

## **Characteristics of the composition of stingless bee bread with health benefits originating from the Kulisusu Subdistrict, North Buton Regency**

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### **ABSTRACT**

This study aims to determine the chemical composition of stingless bee bread from Kulisusu District, Buton Utara Regency. Meanwhile, this research aims to obtain information on the composition of stingless bee bread and the source of nectar, and pollen from Kulisusu District, Buton Utara Regency. The research took place from October to November 2021. Bee Bread samples were taken from beehives in the Forest of Kulisusu District, Buton Utara Regency. Determination of the chemical components of Bee Bread using a spectrophotometer in the Biomedical Laboratory, Faculty of Medicine, Halu Oleo University. The results showed that there were two types of stingless bees, namely *Tetragomula sapiens* and *Tetragomula biroi*. 14 types of plants have been identified as food sources for stingless bees. The chemical composition of Bee Bread is the average protein content of T, *sapiens* is 27.00% and T, *biroi* is 12%. The average carbohydrate content of T, *sapiens* is 45.57%, and T, *biroi* is 58.11%. on the average polyphenol content of T, *sapiens* is 9.88%, and T, *biroi* is 22.56%.

Keywords: Bee Bread, Stingless Bee, *Tetragonula sapiens*, *Tetragonula biroi*, Buton Utara Regency.

### **ABSTRAK**

Penelitian ini bertujuan untuk mengetahui komposisi kimia roti lebah tanpa sengat asal Kecamatan Kulisusu Kabupaten Buton Utara. Sedangkan tujuan penelitian ini adalah untuk memperoleh informasi komposisi roti lebah tanpa sengat serta sumber nektar dan serbuk sari yang berasal dari Kecamatan Kulisusu Kabupaten Buton Utara. Penelitian berlangsung pada bulan Oktober hingga November 2021. Sampel Bee Bread diambil dari sarang lebah di Hutan Kecamatan Kulisusu Kabupaten Buton Utara. Penentuan komponen kimia Bee Bread menggunakan spektrofotometer di Laboratorium Biomedik Fakultas Kedokteran Universitas Halu Oleo. Hasil penelitian menunjukkan terdapat dua jenis lebah tak bersengat, yaitu *Tetragomula sapiens* dan *Tetragomula biroi*. 14 jenis tumbuhan telah diidentifikasi sebagai sumber makanan bagi lebah tak bersengat. Komposisi kimia Bee Bread rata-rata kandungan protein T, *sapiens* 27,00% dan T, *biroi* 12%. Rata-rata kandungan karbohidrat T, *sapiens* 45,57% dan T, *biroi* 58,11%. rata-rata kandungan polifenol T, *sapiens* sebesar 9,88%, dan T, *biroi* sebesar 22,56%.

Kata Kunci: Roti Lebah, Lebah Tanpa Sengat, *Tetragonula sapiens*, *Tetragonula biroi*, Kabupaten Buton Utara.

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## INTRODUCTION

Indonesia boasts a rich diversity of approximately 40 types of stingless bees, meticulously categorized into various genera. Among the array of species, beekeepers across the nation are increasingly focusing on cultivating specific types, such as *Heterotrigona itama*, *Geniotrigona thoracica*, *Lepidotrigona terminata*, *Tetragonula biroi*, and *T. laeviceps*. The burgeoning interest in the widespread cultivation of stingless bees in Indonesia is fueled by their myriad advantages, particularly as a health-enhancing food product for human consumption (Mahmad et al., 2023).

These diminutive yet industrious pollinators contribute to honey production with remarkable health benefits. Numerous studies have highlighted the elevated levels of antioxidants in pot honey derived from stingless bees. Notably, the honey produced by these bees exhibits potent antimicrobial activity, as elucidated by Popova et al. (2021) in their study. The findings of this research underscore the heightened medicinal properties of stingless bee honey, surpassing those of the more commonly known *Apis mellifera* bees. As the awareness of these health-promoting properties continues to grow, the cultivation of stingless bees in Indonesia is poised to witness further expansion, presenting a promising avenue for beekeepers and enthusiasts alike (Chuttong et al., 2023).

