

Bee Wax: Collection and Processing

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BEESWAX

Beeswax is used by the bees to construct their combs in which they store honey, pollen and rear brood. The beeswax is secreted in the form of wax scales by the worker bees in their wax glands located on the underside of the abdomen in the anterior part of the sterna of segment IV to VII. It is estimated that the bees to secrete 1 part of wax consume about 10 to 15 parts of honey. Secreted small wax platelets are scraped off by the bee, chewed and masticated into pliable pieces with the addition of saliva and a variety of enzymes. Once chewed, attached to the comb and re-chewed several times, they finally form part of this architectural masterpiece, a comb of hexagonal cells, a 20 g structure, which can support 1000 g of honey. Wax is also used to cap the ripened honey.



Sources of bees wax

In India, beeswax is generally collected from four species of *Apis* : *Apis cerana indica*, *A. mellifera*, *A. dorsata* and *A. florea*. Therefore, commercial samples of beeswax from India usually represent a composite mixture of waxes derived from these *Apis* species. However, wax marketed in Western and European countries are derived from a single species of honey bee i.e. *A. mellifera*.



Different qualities of wax can be produced by separating new white honeycombs from darker ones or from those with portions of brood.



Wax is rendered from the capping removed during honey extraction. This produces a very high quality, light coloured wax. Light coloured broken combs provide the next quality of wax, whereas old black brood combs yield the smallest proportion and lowest quality of wax. Good quality wax is produced from the combs after honey harvesting from wild bee colonies.



Since whole combs are harvested and crushed or pressed, the proportion of wax per kilograms of honey (10-15%) is much higher than with frame hive beekeeping

Before processing, all comb or wax pieces should be washed thoroughly to remove honey and other debris. Crane (1990) even suggests soaking combs in water for several hours, or up to two days for older brood combs.

Constituents

Virgin beeswax, immediately after being secreted, elaborated and formed into comb, is white. It becomes darker with use inside the hive as pollen, silk and larval debris are inadvertently incorporated. Rendered, but untreated beeswax comes in varying shades of

yellow. Pure white beeswax on the market has always been bleached. The old damaged or diseased combs are the sole sources of natural bees wax which are melted to the pure cake form is darker in colour.

Beeswax is an inert material with high plasticity at a relatively low temperature (around 32 °C). Beeswax is also insoluble in water and resistant to many acids, but is soluble in most organic solvents such as ether, benzene, benzol, chloroform, turpentine oil and after warming, in alcohol and fatty oils. The melting point of beeswax is not constant since the composition varies slightly with its origin. Various pharmacopoeias give a range of 61-66°C or more commonly, 62-65 °C. Pure beeswax from *Apis mellifera* consists of at least 284 different compounds. In those 111 are volatile and 48 compounds were found to contribute to the aroma of beeswax. Quantitatively, the major compounds are saturated and unsaturated monoesters, diesters, saturated and unsaturated hydrocarbons, free acids and hydroxy polyesters. The composition of wax from Asian honeybee species is much simpler and contains fewer compounds in different proportions. The wax secreted by *A. cerana indica* however conforms to British and Pharmacopoea standards except for its low acid value. The other two Indian waxes have lower acid values and lower melting points thus do not match these standards. It is therefore necessary to extract the waxes from different Indian species separately instead of mixing them together.

•Hydrocarbons	14 %
•Monoesters	35 %
•Diesters	14 %
•Triesters	03 %
•Hydroxy Monoesters	04 %
•Hydroxy Polyesters	08 %
•Acid esters	01 %
•Acid Polyesters	02 %
•Free Acids	12 %



Methods of beeswax Extraction

India produces large quantity of beeswax and most of which is exported. In order to increase our production and its quality for export, we have to improve methods of collection, extraction and purification etc. The old, damaged and diseased honey combs are collected and then extracted using one of the following methods.

Wax should never be heated above 85⁰C. If wax is heated directly (without water) or above 85⁰C discolouration occurs. Therefore wax always needs to be processed in water or in a water bath. Wax should not be processed in unprotected steel, iron or copper containers, since it will discolour from reaction with these metals. Direct exposure of wax to hot steam results in partial saponification.

1. Extraction Over Boiling Water

a) **Old wax combs :** The old wax combs are soaked in water for several hours and washed intermittently so as to remove water soluble material from the combs. If this step is not employed, the melted wax will absorb some impurities and colouration also. After this, combs are melted over boiling water. the melted wax floats on the surface and is strained along with boiling water through wet cloth to remove bees and other foreign material present in combs. After cooling, the wax cake is formed at the top of water. The dirt layer at the bottom of cake is removed by scraping.

