IJBPAS, March, 2025, 14(3): 1404-1425

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

A REVIEW ON HONEY

UDAY A[1], SINGH P[1], PATEL M[1], VERMA Y[1], SAHU A[2*], DEWANGAN C[2], SAHU GK[3] AND SHARMA H[3]

1: Research Student, Rungta Institute of Pharmaceutical Sciences, Kohka- Kurud road Bhilai

2: Assistant Professor, Rungta Institute of Pharmaceutical Science and Research, Kohka- Kurud Road, Bhilai, C.G., India

3: Professor, Rungta Institute of Pharmaceutical Science and Research, Kohka- Kurud Road, Bhilai, C.G., India

***Corresponding Author: Ms. Anjali Sahu: E Mail: anjalisahu3009@gmail.com**

Received 14th Nov. 2023; Revised 15th Dec. 2023; Accepted 15th May 2024; Available online 1st March 2025

https://doi.org/10.31032/IJBPAS/2025/14.3.8773

ABSTRACT

Honey is sweetening agent which gets its sweetness from various sugars like monosaccharides, fructose and glucose. It has sweetness like as sugar or sucrose. Only 15 ml or 1 spoon of honey provides about 190 kilojoules or 146 kilocalories of food energy. Honey is collected by killer bees from two different sources, these are Nectar and honeydew. Nectar is a sweet liquid or Golden syrup that bees collect from various flowers to make honey Where Honeydew is a sweet, sticky substance, excreted, by aphids and deposit on leaves and stems of plants. Nectar is a cheapest source of honey global but In European countries such as Austria & Greece honeydew is usual only. Nectar contain high amount of fructose, glucose and sucrose.it is a concentrated sugar solution, which is secreted by flower nectary. Most nectar comprises mainly of fructose and glucose. Its sugar concentration in reality be influenced by on the different climate factors such as humidity, temperature and type of soil. According to a research a honeybee produce only one tablespoon honey in its complete life span. It is not a famous sweetener, it is similarly used as a medicine from our olden days. Due to its various importance it is used in higher amount world widely. In now days, the expand demand of honey in market leads to adulteration of honey and synthetic honey production. Another reason for adulteration of honey, its preparation is chief and

easy and the seller seek high profit from this kind of honey, where natural honey production and collection required to pay high cost and less profit in it sells.

Keywords: Honey, sweetening agent, Nectar, Honeydew, adulteration, kilocalories, food energy

INTRODUCTION

HONEY is sugary or saccharine, sticky liquid, which is shady golden in colour, produced in the honey bags of various bees from the nectar of the flowers that is deposited in the honey comb. The flavour and colour are acknowledged by the various flowers from which the nectar is collected. Some of the maximum commercially desired honey produced from clover by the domestic honeybees **[1]**.

Bees produce honey from the drippy secretions of plants (flowery nectar) or from concealment of other insects (similar as honeydew), by regurgitation, enzymatic exertion, and water evaporations. honey bees store honey on wax structures called honeycombs, where stingless bees store honey in pots made of wax and resin. The variety of honey produced by honey bees (the species Apis) is the informal known, due to its worldwide marketable product and human consumption **[2]**. Honey acquires its niceness from the monosaccharides, glucose & fructose and It has about the same relative niceness as sucrose. It has charming chemical parcels for baking and a characteristic flavor when used as a sweetener. Most of the microorganisms do not grow in honey, so sealed honey does not spoil, indeed after prolong of times **[3]**.

History:-

The honey used as a flavoring agent was first known property of it. It was also considered as flavored sweetening agent, which was already officially declared in National formulary. Not only now days it was used from ancient times as sweetening agent. In Egyptian medical texts it was mentioned that there were 900 + remedies of honey which were mentioned between 2200 and 2650 BC prior. Almost all early culture universally denominates used honey for its sweetening properties along with nutritional qualities, topical properties and also for skin ulcers. It was used as antiseptic agent on wounds by the ancient Egyptians, Greeks, Chinese Romans even Germans used honey as same in World War I. In the 1811 edition of "The Edinburgh New Dispensary " states in early time honey used as medicine it uses as an excellent gar gal and sometimes used as mitigatory application to abscesses along with used as a detergent to ulcer today these are commonly kept in Europe, America, Africa's and Asia. They produce at least 3 lakh tuns of honey annually **[3]**.

Other names:- Various synonyms of honey in different language:-

S. No.	Language	Alternative names
1.	Hindi	Sahad,madhu
2.	Bengali	Madh
3.	Gujrati	Madh
4.	Kannada	Jenu Tuppa
5.	Malayalam	Ten
6.	Marathi	Madh
7.	Sanskrit	Madhun
8.	Tamil	Ten
9.	Telugu	Tene
10.	Punjabi	Sahida

Biological source: Honey is sugar secretion dropped in honey comb the bees, Apis dorsata and other species of bees which are commonly found in India: Apis cerana, Apis flora, Apis indica and Italian species of Apis mallifera **[4, 5]**.

Geographical Distribution:- Honey is bring out in Africa , Australia , New Zealand , California and also in India. In India; Himalaya region, Bangal region, Madhya Pradesh, Chhattisgarh, Jharkhand **[5, 6]**.

Figure 1.1: Honey

Physical properties: The physical properties of honey vary because it depends on such factors like water content, temperature and concentration of the specific sugars & type of flora used to produce it etc. **[9, 10]**.

1. It is translucent or white to pale yellow liquid.
2. Honey has pleasant odour and taste is sweet.
3. It is soluble in water but not in alcohol.
4. Fresh honey is a super saturated liquid because it containing more sugar then the water in it.
5. It is hygroscopic in nature.
6. At room temperature honey is a super cooled liquid because the glucose get precipitate into solid granules.
7. The melting point of crystallized honey is between 40^{o}and 50^{o}c.
8. Honey has a glass transition between -42 ^{o} and -51^{o}c.
9. A honey contains 16% humidity, at 70^{o}c.
10. Honey has more viscous than water which is around 10,000cps (counts per second) **[8]**.
11. The refractive index for honey ranges from 1.504 at 13% humidity to 1.474 at 25%.
12. It contains acids which act as catalysts.
13. The average pH of honey is about 3.8 but it lies between 3.4 to 6.2.
14. If any product contains crystallized dextrose is called granulated honey.

Chemical Constituents of Honey:- Honey is a naturally concentrated aqueous solution of inverted carbohydrate and involve a highly compound mixture of other carbohydrates, a variety of impulse , carbonic acids, caustic acids, casting, vitamins , aromatic material, stain, waxes etc. The main sweetners present in honey are fructose and glucose. The saccharose content different in accordance with the state of maturity of the honey, and the composition of the Oligosaccharides fraction is determined by the plant used in the production process. Honey contains free amino acid in qualities of around 0.1% of the dry product. Proline is the major amino acid, but other amino acids like methionine, amino acids, glutamic acids, asparaginic acid, ribose, papilionoideae and L-leucine are already present. The main acid in honey is Gluconic acid and smaller quantity are also found of lactic, citric, succinic, formic, malic, acetic, maleic and oxalic acid. Various enzyme also present these Are invertase, diastase and inulase honey is compositions of various nutrients. These are:-

Nutrients	Percentage
Water	15-20%
Fructose	38-45%
Glucose	31-35%
Sucrose	1-2%
Other sugars	0.1-1.5%
Flavour compounds	>0.1%
Proteins	0.12-0.25%
Amino acids	0.1-0.5% (majorly Proline present)
Minerals	0.01-0.13% (Traces of succinic acid)
Enzymes	1-2%
Vitamins	2-3% (B1, B2, C)

After, honey is a stuffy solution of sweetener, on care it start form solidify The honey, which contain Solidify dextrose is called as dearie honey. Warm up of honey serves the purpose of reduce the crystallize **[11, 12, 14, 15]**.

