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DETECTION OF PHYSICAL PROPERTIES OF HONEY FROM DIFFERENT LOCATIONS OF MELGHAT REGION OF AMRAVATI DISTRICT, MAHARASHTRA

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ABSTRACT

Melghat honey is an insect product made by wild honey bees *Apis dorsata*, and *Apis cerana indica*. It isobtained from natural combs from the Melghat forest. Melghat is a prime producer of wild honey but the honey is not analyzed to date. The study was carried out to determine the physical characteristics of Melghat honey. Honey samples were collected from four different locations of Melghat during the year 2019 and the physical parameters such as color, pH, specific gravity, moisture, ash, and optical density were detected. The consequences of adulteration if any in the samples were detected by applying Feihe's test. The results were checked based on the specification given by the Bureau of Indian Standards (BIS). It was found that the honey samples had excellent physical properties with all the specifications within the limits specified by the BIS. Thus, the samples fall in the special grade category as per the specifications of BIS. It is concluded that the Melghat honey is of excellent quality with good therapeutic properties and antimicrobial potential. It might be very less susceptible to fermentation and is very fresh and pure without adulteration. There is a need for more research to explore the various properties of Melghat honey for its commercialization.

(Key words: Melghat, wild, honey, *Apis dorsata, Apis cerana indica*)

INTRODUCTION

Honey is a crucial and especially natural substance obtained from the hives of the honey bee. It is one of the highly nutritious natural produce generated by the bees from the nectar of the flowers. The nectar is collected and transformed by them into the golden liquid i.e. honey. Looking back to human history it is found that honey might be considered a prime substance used as a sweetener by ancient man.Khupse *et al.* (2017) mentioned that honey is a wonderful medicine acknowledged by Ayurveda and its regular consumption is helpful for health and strength.

Honney is a wonder food, its nutritional value is very limited; honeys are mostly sugars-fructose and glucose, with some sucrose. Some types provide minuit amount of B complex and C vitamins. Honey does contain some antioxidents, however, mostly polyphenols. Some new studies are looking into the antimicrobial and wound-hearing properties of honey. (Schularz Joe and Fran Benkott, 2008)

Though honey has been recognized and used by the people for years the researchers diverted very recently towards its study. The overall increase in the consumption of honey throughout the world may be the reason behind the interest of researchers. People are now fascinated more and more by the consumption of natural foods like honey due to their numerous nutritional and health-enhancing properties (Shah, 2021).

Honey is readily and abundantly available in the Melghat forest region and is one of the prime jungle products collected by the tribal people from the hives of wild honey bees *Apis dorsata and Apis cerana indica.*Melghat is a tribal and forest area located in the Amravati District of the state of Maharashtra. It is reported that at all times of the year, there are ample flowers available in the Melghat forest for the nourishment of bees thus the honey must be full of excellent medicinal and nutritional properties (Shah, 2022; Anonymous, 2019).

There is very little research found on the analysis of the Melghat honey. Perhaps it can be assumed that the Melghat honey is still untouched from the research point of view. Here the attempt was made to explore the properties of Melghat honey, which may be helpful in developing the brand Melghat. The physical properties of honey are very important as the honey is commercially graded mostly according to its physical properties (Anonymous, 1994-2000).

Our inborn for sweet foods led stone Age humans to forage for the sweetness of honey. Although bees were first domesticated in artificial hives in Egupt and India about 4,500 years ago, it wasn't until bout A.D. 1000 that beekeepers began to understand the interplay between bees and flowers that is required to produce honey. (Schularz Joe and Fran Benkott, 2008).

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MATERIALS AND METHODS

Collection of samples

Different wild honey samples were purchased from the local honey collectors of the Melghat forest. Different locations were selected for the honey collection. The honey samples are supposed to be produced by the wild species of honey bees i.e. *Apis dorsata* and *Apis cerana indica.* The honey samples were prepared for analysis (Anonymous, 2015).

All the important physical properties, as prescribed by the agencies working for the standardization of honey were included for the evaluation of the quality of the Melghat honey. The physical attributes were determined by using the standard procedures as given in the manual published by the Bureau of Indian Standards (Anonymous, 1994-2000). The BIS manual is for describing standard specifications for the extracted honey in the Indian context. Color, pH, specific gravity, moisture, ash content, optical density, and Fiehe's test were the physical parameters studied.

