

# CHEMICAL CHARACTERISTICS OF MULTIFLORAL WILD AND APLIARY HONEY FROM WESTERN GHATS OF KARNATAKA

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## ABSTRACT

Multifloral honey of indigenous honeybee species, *Apis dorsata*, *Apis florea* (wild) and *Apis cerana* (apiary) from three diverse zones of Western Ghats of Karnataka during April 2010 to March 2011. Chemical characteristics of moisture, TRS, NRS, L/D ratio, ash, acidity and pH were determined. Honey of *Apis dorsata* exhibit more moisture (23.55%), acidity (0.518%), ash (1.49%) and pH (0.503) compared to honey of *Apis florea* and *Apis cerana* honey. Similarly, *Apis cerana* honey displays more L/D ratio (1.19) than *Apis dorsata* (1.12) and *Apis florea* (1.13). However, TRS and NRS of honey among three honeybee species demonstrated considerable variations. Excluding L/D ratio and acidity all parameters tested were significant at  $p < 0.01$  and  $p < 0.05$ . Results of the study confirmed the quality of honey of *Apis cerana*, *Apis florea* and *Apis dorsata* were equally good with minor changes in the composition which are discussed in ensuing paper.

## INTRODUCTION

Honey is primarily high-energy carbohydrate food together with amounts of fair amounts of proteins, enzymes, acids, pigments, vitamins and minerals (Crane, 1990). Honey is truly remarkable natural substance elaborated by honeybees to high-density and high-calorific food. Honey is as "nectar gathered, modified and stored in the comb of honeybees". Honey and milk are considered as symbol of prosperity and sanctity. Honey along with milk, curds, sugar and ghee are essential ingredients of panchamrutha, food offerings to God and religious ceremonies. Honey has entice flavour, color, aroma and texture mainly due to the presence of volatile oils, aromatic acids, carotenoids, flavonoids and polyphenols. Because of this unique and complex nature, honey is used as antiseptic, laxative, antibiotic, pacifier, anti-oxidant and ingredient of variety of ayurvedic medicines, bakery, cosmetics, confectionary, and tobacco industry.

The quality of temperate honey of *A. mellifera* including its composition and physico-chemical properties has been well-known. On the contrary, information on composition of tropical honey is limited (Khatija and Ramanujan, 1993; Chunneja et al., 1996; Joshi et al., 2000). Interestingly, no information is available on the composition including the chemical characteristics of all indigenous honeybee species of Western Ghats of Karnataka. 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 chemical characteristics of honey of three indigenous honeybee species, *A. dorsata*, *A. florea* and *A. cerana* from selected three districts viz., Uttara

Kannada, Madikeri and Dakshina Kannada spreading over the Western Ghats of Karnataka.

## MATERIALS AND METHODS

Karnataka state extends from 11°5 N to 19°N and from 74°E to 78°E. 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 km<sup>2</sup>, 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

Three study centres from each of three districts spreading over the Western Ghats were selected for honey samples collection. The study centres include Honnavar, Ankola, Sirsi from Uttara Kannada, Bhagamandala, Napoklu, Virajpet from Madikeri, and Puttur, Sulya, Beltangadi from Dakshina Kannada spreading over prime locality of Western Ghats of Karnataka. Abundant floral resources coupled with suitable environmental factors are mainly responsible for copious honey production in these regions. Honey samples of domesticated hive bee, *A. cerana* were collected from the beekeepers and that of the rock bee, *A. dorsata* and dwarf 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 centre was 13.

