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Quality Assessment of Bumble Bee Species Nectar in Western Maharashtra of India

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Authors' contributions

The all research work was carried out in collaboration among all authors. Author SP designed the study, performed the analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SBS and RCR were analysed the results and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Nectar is a sweet sustenance substance which organization, shading, flavor, and kind of nectar depend primarily on the blossoms, land districts and atmosphere and bumble bee species. We analyzed physicochemical and sensorial qualities attributed to different honey bee species in western Maharashtra of India.
Methodology: *Apis dorsata*, *Cerana indica*, *Apis florea* nectar from various bumble bee species from Kolhapur and Mahabaleshwar locale and remaining sample from market were studied for physicochemical and sensorial evaluation.
Results and Discussion: Brix of *Cerana indica* and *Apis florea* nectar gives 82.82 and 82.43°B which is higher than *Apis dorsata* and Market sample Honey. Acidity of the *Apis dorsata* was 0.38% which is higher than other nectar tests which showed matured marginal and gives the harsh unsuitable taste. *Cerana indica* test from Kolhapur district contains more sugar content 63.55% which gives dim golden color and better sweet taste increment its general agreeableness. *Apis florea* nectar sample from Mahabaleshwar district likewise contains more sugar content 63.35% with light golden shading and sweet taste. The market nectar similarly contains somewhat less

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sugar 62.10% with golden shading and furthermore contains more slag content. Its characteristic for *Cerena indica* and *Apis florea* nectar acknowledged by shopper than market sample honey.
Conclusion: Here we were the reason that the natural nectar test is superior to anything the nectar found in the consumer shops.

Keywords: Different honey; physiochemical analysis; sensory analysis.

1. INTRODUCTION

Nectar is fundamentally made out of sugars and different constituents, for example, catalysts, amino acids, natural acids, carotenoids nutrients, minerals, and sweet-smelling substances. It is wealthy in flavonoids and phenolic acids that display a wide scope of organic impacts and go about as regular cancer prevention agents [1]. The creation, shading, flavor, and kind of nectar depend essentially on the blossoms, land locales, environment, and bumble bee species engaged with its generation, and are likewise influenced by climate conditions, preparing, control and capacity time [2,3]. Nectar is delivered by bumble bees from nectars separated from nectarines of blossom [4] or from the emission of living pieces of plants or from the exude of plant sucking creepy crawlies when they present on plants. Newly gathered nectar is gooey fluid, has a more noteworthy thickness than water, a solid hygroscopic character, generally low warmth conductivity, a low surface tension, and different hues that are fundamentally all subtleties of yellow golden [5].

Characterization of nectar helps our comprehension of its properties and therapeutic applications. Past investigations have been done on physical and substance properties of Nigeria nectars from various areas. Set up the rudimentary fixation (minerals) and utilitarian gatherings present in some nectar tests in the southeast and southwest of Nigeria. Illustrated the substance of all out titrable sharpness, Brix, pH, shading, dampness substance, fiery remains, and microbiological investigation of some Nigeria nectar. Evaluated the nature of Nigeria nectar contrasted with manuka nectar [6].

Significant compound segments of nectar incorporate sugars which speak to the biggest segment about 82% of nectar structure [7]. The production of nectar relies upon the sort of blossoms visited by honey bees, climatic conditions in which the plants develop and development. Since the scrounge territory of the hive is more than 7 km and the honey bees interact with air, soil and water, the convergence of minerals in nectar reflect their sum in the entire locale. The physicochemical investigation of nectar is critical to the nectar business, as these components are personally identified with capacity quality, granulation, surface, season, and the wholesome and restorative characteristics of nectar [8].

Nectar as a therapeutic cure, for the administration of wound recuperating, skin afflictions and different gastrointestinal diseases. Characterization of nectar picked up significance as it is a typical nourishment hotspot for people [9].

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Honey samples

Various different Honey were Collected from the various region and the market which Shown in Table 1 and packed in air tight container and Stored in refrigeration Condition (0±5°C) before Analysis.

2.1.2 Chemical and materials

Most of the chemicals used in this investigation were of analytical grade. The chemicals were obtained from Department of Food Technology and Department of Food Science and Technology, Department of Technology, Shivaji University, Kolhapur.

