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Analysis of Physicochemical Properties of Honey of True Honey Bee (*Hymenoptera: apidae*) of Karanja Ghadge, District-Wardha, Maharashtra, India

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ABSTRACT

As the primary pollinator for many crops, honey bees (Hymenoptera: Apidae) are critically important to honey production and the agricultural economy. Honey is characterized as a natural and raw food that can be consumed not only as a sweetener but also as medicine due to its therapeutic impact on human health. Honey samples were obtained from selected area of Karanja Ghadge in each of the three senatorial zones and labeled as samples K_1 to K_9. The pH, color, moisture content, electrical conductivity, free acid, relative density, viscosity, ash contents, optical density and surface tension of the samples were determined. Results showed that Average mean pH was 3.63, pfund (73.66mm) moisture (18.9%), ash (78.77mg/kg), electrical conductivity (1.56 ms/cm), free acid (67.55%), viscosity (77.18×10^{-3} Ns/m^{-2}), optical density (0.23) and surface tension (11.37×10^{-4} N/m) were obtained from the proximate analysis.

Keywords: Physicochemical analysis, Honeys, Hymenoptera: Apidae, Karanja Ghadge, Wardha, Maharashtra, India.

INTRODUCTION

Honey bees are beneficial social insects plays an important role in providing valuable products like honey, bees wax, pollen, royal jelly etc. to the human beings. Honeybees {(Hymenoptera: Apidae)-*Apis dorsata*, *Apis florea* and *Apis cerana indica*} are the most well-known plant-sucking insects and can collect and transform honey, and deposit, dehydrate, store and leave honey in the honeycomb to ripen and mature. Honeybees collect pollen and nectar from a variety of flowering plants and convert it into the wax and honey[1]. Honey is a sweet and flavourful product which has been consumed as a high nutritive value food[2]. It is essentially composed of a complex mixture of carbohydrates, of which fructose and glucose account for nearly 85–95%, and other minor substances, such as organic acids, amino acids, proteins, minerals, vitamins, and lipids [2].Honey is of good quality as long as it is in the hive, but faulty handling from the time of its harvest until it reaches to market is responsible for its inferior quality[4]. Several factors have contributed to its low quality among which high moisture content is the major quality problem in the country. Harvesting unripens honey, unsuitable honey storage container and storage places also attribute to high moisture content[5]. The quality of honey relied to a great extent on the art of the producer in storing and blending the product[6]. In marketing of honey, consumers should have confidence that they are getting good quality for what they are paying so that the country able to earn foreign currency to revamp the national economy[1]. The physicochemical properties of honey produced in different geographical locations of world have been reported by several researchers[7-9]. A quality product will go a long way in developing the confidence that encourages return, customers and efficient production of a product to any marketing scheme[1]. South and Southwest region of the country are highly potential in forest beekeeping and large volume of honey is produced per annum. In these areas the majority of household keep bees and honey serve as a source of cash incomes for many households[10]. Despite the potentiality of the areas and large volume of honey production, information is lacking on quality perspective based on national and international standards. Therefore, the present study aimed to characterize physicochemical study pH, colour, moisture contain, free acid, ash content, electrical conductivity, optical density, viscosity and surface tension of honey sample K_1 to K_9 in different locations of Karanja Ghadge, District-Wardha, Maharashtra, India.

Materials and Methods:-

Nine honey K_1 to K_9 samples were randomly collected directly from urban areas of Karanja Ghadge, District Wardha, India in the month of January 2025. The samples were filtered in the laboratory. This was done to remove particles. The honey filtrates were stored in brown bottles at room temperature prior use. Physicochemical characteristics such as pH, colour, moisture contain, free

acid, ash content, electrical conductivity, optical density, viscosity and surface tension. Honey samples were evaluated according to the recommended methods[11].

Physicochemical Analysis

Physicochemical parameters were determined according to the literature methods[11-12] recognized by the International Honey Order.

pH:

10 g each of the honey samples was diluted in 75 ml of distilled water and the pH was measured using a pH meter. The pH meter (Elico pH meter) was calibrated using standard buffers of pH 4 and pH 9 before measuring the pH of the samples.

Electrical conductivity:

It was determined using conductivity meter (Elico Conductivity meter) for the solution containing 5 g of each of the honey samples dissolved in 37.5 ml distilled water.

