

## Physico-chemical characteristics of summer honey from Gadchiroli District, India

Aparna S Margonwar

Department of Botany, Shri Sadguru Saibaba Science College, Ashti, Maharashtra, India

### Abstract

Physico-chemical analysis of 50 samples from *Apis florea* and *Apis dorsata* collected from Gadchiroli District during summer 2005 to 2009 were carried out according to Indian standard specifications. Research findings showed that the respective physicochemical parameters of samples ranged from Total reducing 57.66 to 78.84, Glucose 22.17 to 35.13, fructose 24.3 to 44.85. The L/D ratio 0.86 to 1.98, specific gravity 1.23 to 1.56, surface tension 0.119 to 0.163  $\text{NM}^{-1}$ , The viscosity 1.461 to 2.102  $10^{-1} \text{Kgm}^{-1}\text{S}^{-1}$ , The sucrose 0.14% to 3.42%, acidity 0.04 to 0.11, pH 2.3 to 4.09. Summer honey samples visually appeared, transparent, slightly turbid and turbid, colour. Statistical analysis of physicochemical data has revealed that there was no significant difference in the values of physicochemical parameters except sugars like total reducing sugars, Glucose (Dextrose), Fructose (Laevulose) and Sucrose. This study helpful to characterization of honey for commercial purpose.

**Keywords:** honey, physicochemical properties, characterization

### Introduction

Honey is defined as, It is the natural sweet substance produced by honeybees from the nectar of blossoms or from the secretion of living parts of plants or excretions of plant-sucking insects living on parts of plants, which honey bees collect, transform and combine with specific substance of their own, store and leave in the honey comb to ripen and mature [5]. From ancient times, honey was used both as a natural sweetener and a healing agent [11]. The composition and flavor of honey varies, depending mainly on the source of the nectars from which it originates and to a lesser extent on certain external factors-climatic conditions and beekeeping practices in removing and extracting honey [14]. Bee honey is one of the few virtually totally non-allergic foods that body easily assimilates. It contain nutrients especially as energy provider [12]. Therefore physico chemical characteristics help to Asses quality of honey as medicine and as food.

### Materials and Methods

#### Collection of materials

Total 50 samples of *Apis dorsata* (n=25) and *Apis florea* (n=25) were collected from various forest tracts of Gadchiroli district during the period 2005-2009. The squeezing of honeycombs was carried out under personal supervision with the help of expert workers.

#### Labeling of honey-samples

The samples collected were labeled by including the first letters of district followed by forest range, village and then type of hive of honeybee (i.e. either *Apis dorsata* or *Apis florea*). The sample GChoSD means the sample is collected from Gadchiroli district (G), Choudampalli forest range (Cho) and Singanpalli village of *Apis dorsata* (D) hives. Whereas "D" and "F" represents the sample collected from dorsata and florea hives of *Apis*. At the end the numerical number of collected samples is given. For example, GChoSD 2, GGhSD20, GEED 12 and so on.

### Physico-chemical analysis

Physico-chemical analysis of the honey was carried out by using Indian standard [3, 8]. The percentage of total reducing sugars (Laevulose or Fructose + Dextrose or glucose,) Laevulose (%), Dextrose (%), Acidity (%), Sucrose and L/D ratios were estimated. Specific Gravity was measured at 18°C by using density bottle (W/V), Surface Tension ( $\text{Nm}^{-1}$ ) was measured by Stalagno meter 1 ml honey sample was dissolved in 25 ml of distilled water, Viscosity ( $10^{-1} \text{Kgm}^{-1} \text{s}^{-1}$ ) was measured by viscometer 1 ml honey samples was dissolved in 25 ml of distilled water.

### Results and Discussion

#### Honey Appearance

The studied summer honey samples visually appeared, transparent, slightly turbid and turbid it is due to its chemical composition and pollen present in honey.

#### Colour

The colour of honey usually ranges from light yellow to amber, dark amber and black in extreme cases and sometimes even green or red hues [2]. In this studied samples Colour of honey ranged from dark brown, brown, light brown, yellowish brown, yellow and greenish yellow.