Table 1. Collection of honey sample

Sr.No.	Sample Code	Name of honey sample	Region of the honey sample
1	A	Market sample	Market sample from kolhapur
2	B	*Apis dorsata*	Kolhapur
3	C	*Cerena indica*	Kolhapur
4	D	*Apis florea*	Mahabaleshwar

2.2 Methods

2.2.1 Physico-chemical analysis of the honey samples

Physicochemical parameters were analysed using The Official Methods of Analysis of Association of Official Analytical Chemists (AOAC, 1990), The Harmonised Methods of the European Honey Commission [10].

2.2.1.1 Moisture content

A hand refractometer was used. The prism was carefully washed with distilled water and dried with soft tissue paper. A drop of honey sample was directly smeared on the prism and water content (%) was noted.

2.2.1.2 Total soluble solids

Total soluble solids were determined as described by ISO 2173:2003. Hand refractometer with ranges of 50°Brix - 85°Brix, was first standardised. The prism was then washed with water and dried off with a soft tissue. A drop of honey sample was placed on the refractometer prism and the reading was noted.

2.2.1.3 Free acidity

Free acidity was determined by potentiometric titration. Ten (10) grams of honey were then dissolved in 75 mL of distilled water, and an alcoholic solution of phenolphthalein added. The solution was titrated with 0.1 N NaOH. The milliequivalents of acid per kg of honey were determined as 10 times the volume of NaOH.

2.2.1.4 pH

pH was analysed by pH meter in a solution containing 1 g of honey sample in 20 ml of distilled water

2.2.1.5 Ash content

The gravimetric methodology was used for the determination of ash content. Ten grams of the sample were transferred to the crucible and two drops of olive oils were added, then the sample was heated in a hot plate until carbonized. The sample was kept in the preheated furnace, at 550°C, for at least 5 h. The following equation was used in the determination of the ash content:

$$\text{Ash content } (\%) = \frac{\text{Difference of crucible's weight}}{\text{total weight of the sample}}$$

2.2.1.6 Electrical conductivity

The electrical conductivity of a solution of 20 g dry matter of honey in 100 mL of distilled water was measured using an electrical conductivity cell. This analysis is based on the measurement of the electrical resistance, of which the electrical conductivity is reciprocal.

2.2.1.7 Color

Optical density measurement was used for color classification. Honey samples were heated in a water bath at 50°C to dissolve any fine crystals and filtered to remove any coarse particles which may affect the measurement. Samples were allowed to cool at ambient temperature and homogenized using a glass rod before measurement. Spectrometer was used to measure absorbance at OD 560 nm and blank with deionized water [11,12].

2.2.1.8 Sugar

Determination of sugars (total sugar, reducing sugar and non-reducing sugar) was carried out through Lane and Eynon method [13].

Total sugars and reducing sugars: For this solution, 5 g of sample was taken into a beaker and 100 ml of warm water was added to it. The solution was stirred until all the soluble matters were dissolved and filtered through Whatman filter paper into a 250 volumetric flask. 100 mL of the solution was pipetted and prepared into a conical flask, after which 10 mL of diluted hydrogen chloride (HCl) was added and boiled for 5 min. On cooling, the solution was neutralized to phenolphthalein with 10% NaOH and kept in a 250 volumetric flask. This solution was used for titration against Fehling's solution and the reading was calculated as follows:

$$\textbf{Total sugar } (\%) = \frac{\text{Factor } (4.95) \times \text{dilution } (250) \times 2.5}{\text{Titre} \times \text{wt of sample} \times 10}$$

$$\textbf{Reducing sugar } (\%) = \frac{\text{Factor } (4.95) \times \text{dilution } (250)}{\text{Titre} \times \text{wt of sample} \times 10}$$

Non-reducing: Non-reducing sugar was estimated as the difference between the total sugar content and reducing sugar content on subtraction (total sugar-reducing sugar) [14].

2.2.1.9 Sensorial analysis of the honey samples

Sensory evaluation was carried out by a panel of ten semi trained panel members. Hedonic rating

test was employed using a 9-point hedonic scale. Sensory parameters such as color, flavour, taste, mouth feel, consistency, and overall acceptability were evaluated [15]. The following were the numerical scores assigned.

3. RESULTS AND DISCUSSION

Different honey samples from different honey bee species were studied in terms of physicochemical properties. These Physico-chemical Properties gave qualities to differentiate honey Samples (Table 2).