Colour Analysis: -

The colour is dependent on their climatic conditions, floral origin, soil characteristics, species of the bee, honey maturation, and the health of the colony. The colour of honey was determined when honey sample is diluted 50 % then heated to 50°C to dissolve the sugar crystals and the samples were rapidly cooled to room temperature and the absorbance was read at 635 nm against water as a blank using UV Spectrophotometer. The absorbance was converted and classified according to the Pfund scale[12]. The conversion of the absorbance values (A) was done using the following formula**.**

$$Pfund=-38.70+371.39 \times Abs$$

where Abs = absorbance of sample at 635 nm.

Moisture Content

Nine petri dishes were thoroughly washed and dried in the oven. 2.5g of each sample was put into each Petri dish. The weight of each Petri dish and sample was noted. The dishes and samples were put in the oven and heated at 100^0C for 1hr and their weights were measured and noted. The samples were heated for another 1 hr after which their weights were again measured and noted. The drying process was continued until constant weights were obtained. The percentage moisture content of each sample was calculated using the formula – % Moisture = $W_1 – W_2$ x 100 /Weight of sample, Where W_1 = weight of Petri dish and sample before drying, W_2 = weight of Petri-dish and sample after drying.

Ash

Content nine empty crucibles were washed, dried, weighed and their weights noted. 2.5g of each sample was weighed into a separate crucible after which each crucible and sample was placed in a muffle furnace at 5000C for 3 hrs. Each crucible and sample was cooled in desiccators and then weighed again. The percentage ash content was calculated using the formula. % ash = $W_3 – W_1$ x 100/ $W_2 – W_1$, Where W_1 = Weight of empty crucible W_2 = Weight of crucible and sample before burning W_3 = Weight of crucible and ash.

Density

Density bottle (50ml capacity) was washed thoroughly with detergent water and petroleum ether and then dried and weighed. The bottle was filled with water and weighed. The bottle was dried and then filled with the samples one after the other and their weights were recorded. Density of each sample was calculated using the formula – Density of Sample = Weight of sample /Volume of sample.

Acidity:

1 g of each of the honey samples were dissolved in 7.5 ml of distilled water. It was then titrated against standard sodium hydroxide (0.05 N) solution using 1-2 drops of phenolphthalein indicator till pink colour appears and persists at least for 10 sec. Acidity % = (0.23 x volume of sodium hydroxide required for titration)/mass in grams of the honey sample taken for the test (1 g)

Viscosity

Viscosity of honey can be influence by the presence of crystals and air bubbles present in honey. For this reason honey sample were heated to 55ºC for 1 hour electrically operate water bath. Clean the viscometer several times with distilled water and attack to the burette stand in exactly vertical position. Hold the beaker contains distilled water and filled the viscometer with distilled water and suck it into another bath. Just above mark A. Count the flow time between mark A & B. Repeat the recording of flow time for distilled water as well as for given percentage of honey samples[13].

Surface Tension

Surface tension is calculated by using stalagnometer in our laboratory. Clean stalagnometer several times with distlled water and attach it to the burette stand in exactly vertical position. Hold a beaker containing distilled water and dip the lower end of stalgnometer in it suck just above mark A. Count the number of drops falling between marks A & B. Repeat the recording of number of drops for distilled water as well as given percentage of honey samples. Density of liquids is record with use of density bottles[14].

Results and Discussion

The Physiochemical property like pH, colour, moisture contain, free acid, ash content, electrical conductivity, optical density, viscosity and surface tension results of the proximate analysis of honey samples obtained from different location in the Karanja Ghadge are presented in Table 1.

pH

The pH of honey samples ranged from 3.0 to 4.2. Among all the 9 samples, sample K_6 has more pH content whereas sample K_3 has less pH content present at table 1 and shown in figure 1. These results of honey sample are acidic nature. K_3 sample is more acidic and K_6 sample is less acidic in nature, mean value for pH is 3.63[15].