#### Sugars

Primary sugars existed in honey are fructose and glucose, and in nectar honey the content should exceed that of glucose [15]. In present study The Glucose percentage was found to be 22.17 to 35.13 with average 30.67. The fructose percentage was found to be 24.3 to 44.85 and average means glucose present less than fructose. The percentage of total reducing sugars (glucose and fructose) was found to be ranged from 57.66 to 78.84 and average 66.79.

#### Fructose/Glucose (F/G) ratio or Laevulose/Dextrose

F/G ratio indicates the ability of honey to crystallize, since the glucose is less soluble in water than fructose [1]. Honey crystallization is faster when the F/G ratio below 1.0 and it

slows when this ratio is more than 1.0 [6]. Accordingly, Gadchiroli honey crystallized slow because out of 50 samples ten samples F/G ratio near 1.0 and 40 sample F/G ratio is above 1.0. The L/D ratio varied from 0.86 to 1.98 and average was 1.14.

### pH Values

The pH values of samples varied from 2.3 to 4.09 and average 2.92 means all samples were acidic. The high acidity of honey correlates with the fermentation of sugars present in honey into organic acid, which is responsible for two important characteristics of honey: flavor and stability against microbial spoilage [2].

### Specific gravity and Surface Tention

The specific gravity changed from 1.23 to 1.56 with average 1.399. The surface tension varied from 0.119 to 0.163  $\text{NM}^{-1}$  and average was 0.141  $\text{NM}^{-1}$ . Surface tension of honey is an important property in processing of honey, a low value may lead to excessive foaming and scum formation. The values of specific gravity and refractive index ranging from 1.41 – 1.42 and 1.490 -1.49 respectively in 5 unifloral honeys from Pakistan [10].

### Sucrose and Acidity

The sucrose changed from 0.14% to 3.42% and average was 1.93%. The acidity percentage changed from 0.04 to 0.11 and average was 0.078. Physicochemical characteristic of

honey found acidity 8-6 to 33.5 meq/kg. Fructose + glucose ranged between about 68-82% sucrose amount as high as 0.5-3%. F/G ratio 1.31 is almost same for unifloral and multifloral honey from Argentina [4]. Acidity and pH are responsible for antimicrobial activities of honey are also recorded by many workers [6]. Intensity of acidity is in turn controlled by 3 factors – nature of individual acid present total amount of acid present and influence of certain other materials present in honey such as minerals [12].

### Viscosity

The studied physico chemical properties of West Cameroon honey collected from bee hives and found the value for Viscosity ( $69 \text{Ns/m}^2$ ) [9]. pH value was 3.9. Water content 17.1% and Glucose contents (41.3 %). All samples the viscosity changed from 1.461 to 2.102 and average was 1.75  $10^{-1} \text{Kgm}^{-1}\text{S}^{-1}$  the Viscosity of honey changed most rapidly as the temperature rises to room temperature.

Statistical analysis of physicochemical data has revealed that there was no significant difference in the values of physicochemical parameters except sugars like total reducing sugars, Glucose (Dextrose), Fructose (Laevulose) and Sucrose.

It was also noted that all the parameters were found as per standard norms laid down by Bureau of Indian Standards [3].