3.1 Physico-Chemical Analysis of Honey

3.1.1 Moisture and refractive index

Nectar dampness is the quality rule that decides the capacity of nectar to stay stable and to oppose waste by yeast maturation: Higher dampness, showed likelihood that nectar will age upon capacity. sample A, C, and D contains 25%, 26%, 25% moisture content separately which under standard limit, however the example B *Apis dorsata* gives higher Moisture Content 35% which demonstrates that example was somewhat matured. Test A, C, and D gives the 1.49 refractive Index and test B gives 1.46 refractive Index.

3.1.2 Brix (°B*)*

Degrees Brix (°Bx) is the sugar substance of a fluid arrangement. *Cerena indica* which gives the more estimation of sugar contains 82.82°B so *Cerena indica* gives a better sweet taste. *Apis florea* additionally contains most extreme Sugar Contain 82.43°B which has better sensorial quality.

3.1.3 Sharpness and pH

Test A, C, and D shown 0.25, 0.19, and 0.12% sharpness individually. Test B gives extreme acidity 0.38% and pH 4 which demonstrates that the example is marginally aged.

3.1.4 Ash (%)

The Ash content is a quality standard for nectar cause, the bloom nectars having lower slag content than the honeydew ones. Market nectar sample (Test A) having high Ash content shown 1.5%. Test C and Sample D contain 0.33 and 0.31% separately.

3.1.5 Electric conductivity

Test A gives 0.90 mS/m electric conductivity. Test C and Sample D give 0.36 and 0.30 mS/m individually. This estimation relies upon the fiery debris substance of nectar: The higher their substance, the higher the subsequent conductivity.

3.1.6 Color

Absorbance at 560nm of Sample A gives greatest perusing ≥4 which having exceptionally Dark Amber shading. Test C additionally gives Dark Amber Color which demonstrates 3.101 absorbance at 560 nm. Test D gives 0.560 haven golden shading.

3.1.7 Sugar

Sugars are likewise called sweet starches. Nectar is made essentially out of the sugars glucose and fructose Test C and Sample D measured of highest sugar up-to 63.55% and 63.35% along with Reducing Sugar of 65.45% and 64.32% separately when contrasted with Sample A and Sample B in Table 3. Results indicate *Cerena indica* and *Apis florea* Honey to give a better taste.

Fig. 1 Shows the Sugar Present in different honey sample. Sample C and D shown maximum concentration of sugar compared sample A and B.

Table 2. Physico-chemical analysis of honey

Sr. No.	Parameter	Sample A	Sample B	Sample C	Sample D
1.	Brix (^{0}B)	80.18	69.98	82.82	82.43
2.	Refractive index	1.49	1.46	1.49	1.49
3.	Moisture (%)	25	35	26	25
4.	pH	4.5	4	4.7	4.7
5.	Acidity (%)	0.25	0.38	0.19	0.12
6.	Ash (%)	1.5	0.29	0.33	0.31
7.	Colour (Absorbance at 560nm)	≥4	1.995	3.101	0.560
8.	Electric conductivity (mS/m)	0.90	0.28	0.36	0.30

Where, Sample A= market Sample; Sample B=Apis dorsata; Sample C=Cerena indica; Sample D= Apis florea

3.1.8 Sensorial analysis of the honey samples

Sensory evaluation was carried out by a panel of ten semi trained panel members. Hedonic rating test was employed using 9-point hedonic scale. Sensory parameters such as color, flavour, taste, mouth feel, consistency, and overall acceptability were evaluated. The following were the numerical scores assigned (Table 4).

Test C has great dim Amber Color with thick Consistency which additionally contains better Sweet taste and Flavor. *Cerena indica* has extreme Overall worthiness. *Apis florea* Honey gives golden shaded nectar which is sweet than test A and Sample B. Test B was marginally matured which gives noteworthy severe taste and furthermore impact consistency which decrease the general agreeableness.

