Antioxidant Activity and Bioactive Compound Content of Bee Bread Waste from Bingöl, Türkiye

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INTRODUCTION

Bee bread, a naturally fermented product of pollen, nectar, and bee secretions, is a valuable source of bioactive compounds, including polyphenols and flavonoids. While traditionally recognized for its nutritional and functional properties, bee bread waste (BBW) remains an underutilized byproduct of honeybee activity. Given the increasing interest in valorizing food waste and exploring alternative sources of bioactive compounds, investigating the potential of BBW is of great significance. Phenolic compounds and flavonoids play a crucial role in antioxidant defense mechanisms, contributing to the prevention of oxidative stress-related diseases. However, limited research has been conducted on the bioactive profile of BBW and its possible applications in food formulations. This study aims to evaluate the total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity of BBW samples collected from Bingöl, Türkiye. By characterizing these properties, the study seeks to highlight BBW's potential as a functional ingredient, paving the way for its utilization in value-added food products.

OBJECTIVES

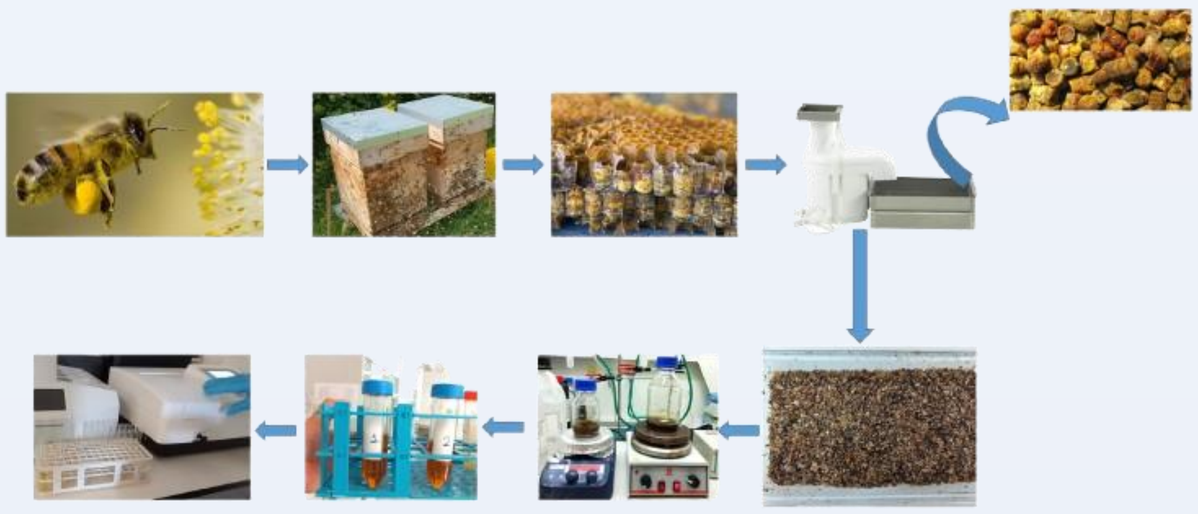
The primary objectives of this study are:

1. To determine the bioactive compound content of bee bread waste (BBW) – Specifically, to quantify the total phenolic content (TPC) and total flavonoid content (TFC) in BBW samples collected from Bingöl, Türkiye.
2. To evaluate the antioxidant activity of BBW – By applying DPPH and FRAP assays, this study aims to assess the antioxidant potential of BBW and its relevance for functional food applications.

By addressing these objectives, the study aims to contribute to the valorization of BBW, promoting its potential role in functional foods and reducing waste in the beekeeping industry.

MATERIALS & METHODS

BBW samples were collected from beekeepers and/or bee product processing facilities from Bingöl, Türkiye under suitable conditions. The extraction of BBW was performed using ethanol according to the procedure described by Markiewicz-Zukowska et al. (2013). 20 g of sample were mixed with 80 mL of 95% ethanol and then put on a shaker at 200 rpm and 37 °C for 24 h. The top layers were decanted and centrifuged at 3000 rpm for 30 min at 20°C. The total phenolic content was determined using the Folin–Ciocalteu method as described by Singleton et al. (1999), with some modifications. The total phenolic content was expressed as gallic acid equivalents (GAE) on a dry weight basis (mg GAE per g of solid), using a calibration curve obtained with gallic acid standards. Flavonoids were determined using the colorimetric assay described by Chang et al. (2002), with some modifications. The total flavonoid content was expressed as quercetin equivalents (QE), using a calibration curve obtained with standard solutions of quercetin. Antioxidant activity was evaluated using the DPPH and FRAP assays (Brand-Williams et al., 1995).



RESULTS

This study has conducted a comprehensive analysis of BBW, identifying key bioactive compounds such as polyphenols and flavonoids. The results of the analyses are presented in Table 1. In a study by Othman et al. (2019), the phytochemical properties of bee bread ethanol extracts were examined, reporting the following: TPC of 21.32–22.54 mg GAE/g, TFC of 2.88–3.92 mg QE/g, DPPH values between 72.04–79.34%, and FRAP values of 1.07–1.08 µmol TE/g.

Bleha et al. (2019) found DPPH activity in bee bread extracts to range from 22.80–92.07%.

Another study investigated the antioxidant activities of bee bread extracts reported DPPH values of 83.81–93.60% and FRAP values between 0.85–2.41 mM FE/g (Akhir et al., 2017).

Harif Fadzilah et al. (2017) identified TPC values ranging from 33.46–135.93 mg GAE/g and TFC values between 15.28–31.80 mg QE/g.

In Oltica et al. (2007), TPC in bee bread extracts ranged from 22.72–8.32 mg GAE/g, TFC from 0.696–0.168 mg QE/g, FRAP from 0.196–0.404, and DPPH activity from 55.69–90.35%.

Table 1. TPC, TFC, and antioxidant capacity of BBW samples

Sample	TPC (mg GAE	TFC	Antioxidant Capacity	
			DPPH	FRAP
1	12.08±0.78	2.34±0.03	47.97±2.14	6.82±0.73
2	11.98±0.59	2.44±0.02	51.63±1.86	7.95±0.66

* The results are represented as mean as ± standard deviation (n=3).
* TPC results are expressed as mg gallic acid equivalent/ g sample
* TFC results are expressed as mg quercetin equivalent/ g sample
* DPPH results are expressed as % inhibition, and FRAP as µmol Trolox equivalent/ g sample.

CONCLUSIONS

When compared with the literature, the results of our study indicate that, although our samples being classified as bee bread waste (BBW) rather than pure bee bread, they demonstrated significant activity. These findings highlight the potential value of BBW, laying a foundation for further research on its applications in food and other sectors. The results suggest that BBW could be a valuable component. Based on this insight, it is planned that follow-up collaborations will be established to develop a more comprehensive project aimed at conducting an in-depth analysis of BBW's components, including proteins, sugars, and fatty acids. This study aligns with the Action's sustainability goals by exploring innovative uses for agricultural by-products. BBW's potential as a sustainable ingredient may help reduce food waste and improve resource efficiency. Utilizing BBW in sustainable food products aligns with the Action's objectives and contributes to the broader goal of enhancing sustainability and competitiveness in the European food industry. Future studies will assess BBW's potential in mitigating the environmental impact of food production, contributing to both environmental and economic sustainability.

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