### Table

**Table 1:** Physicochemical Parameters of Summer Honey

Sr. No	Name and No of Sample	Colour	Visual Apperance	Total Reducing Sugars	Glucose (D %)	Fructose	L/D ratio	Viscosity (10-1 kg M-1S-1)	Specefic gravity	Surface tension (NM-1)	Sucrose	Acidity	Ph
1	GChoSF 1	Brown	Turbid	68.4	29.24	39.16	1.33	1.759	1.5	0.150	2.14	0.05	2.5
2	GChoSD 2	Brown	Turbid	71.61	33.3	39.16	1.818	1.818	1.5	0.150	0.988	0.06	3.1
3	GEEF 3	Brown	slightly hirbid	73.08	29.2	38.32	1.73	1.73	1.37	0.137	1.81	0.57	3.59
4	GGhSD 10	Yellow	Transparent	63.29	33.89	29.42	0.86	1.416	1.29	0.119	2.69	0.09	2.6
5	GMaChaF 11	Brown	slightly turbid	72.51	31.47	41.04	1.3	2.052	1.55	0.161	2.77	0.07	2.65
6	GEED 12	Brown	Turbid	78.84	34.8	44.95	1.29	1.818	1.53	0.150	2.08	0.05	2.62
7	GBTD 13	Brown	slightly turbid	77.24	34.56	42.68	1.23	1.7	1.37	0.141	1.26	0.05	2.55
8	GMasSF 14	Brown	Turbid	70.84	33.66	37.18	1.1	2.111	1.53	0.161	0.14	0.1	3.1
9	GBBD 15	Brown	Turbid	66.98	44.5	32.48	0.94	2.111	1.55	0.161	0.35	0.1	4.09
10	GAVF 16	Brown	Turbid	71.71	32.16	39.55	1.22	2.082	1.53	0.161	3.42	0.05	3.99
11	GGhAdF 17	Light Brown	Transparent	58.3	28.22	29.91	1.05	1.642	1.33	0.133	1.55	0.071	2.68
12	GGhAdD 18	Light Brown	Transparent	57.66	28	29.66	1.05	1.642	1.39	0.137	2.91	0.05	2.8
13	GGhAdF 19	Light Brown	slightly turbid	78.62	26.29	52.28	1.98	1.642	1.32	0.137	1.3	0.07	3.12
14	GGhSD 20	Light Brown	slightly hirbid	67.49	31.58	35.91	1.73	1.73	1.33	0.133	0.513	0.07	3.5
15	GGhSD 21	Light Brown	slightly hirbid	39.81	27.89	31.92	1.642	1.642	1.32	0.141	2.96	0.06	2.85
16	GMaAsF 31	Yellow	Transparent	70.29	30.05	34.24	0.94	1.642	1.3	0.137	2.75	0.07	2.69
17	GMuRD 32	Brown	Turbid	65.42	30.05	29.42	0.979	1.76	1.49	0.160	2.15	0.05	2.5
18	GMuGaF 33	Yellow	Tranparent	64.2	25.13	24.12	0.96	1.42	1.25	0.121	2.59	0.05	2.6
19	GMuGaD 34	light brown	Slightly turbid	70.11	31.25	30.19	0.97	1.781	1.42	0.161	2.6	0.04	2.55
20	GMuGaD 35	Light Brown	Slightly turbid	69.15	28.2	27.42	0.97	1.782	1.38	0.161	2.25	0.04	2.62
21	GMaAsF 36	Light Brown	Slightly turbid	65.89	32.16	39.32	1.22	1.7	1.48	0.185	0.96	0.06	4.02
22	GMaJaD 37	greenish	Slightly	64.7	29.8	30.18	1.01	1.769	1.5	0.163	0.87	0.1	3.0

