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# Nutritional composition of stingless bee honey from different botanical origins

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**Abstract.** The nutritional content of honey varies with its botanical and geographical origins; also, it is influence by environmental, storage and processing factors. The current study aimed at evaluating the nutritional composition of raw unprocessed Malaysian Stingless bee's honey (*Heterotrigona itama*) from different botanical origins. Six honey samples were collected from different botanical origins located in the Southern part of Peninsular Malaysia. It was then analysed for ash, moisture, protein (Kjeldahl method), fat (Soxhlet extraction) and carbohydrates content according to AOAC official method. The ash, moisture, protein and carbohydrate contents of honey samples ranged from 0.15 to 0.90 g/100 g, 27.00 to 31.00 g/100 g, 0.20 to 0.80 g/100 g, and 67.58 to 72.25 g/100 g, respectively. No significant value obtained for the fat analysis of honey samples. Sample with higher moisture content recorded lower carbohydrates content. The health benefits of honey are generally known, however the knowledge of Malaysian Stingless bee honey especially from different botanical origins is still limited. Due to its prospect as functional foods, information on its composition is crucial as preliminary data for further study.

## 1. Introduction

Honey is a supersaturated sugar solution from the nectar or secretion of plant that was converted into honey from the enzyme produced by bees. Honey contained around 80 to 85 % of carbohydrates, 15-17 % of water, 0.3 % of proteins, 0.2 % of ashes. Honey consists of high concentration of fructose and glucose, with low levels of amino acids, phenolic acids, organic acids, vitamins, minerals, enzyme and other phytochemicals [1,2]. Research on honey showed that active compound in honey such as flavonoids, phenolic compounds and certain enzymes (glucose oxidase and catalase) has beneficial effect to our health. The composition in honey especially in stingless bee honey had raised interest among researchers as it has potential benefits in prevention of diseases associated with oxidative stress. Besides it also displays wound healing properties, anti-septic, anti-cancer, and anti-inflammatory capacity [3].

The characteristics of honey is determined predominantly by its complex composition which varies with the botanical resources, geographical origins, storage conditions, bee species, environmental factors and processing methods. Honey obtained from different origin will have different composition of active components [2,3]. The nutritional composition in stingless bee honey remained unclear in our country. In order to extend the knowledge regarding the quality of honey from stingless bees, there is a

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need to carry out a research to prevent fraud and to set a standard for the quality of stingless bee honey.

The aim of the study is to investigate the proximate composition of the stingless bee honey from different botanical origins (single floral and mix botanical).

## 2. Materials and methods

### *2.1 Honey Samples*

Six stingless bee honey samples were collected from various botanical origins namely monofloral and multifloral. All the samples were obtained and transferred at room temperature to the laboratory and were stored in dark until the experiment. Table 1 below showed the source, floral type, and location of the analysed stingless bee honey in this study.

**Table 1.** Source, floral type, and location of the stingless bee honey analysed in this study.

| Source | Floral type | Local tree name | Location |
|---|---|---|---|
| Acacia | Monofloral (stingless bee or *Heterotrigona itama*) | Mangium tree (*Acacia mangium*) | Kota Tinggi |
| Coconut | Monofloral (stingless bee or *Heterotrigona itama*) | Coconut tree (*Cocos nucifera*) | Tangkak |
| Star fruits | Monofloral (stingless bee or *Heterotrigona itama*) | Starfruit or carambola tree (*Averrhoa carambola*) | Pagoh |
| Mangrove | Monofloral (stingless bee or *Heterotrigona itama*) | | Batu Pahat |
| Multifruit | Multifloral (stingless bee or *Heterotrigona itama*) | Local fruits | Kulai Jaya |
| Multriflora | Multifloral (stingless bee or *Heterotrigona itama*) | Local flowers | Parit Botak, Batu Pahat |

All the samples were collected at the Southern region of Malaysia, namely Johore state. The places whereby the samples being obtained were narrowed down to the Southern region as to reduce the effect on the analysis due to environmental factor.