The water used in the melting process should not contain minerals. Soft water, preferably rainwater, should be used. Stainless steel or aluminum or nickel vessels are desirable. Since wax-acids react with zinc resulting into dull colouration of the wax, zinc or galvanised iron or iron vessels should not be used.



b) **Extraction in hot water wax press :** After the wax is extracted by the above method some quantity of wax remains in the scales or cocoons of the bees that remain after filtration also. This is especially observed with old combs. To extract maximum quantity of wax out of these scales, wax press

is employed. The wax scales or the old combs are put in a cloth bag, which is kept in between the two metal plates of the press. The press is kept in boiling water and the wax bag is pressed between the two plates operated by a screw. The melted wax comes out through the bag and floats on the water. The wax press is very successful when large number of old combs are to be handled. The wax extracted by this method is in most of the cases, darker in colour.

- c) Extraction through wax rendering unit
CBRTI has designed wax rendering unit to get the wax in its purest form. In this process the wax is melted over boiling water in a stainless steel tank. The melted wax floats on the surface cold water is induced at the below so melted wax comes above and that was collected in a vessel which is covered with filter cloth. Then the molten wax and is poured in the moulds to get the required size and shape of the wax cakes.



Steam wax Extractor

In this process the wax is melted in an insulated tank by steam blown directly into the mass of wax combs or by contact with steam heated coils. The melted wax drops down and settles in the pan located at the base of the extractor. The extraction of wax by this method, however, requires several hours depending upon the quantity of wax, age of combs, efficiency of insulation, etc.

Solar Wax Extractor

This is one of the best methods of wax extraction as the wax is bleached to some extent as a thin film of melted wax flows slowly into the receiving pan. Moreover, there is no likelihood of any contamination



with chemicals or spoilage of colour due to excessive heating. Its disadvantage however lies in the length of time required to melt the wax.

Solar wax extractor has immense potential in our conditions but has not been exploited by the people. This method is very efficient for melting burr and bridge combs, cappings, damaged new combs, etc. The combs are washed with water as described earlier and are placed in solar wax extractor covered with double glass plates. The extractor is arranged in an inclined position facing the sun. The melted wax slowly flows and accumulates in the receptacle, half filled with water.

The wax cakes thus prepared are packed and stored in cool temperature for future use.

Uses of Beeswax



The beeswax has numerous uses in beekeeping as well as in other industries. It is chiefly used to manufacture the comb foundation sheets on which bees construct their combs. In developing countries, most nationally produced wax is used by beekeepers for making comb foundation sheets

In India, rock bees *A. dorsata* are the main source of wax production. This wax is of poor quality owing to impurities such as larval juices, dirt etc., because of unhygienic extraction methods. It was thus, not used in manufacturing the comb foundation sheets. But recent experimentation involving hygienic extraction methods showed its acceptance by the hive bees as comb foundation material.



The cosmetic and the pharmaceutical industries are the other large users of beeswax. For centuries, beeswax was appreciated as the best material for making candles. Ancient jewellers and artisans knew how to form delicate objects from wax and cast them later in precious metals. Colours of ancient wall paintings and icons contain beeswax, which has



remained unchanged for more than 2000 years. Beeswax has long found use in medicinal practices and in creams and lotions. Of all the primary bee products it has been, and remains, the most versatile and most widely used material. Beeswax is also used in waterproofing, shoes and floor polishes, wax models, carbon papers, inks, adhesive tapes, insulating tapes, etc. Large quantities of beeswax are also used in ammunition factories.

As a coating for drugs or pills, beeswax facilitates ingestion but retards dissolution of the enclosed compounds until they reach the digestive tract. Beeswax can also be prepared as a mixture with the drug and then functions as a time release mechanism, releasing the drug over a longer period of time. Beeswax can be used to fill capsules with equal amounts of drugs or other ingredients of various granule sizes. The granules of drugs are made adhesive by coating them with molten wax

Though in many cases beeswax can be replaced with cheaper, synthetic waxes, its very special characteristics, medicinal benefits, plasticity and aroma ensure its continuing use. Many of these characteristics cannot be achieved with artificial waxes. The trend for more natural products in cosmetics may also increase its use. Presently, there is a scarcity of beeswax in industrialized countries,

Bleaching of Beeswax

Beeswax is white in colour when secreted by the honey bees in the form of small wax scales. Bees use this wax for construction of their combs. Bees rear brood and store honey and pollen in the combs. These materials impart yellow to brown colour to the

beeswax. Capping wax, i.e., the wax used to seal cells with mature honey, does not come into contact with pollen, honey or brood. Therefore the white cappings wax is always in the purest form. Change in colour of beeswax is also due to other impurities, place of origin and method of rendering.

Beeswax is extracted by different methods for various industrial applications. Such wax contains impurities and is coloured. Purification and bleaching of beeswax is necessary, when it is intended to use for other purposes, particularly for cosmetic and pharmaceutical uses. Being a biological product, improper methods may make beeswax useless. Following are the methods for bleaching crude beeswax.

I. Physical methods

(1) Adsorbant and filter bleaching :

This is the most common method in the U. S. A. and other Western countries. An ordinary plate and filter press is suitable for bleaching of beeswax. A series of waffle like plates are interleaved with filter paper or canvas cloth and separated by frames. The most appropriate are the square aluminium plates and frames.

