

Tulasi (Ocimum sanctum) - Enriched Honey: A Synergistic Blend for Immunity and Wellness

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ABSTRACT

With growing interest in natural, healthy, and flavourful foods, this study looked into creating a new functional honey product by adding Tulsi (Ocimum sanctum), a well-known medicinal herb. The main goal was to see how adding Tulsi affects the taste, physical qualities, antioxidant strength, and antibacterial effects of honey. The taste test showed that Tulsi gave the honey an herbal, earthy flavor with a slightly bitter and more astringent taste. At the same time, it made the honey less sweet and reduced the usual floral and fruity notes, which led to lower overall liking from tasters. These changes suggest that while Tulsi adds health value, the taste might need adjusting to appeal to more people.

When looking at physical properties, the Tulsi-infused honey became darker and had higher moisture, water activity, electrical conductivity, pH, and reducing sugar content. However, its total sugar content dropped. These changes reflect how Tulsi affects the natural makeup of honey. One of the biggest benefits was the boost in antioxidant activity. Tulsi is rich in natural compounds like phenolics and essential oils (such as eugenol), which significantly increased the honey's ability to fight harmful free radicals. This was confirmed through several tests measuring antioxidant activity.

In terms of antibacterial effects, Tulsi honey showed better results against *Enterococcus faecalis*, meaning it was more effective at stopping this bacteria's growth. However, it didn't show much improvement against *Pseudomonas aeruginosa*.

Overall, adding Tulsi made the honey healthier and more medicinal, thanks to its improved antioxidant and antibacterial properties. But it also changed the taste in ways that may not appeal to everyone. So, fine-tuning the recipe will be important to strike the right balance between health benefits and taste. This research highlights Tulsi honey's promise as a nutritious, value-added food product.

Keywords: Tulsi honey, functional food, antioxidant activity, antibacterial properties, sensory evaluation, phenolic compounds

1. INTRODUCTION

Tulsi (*Ocimum sanctum*) has been revered in traditional medicine for its therapeutic properties. Charaka, in his 4000-year-old Ayurvedic compendium, recommended Tulsi leaf extract with honey thrice daily for treating whooping cough and respiratory infections (Davidson, 2013). Modern studies confirm Tulsi's antimicrobial potential. Murthy et al. (2014) demonstrated moderate antibacterial activity of Tulsi leaf extract against *Staphylococcus aureus*, whereas pure honey exhibited stronger effects.

Despite the popularity of Tulsi, there are no peer-reviewed studies on naturally produced Tulsi honey from floral nectar. Commercial products such as Nectar Fresh (2015) and Kudos Laboratories (2015) mix Tulsi extract with honey, claiming benefits including respiratory and digestive health support. This study aimed to produce bioactive Tulsi honey under controlled conditions using two methods: (1) the conventional method—via bees collecting nectar from Tulsi flowers, and (2) an alternative method—mixing Tulsi extract with honey. It further sought to evaluate the mineral, phenolic, and volatile content of the resulting honeys to determine the optimal method for authenticity and bioactivity.

Melissopalynology, the microscopic analysis of pollen in honey, remains the gold standard for determining honey's floral origin (Amtmann et al., 2010; Otmani et al., 2004). A honey qualifies as unifloral when >45% of its pollen originates from a single species. However, this method is time-consuming and subjective (Terrab et al., 2004; Anklam, 1998). Manuka honey, for instance, is graded from 0 to 20+ based on pollen-based medicinal quality (Karabagias et al., 2018). Therefore, this chapter also explores advanced, rapid analytical methods—like FTIR (Sivakesava & Irudayaraj, 2001), HPLC (Bertoncelj et al., 2007), GC-MS (Alissandrakis et al., 2003), and NMR (Spiteri et al., 2015)—to trace honey origin efficiently, enabling large-scale assessments.