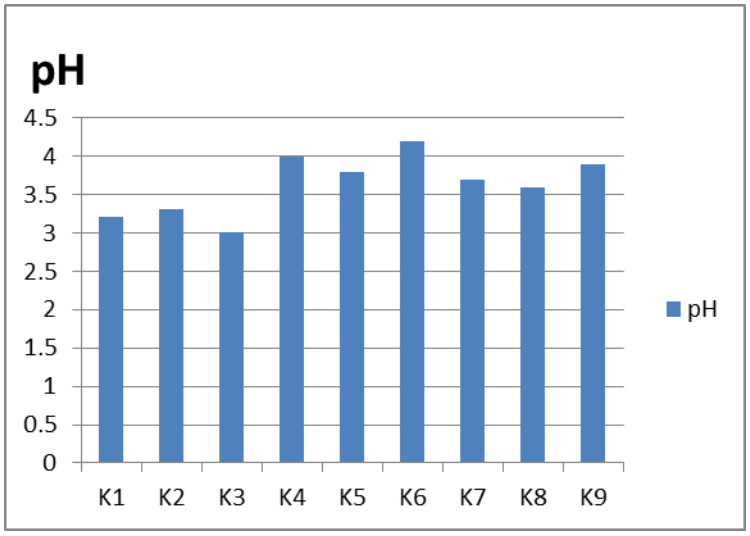

Fig.1 Graphical representation of pH values for different honey samples

Colour

The colour intensity of honey samples ranged from 0.24 to 1.13 mAU. Among all the 9 samples sample K_1 has more colour intensity, whereas sample K_6 has less colour intensity. The honey samples have amber, light amber dark amber colours. Colour is one of the honey attribute, used by consumers for quality appreciation and acceptability. The pfund value of all honey samples was found 38 mm to 122 mm. Dark amber colours sample K_1, K_2 and samples K_3 have maxim pfund value and light amber colours sample K_4, K_5 and samples K_6 have minimum pfund value[10] and mean pfund value is 73.66mm.

Moisture Content

Moisture content has a particular role to play in determining the solidity of honey, with elevated moisture content being a distinctive factor that typically falls within the range of 16-23% shown in table no.1 At a temperature of 24 °C and a moisture content of mean value 18.9%. The samples K_3 and K_8 have maximum moisture contain[16].

Free Acidity (FA)

The honey samples are analysed having free acid values ranged within 58-76 meq/kg with average value 67.55 meq/kg show in table no. 1 and figure 2. The free acid values normal range is obtained 17.6 meq/kg to 50.4 meq/kg are reported in literature. The acidity of honey is mainly due to the presence of organic acids, particularly the gluconic acid and inorganic ions such as phosphate and chloride[15].

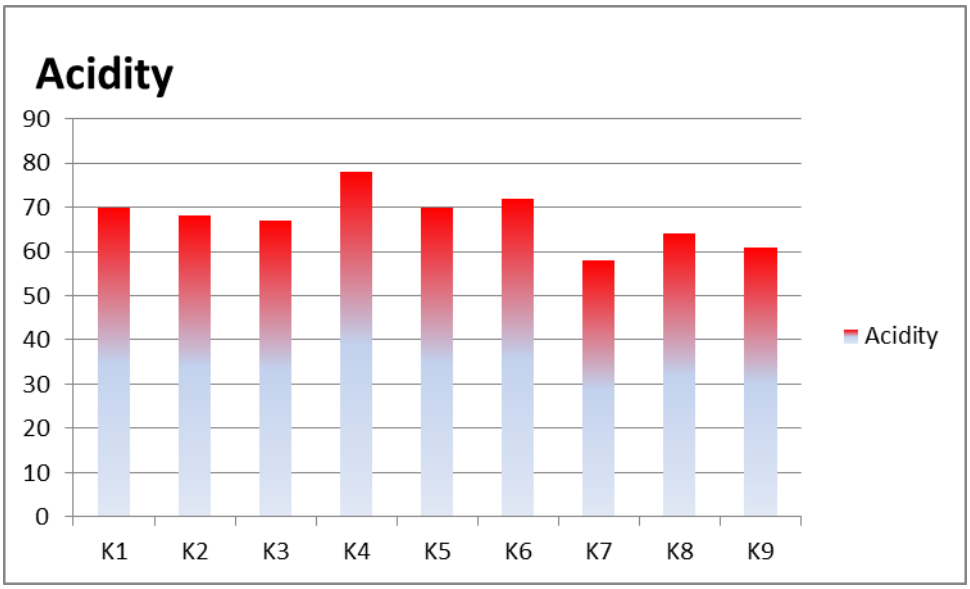

Fig.2 Graphical representation of acidity for different honey samples

Ash Contain

After incineration ash represents the mineral residue of the honey. The determination of the ash offers the possibility of knowing the overall mineral content of the honey. Its value in the analyzed samples varied from 70 to 85 mg/kg with an average value of 78.77 shows in table no. 1. The permissible limit of ash content of honeys 60 mg/kg and 120 mg/kg of honey sample[15].