Apart from its very distinctive honey product, stingless bees also have a by-product, namely bee bread, as one of the bees' main food. Bee bread is a honey bee product produced from flower pollen. Based on research conducted by Kapitanhita et al. (2018), *Trigona* bee bread production can reach 33.8 g per colony. Bee bread itself has complete nutritional value starting from carbohydrates, protein, and the minerals that make up it. The nutritional value of bee bread varies depending on the chemical makeup of the product, which is influenced by various factors including plant origin, location, climate, soil type, beekeeping activities, and bee species (Aylanc et al., 2021). Based on this, this research was carried out to see the levels of chemical components of bee bread from stingless bees from Kulisusu District, North Buton Regency.

## LITERATURE REVIEW

### Bee Bread

Bee bread, also known as bee pollen, is a natural product produced by honey bees through the fermentation process of flower pollen collected from plants by worker bees. Worker bees collect pollen from flowers using their legs equipped with fine hairs that attract and hold it (Didaras et al., 2020). They carry this pollen back to the hive as the bee colony's main protein source. Bee bread is rich in essential nutrients such as protein, carbohydrates, vitamins, and minerals. The high nutritional content makes it an important food for bee larvae, which require good nutritional intake for their growth and development (Mayda et al., 2020).

In the next stage, worker bees add water, enzymes, and bacteria to the pollen that has been collected. This fermentation process increases the digestibility of pollen, turning it into a substance that is more easily digested and absorbed by bees. Bee bread has an important role in bee colonies (Barta et al., 2022). Apart from being a food source for larvae, bee bread is also given to adult bees, especially queens and workers, as a nutritional supplement to support their daily activities. The nutritional quality of bee bread can vary depending on the type of plant from which the pollen is collected. Bees tend to choose a variety of pollen sources to ensure optimal nutritional balance (Darwish et al., 2023).

Bee bread also contains antioxidants, which can help fight free radicals and support cell health in bees' bodies. This antioxidant also provides human health benefits when consuming bee products containing bee bread. Humans have begun recognizing the nutritional value of bee bread and use products containing bee bread as health supplements (Martinello & Mutinelli, 2021). Bee bread has been integrated into various products, supplements, and cosmetics. Excessive collection of bee bread by bees can threaten the sustainability of bee colonies. Therefore, sustainable and ethical bee farming practices are essential to ensure the welfare of bees and the sustainability of bee bread resources (Luo et al., 2021).

Overall, bee bread or bee pollen is a natural product that contains high nutrients and has a vital role in the life of bee colonies. With a better understanding of its nutritional value and health benefits, bee bread can continue to be a focus of research and use in various fields (Mărgăoan et al., 2019).

### Stingless Bee

Stingless bees are social insects that are rich in benefits because they produce honey which is known to have health benefits. Apart from honey, other products produced include pollen, royal jelly, and propolis. Based on biological characteristics, bees are divided into two large groups, namely those with stings and those without stings. The genus *Apis* is a type of stinging bee that has good productivity in producing honey, while the genus *Stingless bees* is a type of stingless honeybee that is not widely cultivated (Mohammad et al., 2021).

Stingless bees live naturally, and people in general do not know that this type of bee is a honey-producing bee that can be cultivated. Only the *Apis* species is known as a honey producer. However, now many people know Stingless bees as a type of stingless bee that can produce honey and propolis (Harianja et al., 2023).

Stingless bees are a species from the genus *Melliponini* which has the unique characteristic of producing propolis in addition to honey. Stingless bees are honey bees that do not have stings, so these bees produce propolis as a means of self-defense (Pimentel et al., 2022). Naturally, Stingless bees make nests in holes, trees, cracks in walls, and bamboo

holes in the house. The doorway is a hole 1 cm long, produces honey and an adhesive substance in the form of wax which is produced in very small quantities. These bees don't like to move from place to place (Withaningsih et al., 2023).

This type of bee is more commonly found in tropical regions with hot climates compared to subtropics with 4 seasons (winter, spring, summer, and fall). Stingless bees tend to be attracted to food sources that are located lower and closer to the nest entrance compared to food sources that are further away and higher (Castelli et al., 2022).

Stingless bees can live at temperatures of 22-25°C and humidity of 70-80%. The baby cells are horizontal in a wooden hole with one main entrance (hole) to the nest. By cultivating Stingless bees you will get benefits including:

- a) Ecological benefits: pollination process by bees in connection with food.
- b) Economic benefits: the products produced by Stingless bees are honey, propolis, bee pollen, etc.
- c) Social benefits: as a source of income, opening up business opportunities for the community, research objects, and regional potential.

