

## PHYSICO-CHEMICAL PROPERTIES OF *APIS CERANA- INDICA* F. HONEY FROM UTTARKASHI DISTRICT OF UTTARAKHAND, INDIA

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### Abstract

The present study was undertaken to determine the physico-chemical properties of *Apis cerana- indica* F. honey obtained from Uttarkashi district of Uttarakhand state. The 11 honey samples were analyzed for their physico-chemical properties *i.e.*, viscosity, specific gravity, moisture, Hydroxymethylfurfural (HMF), Total reducing sugars (TRS), fructose, glucose and sucrose. The results showed that the moisture percentage ranged from 19-25 percent. Fructose and glucose represented the major sugars in all honey samples. The fructose percentage ranged from 37.27 - 40.51, whereas values for glucose were 35.12 - 38.04 percent. Out of 11, six honey samples *viz.*, NAW-6 (glucose to water ratio 1.61), BAR-6 (1.59), UTT-6 (1.68), GUN-6 (1.40) and KAM-6 (1.57) showed lower granulation tendency. The study indicated that the honey samples had good quality and will be important for the commercialization of regional honey.

**Key words:** *Apis cerana- indica*, honey, physico-chemical properties.

### INTRODUCTION

Honey is one of the most complex foodstuffs produced by nature and certainly the only sweetening agent that can be used by human without any processing [1]. It is the natural sweet substance produced by bees from the nectar of plants, which bees collect, transform by combining with specific substances of either own, deposit, hydrate, store and leave in honeycomb to ripen and mature [2]. Honey possesses valuable nourishing, healing and prophylactic properties [3]. These properties can be interpreted by its physical and chemical composition.

Major chemical components of honey include sugars which represent the largest portion about 82% of honey composition [4]. The composition of honey depends on the type of flowers visited by bees, climatic conditions in which the plants grow and maturation [5, 6]. Since the forage area of the hive is more than 7 km<sup>2</sup> and the bees come in contact with air, soil and water, the concentration of minerals in honey reflects their amount in the whole region [7, 8]. The physico-chemical analysis of honey is important to the honey industry, as these factors are intimately related to storage quality, granulation, texture, flavor, and the nutritional and medicinal qualities of honey.

In Uttarkashi district of Uttarakhand state, the consumption of honey as food has increased considerably in recent years due to changing trends. Unfortunately, negligible data is

available on the potentially physical and chemical properties of honeys produced in different localities. Therefore, the present study was carried out to provide information on the physico-chemical properties of honey from the area.

### MATERIALS AND METHODS

Uttarkashi district lies in the northwestern part of Uttarakhand state in India. It is bounded by North Latitudes 30°27'18" and 31°27'42" and East Longitudes 77° 48' 26" and 79° 24' 00" (Figure 1). Eleven honey samples were collected from different localities of district Uttarkashi during the years 2009-10. All samples were raw and unprocessed, and collected from wall hives of domesticated *Apis cerana-indica* colonies. Details of honey samples were given (Table.1). The 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 containers at room temperature. The collected samples were analyzed for physico-chemical properties like specific gravity, viscosity, moisture %, ash %, sugar % and HMF. The moisture content was determined with the help of the oven at a constant temperature of 100°C for three hours. Ash content was determined through ignition of honey samples in a muffle furnace at 550°C to a constant weight. Major sugars, total reducing

sugar and HMF value were estimated by the standard methods [9, 10].

## RESULTS AND DISCUSSION

### Specific gravity

Specific gravity of honey depends on the water content of the honey and is greater than water. In present study the specific gravity ranged between 1.3648 - 1.4101 (Table 1), which are similar to the values (1.365 - 1.432) observed by various workers from India including Garhwal Himalayan region [11, 12, 13].

### Viscosity

The viscosity was varied between 10 and 30 poise and similar to the values recorded by different workers all around the globe [12, 14, 15, 16]. Honey of high quality is usually thick and viscous. The viscosity depends on a large variety of substances and therefore varies with its composition and particularly with its water content. It is an important technical parameter during honey processing because it reduces honey flow during extraction, pumping, settling, filtration, mixing and bottling. The viscosity of a honey sample is a function of the composition of its sugars, water and colloid content. If the concentration of water is increased, honey becomes less viscous. Proteins and other colloidal substances increases honey viscosity, but their amount in honey may be insignificant. The percentage of fructose content in honey has also been found to affect its viscosity and rheological properties. honeys become less viscous with increase in fructose content [17].