Electrical Conductivity

The electrical conductivity is one of the important property of honey is closely related to their concentration of mineral salts, organic acids, and proteins[13]. The studied honeys show electrical conductivities varying within 1.04 – 2.20 ms/cm with an average value of 1.56 ms/cm shown in table 1.

Optical density

Density of honey is an important factor. It may increase or decrease with the variation in moisture content. Result of the analysis showed that all investigated samples had low density comparable to the standard density of 1.4g/ml. The optical density of honey was found in between 0.16 to 0.36 with average value 0.23 shown in table 1. The optical densities of all honey samples are laevorotatory due to high amount of fructose[15].

Viscosity

Viscosity (in the absence of any other additive) is affected by the nature of nectar and temperature. High viscosity of honey can impose difficulties during processing and storage. Result of the analysis showed that the viscosities of all the samples lie within the acceptable range. The viscosity of honey can range from 67.82×10^{-3} to 92.30×10^{-3} Ns/m^{-2} with mean value 77.18×10^{-3} Ns/m^{-2}

compare to viscosity ranges from 17.6 $\times 10^{-3}$ to 252 $\times 10^{-3}$ Ns/m^{-2} [17]. It depends on the type of honey and the temperature at which it's measured. Honey is more viscous than water because of the strong intermolecular forces between its particles. Viscosity is a fluid's property to resist deformation at a given rate. Viscosity is one of the most significant physical and sensory characteristics of honey, which affects the quality of the product as well as the area from which honey is collected.

Surface Tension:

The surface tension of honey is a crucial component in the processing of honey. Honey is viscous; its surface tension is lower than that of water, cohesive forces between honey molecules are weaker and the liquid is less resistant to being pulled over the edge of the penny. The experiment demonstrates that water with its higher surface tension, can hold more drops on a penny before spilling compared to hone[18]. Standard surface tension of honey sample is around 5×10^{-4} to 15×10^{-4} N/m , which is similar to water and glycerine[18]. In experiment surface tension of all honey sample was found 10.20×10^{-4} to 12.64×10^{-4} N/m with average value 11.37×10^{-4} N/m.

Conclusion

In this study, physicochemical properties of nine raw honey samples K_1 to K_9 are collected from different regions of Karanja Ghadge, District-Wardha, Maharashtra, India were determined. As a result of this study, it was found that Honey's pH, colour, moisture content, electrical conductivity, free acid, relative density, viscosity, ash contents, optical density and surface tension are multifaceted attributes that collectively define its uniqueness. The colour of honey offers visual cues to its flavour and potential health benefits. The pH level and acidity play a crucial role in preserving honey and enhancing its taste. The results of this study indicated that the physiochemical characteristics of fresh honey samples were within recommended limits of international standards than our samples. Evidence showed that the freshness and purity of fresh honey were due to dominant flora. This study indicates that physicochemical characteristic for all honey samples within permissible limit therefore honey samples K_1 to K_9 with good nutritional and medicinal properties.

