A REVIEW ON FACTORS THAT AFFECT THE DIFFERENT PHYSICOCHEMICAL AND ANTIOXIDANT PROPERTIES OF STINGLESS BEE *(Heterotrigona itama)* HONEY IN MALAYSIA

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Abstract: Predominantly, it has been stated that stingless bee honey is higher nutritional values than honeybee honey. However, there have been limited studies on its quality. The quality of stingless bee honey also has been questioned and documented to not meet the International Honey Commission (IHC) quality standards set for honey. This review aims to identify the factors that affect the different physicochemical characteristics and antioxidant properties of stingless bee honey in Malaysia. Based on recent studies, the physicochemical and antioxidant properties of Malaysian stingless bee honey were gathered and compared. Various aspects such as moisture content, pH, colour, electrical conductivity (EC), ash content, hydroxymethylfurfural (HMF), total phenolic content (TPC), total flavonoid content (TFC) and free radical scavenging activity (DPPH) and ferric reducing antioxidant power (FRAP) were analysed. As a result, stingless bee honey possessed greater moisture content ranging between (17.07 - 41.49%), pH (2.92 – 5.50), DPPH (1.98 – 44.05%), TPC (3.04 – 9.37mg GAE/100g), TFC (3.63 – 14.44mg QUE/100g), colour intensity (0.09 – 1.056mAU), EC (0.19 – 1.187mS/cm), lower ash content (0.01 – 3.11%), HMF (0.04 – 85.9mg/kg) and FRAP (0.19 – 0.22abs). The findings revealed that the physicochemical and antioxidant properties of the stingless bee honey investigated were highly dependent on several factors such as botanical sources, geographical origins, climatic condition, environmental pollution, beekeeping's processing, handling, and storage conditions which must be taken into consideration for future research.

Keywords: Stingless bee, physicochemical, antioxidant, geographical origin

1. Introduction

Kelulut honey or stingless bee *(Heterotrigona itama)* honey is complex multiflora honey produced by stingless bees from *Trigona spp.* It is primarily composed of sugar, fructose and glucose. Proteins, amino acids, enzymes, organic acids, mineral elements, and vitamins are also found in stingless bee honey but in a small proportion. Some of these components are naturally found in nectar or pollen, while others are added or inserted by bees during the honey maturation process. Predominantly, it has been stated that stingless bees honey is higher in antioxidant activity, moisture content, ash content, water activity, polyphenol, and flavonoids content than *Apis mellifera* bees which carries remarkable health benefits to humans (Shamsudin et al., 2019; Yap et al., 2019).

Honey produced by different species of stingless bees has different physicochemical characteristics and antioxidant properties. However, various factors such as botanical source,

geographical origin, harvesting seasons, climate condition, environmental status, bees species, processing method, and storage condition may affect the quality and antioxidant of the honey itself (Zarei et al., 2019). Many difficulties have been faced in determining the purity and originality of stingless honey.

2. Discussion

The findings revealed that the physicochemical and antioxidant properties of the *kelulut* honey investigated were different and highly dependent on factors such as botanical sources, geographical origins, climatic condition, environmental pollution, beekeeping's processing, handling, and storage conditions. Due to their smaller size, the speciality of *H. itama* species is the tendency to pollinate tiny flowers that cannot be accomplished by other large honeybees (Rao et al., 2016). Therefore, it is possible for them to collect many types of nectar and pollen during foraging activity which resulted in different physicochemical and antioxidant properties. This stingless bee honey is distinguished by the fact that it is naturally kept in the pot (cerumen), which contributes to its therapeutic characteristics, particularly in the wound healing process. (Shamsudin et al., 2019). As the result of the honey being stored in cerumen pots, the quality of the stingless bee honey is impacted by the penetration of phytochemicals from the cerumen (Abd Jalil et al., 2017). The nectars must go through three separate transformation stages resulted in different properties of honey.

Apart from that, botanical origins have been shown to have a major impact on its physical and chemical properties due to the wide variability in the chemical structure of plant nectars and secretions. According to Gismondi et al. (2018) and by Tomczyk et al., (2019), the chemical composition of honey strongly depends on the kind of nectar flow. In turn, the biochemical profile of nectar is qualitatively influenced by genetics and physiology of the source plant, environmental factors (climatic conditions), soil characteristics and typology of pollinators. Each geographical area is characterized by specific climatic conditions that favour the growth of specific plants. The climatic conditions of a specific area also can be affected by pollution, which affects the plants and animals living in that area.

Honey also can be affected by environmental pollution such as heavy metals, pesticides, organic pollutants, pathogens, and radioactivity, and so on. Besides, air pollution and agricultural events also influence the sources of honey nutrients as heavy metals are adsorbed via organic matters, minerals, and carbonates from the soil to the nectars (Alahabadi et al., 2017). The chemical pollutants also increased due to the usage of several chemical compounds which affected environmental mediums such as water, soil, and air as a result of urbanization, agricultural activities, and industrialization (Matin et al., 2016). High density of heavy metals, metallic and toxic chemical elements in honey may affect the different values obtained and can be a threat to health.

Since honey can be considered a heat-sensitive material, some alteration on its physicochemical characteristics might occur. It is essential to control the temperature as the hot air should be hot enough to reduce the moisture content but not exceed the temperature limit above 40 °C. Honey contamination also can arise from different sources, such as the manner of collecting honey by beekeepers, as well as the storage of honey by the consumer (Soares et al., 2017).

3. Conclusion

Several variables impact honey quality, including bee species, botanical sources, geographical origins, climates condition, pollution, handling, processing, and storage conditions. As a result, assessing these variables is critical for determining the quality and authenticity of honey. A wider study with a significant number of samples must be carried out to obtain more insights into the effect of these factors on the parameters that have been studied.

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