

Mineral Variations of Honey of Indigenous Honeybee Species from Western Ghats of Karnataka.

*M. V. Balasubramanyam¹, Chandrasekhara Reddy²

1. Department of Zoology, Maharani's Science College for Women, Bangalore-560 001, India.
2. Bee Division, Department of Zoology, Bangalore University, Jnana Bharathi, Bangalore-560 056, India.

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*Author for correspondence:

Mr. M. V. Balasubramanyam
Department of Zoology,
Maharani's Science College for Women,
Bangalore-560 001, India.
E-mail: balu_mv09@yahoo.com

ABSTRACT

Honeybees effectuate nectar to honey transformation. A preliminary study was conducted to evaluate mineral content of multifloral honey of indigenous honeybee species, *Apis dorsata*, *Apis florea* (wild) and *Apis cerana* (apiary) from different geographical areas of Western Ghats of Karnataka during April 2009 to March 2010. Quantitatively, potassium was higher while chromium was least in honey among all three honeybee species. Seasonally, mineral content of honey was higher in winter flow than the summer flow. Regionally, honey from Hassan showed maximum mineral content followed by Dakshina Kannada, Udupi and Uttara Kannada districts. Mineral content of *A. dorsata* honey was much higher than *A. florea* and *A. cerana*. The study clearly revealed that mineral content of honey varied among the species, different geographic areas and seasons. The honey mineral content, species, geographical and seasonal differences are presented and discussed.

INTRODUCTION

Indian honey is of many types. It may unifloral or multifloral, extracted or squeezed, processed or raw, ripe or unripened. Honey may also be obtained exclusively from *A. dorsata* or *Apis florea* or *Apis cerana* or mixed type. Honey has enticed flavour, color, aroma and texture. Because of its unique and complex nature, honey is used as antiseptic, laxative, antibiotic, pacifier, anti-oxidant and ingredient of variety of ayurvedic medicines. Several beekeeping practices coupled with improper settling, straining, blending, heating, bottling and storage condition can change the quality of honey. Honey is primarily high-energy carbohydrate food together with amounts of fair amounts of proteins, enzymes, acids, pigments, vitamins and minerals [1]. Honey is truly remarkable substance elaborated by bees to high-density and high-energy food. Honey is as "nectar gathered, modified and stored in the comb of honeybees.

The quality of temperate honey of *A. mellifera* including its composition and physico-chemical properties has been well-known [2]. On the contrary, information on composition of tropical honey is limited [3, 4-5]. Interestingly, no information is available on the composition including the mineral content of all indigenous honeybee species. It is of great economic importance to know the factors affecting the quality of honey. Further, many countries use the physical and chemical characteristics of honey as a measure of honey quality. The primary objective of the present study is to provide comprehensive information on the mineral content which happens to be chemical characteristic of honey of three indigenous honeybee species, *A. dorsata*, *A.*

florea and *A. cerana* from four districts namely, Uttara Kannada, Dakshina Kannada, Udupi and Hassan spreading over the Western Ghats of Karnataka. The study also includes the seasonal variations like summer honey flow and winter honey flow, species variations and mineral wise changes that may occur in various honey samples.

MATERIALS AND METHODS

Karnataka state extends from 11° 5' N to 19° N latitudes and from 74° E to 78° E longitudes. It lies in Deccan plateau with three major physical divisions viz., coast, malnad and maidan. The total geographical area of the State is 1, 91,791 sq. kms, of which 54.70 % as net sown area, 16.14% forests, 10.66% not available for cultivation, 9.55% uncultivated land and 8.96% fallow land. The flora of Karnataka is rich and diversified, which includes agricultural, plantation, commercial, horticultural and forest flora. The temperature varied from 11° C to 41° C and the humidity ranges from 27.7% to 86.45%.

Honey collection

Four districts spreading over the Western Ghats were selected for honey samples collection. Honey samples of domesticated hive bee, *Apis cerana* were collected from the beekeepers and that of the rock bee, *A. dorsata* and little bee, *A. florea* were procured from tribals and honey hunters. The honey of *A. cerana* was extracted by honey extractor and that of *A. dorsata* and *A. florea* were obtained by squeezing and filtration. All honey samples were raw and unprocessed. The honey sample size from each study center was 15. Honey samples collected during April-May were categorized as summer flow and September- November as winter flow.

Preparation of honey samples

The honey samples were collected in sterilized polythene bottles from the place of honey extraction. The honey was filtered through single thickness fine cloth to remove suspended particles like dirt, beeswax and other impurities. Later it was stored in airtight container at room temperature under hygienic conditions.