		yellow	turbid										5
23	GMaAdD 38	Light Brown	Slightly turbid	59.2	28.6	28.8	1.01	1.69	1.35	0.159	0.95	0.06	2.35
24	GMaAdD 39	yellowish brown	Slightly turbid	59.9	22.15	25.62	1.16	1.803	1.32	0.159	0.75	0.1	2.3
25	GMaMuD 40	Brown	Slightly turbid	62.78	23.4	24.3	1.04	1.759	1.38	0.159	0.7	0.09	2.18
26	GMuMuF 41	Light Brown	Tranparent	98.12	33.7	37.3	1.11	1.451	1.23	0.119	1.3	0.07	2.92
27	GMuMuF 42	yellowish brown	Tranparent	63.15	31.23	29.15	0.93	1.482	1.3	0.121	2.15	0.07	2.8
28	GchaGiD 43	Brown	Turbid	68.65	38.5	34.89	0.91	2.075	1.52	0.165	2.16	0.05	3.5
29	GMaUD 44	Brown	Turbid	68.72	34.4	35.89	1.04	2.102	1.53	0.165	2.08	0.05	3.12
30	GMaKaD 63	light brown	slightly turbid	63.3	30.5	30.15	0.96	1.68	1.29	0.137	1.75	0.11	3.09
31	GMaKaD 64	light brown	slightly turbid	64.89	29.8	32.5	1.09	1.802	1.28	0.138	1.8	0.1	3.1
32	GMaAnD 65	light brown	slightly turbid	67.2	27.4	33.88	1.23	1.78	1.3	0.137	2.5	0.06	2.68
33	GMaAnF 66	Yellow	slightly turbid	59.8	28.22	29.5	1.04	1.752	1.32	0.138	3.32	0.05	2.29
34	GMaAnF 67	light brown	slightly turbid	69.5	23.45	32.9	1.4	1.759	1.3	0.136	0.96	0.1	3.5
35	GMaAaD 87	Light Brown	slightly turbid	70.28	32.11	36.3	1.12	1.691	1.29	0.133	0.87	0.11	3.58
36	GMaUF 88	greenish brown	slightly turbid	71.44	34.8	38.5	1.1	1.69	1.28	0.133	0.35	0.11	2.32
37	GMaUF 89	yellowish brown	slightly turbid	73.4	33.71	33.6	0.99	1.652	1.4	0.138	1.5	0.08	2.4
38	GMaKoF 90	yellowish brown	slightly turbid	68.05	30.18	34.05	1.12	1.78	1.42	0.137	1.79	0.071	2.6
39	GMaKoF 91	Light Brown	slightly turbid	65.38	38.5	33.09	1.08	1.759	1.45	0.137	2.05	0.06	2.78
40	GMaKoD 92	yellowish brown	Transparent	62.08	28.12	31.7	1.12	1.74	1.38	0.136	1.82	0.05	2.32
41	GMaAsF 93	greenish brown	Transparent	58.5	22.17	28.04	1.26	1.749	1.32	0.136	3.19	0.05	2.31
42	GMaAsF 94	Yellow	Transparent	59.87	25.5	24.5	0.96	1.75	1.3	0.137	3.81	0.06	2.3
43	GEEF 95	Light Brown	Transparent	62.02	25.5	27.4	0.93	1.43	1.5	0.136	3.2	0.06	2.9
44	GMaUF 100	Light Brown	Transparent	60.15	30.68	25.16	1.21	1.785	1.35	0.137	2.73	0.072	2.35
45	GMaUF 101	Light Brown	Transparent	65.4	29.5	30.18	0.97	2.011	1.42	0.136	2.8	0.09	2.72
46	GMaKoF 102	Brown	Transparent	63.59	31.18	30.5	1.02	1.61	1.5	0.136	2.02	0.06	2.68
47	GEGoD 103	Brown	Trurbid	69.1	34.42	35.89	0.95	1.731	1.5	0.147	3.12	0.04	3.61
48	GEGoD 104	Brown	slightly turbid	65.32	30.12	28.8	1.045	1.738	1.38	0.133	3.1	0.05	3.89
49	GEED 105	Brown	slightly turbid	67.29	35.5	35.09	1.01	1.75	1.55	0.155	2.75	0.08	3.9
50	GEEF 106	Brown	slightly turbid	66.28	35.13	34.24	1.02	1.748	1.56	0.150	2.7	0.07	3.5

**Table 2:** Physicochemical Parameters of Summer Honey sample Showing Mean, Standard Deviation and Variance

Parameter	Summer				
	brown, light brown, yellow yellowish brown, greenish yellow				
Colour	Transparent slightly turbid, turbid				
Visual appearance	Min	Max	Mean	±SD	Variance
Total reducing sugar	57.66	78.84	66.79	±7.79065	60.6943
Glucose	22.17	35.13	30.67	±4.29491	18.44681
Fructose	24.3	44.85	33.20	±5.63034	31.7007
L/D ratio	0.86	1.98	1.142	±0.24857	0.06179
Specific gravity	1.23	1.56	1.39	±0.09794	0.00959
Ph	2.3	4.09	2.91	±0.5304	0.28132
Surface tension $\text{NM}^{-1}$	0.11871	0.1628	0.141	±0.02293	0.00053
Viscosity $10^{-1}\text{KgM}^{-1}\text{S}^{-1}$	1.461	2.102	1.75	±0.16745	0.02804
Sucrose	0.4	3.42	1.93	±0.86404	0.92179
Acidity	0.04	0.11	0.07	±0.07374	0.00544

