

# Nectar

By Chris Colby

**T**he 1970s and '80s saw a spike in generic food. Many supermarkets sold food (or “food”) in white containers labeled with only the name of the food. These days, consumers are more aware of where their food comes from, how it is processed, and the varieties available.

Recently I learned – mostly as a result of making mead and judging some mead contests – that there is a wide variety of honeys out there, and each may be processed in different ways. To understand why different varieties of honey have different characteristics, and how processing affects these traits, it's best to start with how bees make honey.

### Winter in the hive

Honeybees are eusocial insects, meaning they have a queen that lays eggs while all the other females in the hive are nonreproductive worker bees. All the worker bees are sisters. During winter, honeybees mostly remain in their hive. The numerous worker bees huddle around the queen, forming a winter cluster. The heat

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Learn more about bee safety and beekeeping in our common-sense guide for beginners (<http://bit.ly/10C82Y5>).

Forum/darmanax



Y. HANCOCK; INSETS: CLOCKWISE FROM TOP RIGHT: CHUCK'S TOOLS PHOTOGRAPHY; FOTODIA (3); TERRY OWEN; ACHINA; AM13; SHUTTERSTOCK

of their metabolic activity, which can be increased by shivering or beating their wings, keeps the queen and other members of the cluster warm – quite warm, in fact. The queen is kept at 81 degrees Fahrenheit during the coldest days of winter. The fuel for all this heat is the honey produced earlier in the year.

### Spring and beyond

Once the first spring flowers emerge, worker bees visit them and collect nectar and pollen. Nectar is a liquid solution, produced by the plant, containing more than 50 percent water. The main solid dissolved in nectar is sucrose, followed by lesser amounts of fructose, glucose, maltose and other sugars. Whatever floral compounds responsible for the flower's scent are also present in the nectar. A worker bee collects 50 to 60 milligrams of nectar – about 90 percent of her body weight – before returning to the hive. Much of this nectar is stored in the bee's honey sac (or honey

stomach), an outcropping of the digestive system.

Pollen is “plant sperm,” and worker bees collect this, too. Worker bees get pollen grains stuck on their “hair” when they visit flowers. They then groom themselves to roll the pollen into balls and move the balls to their pollen basket, a structure on their hind legs. They bring this pollen back to the hive. Of course, some pollen rubs off the bee whenever she visits a flower, potentially pollinating it, and that is why flowers maintain the necessary features to attract bees.

Worker bees use some of the nectar and pollen for their own nutrition. They will also regurgitate it to feed their sisters. The remaining nectar and pollen, if any, goes toward honey production. In early spring, most of the nectar and pollen is immediately consumed by the workers to restore the health of the hive, fuel hive maintenance activities, and produce new bees. Typically, honey production lags behind the first appearance of flowers by several weeks.

Hives stand at the ready for their winged residents. **INSETS, CLOCKWISE FROM TOP RIGHT:** A spoonful of delicious-looking honey goes into a sealable jar; a colony of bees swarms before finding a new home; a honeybee laden with pollen returns to the hive; and a beekeeper inspects a frame covered with bees and wax from a Langstroth-style beehive.



TOP TO BOTTOM: Fireweed (*Chamerion angustifolium*) is a favorite flower for honeybees, and the resulting honey has a mild flavor; while gathering pollen, honeybees also help with pollination; some people consider bee pollen to be a healthy food supplement; and beekeepers often remove the raw honeycomb before harvesting the honey.

## From nectar to honey

Honey production actually starts inside individual worker bees. The honey sac secretes enzymes into the nectar to begin modifying it. One of these enzymes is invertase, which splits a sucrose molecule into its two component sugars – fructose and glucose. Another enzyme is glucose oxidase, which begins converting glucose into gluconic acid and hydrogen peroxide. Hydrogen peroxide acts as an anti-bacterial agent, and the bees secrete this enzyme to a greater degree in nectars with higher water content – in which bacterial growth is more likely.

Back at the hive, nectar may be regurgitated into other bees or into cells in the comb. Once in the comb, the bees fan the liquid with their wings to dehydrate it. The liquid nectar gradually loses water, and when the liquid content reaches 17 percent, the cell in the honeycomb is capped, sealing in the solution that is now honey. In arid conditions, honey may contain as little as 15 percent water.

