



Physicochemical Characterization of *Apis cerana* F. Honey from Thailand: Implications for Quality Standards

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ABSTRACT

This study provides a comprehensive physicochemical analysis of the honey produced by the Eastern honey bee (*Apis cerana* F.), obtained from local beekeepers in Southern Thailand during 2023-2024. A total of thirty-five honey samples were assessed for several key quality parameters essential for standardization. The moisture content ranged from 19.7% to 28.3%, while the ash content varied between 0.12% and 0.40%. Electrical conductivity was recorded between 0.28 mS/cm and 0.55 mS/cm. The color ranged from 14.0 to 108.3 mm Pfund, indicating a spectrum from white to amber. pH values were between 3.6 and 4.8, and free acidity ranged from 33.0 to 72.0 mEq/kg. Diastase activity varied from 1.16 to 12.15 DN. Sugar analyses revealed fructose levels from 33.83 to 48.54 g/100 g and glucose from 35.13 to 51.54 g/100 g, with sucrose detected in five samples. Notably, there is a lack of existing data on the physicochemical properties of *A. cerana* honey in Thailand, with only one prior study reporting a moisture content range of 18.5% to 24.5%, which aligns with our findings. These results offer valuable insights into the unique physicochemical characteristics of *A. cerana* honey in this region, contributing to the development of quality standards and the growth of the local honey industry. Further research is warranted to establish specific standards for *A. cerana* honey that align with international benchmarks.

INTRODUCTION

Honey is a natural substance composed of a complex mixture of sugars, organic acids, enzymes, amino acids, minerals, and pollen, which reflects its botanical and geographical origin. It is typically viscous, ranging in color from pale yellow to dark amber, and is known for its distinctive sweetness and therapeutic properties (Crane, 2009). The production of honey involves repeated digestion and regurgitation by honey bees, during which nectar is transformed through enzymatic activity primarily diastase, amylase, and invertase under acidic conditions in the bee's stomach (Comara et al., 2017).

Among of various honey bee species, *Apis cerana*, commonly known as the Eastern honey bee, is a native species widely distributed across southern and southeastern Asia. It is well known for its remarkable adaptability to diverse ecological conditions, ranging from tropical lowland to mountainous regions and for resilience to environmental stressors and pests. This adaptability is attributed to its genetic diversity and behavioral plasticity, enabling it to survive under varying climatic conditions and floral availabilities (Hepburn & Radloff, 2011).

In agricultural ecosystems, *A. cerana* plays a crucial role in the pollination of a wide variety of crops, including fruits, vegetables, and oilseeds. Studies have shown that its foraging behavior is well-suited to small flowers and native plant species, making it an efficient pollinator in both natural and cultivated landscapes (Partap, 2011).

In Thailand, *A. cerana* has been traditionally managed by local beekeepers, especially in rural and forested areas to produce honey, that is valued for its unique flavor profile and potential medicinal properties, which are influenced by the diverse floral sources in the region. However, there is a notable lack of scientific data on the physicochemical properties of *A. cerana* honey in Thailand. Therefore, this study aims to address this gap by providing a comprehensive physicochemical characterization of *A. cerana* honey collected from local beekeepers in Southern Thailand during 2023-2024. By analyzing key quality parameters, the findings offer valuable insights for the development of specific quality standards for *A. cerana* honey. Establishing such standards is essential not only for ensuring product quality and consumer safety but also for supporting the sustainable growth of the local honey industry and aligning with international benchmarks.

MATERIALS AND METHODS

Honey physicochemical analysis



35 samples were collected from a mixed deciduous forest area within Pathio district, Chumphon province, southern Thailand

• Ash content
(AOAC Method 941.15, 2005)
• Diastase activity
(AOAC Method 979.10, 2005)
• Electrical conductivity
(IEC Method 2009)
• Moisture
(AOAC Method 941.15, 2005)

• pH and free acidity
(AOAC Method 941.15, 2005)
• Color
(Honey Color Chart (HCC) colorimeter)
• Sugar content
(AOAC Method 971.20 (1977), 1974 with Refractometer Index (REFC))

RESULTS AND DISCUSSION

Table 1 Physicochemical Characteristics of *Apis cerana* (AC) honey compare with *Apis dorsata* (AD) and *Apis mellifera* (AM) Honey (TAS 8003-2013 Standard)