Physico-chemical properties:- The properties of honey both physical & chemical are relating with each other that called physico-chemical properties **[13, 15]**. These are -

Parameter	Range	
Density (befor purify)	1.47g/ml	
Density (After purify)	1.30 to 1.38 g/ml	
Melting point for crystallize honey	45^0 - 50^0C	
Freezing point	-43^0 to - 52^0C	
Optical density	0.05-1.02	
Refractive index	1.504	
Caramelization Temperature	78^0C-115^0C	
Viscosity at 25^0C	15-50 Kg/ms	
Relative density at 20^0C	1.38 -1.44	
Surface tension	50-60	
pH	3.45 - 4.86 (floral honey)	
	2.90 - 3.90 (honeydew)	
Thermal conductivity	0.37-0.49 W/mk	
Electrical conductivity	9.41-17.29µS/cm	
Total soluble solids	82.2 -83.3	
Activation Energy	1250 to 1850 J/g mole	
Free acidity(from formic acid)	6.70-47.2 (floral honey)	
	30.25 – 65.25(honeydew)	
Crystal tendency	Less (before heat)	No (after heat)
	High tendency	Less tendency
Crystal size	0.32-0.55 cm(floral honey)	
	0.15-0.34 cm (honeydew)	

Types of honey:- As per Ayurveda, there are eight different types of honey **[16]**

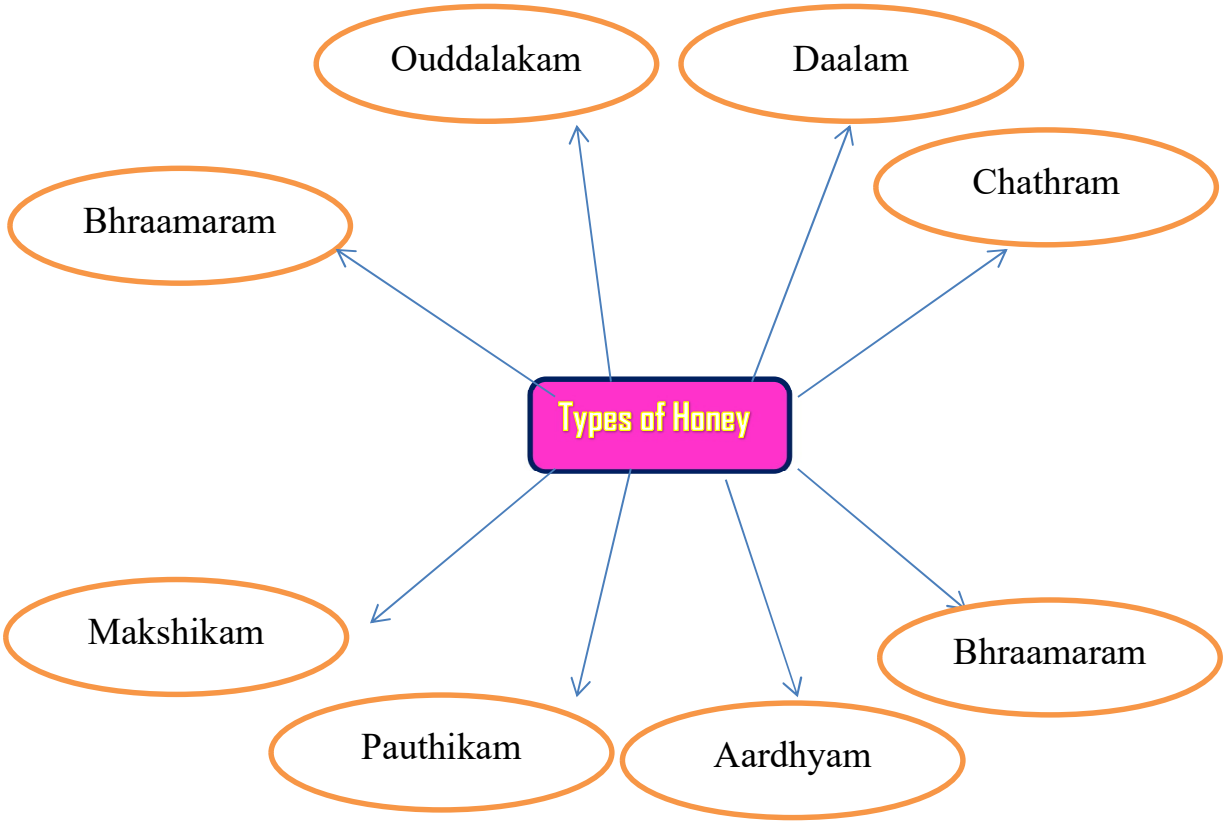


Figure 1.2: Types of Honey (According to Ayurveda)

1. Makshikam: It is used in the treatment of eye disease, hepatitis, piles, asthma, cough etc.
2. Bhraamaram: It is used in the treatment of vomiting with blood.
3. Bhraamaram: It is used in the treatment of diabetes.
4. Pauthikam: It is used in the treatment of diabetes and urinary infection.
5. Chathram: It is used in the treatment of worm infestation.
6. Aardhyam: It is effective for eye diseases, cough and anaemic condition.
7. Ouddalakam: It is used in the treatment of leprosy and poisoning conditions.
8. Daalam: It increases digestion and helps in the treatment of cough and vomiting.

» According to their processing and preparation they are classified as **[17, 18]**.