### Ash %

The ash content in honey is generally small and depends on nectar composition of predominant plants in their formation [14]. The ash content in the honey samples varied between 0.09 - 0.18 % (Table 1), which is in the acceptable range. These values showed good agreement with the earlier reported values (0.12 - 0.28%) by various workers from India [11, 18]. Similar values were observed by Unal and Kuplulu [19] in Turkey honey *i.e.*, 0.15%, Cantarelli *et al.* [20] in Argentina honey, *i.e.* 0.11% and Salim *et al.* [21] in Algeria honey, *i.e.* 0.14%. The ash content is associated with botanical and geographical origins of honey samples.

### Hydroxymethylfurfural (HMF)

The HMF content is widely recognized as a parameter in evaluating the freshness of honey. This is a byproduct of fructose decay and formed during storage or during heating. Thus, its presence is considered the main indicator of

honey deterioration. The excessive value of HMF indicates overheating during processing, prolonged storage or adulteration with invert sugars [22, 23]. Besides, honeys from subtropical countries have naturally high content of HMF due to the high temperatures [24]. In present investigation the HMF values were recorded between 13.80 and 36.86 (Table 1). Similar HMF values were also observed by Finola *et al.* [25] in Argentina honey. According to Codex Alimentarius [26] and Council Directive of the European Union [2], the HMF values of all 11 honey samples were found in the acceptable standard ( $\leq 40$  mg/kg).

### Moisture %

The moisture percentage or water content of honey was observed between 19 to 25 percent (Table 2). These values were in the range of earlier reported value (23%) by Natarajan and Yesuvadian [27] from Kerala, India. Singh and Bath [28] also determined the similar moisture percentage values (18.7 - 21.8) for some Indian honey. Generally, the Indian honey has significantly higher moisture content (20-25%) in comparison to the Western honeys *i.e.*, 12-15% [12]. Singh [11] reported 19.98 % moisture content in the multifloral honeys from northern India. Jasim *et al.* [29] and Nawani [30] reported 20.12 - 23.82 % moisture in *A. cerana-indica* honey. Honey moisture content, a critical variable influencing product quality, granulation and texture, is significantly affected by conditions under which honey is stored following its extraction from the hive. Higher water content could lead to undesirable honey fermentation during storage [31, 32]. The water content depends upon the environmental factors during production such as weather and humidity inside the hive, but also on nectar conditions and treatment of honey during extraction and storage. It can be reduced before or after extraction by special techniques.

### Sugar composition and granulation

Glucose, fructose and sucrose are the major constituents of honey. The glucose, fructose and sucrose contents ranged from 35.12% to 38.04%, 37.27% to 40.51% and 0.19% to 1.02% respectively (Table 2). These values are similar to the values recorded by Makhloufi *et al.* [33] from Algerian honey. The total reducing sugar (TRS) content was varied between 73% to 78.09%. Khatija and Ramajunam [34] also reported 72.66% to 75.30% TRS in honey samples from Hyderabad, India.

The large difference between fructose and glucose percentage in honey, indicates lower granulation tendency. Differences in fructose and glucose contents in present study ranged between 1.21 and 2.93 (Table 2). Analyzing the relationship between granulation and indices type suggests that the fructose to glucose ratio may not be an effective gauge of granulation tendency. While glucose percentage is a useful indicator of honey granulation, the glucose to water ratio appears to be one of the most effective indicators predicting granulation in honey. The glucose to water ratio may be used both to predict and control granulation tendency. Glucose to water ratios of 1.7 or less were considered non-granulating, while ratios of 2.1 or more predicted rapid granulation [35, 36, 37]. In present investigation the glucose to water ratio varied from 1.40 to 1.95 and showed moderate granulation properties (Table 2). Out of 11, six honey samples viz., NAW-6 (ratio: 1.61), BAR-6 (1.59), UTT-6 (1.68), GUN-6 (1.40) and KAM-6 (1.57) showed lower granulation tendency.

Similarly, glucose-water to fructose ratio  $> 0.50$  predicted rapid and ratio  $< 0.20$  predicted slow granulation [37, 38]. In our study the glucose-water to fructose ratio ranged between 0.26 and

0.46, which showed relatively low granulation tendency. The honey fructose to glucose ratio reaching 1.14 indicates a tendency to granulate more rapidly than the honey with a ratio significantly below 1.14 [36, 37, 40]. It is generally believed that the higher glucose content has the greater tendency toward granulation. The percentage of glucose in analyzed honey samples ranged from 35.37% to 38.04%. This is relatively low range and indicates that the honey samples taken in this study are slow granulating. In terms of consumer appeal, granulated honey (*i.e.*, honey in a semi-solid state) is generally regarded as unacceptable. Therefore, the granulation process should be avoided through proper storage index practices that maintain optimal storage temperature.