Analysis of honey samples

All honey samples were prepared according to the method described by [6, 7] for the identification of their floral source on the basis of pollen grains. The detection of potassium, calcium, sodium, magnesium, iron, manganese, copper, chromium and zinc was done by Atomic Absorption Spectroscopy [8]. The phosphorous was identified by colorimeter method [8].

Table 1. Wavelength and Fuel Required for Different Mineral Constituents.

| Sl. No | Element | Wave length (n m) | Fuel |
|--------|-----------|-------------------|-----------------|
| 1 | Potassium | 766.6 | Air/ Acetylene. |
| 2 | Calcium | 228.85 | Air/ Acetylene. |
| 3 | Sodium | 166.6 | Air/ Acetylene. |
| 4 | Magnesium | 285.20 | Air/ Acetylene. |
| 5 | Iron | 248.37 | Air/ Acetylene. |
| 6 | Manganese | 279.9 | Air/ Acetylene. |
| 7 | Copper | 324.80 | Air/ Acetylene. |
| 8 | Chromium | 357.90 | Air/ Acetylene. |
| 9 | Zinc | 213.90 | Air/ Acetylene. |

Lamp current: 3.5 m A.

RESULTS AND DISCUSSION

Melissopalynological studies of honey samples from the study area revealed the occurrence of plantation, (*Cocus nucifera*, *Coffea arabica*, *Tectona grandis*), forest crops, (*Syzygium caryophyllatum*, *Borassus flabellifera*, *Sapindus emarginatus*) and commercial crops (*Musa paradisiaca*, *Ricinus communis*, *Anacardium occidentale*) along with many minor floral sources (Table 2).

The minerals of honey of three honeybee species were clearly categorized as major minerals (potassium, phosphorous, calcium, sodium and magnesium) and minor

minerals (iron, manganese, copper, chromium and zinc). Potassium content of *A.dorsata* honey was highest 65.21ppm while *A.cerana* honey was 60.00 ppm (Fig. 1). Chromium content of *A. dorsata* and *A.florea* was 0.022ppm and 0.023 ppm respectively (Fig. 2). [9] analyzed honey samples and reported average content of phosphorous, potassium, calcium, magnesium, iron and zinc in range of 8-10ppm, 65-75ppm, 6-7ppm, 2-4 ppm, 0.25-0.52 ppm and 0.012 – 0.029ppm respectively in North-Western Himalayas.

Table 2. Major Bee Flora of Western Ghats of Karnataka.

| Sr. No | Family | Botanical Name | Source |
|--------|----------------|--------------------------------|--------|
| 1 | Anacardiaceae | <i>Anacardium occidentale</i> | N+P |
| 2 | Anacardiaceae | <i>Mangifera indica</i> | N+P |
| 3 | Aracaceae | <i>Borassus flabelliformis</i> | N+P |
| 4 | Aracaceae | <i>Cocus nucifera</i> | N+P |
| 5 | Bignoniaceae | <i>Tectoma stans</i> | N+P |
| 6 | Compositae | <i>Ageratum conyzoides</i> | N+P |
| 7 | Cruciferae | <i>Brassica juncea</i> | N+P |
| 8 | Euphorbiaceae | <i>Ricinus communis</i> | N+P |
| 9 | Musaceae | <i>Musa paradisica</i> | N+P |
| 10 | Myrtaceae | <i>Syzygium caryophyllatum</i> | N+P |
| 11 | Rubiaceae | <i>Coffea arabica</i> | N+P |
| 12 | Rutaceae | <i>Citrus species</i> | N+P |
| 13 | Sapindaceae | <i>Sapindus emarginatus</i> | N+P |
| 14 | Verbenaceae | <i>Tectona grandis</i> | N+P |
| 15 | Zygophyllaceae | <i>Tribulus terrestris</i> | N+P |