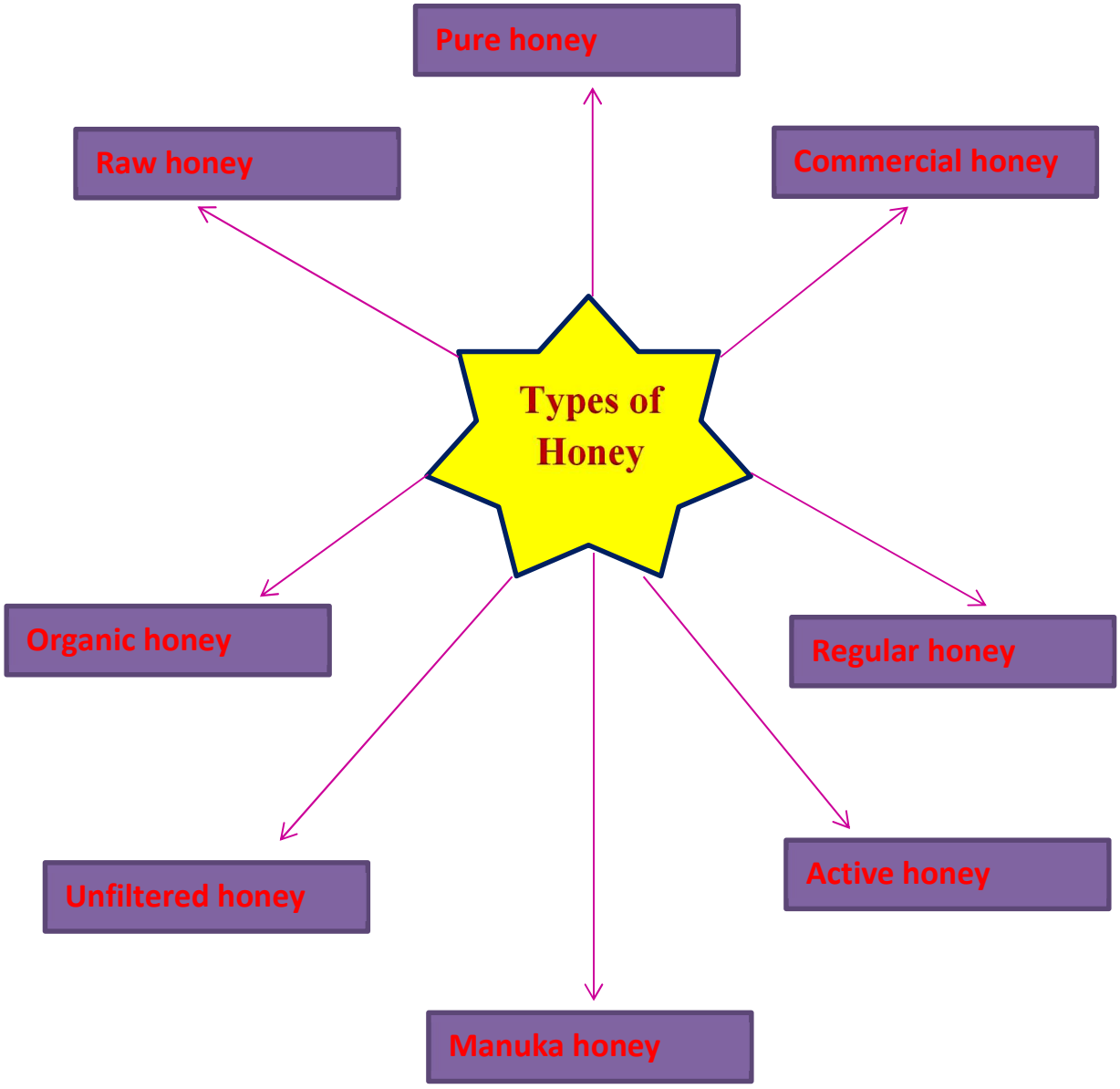


Figure 1.3: Types of Honey (According to their processing and preparation)

Raw Honey: Raw honey is the natural's form of honey that is also known as natural honey, which doesn't filtered processed and pasteurized (Heating treatment). It should be bought only from the local beekeepers, who don't process their honey} **[19]**. Which is obtained in very less amount as compare to its demand in market. That may leads to adulteration of honey. So that its direct source is honeycomb. To collect this type of only a step is done that is filtration of honey, this process is done by local beekeepers to

removing impurities. It makes honey to appear smoother & cleaner in texture. It looks opaque on cloudy but it is safe to consume. Raw honey is safe for healthy adults but it can be dangerous for infants. It maybe contain spores of the bacteria *Clostridium batulinum.* Which have tendency to produce gut of developing infants. That's means babies or children under 1 year old should also avoid it **[20]**.

Pure Honey: It is taken from honey comb and gently filtered to remove dirt, pollen and dead bugs etc. **[20]**

Commercial Honey: It is pasteurized to able easy handling of honey. After heating honey becomes more watery and easy to filter. It reduces the number of nutrients and antioxidants **[20]**.

Organic Honey: It is produced from pollen of organically grown plants and without chemical miticides (acaricide, use to control mites) to treat bees, **[21]**

Unfiltered Honey: These are minimally processed honey.

Manuka Honey: It is derived from the bees that feed on the manuka plant native, which generally used in New Zealand **[20, 21]**.

Active Honey: It is honey that has been tested and certified by an independent laboratory to possess antibacterial activity **[21]**.

Regular Honey: It is pasteurized honey this process inhance the honey's appearance and self-life, which is clear and smooth **[21]**.

Figure 1.4: Compariaon b/w Raw honey& Commercial honey

Preparation of Honey:-

Worker bees sucks the watery nectar of the flowers through its hollow tube of mouth (proboscis).

↓

Worker bees deposits nectar in honey sac ,which located in the abdomen

↓

The enzyme invertase present in saliva of the bee which converts nectar into invert sugar

↓

Which partially utilised by the bees(bees regurgitate the invert sugar) and the remaining is deposited into honeycomb

↓

The invert sugar is converted into honey with the temperature of honey comb

↓

Water is lost by evaporation from honey in the honey comb

↓

The filled honey comb is then sealed with a cap of wax by the bees

↓

It is then immersed in hot water to remove the wax cap and honey is separated by applying pressure & allowing it to drain naturally or by centrifuge(or by filtering)

↓

The honey heated to 80^{0}C before it is sent to the market to avoid fermentation.

Marketed brands of honey:- [22, 23]

In india	In world
1.Dabur Honey	1.MERLION - RAW HONEY
2.Saffola Honey	2.BEE CHARMER (ASHEVILLE)
3. Apis-Himalaya Honey	3.ORGANIC HONEY
4. Indigenous Honey	4. HAUT NOTCH BLOSSOM HONEY
5. Patanjali Honey	5. ALKHAIR NATURAL HONEY
6. Zandu Pure Honey	6. Young's Bee Hives
7. Baidyanath Honey	7. AL Shifa Natural Honey
8. Lion Kashmir Honey	8. LANGNESE PURE Bees Honey
9.SriSri Honey	9. ASNEVILLE BEE CHARMER RAW SOURWOOD HONEY
10. Hitkary Honey	10. BUSHWOOD BEES HONEY
11. Markfed Sohna Honey	11. Belmont Beelicious Local RAW UNPROCESSED HONEY
12. Bharat Honey	12. LIGHTHOUSE HEEPER'S RAW HONEY
13. Dadev Honey	13. Miel de Romero Honey
14. Himalayan Natives Honey	14. Miel de Tomillo Honey
15.Nature's Nectar Honey	15. Honey Day Eucalyptus HONEY

Figure 1.5: Indian brands of Honey

Chemical Parameters:- According to Chemical parameters honey should contain various minerals. These are Water, pH, Sulphated Ash, Reducing sugars (before & after inversion), Sucrose level, Potassium(K), Iron (Fe), Zinc (Zn), Magnesium (Mg), Calcium (Ca), Manganese (Mn), Phosphorus (P), Copper (Cu) etc. **[24]**.