RESULTS AND DISCUSSION

The results obtained are given in Tables 1 and 2.Here H_1, H_2, H_3, and H_4 represent the honey samples with different locations. SD stands for standard deviation.

Color

The colors of liquid honey were found in a variety of ranges right from very light to dark.Krell, (1996), and Da-Silva *et al.*(2016) observed the variations in the color of honey, it might be due to an assortment of properties and content such as climatic and agricultural conditions, floral source, techniques and methods used for its processing, storage temperature and time, water and ash content, optical density, and composition. Shobham *et al.*(2017) mentioned that the color of honey depends on the minerals and pigments present.

Table 1. Physical properties of Melghat honey (A)

Honey	Samples	Physical parameters							
		Color	Fiehe's test	pH	mean	SD	Specific Gravity	mean	SD
H_1	1	A	Negative	4.38	4.32	0.04	1.45	1.42	0.03
	2	A	Positive	4.33			1.43		
	3	LA	Negative	4.27			1.41		
	4	A	Negative	4.30			1.38		
H_2	1	LA	Negative	3.88	3.98	0.08	1.40	1.40	0.02
	2	LA	Negative	3.94			1.42		
	3	LA	Positive	4.08			1.37		
	4	ELA	Negative	4.02			1.41		
H_3	1	LA	Negative	4.36	4.61	0.27	1.44	1.41	0.02
	2	ELA	Negative	5.07			1.42		
	3	LA	Negative	4.46			1.38		
	4	LA	Negative	4.56			1.41		
H_4	1	DA	Positive	3.93	3.71	0.20	1.42	1.39	0.02
	2	A	Negative	3.72			1.38		
	3	DA	Negative	3.78			1.37		
	4	DA	Positive	3.39			1.39		

Table 2. Physical properties of Melghat honey (B)

Honeys	Samples	Physical parameters								
		Moisture	mean	SD	Ash	mean	SD	Optical Density	Mean	SD
H_1	1	18.38	18.4	0.15	0.39	0.29	0.11	0.22	0.24	0.04
	2	18.24			0.35			0.26		
	3	18.65			0.11			0.29		
	4	18.33			0.31			0.19		
H_2	1	18.35	19.00	0.64	BLQ	0.04	0.05	0.20	0.19	0.03
	2	18.45			0.10			0.19		
	3	19.89			BLQ			0.15		
	4	19.32			0.08			0.23		
H_3	1	19.51	18.80	0.45	0.15	0.08	0.08	0.19	0.15	0.03
	2	18.59			BLQ			0.12		
	3	18.79			0.17			0.16		
	4	18.29			BLQ			0.13		
H_4	1	18.88	19.04	0.42	0.14	0.22	0.09	0.29	0.28	0.03
	2	19.68			0.17			0.25		
	3	18.51			0.19			0.26		
	4	19.09			0.38			0.32		

White and Doner (1980) studied the relationship between color and flavor of honey and found that dark-colored honeys were intense in flavour, while mild-flavored honeys were light in color.

It was observed that the honey samples examined in the current study were ranging from light to dark amber in color. The colors were categorized as DA (dark amber), A (Amber), LA (light amber), and ELA (extra light amber). Extremely light color samples were hardly present in the present set. The honey samples from the same locations were having a similarity in color patterns. Specific gravity (SG) and optical density (OD) were found concerning their color i.e. the values of specific gravity were slightly lower in the light-colored samples than in the darker once. Optical density also tended towards its lower values in the light-colored honey samples. Other properties of the honey samples did not show any significant relationship with color. The results were supported by Sohaimy and Almasi as they found similar color range (Sohaimy *et al.*, 2015; Almasi and Basavarajappa, 2019).

Fiehe's test

Fiehe's test was employed for all the honey samples under study. It is a test used for the detection of the presence of hydroxymethylfurfural in the given honey sample. It is primarily used as an indication of adulteration. Since almost all samples with some exceptions showed a negative result of Fiehe's test, the samples were found to exhibit no adulteration as per the guidelines given by the Bureau of Indian Standards (Anonymous, 1994-2000) for grading honey.

