Ask the Honey Expert

by JONATHAN W. WHITE, PhD., President
Honeydata Corporation
725 Tussey Lane
State College, PA 16801
Fax (814) 861-5898 Email: jaqite@home.com

Editor's Note: We are honored to have Dr. Jonathan W. White, the world renowned honey expert, as our newest columnist. He will do an occasional honey question and answer column for the *American Bee Journal.* Dr. White worked for the USDA for many years before retiring and starting his own business, Honeydata Corporation. He now resides at State College, PA and would be happy to answer your honey-related questions. Dr. White has written hundreds of papers, given many talks and authored several chapters on honey in various textbooks. You may recall that he is author of our chapter on honey in *The Hive and the Honey Bee* and still writes occasional articles for the *American Bee Journal.* Dr. White also developed the analytical method for detection of high fructose corn syrup and other adulterants in honey that is now recognized throughout the world (see his April, 2000 *ABJ* article on *Isotope Ratio Testing of Honey*). He says information for his question and answer column is "from my 53-year collection in my technical files, with 89 categories." Readers are encouraged to send their honey questions either directly to Dr. White or the *American Bee Journal.*

Q HMF

What is HMF and why do the Europeans use it as a honey quality factor?

A

HMF is the "quick name" for hydroxymethyl furfural. This material is formed from fructose, the principal sugar in honey, in the presence of acid. Honey is acid enough to facilitate this change. Its production is very slow in honey at temperatures encountered in the hive and in handling by the beekeeper. However, it is accelerated by heat and does accumulate in honey; the rate of formation depends upon the time and temperature to which the honey is exposed. A chart showing the time needed to accumulate 3 milligrams of HMF per 100 g. honey at temperatures from 20 to 80 degrees Centigrade (68° and 176° F) is shown in Chapter 5 of Eva Crane's *Honey: a Comprehensive Survey.* The times range linearly from over 100 days at 30°C (86°F) to 2 days at 60° C (140°F).

Color tests for honey adulteration and quality were introduced over 100 years ago. At that time and since, there was great concern, particularly in Europe, about adulteration of honey with invert sugar; made from sucrose by acid treatment. Many color tests were developed for the invert sugar, the most-used being the Fiehe test. These tests were finally found to be responding to HMF. Many countries will not accept honey showing an HMF value of 5 mg/100g, believing that overheating has reduced its quality. Processing of honey for yeast destruction and liquefaction should include a cooling step after the required time for heating. Bulk honey cools quite slowly otherwise, with significant HMF production until it reaches about 125° F (52° C).

Q Honey Crystallization

Why does honey crystallize?

A

Glucose (dextrose) and fructose (levulose) are the principal sugars in honey. Nearly all honeys contain more levulose than dextrose. The crystals formed in honey after extraction and storage are dextrose hydrate, which consist of one molecule of water combined with each dextrose molecule. Whether or not a honey will granulate is governed by its ratio of levulose to dextrose, which differs among different honeys. Some honeys rarely granulate and some never do so (tupelo, sage) because they have much more levulose than dextrose, meaning that the concentration of dextrose is lower that that providing a saturated solution. Some honeys always granulate rapidly (blue curls). They contain much more dextrose than levulose. Granulation after packing may be due to inadequate processing (heating or filtration) leaving some "seed crystals" in the product. A device to check honey for dextrose hydrate crystals is the "granulation detector" I developed many years ago. It was described in the *American Bee Journal* (91: 376-377, 1961) and was commercially available for a period thereafter. It is easily constructed and shows even minute "seed crystals" in honey. It has been widely used in judging honey.

Q Creamed honey

What's the best way to use honey crystallization for creamed honey production?

A

To produce creamed (finely crystallized, semi-solid) honey is actually quite simple and can be done at home. Dr. E. J. Dyce described the process in a patent (US 1,937,893, 1935). The honey must be heated just enough to dissolve any dextrose hydrate crystals present. After cooling to room temperature, it is thoroughly mixed with not over 8-10% of a finely granulated honey of the texture desired for the final product. Suitable honey spreads, useful as "seed", are widely available in food markets. After thorough mixing and placing in the final containers, they must be held for at least four days at about 57° F or until the texture is okay. This temperature is not critical, a range of about 2 degrees each way is okay, though the Dyce patent states that "a deviation of about 2 or 3 degrees F may double the time necessary for thorough crystal formation."

Q Comb Honey vs. Liquid Honey

Is comb honey better for you than extracted honey?

A

There is little difference between prop-

erly extracted and carefully processed liquid and comb honey. Flavor may be a little better for comb honey.

Q Honey Viscosity

What is the viscosity range for honey?

A

In 1932 Chataway published her work (*Canadian J. Research* 6: 532-547) on the use of viscosity as a means to measure the moisture content of honey. For 60 honeys she found a nearly straight-line relationship between the logarithm of viscosity (by a falling-ball procedure) and moisture by the AOAC vacuum drying method, with an average difference of only 0.20% moisture. She noted that a 0.1% difference in moisture gives a 4-6% difference in viscosity. Monroe in 1943 (*J. Econ. Entomol.* 36: 769-777) measured viscosity for 6 honeys at a range of moisture contents and temperatures. Values he found ranged from 729.6 poises for a sage honey at 18.6% moisture and 41.7° C. to 95 at 50.7°. At 16.5% moisture and 25° C. other values he reported were 115 poises for sage, 87.5 for sweet clover, and 94.0 for white clover honey.

Q Heating Honey

What temperature should I use to strain my honey and yet not darken it or hurt the flavor?