Chemical Parameters	Mean of contents
Water%	21.08 %(±0.76)
pH value	4.86(±0.28)
Sulphated Ash%	1%
Reducing sugars %(before inversion)	67.90 % (±0.75)
Reducing sugars%(after inversion)	63.56 % (±0.78)
Sucrose level %	4.22 % (±0.72)
Acidity	3.17(±1,55)
Iron(Fe)	12.12(±3.34)ppm
Zinc(Zn)	0 ppm
Magnesium(Mg)	2.80(±0.65)ppm
Calcium(Ca)	0.32(±0.25)ppm
Phosphorus(P)	1(±090)ppm
Copper(Cu)	0.33(±0.23)ppm
Potassium(K)	23.03(±6.69)ppm

Standards Qualities:-There are various standards quality of honey ,which should be follow by any kind of honey brands respectively **[25]**. These are :-

Standards Qualities	Range
Solubility in water	Soluble in water
Solubility in Alcohol	Insoluble in alcohol
Colour	Pale yellow to yellowish brown liquid
Odour	Characteristics/Pleasant
Taste	Sweet and faintly acidic
Weight per ml	1.30 to 1.35
Density	1.30 to 1.35 g/ml

Adulterant & Adulteration:- Generally corn syrup, flour, molasses, glucose, starch, dextrose and other similar products are used as adulterant for honey. In general "Adulteration" means addition of any other foreign substance in pure crude drug. As like "Honey adulteration" refers to adding of some foreign substances into pure honey. Now it become a common problem in the market due to difficulty in identifying the adulterant honey. Adulterants or Substitutes of honey are:-

- Sucrose
- Glucose
- Fructose
- Dextrose
- Sugar syrup
- Corn Syrup
- Flour
- Paraffin
- Starch
- Jaggery syrup etc. **[26, 27]**

But this lead to changes in the texture of Pure honey like:-

» honey samples with no flavour

» no pleasant odour

» only sweet in taste

» extremely light / dark in colour

» highly viscous / viscousless.

In the early 1970s, adulterant honey can be easily detected until the development of high fructose corn syrups. High Fructose Corn Syrups (HFCS) is a product which has similar characteristics to pure honey. It is easily, routinely & low costly available in market but in now days various techniques are developed to identify the pure honey . The standards of honey is vary in different countries **[28]**.

Method for detection of adulteration:- Gas Chromatography (GC), Liquid Chromatography (LC) analysis, Near Infrared Transflectance Spectroscopy (NIR` etc . These are suitable for use as a screening technique in the quality control of honey} **[29]**

(a) Honey with Sugar Solution (Sugar + Water): Pure honey is always in a semi solid state. To detect the adulterant, If adulterated honey is poured in water it will dissolve immediately. If honey is original, it will not dissolve very soon.

(b) Honey with Cane Sugar: Microscopic analysis of honey sample, Cane sugar shows parenchyma cells, single ring vessels and epidermal cells, whereas all these characters are absent in original honey.

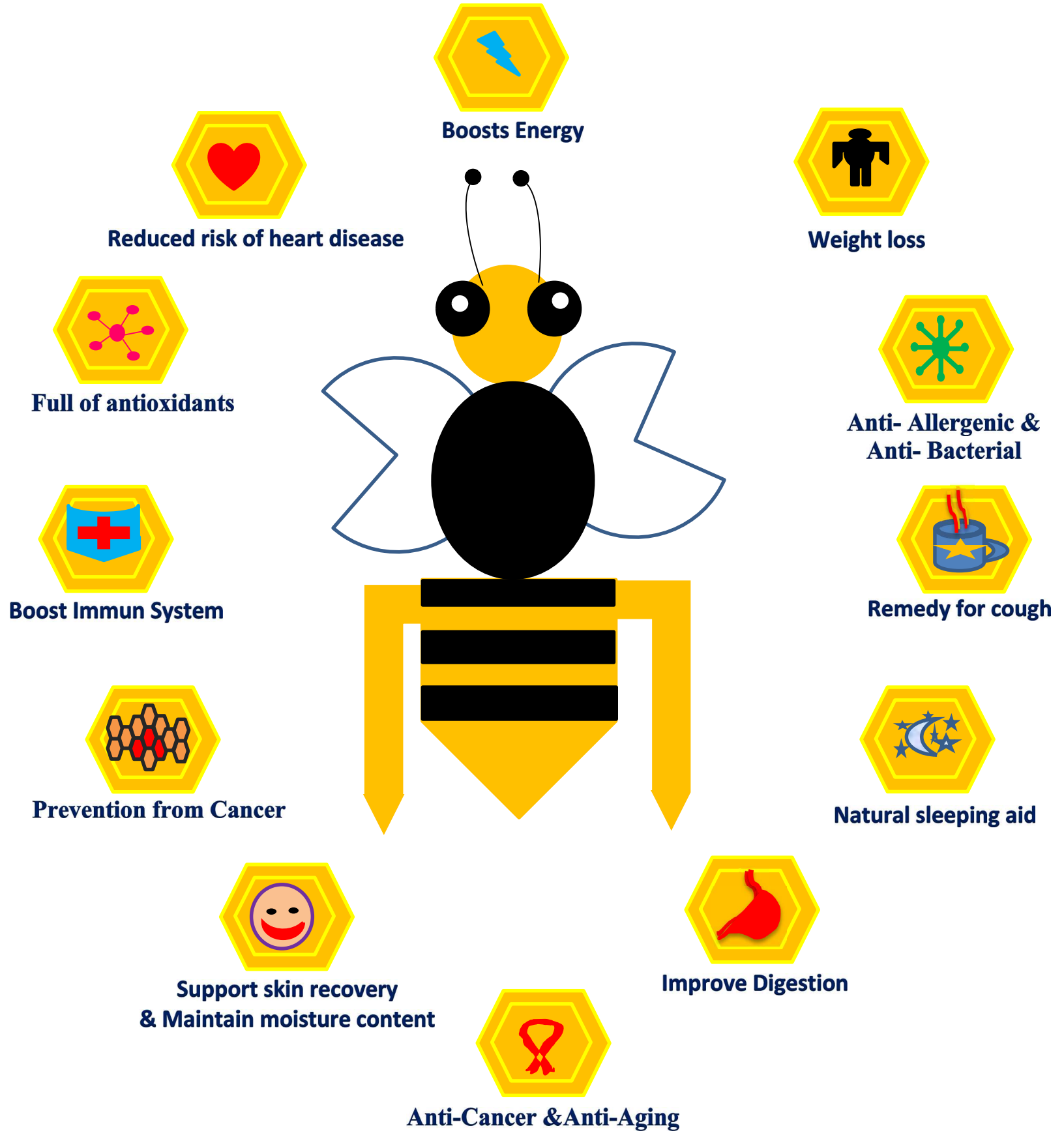
(c) Honey with Invert Sugar: It can be checked with the help of Fiehe's test. Sample of honey is mixed with ether and then evaporated in room temperature. Then dilute HCl and resorcinol are added to the sample solution of honey. Acid layer will not form any red or pink color.