Environmental factors (temperature, humidity, and light intensity) and real-time influence the flying activity of Stingless bees. High temperature and light intensity increase bee activity, while high humidity reduces bee activity. People who live in villages are generally familiar with galo-galo (Liporoni et al., 2020). These bees generally nest in the walls of houses made of stone without plaster, walls that have cracks or cavities around the stone. Their nests are unique because they have tunnels made of wax that lead out as gates to the nest (Kratschmer et al., 2020).

### Plant Sources of Pollen

Plants as a source of pollen refers to the important role of plants in producing pollen which is the male reproductive cell. Pollen has a major role in the fertilization process of plants, helping to transfer sperm cells to the female part of the flower for fertilization. Pollen is a microscopic structure produced by the male reproductive organs of plants, called stamens in flowers (Liu et al., 2021). This structure consists of strong and protective cell walls that enclose the sperm cells. The main function of pollen is to transfer plant sperm cells from one flower to another. This process is known as pollination and is a key step in the life cycle of flowering plants (Pereira et al., 2021).

Pollen can be spread by the wind or by animals, especially bees and butterflies, which search for nectar in flowers. Wind-pollinated plants usually produce larger amounts of pollen and are lighter in weight so they can be carried by the wind. Various plants provide pollen contributions that vary in size, shape, and color (Kline et al., 2022). These traits often play an important role in attracting certain pollinators, such as bees or hummingbirds. Plants as pollen sources have a crucial role in maintaining biodiversity and ecosystem balance. The pollination process helps in the formation of fruit and seeds, which then supports the growth and survival of various types of organisms (Khalifa et al., 2021).

Some plants have special symbiotic relationships with certain pollinators. For example, certain flowers may develop in such a way that only certain pollinators can reach and collect the pollen. Pollen is also an important source of nutrition for several animals, especially bees which collect pollen as raw material for making bee bread or food for bee larvae. In an agricultural context, pollen has a large role in the formation of fruit and plant seeds. In forestry, pollen also plays an important role in tree plant reproduction, supporting forest regeneration (Kumar et al., 2020).

Although pollen plays a vital role in the ecosystem, some people experience allergic reactions to pollen, which can cause respiratory problems and other allergy symptoms. Therefore, the study of the types and distribution of pollen is important in understanding its impact on human health (D'Amato et al., 2020).

## RESEARCH METHOD

This research was carried out using a qualitative approach through observation methods. This research was carried out in Kulisusu District, North Buton Regency. Sample collection and collection were carried out using the purposive sampling method. In the process, the search for bee colony nests is carried out by exploring. Once found, the type of bee will be observed, both from the characteristics of the nest and the nesting plants within a radius of 200 meters from the beehive.

## RESULTS AND DISCUSSION

### Types of Stingless Bees

Table 1 Types of Stingless Bees in Kulisusu District, North Buton Regency

Nest Number	Nesting Place	Types of Bees	Nest Position	
			S	E
1	Coconut	Tetragonula sapiens	-4.659225	123.1159683
2	Cashew	Tetragonula sapiens	-4.766465	123.179675
3	Cashew	Tetragomula sapiens	-4.7619733	123.1819417
4	Biti	Tetragomula biroi	-4.8362259	123.1748334

The research results showed that there were two types of stingless bees found in 4 (four) nests in Kulisusu District, North Buton Regency, namely, *Tetragonula sapiens* and *Tetragonula biorei*. More details can be seen in Table 1.

### Chemical Composition of Bee Bread

The chemical composition contained in Bee Bread shows differences in the high and low areas in each nest. More details can be seen in Table 2.

**Table 2. Protein Content, Carbohydrate Content, and Polyphenol Content of Stingless Bee Bread**

Nest Number	Types of Bees	Parameter		
		Protein Content (%)	Carbohydrate Content (%)	Polyphenol Content (%)
1	<i>T.sapiens</i>	31.12%	38.35%	10.97%
2	<i>T.sapiens</i>	21.5%	56.61%	10.34%
3	<i>T.sapiens</i>	28.4%	41.77%	8.33%
5	Ratarata	27.00%	45.57%	9.88%
4	<i>T. biroi</i>	12%	58.11%	22.56%

### Plant Sources of Propolis Sap

The results of this research show that there are 14 plants used by stingless bees that produce sources of pollen (P) and nectar (N) in Kulisusu District, North Buton Regency. The types of plants obtained at the research location can be seen in Table 3.