Table 3. Sugar present in different honey sample

Sr. no.	Sample code	Total sugar (%)	Reducing sugar (%)	Sucrose (%)
1	A	62.10	63.22	1.85
2	B	61.60	62.35	1.68
3	C	63.55	65.45	2.85
4	D	63.35	64.32	2.71

Where, Sample A= Market Sample; Sample B=Apis dorsata; Sample C=Cerena indica; Sample D= Apis florea

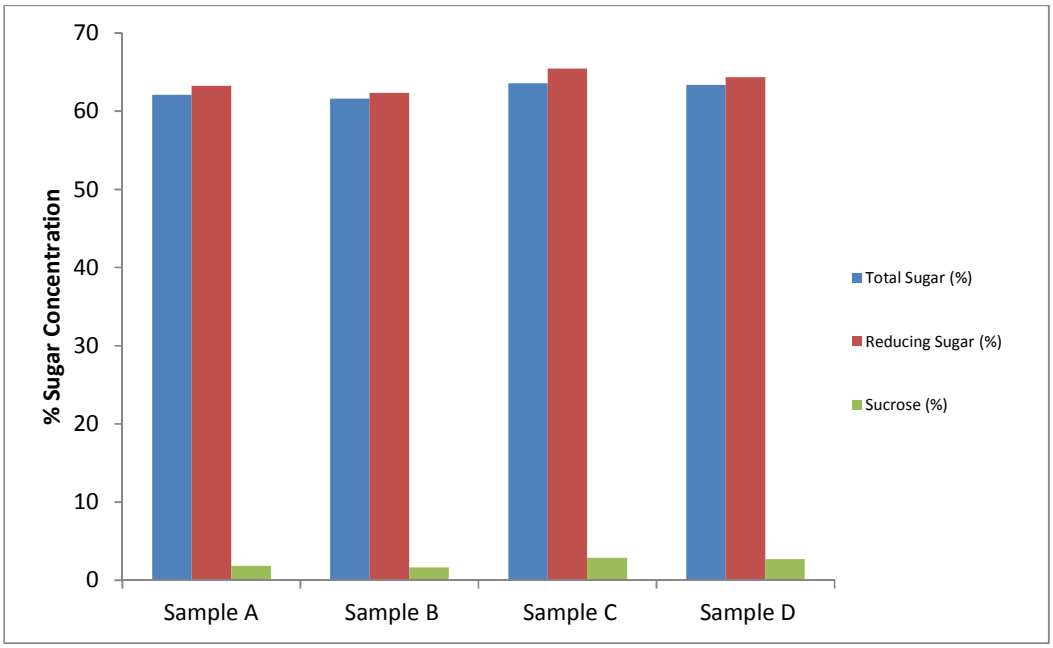

Fig. 1. Sugar present in different honey samples from different honey bee species from different honey bee species

Where, Sample A= Market sample; Sample B= Apis dorsata; Sample C= Cerena indica; Sample D= Apis florea

Table 4. Sensory analysis of different honey samples from different honey bee species from different honey bee species

Parameter	Sample A	Sample B	Sample C	Sample D
Colour	8	7	8.5	7
Flavour	8	7	8.5	8.5
Taste	8	6.5	8.5	8.5
Mouth feel	7.5	7	8.5	8
Consistency	8	6.5	8.5	7
Overall acceptability	7	6	8	8

Where, Sample A= Market sample; Sample B=Apis dorsata; Sample C=Cerena indica; Sample D= Apis florea

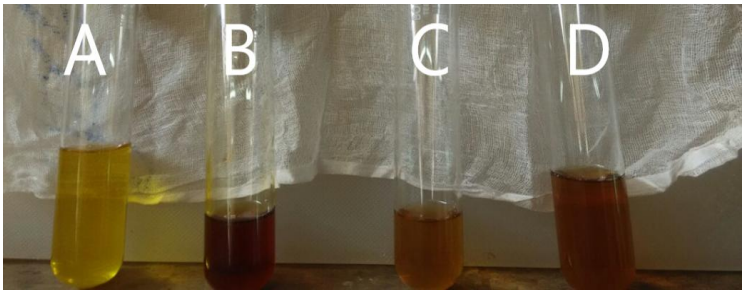

Fig. 2. Different honey samples from different honey bee species
Where, Sample A= Market sample market Sample; Sample B=Apis dorsata; Sample C=Cerena indica; Sample D= Apis florea

Cerena indica and *Apis florea* Honey gave preferable sensorial quality over the market test Market sample (Fig. 2).

4. CONCLUSION

Diverse dissected Honey samples demonstrate that market sample showcase sample contains maximum mineral than *Cerena indica* and *Apis florea* Honey. Be that as it may, *Cerena indica* and *Apis florea* Honey give better by and large agreeableness since it gives dull golden and golden hued nectar separately with greatest Sugar content which gives sweet taste nectar than market sample Honey sample so *Cerena* indica nectar will, for the most part, acknowledged by shoppers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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