

Compendium on Scientific Beekeeping

Funded by National Beekeeping and Honey Mission

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अमृत महोत्सव



ICAR - Krishi Vigyan Kendra, North Goa

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Introduction:

Beekeeping is an ideal activity which provides supplementary income to a large number of rural, hilly and tribal population and also for horticulturists, agriculturist, hobbyist, etc., because of the rich flora available in abundance in the country. Any beginner, who wants to start beekeeping should know some of the aspects of beehive, tools, locations where honeybee can be kept with an attempt to know honey bee and its handling. A beekeeper needs little investment to start with. One should know and learn more about honey bee and its requirement in order to make honey bee work for beekeeper.

Honey is the most important primary product of beekeeping both from quantitative and economic point of view. "Honey is the natural sweet substance produced by honey bees from the nectar of blossom or from the secretion of living parts of plants or excretions of plant sucking insects on the living parts of plants, which honey bees collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature". It increases physical and intellectual fatigue, favour the assimilation and digestion of food palliate to a nutritional insufficiency in amino acids, mineral, trace elements, vitamins etc. A 100gms of honey give approximately 300 calories to the body and honey consumption for an adult should be 30 to 40 grams per day and for babies and children 5 to 15 grams per day.





Types of honey:

There are two types of honey; apiary honey and forest honey.

Processed honey

Apiary honey:

Honey produced by the Indian hive bee, *Apis cerana indica* and the European bee *Apis mellifera* in apiaries and collected by the modern extraction method is called apiary honey. Apiary honeys are transparent and are free from foreign materials.

Forest honey:

Honeys produced by the rock-bee *Apis dorsata* and *Apis florea* in forests and collected by the crude method; squeezing the comb, are termed as forest honeys. Forest honey is turbid due to the presence of pollen, wax, brood and other particles due to squeezing.

Training is imparted through CBRTI and SBEC's to collect the forest honey hygienically and without destroying the bees and combs. *Trigona* bees are very common in many parts of the country, which gives about 500 to 600 grams of honey per colony. Honey collected from *Trigona* bees is having high medicinal value.

Granulation of Honey:

There is a misconception among the common consumers that granulated honey is an adulterated honey, having common sugar. This is not correct. In fact, granulation is a natural process of crystallization of the glucose content in honey. Honey is a super saturated solution of glucose, fructose, sucrose and other sugars. Among these sugars, glucose is the most liable to granulate or crystallize under conditions of low temperature and high moisture content. Granulated honey can be re-liquefied by keeping the container in hot water.



COMPONENTS OF HONEY:

Sweetness of honey depends upon sugars which are its major components (70 to 80 %). The simple sugars fructose and glucose are abundant and fructose is responsible for most of the physical and nutritional characteristics of honey. Small quantities of other disaccharide sugars such as sucrose, maltose, isomaltose and a few polysaccharides and oligosaccharides are also present. Sugars are sources of metabolic energy that is essential for life processes. Sugars are easily digestible and give instant energy. They are directly absorbed into the blood stream that on circulation provides rapid source of energy.

Water:

It is the second most important component of the honey. Its content is critical, since it affects the storage of honey. Honey with less than 18% water content can be stored with little to no risk of fermentation.

Organic acids:

Among the minor constituents organic acids are the most important and of these gluconic acid, which is a byproduct of enzymatic digestion of glucose, predominates. The organic acids are responsible for the acidity in terms of pH value of honey and contribute largely to its characteristic taste.

Vitamins:

Honey contains several vitamins of little significance to man, but they supplement human diet with other content of honey. These include ascorbic acid, niacin, pantothenic acid, riboflavin and thiamine, Vitamin B and a group of various vitamins. They improve metabolism and appetite. It also stabilizes the nerves system of the human body.



Enzymes:

Honey enzymes originate from the glandular secretion of worker honey bees. These are added to nectar during its conversion into honey. Of these, invertase and diastase is the best known. It splits C_{12} sucrose into 2 C_6 glucose and fructose. Diastase is a strong digesting enzyme. Glucose oxidase enzyme produces gluconic acid, hydrogen peroxide and catalase which utilize hydrogen peroxide. All these biologically active honey enzymes improve the digestive system.

Minerals:

Minerals are present in very small quantities. Generally minerals are referred to as "Ash". About 11 minerals and 17 trace elements in trace are identified in normal honeys. Contents of minerals vary greatly from darker to lighter honey. Generally darker honey contains more minerals than lighter ones.

Colour of honey:

The color of liquid honey ranges from white to dark, depending upon the plant source. The nectar collected with high minerals has the impact on colour. Jamun and karvi honeys are amber to dark amber, litchi and mustard are light yellow in color, sunflower, berseem are golden yellow in color, cotton, plectranthus are white in colour; rubber, tamarindus are light yellow in color.

Characters & Composition:

Honey is viscous and hygroscopic. The color varies with botanical origin, age and storage conditions and ranges from white, pale to dark amber or black. In temperate climates most honeys crystallize at normal storage temperatures. This is due to the fact that honey is an over saturated sugar solution.

The components of the honeys are same. Sugars account for 75 to 85% of honey dry matter. The simple sugars fructose and glucose are abundant and fructose is responsible for most of the physical and nutritional characteristics of honey. Small quantities of other disaccharide sugars such as sucrose, maltose, isomaltose) and a



few tri-saccharides and ligo- saccharides are also present. Water is the second most important component of the honey. Its content is critical, since it affects the storage of honey. Honey with less than 18% water content can be stored with little or no risk of fermentation.

Among the minor constituents, organic acids are the most important and of these gluconic acid, which is a by-product of enzymatic digestion of glucose, predominates. The organic acids are responsible for the acidity of honey and contribute largely to its characteristic taste. Minerals are present in very small quantities. Other trace elements include nitrogenous compounds among which the enzymes originate from salivary secretions of the worker honey bees. They have an important role in the formation honey. Enzymes like invertase, diastase and vitamins are also present in honey. Hydroxy methyl furfural (HMF) is a by-product of fructose decay is virtually absent in newly produced honey, formed during storage or during heating. Its presence is considered as the main indicator of honey deterioration.

The presence of Hydrogen peroxide (H_2O_2) an enzymatic by-product during the formation of gluconic acid from glucose is responsible for the antibacterial activity in the honey. In honey solutions with right pH, antibacterial activity is more, which is due to the presence of hydrogen peroxide.

CALORIFIC VALUE OF HONEY and COMMON FOOD STUFFS:

Product	Calories/Kg.
Apple	4181
Carrot	330
Cheese	3,480
Egg	1,272
Honey	3,000
Milk	670
Peas	3,150
Potato	970



HONEY

Invertase

Nectar ----- Honey
(Sugar + water) (Levulose + Dextrose)

Composition of Honey	(%)
Water	17.00
Dextrose	40-50
Levulose	34.00
Sucrose	01.00
Phosphorus	03.18
Gum	00.15
Acids	00.08
Nitrogenous	00.04

Why Develop Beekeeping?

Beekeeping is an activity that fits well with the concept of small-scale agricultural development. It is a labor-intensive undertaking which can be easily integrated into larger agricultural or forestry projects. Bees not only aid in the pollination of some crops used in such projects, but they make use of otherwise unused resources - nectar and pollen.

All the inputs necessary for carrying out a beekeeping venture can be made locally. Smokers, protective clothing, veils, and hives can be made by local tinsmiths, tailors, carpenters, or basket makers. Thus, a beekeeping project can create work and income for these people.



