yogyakarta: a-d. Arecaceae; e-f. Asteraceae; g-h. Fabaceae; i. Amaranthaceae; j. Vebernaceae; k. Sapindaceae; l-m. Malvaceae; n. Scrophulariaceae; o. Dipterocarpaceae

According to Simioni *et al.* (2015) that air temperature is one of the main factors that affect the external activity of bees. The peak of bee activity occurs when the air temperature of the hive is 25°C because the air temperature is not too cold or hot so that it supports the activity of bees in collecting pollen. Another environmental factor that affects the daily activities of bees is air humidity. Based on Fig. 3., it can be seen that the peak of bee flying activity occurs when the humidity of the hive is 78% and 75%. This is in accordance with the statement of (Luis *et al*., 2015) that the flying activity of bees becomes more limited and decreases if the humidity increases.

Diversity of bee pollen feed sources. Pollen was observed from bee hives, especially in pollen pots, to determine the diversity of food sources for *T. laeviceps* bees from various types of vegetation because bees take nectar from flowers so that pollen is also taken as shown in Fig. 4. Among the diversity of pollen identified from pollen sacs taken from beehives in the Turi area, there are several pollens from plant families that dominate the pollen sacs, such as the Arecaceae, Ateraceae, and Malvaceae families. The pollen of the Arecaceae family dominates the collection of *T. laeviceps* bees because Turi is an area dominated by Salak (*Salacca* sp.) plantations. Salak is a member of the Arecaceae family. This plant is classified as a perennial plant, which is a plant that can continue to grow for more than two years with a habitus of trees and shrubs. This can increase the availability of food sources for bees in the long term. The pollen of the Arecaceae family has several characteristics including oval shaped, monad pollen units, monocolpate type aperture and even some without aperture, psilate to echinate type ornamentation.

The family that also dominates the pollen in the Turi area is the Asteraceae family. The dominance of pollen from this family is because this family produces nectar so that it can attract the attention of bees and has a colorful flower crown due to the presence of flavonoid compounds so that this family plant acts as a bee attractant. Plants of the Asteraceae family are classified as annual and perennial plants that are able to flower throughout the year so as to produce pollen needs for bees (Andi *et al*., 2019). This plant lives with various habits such as herbs, shrubs, and shrubs (Agata & Beata, 2021). The characteristics of Asteraceae pollen are monad pollen units, tricolporate aperture type, circular shape, and the ornamentation type is generally echinate (Salamah *et al*., 2019). The Malvaceae family has a striking flower crown color with a large size and abundant stamens so that it can act as an attractant for bees (Tambde *et al*., 2016). This family includes seasonal and annual plants with habitus in the form of herbs, shrubs, and trees so that they can produce more nectar and pollen in a short time. The characteristics of *Malvacae* pollen are monad pollen unit, spheroidal and globular shape, colporate or porate aperture type, echinate ornamentation type (Suedy, 2012).

The content of bee bioactive compounds. In this study, methanol was used as a solvent to obtain compounds based on their level of polarity. The results of the sample extract are in the form of bioactive compounds which are included in secondary metabolites and can be used in the health sector. The following Fig 5. is the chromatogram of the propolis extracts sample.

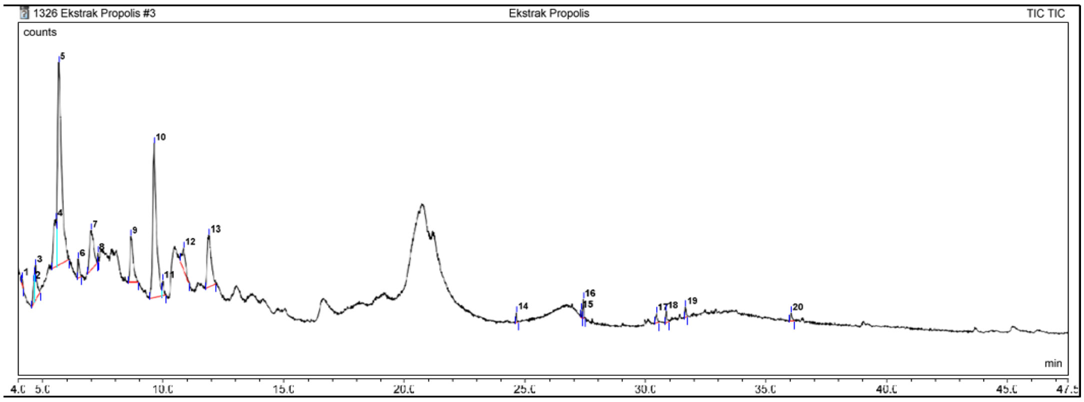

Fig. 5. Chromatogram analysis of gas chromatography from bee propolis samples of *Tetragonula laeviceps* in the Turi, Yogyakarta

Fig. 5 shows that the chromatogram of the propolis extraction analysis using GC-MS there were 60 detected peaks. The compounds that represent each peak are presented in the Table 1 as follows.