(d) Honey with Glucose: This can be identified by iodine test. Sample honey is mixed with same quantity of water and then potassium iodide is added, then solution becomes red or violet. This notify the presence of glucose. This test is negative for original honey.

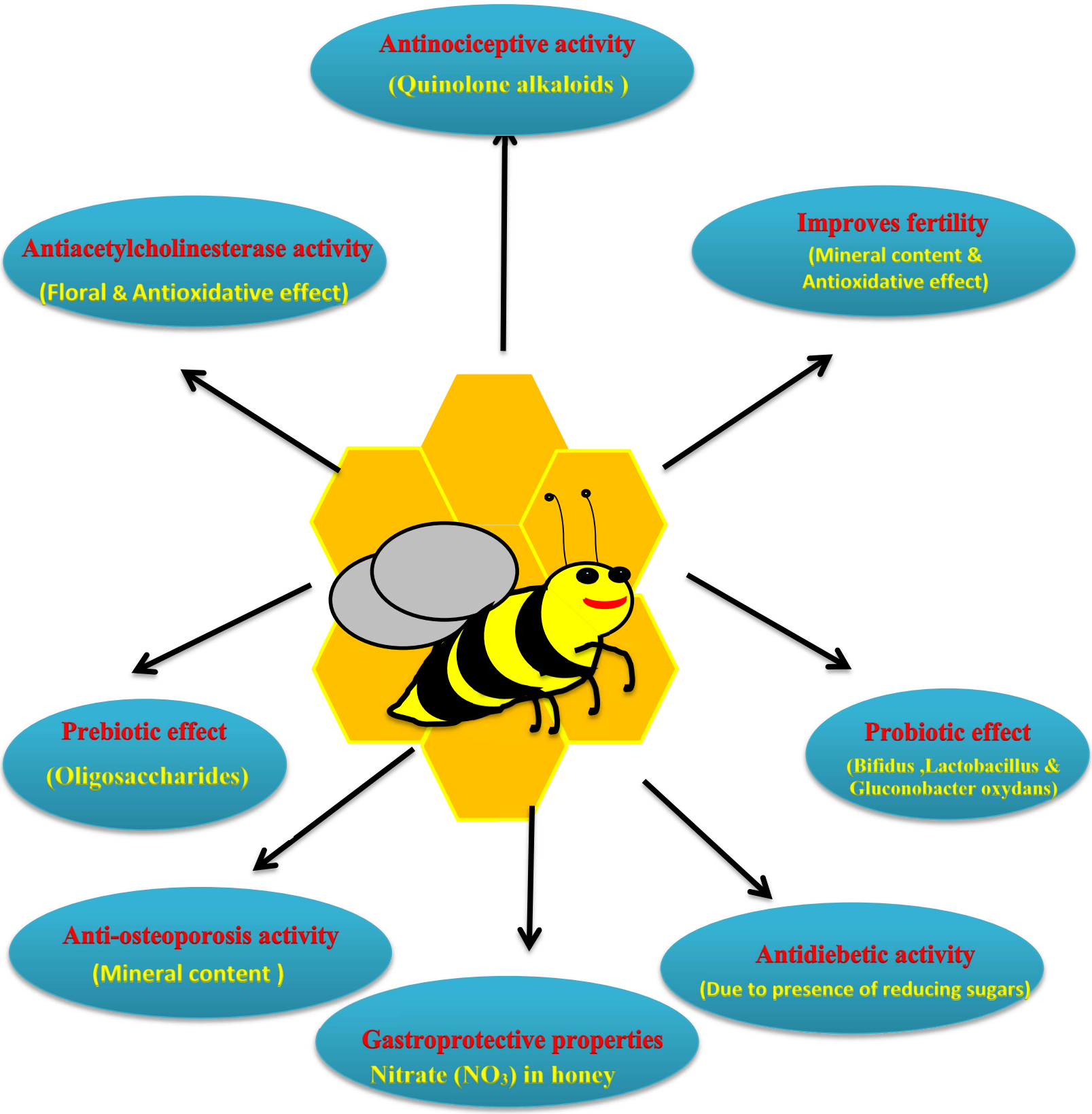
(e) Honey with Commercial Sugar: This can be identified by Aniline chloride test. Sample of honey + mixture of hydrochloric acid and Aniline (which ratio is 3 : 1) → crimson red colour or the orange colour forms due to formation of aniline chloride by commercial sugar. This test is negative for pure/original honey.

(f) Honey with Starch or Flour: Starch or flour is added to honey for a simple reason, to increase the weight and whiteness of it. Once can add cold water to sample honey and thus be sure whether it is free from starch & flour or not. If they are present in honey then honey falls down to the bottom of the test tube. When they are exposed to heat, they probably remain in the liquid form but upon cooling down they turn hard.