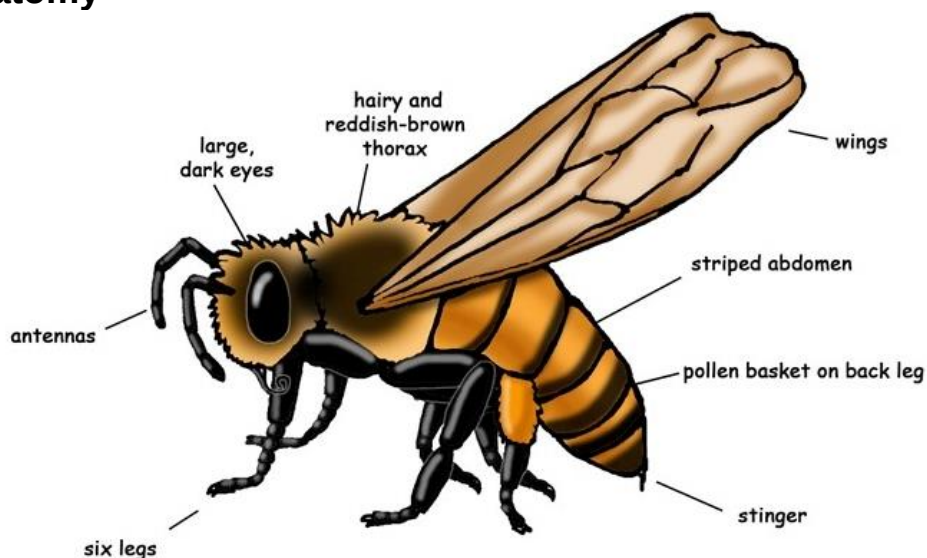
Beekeeping can:

- supply an additional non-perishable food for rural people.
- provide cash crops for rural people honey and wax.
- be a means of gainful work when the farmer is not involved in planting staple crops.
- create work for local craftsmen who make equipment.
- increase the production of other crops such as peanuts, coffee, and citrus through better pollination. insect pollination is important for many cultivated plants.

Beekeeping is a family activity which has the following advantages over other types of agriculture:

- It needs a relatively small investment.
- It uses little land and the quality of the land is not important.
- It is a flexible activity for both sexes of any age.
- It can be carried on as a productive secondary activity with low level technology, or as a primary undertaking with more complicated techniques.
- Beekeeping does not compete for resources with other types of agriculture - the nectar and pollen of plants are a true bonus.

Bee Anatomy





Types of bees:

There are four species in the bee genus *Apis*-- three which are native to Asia and one which is native to the Euro-African region. All of these are similar in appearance, though there are size and color differences. All build vertical combs that are two cells thick.

The giant or rock honey bee (*Apis dorsata*) and the little honey bee (*A. florea*) are found in Asia. Both of these bees build a single-comb, exposed nest. Nests are often seen hanging from branches of trees, roofs, or ceilings. The adult bees hang in curtains around the nest to control nest conditions. Brood and honey stores are in the same comb - the brood in the lower section and the honey in the upper section.

Two other species of *Apis* (*mellifera* and *cerana*) normally build multi-comb nests in enclosed cavities. These bees can be kept in hives, and methods have been devised to allow for a more rational utilization of their potential. It is with these two species that a potential for beekeeping development exists.

Stingless bees:

In tropical regions, some species of stingless bees-- notably *Trigona* and *Melipona*- are robbed of their honey. All of these bees build their nests inside cavities. Even though these bees do not sting, they defend their colony by biting the intruder. Some secrete irritating substances along with the bite.



Colony



Apis dorsata



Apis florea



Apis cerena indica



Apis mellifera



Trigona

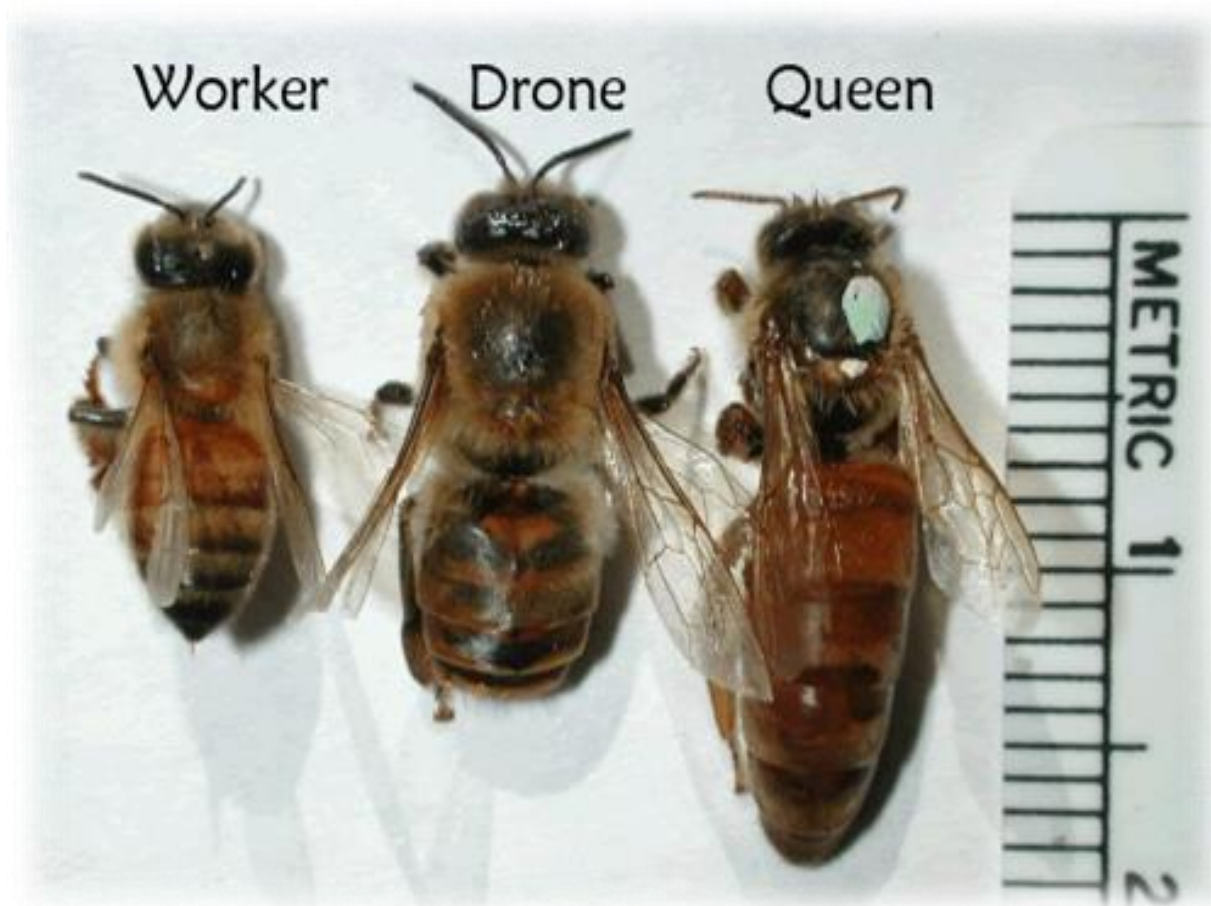


Characters of bee species desirable for beekeeping:

- High honey production
- Gentleness
- Low tendency to swarm
- Low tendency to abscond
- Calm on combs when colony is worked
- Disease resistant
- Little use of propolis
- Little brood-rearing during dearth periods to conserve stores

The Bee Colony:

A bee colony comprises of bees which live in hexagonal wax cells and is composed of-queen, drones and workers.





QUEEN:

In a bee colony only one queen can live at a time. It is the mother of the colony and has total control over the colony. Its main job is to lay eggs depending on season it controls the bee population in a colony. It can lay 500-1500 eggs/day. It takes about 15-16 days for the development of queen from egg stage. It is larger than worker, longer than drone and has long, tapering abdomen. It lives for 4-5 years.

DEVELOPMENT OF QUEEN:

The queen is developed due to death or aging. The workers build queen cells, eggs are laid in that cell, egg stage is for 03 days, larva, 5-6 days. A special proteinaceous food called 'Royal jelly' is fed and then they seal the cell. The pupal stage is for 7-8 days. The adult stays for 2-3 days and flies out with drones for mating. It mates with 8-10 drones and collects sperms in spermatheca.

DRONES:

The drones are larger, fatter than queen and drone and have short tongue. They cannot collect pollen as they don't have pollen basket. They don't have wax glands and also no sting to defend. Their number varies from 0-1000 in a colony. It takes about 24 days for the development of a drone from egg stage. It does no work in the hive and mates with queen and dies. It is the only male in colony.

WORKERS:

They are smaller than queen, drones. There are about 5000-75000 in a colony. They do all hive, field works, collect water, pollen, nectar, protect hive, clean hive, build wax comb, nurse young ones, control hive temp. It takes 21 days from egg-adult stage. It lives for 6 weeks, equipped with pollen baskets, have wax glands and has sting to defend.