Table 3

Abbreviation	Parameters		
TRS	Total reducing sugar %	ST	Surface tension (NM <sup>-1</sup> )
D	Dextrose %	V	Viscosity (10 <sup>-1</sup> KgM <sup>-1</sup> S <sup>-1</sup> )
F	Fructose %	A	Acidity %
L/D	L/D ratio	S	Sucrose %
SG	Specific gravity		

### Conclusion

As honey is used in medicine and food, it is essential to know the composition and its quality. Physicochemical analysis will be helpful to know the composition and quality of honey. It will also help to check adulteration of honey which is directly related to the natural ecosystem and also by community of people involved with the honey resource extraction and trade. In conclusion, these studies will contribute to assessment of honey.

### References

- Amir Y, Yesli A, Bengana M, Sadoudi R, Amrouche T, Physicochemical and microbiological assessment of honey from Algeria. *Electron. J. Environ. Agric. Food Chem.* 20109; (9):1485-1494.
- Bogdanov S, Jurendic T, Sieber R, Gallmann P. Honey for nutrition and health: a review. *J. Am. coll. Nutr.* 2008; 27:677-689.
- Bureau of Indian Standards, IS: 4941-1974, IS: 4941-1994, IS: 8464-1977.
- Ciappini, Maria G, Maria V, Maria G, Susana G. Martha. Characterization of different floral origins honey samples from Sonta Fe (Argentina) by Palynological, Physicochemical and Sensory data. *Apiacta.* 2002; 43:25-36.
- Codex Alimentarius Commission., Codex Standards for sugars (honey). Supplement 2 to Codex Alimentarius Vol. III. Food and Agriculture Organization of the United Nations and World Health Organization, Rome, 1989.
- Croft L. Honey and health. Welling borough, UK; Thorsons Publishing, 1987, 111.
- Draiaia R, Chefrou A, Dainese N, Borin A, Manzinello C, Gallina A, Mutinelli F. Physicochemical parameters and antibiotics residuals in Algerian honey. *J. Biotechnol.* 2015; 14(14):1242-1251.
- Indian standard specifications IS: 8464-1977.
- Joseph T, Julius A, Fonteh F, Delphine D, Jonnas P, Antoine M. Physico-chemical and microbiological characteristics of honey from the Sudano-guinean zone of West Cameroon. *Afr. J. of Biotechnology.* 2007; 6(7):908-913.
- Kamal A, Saceda R, Nauman R, Tabasscum GM, Amjad Q, Khalid N. Comparative study of Honey Collected from Different Flora of Pakistan. *On Line Journal of Biological Sciences.* 2002; 2(9):626-627.
- National Honey Board, Honey-Health and therapeutic qualities, 2002. Retrieved January 14, 2004 from the World Wide Web: [http://www.nhb.org/info-pub/month/2002/10\\_2002 Month Report.pdf](http://www.nhb.org/info-pub/month/2002/10_2002%20Month%20Report.pdf).
- Rahman M, Allan R, Azirum S. Antibacterial activity of propolis and honey against *Staphylococcus aureus* and *Escherichia coli*. *Afr. J. Microbiol. Res.* 2010; 4:1872-1878.
- Root AI. Encyclopedia of bee culture published by J D Jain international Books & periodical supply service New Delhi, 1985.
- White J. Composition of Honey, in *Honey A Comprehensive Survey* (Ed. Crane E); Heinemann, London, 1975, 157-206.
- Zafar A, Safdar M, Siddiqui N, Mumtaz A, Hameed T, Sial MU. Chemical analysis and sensory evaluation of branded honey collected from Islamabad and Rawalpindi market. *J. Agric. Res.* 2008; 2:86-91.