The characteristic of stingless bee’s products (*Tetragonula* spp.) in Lombok Island

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**Abstract.** Beekeeping is one of the excellent businesses for people around the forest. To date, the bee species that began to broaden are stingless bees. *Tetragonula* spp. is a stingless bee species in Lombok that have been promoted. This research aim is to determine the characteristic of stingless beekeeping products in Lombok. The meliponiculture products of *Tetragonula* spp. consist of honey, beebread, and propolis. SNI 3545 was used to examine the honey characteristic of *Tetragonula* spp., the proximate analysis was performed for beebread products and phytochemical analysis was used to stingless bee propolis products. The results showed that stingless bee honey has a value that fulfills 65% standard, the diastase enzyme was <3 DN and acidity was > 200 ml NaOH/kg. The average content of moisture, ash, protein, fat, and carbohydrates from bee bread were 24, 2, 15, 9.5, and 49% respectively. The phytochemical analysis results of propolis determined that all samples contain flavonoids, tannins, saponins. Several of them positively steroid detected. This study results could be used to considerate further research related in manufactured final products of stingless bee products as raw materials.

**Keywords:** Stingless bee, honey, beebread, propolis, Lombok

1. **Introduction**
Stingless beekeeping was developed in West Nusa Tenggara (NTB), especially in Lombok Island [1]. Beekeeping is one of the excellent businesses especially for people around the forest [2]. Several bee species that have been cultivated in Lombok are from genus *Apis* and *Trigona/Tetragonula* [3]. Along with the development of information and technology, the trend of Apiculture began to decrease [4]. On the other hand, stingless beekeeping (Meliponiculture) of *Tetragonula* spp become enhancing that reported by Kahono et al. [5] who said that stingless bees that produce increasing amounts of medicinal honey, propolis, and their derivative products have gradually been developed.

The stingless bee species in Lombok are *Trigona sapiens* and *T. clypearis* [3]. These two species is an Australian stingless bee [6]. One of these, *T. sapiens*, were found in Sulawesi [7]. In Lombok, *T. sapiens* and *T. clypearis* have different habitat characteristics in nature [3]. Stingless bee products that have been cultivated in Lombok have not been explored much. Honey is the main product managed by the community as a beekeeping product [1]. This product has some specific standardization in most countries where it produced. Indonesia also has the Indonesian National Standard (SNI) no. 3545 for honey bee [8]. While for other products such as bee bread and propolis, it is only waste in stingless bee honey production [1]. The problem for the beekeeper to use them is the lack of information and...
technological access. The aim of the research was to determine the characteristics of beekeeping products of Tetragonula spp. cultivated in Lombok, which are honey, bee bread, and propolis.

2. Materials and methods

2.1. Bee bread
Bee bread samples were collected from several locations in Lombok and were harvested in rainy and dry seasons. The bee bread analysis was performed with proximate analysis which moisture, ash, protein, fat and carbohydrate content as parameters. The moisture, ash, protein and fat content were carried out based on the SNI method. 01-2891-1992 points 5.1, 6.1, 7.1, and 8.2 in sequence. While carbohydrate parameters were calculated using IK technique.5.4.5 (calculation method). The proximate analysis was carried out at the Indonesian Center for Agro-Industry (BBIA), Bogor.

2.2. Honey
The honey samples were harvested during the rainy season and dry season. The parameters were tested for diastase enzyme activity using the SNI test method. 3545: 2013, attachment C; Hydroxymethylfurfural (HMF) was analyzed using SNI 3545: 2013 test method. attachment D; Moisture uses the SN1-01-2891-1992 test method, item 5.1; reducing sugar which is calculated as glucose using the SNI test method. 01-2892, point 3.1; Sucrose uses the SNI test method. 01-2892, point 3.1; acidity using the SNI test method. 3545: 2013, attachment F; and ash using the SN1-01-2891-1992 test method, item 6.1. The analyzing of the honey quality standard parameters was tested at BBIA, Bogor.

2.3. Propolis
Propolis analyzed for phytochemicals was crude propolis. This part was obtained from the harvesting of honey which is carried out in two seasons, dry and rainy season. The method used in the crude propolis phytochemical test was a qualitative measurement through color visualization. The tested components are flavonoid, alkaloid, tannin, saponin, steroid, quinones and triterpenoid test. This analysis was carried out at the Biofarmaka Study Center, IPB.