Division of labour in workers

AGE

(in days)

1-3

3-6

6-10

10-15

15-20

20-30

Till aging

Aged-death

WORKS

hive cleaning, maintaining temp

feeding baby bees, develops stinging ability

production of Royal jelly, feeding

learn flying

knowing the details of hive, flowers

food collection, wax comb preparation

supply of things required for colony

maintains hygiene, protection

<u>What Bee needs to live?</u> 1. Bee wax 2. Nectar 3. Water 4. Flowers 5. Tree and flower buds 6. A home	<u>Where hive should be kept?</u> 1. Good source of pollen 2. Cool places 3. Less enemy attack, total dark in night 4. Free flying areas 5. Avoid factories, both room, kitchen 6. Avoid disturbances, ants 7. Manageable heights
<u>SOURCE OF POLLEN</u> 1. Champaka 2. Coconut 3. Sorghum 4. Onion 5. Paddy 6. Ragi etc...	<u>SOURCE OF NECTAR</u> 1. Teak 2. Arecanut 3. Neem 4. Sesamum 5. Sugarcane etc...



PLANTS - SOURCE OF HONEY + POLLEN

- | | | |
|---------------|---------------|---------------------|
| 1. Jamun | 2. Tamarind | 3. Pongamia |
| 4. Orange | 5. Lime | 6. Drum stick |
| 7. Eucalyptus | 8. Coffee | 9. Cardamom |
| 10. Banana | 11. Horsegram | 12. Mustard, etc... |

Equipments required for starting a colony of Honeybees

1. Hive Stand :

Used to keep bottom board up off the ground, keeping it dry and stopping it from rotting quickly. You may buy commercial stands or use concrete blocks, wood 4x4 or 6x6, or hardwood pallets.

2. Bottom Board :

Brood chambers are placed on a bottom board to provide an entrance for bees to use. This board may be treated with naphthalene to help extend its life.

3. Brood Chamber:

This is the area in which the frames are used by the colony to raise new bees.

4. Frames :

These are rectangular structures made of wood or plastic and are used to hold wax foundation embossed with hexagonal worker cells .

5. Inner Cover :

Also called a crown board. This is a wooden board usually used with an oblong hole in its center. Its purpose is multiple: it keeps the bees in the hive when the outer roof is removed, may be used with a bee escape to remove honey, and assists in feeding bees. Also serves to rid off the excess moisture, at different seasons.

6. Metal Outer Cover:

Used to protect the colony from the weather. Each cover should be secured by a weight (brick or stone of similar size) to prevent wind from blowing it off.



Personal Equipment:

As an aspiring beekeeper one should make sure that all the personal equipment needs to be taken for handling bees before they arrive. This equipment would consist of protective clothing, hive tool, smoker, and a good reference book on beginning beekeeping.

1. Protective Clothing:

There are basically two methods to choose from. First, a hat and veil along with coveralls or own clothing like jeans, etc. Second, a commercial suit or jacket with veil attached. A veil is the most important and should always be worn when handling bees. It's no fun getting stung on the face! If trousers are not elasticized, always tuck them into your socks to keep the bees out.

2. Gloves:

The new beekeeper should wear gloves. This will help to build confidence in handling the bees and prevent a lot of stings. Gloves as well keep the hands clean as they would soon get sticky and full of propolis and other sticky material. Gloves should be a comfortable fit with long gauntlets.

3. Hive Tool:

This is an important tool to the beekeeper. It is used to lever the hive bodies apart, or for separating frames. Screwdrivers or old chisels are not recommended as these will damage the hive parts, often leaving holes for the bees to get out or wasps and ants to get in.

4. Smoker:

A smoker is necessary when working with bees. Smoke is used to control the bees, and a little smoke goes a long way! A reasonably large smoker is a good investment. It is easier to use.

5. Frame Feeder:

This is usually a plastic frame-sized container that can be inserted in the hive in place of a frame removed from the deep super (brood chamber). This type of feeder must have some kind of flotation that allows bees to reach the syrup without drowning.



Smoker



Hive Tool



Honey Extractor



Veil

Bee Apiary Location:

The ideal location for your apiary would be as follows:

- Away from areas subjected to pesticides, pollution, smoke, etc.
- Close to fresh water source or means of providing fresh water.
- Easy access for the beekeeper, if possible with easy vehicle
- Near food sources throughout the changing season: for the area should be near or should have access for the bees to plants like Coconut, Drumsticks, Rubber, Tamarind, Soapnut, Coffee, Sunflower, Ginger, Barseem, Coriander, Mustard, Litchi crops, Eucalyptus, Jamun, Karanji, etc. A good mix of these nectar / pollen yielding blooms should ensure a healthy productive colony of bees.
- On the upper sides of slopes to improve air drainage away from hives.
- Away from heavy tree canopy & wet bottom land.
- In open fields with protective cover from the prevailing winds and noontime summer shade.
- With entrances oriented to the south, east or south-east.
- Not overlooking or with main flight lines crossing public thorough fares or footpaths.



A beginner beekeeper should know one of the most important aspect i.e. **procuring a Nucleus Hive**, which is highly recommended. While procuring; one should observe following:

1. A fresh egg laying queen should be present in the colony.
2. Nucleus hive should have 5 frames with
 - a) One frame of pollen & honey each.
 - b) Three frames of brood with bees.

Care during June - November

1. Preserve frames of super, expose to sulphur or neem smoke or carbon disulphide fumes or paradichlorobane (P.D.B.)
2. Protect hive from rain & wind
3. Frames from super removed, bees occupy family room
4. Clean the area near hive
5. Clean the entire hive once in a week
6. Protect against enemies
7. Feed sugar syrup-100ml water once week

Care during December - March

1. Best to capture new colonies
2. Reduce drones if more
3. Fix the frames in super with artificial comb
4. Remove aged queen, if young queen then remove queen cell
5. If required replace colony
6. Do not frequent disturbance

Enemies of bees

- | | | |
|-----------|-------------|-------------------------|
| 1. Moths | 2. Ants | 3. Yellow harnet, wasps |
| 4. Snails | 5. Tree dog | 6. Mongoose |
| 7. Rats | 8. Frogs | 9. Owl etc.. |

Diseases

1. Acaine-Folbex-PKticket
2. Nosema-Fumidil B
3. Europeon foul brood, Sac brood-Virus



When bees sting?

1. Self and colony protection
2. Absence of queen in hive
3. When bees of another colony try steal
4. Rough handling
5. Unfavourable climate
6. Inspecting hive by blocking bees hive entry
7. Bad smell
8. Suspicion as enemy
9. Presence of queen cells in the hive
10. Increased enemy attack
11. Removing the honey
12. If injured while inspecting

HOW TO AVOID BEE STING?

1. Smearing green leaf extract
2. Smearing onion juice
3. Smearing honey
4. Use gloves, cap with net

Keeping of Records:

It is a good idea to keep records, as memories are not as good as we would like them to be! Especially if you are tracking for a period of years. A sheet of paper tucked to the underside of the outer cover is a good place to keep records. In addition, a hive diary can be kept and filled out each time while working with hives. Referring to the diary before going to the apiary will assist in remembering any needed supplies or equipment.



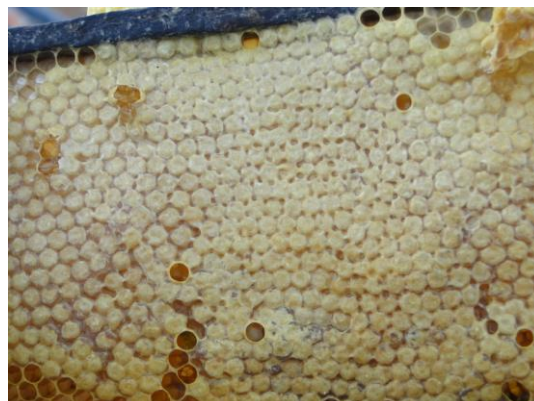
The information on each hive kept will vary with the beekeeper. Some general areas would be:

- Has the colony sufficient room? Number of frames of sealed brood, number of frames covered by adult bees.
- Hive characteristics: gentle, aggressive, productive, etc.
- Is the Queen present and laying the expected quantity of eggs? Is the brood pattern tight and even?
- In early season, is the colony building up in size as fast as other colonies in the apiary?
- Mid season, is there any Queen cells present in the colony? Swarming record (how often, what time of year).
- Effects of last manipulation and time elapsed.
- Are there any signs of disease or abnormality?
- Are there enough stores to last until the next inspection?
- Medication schedule (type, when, for what reason).
- How much honey was obtained?
- Seasonal ability survival and stores requirement, Re-queening, year and date.

