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Post Harvest Techniques Responsible For Quality Production of Honey in Bastar Tribal Regions

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Introduction

According to the Codex standard for honey adopted by the Codex Alimentarius Commission, Honey is the natural sweet substance produced by honeybees from the nectar of plants or from secretions of living parts of plants or excretions of plant sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store, and leave in the honeycomb to ripen and mature.

According to FSSAI, Honey is the natural sweet substance produced by honeybees from the nectar of plants or from secretions of living parts of plants or excretions of plant sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store, and leave in the honeycomb to ripen and mature.

Categories of Honey

Monofloral honey is where the bees have been foraging predominantly on one type of plant and is named according to that plant. (> 45% pollen from one plant). Few examples are:

- Thyme Honey
- Jamun Honey
- Acacia Honey
- Lychee Honey
- Clover Honey
- Ajwain Honey
- Acacia Honey
- Buckwheat Honey
- Clover Honey

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- Dandelion Honey
- Clover Honey
- Heather Honey
- Lavender Honey
- Orange Blossom Honey

Uni-floral honey's price is always several times higher than multi-floral honey, this is because, the dominant blossom's nectar and pollen determine the taste, flavor and properties. The premium quality of unifloral honey also depends upon geographical area and plant species e.g., Mahua honey from Bastar. Unifloral honey is the result of two conditions. First, the target plant must predominate so the bees have little choice of plants. Second, the beekeeper must time the introduction of the hive and the actual harvesting of the comb to coincide with this blooming period.

Multifloral Honey (also known as polyfloral) has several botanical sources, none of which is predominant (<45% pollen from one plant). This definition should not be seen as a lack of identity or minor quality. There is not only one single type of multifloral honey because there are endless possible floral combinations which may exist in honey. Every kind of multifloral honey has its own specific features that repeat themselves year after year with a smaller or greater degree of variability.

Nomenclature of Honey according to Production

- **Extracted honey:** It is the most basic and widespread hive product. It is obtained by centrifuging decapped broodless combs. Honey extraction is the central practice of removing honey from honeycomb so that it is isolated in a pure liquid form. The honey is stored by honeybees in their beeswax honeycomb.
- **Pressed Honey:** Itis honey obtained by pressing brood less combs with or without the application of moderate heat. Although this is more complex but also more gentle than the usual spinning. Pressed honey has a very intense aroma and contains a lot of flower pollen.
- **Drained Honey:** It is honey obtained by draining decapped broodless combs. Honey may be designated according to the following styles according to the processing procedure:

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- **Comb Honey:** Itis honey, stored by bees in the cells of freshly built broodless combs an which is sold in sealed whole combs or sections of such combs.

Chunk Honey: It is honey containing one or more pieces of comb honey.

Creamed (or creamy or set) Honey: It is honey which has a fine crystalline structure, and which may have undergone a physical process to give it that structure and to make it easy to spread.

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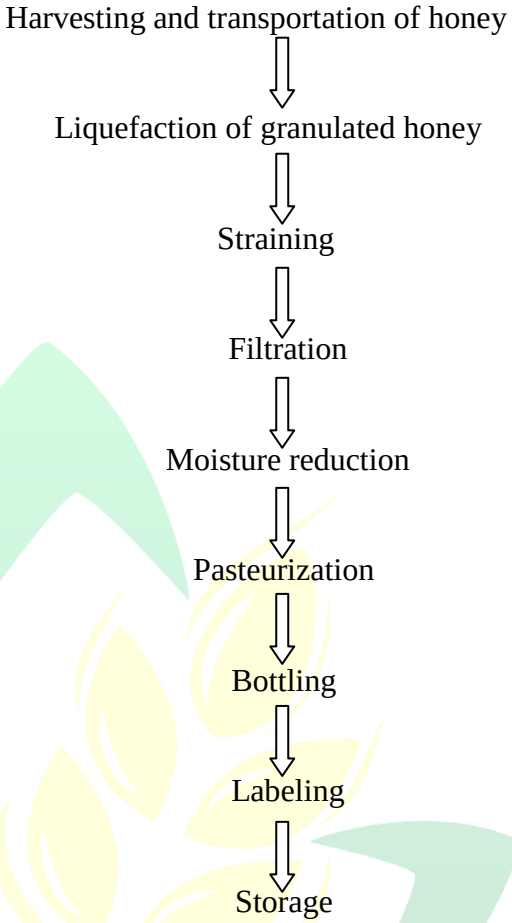
Honey Processing: Flow diagram of Honey Processing



1. Harvesting and Transport of Raw Honey

Some procedures for harvesting and transport of honey must be followed, so that there should be efficient collection, to maintain its original characteristics and composition, hence its quality. In rainy days or when the relative humidity is high, harvest of honey is not recommended, because this would lead to increased moisture content in the honey. When harvesting, care should be taken not to throw smoke directly on the honeycombs; this should be performed at small amounts, by using the bee smoker far away from the frames of honeycombs. These procedures are followed so that there is reduction of the incorporation of the smoke able smell into honey. High colony yields are only possible with well populated colonies in areas with abundant nectariferous flora. The honey needs to be harvested before the bees can consume it for further colony development, but sufficient quantities have to be left to provide for the basic needs of the colony. However, the different management and harvesting techniques can influence the final quality of the honey.