The low water content of honey ensures that bacteria cannot reproduce and lead to spoilage. It also prevents wild yeasts from fermenting the honey. (*Clostridium botulinum* spores, however, can survive in honey, so it is not advisable to feed it to children under the age of 2. Adults will excrete the spores before they can grow and cause a problem. However,

in young children, whose guts may not be completely colonized by bacteria, this botulinum-toxin producing bacteria can take hold.)

Honey is sweet, but it is also acidic. Honey gets its acidity mainly from gluconic acid, but may also contain citric acid and malic acid (the most abundant acid in green apples). Honey can also contain acetic acid (the main acid in vinegar) or butyric acid. Butyric acid is found in some cheeses and is also the acid that causes the distinctive smell of human vomit. Excessive amounts of either acetic or butyric acid yield off flavors or aromas.

The pH of honey varies, but the median value is 3.9, a value slightly higher than most fruit juices. Most honey is light in color. However, there are some darker varieties, and those honeys typically have higher pH values and higher levels of sodium and potassium.

Bees also unload their pollen into cells within the honeycomb. The mass of pollen in a comb cell is called bee bread and is the major source of protein, oils, vitamins and minerals for the bees. Pollen is essential for the development of young bees. During the gathering and placing of nectar in cells in the comb, smaller amounts of pollen end up in the nectar cells and therefore in the final honey.

Wild bees produce sufficient honey to survive the winter and restart hive activity in the spring. Commercial honeybees, however, have been selected to produce a large excess of honey. Beekeepers take honey from commercial hives when it reaches a level at which removing it does not endanger the hive.

So, in short, bees take liquid nectar from flowers, break down the sucrose in it and evaporate much of the water to leave a stable form of nutrition for the hive. Honey contains not only the sugar from the nectar, but also the aroma compounds of the flowers from which the nectar was harvested. Raw honey also contains stray pollen grains and bee parts (wings, legs, etc.), wax from the comb, propolis (a resin bees use to seal their hive), and airborne contaminants such as wild yeast and bacteria. Consumers can buy honey in many forms, ranging from honeycombs to the popular liquid honey. In addition to the different forms of honey, there are different varieties of honey – determined by the type of nectar used to produce it.

## Forms of honey

Honey can be purchased raw, but most commercial honey is processed in one or more ways. Honey may be filtered, pasteurized or creamed, and each process alters the honey with the goal of making it more desirable to consumers. Increasingly, however, folks are becoming aware of the health benefits of raw honey.





## Pasteurization and crystallization

Many foods are pasteurized. However, the water content in raw honey is low enough that the growth of microorganisms is suppressed. So why is some honey pasteurized? Honey is pasteurized to slow the formation of crystals. In raw honey, particles floating in the honey – pollen, bits of wax, etc. – serve as the nucleation site for a crystal. Crystallization does not harm honey – simply heating it melts the crystal back into a liquid. However, many consumers find crystallized honey unsightly. Pasteurization does not harm the honey, but some of the more delicate aromas may be destroyed. Also, small amounts of caramelization may occur in the process.

## Filtration

Most commercially available honey is filtered. Although raw honey is perfectly safe to eat, it may not appeal to consumers.

Honey can be filtered to various degrees. Some raw honeys undergo a coarse filtration that really only removes wings and “chunks” large enough to be seen with the naked eye. Most commercial honey, however, is filtered to remove particles down to 0.1 to 10 micrometers. This filtration is tight enough to not only remove macroscopic contaminants, but most pollen as well.

Another, even tighter form of filtration is ultrafiltration, which separates out particles as small as 0.001 to 0.1 micrometers. In order for honey to be ultrafiltered, it must first be watered down. The filtered liquid is used in the food industry as a sweetener, but is not considered a honey because its water content exceeds 20 percent.

## Creamed honey

Creamed honey is honey that has been whipped to break down any existing crystals in the honey to a very small size. This retards the quick formation of large crystals. The result is a honey that is somewhat granulated.