You will need some method / way of extracting the excess honey stores your bees have gathered.



Bee with Honey on Super frame



Sealed Super frame filled with honey



Cutting the seal and honey collection from Super frames



Honey Processing

Many species of bees collect nectar which they convert into honey and store as a food source. However, only bees which live together in large colonies store appreciable quantities of honey. These are bees of the genus *Apis* and some of the Meliponinae (stingless bees). Bees prepare honey mainly from the nectar of flowers, but other plant saps and honeydew are also used. As each bee sucks the liquid up through its proboscis and into the honey sac, a small amount of enzymes are added and water is evaporated. The enzymes convert sugars in the nectar into different types of sugars, honey always contains a wide range of sugars, varying according to the nectar source. After the liquid has been placed in the cell of honeycomb, bees continue to process it. The temperature of the hive is usually around 35°C and this temperature together with ventilation produced by fanning bees, causes further evaporation of water from the honey. When the water content is less than 20% the bees seal the cell with a wax capping: the honey is now considered 'ripe' and will not ferment. Honey consists of a mixture of sugars, mostly glucose and fructose. In addition to water (usually 17-20%) it also contains very small amounts of other substances, including minerals, vitamins, proteins and amino acids. A very minor, but important component of most honey is pollen.

Processing

Honey should be processed as soon as possible after removal from the hive. Honey processing is a sticky operation, in which time and patience are required to achieve the best results. Careful protection against contamination by ants and flying insects is needed at all stages of processing.

It is important to remember that:

- Honey is a food and it must therefore be handled hygienically, and all equipment must be perfectly clean.
- Honey is hygroscopic and will absorb moisture, therefore all honey processing equipment must be perfectly dry. Too much water in honey causes it to ferment.



Honeycombs from top-bar hives or traditional hives Cut-comb

Honey

Collect pieces of comb consisting only of sealed and undamaged honeycomb, cut them into neat portions and package them carefully for sale. Since the honey in the comb is untouched and is readily seen to be pure, honey presented in this way fetches a high price. Honey which has not been open to the air has a finer flavour than honey which has been subjected to processing in any way.

Strained honey

To prepare strained honey, remove the wax cappings of the honeycomb with a knife and break the combs into pieces, see Figure 1. Make sure that you do not use unsealed combs containing unripe honey or pollen. Use a cotton cloth to strain the honey from the pieces of honeycomb into a clean, dry container. Strained honey must not contain any trace of wax or other debris. Figure 1: Remove the wax cappings from the honeycomb Honey processing Practical Action It is best to use a fairly course strainer at first, to remove large particles and then to use successively finer strainers. Finally squeeze the combs inside a cloth bag remove as much honey as possible. Form the wax into a block by melting it gently in a water bath or solar wax extractor.

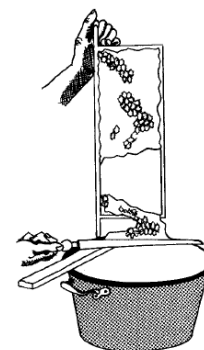


Figure 1: Remove the wax cappings from the honeycomb

Honey combs from frame hives Cut-comb honey

To produce cut-comb honey from frame hives it is necessary to use a wax foundation which does not contain strengthening wires and is thinner than that normally used in wired frames. Portions of cut-comb can be prepared for sale as described above.

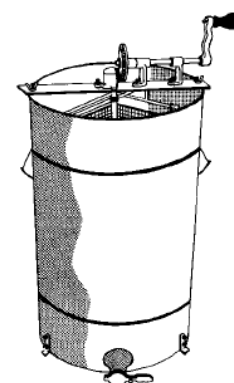


Figure 2: An extractor



Strained honey

Remove the wax capping from the honeycombs with a long sharp knife which has been standing in warm water. Hold one end of the top-bar of the frame and rest the other end of the top-bar on a piece of wood placed across a dish, see Figure 1. Start cutting at the bottom of the frame and cut off the thin layer of wax capping and allow it to fall into the dish below the frame. Turn the frame around and cut off the capping on the other side and then place the frame in an extractor, Figure 2.

Some honey will stick to the wax capping; do not waste this, but strain it out of the dish. Honey drains very slowly from capping and may take over 24 hours. Containers for marketing honey must be lightweight, low cost, and preferably transparent so that customers can see the product. Glass or plastic containers are usually used but in many countries these are difficult to obtain. Plastic sachets are cheaper alternatives. In addition to attracting customers the label you put on your honey should give the following information:

- Contents: Pure Honey
- Source of the honey (eg sunflower, mixed blossom, tree honey etc)
- The country and district it was produced in
- Your name and address
- The weight of honey in the container.

You may wish to add other information for the customer. For example, if you are packing comb honey, you could remind the purchaser that the whole comb including the wax is completely edible, or if you are selling strained honey, you may wish to provide an explanation of granulation.

Glucose is a major constituent of honey and when it crystalizes (i.e. turns from a liquid to a solid), the honey becomes solid (granulated). Some honeys are much more prone to granulation than others but almost all honey will granulate if its temperature falls below 24°C. Granulation is a natural process and there is no difference in nutritional value between solid and liquid honey. If honey is required in the granulated form, but it is slow to granulate, the addition of 20% finely granulated honey will cause it to granulate if kept at a low temperature. Figure 2: An extractor



Honey processing Practical Action If a jar of granulated honey is required in the liquid form, stand it in warm water (60°C).

The aroma and taste of honey are its most important features, but honey is often judged according to its colour. The colour of honey depends mainly upon the source of the nectar. Usually dark coloured honeys have a strong flavour while pale honeys have a more delicate flavour. Generally light coloured honeys are more highly valued than dark. Colour can sometimes be an indicator of quality because honey becomes darker during storage and heating.

Water content

If the water content of honey is greater than 19% the honey is likely to ferment. A low water content is therefore essential. Water content can be measured using a refractometer. In areas with a very high humidity it can be difficult to produce honey of sufficiently low water content.

HMF

HMF (Hydroxy methyl furfural) is a break-down product of fructose (one of the main sugars in honey) formed slowly during storage but very quickly when honey is heated. The amount of HMF present in honey is therefore used as a guide to the amount of heating which has taken place. Some countries set an HMF limit for imported honey. HMF is measured by laboratory tests and technical advice should be sought if export is being considered. Some honeys have a very high pollen content which makes them appear cloudy and this is considered to be low quality. The presence of any other contaminations (e.g. particles of wax, bees, splinters of wood, dust) make the honey of very low value.



Uses of honey:

Honey as Medicine:

Applied directly on wounds, sores, bedsores, ulcers, burns etc. It helps against infections, promotes tissue generation, rapid healing, cleansing action on wounds, reduction of inflammation, gives comfort on honey dressing, and reduces scarring also in its pure, unprocessed form. If applied immediately on burns, reduces blistering of burns and speed regeneration of new tissue. Honey medicated pads are in use for healing the wounds. Honey reduces and cures eye cataracts. Cures conjunctivitis and various afflictions of cornea if applied directly into the eye. e.g. Lotus honey in India.

Honey in Ayurveda:

Honey is used as vehicle for faster absorption of various drugs such as herbal extracts. Honey can be assimilated fast since it is a predigested food. Most of the Ayurvedic medicines contain honey as one of the main ingredient.

Creamed honey:

As an alternative to liquid honey, techniques have been developed to guide the natural crystallization of honey towards completely crystallized, stable and homogenous end products with a pleasant appearance, creamy consistency and good reception by most consumers.

Uni-floral Honeys:

Specific benefits of unifloral honey are reported based on the assumption that honey made from the nectar of a medicinal plant has the same or similar beneficial activity as the one recognized for the whole plant or same part of it e.g. Jambul honey.