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Honeycombs that are at least two-thirds capped are uncapped using a long-handled uncapping fork, the beekeeper scrapes the caps from both sides of the honeycomb onto a capping tray. The honeycombs are inserted into an extractor, a large drum that employs centrifugal force to draw out the honey. The extractor is started at a slow speed to prevent the breaking of combs. As the extractor spins, the honey is pulled out and up against the walls. It drips down to the cone-shaped bottom and out of the extractor through a spigot. Positioned under the spigot is a honey bucket topped by two sieves, one coarse anyone fine, to hold back wax particles and other debris. The honey is poured into food grade plastic buckets or drums and taken to the Industrial processor.

Composition of fully Ripened honey

Constituents	Percentage
Levulose	41.0
Dextrose	35.0
Sucrose	1.9
Dextrin	1.5
Minerals	2.0
Water	17.0
Undetermined (enzymes, vitamins, pigments etc.)	16.0

Pigments: Carotene, chlorophyll and xanthophyll are the important pigments present in honey.

Minerals: Potassium, Calcium, Phosphorus, Sodium, Magnesium, Manganese, Copper, Sulphur, Silicaand Iron are the minerals present in honey.

Vitamins: Vitamin B1 (Thiamine), B2 (Riboflavin), Nicotinic acid, Vitamin K, Folic acid, Ascorbic acid and Pantothenic acid are the vitamins present in honey.

Physical Properties of Honey

- Honey is hygroscopic. If exposed to air it absorbs moisture.
- Honey is a viscous fluid.
- Heating of honey reduces viscosity.
- Specific gravity of pure honey is 1.35 to 1.44 gm/cc.
- Refractive index of honey helps to find moisture content which is measured using refract meter.

Purity Test for Honey

- Measure specific gravity of honey using hydrometer.

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- If the specific gravity is between 1.25 to 1.44, honey is pure.

Aroma and Flavour of Honey

- It is acquired from the nectar of the flower.
- It is lost if heated or exposed to air for long time.

Colour of Honey

- Depend upon the nectar of flower and the plant species.
- Dark honey has stronger flavour.
- Lighter honey has more pleasant smell.

The vehicle used in transporting the honey to the processing area must be subjected to a hygienic process. It is necessary that the vehicle did not recently transport any material that might have left some type of toxic residue, or otherwise has strong odor. Long distance transport and keeping the honey buckets in open before processing may lead to the deterioration in quality as it may lead to increase in the hydro methyl furfural and decrease in Diastase activity.

2. Liquefaction of Granulated Honey

Honey crystallization or granulation is a natural phenomenon by which honey turns from liquid (runny) state to a semi-solid state. Crystallization of honey is neither the adulteration of honey with sugar nor it is an unnatural product. Most pure raw or unheated honey has a natural tendency to crystallize over time. Crystallization does not affect the honey except for colour and texture. Crystallized honey is not spoiled and preserves the flavour and quality characteristics of the liquid honey. Some honeys crystallize uniformly; some will be partially crystallized and form two layers, with the crystallized layer on the bottom of the jar and a liquid on top. Honeys also vary in the size of the crystals formed. Some form fine crystals and others large, gritty ones. The more rapid honey crystallizes, the finer the texture will be. Crystallized honey tends to set a lighter/paler colour than when liquid. This is due to the fact that glucose sugar tends to separate out in dehydrating crystals form, and that glucose crystals are naturally pure white. Darker honeys retain a brownish appearance. Heating is the most widely used processing method in the honey because of granulation, high viscosity at low temperature and existence of yeast. According to the various honey regulations, it is forbidden to heat honey as it impairs its quality significantly. Therefore, honey should be liquefied in such a way as to avoid heat damage to its various constituents. The liquefaction time depends on the glucose concentration; the higher the glucose content and the larger the

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crystals, the longer the liquefaction time. Heating should be applied indirectly, not by direct flame to a container. Heating at higher temperatures of for a longer period of time will cause honey damage, development of hydroxymethyl furfural, loss of diastase, decrease of aroma and in extreme cases building of a caramel like taste because of maillard reaction. Overheating is determined most easily by the measurement of hydroxymethyl furfural (HMF)and honey enzyme activity. Honey should be heated with care to prevent overheating.