### *2.2 Proximate Analysis*

*2.2.1 Ash* Five grams of honey samples was incinerated at 550°C overnight until the weight was constant according to AOAC Official Method 942.05 [4].

The ash content on dry basis was calculated according to the following equation [6]:

$$\text{Ash content on dry basis (\%)} = \text{Weight of ash obtained (g)} / \text{Weight of sample (g)} \times 100 \quad (1)$$

*2.2.2 Moisture* Moisture content of samples was measured by weighing and drying 2.0g of sample in crucible overnight at 60°C. The percentage of moisture content was calculated on dry basis according to the following equation [5,6]:

Moisture content on dry basis (%)
= Weight of moisture obtained (g) / Weight of sample (g) (2)

*2.2.3 Protein* The protein content was determined using Kjeldahl method according to AOAC Official Method 963.15 using a digestion system and a distillation unit (Velp UDK 159) [7]. The Kjeldahl procedure is divided into three steps namely digestion, distillation and titration. In the digestion step, the organic nitrogen in honey will be converted to ammonium sulphate in the presence of mixed catalyst at approximately 370°C. In the distillation step, the digested sample will then be made alkaline with sodium hydroxide and the nitrogen is distilled off as ammonia nitrogen. The ammonia nitrogen will be trapped in boric acid solution and the amount will be quantified by titration with 0.1 N hydrochloric acids. The protein content was calculated by multiplying the nitrogen content with a universal conversion factor of 6.25 [6].

*2.2.4 Fat* The fat content was determined using Soxhlet extraction procedure following AOAC Official Method 988.05 [7]. The wet honey sample was freeze-dried prior to extraction. The percentage of fat content was calculated according to the following equation:

Fat content (%)
= Weight of fat obtained (g) / Weight of sample (g) × 100 (3)

*2.2.5 Carbohydrate* Carbohydrate content of honey samples was calculated using equation below [6]:

Carbohydrate (%)
= 100% − (Moisture+Ash+Fat+Protein)% (4)

## 3. Results and discussion

Table 2 shows the results of proximate analysis of six stingless bee honey samples collected from different botanical origins including moisture, ash, carbohydrate, protein and fat content.

**Table 2.** Nutritional composition of stingless bee honey samples.

| | **Acacia** | **Coconut** | **Mangrove** | **Star fruit** | **Multifruit** | **Multiflora** |
|---|---|---|---|---|---|---|
| Moisture content (g/100g) | 31.00 | 29.00 | 30.00 | 31.00 | 27.00 | 31.00 |
| Ash (g/100g) | 0.17 | 0.90 | 0.47 | 0.20 | 0.15 | 0.62 |
| Carbohydrate (g/100g) | 68.33 | 69.30 | 69.33 | 68.60 | 72.25 | 67.58 |
| Protein (g/100g) | 0.50 | 0.80 | 0.20 | 0.20 | 0.60 | 0.80 |
| Fat content (g/100g) | negligible | negligible | negligible | negligible | negligible | negligible |

The moisture content of the samples investigated fall in between 27.00 to 31.00 g/100 g. Stingless bee honey samples collected from the acacia, mangrove and multiflora botanical recorded highest moisture value followed by samples from coconut (29.00 g/100g) and the lowest from multifruit (27.00 g/100g) origin. According to MS 2683, the moisture content of raw unprocessed Malaysian stingless bee honey shall not be more than 35% [8]. The moisture content of all the samples tested fall within the limit as prescribed [8,15]. As reported by Chuttong *et al.*, the moisture content of stingless bee honey samples from Thailand ranged from 25 to 47 g/100g with average of 31±5.4 g/100g [9]. Stingless bee honey is known to have higher moisture than that of honey produced by *Apis mellifera*. The shelf-life of honey was greatly affected by the moisture content as it will promote fermentation [3,10]. Greater care was

essential in handling stingless bee honey due to its higher moisture content that favours fermentation [2].

