

Phytochemical content, antioxidant activity and mineral elements of honey produced by four different species of Malaysian stingless bees

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Abstract

This study investigated the phytochemical composition of honey from four species of Malaysian stingless bee i.e. *Tetragonula laeviceps*, *Geniotrigona thoracica*, *Lepidotrigona terminata*, as well as *Heterotrigona itama*. The measured phytochemical composition was total phenolic content (TPC), total flavonoid content (TFC), antioxidant activity, pH, colour intensity, and mineral element analysis i.e. Magnesium (Mg), Calcium (Ca), Zinc (Zn), Potassium (K), and Sodium (Na). The production of honey by the *L. terminata* had the highest TPC value (6.74±0.57 mg GAE/100 g FW) while the *T. laeviceps* possesses the highest TFC value (14.85±3.71 mg QE/100 g FW). In the antioxidant activity measurement, honey from the *H. itama* obtained the highest percentage of 1,1-diphenyl-2-picrylhydrazyl (DPPH) inhibition (29.52±0.45%) and honey from *T. laeviceps* displayed the highest value in the Ferric reducing antioxidant power (FRAP) analysis (0.95±0.013 abs). The four distinct stingless bee species' colour intensity demonstrated the variation of colour intensity in the range of 0.09-0.23 abs mAU. All honey obtained the pH values (4.75-5.03) within the acidic medium. Mg is the major mineral element in all honey samples which is followed by Na, Ca, K, and Zn.

1. Introduction

Honey is a supersaturated sugar solution containing beneficial natural remedy that is popular for food and medicinal usage. It comes from the plant's floral nectar part which is being converted into honey using the enzymes produced by the bees (Cantarelli *et al.*, 2008). Da Silva *et al.* (2013) reported that honey contains 80-85% carbohydrates, 15-17% water, 0.3% protein, and 0.2% ashes. The authors added that honey contains high fructose and glucose concentration, and low amino acids, minerals, organic acids, phenolic acids, vitamins, enzymes, and other phytochemicals levels.

Recently, studies on stingless bee honey gained wide attention in Malaysia. Stingless bee honey is sugary liquid, superb in taste, and odour (Chuttong *et al.*, 2016). Biluca *et al.* (2014) explained that the stingless bee

honey has various phytochemical content as opposed to regular honey bee in terms of colour, taste, water, viscosity, and sugar contents. Moreover, stingless bee honey has a greater content of polyphenols and flavonoids as compared to the honey that is produced by *Apis* spp. (Rodriguez-Malaver *et al.*, 2009; Rodriguez-Malaver *et al.*, 2013; Biluca *et al.*, 2016). In addition, Maringgal *et al.* (2019) indicated that stingless bee honey from six regions in Malaysia has significant variation in its phytochemical content in terms of total phenolic content (TPC), total flavonoid content (TFC), antioxidant activity, colour intensity, and pH. The authors also found that the phytochemical content has a significant correlation with the botanical and geographical regions in Malaysia. A seminal study in this area is the work of Lim *et al.* (2019) who explained that the stingless bee honey's nutritional value is also

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