N=Nectar, P=Pollen

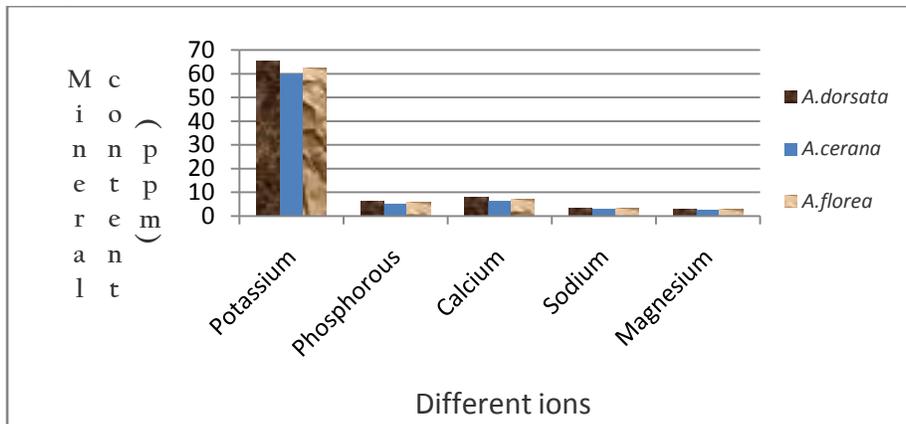


Fig 1. Major Mineral Content of Honey from Different Honeybee Species during the Year 2009-10.

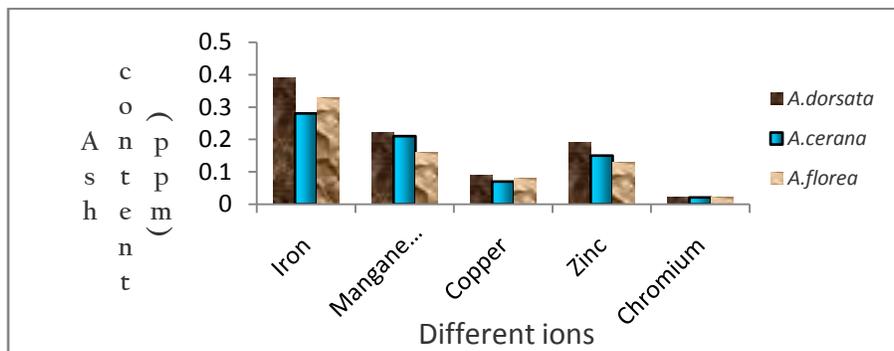


Fig 2. Minor Mineral Content of Honey from Different Honeybee Species during the Year 2009-10.

[10] Reported positive correlation of most of the minerals such as potassium, iron, manganese and magnesium content of honey with electrical conductivity. Honey contains less sodium than potassium and hence it is suggested to use Na/K ratio to detect honey adulteration [11]. Various parameters such as color, aroma, flavour, texture, medicinal properties of honey are largely dependent on mineral content which eventually are derived from floral resources [12, 13].

A. dorsata honey of Hassan district showed maximum ash content (0.85%) followed by Dakshina Kannada, Udupi and Uttara

Kannada with 0.79%, 0.66% and 0.61% respectively (Fig. 3). The mean ash content of honey was 0.408% and potassium was most abundant of all the elements [14]. Ash content of different honey samples from different honeybee species varied due to different floral sources, climatic conditions and edaphic factors [15]. *A. florea* honey from Hassan had more ash content (0.72%) as compared to *A. cerana* (0.69%). *A. dorsata* and *A. cerana* honey from Uttara Kannada had 0.60% and 0.50% ash content respectively. Darker honeys have comparatively higher ash content than lighter honeys.