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REFERENCES

1. Codex Alimentarius Commission, Draft revised standard for standard for honey (at step 10 of the Codex procedure). Alinorm 01 (25), 19–26, 2001.
2. Gomes S., Dias LG, Moreira LL, Rodrigues P and Estevinho L. Physicochemical, microbiological and antimicrobial properties of commercial honeys from Portugal. Food and Chemical Toxicology, 2010; 48:544-548.
3. FAO, "FAOSTAT database on agriculture and nutrition. Food and agricultural organization of the United Nations, Rome, Italy, 2010. Available: http://faostat.fao.org/site/569. [Accessed 12th Aug. 2012]," 2012.
4. Crane E. A comprehensive survey of honey. London UK: EBRA, 1976.
5. Adgaba N.. "Effect of storing honey in local containers," in Proceedings of 4th National Livestock improvement Conference, November 13-15, Addis Ababa, Ethiopia, 109-112, 1991.
6. Food Chain, "Quality of honey for export," A Journal about Small-Acale Food Processing, 1, 1-16, 1995
7. El Sohaimy, SA.,Masry SHD, Shehata MG.Physicochemical characteristics of honey from different origins. Ann. Agric. Sci. 2015; 60:279–287.
8. Gobessa S, Seifu E and Bezabih A. Physicochemical properties of honey produced in the Homesha district of Western Ethiopia.J. Apicultural Science.2012;56:33-40.
9. Gebremedhin G, Tadesse G and Kebede E, Physiochemical characteristics of honey obtained from traditional and modern hive production systems in Tigray region, Northern Ethiopia. Momona Ethiopian J. Science. 2013;5:115-128.
10. Shenkute AG, Getachew Y, Assefa D, Adgaba N, Ganga G and Abebe W. Honey production systems (Apis Mellifera L.) in Kaffa, Sheka and Bench-Maji zones of Ethiopia. J. Agric. Ext. and Rural Devt. 2012;4:528-541.
11. Ur-Rehman S, Farooq Khan Z, Maqbool T. Physical and spectroscopic characterization of Pakistani honey. Cienc. E Investig. Agrar. 2008;35:199–204.
12. Bogdanov S, Bee Product Science, International Honey Commision. 2009.
13. Junzheng P and Changying J. General rheological model for natural honeys in China . J. Food Eng. 1998; 36 : 165–168 .
14. Oroiann M, Paduret S, Amariei S, Gutt G. Chemical Composition and Temperature Influence on Honey Texture Properties. J. Food Sci. Technol. 2016;53:431–440.
15. Yaiche HA, and Khali M. Composition physicochim ique des miels algeriens. Determination des ´ elements traces et des ´ el´ements potentiellement toxiques, Afrique Science, 2014;10 (2):127–136.

16. Terrab A, Recamales AF,.Hernanz D and Heredia FJ. Characterisation of Spanish thyme honeys by their physicochemical characteristics and mineral contents. Food Chemistry. 2004; 88 (4): 537–542.
17. Bogdanov S. Water Content Comparism of Refractometric Methods with the Karl Fisher Method. Dyon International Honey Commission 2009.
18. Margonwar AS, Kalkar SA, Paulkar NM. Studies on the Physicochemical Characteristics of Winter Honey From the Region of Gadchiroli District, State of Maharashtra, India. Cureus J Eng 1.2024 : 44388-024-00180-188.

Table No. 1:- Physico-Chemical Properties of Honey Sample of True Honey

Bee (Hymenoptera: Apidae)

S.N	Sample Code	Colour Analysis	pH	pfund value mm	Moisture Content %	Free Acid Meq/kg	Ash Content Mg/kg	Electrical Conductivity ms/cm	Optical Density g/ml	Viscosity Ns/m^{-2}	Surface Tension N/m
1	K_1	Dark Amber	3.2	122	20	70	72	1.80	0.20	92.30×10^{-3}	12.34×10^{-4}
2	K_2	Dark Amber	3.3	118	18	68	78	1.82	0.22	88.27×10^{-3}	10.95×10^{-4}
3	K_3	Dark Amber	3	119	23	67	70	1.70	0.18	84.78×10^{-3}	10.20×10^{-4}
4	K_4	Light Amber	4.0	40	16	78	80	1.10	0.36	70.42×10^{-3}	11.56×10^{-4}
5	K_5	Light Amber	3.8	48	19	70	85	1.04	0.30	67.82×10^{-3}	11.84×30^{-4}
6	K_6	Light Amber	4.2	38	17	72	84	1.22	0.26	72.64×10^{-3}	10.68×10^{-4}
7	K_7	Light Amber	3.7	60	20	58	82	1.30	0.18	77.11×10^{-3}	10.41×10^{-4}
8	K_8	Light Amber	3.6	56	22	64	78	2.20	0.16	72.82×10^{-3}	12.64×10^{-4}
9	K_9	Light Amber	3.9	62	18	61	80	1.92	0.21	68.49×10^{-3}	11.72×10^{-4}

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Conflict of Interest Statement:
The authors have no conflicts of interest to declare.