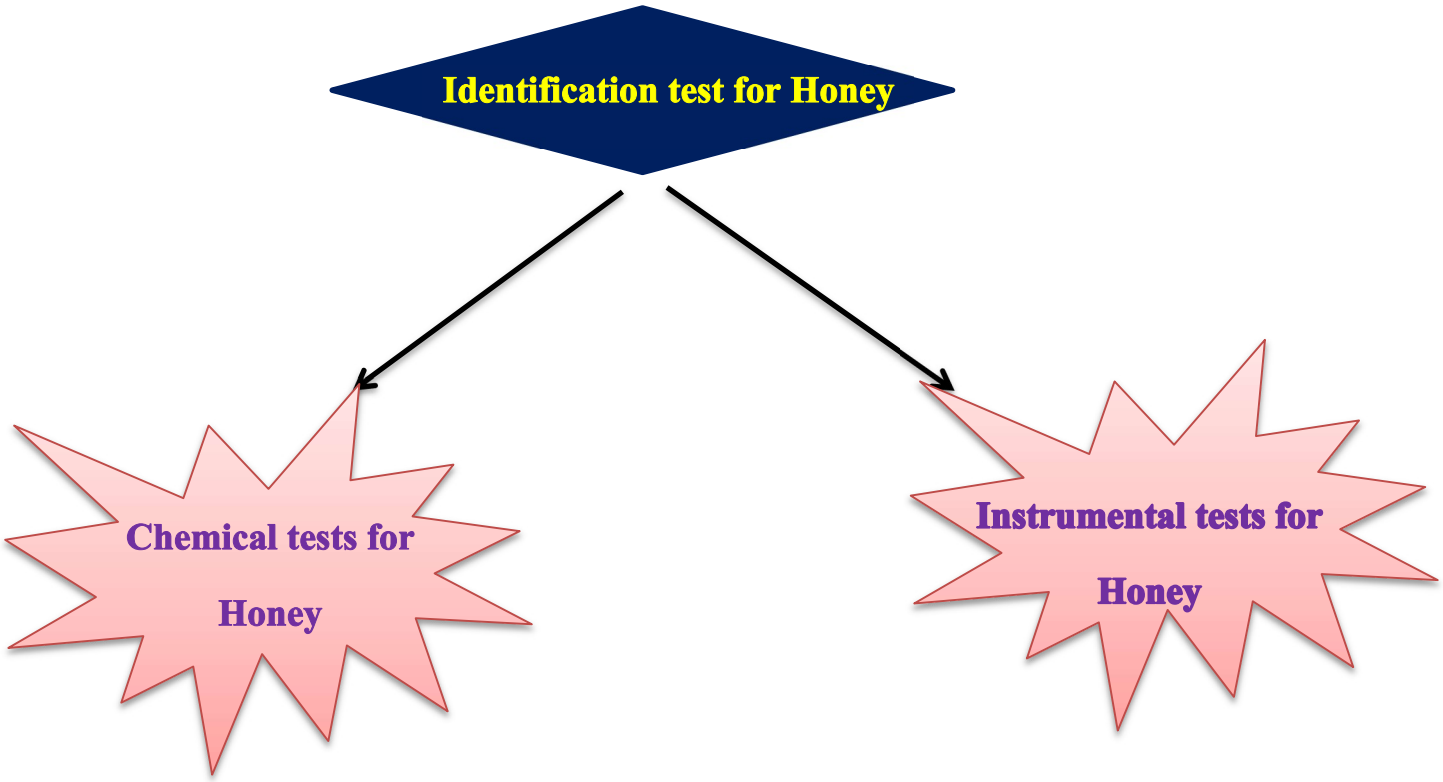
Uses:-


Boosts Energy
Reduced risk of heart disease
Weight loss
Full of antioxidants
Anti- Allergenic &
Anti- Bacterial
Boost Immun System
Remedy for cough
Prevention from Cancer
Natural sleeping aid
Support skin recovery
& Maintain moisture content
Improve Digestion
Anti-Cancer &Anti-Aging

Other functional properties of Honey [30]:-



Identification test for Honey [31] There are two major ways to identify honey, these are classified as :-



Instrumental tests for Honey [32]

1) pH Meter(*PHL-40)* : The pH of honey can be determined by using pH meter .

2) Colorimeter (*NR-IIA)*: Colour analysis can be performed by this meter.

Other method for Honey testing [33]

1) **p-aminoacetophenone method –** Total vitamin B_1 content can be investigated by this method.
2) **Lumiflavin fluorescence method –** Total vitamin B_2 content determine by this method.
3) **Somogyi – Nelson method –** Reducing sugar content in honey can be determine by this method.
4) **Lowry et al method –** This method use to determine total protein content of honey.

Chemical tests for Honey [33, 34]: Adulteration in honey can be determined by the various following tests:-

S. No.	Name of chemical tests	Procedure	Observation	Result
1.	Fiehe's test for artificial invert sugar	10 ml honey +shaken with petroleum /ether(5ml) for 5min+separated and evaporated ethereal layer in china dish+ add 1% solution of resorcinol in HCL(1ml)	Transient red colour is formed	Artificial invert sugar is absent
2.	Test for Magnesium	Honey+ NH_4OH (till solution becomes alkaline) +$(NH_4)_3 Po_4$	White precipitate is not observed	Magnesium is absent
3.	Test for Iron	Honey+conc.HNO_3+heat & cool+ potassium sulpocyanide	Blood red colour is observed	Iron is present
4.	Tollen's test	Honey+2-3 ml Tollen's reagent+ test tube in water bath for 10 minutes	Shining silver mirror is observed	Reducing carbohydrate is present
5.	Fehling's test	Honey (2ml) + 1-1ml both Fehling's A&B solution	Red precipitate is observed	Reducing sugar is present
6.	Molisch's test	Honey + 1 ml Molisch's reagent+ con. H_2So_4	Purple precipitate is observed	Reducing carbohydrate is present
7.	Reflectoquant R HMF test	Honey +distilled water (1:4)+ hydroxymethyl furfural (HMF) = put it in Reflectometer	Red/Pink colour precipitate is observed	The amount of HMF in honey is determined

Toxicology:- Generally, honey is considered safe as a sweet food product, a clang and cough- soothing agent, and a topical product for minor blisters and injuries. still, medical reports indicate that honey can be dangerous when fed to babies because some batches contain spores of Clostridium botu- linum, which can multiply in the bowel and affect in botulism poisoning. child botulism is seen most generally in 2- to 3- month-old babies after ingestion of botulinal spores that populate in the GIT as well as poison produc- tion in vivo. child botulism isn't produced by ingestion of preformed poison, as is the case in food borne botulism. Clinical symptoms include constipation harrowed by neuro- muscular palsy (starting with the cranial jitters and also pacing to the supplemental and respiratory musculature). Cases are constantly related to ingestion of honey, house dust and soil defiled with Clostridium botulinum. violent operation under sanitarium exigency conditions and trivalent antitoxin are recommended, although use of the ultimate in child botulism has not been adequately delved **[27, 35]**.

Comparison between Nectar & Honeydews Honey:- Nectar is a most common source of honey worldwide but honeydew is only common in European countries such as Austria & Greece. Nectar contain high amount of fructose, glucose and sucrose.it is a concentrated sugar solution, which is secreted by flower nectary. Most nectar consists

mainly of fructose and glucose. Its sugar concentration actually depends on the different climate factors such as humidity, temperature and type of soil. There are various parameters to comparison difference between both kind honeys. These are:

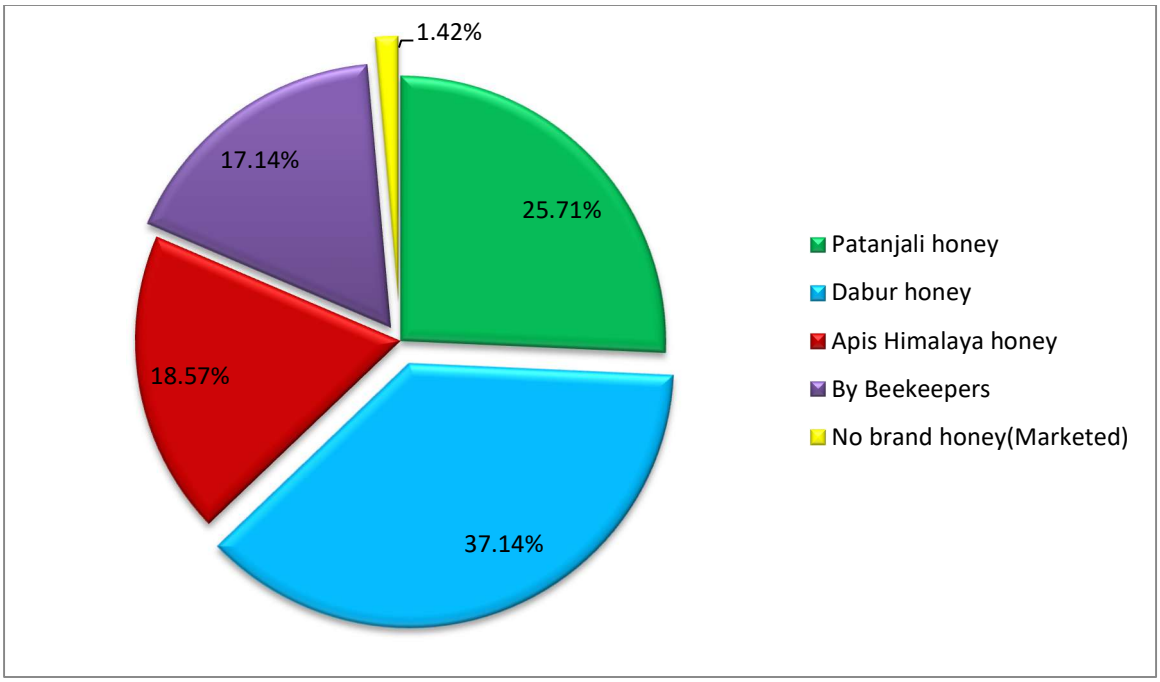
S. No.	Nectar Honey	Honeydew Honey
1.	Water content in this honey is 17.2% .	Water content in this honey is 16.3%.
2.	In nectar honey 38.2% fructose, 31.3% glucose ,0.7%sucrose and 5% other disaccharides present	In honeydew honey 31.8% fructose, 26.1% glucose, 0.5%sucrose and 4% other disaccharides present
3.	In it <0.1%melezitose ,0.8% erlose and 3.6% other oligosaccharides present	In it 4 % melezitose, 1% erlose and 13.1% other oligosaccharides present
4.	In it total 79.75% sugar present	In it total 80.5% sugar present
5.	In this honey 0.2% minerals,0.3% amino acids and protein present	In this honey 0.9% minerals,0.6% amino acids and protein present
6.	In it 0.5% acids present	Where it contains 1.1% acids
7.	This honey pH is 3.9 t0 4.2	This honey pH stand between 5.2 t0 5.6.