A centrifugal pump can be used to maintain an even flow and pressure to the filter press. The hot liquid beeswax with diatomaceous earth or activated charcoal particles (as adsorbant) passes through the pump and filter press. The filter press should be heated by a hot water steam jacket. The temperature of liquid wax should be maintained constant at 90 - 100°C throughout the filtration. The pressure of the pump should be maintained at about 5 kg in the beginning and 18-20 kg at the end. Good agitation of liquid wax should be provided before actual filtration. The drain cocks provided in the frames allow the bleached wax to collect in a pan underneath the press.

This filter press process for bleaching of beeswax is used when large quantity, (1000 kg per day) of beeswax is handled .

(2) Sun/Solar bleaching :

The sunrays absorb some colours over a period of time. This is the most simple and best method for bleaching of beeswax on a small scale. It is, however, a time consuming

method and is not applicable for commercial use. A detailed method of solar wax extraction is described above.

The sun bleaching process requires continuous and strong sunrays for a long period. In some regions this restricts use of solar bleaching. Sun bleaching however is better, since it does not involve use of any chemicals and does not remove as much natural aroma as in other bleaching process.

II. Chemical Bleaching

(1) **Hydrogen Peroxide (H₂O₂) :**

Several chemicals are used to bleach beeswax but hydrogen peroxide is used most commonly. Bleaching takes place at 113°C with rapid agitation. Two or more high speed mixers are needed for this process. Concentrated technical grade hydrogen peroxide is dripped into the hot liquid wax followed by benzoyl peroxide in granular or powder form. The amounts used are based on experience and laboratory tests. Liquid beeswax and the peroxide should be mixed thoroughly by rapid agitation. Since concentrated peroxide is harmful, protective equipment should be used for the eyes, skin and lungs.

The bleaching action should be continued with agitation till the bubbling ceases to appear in the beeswax. Fully bleached wax can then be cooled.

(2) **Sulphuric Acid (H₂SO₄) and Sodium Peroxide (Na₂O₂)**

Beeswax is melted by direct contact with steam. The wax is drawn off after settling and treated with a solution formed of H₂SO₄, 12.5; Na₂O₂, 9.5; and water 978 parts. The bath is rendered slightly alkaline by adding sodium silicate solution. It is heated with steam to 78-80°C and agitated with a current of air. The wax is then drawn off into acidulated water which has been boiled by steam. The bleached wax is then collected in a suitable container.

Care should be taken to choose suitable containers for handling beeswax. Containers made of wood or stainless steel are the best, but aluminium vessels can also be used. The bleached wax can further be made into cakes of desired shape and size.



Storage

Beeswax should only be stored in its rendered, clean form. Before rendering, it will quickly be attacked by wax moths, which are able to destroy large quantities of wax in short periods of time. Clean wax in large blocks is not attacked by wax moths. Storage should be in cool dry places and never in the same room with any kind of pesticide. Wax will slowly crystallize over time and as a consequence become harder, but this process is reversible without any damage, just as with crystallized honey. The white bloom, i.e. dust, that sometimes appears on the outside of a wax cake or candle consists of small wax crystals. When melted or pressed with the rest of the wax it reverts to normal beeswax without any residues or impurities. Wax can be stored for very long periods of time without losing its major characteristics as items from Egyptian graves more than 2000 years old have shown.

Preparation of Comb Foundation Sheets:

Quality C.F sheets are usually made by specialized manufacturers, since the pattern imprinting requires special roller presses. Such presses, were very expensive, ranging from hand operated roller presses to complete Automatic manufacturing. However, since at least 1989 inexpensive presses with moulded plastic rollers have been available at lower price of metal rollers. These plastic rollers do not last as long as steel rollers, but they are much cheaper to buy. Hand operated roller presses are generally used till 2000. Due to wider spread and development of commercial beekeeping with *Apis mellifera* increase the demand of Comb Foundation sheet. Central Bee Research and Training Institution has procured one Automatic Comb Foundation Mill under UNDP-KVIC Project for supply of Quality comb foundation sheets for *Apis mellifera* . CBRTI is selling the Comb foundation sheet to the needy beekeepers all over India.



The unit is running as service motto. CBRTI also provides the service to the beekeepers who are having the wax, they can bring to CBRTI . The wax is converted into C.F. sheet with nominal service charges. Before processing for C.F.Sheet, wax is tested as per BIS standards to find out its purity. Bees will not accept foundation made of synthetic waxes such as paraffin wax. The bees may accept small quantities of paraffin wax mixed with beeswax. Using such mixed foundation sheets, however, is a severe breach of good beekeeping practices, since it will adulterate all wax rendered from such combs. CBRTI is taking care of all these things during preparation of C.F. Sheet. CBRTI also impart training in collection and purification of beeswax . CBRTI also conducted training cum awareness camps in tribal populated areas of different states to bring the awarenss to collect the bees wax from the natural colonies. Purification methodologies also thought with audio visual aids