Honey Crystallization

What is crystallized honey?

Honey sometimes takes on a semi-solid state known as crystallized or granulated honey. This natural phenomenon happens when glucose, one of three main sugars in honey, spontaneously precipitates out of the supersaturated honey solution. The glucose loses water (becoming glucose monohydrate) and takes the form of a crystal (a solid body with a precise and orderly structure).[1] The crystals form a lattice which immobilizes other components of honey in a suspension thus creating the semi-solid state.[2]

The water that was previously associated with the glucose becomes available for other purposes, thus increasing the moisture content in some parts of the container of honey. Because of the increased moisture, the honey becomes more susceptible to fermentation.

While crystallization is usually undesirable in liquid honey, controlled crystallization can be used to make a desirable product. Crystallization can be deliberately induced, and with control, can be used to create a product known as cremed honey. This is also known as creamed honey, spun honey, whipped honey, churned honey or honey fondant. Spontaneous crystallization results in a coarse and grainy product. Controlled crystallization results in a product with a smooth, spreadable consistency.

Why does honey crystallize?

Honey crystallizes because it is a supersaturated solution. This supersaturated state occurs because there is so much sugar in honey (more than 70%) relative to the water content (often less than 20%). Glucose tends to precipitate out of solution and the solution changes to the more stable saturated state.

The monohydrate form of glucose can serve as seeds or nuclei which are the essential starting points for the formation of crystals. Other small particles, or even air bubbles, can also serve as seeds for the initiation of crystallization.

What factors influence crystallization?

Many factors influence the crystallization of honey. Some batches of honey never crystallize, while others do so within a few days of extraction. Honey removed from the comb and processed with extractors and pumps is likely to crystallize faster than if it was left in the comb.[1] Most liquid honey crystallizes within a few weeks of extraction.

The tendency of honey to crystallize depends primarily on its glucose content and moisture level. The overall composition of honey, which includes sugars other than glucose and more than 180 identified substances such as minerals, acids and

proteins, also influences crystallization. Additionally, crystallization can be stimulated by any small particles–dust, pollen, bits of wax or propolis, air bubbles–that are present in the honey. These factors are related to the type of honey and are influenced by how the honey is handled and processed. Storage conditions–temperature, relative humidity and type of container–may also influence the tendency of honey to crystallize.

How do the sugars in honey influence its tendency to crystallize?

Honey is composed primarily of sugars, the main ones being glucose and fructose (in nearly equal proportions) as well as maltose and sucrose.[3] Because the sugar concentration is so high, the sugars precipitate out and serve as nuclei for crystals. When honey is heated, the sugar crystals redissolve to a liquid state.

How is crystallization used to make cremed honey?

Having the texture of butter, finely granulated honey makes an exceptional spread. Worldwide. in fact. cremed honey is consumed more often than liquid honey.[4] To produce fine crystals, many seeds or nuclei of solids must be present in the honey. The Dyce process is often used to make cremed honey. The method involves adding starter nuclei to honey after it has been heated twice [to 120 °F (49 °C) and 150 °F (66 °C)] and then strained. Chilled, dried and finely ground honey–serving as the starter seed–is mixed into the cooling, liquid honey. The product is firm in three days, and in six days it has a creamy, spreadable consistency.

Can crystallization be avoided?

Spontaneous crystallization is controlled primarily through proper storage, heating and/or filtering. Holding honey at temperatures in the range of 104–140 °F (40–71 °C) during bottling also slows the rate of crystallization. Mild heat treatment delays crystallization by dissolving crystals and flash heating to 140–160 °F (60–71 °C) dissolves crystals and expels incorporated air (which can also stimulate crystallization). Filtering removes particles that can act as nuclei that might initiate crystallization. Honey with a low glucose-to-water ratio is likely to remain liquid, avoiding crystallization. [1]

Do certa[illegible]f honey crysta[illegible] readily than o[illegible]

Although most varie[illegible] of honey crystallize aft[illegible] extracting, those that contain less than 30% glucose, such as tupelo and sage honeys, resist granulation.[3] Table 1 lists several varieties of honey and their granulation tendencies.

How does crystallization affect honey quality?

In terms of consumer appeal, granulated honey is generally regarded as unacceptable. When granulation is incomplete, the crystalline layer is overlaid by a layer of liquid with a water content higher than that of the original honey. This creates a favorable environment for the growth of yeast and may lead to fermentation.[1]

How does storage affect crystallization?

At room temperature, crystallization begins within weeks or months (but rarely days). The crystallization process can be avoided with proper storage, with emphasis on proper storage temperature. For long-term storage,

the use of air-tight, moisture-resistant stainless steel drums is recommended.

Cool temperatures [below 50 °F (10 °C)] are ideal for preventing crystallization. Moderate temperatures [50–70 °F (10–21 °C)] generally encourage crystallization. Warm temperatures [70–81 °F (21–27 °C)] discourage crystallization but degrade the honey. Very warm temperatures [over 81 °F (27 °C)] prevent crystallization but encourage spoilage by fermentation as well as degrading the honey.

Processed honey should be stored between 64-75 °F (18-24 °C). Unprocessed honey should be stored at or below 50 °F (10 °C). Alternatively, one study has shown that honey can be preserved in a liquid state if it is stored at 32 °F (0 °C) for at least five weeks, followed by storage at 57 °F (14 °C).[5]

Does the container in which the honey is stored affect crystallization?

Honey is sensitive to moisture in the surrounding atmosphere. During storage, low-density polyethylene containers can allow moisture to escape, which may contribute to the crystallization process.[1]

References

[1] Assil, H.I. et al. 1991. Crystal control in processed liquid honey. Journal of Food Science 56(4):1034.
[2] McGee, H. 1984. "On Food and Cooking: The science and lore of the kitchen." Macmillan Publishing Company, New York.
[3] Crane, E. 1980. "A Book of Honey," Charles Scribner's Sons.
[4] Graham, J.M., ed. 1992. "The Hive and the Honey Bee," Dadant & Sons, Inc., Illinois.
[5] Townsend, G.F. Processing and storing liquid honey. Chpt. 9 in "Honey."

Table 1. Crystal[illegible] Tendencies of V[illegible]ral Types of Honey

Honey	Crystal[illegible]
Acacia	-
Alfalfa	+
Cotton	+
Cranberry	-
Dandelion	+
Gallberry	-
Grape	-
Mesquite	+
Mexican Clover	-
Milkweed	-
Palmetto	-
Prune	+
Rape	+
Raspberry	-
Sage	-
Sourwood	-
Sunflower	-
Tupelo	-

*** (+) means higher than average values; (-) means lower than average values.**

Adapted from White, J.W., Riethof, M.L., Subers, M.H., & Kushnir, I. 1962. Composition of American Honeys. Tech. Bulletin 1261. U.S. Dept. of Agric.