The unifloral honeys and organic honey in India is having high demand today, due to its medicinal importance and other characters. Jamun in Mahabaleshwar, litchi in Bihar, coffee in Karnataka are some of the famous unifloral honeys. The Mahabaleshwar forest is bestowed with several pleistacial species like carvi, uhyatti, strobilanthus which are the sources of organic honeys.



Comb honey:

Comb honey is a section of sealed comb built of new beeswax with light colored honey, which remains liquid until consumed. Round square or hexagonal sections with prefabricated wood or plastic frames are given to the colonies with a very thin foundation sheet. The specially prepared colony fills up the section with comb and honey, which is directly packaged in attractive clear containers to protect the contents from contamination, moisture and breakage.

Honey in cosmetics:

Honey is used in moisturizing and nourishing creams, lotions and shampoos.

Honey and mead (fermented product)

Meads and Wines are prepared from honey in many African and European countries. Honey vinegar can be produced from mead in the same way as wine vinegar. Most countries permit the production of alcoholic beverages for personal consumption, but require special licenses for commercial production and sale.

Honey as a food:

Honey is most commonly consumed in its unprocessed state, liquid, crystallized and in the comb. In almost all Asian countries honey is considered as medicine. In western countries the per capita consumption is more and considered as a food item. The traditional use of Honey in food preparations has been substituted in most cases by sugar and more recently by various sugar syrups derived from starches. Honey drinks are also common mixed with lemon juice for a pleasant sweet and sour taste.

Honey is largely used on small scale and industrial level in baked products, confectionery, candy, marmalades, jams, spreads, breakfast cereals, beverages, milk products and many preserved products. The use of honey mixed with milk or milk products is a very common home remedy against colds and infections of the throat.



Market Outlook:

The major honey producers are Russia, China, USA, Mexico, Argentina, Canada, Brazil, and Australia. The major exporters are China, Mexico, Argentina. The major consumers and importers are Germany, Japan, USA, UK. In countries with well developed honey consumption, product diversity is increasing on the basis of different product qualities and characteristics. In addition to the traditional liquid and crystallized honey of different colors, diversification based on the taste and botanical or geographic origin is slowly increasing. Unifloral honeys are increasingly requested and appreciated, despite their higher prices; multifloral honeys from certain geographic regions are also increasingly popular and appreciated by local consumers or tourists.

Homemade remedies:

- Indian gooseberry fruit (Amla) is very nutritious, which is rich in vitamin C, and also contains calcium, phosphorous, iron and pectin. It is a panacea for many disorders. Amla mixed with honey is good for improving eyesight, treating conjunctivitis, and glaucoma. It also improves body resistance and protects the body from infection. It strengthens the heart, hair and different glands in the body. Dried amla with honey is good for rheumatism.
- Garlic along with honey is an excellent remedy for cough. It soothes sore throat, help in cold and cough.
- Ginger juice and honey is an effective medicine for indigestion, nausea, vomiting. Honey along with cinnamon powder decoction taken before breakfast and in the night before sleep is excellent for weight loss and regular use does not allow the fat to accumulate in the body.



COMMERCIAL PRODUCTION OF BEE POLLEN

Introduction :

Beekeeping in India is mainly known for production of honey and to some extent beeswax. There are several other bee products which a beekeeper can get depending upon the variety of the bees, local vegetation, climate and other factors. Pollen is one of the valuable bee products that a beekeeper can produce in many parts of the country and thereby can augment his income.

What is Pollen?

Pollen grains are the male reproductive units produced in the anthers of flowers. Each pollen grain contains one to several cells. Each plant species has a distinct pollen type and produces pollen in either small or large quantities depending upon the mode of its transport from the anther to the stigma of another flower, in the process of pollination. For example, in wind pollinated flowers, pollen is produced in large quantities, while in insect pollinated flowers it is produced in relatively small quantities. After the pollen grain gets on to the surface of a suitable stigma, it germinates and produces a long tube that traverses the style and reaches the embryo sac of the ovule, situated in the ovary of the flower. In the embryo sac the sperm cell of the pollen unites with the egg cell of the ovary. This process is fertilization. In order that pollen grains survive the entire process of pollination and fertilization, they contain nutrients that can sustain their life and growth. Pollen grains occur in different sizes, shapes and have different surface features. They are normally 10 micrometers (micrometer = one thousandth of a millimeter) to 150 micrometers in size. They may be spherical, ellipsoid or 3- to many-sided polygons. Their surface may be smooth, spiny or thorny; or may have a reticulated or other type of design. Usually the pollen grains have on their surface special thin circular or furrow-like openings called apertures, through which they germinate and grow the pollen tube in the process of fertilization. Pollen grains are usually produced as single units; sometimes they may occur as clusters of 2, 4, 8 or more grains.



Pollen in Honeybee Nutrition

Because of the high level of energy requirement to do their work within and outside the colony, honey bees require proteins (amino acids), carbohydrates (sugars), lipids (fatty acids, sterols), vitamins, minerals (salts), and water. The nutrients in pollen include all these components. Pollen thus constitutes an important diet of several bee species including honey bees. It provides the nutritional building blocks needed to nurture the young bees. It is essential for the body growth. Adult worker bees obtain dietary protein from pollen. Worker bees consume pollen also for production of royal jelly, which is fed to worker larvae less than 3 days old. Older worker larvae are given a diet of stored pollen mixed with honey. Worker bees feed drone bees a mixture of glandular secretions, pollen and honey. This food provides them with the dietary protein. Larval and adult queens obtain their protein from royal jelly secreted by young worker bees. Royal jelly constitutes an essential food for the queen bee that enables egg-laying.

An average size *Apis mellifera* bee colony needs about 50 kg or more of pollen in a year for the growth of its bee population and normal functioning. Not all pollens are nutritionally alike; bees generally collect and utilize a mixture, and many individual pollens are nutritionally inadequate. In gathering pollen, forager bees fly from flower to flower and collect pollen grains from the anthers using their mouth parts and front legs. Often the pollen grains on the flower stick to the body of the bees. The bees then scrape all the pollen grains from different body parts using their three pairs of legs. In this process they also add a tiny amount of nectar regurgitated from their honey stomach to the pollen to make it sticky, and then use their legs to transfer this pollen on to a special feature the pollen basket on each of the hind legs. Here the pollen is kneaded into a ball or pellet. Once the pollen baskets are full, they return to their hive to store the pollen in a comb. Bees store pollen in pollen store cells of combs. Here it undergoes a lactic acid fermentation and is thus preserved. Bee bread is the partially digested pollen and honey mixture stored in the combs.



Composition of Bee Pollen

Composition of pollen changes from species to species and variation in absolute amounts of the different components can be very large. Any one type of pollen does not contain all the constituents or characteristics mentioned below for the pollen in general.

A major constituent of pollen is the protein. Protein content in pollen can vary between 10 and 35 per cent, though amounts of 40 per cent or above were reported.

Nutritional Properties

The major components in pollen useful in human nutrition are proteins and amino acid, lipids (fats, oils or their derivatives) and sugars. Pollen contains all 8 essential amino acids, which the body is unable to biosynthesize, in a very favorable proportion for human consumption. Many enzymes (proteins) are also present. Some, like glucose oxidase are added by the bees in the process of pollen gathering and storage. Pollen is a source of major minerals potassium, sodium, calcium, magnesium, phosphorous, sulphur, aluminum, boron, chlorine, copper, iodine, iron, manganese, nickel, silicon, titanium and zinc. Pollen contains the B- Vitamins 2, 3, 6, and 12, as well as Vitamins C, E, H, i.e., riboflavin, nicotinic acid, pantothenic acid, pyridoxine, ascorbic acid, tocopherol, biotin, plus at least 11 Carotenoids (Vitamin A).