**Table 1: Chemical characteristics of honey<sup>#</sup> from Uttara Kannada of Western Ghats of Karnataka**

S. No.	Parameters	Honeybee species			F-ratio
		<i>A. dorsata</i>	<i>A. cerana</i>	<i>A. florea</i>	
1.	Moisture (%)	21.45	20.87	18.64	7.10*
2.	Total reducing sugars (%)	76.69	73.65	73.22	5.96*
3.	Laevulose (%)	40.15	39.75	39.01	3.14**
4.	Dextrose (%)	36.54	33.90	34.21	1.72**
5.	L/D ratio	1.098	1.17	1.14	0.145 +
6.	Non reducing sugars (%)	3.85	2.70	3.08	1.05**
7.	Ash (%)	1.49	1.22	1.12	0.732**
8.	Acidity (%)	0.503	0.418	0.371	0.012 +
9.	pH	4.85	4.01	3.73	0.621**

# Sample size = 39, \*Significant at  $p < 0.01$ , \*\*Significant at  $p < 0.05$ , + Non-significant at  $p < 0.01$

**Table 2: Chemical characteristics of honey<sup>#</sup> from Madikeri of Western Ghats of Karnataka**

S. No.	Parameters	Honeybee species			F-ratio
		<i>A. dorsata</i>	<i>A. cerana</i>	<i>A. florea</i>	
1.	Moisture (%)	23.55	21.07	20.90	5.17*
2.	Total reducing sugars (%)	75.01	72.12	73.14	8.04*
3.	Laevulose (%)	39.21	39.15	38.72	4.62**
4.	Dextrose (%)	35.80	32.97	34.42	3.19**
5.	L/D ratio	1.095	1.18	1.12	0.028 +
6.	Non reducing sugars (%)	2.73	3.14	2.85	0.374**
7.	Ash (%)	1.40	1.31	1.35	0.012**
8.	Acidity (%)	0.518	0.403	0.381	0.178 +
9.	pH	4.70	3.83	3.75	1.217**

# Sample size = 39, \*Significant at  $p < 0.01$ , \*\*Significant at  $p < 0.05$ , + Non-significant at  $p < 0.01$

**Table 3: Chemical characteristics of honey<sup>#</sup> from Dakshina Kannada of Western Ghats of Karnataka**

S.No.	Parameters	Honeybee species			F-ratio
		<i>A. dorsata</i>	<i>A. cerana</i>	<i>A. florea</i>	
1.	Moisture (%)	22.45	19.87	19.64	4.06*
2.	Total reducing sugars (%)	76.08	72.83	72.87	9.18*
3.	Laevulose (%)	40.21	39.71	38.75	2.13**
4.	Dextrose (%)	35.87	33.12	34.12	5.71**
5.	L/D ratio	1.12	1.19	1.13	0.085 +
6.	Non reducing sugars (%)	2.98	3.07	2.76	0.103**
7.	Ash (%)	1.26	1.16	1.17	0.831**
8.	Acidity (%)	0.425	0.351	0.381	0.123 +
9.	pH	4.74	3.90	3.65	1.762**

# Sample size = 39, \*Significant at  $p < 0.01$ , \*\*Significant at  $p < 0.05$ , + Non-significant at  $p < 0.01$

### 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

Chemical characteristics of moisture, TRS, Laevulose, Dextrose, NRS, L/D ratio, ash and acidity were determined by the method followed by Joshi *et al.*, (2000) and Balasubramanyam (2006). The pH of honey was measured by pH meter.

### Statistical analysis of data

Data of the nine chemical characteristics of honey samples was analyzed by F-test. The analysis of variance (ANOVA) along the F-test was calculated and significant levels were determined using F-table ( $p < 0.01$  and  $p < 0.05$ ).

## RESULTS AND DISCUSSION

The moisture content of honey samples had a value of 18.64%

to 23.55% in *A. florea* and *A. dorsata* from Uttara Kannada and Madikeri districts respectively (Table 1, 2). The analysis of variance of moisture levels of honey from three honeybee species was significant at 1% level. Jasim *et al.*, (2007) reported moisture content to  $20.12 \pm 2.66\%$  and  $21.51 \pm 2.38\%$  in *A. cerana* and *A. dorsata* honey respectively. The moisture levels are one of most crucial parameter of honey which affects the optical density, refractive index, surface tension and viscosity (Oddo *et al.*, 1995). Sharma (1998) reported that moisture level of autumn honey was more than summer honey. Honey is an excellent hygroscopic product and has tendency to absorb atmospheric moisture and thus readily increase its moisture levels. Further, the moisture levels may also largely depend on method of extraction of honey which may differ from region, species and practices.

