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PRELIMINARY STUDY ON MOISTURE, FAT, AND PROTEIN CONTENTS OF BEE BREAD FROM *Apis cerana* FROM DIFFERENT REGIONS IN NORTH LOMBOK REGENCY, INDONESIA

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ABSTRACT

Apis cerana is one of the honeybee species from the Apis genus that produce honey, bee bread, royal jelly, and propolis. The objective of this study was to determine the honeybee forages as the pollen source and to evaluate the moisture, fat, and protein contents of bee bread from the bee of Apis cerana from different regions (Sigar Penjalin, Teniga, and Medana villages) in North Lombok, Indonesia. The methods used to determine the pollen source were taken flowers sample and then checking pollen at anther of flowers. The moisture, fat, and protein contents were determined using proximate analysis. The results showed that the honeybee forages as the pollen source from Sigar Penjalin village were maize, cashew, damar, kapok, calabash, breadfruit, passion fruit, and acacia. The plant flowers as the pollen source from Teniga village were coconut, coffee, cacao, citrus, guava, leucaena, papaya, and sugar palm, while those from Medana village were jackfruit, mangosteen, Java apple, maize, rice, candlenut, soybean, and banana. The moisture and fat contents of bee bread from Sigar Penjalin and Teniga villages were similar, and both were lower than the moisture and fat contents of bee bread from Medana village. The protein content of bee bread from Sigar Penjalin and Medana villages were similar, and both were lower than the protein content of bee bread from Teniga village. Thus, the bee bread from Teniga village was higher in protein content for all beekeeping regions, however Teniga village and Sigar Penjalin were similar in moisture and fat contents.

Keywords: *Beekeeping, flowers, geographical regions, hive, pollen*

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INTRODUCTION

Indonesia is an archipelagic country with different geographical regions, different vegetations and with popular honeybees species to produce honey, bee pollen, and bee bread such as *Apis dorsata*, *Apis mellifera*, and *Apis cerana*. In North Lombok Regency, the presence of *Apis dorsata* is limited. However, *Apis cerana* colonies live wild in nature, and *Apis mellifera* is not found. The beekeepers in the North Lombok Regency especially in Tanjung District use two types of hives, i.e., the traditional hive (the local name is called *Glodok* hive) and the modern hive (box hive made from the dry board). The empty *Glodok* hive and box hive are usually hanged in large trees to invite the wild colonies of *Apis cerana*. In the hives, they can build their nest, produce honey and bee bread that are harvested by the beekeepers. Bee bread is produced from pollen that is mixed with honey and bee secretion and stored in the combs (Bogdanov, 2017). The bee bread product from the colonies of *Apis cerana* from North Lombok has not been studied, therefore the information about it is lacking.

Bee pollen contains water, carbohydrates (fructose, glucose, sucrose, fibers), protein, free amino acids, fat, minerals, vitamins, flavonoids, fatty acids, and other bioactive compounds. differences in botanical origins, climatic conditions, and seasonal variation impact the chemical composition of bee bread (Bogdanov, 2017; Urcan *et al*., 2017; Baltrušaitytė *et al*., 2007). Taha *et al*. (2019) reported that pollen collected by the colonies of *Apis mellifera* contains protein and the profile of amino acids is differs as the pollen source is different. Zuluaga *et al*. (2015) reported that the Colombian bee bread from the *Apis mellifera* contains moisture content of 15.7 g/100 g, ash of 2.4 g in dry matter (DM) basis, lipids of 3.4 g DM, protein of 23.1 g DM, total flavonoid content of 3.2 mg Quercetin/g, and total phenolic content of 8.9 mg Gallic acid/g bee bread. In addition, the chemical composition of bee bread has been studied (Sobral *et al*., 2017; Čeksteryte *et al*., 2016; Kaplan *et al*., 2016; Tavdidishvili *et al*., 2014; Čeksteryte and Jansen 2012), but has not fully studied in Indonesia. The objective of this study was to determine the honeybee forages as the pollen source and to determine the moisture, fat, and protein contents of bee bread from *Apis cerana* from different regions in North Lombok, Indonesia.