**Table 3. List Of Plants Found Around Stingless Bee Hives**

No	Plant Names		Family	Source	Nest			
	Local Name	Latin Name			✓	×	×	×
1	Cashew	<i>Anacardium occidentale</i>	Anacardiaceae	N*	✓	✓	✓	✓
2	Nutmeg	<i>Myristica fragrans</i>	Myristicaceae	NP*	✓	×	×	×
3	Coconut	<i>Cocos nucifera</i>	Arecaceae	NP*	✓	×	×	×
4	Jackfruit	<i>Artocarpus heterophyllus</i>	Moraceae	PR*	✓	✓	×	×
5	Sugar palm	<i>Arenga pinnata</i>	Aracaceae	NP*	✓	×	×	×
6	Bitty	<i>Vitex copassus</i>	Verbenaceae	N*	×	×	×	✓
7	Sea banyan	<i>Ficus superb</i>	Moraceae	PR*	×	×	×	✓
8	Mangroves	<i>Rhizophora sp</i>	Rhizophoraceae	P*	×	×	×	✓
9	Orange	<i>Citrus sp</i>	Rutaceae	NP*	×	×	×	✓
10	Mango	<i>Mangifera indica</i>	Anacardiaceae	P*	×	×	×	✓
11	Cassava	<i>Monihot esculenta</i>	Euphorbiaceae	NP*	✓	×	×	×
12	Bandotan grass	<i>Ageratum conyzoides</i>	Asteraceae	P*	✓	×	×	×
13	Cocoa	<i>Theobroma cacao</i>	Malvaceae	N*	×	✓	×	×
14	Angsana	<i>Pterocarpus indicus</i>	Fabaceae	N*	×	×	✓	×

Note: ✓ = Found around the nest. × = Not found around the nest N = Nectar. P = Pollen

### Types of Bees in Kulisusu District

Types of stingless bees in Kulisusu District, North Buton Regency, there are 2 (two) types of stingless bees from 4 stingless bee hives, namely *T. sapiens* and *T. biroi*. *T. Sapiens* has a black thorax and hair. Meanwhile, *T. biroi* is a group of bees that are aggressive, have a black head and thorax, and have black stripes on the abdomen.

The results of observations in the field found 14 types of plants that contain nectar and pollen which are a source of food for bees. Compared to several previous studies, these 14 types of plants are lower than those found in Yogyakarta, 18-28 types were found based on altitude, likewise in Kampar Regency there were 26 types of potential trigona food found.

### Feed Source

Not all types of plants are liked by honey bees. Nectar and pollen are the primary binders for bees to come to a plant. Meanwhile, the characteristics of plants that are visible from the outside, such as flower color, flower aroma, and flower shape, are secondary because they only stimulate the sense organs.

Pollen from plants is used by bees as a source of protein. Pollen consumed by stingless bees (*trigona*) which has been mixed with enzymes found in bee saliva and mixed with honey is then stored in the hive and undergoes fermentation, called Bee Pollen/Bee Bread. Beebread differs from pollen by its lower Ph (3.8-4.3), containing less protein and fat but more carbohydrates and lactic acid. Bee bread has better bioavailability because the pollen wall, which cannot be destroyed by gastrointestinal fluids, has been partially damaged by fermentation and functionally and the energy-rich

pollen content can be assimilated and used more easily. Proper hive management promotes the collection of bee bread, aimed at marketing it for human consumption because it can be considered as a food supplement due to its content of various nutrients.

One contribution to its high nutritional value is the presence of large amounts of protein, vitamins, and phenolic compounds as natural anti-oxidants. The potential applications of "bee bread" as food and as a nutraceutical supplement depend largely on its chemical composition which varies directly with the flora, region, and time of collection by the bees. Beebread differs from pollen by its lower Ph (3.8-4.3), containing less protein and fat but more carbohydrates and lactic acid. Bee bread has better bioavailability because the pollen wall, which cannot be destroyed by gastrointestinal fluids, has been partially damaged by fermentation and functionally and the energy-rich pollen content can be assimilated and used more readily. Bee bread has antimicrobial, hepatoprotective antioxidant, immunomodulating and antiradiation activity, and adaptogenic properties. It stimulates the protective forces of the human body, normalizes metabolism, has a positive influence on the liver, and the function of the nervous and endocrine systems, and improves tissue regeneration, and physical and mental resilience of the human body.