2.4. Data analysis
The data is processed using a simple statistical method that displays the mean and standard deviation. Besides, a descriptive analysis of the results was also carried out.

3. Results
The proximate analysis of bee bread samples obtained from several locations in Lombok showed that the moisture content in bee bread samples harvested in the rainy season had an average of 25.40% with a standard deviation of ± 6.51%. While the parameters of ash, protein, fat, and carbohydrate have an average percentage with a standard deviation of 2.36 ± 0.16%; 15.35 ± 0.07%; 14.00 ± 4.81% and 42.85 ± 1.48% respectively. This value is not much different from the sample of bee bread harvested in the dry season, which is the content of moisture, ash, protein, fat, and carbohydrates, respectively 24.00 ± 2.28%; 2.29 ± 0.28%; 15.13 ± 1.53%; 9.64 ± 2.91% and 48.95 ± 2.54%. The results of the character analysis of Trigona/ Tetragonula honey from Lombok are presented in table 1. Then the phytochemicals analysis results also present in table 2. Flavonoid, tannins, and saponins were detected in all samples. Meanwhile, steroid was detected only in Rarung and Timbanuh samples.

4. Discussion

4.1. Bee bread
The average moisture content of bee bread harvested in the rainy season is slightly higher than it harvested in the dry season. But statistically, these values are not significantly different because of the
high standard deviation in the value of water content in the rainy season. This value is also higher when compared to bee bread from Colombia where Zuluaga et al. [9] obtained a moisture content of 15% with a large standard deviation which was 3.6%. The value of ash and protein content is also not much difference between bee bread harvested in the rainy and dry seasons.

Unlike the water, ash and protein content, the average fat and carbohydrate composition of bee bread harvested in the two seasons is different. During the rainy season, the fat bee bread content is high while in the dry season the content is lower. In contrast to the composition of fat, the composition of carbohydrate bee bread in the rainy season is lower than the composition of it in the dry season. In the rainy season, bees have lower activity outside the nest compared to their activities in the dry season. And in the dry season, the opposite applies. Fat is used, as a food reserve to meet its energy needs during the rainy season. Meanwhile energy in the dry season can be filled with high carbohydrates.

### Table 1. Characteristics of Trigona/ Tetragonula honey in Lombok.

| Parameter (unit)                  | SNI 3545 | Rainy season | Dry season |
|----------------------------------|----------|--------------|------------|
| Diastase enzyme activity (DN)    | min. 3   | 0.00 ±0.00   | 0.00 ±0.00 |
| HMF (mg/kg)                      | max. 50  | 0.00 ±0.00   | 0.00 ±0.00 |
| Moisture (%)                     | max. 22  | 28.37 ±0.21  | 28.30 ±2.55|
| Reducing sugar (glucose) (%)     | min. 65  | 32.20 ±0.87  | 37.63 ±4.56|
| Sucrose (%)                      | max. 5   | 0.00 ±0.00   | 0.00 ±0.00 |
| Acidity (ml NaOH 1N/kg)          | max. 50  | 313.33 ±38.55| 294.33 ±27.61|
| Ash (%)                          | max. 0.5 | 1.18 ±0.38   | 0.93 ±0.12 |

### Table 2. The result of phytochemicals analysis raw propolis.

| No. | Sample code | Phytochemical parameter |
|-----|-------------|-------------------------|
|     |             | Flavonoid | Alkaloid | Tanin | Saponin | Quinon | Steroid | Triterpenoid |
| 1   | GG R        | +         | -        | +      | +       | -       | -       | -           |
| 2   | GG D        | +         | -        | +      | +       | -       | -       | -           |
| 3   | LK R        | +         | -        | +      | +       | -       | -       | -           |
| 4   | LK D        | +         | -        | +      | +       | -       | -       | -           |
| 5   | RR R        | +         | -        | +      | +       | -       | -       | -           |
| 6   | RR D        | +         | -        | +      | +       | -       | +       | -           |
| 7   | TB R        | +         | -        | +      | +       | -       | +       | -           |
| 8   | TB D        | +         | -        | +      | +       | -       | -       | -           |

Description: GG: Gangga; LK: Langko; RR: Rarung; TB: Timbanuh; R: Rainy season; D: Dry season

4.2. Honey

SNI 3545: 2013 included diastase enzyme activity as one of the quality indicators of honey. This enzyme serves to digest starch [10]. The minimum value of this enzyme activity is 3 DN. Based on the results it is known that the honey samples have not detected any activity of these enzymes. In the study of Chuttong et al. [11] it was stated that from 11 species of stingless bees, 5 of them were not detected by this enzyme activity. The species, which do not have diastase activity, are H. Fimbriata, L. Furva, T. Fuscobalteata, T. Testaceitarsis and T. apicalis.