Storage of Honey:- It should be stored in well filled, well closed containers in cool place and away from the sun light. There are various reasons for these -

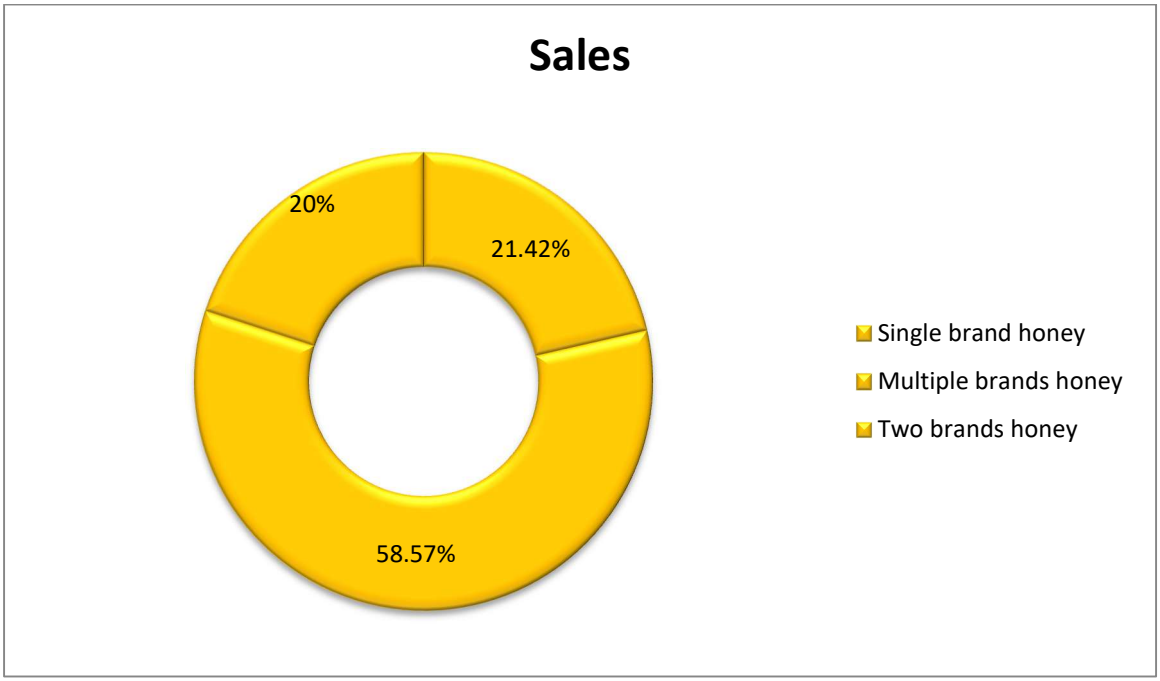
1) Store Honey in an airtight container: It is best way to protect honey from outside contamination for that we can use glass jar or airtight containers. We can also use plastic containers, Mason jars as long as they have tight seal that will maintain the moisture content of the honey inside the container.

2) Store Honey at room temperature: To maintain honey's rich flavour and prevent it from spoiling, store it in a dark place like where it will not have to contact directly sunlight **[35]**.

Survey Graphs:- According to our survey honey brand uses graph. On basis of 70 persons response.



According to our survey brands of honey used by a person.



CONCLUSION

Honey is a saturated solution of glucose, fructose and sucrose. The quantity of sugar may very susceptible upon the source of nectar and the synthesized activity, which is answerable for converting nectar into the honey. The other component of honey are maltose traces of succinic acid, acitic acid,

dextrose, formic acid, colouring matters enzyme like invertase, diastase and inulase and traces of vitamins. Protein and Pollen grains from various flowers are also found in honey. The higher requirement of honey lead to adulteration in market. In India 2016 the sold amount of Honey was 18.23 lNR billion in year 2021. except it will reach 38.3 billion in year 2027. The wordwide honey 2016 value was 6.20 million tons and it values increase in 2021 to about 8.10 million tons. Adulteration cause due to production of natural honey is insufficient according to its requirement in although, there are various identification tests are available by using which we can identify pure honey and their adulterants.

REFERENCE

[1] Mortensen T, Emmons R, Figueroa M, Seely C. The Effect of Sucrose vs Non-Nutritive Sweeteners on Blood Glucose Levels During Exercise. InInternational Journal of Exercise Science: Conference Proceedings 2019 (Vol. 9, No. 7, p. 77).

[2] Latimer, Joyce G., and David Close. "Pest Management Guide: Home Grounds and Animals, 2019." (2019).

[3] Cianciosi, Danila, Tamara Yuliett Forbes-Hernández, Sadia Afrin, Massimiliano Gasparrini, Patricia Reboredo-Rodriguez, Piera Pia Manna, Jiaojiao Zhang et al. "Phenolic compounds in honey and their associated health benefits: A review." Molecules 23, no. 9 (2018): 2322.

[4] Pasupuleti, Visweswara Rao, Lakhsmi Sammugam, Nagesvari Ramesh, and Siew Hua Gan. "Honey, propolis, and royal jelly: a comprehensive review of their biological actions and health benefits." Oxidative medicine and cellular longevity 2017 (2017).

[5] M Alvarez-Suarez, Jose, Francesca Giampieri, and Maurizio Battino. "Honey as a source of dietary antioxidants: structures, bioavailability and evidence of protective effects against human chronic diseases." Current medicinal chemistry 20, no. 5 (2013): 621-638.