A

A check of my limited files provides the following: Detroy, ARS, 1960: 110-120°F; Townsend & Adie, Ontario Agricultural College, 1954:100-120°F; Sechrist, 1938: 100°F (small scale); E.R.Root, (1936) Below 160°F (!!); *ABC&XYZ of Bee Culture*: (1962): maximum 130°F; *Hive & Honeybee* (1992): 120°F. Some heating is needed to reduce viscosity enough to allow reasonable flow rate; a maximum of 120°F seems to be a good choice.

Q Keeping Qualities

Will honey really keep forever?

A

This depends on what is mean by "keep forever". We have read of the use of honey in ancient times for embalming (preserving) the remains of important people. However, honey does slowly change (darkens and changes somewhat in composition) with storage. If granulated honey is stored for a number of months at room temperature, it may begin to liquefy, beginning at the top. Looking at this, we found that this is a result of the loss of dextrose content, which was described in our Technical Bulletin 1261 (1962). Clover honey from the 1923 and 1957 crops was analyzed. The long time span emphasized these changes: while levulose content of the 1923 honey was only about 8.3% less than the 1957 honey, the dextrose was 30.6% lower. The more complex dextrose-containing sugars, which were formed at the expense of free dextrose, were 150-198% higher in the 1923 honey. Color and flavor were very different. Also given in the Bulletin are analyses of 4 honeys kept at -4° F and at room temperature for 1 ½ to 2 years. The same changes in sugars were found, but to a lesser extent.

So, to answer the question, NO! The only way to keep honey in its original state "forever" is to hold it at freezing temperatures.

Q High Moisture Honey

If I have high moisture honey, what is the most economical way to lower moisture after it has already been extracted on a small-scale basis?

A

Several different methods for reducing the moisture content of comb and extracted honey have been described, for several scales of operation. An earlier described (and obsolete) way is to pass heated air (not over 100°F) over the honey in containers allowing as much surface area as possible, in a confined space and exhausting the air at a slow rate as it picks up moisture.

In my opinion, the best and easiest way is to use a dehumidifier in an enclosed space; this removes the need for heating and also for removing the moist air, since the water is removed and collected by the dehumidifier. Gene Killion described in the *American Bee Journal* (90: 14 (1950) the use of the dehumidifier for comb honey, bringing down moisture in 130 supers of comb honey from 21% to 17.1% at 79°F and relative humidity of 32 in 23 days.

Q Destroying Yeast Cells in Honey

To what temperature should I heat my honey to destroy yeast cells that cause fermentation? Will this temperature darken my honey?

A

A great deal of attention was given in Canada in the 1930s to elimination of the frequent fermentation of honey after extraction. At the time the practice was to heat the honey to 145° and hold for 30 minutes, or to 160° or more and hold for a short time. Obviously, at least the latter practice is detrimental to honey quality, especially since little attention was given to reducing the temperature after the heating. Dr. G. F. Townsend at the Ontario Agricultural College in Guelph studied this and published a paper in 1939 (*Jour. Economic Entomology* 32, 650-655) which included a graph relating time of heating at several temperatures required to destroy five different sugar-tolerant yeasts in honey in small-scale tests. These were very small-scale tests (3 ml., at 100°F before being placed at the test temperature); they were intended as a starting point for further larger-scale work. His data are summarized as follows: time for yeast destruction, 130° F, 170 min., 135°, 60 min., 140°, 22 min., 145°, 7.5 min., 150°, 2.8 min., 155°, 1.0 min. This was a study of thermal death times, needed before any development work; with practical-scaled equipment the come-up time would to some extent reduce these times. They would be more accurate for flash heating followed by rapid cooling. Honey color would not be affected significantly, providing the batches are small or are cooled.

Q Honey as an Antiseptic

Why is honey considered an antiseptic dressing for wounds, yet certain organisms such as yeast and bee disease spores can survive in honey?

A

This is an interesting question. The effective use of honey for medical dressings and other similar purposes requires some dilution. In the early 1960s we studied the long-known antibiotic principle in honey, called "inhibine", finding it due to the production of hydrogen peroxide in diluted honey by a reaction between a little-known enzyme in honey, glucose oxidase, upon glucose (dextrose), producing gluconic acid (which we found to be the principal acid in honey) and hydrogen peroxide. This takes place only while the honey is diluted. A brief review of the early research was published in the *American Bee Journal* (102, 430-331, 1962) and in a later review, (106, No. 6, (1966).

Q Heat Effect on Honey Enzymes

What does it mean when someone says heat destroys the vital enzymes of honey? What are the enzymes and what good are they?

A

Enzymes are, according to Webster's dictionary, "any of numerous complex proteins that are produced by living cells and catalyze specific biochemical reactions at body temperatures." Honey enzymes, largely originating in the honey bee, include "diastase" (alpha-amylase and beta-amylase) which split starch by differ-

ent processes, "invertase", (sucrase, saccharase) which splits the sucrose in nectar into dextrose and levulose, and another sugar, erlose. There are other enzymes: glucose oxidase, which produces gluconic acid, the principal acid in honey, and hydrogen peroxide, and catalase, which destroys the peroxide. All enzymes are inactivated by heat. However, the function of the invertases is to make possible the ripening of honey into the high-density material it is so that the low water content needed to protect it from fermentation is attained.

Q Hygroscopicity

What is honey hygroscopicity? Why is it considered important for bakers?

A

Hygroscopicity is the property of absorbing moisture from the air. In the case of honey it results largely from the high concentration of fructose. It is a desirable property in baking because it assists in keeping baked goods from drying out. It is a very useful property of honey in food manufacturing. A dehydrated honey will revert to a thick syrup in a short time when exposed to the air.