Table 1. Profile of the bioactive compound of bee propolis *Tetragonula laeviceps* from Turi, Yogyakarta

No	Molecule	Chemical Formula	Area (%)	Description
Alkaloid (70%)				
1	Oxiranemethanol, (R)-	$C_3H_6O_2$	0,19	Volatile compounds
2	Isobutane	C_4H_{10}	1,92	Cosmetic raw materials
3	Oxirane, 2,3-dimethyl-, trans-	C_4H_8O	2,89	Anti-inflammatory, anti-cancer
4	Ethanimidic acid, ethyl ester	C_4H_9NO	5,92	Anti-oksidant, anti-cancer
5	2-Fluoro-ß-alanine	$C_3H_6FNO_2$	33,55	Anti-fungi
6	Glycidol	$C_3H_6O_2$	1,20	*In vivo* induction, genotoxicity, and carcinogenicity
7	Carbamic acid, methylnitroso-,ethyl ester	$C_4H_8N_2O_3$	6,89	Aromatic compound
8	α-D-Mannopyranoside, methyl 3,6-anhydro-	$C_7H_{12}O_5$	0,25	Anti-oksidant
9	1,2,3-Butanetriol	$C_4H_{10}O_3$	6,27	Food substitute for oils and fats
10	Oxiranemethanol, (R)-	$C_3H_6O_2$	24,07	Volatile compounds
11	3,4-Furandiol, tetrahydro-, trans-	$C_4H_8O_3$	0,97	Anti-oksidant
12	3,4-Furandiol, tetrahydro-, trans-	$C_4H_8O_3$	3,28	Anti-oksidant
13	Thioacetic acid	C_2H_4OS	8,79	Fine chemical raw materials
14	2,3-Epoxyhexanol	$C_6H_{12}O_2$	0,44	Anti-bacteria, anti-oksidant
15	2,3-Epoxyhexanol	$C_6H_{12}O_2$	0,51	Anti-bacteria, anti-oksidant
Fenolik (20%)				
16	Hydroperoxide, heptyl	$C_7H_{16}O_2$	0,22	Anti-oksidant
17	Hydroperoxide, heptyl	$C_7H_{16}O_2$	0,68	Anti-oksidant
18	Hydroperoxide, heptyl	$C_7H_{16}O_2$	0,68	Anti-oksidant
19	Cyclopenta[c]furo[3',2':4,5]furo[2,3-h][1]benzopyran-11(1H)-	$C_{17}H_{14}O_7$	0,65	Anti-oksidant
Terpenoid (5%)				
20	3-Trifluoroacetoxydodecane	$C_{14}H_{25}F_3O_2$	0,64	Anti-virus

Based on the Table 1, it can be observed that there were 20 chemical compounds identified from the bee propolis sample of *T. laeviceps* using GC-MS. The results of the identified compounds were then compared with the databases at NIST 62 and Pubchem NCBI. The dominating compound in the sample of bee propolis *T. laeviceps* is 2-Fluoro-ß-alanine with C, H, O, and N groups of 33.55%, this compound belongs to the alkaloid group that functions as a substrate for bile acid conjugate enzymes in cancer patients and antifungal (Serve *et al*., 2010). These compounds include organooxygen compounds and organonitrogen compounds derived from beta-amino acids. The second most abundant compound is oxiranemethanol, (R)- with the chemical formula $C_3H_6O_2$ of 24.07%, this compound belongs to the alkaloid group that functions as an ingredient in making cosmetics. The next dominating compound is thioacetic acid with the chemical formula C_2H_4OS of 8.79%, this compound includes organosulfur compounds which are generally used as other chemical raw materials and raw materials for synthetic drugs. Thioacetic acid is a combination of anhydride and H_2S. The characteristics of this compound are clear yellow liquid with a strong odor, toxic if swallowed, inhaled, and absorbed by the skin. The reactivity of thioacetic acid is generally in selective amide or peptide bonds synthesized from the reaction between active carboxylic acids such as hydrochloric acid, esters with Na_2S, H_2S or NaSH (Sachitanand & Hosahudya, 2014).