The FAO monograph on 'Value Added Products from Beekeeping', reports that pollen was found to be richer in most ingredients (average protein, fat, mineral and vitamin content) when compared on a weight or calorie content basis than such foods as beef, fried chicken, baked beans, whole wheat bread, apple, raw cabbage and tomatoes. While comparable in protein and mineral content with beef and beans, pollen averages more than ten times the thiamin and riboflavin or several times the niacin content. An important point to note is that pollen is usually consumed in quite small quantities and the daily requirements of vitamins, proteins and minerals cannot be taken up through the consumption of pollen alone. However, it can be a substantial source of essential nutrients where dietary uptake is chronically insufficient. Bees Pollen for Health and Hygiene Pollen is frequently called the "only perfectly complete food". Though pollen is claimed to possess mysterious powers and extraordinary



nutritional value, caution should be exercised in accepting the many claims made to the credit of pollen. Pollen is a storehouse of vitamins, minerals, proteins, fats and oils, carbohydrates, amino acids, More than 100 enzymes and coenzymes, hormones, peptones, polypeptides and globulins, high concentrations of the nucleic acids and a variety of antibiotic substances. Thus many use honeybee pollen for health reasons. Honeybee pollen allows the body's own healing and rejuvenation mechanisms to perform their normal functions of building restoring and maintaining and protecting every cell. Pollen is prescribed for treatment of various prostate problems. However, pollen has not been officially recognized as a medicinal drug.

Consumption of pollen appears to improve the general condition and food conversion rate in animals as well as people. It may be therefore used for support in accompanying other cures. As food: Pollen is mainly used as a food or food supplement. There are reports of use of pollen in diets for domestic animals and laboratory insects resulting in improvements of health, growth and food conversion rates. However, the relatively high cost of pollen has to be considered while formulating feeds or feed supplements.

The FAO monograph on Value Added Products from Beekeeping, suggests that the nutritional value of beebread is much higher in places where limited food variety or quantity create nutrient imbalances. It is particularly children who might benefit the most from regular pollen supplements in their diets. In cosmetics:

Pollen is included in some cosmetic preparations with claims of rejuvenating and nourishing effects for the skin. However, there is a considerable allergy risk for a large percentage of the population. Including alcoholic or aqueous pollen extracts in cosmetic formulations appears to cause no or only rare allergic reactions.

Pollen Collection

Collection of pollen pellets that forager bees bring into the colony is done by using traps. These differ greatly in design and place of installation in the hive, but all contain in the main a wire- mesh or grid through which the returning pollen foragers must pass through, so as to dislodge the pollen pellets from their legs and a container or tray to gather the falling pellets. The Central Bee Research and Training Institute suggest a



simple floor-board type pollen trap to be adequate for Indian conditions. The wire-mesh or grid is used in place of the entrance gate on the floor-board. The size of the holes in the wire-mesh or plastic sheet used for the trap depends upon the worker bee cell size. For *Apis mellifera* bee colonies, the hole size of 5-mm (5-mesh) has been found to be suitable. The tray gathering the falling pollen is kept just in front of this entrance gate. It is covered by a 3-or 4-mesh screen. The screen prevents bees getting into the tray.

The design and size of the mesh in the trap is such that some pollen foragers succeed in going into the hive with their pollen loads. Normally about 50 - 60 per cent of the pollen brought in by the foragers gets trapped and collected into the tray. Pollen trap should not be used continuously in the colony. If trap is used continuously, it may discourage pollen gathering activity and in turn may affect the brood rearing activity within the colony.

For trapping pollen the pollen trap is inserted in front of the hive. The hive with the trap is kept at a place where a good source of pollen is available. Pollen is normally available in plants during morning hours. The pollen trap should be used during the active pollen foraging period. The pollen trap should not be used for more than 3-5 hours. The pollen pellets gathered in the tray are transferred to a clean container.

Appreciable quantities of pollen can be collected during blooming season of major pollen sources like coconut, coriander, maize, mustard and sunflower. In the attempts to collect pollen from *Apis mellifera* colonies maintained coconut orchards in Vijayarai, Andhra Pradesh, an average 92 gm of pollen was collected from a hive in a day. Generally bees collect the pollen from one plant species in one trip. The pollen loads collected at one line therefore have distinctive colours depending on the available source, i.e., yellow for pollen from mustard, orange for pollen from sunflower, purple for pollen from coriander and creamy white in the case of pollen from coconut palm.

When Not to be Collected

Avoid the pollen collection in rain / snow fall days. Do not use diseased colonies for pollen collection. Do not collect pollen during spraying / dusting of pesticides/insecticides on crops. Avoid the swarming season of the colonies. Avoid the trap during the poisonous pasturage pollen.



Preservation of Pollen

Make sure the pollen gets into a refrigerator (freezer) within 8 hours after collection. Pollen should be kept as cool and dry as possible while transporting. stored pollen is a good medium for growth of fungi and bacteria especially in moist environments. The danger from this is minimized by dehydration and preserving in closed containers at low temperatures and in dry places. Pollen needs to be dried to less than 10 per cent, preferably 5 to 8 per cent moisture content. Poorly dried pollen gets rotten and becomes useless. Proper quality control, processing and cold storage are all critical and expensive steps when producing a raw, unprocessed specialty food like bee pollen. Processing techniques have been developed to increase shelf life by preventing spoilage. Processing involves desiccation under controlled conditions to remove moisture and irradiation to prevent infection and spoilage. Processed pollen is then stored in a deep-fridge. If large quantities of pollen are to be collected, a pollen drier is recommended. Pollen is dried in controlled temperatures of less than 45°C, preferably at 40°C. Heat spoils the pollen quality. Enzymes, which are an important component of bee pollen exhibiting bioactivity, are damaged or killed on exposure to excessive heat.

Pollen can be kept at room temperature (about 25 to 30° C) in a dark place for several months, when its moisture content is less than 10 percent. Dried pollen may be refrigerated at 5° C and can be kept without spoilage for at least a year. Frozen to -15°C, pollen can be preserved for many years without quality loss. Pollen collected for supplementary feeding to bees can be preserved in another way. The shade dried pollen loads are kept in an air-tig at the bottom: over this layer spread about 2 cm high layer of pollen loads; repeat with layers of powdered sugar and pollen loads and fill the bottle, topping finally with a layer of powdered sugar. Such stored pollen loads can be used to feed bee colonies either directly by making a patty or by using in pollen supplement formulations.



Cleaning of Pollen

Pollen loads may get contaminated with debris and several extraneous materials and need to be cleaned. Some of these are bee parts like legs, hairs; bits of plant material like leaves and straw; pollinia or stamens that stick to bees; hair-like fibres; various insects, ticks and small creatures and mummies and scales resulting from bee diseases; cocoons and cobwebs. The preserved pollen loads should be cleaned of all such extraneous matter.

The collection of high quality pollen for supplementary feeding to bees is possibly the most important of the bee nutrition management programs. The use of trapped pollen as feed to the bee colonies results in improved honey production, in successful queen bee rearing and in increased profits from a bee fanning business. There are several plant species that can yield good quantity of pollen: coconut, coriander, maize, mustard, sesame and sunflower. Some profitable nectar sources trees like the rubber tree are valuable for honey production, but have little or no pollen. In such cases feeding of bee colonies with pollen results in increased honey production. Feeding queen-cell starter colonies with high quality pollen helps in queen production. This also helps in queen cell rearing, royal jelly production and drone production.

Pollen products:

Pollen with honey, Pollen tablets and Pollen capsules.



ROYAL JELLY PRODUCTION

Introduction

India is having diverse agro-climatic conditions and rich heritage of flora and fauna conducive to production of various bees hive products of late, honey production has taken momentum in India and is a sustainable source of income to many. Among other hive products, interest is growing in the use of royal jelly as a dietary supplement, as a medicine and in cosmetics.

What is Royal jelly?

Royal jelly is produced by worker bees and is fed to the larvae, queen and drones. It is secreted by nurse bees of the age of 4 to 11 days. Royal jelly is secreted in a pair of long glands distributed in many loops and coils in the head. The ducts of these glands open on the sub-oral plate of the hypopharynx. Each gland consists of numerous small cellular bodies, which are attached by small necks to a duct. The secretion of the food gland is sticky and milky fluid.

Larva of worker bees is fed a mixture of pollen and honey after the feed of Royal Jelly for 3 days. However, larvae that continues to receive the Royal Jelly diet hatch as a Queen Bee. It is solely the Royal Jelly that makes Queen a Queen. The Queen Bee is about 45% longer and 60% heavier than the normal worker bee. She lays about 2000 eggs per day, which all together weight approximately 2 times her own body weight. The Queen has a life span of about 5 years compared to the average 45 days lifespan of the worker bee.