Sample	Ash (%)	Diastase (DN)	EC (mS/cm)	Moisture (%)	Free acidity (mEq/kg)	pH	Color (mm Pfund)
AC-PH1	0.28	1.16	0.33	22.20	73.17	3.58	14.0
AC-PH2	0.29	1.26	0.40	20.23	54.67	4.15	24.7
AC-PH3	0.40	3.77	0.50	21.27	48.33	4.05	58.33
AC-PH4	0.19	1.89	0.33	19.17	56.10	3.68	37.50
AC-PH5	0.29	1.66	0.44	21.33	59.33	4.12	41.50
AC-PH6	0.37	3.50	0.55	22.03	40.50	3.97	52.00
AC-PH7	0.25	2.40	0.54	21.67	58.17	3.69	39.17
AC-PH8	0.31	3.15	0.56	22.17	55.33	3.87	34.00
AC-PH9	0.36	4.68	0.46	26.10	44.50	4.06	45.67
AC-PH10	0.36	3.54	0.51	19.20	58.00	4.14	30.67
AC-PH11	0.31	2.35	0.55	20.53	62.83	3.66	36.67
AC-PH12	0.32	3.17	0.54	20.40	56.00	3.81	71.00
AC-PH13	0.23	3.97	0.44	21.90	50.33	4.10	38.00
AC-PH14	0.33	2.82	0.44	21.60	51.00	3.79	76.00
AC-PH15	0.36	4.51	0.44	20.77	48.33	4.12	45.00
AC-PH16	0.23	2.94	0.54	21.07	55.00	3.75	75.00
AC-PH17	0.24	4.25	0.44	24.17	44.00	3.78	48.00
AC-PH18	0.29	3.26	0.46	19.97	43.10	3.81	50.33
AC-PH19	0.33	6.59	0.46	21.17	43.33	3.74	71.67
AC-PH20	0.33	6.70	0.53	21.90	53.00	3.69	55.17
AC-PH21	0.23	3.86	0.50	21.33	52.67	3.68	39.00
AC-PH22	0.36	3.15	0.50	22.79	52.00	3.72	50.00
AC-PH23	0.21	5.52	0.28	25.70	49.67	3.85	50.33
AC-PH24	0.30	5.47	0.44	25.13	46.00	4.14	46.67
AC-PH25	0.45	5.67	0.39	28.50	42.43	4.06	42.67
AC-PH26	0.38	5.06	0.45	25.45	45.67	4.21	45.00
AC-PH27	0.21	6.01	0.41	24.53	47.17	4.01	37.00
AC-PH28	0.21	5.65	0.50	24.10	46.00	4.00	70.33
AC-PH29	0.22	12.15	0.39	25.00	51.33	3.94	41.00
AC-PH30	0.26	3.85	0.50	22.63	61.00	3.91	39.67
AC-PH31	0.21	1.60	0.43	21.00	58.33	3.84	41.67
AC-PH32	0.27	6.60	0.43	22.87	49.33	4.03	44.00
AD-S1	0.35	1.99	0.45	26.80	40.33	4.13	31.67
AD-S2	0.29	3.70	0.42	27.53	48.00	4.09	39.67
AD-S3	0.12	3.47	0.44	27.33	54.67	3.87	42.67
TAS 8003-2013 Standard	<0.8	>3.0	<0.8	<21.0	<50	Not specified	Not specified



Figure 1 The Sugar Profile of *Apis cerana* Honey Samples from Southern Thailand

The moisture content of *A. cerana* honey ranged from 19.7% to 28.3%, with a mean of 24.0%. However, according to *Apis mellifera* L. honey standards, moisture content typically should not exceed 20% to prevent fermentation. (Bogdanov et al., 2004).

The ash content (0.12–0.40%) and electrical conductivity (0.28–0.55 mS/cm) reflect moderate mineral levels typical of floral honey (Terrab et al., 2003). Color varied widely (14.0–108.3 mm Pfund), indicating diverse nectar sources (Partap, 2011). pH values (3.6–4.8) and free acidity (33.0–72.0 mEq/kg) suggest good acidity and antimicrobial potential. Diastase activity (1.16–12.15 DN) demonstrate enzymatic variability that may be influenced by heat exposure or floral origin (White, 1978). Compared to standards for *A. mellifera* honey, the fructose (33.83–48.54 g/100 g) and glucose (35.13–51.54 g/100 g) contents of *A. cerana* honey are generally lower. Typical *A. mellifera* honey exhibits total reducing sugars often exceeding 60 g/100 g, indicating *A. cerana* honey may have a comparatively lower sugar concentration, potentially influenced by regional floral sources and bee species.

CONCLUSION

The physicochemical analysis of *A. cerana* honey from Southern Thailand reveals distinct characteristics, including high moisture variability, moderate mineral content, and diverse sugar profiles. These findings highlight the need for species-specific quality standards. Establishing such standards will enhance product reliability and support sustainable development of the local honey industry.

REFERENCES

- Crane, E. (2009). Honey: A comprehensive survey. Northern Bee Books.
- Comara, L., Biagi, M., Xiao, J., & Bufando, B. (2017). Therapeutic properties of bioactive compounds from different honeybee products. *Frontiers in Pharmacology*, 8, 412.
- Bogdanov, S., Ratoff, K., & Oude, L. P. (2004). Physico-chemical methods for the characterization of uniflorous honeys. *Apidologie*, 35(Suppl. 1), S4-S17.
- Partap, U. (2011). The Pollination Role of Honeybees in Mountain Agriculture. ICIMOD.
- Terrab, A., Diaz, M. J., & Hendrix, F. J. (2003). Characterization of Moroccan uniflorous honeys by their physicochemical characteristics. *Food Chemistry*, 79(3), 373-379.
- White, J. W. (1978). Honey: Its Quality control in the food industry (Vol. 2, pp. 157-206). Academic Press.
- Hepburn, H. R., & Radloff, S. E. (2011). Honeybees of Asia. Springer.

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