Total reducing sugars of honey varied between 72.12% and 76.69% in *A. cerana* and *A. dorsata* from Madikeri and Uttara Kannada respectively (Table 1, 2). The analysis of variance of total reducing sugars of honey from three honeybee species was significant at 1% level. Laevulose content of honey ranged

between 38.72% and 40.21% in *A. florea* and *A. dorsata* from Madikeri and Dakshina Kannada respectively (Table 2, 3). The analysis of variance of fructose levels of honey from three honeybee species was significant at 5 % level. The dextrose content of honey ranged between 33.12% and 36.54% in *A. cerana* and *A. dorsata* from Dakshina Kannada and Uttara Kannada respectively (Table 1, 3). The analysis of variance of dextrose levels of honey from three honeybee species was significant at 5 % level. The L/D ratio of honey ranged between 1.098 and 1.19 in *A. dorsata* and *A. cerana* from Uttara Kannada and Dakshina Kannada (Table 1, 3). The analysis of variance of L/D ratio of honey from three honeybee species was not significant at 1 % level. Popek (2002) recorded TRS ranging between  $69.07 \pm 2.73\%$  to  $79.69 \pm 3.40\%$  in unifloral melliferous honey of Punjab. Bureau of Indian Standards (2007) in its specification of honey prescribed the minimum level of 65% for total reducing sugars. Khatija and Ramajunam (1993) reported 72.66% to 75.30% of TRS from honey from Hyderabad. In the present study, the laevulose level is more than that of dextrose which is characteristic feature of all non-granulating, non-fermenting and authentic honey (Terrab *et al.*, 2002). The laevulose in all honey samples was more than dextrose and the L/D ratio in more than 1 which is highlighting nature of genuine honeys.

The non-reducing sugars of honey ranged between 2.70% and 3.85% in *A. cerana* and *A. dorsata* from Uttara Kannada district (Table 1). The analysis of variance of NRS level of honey from three honeybee species was significant at 5 % level. The non-reducing sugar concentrations usually are between 2-5% in all special, standard grade and Agmark honeys (BIS, 1997). The content of sucrose (2-5%) is an excellent indicator of non-adulterated honey.

The ash content of honey varied between 1.12% and 1.49% in *A. florea* and *A. dorsata* from Uttara Kannada district (Table 1). The analysis of variance of ash content of honey from three honeybee species was significant at 5 % level. The ash content is a measure of mineral content of honey. Though the quantities of minerals are less, they play a vital role in determining the color and nutritional value of honey. Rodrigreuz *et al.*, (1994) found that mineral content of honey from Spain varied from 0.06% to 1.34% in *A. mellifera* species. Variations such as aroma, flavor, medicinal value and keeping qualities of honey are largely dependent on the mineral content of honey (Wakhle, 1997). Mineral content of honey was highly variable with the species of honeybee, seasons, color and geographical zones.

The acidity content of honey varied between 0.351% and 0.518% in *A. cerana* and *A. dorsata* from Dakshina Kannada and Uttara Kannada districts respectively (Table 1, 3). The analysis of variance of acidity content of honey from three honeybee species was not significant at 1% level. According to Agmark specifications, the maximum limit of acidity is 0.3%. Acidity of honey is due to the presence of formic, butyric, acetic and lactic acids due to the action of osmophilic yeasts and sugar-tolerant bacteria which readily act on honey sugars (Balasubramanyam and Reddy, 2003). Generally, Indian honeys possess higher acidity as compared to foreign samples due to tropical climatic conditions. Further, it has been also reported that fresh honeys have less acidic than stored honey samples.

The pH content of honey varied between 3.65 and 4.85 in *A. florea* and *A. dorsata* from Dakshina Kannada and Uttara Kannada districts respectively (Table 1, 3). The analysis of variance of pH content of honey from three honeybee species was significant at 5 % level. Esti *et al.*, (1997) reported pH in the range of 3.05 – 4.50. Gurel *et al.*, (1998) reported pH in the honey in range of 3.61 – 4.97.

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