MATERIALS AND METHODS

Beekeeping regions

The regions for beekeeping of honeybee *Apis cerana* were in Sigar Penjalin, Teniga, and Medana Villages, Tanjung District, Nort Lombok Regency. Each region has a different characteristic where Sigar Penjalin village with an altitude was 20 above sea level (asl) with the temperature was ranged from 31 to 35^{o}C. The Teniga village with altitude 268 asl and the temperature was ranged from 20 to 30^{o}C, while the Medana village with altitude 50 asl and the temperature was ranged from 22 to 33^{o}C.

Inventory of honeybee forages

The inventory of honeybee forages as the pollen source was performed at a radius of 500 m around of beekeeping location. The pollen source from plant flowers was identified by methods from Agussalim *et al*. (2018; 2017). Briefly, flowers sample were taken to determine the plant types which can produce pollen. For checking the flower plants that produce pollen was performed with checking at anther of flowers.

Bee bread collection and analysis

The bee bread from the bee of *Apis cerana* was collected from three box hives in each beekeeping region, 20 g of bee bread was collected from each hive and the total of bee bread in each beekeeping region was 60 g. The bee bread was collected by opening the wax as the cover of the bee bread in combs and removing the bee bread from the nest, then the sample was put in the plastic bag, which has been labeled according to

beekeeping regions. The collecting of bee bread from honeybee *Apis cerana* was displayed in Figure 1. The moisture, fat, and protein contents of bee bread were moisture, fat, and protein content were determined using proximate analysis according to the methods of AOAC (2005). For all analyses, the chemical composition of bee bread was performed in duplicate for the three replicates.

Figure 1. The collecting of bee bread from the bee hives of *Apis cerana* (a. box hive for beekeeping, b. removing bee bread from the combs, c. bee bread sample from Sigar Penjalin village, d. bee bread sample from Teniga village, and e. bee bread sample from Medana village).

Statistical analysis

The data of honeybee forages as the pollen source was analyzed by descriptive analysis, while the moisture, fat, and protein contents were analyzed by one-way analysis of variance using SPSS (Windows version of SPSS, release 23) and significant differences between the means were identified with honestly significant difference test (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Honeybee forages

The results showed that the honeybee forages as the pollen source from each region for beekeeping is different was shown in Table 1. The plant types as the pollen source in Sigar Penjalin village consists of maize, cashew, damar, kapok, calabash, breadfruit, passion fruit, and acacia.

The plant flowers as the pollen source from Teniga village consists of coconut, coffee, cacao, citrus, guava, leucaena, papaya, and sugar palm, while from Medana village consists of jackfruit, mangosteen, Java apple, maize, rice, candlenut, soybean, and banana. These tropical plants are known as bee pollen sources. Agussalim *et al*. (2017; 2018) explained that coconut and maize are the potentials as the pollen source for the honeybees.

The combination of those plants as pollen sources in each region could provide different characteristics of bee pollen and bee bread. Every plant has a different blooming period and the production of pollen in each flower depends on the plant types, flower size, and the land condition especially soil nutrients, but our study has not been measured the pollen production. Bogdanov (2017) explained that pollen in the hive is mixed with honey and bee secretion and stored in the combs that are called bee bread. Bee bread undergoes a lactic acid fermentation and can be preserved. Furthermore, Abrol (2011) explained that pollen is the main protein source in the hive and the raw materials to produce royal jelly as the food of the queen bee.

The availability of pollen sources is a key factor for the beekeeping success to increase the productivity of honeybee because the queen bee requires much more protein source from pollen to produce eggs than the worker bees. In Indonesia, when maize is blooming, most beekeepers place the honeybee colonies, especially *Apis mellifera* to harvest pollen using pollen trap or to improve (strengthen) the colony in the hive. The plant types as the pollen source in the study (Table 1) is different to those previously reported (Taha *et al*., 2019; Agussalim *et al*., 2018, 2017; Ismail *et al*., 2013). This relates to the types of plants that can grow in the geographical regions.