Royal jelly contains a broad range of Vitamins, amino acids, including all of the essential ones, proteins, minerals, lipids and carbohydrates. It also contains aspartic acid, a component that aids in cellular health.



How to produce?

The methodology involves management of colonies, grafting of larvae, collection and storage of royal jelly. The royal jelly production involves the same procedure as that of commercial queen rearing except that the cycle is not completed. Colonies were conditioned with 10 frame brood and bees. Before grafting all the three bars with 30 queen cells were brushed with royal jelly. The inner surfaces of plastic cups were of 10mm diameter and 15mm height and given to experimental colonies so that the bees would clean and prepare them for acceptance of larvae. Efforts were taken to graft one-day-old larvae in the cells.

On the third day each larvae was removed and the royal jelly was extracted by scooping with the stick. Colonies with swarming impulse produce comparatively more Royal Jelly.

In order to increase and diversify income from beekeeping, technologies for production of other hive products need to be developed, introduced to and popularized among the local beekeepers.

Therapeutic values of Royal Jelly

- **ANTI AGING AGENT**
- **HORMONAL STIMULANT**
- **ENERGY ENHANCER**
- **NATURAL ANTIDEPRESSANT**
- **CHOLESTROL CONTROL PRESERVATION**

Preservation:

Royal jelly should be placed into dark glass vials or food- grade plastic containers. It should be refrigerated immediately. Royal jelly should be collected in plastic bags and should be packed with ice packs in thermocol containers. Since the royal jelly is perishable, producers must have immediate access to proper cold storage. Refrigeration of royal jelly at 5°C is a minimum precaution. Common household freezers can be used. Royal Jelly should be stored at temperatures below 20°C, which is attainable in commercial freezers.



Scope of Marketing:

Today's consumer is keen in a healthy life and consequently in the consumption of healthy and nutritious food. Royal jelly is considered as the richest food in the world. Consumers increasingly take into account the time needed to prepare and cook meals. Since all beehive products are natural and ready for consumption, the time factor doesn't arise. Increasing level of international travel, high standard of living, the emergence of international and ethnic food restaurants, natural and organic products restaurants have stimulated many European consumers to become adventurous and to shift from traditional consumption patterns to menus that reflect international cuisine. This includes cuisines of honey, royal jelly, pollen etc. Hence the demand of Royal Jelly and other beehive products are extremely high in the market.

MODERN HONEY TESTING KIT

Introduction:

Honey is used as traditional medicine and recently is in demand for food and cosmetic products. When honey is being produced in the field of Agriculture, Farms and Forest, it is necessary to test the condition and composition, as prerequisite for quality control. This is important and essential for both the producer and the purchaser. Various tests and sophisticated equipments used for analysis of honey in the laboratory, are time consuming and are costly.

The Central Bee Research and Training Institute, KVIC, Pune has developed a portable honey testing kit. The old honey testing kit was modified to suit the modern testing and easy handling. This modern honey testing kit enables testing of honey in the field, within a few minutes. In this way, the grade of the honey and adulteration in honey, if any, can be decided in the field itself.

The kit consists the items (table-I) kept intact in separate compartments in a lightweight fiber box.



Methods for testing of honey

1. Test for Moisture % by brix or honey hydrometer.

- 1.1. Take honey in a measuring cylinder
- 1.2. Keep the clean hydrometer in the honey to be tested, without touching to the sides of the measuring cylinder.
- 1.3. Observe the reading of the brix hydrometer scale after it is stabilized. This reading is sugar concentration in honey
- 1.4. Deduct the value from 100 to get moisture percentage.

Eg. If the brix reading is 80.5,

Then moisture in the said honey is $(100 - 80.5) = 19.5\%$

Table-I Contents of honey testing kit.

	Item	Qty
A. Equipments		
1.	Brix or honey hydrometer Range 60 to 90% sugar concentration	1
2.	Spirit Lamp	1
3.	Dispenser / Syringe Marked 'H' for honey, Marked 'A' for Fehlings solution "A", Marked 'B' for Fehlings solution "B"	3 (+1 spare)
B. Glass wares		
1.	Measuring cylinder - 250 ml	1
2.	Volumetric Flask - 50 ml	1
3.	Graduated Pipette -1 ml.	1
4.	Mortar and Pestle - 80 mm dia	1
5.	Evaporating Dish - 80mm dia	1
6.	Small Bottle (marked 'R')	
7.	Hard glass test tubes - 20 mm dia	2
8.	Dropper for Hydrochloric Acid (Marked HCL) for Resorcinol Solution (Marked "R") for Methylene Blue (Marked "M")	1 each
9.	Beaker	1
1	Glass Rod	1
C. Chemicals		
1.	Diethyl ether/Ethyl Acetate/Petroleum Ether	100ml
2.	Resorcinol crystals	25
3.	Concentrated Hydrochloric Acid	50 ml
4.	Fehling's Solution "A" (0.05 N Copper Sulphate solution)	50 ml.



5.	Fehling's Solution "B" (0.05 N Potassium Sodium tartrate solution)	50 ml.
6.	Methylene blue indicator solution	25 ml
7.	Anhydrous sodium carbonate	25 gm
Miscellaneous		
1.	Test Tube Stand	1
2.	Test Tube Holder - SS	1
3.	Marker pen	1
4.	Spatula (SS)	1
5.	Pumice Stones	–
6.	Test tube brush	1
7.	Cotton	–
8.	Match box	1

2. Qualitative Fiesh's Test

A. Items required –

- | | |
|--|---------------------|
| 1. Pestle and Mortar | 2. Evaporating dish |
| 3. Bottle / Scintillating vial marked "R." | 4. Dropper |

B. Chemicals -

- | | |
|-----------------------------|------------------------|
| 1. Diethyl ether | 2. Resorcinol crystals |
| 2. Cone. Hydrochloric Acid. | |

C. Preparation of Resorcinol Solution:

Dissolve 1 Small piece of resorcinol crystal in 1 ml of concentrated hydrochloric acid. This solution should be prepared fresh each time.

2. Method for Fieh's test

2.1 Take approximately 5 gms (4ml from syringe) of honey in the mortar

2.2 Add about 10 ml of ether

2.3 Stir well with pestle for 2 minutes

2.4 Decant the supernitent liquid extract in the evaporating dish and allow it to dry completely

2.5 Add a drop of resorcinol solution * to the evaporating dish and observe the colour.

- Cherry red colour indicates presence of large quantity of hydroxy methyl furfural (H.M.F.) This is "**POSITIVE TEST**". Such honey fails the test.
- Any other colour ranging from yellow to pink has no significance and is termed as "**NEGATIVE TEST**".



3. Preparation of honey solution for test.

- 3.1 Take accurately 14 units honey from the syringe marked "H" and transfer to 50 ml volumetric flask.
- 3.2 Add little water and mix thoroughly by shaking, after closing the mouth of the flask properly, to dissolve the honey completely.
- 3.3 Make the volume 50 ml.

4. Test for Total Reducing Sugars (TRS)

A. Items required

1. Dispenser /syringe for honey marked 'H'
2. Dispenser / Syringe for reagents marked 'A' and 'B'
3. Volumetric flask
4. Graduated Pipette 1 ml,
5. Hard Glass test tube - 20mm dia,
6. Spirit lamp.

B. Reagents

1. Fehling's Solution "A" ,
 2. Fehling's Solution "B"
 3. Methyl Blue Indicator Solution,
 4. Water
- 4.1 Take one ml of Fehling's solution "A" with the help of syringe marked "A" in the test tube and similarly take one ml of Fehling's solution "B" with the help of syringe marked "B" in the same test tube.
 - 4.2 Add 1 ml honey solution and 2-3 pieces of pumice stones to avoid bumping in test tube while heating. These stones can be used repeatedly after cleaning.
 - 4.3 Heat gently by holding the test tubes with a help of test tube holder, till the colour of the solution changes from blue to brick red.
 - 4.4 Add a drop of methylene blue indicator.
 - 4.5 Take one ml of honey solution using 1 ml graduated pipette.
 - 4.6 Continue adding honey solution while heating carefully drop by drop, till dark red precipitate at the bottom and a colourless supernatant liquid are formed.
 - 4.7 Note the reading on the pipette. This is the end point.