### **Factors that Influence Stingless Bees in Collecting Pollen.**

The flying activity of stingless bees in search of pollen is one of the foraging activities. Stingless bees usually leave the nest to look for pollen at 6-8 a.m. Not all flowering plants bloom in the morning, this is what causes differences in pollen collection from various flowering plants by *H. itama* and *T. laeviceps*. The environmental factors temperature and light intensity are positively correlated with the flight activity of *T. laeviceps* while the opposite is true for air humidity.

Differences in consumption patterns between stingless bee colonies are influenced by the flowers that are blooming around the nest. If the flowers that are blooming around the beehive are different, the pollen collected will be different. Every flowering plant that produces pollen varies in quantity and maturity. The amount of pollen produced depends on the maturity of the pollen which also influences the aperture type, shape, and size of the pollen. The distance and height of food sources also influence stingless bees in collecting pollen. Food sources that are close to the nest and not too high are more likely to be visited by stingless bees than food sources that are far from the nest and too high. This is because the size of stingless bees is small so they are not able to fly too far from the nest and do not look for high places.

### **Chemical Composition of Bee Bread**

The protein content in the non-segmented bee bread from Kulisusu District, North Kuton Regency, *T. sapiens* types with an average of 27.00%, *T. biroi* type 12%. The protein content in the non-segmented bee bread is influenced by the food source. The protein content of unsegmented Bee Bread varies greatly, depending on the feed source. According to Kamilia, the protein test results showed that the protein content was 25.82%. According to research by Lesmana (2018), the protein content found was 10.11%, and the protein content of *T. sapiens* and *T. biroi* was higher compared to previous research.

The carbohydrate content in the stingless bee bread of the *T. sapiens* type is on average 45.57% and the *T. biroi* type of bee bread is 57.11%. According to Berene's analysis, the content of stingless bee Bread carbohydrates is 24.40%, while Utomo's research it shows a carbohydrate content value of 2.26%, and Lesmana's research shows a carbohydrate content value of 48.60%. For both types of stingless bees, *T. sapiens* and *T. biroi*, the carbohydrate content values were higher compared to previous research.

The polyphenol content of non-sod bee Bread in the *T. sapiens* bee species is 9.88% on average and the *T. biroi* bee species is 22.56%. Compas stated that stingless Bee Bread also contains polyphenol/flafonoid compounds that have antioxidant activity. According to Utomo's research, Bee bread's polyphenol content is 1.76%. Compared with previous research, the levels of *T. sapiens* and *T. biroi* were higher.

Based on the results of testing the carbohydrate, protein, and polyphenol levels of trigona bees based on the location of the nest, the values vary. The difference in value varies due to differences in bee food plants around the beehive.

### **CONCLUSIONS AND SUGGESTIONS**

Through research results, it was found that the types of stingless bees in Kulisusu District, North Buton Regency have two types of stingless bees, namely *Tetragonula sapiens* and *Tetragonula biroi*. The food sources for bees around the nest are 14 types of plants including cashew (*Anacardium occidentale*), nutmeg (*Myristica fragrans*), coconut (*Cocos nucifera*), jackfruit (*Artocarpus heterophyllus*), sugar palm (*Arenga pinnata*), bitti (*Vitex copassus*), banyan sea (*Ficus superb*), Mangrove (*Rhizophora* sp), Orange (*Citrus* sp), Mango (*Mangifera indica*), Cassava (*Monihot esculenta*), Bandotan grass (*Ageratum conyzoides*), Cocoa (*Theobroma cacao*) and Angsana (*Pterocarpus indicus*). Lastly, regarding the chemical composition of bee bread, the protein content of *Tetragonula sapiens* is 27.00% on average and the protein content of *Tetragonula biroi* is 12%, the carbohydrate content of *Tetragonula sapiens* is 45.57% on average and the carbohydrate content of *Tetragonula biroi* is 58.11%, the polyphenol content of *Tetragonula sapiens* is on average the average was 9.88% and the polyphenol content of *Tetragonula biro* was 22.56%.

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