Based on the results of the GC-MS analysis of the bee propolis samples, *T. laeviceps* showed that the tested propolis samples contained several bioactive compounds consisting of alkaloids (70%), flavonoids (20%), and terpenoids (5%). The bioactive compounds that dominate the analysis results are alkaloids. This is because the feed source visited by the bee *T. laeviceps* produces a lot of alkaloid compounds. This is in accordance with the statement of (Royid *et al*., 2018) that the location of a plant will affect the content and composition of bioactive compounds in plants and bioactive compounds taken by bees will affect the content of propolis.

Bee identification and morphometry. In this observation, identification of the *T. laeviceps* bee was carried out, as well as the measurement of the body morphometric character of the *T. laeviceps* bee as presented in Fig. 6.

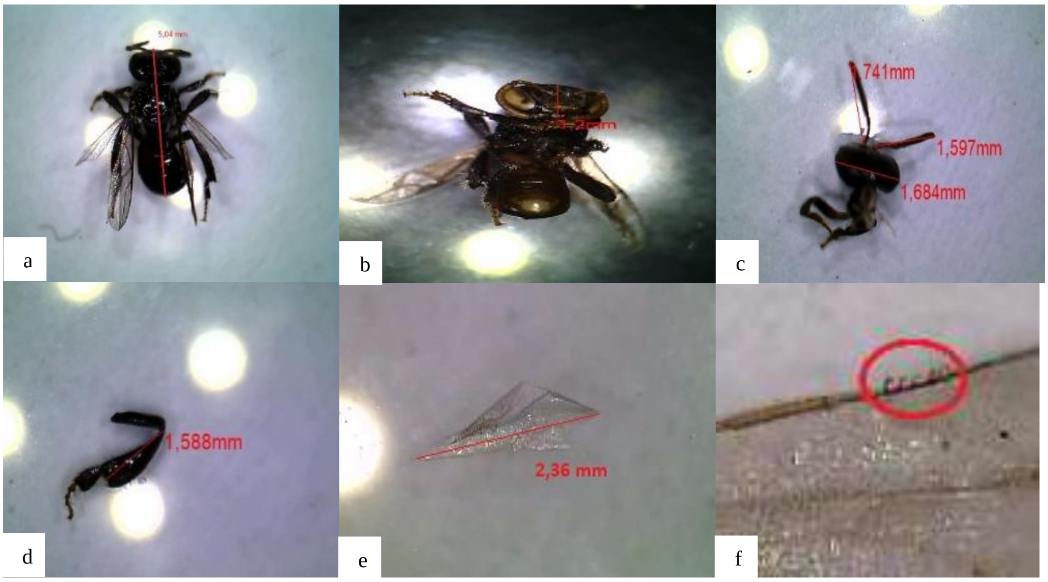

Fig. 6. Bee body morphometry: a. Body length; b. Head length; c. Caput (frontal); d. Hind limbs; e. Forewing; f. Number of hamulli on hindwing.

The sample of worker bees used in this study has a blackish brown body. In the caput (head) there are three ocelli eyes and a pair of compound eyes that are blackish brown. The abdomen is dark brown. The color of the forewings is uniform and the hindwings are semi-transparent. The number of hamuli is 5 on each hindwing (Table 2). The results of this observation are in accordance with the statement of Trianto & Purwanto (2020) that the body of the *T. laeviceps* bee worker bee is dominated by black color with a blackish brown belly. The head is black with a few fine white hairs. The forewings are uniform in shape and size and the hind wings are semi-transparent with dark brown wing venation. The number of hamuli on each hind wing is 5 pieces.

Table 2. The results of the measurement of morphometric characters in 5 samples of worker bees *Tetragonula laeviceps* in Turi, Yogyakarta

Characteristics	Size (mm) Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	SD
BL	5.04	4.87	4.59	4.84	4.76	4.82	0.16
HL	1.20	1.76	2.00	1.76	1.67	1.68	0.29
HW	1.87	0.99	0.94	2.00	1.83	1.52	0.52
DBO	0.39	0.32	0.35	0.53	0.36	0.39	0.08
OOD	0.28	0.25	0.25	0.35	0.29	0.28	0.04
AL	1.21	1.46	2.17	1.17	1.10	1.42	0.44
HLL	3.84	4.11	4.84	3.99	3.91	4.14	0.40
HTL	1.35	1.59	1.43	1.56	1.62	1.51	0.12
HTW	0.41	0.56	0.53	0.54	0.47	0.50	0.06
HBL	0.71	0.65	0.46	0.60	0.67	0.62	0.09
HBW	0.14	0.36	0.34	0.33	0.36	0.31	0.09
FL	2.36	2.27	3.12	3.86	4.16	3.16	0.86
FW	0.40	0.37	0.34	1.62	1.72	0.89	0.72
WL2	1.48	2.78	0.76	2.42	2.61	2.01	0.86
NH	5	5	5	5	5	5	5