- 4.8 Repeat the procedure to get at least two consistent readings of the end point.
- 4.9 Volume of honey solution is directly corresponding to the value of total reducing sugars (end point) as per Table 2. For Example - If total honey solution consumed is 1.78 ml then corresponding total reducing sugars in honey is 74%.
- 4.10 Reject the sample reading more than 2.05 ml. Which correspond to contain less than 65% Total Reducing Sugars.

Table-2 Volume of Honey Solution and corresponding total reducing sugars

Volume of Honey Soln.	Total reducing sugars%	Volume of Honey Soln.	Total reducing sugars %
(end point)		(end point)	
1.51	83	1.81	73
1.54	82	1.84	72
1.57	81	1.87	71
1.60	80	1.90	70
1.63	79	1.93	69
1.66	78	1.96	68
1.69	77	1.99	67
1.72	76	2.02	66
1.75	75	2.05	65
1.78	74	More than 2.05	Less than 65

NOTE:

The quantity of honey 14 units (approx.0.35 ml) from given syringe) taken based on the 20% moisture content honey which weights 0.5 g. If the moisture is less than 20%, add 1 percent to the reading of sugars for every percent of moisture less than 20%. And if the moisture is more than 20% deduct 1 percent from the reading of sugars for every percent of moisture more than 20%. For example if the end point is 1.60 (corresponds to 80% TRS) obtained for honey containing 19 % moisture then the sugar content would be $80 + 1 = 81\%$ and for honey containing 21 % moisture the sugar content would be $80 - 1 = 79\%$.



5. Test for Non Reducing Sugars (Sucrose %)

5.1 Take 3 pieces of Pumice stones in test tube and take same honey solution (as in 3) up to the mark. (Note: It is necessary to take the Pumice stones in the test tube before taking the honey solution).

5.2 Add 2 drops of concentrated Hydrochloric acid using the dropper

5.3 Boil gently for one minute and allow to cool.

5.4 Make up the volume by adding water to its original mark.

5.5 Add Sodium carbonate powder pinch by pinch to neutralize till no effervescence appear.

5.6 Perform the titration as in 4, observe the end point and corresponding value as per table 2. This is "B".

5.7 Calculate the percentage of non-reducing sugars as follows.

Percent of non-reducing sugars value (5.B - 4.A) Eg. If reading of honey solution before inversion is 1.78 rnl = corresponding total reducing sugars 74% (4A). If reading after addition of acid and sodium carbonate is 1.72 ml corresponding total reducing sugars after inversion are 76% (5B)

Then Calculate Percentage of non-reducing sugars (76 - 74) = 2% This should be less than 5 percent as per *AGMIBIS*. If more send the sample to lab for detail analysis.

Precautions:

1. Liquefy honey if granulated before analysis by heating it indirectly in a water bath at 400 C, for 15 minutes till all the crystals are dissolved.
2. Please clean thoroughly syringes, glass wares etc. immediately after use.
3. Keep honey testing kit away from flame and reach of children.
4. Refer BIS Bulletin NO. 4941-1994 for more details.
5. All laboratory grade reagents are readily available with the distributors of chemical reagents. 3.4639 g copper sulphate accurately weighed, when dissolved in water and made volume 50 ml yields 0.05 N Fehling's Solution "A". 17.3 g of potassium sodium tartrate and 5 g of sodium hydroxide both dissolved in water and made volume 50rnl yields Fehling's Solution "B".



Thus, beekeeping can be profitable from the beginning. After it is started and expertise is gained, it is easy for a beekeeper to increase the number of hives. A dependence on outside resources or inputs is not necessary to do this. Bees feed themselves from the existing nectar and pollen resources of the area by foraging far beyond the small amount of land on which small farmers usually consider honey a cash crop instead of a product for home consumption. Honey has a high cash value relative to its weight and bulk. Properly stored, it is essentially a non-perishable product, it is economical and easy to transport. These characteristics make honey an attractive enterprise for small and marginal farmers and can generate additional income.

CENTRAL BEE RESEARCH AND TRAINING INSTITUTE - PUNE

The Central Bee Research and Training Institute (CBRTI) has its origin in a small Apicultural research center at Mahabaleshwar (Maharashtra) in 1952. A unique comprehensive and integrated bee research program was initiated. The Indian beekeeping industry had been largely forest based. The people involved in the beekeeping industry handling *Apis cerana* bees were mostly from rural, tribal and forest populations were using unhygienic traditional and uneconomical methods. This situation called for a thorough understanding of the bees, bee plants and the ecosystem in each beekeeping region to start modern beekeeping industry. The Khadi and Village Industries Commission (KVIC) recognized the importance of strong research base for improving the beekeeping Industry in India under the Directorate of Beekeeping industry established CBRTI at Pune, on 1st November 1962. It was entrusted with the responsibility of Apicultural research and Training activities.

Training Programme under CBRTI, PUNE:

The institute is one of the premier centers for beekeeping training in the country and is recognized internationally as beekeeping training center for developing countries in Asia and Africa continents. The training department conducts following course with modern audio visual aids along with the help of Directorate of Human Resource Development (HRD).



Sr. No.	Name of the Training course	Duration	Eligibility
1.	Diploma course in Beekeeping	6 months	B.Sc. B.Sc.IBiology / AgrilForest
2.	Certificate course in Beekeeping	1 months	S.S.c. or Equivalent
3.	Rock bee handling	20 days	Honey hunters / tribals
4.	Elementary course in Beekeeping	15 Days	S.S.C or Equivalent
5.	Short term Training in beekeeping	5 days	Hobbyist or Amateur
6.	Queen Rearing. pollination pathology. CF Sheet etc.	15 days	Personnel with back-ground in Beekeeping / Beekeeper
7.	Honey Processing	5 days	Any not specified
8.	Analysis of Honey.	5 days	B. Sc. Chern.
9.	Tailor made course in Beekeeping	10-15 days	In-service persons of Govt. Organisations / Beekeeping Co- op. Society
10.	Management of <i>Apis mellifera</i>	1 Week	Personnel with Back -ground in Beekeeping /Beekeeper
11.	Melittopalynology Pollen & propolis collection	1 week	Personnel with back-ground in Beekeeping /Beekeeper
12.	Training in Honey Testing Kit	1 day	Any layman

Course No.1, 2, and 3 are stipendiary. Other courses are on payment basis.

Marketing:

Recently this Institute has taken up TRADING activity of Honey and other bee products at National Level. Now the consumers get PUREST NATURAL and BEST QUALITY OF PROCESSED AND AGMARKED "KHADI HONEY" at cheapest price which is packed under most hygienic conditions in most suitable packing through new HONEY PARLOUR.



References

1. "Honey", Extension Folder, **Directorate of Forest Based Industry**, Khadi and Village Industries Commission
2. "Beekeeping for beginners, Extension Folder, **Directorate of Forest Based Industry**, Khadi and Village Industries Commission
3. "Technical Bulletin on "Pollen, Royal Jelly and Modern Honey Testing Kit" by CBRTI, Pune.

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Mr. Melywn D'Souza – 9890961831

Mr. Savio – 9764894212

Mr. Suprajit Raikar – 9689924767

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Contact for :
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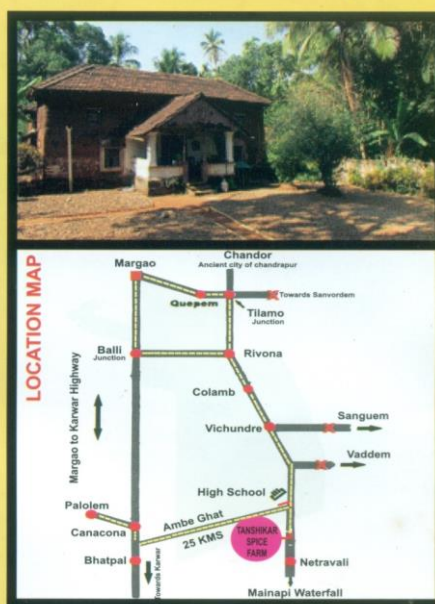
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Location Map



Tanshikar Rest House is just 35KM from Palolem beach, 50Km from Margao & 91Km from Panaji.

Tanshikar

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