It was reported that the positive result of Fiehe's test does not always confirm adulteration; it might be due to ageing, or the presence of impurities that appeared during the handling, extraction, processing, and storage of honey (Kavapurayil *et al.*, 2014). The Fiehe's test found negative for the samples studied by Borges *et al.* (2019) and Aljohar *et al.* (2018).

pH

The basic or acidic characteristics of any honey sample can be revealed from its pH value. All the previously published literature says that the nature of honey is always acidic. The locational variations or the differences in the botanical sources cannot change the nature of honey from acidic to basic (Atul *et al.*, 2018; Manukumar *et al.*, 2013).

The pH of the Melghat honey samples was ranging between 3.39 and 5.07. There were significant similarities found in the pH of honeys belonging to the same locations. The low pH values of the Melghat honey samples show that these honeys might have the potential to fight strongly against microorganisms as well as with high stability and shelf life. Melghat honey might have tremendous medicinal and therapeutic potential.

The present values were found in accordance with many previous studies. The pH values obtained by different scientists are given in the bracket i.e. Chin and Sown dhararajan (2019) (pH 3.17- 5.85); Harun *et al.*(2017) (pH 4.32); Gebru (2015) (pH 2.99- 4.45). The honey samples from Nigeria, Tunisia, Serbia, Istambul, Ethiopia, Iran, and China were analyzed in the above studies. Sohaimy *et al.* (2015) analyzed the Yemeni, Egyptian, Alexandrian, Kashmiri, and Saudi honey samples and stated that the potential of honey against microorganisms and its flavor is related to the pH.

Bogdanov *et al.*(2004) and Shobham *et al.*(2017) reported that the low pH of honey is mainly due to the organic acids as well as phosphates and chloride ions. In addition, the formation of HMF, floral origin, and pollens, storage parameters (temperature and humidity), and consequences of adulteration also affect the acidity (Pande and Jude, 2019; Sohaimy *et al.,* 2015). Dimins *et al.* (2006) stated that the pH of honey determines its quality, as the shelf life of honey is strongly dependent upon its pH.

Specific gravity (relative density)

The relative density of honey reflects the amount of sugar and moisture present in it.Here in this study, the values of specific gravity were lying between 1.37 and 1.45. The values of location one honey samples were on the higher side, while location four honey samples were at the bottom of the table. There was a significant relationship found between pH and specific gravity, while the latter was in the inverse relationship with the water content. The variation in the values of the specific gravities of different honey samples might be due to the difference in their composition especially the content of moisture and sugar.

The values were similar to Atul *et al.* (2018) (1.39-1.42), who assessed the Indian honey samples and mentioned that the specific gravity of honey depends on its moisture content. Almasi and Basavarajappa (2019) studied honey and got values (1.39 to 1.42) similar to the current data. The values obtained by Kavapurayil *et al.* (2014)were in some lower range (1.30 to 1.42).

No value of specific gravity obtained in this study was below the standard value given by BIS (Anonymous, 1994-2000). All the honey samples from the Melghat might be recognized as graded honey samples as per the limit set by BIS. According to it the minimum specific gravity of honey must be above 1.37 for its grading.

The variation in the specific gravity values might be due to the difference in the water content as well as the overall composition of honey samples.

Moisture

As per Krell (1996) water, the second most bulk-forming agent in the honey, and solvent dissolving all the other constituents, is one of the most crucial parameters regarding the quality of honey. Here the water contents were ranging between 18.24% and 19.89% i.e. below 20%. Thus, all the samples were fall in the special grade as specified by the BIS and the EU (Anonymous, 1994-2000; Dimins *et al.*, 2006). With few exceptions,there was an inverse relationship found between the specific gravity and moisture.

The results were appeared to be contemporaneous with the results drown by Pande and Jude (2019), (18% -

19.4%);Gebru (2015) (17 - 23 %); Bogoviku and Gedeshi (2015) (14.3 - 21%);Kavapurayil *et al.* (2014) (22.6 - 26.2%); Manukumar *et al.* (2013) (15.69 – 17.23%) and Harun *et al.* (2017) (16.31 %). Sohaimy *et al.* (2015) investigated honey samples from Egypt (moisture 18.32%), Saudi (15.64%), Yemen (16.28 %), and Kashmir (14.73%).