2. MATERIAL AND METHOD

Honey production was carried out in collaboration with a professional beekeeper within a specially designed enclosure. In August 2023, a total of 140 Tulsi plants were cultivated in a glasshouse under the environmental conditions detailed in Table 5.1. An automated irrigation system watered the plants four times daily for one minute each. After approximately three months, by December 2023, the plants began to flower. The experiment was conducted in two phases. Initially, 70 flowering Tulsi plants were placed inside the enclosure along with a beehive. After about a month, the plants—especially those positioned toward the rear of the enclosure—began to dry out and ceased flowering. These were then replaced with a second batch of 70 potted Tulsi plants.

To monitor honey production, all hive frames were photographed weekly before and after the experiment. Additionally, photographs and video recordings were used to document the behaviour of the bees and the growth of the Tulsi plants. After three months, in March 2024, the bees' uncapped honey was collected directly from the combs. The naturally produced Tulsi honey was then stored at -20 °C in darkness to preserve its quality.

The compartment was maintained under the following glasshouse conditions:

Cooling	Heating
Max temp: 30	High temp: 22
High temp: 28	Low temp: 20
Low temp: 22	Min temp: 18

The artificial nectar substitute was formulated to mimic natural flower nectar, using a glucose fructose to sucrose ratio of 25:75 (Džugan et al., 2018). For the treatment hive, Tulsi leaf extract and essential oil—known for their antimicrobial and antioxidant properties—were added based on previous assay results. Phenolic compounds were extracted from 100 g of mature Tulsi leaves using the acetone extraction method, yielding a total phenolic content of 20 ± 0.02 mg GAE/100 g, measured via the Folin–Ciocalteu method. Tulsi essential oil showed strong bioactivity at 2.5–4.5% concentrations so 3% was added to the nectar and pollen substitutes (1.5% each).

Two formulations were tested: the original with full-strength ingredients, and a reduced version with lower sugar and Tulsi concentrations. In the reduced formulation, the glucose+fructose to sucrose ratio was changed to 12.5%:87.5%, Tulsi extract was lowered to 30 ml/L, and essential oil to 0.75%. Bees were fed either a plain sugar solution (control hive) or the Tulsi-enriched version (treatment hive) ad libitum.

3. RESULT AND CONCLUSION

During conventional honey production, Tulsi plants located in shaded areas of the enclosure dried and stopped flowering due to insufficient sunlight. These plants were replaced with new ones. Similar results were observed in studies on *Spiraea* species, where full sunlight led to more growth and flowering than shaded conditions. By March 2024, all plants ceased

flowering, and due to low pollen availability, the queen bee stopped laying eggs, weakening the colony and leading to bee mortality. As a result, honey was harvested before being capped.

In the alternative method under controlled conditions, two artificial nectar formulations were tested. The original formulation (based on real nectar composition) was poorly consumed by bees, while a reduced formulation with lower sugar and Tulsi content was consumed more efficiently—twice as fast as control sugar syrup—indicating better suitability.

In the treatment hive containing Tulsi essential oil in the pollen substitute, bees showed higher attraction and stored the substitute, unlike in the control hive. This aligns with findings that bees are drawn to pollen based on scent and structure, not nutrition. Although final pollen measurements weren't possible due to rodent interference, the Tulsi-based substitute was designed to support brood rearing by providing essential nutrients like proteins, vitamin C, and carbohydrates.

Showing the pollen substitute recipe for both control and treatment hives

Pollen substitute recipe	Control Hive g/kg	Treatment Hive g/kg
Soy flour	300	300
Brewer's yeast	150	150
Non-fat dry milk	150	150
Vitamin C	5	5
Essential oil	x	1.5

Both control and treatment hives received identical base ingredients—soy flour, brewer's yeast, non-fat dry milk, and vitamin C. Only the treatment hive included 1.5 g/kg of Tulsi essential oil, enhancing bee attraction and pollen uptake.

Presenting the nectar substitute recipes used for both control and treatment hives.