Table 1. Honeybee forages as the pollen source *Apis cerana* from different beekeeping regions

Beekeeping regions		
Sigar Penjalin	Teniga	Medana
Maize (*Zea mays*)	Coconut (*Cocus nucifera*)	Jackfruit (*Artocarpus heterophyllus*)
Cashew (*Anacardium occidentale*)	Coffee (*Coffea* sp.)	Mangosteen (*Garcinia mango stana*)
Damar (*Agathis* sp.)	Cacao (*Theobroma cacao*)	Java apple (*Eugenia javanica*)
Kapok (*Ceiba pentandra*)	Citrus (*Citrus* sp.)	Maize (Zea mays)
Calabash (*Lagenaria siceraria*)	Guava (*Psidium guajava*)	Rice (*Oryza sativa*)
Breadfruit (*Artocarpus altilis*)	Leucaena (*Leucaena leucocephala*)	Candlenut (*Aleurites mollucana*)
Passion fruit (*Passiflora* sp.)	Papaya (*Carica papaya*)	Soybean (*Glycine soya*)
Acacia (*Acacia* sp.)	Sugar palm (*Arenga pinnata*)	Banana (*Musa paradisiaca*)

Bee bread chemical composition

Bee bread is fermented pollen that mixed with honey and honeybees secretion (worker bee's saliva) and stored in the combs (Bogdanov, 2017). The bee bread is used by honeybees as the food for the larvae and used by young workers to produce royal jelly (Bakour *et al*., 2019; Bogdanov, 2017; Markiewicz-Żukowska et al., 2013). The results showed that the different regions for the beekeeping of *Apis cerana* was influenced the moisture, fat, and protein contents of bee bread. The moisture content of bee bread from Sigar Penjalin and Teniga villages were similar (23.4% and 24.1%) and was lower than the moisture content of bee bread from Medana village (27.9%) ($p<0.01$).

The fat content of bee bread from Sigar Penjalin and Teniga villages were similar (2.32% and 2.80%) and was lower than the fat content of bee bread from Medana village (4.09%) ($p<0.01$). The protein content of bee bread from Teniga village (20.6%) was higher than the protein content of bee bread from Sigar Penjalin and Medana villages (18.7% and 16.9%) ($p<0.05$) (Table 2).

Table 2. The chemical composition of bee bread from the bee of *Apis cerana* from different regions

Variables	Beekeeping regions		
	Sigar Penjalin	Teniga	Medana
Moisture content, %	23.45±1.16[b]	24.10±0.30[b]	27.87±0.33[a]
Fat content, %	2.32±0.57[b]	2.80±0.45[b]	4.09±0.34[a]
Protein content, %	18.65±1.85[b]	20.58±0.42[a]	16.92±0.53[b]

[a,b] Different superscripts in same rows indicate significant differences at $p<0.05$

In our study, the differences in moisture, fat, and protein contents from bee bread of *Apis cerana* from each region is affected by the different plant types as the pollen source (Table 1). Furthermore, the chemical composition of bee bread is affected by honeybees species, botanical origins, climatic conditions, and seasonal variation (Taha *et al*., 2019; Bogdanov 2017; Urcan *et al*., 2017; Baltrušaitytė *et al*., 2007). The moisture, fat, and protein contents in the study (Table 2) is differs to those previously reported (Taha *et al*., 2019; Bakour *et al*., 2019; Bogdanov 2017; Urcan *et al*., 2017; Zuluaga *et al*., 2015).

CONCLUSIONS

Honeybee forages as the pollen source from Sigar Penjalin village consists of maize, cashew, damar, kapok, calabash, breadfruit, passion fruit, and acacia. Those of Teniga village consists of coconut, coffee, cacao, citrus, guava, leucaena, papaya, and sugar palm, while those of Medana village consists of jackfruit, mangosteen, Java apple, maize, rice, candlenut, soybean, and banana. The bee bread from *Apis cerana* from Teniga village was higher in protein content for all beekeeping regions, however Teniga village and Sigar Penjalin were similar in moisture and fat contents.

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