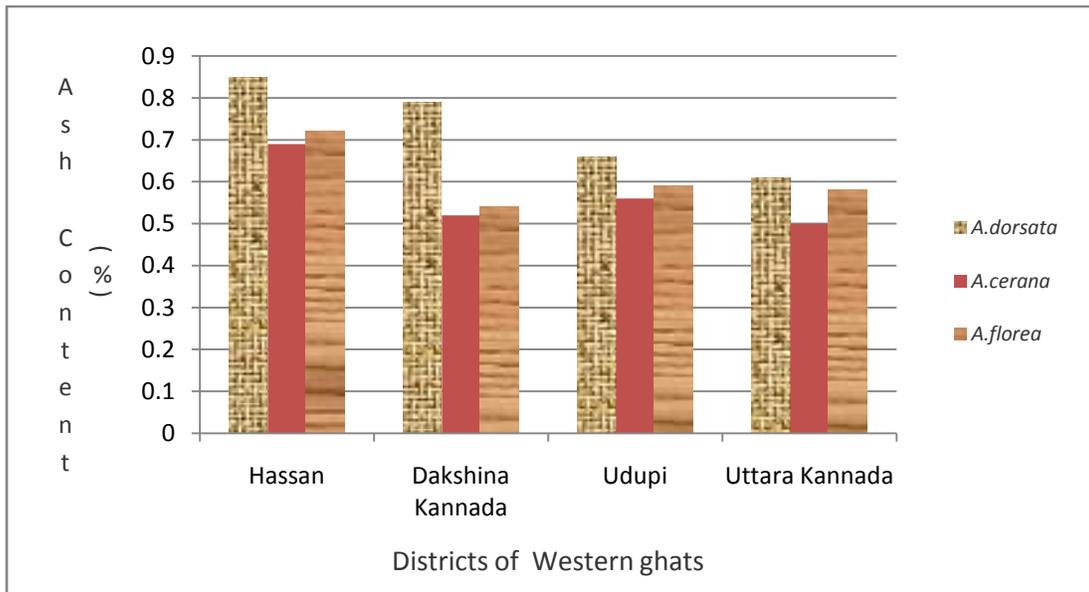


Fig 3. Mineral Content of Honey in Different Districts of Western Ghats during Year 2009-10.

Honeys are rich in ash content and highly variable with species of honeybee. Honey may be also dark which are related to the plant source of honey, which include a high content of tyrosine, tryptophan and the presence of polyphenolic compounds [16, 17].

Mineral content of *A. dorsata* honey was 0.67% and 0.85% in summer and winter

seasons respectively, while mineral content of *A. cerana* honey was 0.61% and 0.73% in similar seasons. Mineral content of *A. florea* honey was 0.63% in summer and 0.75% in winter (Fig. 4). Similar findings were found by [11] in honey of *A. cerana* in North-Western Himalayas. Mineral content of honey from all three honeybee species varied seasonally probably due to duration

of honey ripening process, abundance of floral resources and activity of honeybees. The honey ripening period is comparatively less in the summer than winter because of plenty of availability of floral resources.

Further, other reasons behind the seasonal fluctuations of mineral content of honey from three honeybee species are yet to be ascertained.

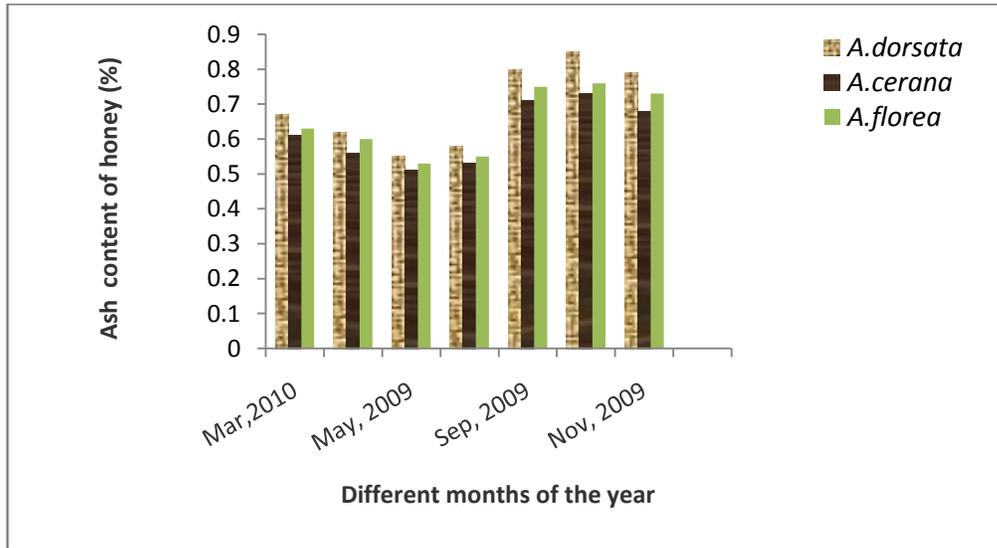


Fig 4. Seasonal Variations of Mineral Content of Honey from Different Honeybee Species during the Year 2009-10.

Honey that is available in the market for human consumption, whether it is liquid or crystallized must be well ripened with proper moisture content. It must be free from extraneous materials such as excessive pollen, dust, insect parts, wax and other impurities. It must not ferment and above all it must be excellent flavour and aroma. It must, of course, be free of off-flavors or color of any origin. Honey must be as original as it exists in the cells of comb before it is extracted. To market honey in its original conditions of high quality and delectable flavour and fragrance is possibly the greatest responsibility of the beekeepers and honey packers.

CONCLUSION

Of all the minerals tested in honey samples

from three indigenous honeybee species, potassium and chromium were maximum and minimum respectively. Honey from Hassan district had higher mineral content compared to other districts. Mineral content of *A.dorsata* honey was more compared to *A.cerana* and *A.florea*. All these factors play a crucial role in selecting honey in preparation of Ayurvedic and related other naturopathic therapies.

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