### CONCLUSION

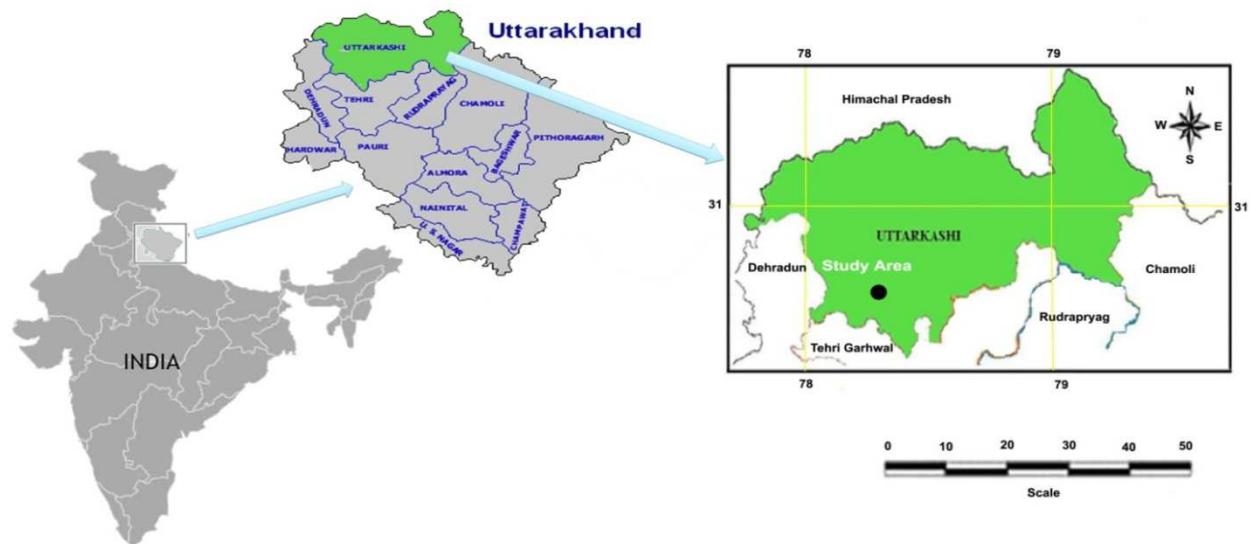
The aim of present study was to evaluate and compare the physico-chemical properties of some honey samples from Uttarkashi district of Uttarakhand state. The results showed that all the samples have good quality. This study would be helpful to understand local honey properties and very important towards the commercialization of regional honey.

**Table 1.** Physico-chemical properties of *Apis cerana-indica* L. honey from Uttarakashi district of Uttarakhand state.

S. No.	Sample Code	Specific Gravity	Viscosity (poise)	Ash%	H.M.F. Mg/kg
1	NAW-6	1.3799	20	0.09	26.10
2	BAR-6	1.3840	16	0.16	23.12
3	MAN-6	1.4012	30	0.15	16.89
4	UTT-6	1.3959	10	0.11	36.86
5	GUN-6	1.3648	10	0.12	13.80
6	BHU-6	1.4101	30	0.12	24.60
7	POK-6	1.4057	25	0.18	25.72
8	TIN-6	1.3888	20	0.12	21.50
9	SIR-6	1.3950	30	0.14	22.00
10	PAS-6	1.3966	20	0.13	20.12
11	KAM-6	1.3843	16	0.11	21.50

**Table 2.** Water content, sugar composition and granulation indices of *A. cerana-indica* L. honeys.

S. No.	Sample Code	Moisture %	Sugar composition (%)				Granulation indices			
			G %	F %	S %	TRS	F/G	F-G	G/W	(G-W/F)
1	NAW-6	23	37.04	38.25	0.49	75.29	1.03	1.21	1.61	0.36
2	BAR-6	22.6	36.01	37.27	0.35	73.28	1.04	1.26	1.59	0.35
3	MAN-6	20.1	37.3	39.51	0.84	76.81	1.06	2.21	1.85	0.43
4	UTT-6	21	35.37	37.93	0.67	73.30	1.07	2.56	1.68	0.37
5	GUN-6	25	35.12	37.88	1.02	73.00	1.08	2.76	1.4	0.26
6	BHU-6	19	37.14	39.15	0.19	76.29	1.05	2.01	1.95	0.46
7	POK-6	19.5	37.18	40.08	0.86	77.26	1.08	2.9	1.9	0.44
8	TIN-6	21.8	38.04	39.41	0.45	77.45	1.04	1.37	1.74	0.41
9	SIR-6	21	37.82	40.13	0.27	77.95	1.06	2.31	1.8	0.42
10	PAS-6	20.8	37.58	40.51	0.41	78.09	1.07	2.93	1.8	0.41
11	KAM-6	22.4	35.37	37.93	0.74	73.30	1.07	2.56	1.57	0.34

**Figure 1.** Map showing the study area.

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