Notes: BL= Body length; HL= Head lenght; HW= Head width; DBO= Distance between two lateral ocelli; OOD= Ocello-ocular distance; AL= Antennal length; HLL= Hind leg length; HTL= Hind tibial length; HTW= Hind tibial width; HBL= Hind basitarsus length; HBW= Hind basitarsus length; FL= Fore wing length; FW= Fore wing width; WL2= Bifurication between veins M and Cu; NH= Number of hamuli in Hind wing

The worker bees from this study had different sizes but were not significantly different from other studies. This size difference is the result of morphological adaptation to the environment. Changes in temperature or environment cause bees to adapt morphologically to adapt to the environment of flying activities and activities to find food sources. The following is a comparison of the body morphometry of the *Tetragonula* bee from the Turi region with the body morphometry of the bee found in Pandeglang, Banten (Fig. 7).

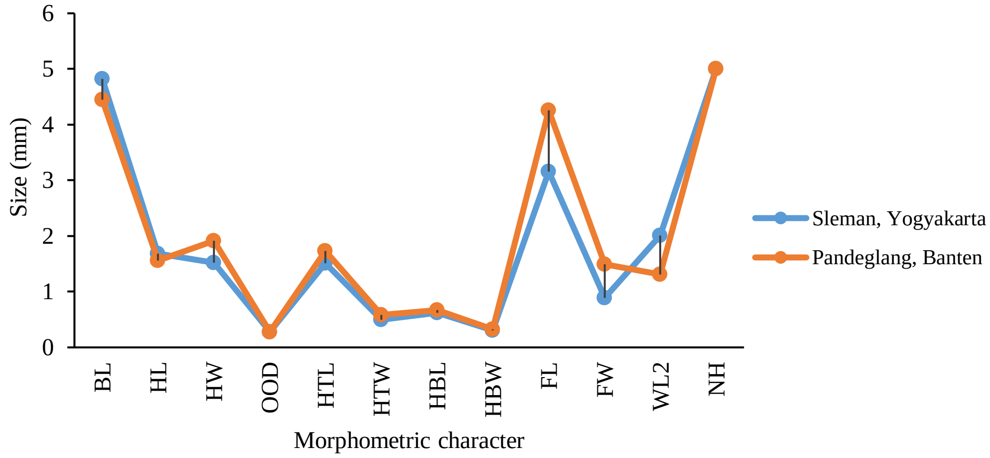

Fig. 7. Comparison of morphometric character sizes in *Tetragonula laeviceps* bees in Sleman, Yogyakarta and Pandeglang, Banten

Based on the Fig. 7, the results of the measurement of the morphometric character of the *T. laeviceps* bee in Sleman and Pandeglang have almost the same pattern of morphometric characters. This is because the two regions have similarities in their topographic conditions. The similarity in body composition and morphology of bees is considered as a form of adaptation to the daily flying activities of bees in exploiting flowers which have the potential as a source of food in almost the same environment. The topography of Sleman, Yogyakarta is a hilly area with an average air temperature of 22°C-35°C with an altitude of <100 to > 1000 mdpl (Pemerintah Kabupaten Sleman, 2017). While in the Pandeglang area, Banten is also a mountainous area with air temperatures ranging from 22°C-32°C and located at an altitude between 0 - 1778 meters above sea level (Biro Pemkesra, 2018).

CONCLUSION

The air temperature, humidity, and accessibility of feed supplies are the key environmental elements that have an impact on bees' daily activity food sources. The peak of bee activity occurs when the temperature and humidity of the air are not too high or low, as well as the source of feed if there are a lot of food sources around, the more pollen the bees get as well such as *Carica papaya*. The dominating pollen comes from the Arecaceae, Ateraceae, and Malvaceae plant families because it has the same character, which is an annual plant that produces abundant pollen needs for bees. The groups of bioactive compounds that dominate the propolis of the *T. laeviceps* bee from Turi are alkaloids (70%), phenolic (20%), and terpenoids (5%) with the most dominant compound being 2-Fluoro-ß-alanine ($C_3H_6FNO_2$) of 33.50%. The results of the measurement of the morphometric characteristics of the *T. laeviceps* bee in Sleman, Yogyakarta and Pandeglang, Banten have the same characteristic pattern.

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