Gebru(2015),Bogoviku and Gedeshi (2015), Kavapurayil *et al.* (2014),Manukumar *et al.* (2013), Almasi and Basavarajappa(2019) confirmed that the water in honey may vary greatly depending upon numerous factors such as storage conditions (temperature and humidity), stage of ripening and maturation of honey, climatic conditions during harvesting, botanical origin, environmental and locational factors, types and the condition of hives, and types and implementation of methods of handling and processing etc.

The moisture in honey is an important criterion for its grading and determination of its level of maturity (under ripened honey has more moisture). As per the opinion of Dimins *et al.*(2006), Da-Silva *et al.*(2016) and Manzoor *et al.*(2013) many physical parameters of honey, like color, taste, flavor, viscosity, relative density, and solubility are strongly affected by its water content.

As the moisture content of the inspected honey samples was much low, it can be said that the Melghat honeys would have a high shelf life with excellent quality and a remarkable potential to fight against micro organisms. The susceptibility of these honey samples for fermentation and granulation must be quite low, as low moisture prevents the growth of yeast and mold as well as crystallization of sugars (Amabye,2017 ; White and Doner, 1980; Bogdanov *et al.* 2004).

The honey samples in the current study were having moisture values absolutely within the range and can be considered as special grade honey as per the BIS standards and could be got the premium value in the honey market.

Ash content

Ash content of any food item is an important quality parameter, especially for honey. Many factors such as the floral origin of honey, types of pollen, etc, affect the ash content of honey.

The ash content of the Melghat honey was found within the limit specified by the BIS. The ash content of the samples was laid below 0.39%. The low ash content of the Melghat honey samples might be an indication of fresh honey without adulteration.

The variations in the ash value of honey samples might be an upshot of ample reasons. It was reported that the minerals mostly affect the ash value of honey. The type of soil within the area influences the mineral of honey. The ash content was also related to the color and electrical conductivity of honey. The higher value of ash was generally observed in the darker colored and strong-flavored honey. As per the findings of Da-Silva *et al.*(2016) and Amabye (2017) the higher range of organic residues and trace elements also affect the ash content. Atul *et al.* (2018) stated that the ash content of honey can be used for the investigation of its botanical origin in the case of single-flower honey as well as to differentiate between the blossom and honeydew honey. The high ash content in honey is an indication of its adulteration, so owing to low ash content, the honey samples investigated in this study, were must be free from adulteration (Bogoviku and Gedeshi, 2015). The data on ash content obtained in this study was significant in accordance with Gebru (2015) (0.09-0.30%); Harun *et al.*(2017) (0.30%); and Atul *et al.*(2018) (0.09-0.49%).

Optical density

The optical density of a substance is determined by using a spectrophotometer. It is measured in terms of absorbance of light and it is a logarithm of the ratio of the falling light intensity to the intensity of transmitted light. The turbidity due to any objectionable matter, the freshness of the honey, and its color can be detected by using this tool.

It was revealed from the results that the optical densities were ranging between 0.12 and 0.32 and within the limit of BIS (max 0.3). Significant similarities were observed in the values of optical densities for the honey samples collected from identical locations with very infinitesimal variations. The optical densities were appeared to be following its color and moisture content.

As stated by White and Doner (1980), Kavapurayil *et al.* (2014), Shobham *et al.*(2017) the slight variations in the optical densities of honey samples might be due to the differences in the color shades and the colors of the honeys may vary due to numerous factors such as the overall composition of honey, differences in the climate of geographical location as well as during harvesting, floral origin and storage conditions. The results obtained by Almasi and Basavarajappa (2019) (1.28 to 1.55) and Manzoor *et al.* (2013) (1.05 to 1.06) were much higher than the current data.

From the above study, it is concluded that the physical properties of the Melghat honey samples were found in line with previously published data. All the samples fall in the special grade category as specified by the Bureau of Indian Standards and they are of excellent quality with good therapeutic properties and antimicrobial potential. These samples might have very less possibility of fermentation as well as they must be very fresh and pure without adulteration. There is a need for more research to explore the various physico-chemical, nutritional and therapeutic properties of Melghat honey for its commercialization.

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