Heating by water bath:

- This is best for the batch process and also from point of optimal heat transfer. The care should be taken that temperature should not go beyond 40oC to 45 ^{o}C. The time required will depend upon amount of honey taken, the extent of granulation and kind of honey. Stir occasionally to even the heat throughout the honey, as crystallized honey is a poor conductor of heat. It is a lengthy process and may take several hours. There are only few commercially available heating water bath systems.
- Honey can be liquefied by using the double jacketed vat. Hot water was circulated in a water jacket around the honey container to heat honey. The temperature of the circulated water should be maintained in such a way that maximum temperature of honey should be around 45 degree Celsius.
- Immersion heaters can be placed on the granulated honey, which progressively sink upon honey melting. This high-quality food-grade stainless steel immersion heater can be used. Simply hang the heater on the top of the honey drum with the heat coils resting on the inside of the tank. The temperature controller is also there, and a heat range from 30^{o}C to 80 ^{o}C can be adjusted.
- Honey can be liquefied by placing the vessels on electric plates or directly placed on the wood fire. Although an air gap is maintained between the electric plates or the wood fire and the honey drum, but still it is a kind of direct heating of honey and is not recommended. This type of heating is widely used by small beekeepers.

Water bath method utilizing geothermal water

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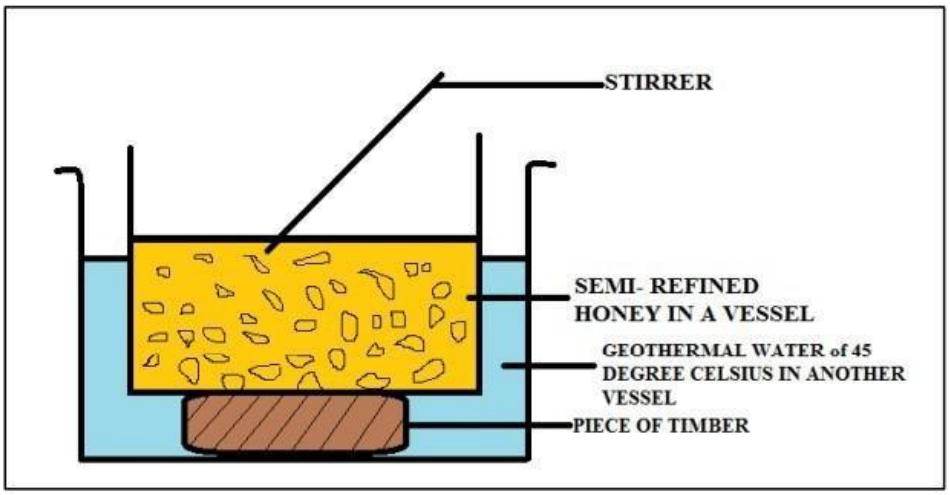
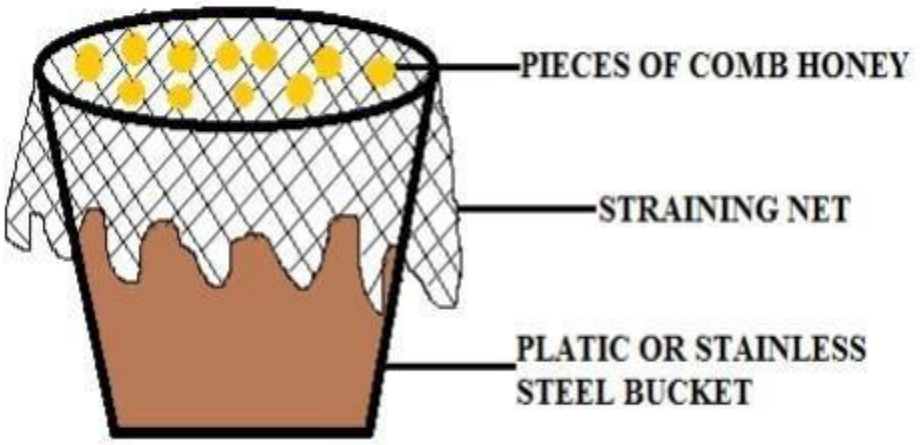


3. Straining

The straining operation to remove suspended solids (including large wax particles) is carried out either manually or by mechanical means. The method and the equipment used for straining depend on the size of the operation. In small-scale operations, straining is done using cloth or nylon bags, which are frequently cleaned to remove the suspended particles. In large-scale operations, the straining operation is combined with the preheating (up to 40°C) operation in a jacketed tank fitted with a stirrer. The uncapped honey is allowed to strain through a cotton cloth or net into a dry suitable container. After that the folded straining net or cloth is tie over the mouth of the container. Than allow the liquid honey to settle overnight. The scum needs to be removed from the surface of the honey through spoon before the honey is packed.