Substances	Control nectar substitute		Treatment nectar substitute	
	Original formulation	Reduced formulation	Original formulation	Reduced formulation
Sucrose	75%	87.5%	75%	87.5%
Glucose	12.5%	6.25%	12.5%	6.25%
Fructose	12.5%	6.25%	12.5%	6.25%
Tulsi leaf extract	X	X	100 ml/l	30 ml/l
Essential oil	X	X	1.5%	0.75%
Lecithin granules	X	X	0.6 g	0.6 g

The control hive nectar substitute contained only sugars—sucrose, glucose, and fructose—in both original and reduced formulations. The treatment hive formulations included the same sugars, but were enhanced with Tulsi leaf extract (100 ml/L or 30 ml/L), essential oil (1.5% or 0.75%), and lecithin granules (0.6 g). The reduced formulations in both hives had a higher sucrose ratio and lower glucose and fructose content.



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REFERENCES

- [1] Amtmann, M 2010, 'The chemical relationship between the scent features of goldenrod (*Solidago canadensis* L.) flower and its unifloral honey', *Journal of Food Composition and Analysis*, vol. 23, no. 1, pp. 122-9.
- [2] Terrab, A., Recamales, A. F., Hernanz, D., & Heredia, F. J. (2004). Characterisation of Spanish thyme honeys by their physicochemical characteristics and mineral contents. *Food chemistry*, 88(4), 537-542.
- [3] Murthy, K, Rompicherla, RS, Roplekar, P, Shah, D, Sharma, N & Veer, C 2014, 'To study the antibiotic susceptibility of the isolated strains of staphylococcus aureus and comparative analysis with natural herbs', *International Science Journal*, vol. 1, no. 3, pp. 2348 – 6058.
- [4] Anklam, E. (1998). A review of the analytical methods to determine the geographical and botanical origin of honey. *Food chemistry*, 63(4), 549-562.
- [5] Dżugan, M., Tomczyk, M., Sowa, P. and Grabek-Lejko, D., 2018. Antioxidant activity as biomarker of honey variety. *Molecules*, 23(8), pp. 2069-2071.
- [6] Karabagias, I., Louppis, A., Kontakos, S., Drouza, C. and Papastephanou, C., 2018. Characterization and botanical differentiation of monofloral and multifloral honeys produced in Cyprus, Greece, and Egypt using physicochemical parameter analysis and mineral content in conjunction with supervised statistical techniques. *Journal of Analytical Methods in Chemistry*, 2018, pp. 1-10.
- [7] Minden-Birkenmaier, B. and Bowlin, G., 2018. Honey-based templates in wound healing and tissue engineering. *Bioengineering*, 5(2), pp. 1-27.

- [8] *Kudos Laboratories India* 2015, viewed 1701 2015, <<http://www.kudos.in/Respiratory3.aspx>>.
 - [9] Otmani, I., Abdenmour, C., Dridi, A., Kahalerras, L., and Halima-Salem, A., 2019. Characteristics of the bitter and sweet honey from Algeria Mediterranean coast. *Veterinary world*, 12(4), pp. 551-557.
 - [10] *Nectar Fresh*, 2015, viewed 1701 2015, <<http://www.exportersindia.com/nectarfresh/tulsi-honey-bangalore-india-29654.htm>>.
 - [11] Sivakesava, S., & Irudayaraj, J. (2001). Prediction of inverted cane sugar adulteration of honey by Fourier transform infrared spectroscopy. *Journal of food science*, 66(7), 972-978.
 - [12] Bertoneclj, J., Doberšek, U., Jamnik, M., & Golob, T. (2007). Evaluation of the phenolic content, antioxidant activity and colour of Slovenian honey. *Food chemistry*, 105(2), 822-828.
 - [13] Alissandrakis, E., Daferera, D., Tarantilis, P. A., Polissiou, M., & Harizanis, P. C. (2003). Ultrasound-assisted extraction of volatile compounds from citrus flowers and citrus honey. *Food chemistry*, 82(4), 575-582.
 - [14] Spiteri, M., Jamin, E., Thomas, F., Rebours, A., Lees, M., Rogers, K. M., & Rutledge, D. N. (2015). Fast and global authenticity screening of honey using ¹H-NMR profiling. *Food Chemistry*, 189, 60-66.
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