The presence of hydroxymethylfurfural in honey is a standard quality indicator related to authenticity or improper storage [12]. This compound was not detected in Lombok stingless bee honey. The value of HMF honey from several species of stingless bee contented from 27 mg/kg to 51
mg/kg [14]. In another location, Southern Mexico, a similar condition was found where HMF was not detected especially in *M. solani*, *S. mexicana*, and *M. beecheii* [13]. This result shows that the quality of stingless bee honey from Lombok has met SNI and international honey standards.

The moisture content of stingless bee honey from Lombok has not required the SNI 3545. Honey with moisture content more than 22% is very susceptible to attack by microorganisms. It makes it easy to be fermented. Themoisture content of honey that harvested in the rainy season was relatively the same as that in the dry season. The value of honey moisture content from the stingless bee was relatively higher than that from *Apis mellifera* [12]. According to it, this was caused by the high hygroscopicity of stingless bee honey which is the basic characteristic [12, 13].

The other quality standard parameter is the content of reducing sugar. In this study, reducing sugar identified with glucose content. The glucose content of Lombok stingless bee honey in the dry season and the rainy season were low. It is relatively the same as the honey from Northeastern Brazil which is in the range of 37-45% [15]. One thing that affects this value is the kind of feed from the bee itself because glucose content has a close relationship with the nectar characteristics of the flower and also varies in plant species [14].

Another sugar content in honey which also be the quality standard parameter is sucrose content. High sucrose values indicate the authenticity of honey. In stingless bee honey from Lombok, the presence of sucrose was not detected. The results of the review related to the sucrose content of stingless bee honey originating from Asia in this case Malaysia and Thailand showed the same conditions [11, 16, 17].

The characteristic that distinguishes stingless bee honey from Apis honey is its taste. Stingless bee honey has a sour taste. Based on the study, the acidity of honey was very high when it is compared to the required quality standard of honey acidity. Several species of stingless bee that have high acidity levels are from *H. fimbriata, L. flavibasis, L. doipaensis, T. apicalis* and *T. melanoleuka* [11]. These species are stingless bees which came from Southeast Asia.

Ash content is one of the quality indicators of honey which in its development is harmonized with its electrical conductivity. Ash content describes the total minerals present in honey where this is directly influenced by the environment, geographical conditions and botanical aspects of origin [18]. Lombok stingless bee honey has a high ash content. The high ash content is also possessed by honey from *Tetragonula fuscobalteata, Homotrigona fimbriata, Lepidotrigona doipaensis* and *L. flavibasis* from Thailand also *Friseomalita aff Varia* from Venezuela [11, 16, 17].

4.3. Propolis

Phytochemicals analysis of raw propolis showed the presence of flavonoids, tannins, and saponins in all tested samples. This study knew that raw propolis originating from Rarung, Central Lombok district, which was harvested during the dry season was positively containing steroids. Steroids are also detected in propolis originating from Timbanuh, East Lombok district, which is harvested during the rainy season. Propolis extracted using methanol was detected to contain secondary metabolites that were relatively similar to propolis from Lombok, especially from *H. itama*, which are flavonoids and saponins [19]. The study of it in other parts of Indonesia which showed the same content are propolis originating from Pekanbaru and Kendal [20].

5. Conclusion

Stingless bee products that come from Lombok have their characteristics. The proximate analysis of bee bread shows relatively similar content for moisture, ash, and protein of bee bread when harvested in rainy and dry seasons. The difference between them is the fat and carbohydrate content, which is inversely proportional between the two. During the rainy season beebread fat content was higher and carbohydrates were lower than it in the dry season. While in the dry season the opposite happened.

Analysis of honey also shows the peculiarities of honey from Lombok have a low content of glucose and high moisture content, ash and acidity. Most of SNI parameter for stingless bee honey
cannot be reached. Each propolis samples consist of flavonoids, saponin, and tannin. Some of them in other locations and different seasons are positively steroids detected.

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