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4. Filtration

The strained honey is further processed using pressure filters. Typically, a polypropylene micro filter of 80 µm is used as a filter medium. The honey temperature is maintained between 50 – 55°C, which prevents the melting of the beeswax. Large-scale processors subject honey to coarse filtration, centrifugal clarification, fine filtration, and blending, prior to filling. The filtration should be done carefully so that required pollen count in the honey must be retained. The various types of filtration units which are available are filter press, sparkle filters etc.

5. Moisture Reduction

Moisture is one of the most important parameter of honey quality. Most of the extracted honeys are having the higher moisture than the prescribed standards because of extraction of unripened honey. The amount of water present in honey determines its stability against fermentation and granulation. Honey having high water content ferments easily with time. So, it is necessary to process the honey by subjecting it to thermal treatment to prevent fermentation by sugar tolerant yeasts. Treatment in a closed system minimizes losses of volatile aroma during heating. The honey streams help in increasing the exposed surface area of honey in contact with drying air. In this multiple effect evaporation system, raw honey was preheated (40–45 °C) and then filtered through 80 lm polypropylene micro-filter. This honey was heated up to 60–65 °C in first effect to destroy osmo-phillic yeast cells, held at 60°C for evaporation of water under vacuum and Then cooled in third effect before passing into settling tanks for bottling.

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Equipment consisted of a closed housing with an inlet port on the top side and an outlet port on the bottom edge. The honey will enter the inlet port and flows downward across a series of trays arranged in a zigzagged manner up to the outlet port. A metal screen is used on each tray to spread the honey evenly throughout the tray. There is a coil and an evaporator heater used to dry and warm the air circulated over the honey layer to remove moisture.

6. Pasteurization of Honey

Honey can be consumed pasteurized or not. Honey is low in humidity and high in acidity, which means that bacteria cannot survive in it. Honey is pasteurized for quality reasons. Pasteurization of honey reduces the chance of fermentation and also delays granulation. Different Temperature and Time combinations are suggested. Heating the honey to 63°C for 30 minutes or 65.5°C for 30 minutes or temperature be brought to 77° C momentarily and followed by the rapid cooling.

7. Bottling

Depending on the market requirement, honey may be bottled directly into small containers for retail sale or into large drums for storage or export to another countries. In an effort to appeal to a wide range of consumers, honey is packaged in containers of many different sizes and styles. These include glass, plastic containers, honey tubs, or even squeeze bottles, Like most aspects of honey processing, bottling can involve automation in large operations, or manual labour such as a hand valve on a plastic pail in smaller operations.

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Presence of air bubbles in the packaging containers can provoke nucleation and crystallization of honey. The filling of honey in the bottles is normally done at the high temperature. Filling at higher temperatures eliminates air bubbles and avoids air incorporation during packing due to low viscosity.

8. Labelling

The label on a honey container in a retail outlet should include the word "Honey" or, possibly, an indicationof a floral source, such as “Mustard Honey. “It also needs to state the net weight, the name and addressof the honey dealer and the FSSAI registration number of the packer, as well as the nutrition facts table.The label should also identify the country of origin and indicate whether the honey is creamed, liquid orpasteurized. Honey sold at a Apiary or farmers' market does not need to meet the same labeling requirements because it's usually coming directly from the producer.

9. Storage

Honey quality deteriorates during storage with time which is actually governed by the storage temperature, moisture content of honey, storage structure and ambient relative humidity. During storage honey becomes darker in colour particularly at higher temperatures. Sugars and vitamin content in honey decrease and acidity increases during storage. The breakdown of various sugars results into increase in hydroxyl methyl furfural (HMF) which is a very sensitive indicator of honey quality. Higher HMF is also an indication of heated

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honey. During prolonged storage, flavour of the honey is also lost. Honey with moisture content above 19 per cent is known to ferment if stored at temperatures between 11-20°C.

Following points should be noted to ensure that honey doesn't deteriorate during storage:

- Honey should be stored in food grade glass or stainless-steel containers.
- The honey stored under refrigerated conditions does not spoil and shelf life remains quite long.
- Honey should be stored in an airtight container and the pack should immediately be closed after its use. It is so because honey being hygroscopic, may absorb moisture in an atmosphere with more than 20 percent relative humidity, which may trigger off some fermentation and spoilage may occur. The colour and taste may also change.
- Care should be taken to ensure that stored honey is free from contaminants.
- The room used to store honey should be dry, clean, and closed. The ideal room temperature for storing honey is 20°C.
- Always label the stored containers and include details of the harvesting date, treatment, and expected storage life.

Studies on various unifloral melliferous honeys have revealed that the honeys do not conform to the quality when stored at 40°C even for 3 months, and the honey start losing their quality after 9 months when stored at room temperature. So, it is always better not to store the honeys for too long and should be finished at the earliest possible.

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