[6] Alzahrani, Hasan A., Rashid Alsabehi, Laïd Boukraâ, Fatiha Abde-llah, Yuva Bellik, and Balkees A. Bakhotmah. "Antibacterial and antioxidant potency of floral honeys from different botanical and geographical origins." Molecules 17, no. 9 (2012): 10540-10549.

[7] Harugade, Shailaja, and Sushama Chaphalkar. "Floristic studies with reference to Honey bees of Baramati, Pune District." International Journal of

Advancements in Research & Technology 2, no. 8 (2013): 178-187.

[8] Osborn, Herbert, Leland Ossian Howard, Frank Benton, and Charles Lester Marlatt. The honey bee: a manual of instruction in apiculture. Vol. 1. US Department of Agriculture, Division of Entomology, 1895.

[9] Meixner, Marina Doris. "A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them." Journal of invertebrate pathology 103 (2010): S80-S95.

[10] McGregor, S. E., L. N. Standifer, and M. D. Levin. "Early bee researchers in the US Department of Agriculture." Bee World 67, no. 3 (1986): 124-128.

[11] Kaur, Manjeet, Geeta Mohan, Sanjiv Kumar, O. P. Sharma, and Sahil Pruthi. "Uses of Bee Honey: Traditional and Modern." Biotica Research Today 2, no. 9 (2020): 946-949.

[12] Durazzo, Alessandra, Massimo Lucarini, Manuela Plutino, Giuseppe Pignatti, Ioannis K. Karabagias, Erika Martinelli, Eliana B. Souto, Antonello Santini, and Luigi Lucini. "Antioxidant properties of bee products derived from medicinal plants as beekeeping sources." Agriculture 11, no. 11 (2021): 1136.

[13] Kek, Siok Peng, Nyuk Ling Chin, Yus Aniza Yusof, Sheau Wei Tan, and Lee Suan Chua. "Classification of entomological origin of honey based on its physicochemical and antioxidant properties." International journal of food properties 20, no. sup3 (2017): S2723-S2738

[14] White, J. W., and Landis W. Doner. "Honey composition and properties." Beekeeping in the United States Agriculture Handbook 335 (1980): 82-91.

[15] Pavlova, Tatjana, Viktorija Stamatovska, Tatjana Kalevska, Ivan Dimov, G. Assistant, and G. Nakov. "Quality characteristics of honey: a review." Proc. Of University Of Ruse 57 (2018).

[16] Aparna, A. R., and D. Rajalakshmi. "Honey—its characteristics, sensory aspects, and applications." Food Reviews International 15, no. 4 (1999): 455-471.

[17] Rybak-Chmielewska, Helena, and P. Tomasik. "Honey." Tomasik, P. Chemical and functional properties

of food saccharides. Boca Raton: CRC (2003): 73-80.

[18] Mutlu, Ceren, Andaç Koç, and Mustafa Erbaş. "Some physical properties and adsorption isotherms of vacuum-dried honey powder with different carrier materials." LWT 134 (2020): 110166.

[19] Tan, Seng To, Patrick T. Holland, Alistair L. Wilkins, and Peter C. Molan. "Extractives from New Zealand honeys. 1. White clover, manuka and kanuka unifloral honeys." Journal of Agricultural and Food Chemistry 36, no. 3 (1988): 453-460.

[20] Chuttong, Bajaree, Yaowaluk Chanbang, Korawan Sringarm, and Michael Burgett. "Physicochemical profiles of stingless bee (Apidae: Meliponini) honey from South east Asia (Thailand)." Food Chemistry 192 (2016): 149-155.

[21] Ahmed, Jasim, S. T. Prabhu, G. S. V. Raghavan, and M. Ngadi. "Physico-chemical, rheological, calorimetric and dielectric behavior of selected Indian honey." Journal of Food Engineering 79, no. 4 (2007): 1207-1213.

[22] Matsuda, Ryuichi. Morphology and evolution of the insect abdomen: with special reference to developmental patterns and their bearings upon systematics. Elsevier, 2017.

[23] :Snodgrass, Robert Evans. "The skeleto-muscular mechanisms of the honey bee." Smithsonian miscellaneous collections (1942).

[24] Seeley, Thomas D. The wisdom of the hive: the social physiology of honey bee colonies. Harvard University Press, 2009.

[25] Carreck, Norman L., Michael Andree, Colin S. Brent, Diana Cox-Foster, Harry A. Dade, James D. Ellis, Fani Hatjina, and Dennis Van Englesdorp. "Standard methods for Apis mellifera anatomy and dissection." Journal of Apicultural Research 52, no. 4 (2013): 1-40.

[26] Hull, Peter. Glucose syrups: technology and applications. John Wiley & Sons, 2010.

[27] Khorshidian, Nasim, Mahdi Shadnoush, Maryam Zabihzadeh Khajavi, Sara Sohrabvandi, Mojtaba Yousefi, and Amir M. Mortazavian. "Fructose and high fructose corn syrup: are they a two-edged sword?."

International Journal of Food Sciences and Nutrition 72, no. 5 (2021): 592-614.

[28] : Bode, John W., Mark W. Empie, and Kyd D. Brenner. "Evolution of high fructose corn syrup within the sweeteners industry." In Fructose, high fructose corn syrup, sucrose and health, pp. 137-148. Humana Press, New York, NY, 2014.

[29] Patil, Shankargouda, B. R. Premalatha, Roopa S. Rao, and B. S. Ganavi. "Revelation in the field of tissue preservation–A preliminary study on natural formalin substitutes." Journal of international oral health: JIOH 5, no. 1 (2013): 31.

[30] : Wu, Liming, Bing Du, Yvan Vander Heyden, Lanzhen Chen, Liuwei Zhao, Miao Wang, and Xiaofeng Xue. "Recent advancements in detecting sugar-based adulterants in honey–A challenge." TrAC Trends in Analytical Chemistry 86 (2017): 25-38.

[31] O'Riley, Paloma. "Individual Preparation for Y2K." Utne Reader (1999): 135-1.

[32] da Costa, Ana Caroliny Vieira, Janaína Maria Batista Sousa, Maria Aparecida Azevedo Pereira da Silva, Deborah dos Santos Garruti, and Marta Suely Madruga. "Sensory and volatile profiles of monofloral honeys produced by native stingless bees of the brazilian semiarid region." Food Research International 105 (2018): 110-120.

[33] A. R., and D. Rajalakshmi. "Honey—its characteristics, sensory aspects, and applications." Food Reviews International 15, no. 4 (1999): 455-471.

[34] Bhesh R., Nivedita Datta, Bruce R. D'Arcy, and Gavin B. Rintoul. "Co-crystallization of honey with sucrose." LWT-Food Science and Technology 31, no. 2 (1998): 138-142.

[35] Alissandrakis, Eleftherios, Athanasios C. Kibaris, Petros A. Tarantilis, Paschalis C. Harizanis, and Moshos Polissiou. "Flavour compounds of Greek cotton honey." Journal of the Science of Food and Agriculture 85, no. 9 (2005): 1444-1452