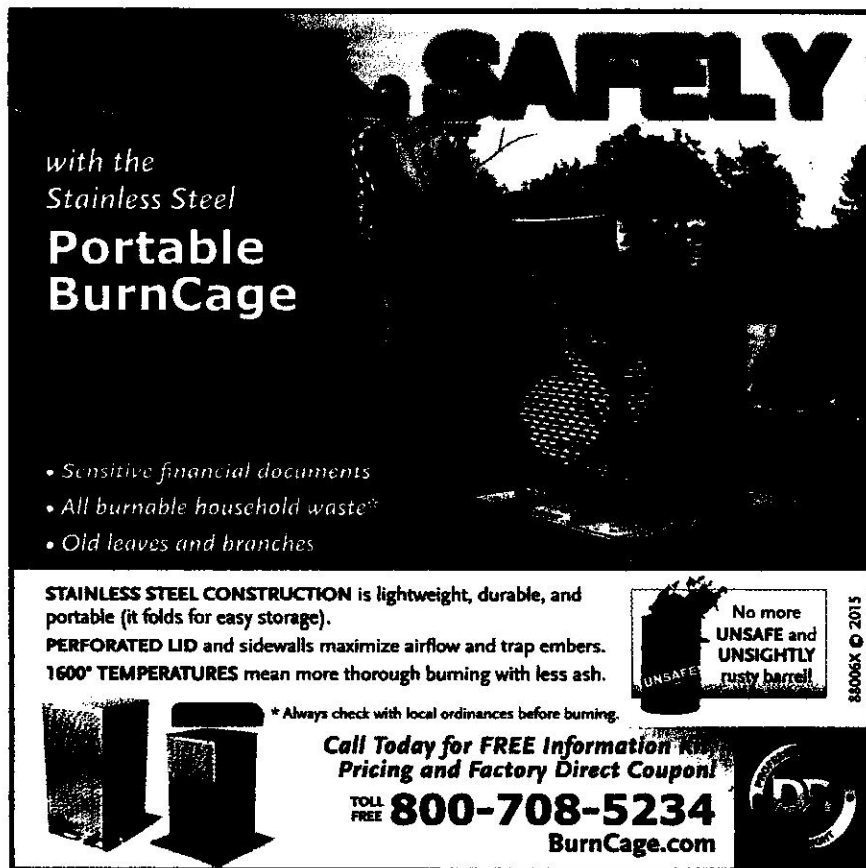
## Raw honey

Many honey producers also sell raw honey. Raw honey is usually lightly filtered – just enough to remove the large bits. Raw honey will crystallize, but can be reheated to dissolve the crystals. Because it is not pasteurized, the aroma of the honey will not be diminished. Raw honey may be slightly more nutritious than filtered honey because of the small amount of protein found in the pollen grains.

Mead makers – the folks who make honey wine – view raw honey as the highest quality honey. Compared to other forms of honey, raw honey just smells and tastes better. Some claim honey harvested earlier in the season is generally preferable to honey harvested later.

Raw honey is generally sold as a liquid, although it may be crystallized on the store shelf. Some sources also sell chunks of honeycomb. This is, of course, as raw as honey gets – but it also takes more work to get the honey you want if you need to drain it from the comb. 🐝

*Chris Colby is an avid gardener who lives in Bastrop, Texas, with his wife and cats. His academic background is in biology – a Ph.D. from Boston University – but his main interest is in brewing beer.*



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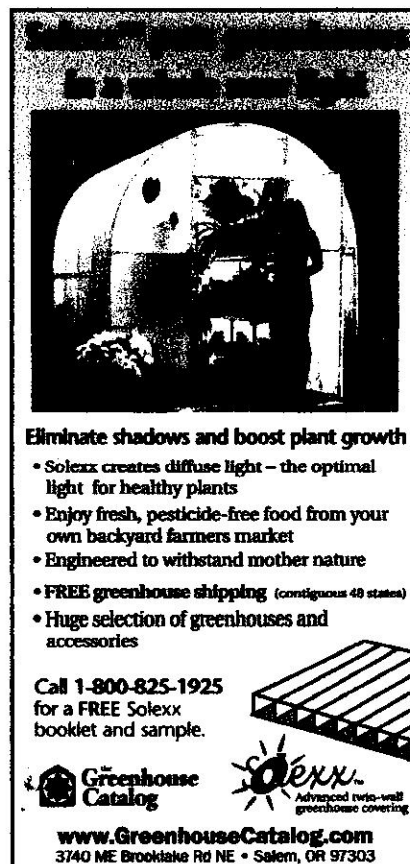
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