The ash content of the samples analysed in this study varied between 0.15 and 0.90 g/100 g. The highest ash content was recorded in stingless bee honey samples obtained from coconut botanical (0.90 g/100g) whereas the lowest was from multifruit origins of 0.15 g/100g. The ash contents of honey obtained in this study were all within the limits of < 1.0 g/100 g as specified by the Malaysian Standards (MS 2683:2017) [8]. This was further supported by the study of [6] and [15] where the ash content in stingless bee's honey produced by *Heterotrigona itama* recorded a very low amount of 0.08 g/100g and between 0.15±0.01 and 0.67±0.00 g/100g respectively. However, the results were different from Chuttong *et al*. (2016) who reported the ash content of all the stingless bee honey obtained in their study were < 1.8 g/100 g except from honey from *T. melanoleuca* (3.1g/100g) [9]. Since the honey samples were obtained from different botanical origins, thus the materials collected and the environment will be different. These will lead to the variation in the ash content analysed. Ash content can be used to determine the botanical origin of the honeys. Several studies have shown that botanical origins will affect the ash content of the honey and lighter colour honey deemed to have lower ash content than that of darker colour honey [6,11].

Protein in stingless bee honey samples from this study were in the ranged of 0.2 to 0.8 g/100g. The highest value of 0.8 g/100g was recorded in the samples retrieved from coconut and multiflora botanical origins. Meanwhile, samples obtained from mangrove and start fruits botanical recorded the lowest protein value of 0.2 g/100g. As reported by Kek *et al*., highest value of protein content was found in stingless bee honey (0.85g/100g) from *Heterotrigona itama* species [6]. Protein in honey was mainly make up of enzymes and free amino acids. The protein was present in the nectar itself and mostly was added by the bees during the ripening process of the honey [11,12]. Enzyme amylase, invertase and glucose oxidase were the main enzymes in honey, which has function in promoting health benefits in human.

The total carbohydrate contents of samples investigated in this study ranged between 67.58 to 72.25 g/100 g. According to Kek *et al*., stingless bee honey with lowest moisture and protein content will have the highest carbohydrate content [6]. In this study, stingless bee honey sample from multifruit botanical reported to have the highest carbohydrate content of 72.25 g/100g. Meanwhile, sample from multiflora botanical recorded the lowest carbohydrate content of 67.58 g/100g, the lower carbohydrate content making it less sweet but waterier. The average carbohydrate content of stingless bee honey samples tested was 69.23 g/100g which still compliance with the international norms (not less than 60.0 g/100g) [11]. The high carbohydrate values signified that it was the main constituent in honey which can provide energy upon consumption and was a good source of energy for athlete [13].

The samples tested in this study recorded too little or negligible amount of fat. According to Kek *et al*. there was no significant value for fat content in honey thus, it was not included in the calculation for total carbohydrates [6]. Due to the very minute amount of fat in stingless bee honey, thus it will not be a good source of lipid [5].

Generally, the results obtained from the six stingless bee honey samples tested showed that the moisture content ranged from 27.00 to 31.00 g/100 g with a mean value of 29.83 g/100 g. The ash contents recorded fall between 0.15 and 0.90 g/100 g with an average of 0.42 g/100 g. Protein values varied from 0.20 to 0.80 g/100 g with an average of 0.52 g/100 g. The total carbohydrate contents ranged between 67.58 to 72.25 g/100 g with a mean of 69.23 g/100 g. The fat contents in the stingless bee honey samples were too little and negligible.

## Conclusion

The moisture and ash content obtained from this study coincide with those specified by Malaysian Standards (MS 2683:2017). The carbohydrate, protein and fat contents recorded were still within the norms. From this study, we can conclude that Malaysian stingless bee's honey from *H. itama* has higher moisture content than honey from *A. mellifera*. The ash content of stingless bee honey obtained from coconut and multiflora botanical recorded a higher value than the specification by Codex

Alimentarius Commission for *A. mellifera* honey [14]. However, it was still within the range set by Malaysian Standards (MS 2683). Other parameters, such as protein, carbohydrate and fat contents were similar to that of *A. mellifera* honey. Honey compositions depend greatly on the botanical origin of honey, thus further research is essential to explore in depth the functionality of honey as functional foods and its benefits to health.

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