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By George Clayton Cone

Editors Note: George Clayton Cone is Technical Consultant to Lallemand Inc., Montreal, Canada; Director of Lallemand Pty. Ltd., Australia; Marketing Manager for Lallemand North America; and Technical Director of American Yeast Company, Baltimore, Maryland. His 45-year career has been spent in production, quality control, research and development, and the industrial application of yeast.

At the beginning of time, honey wine was the drink of the gods. They were fortunate enough to have a spring in heaven that flowed with mead, and they were kind enough to share it as they walked among us mortals. This is what has been passed down to us in Sanskrit.

Bacchus was no doubt the god of mead before he became the god of wine. Mead was in the Mediterranean region before the vines arrived and was plentiful in cold regions that vines never moved into. It was in Babylon before barley was harvested and malted. Both grapes and grain found their way into honey wine at an early date. At first they complemented the mead, and later honey wine complemented many other fermented beverages. Pure honey wine came to be known as mead. Later blends became known by wonderful mystic names: "pyment" -- mead fermented with grapes; "hippocras" -- pyment with spices added; "metheglin" -- mead with spices or herbs added; "cyser" -- mead with apple juice or cider; and "melomel" -- mead and fruit.

Because of the mild nature of honey, the taste of mead can readily be affected by small additions of any number of herbs, spices, fruits, fruit juices, berries and even vegetables. Also, because of this mild nature, honey can complement numerous fermented beverages without becoming obtrusive.

This mild nature of honey is strongly influenced by the feeding habits of the bee. The flavor and aroma take on the character of whatever flowers the bee is pollinating in the region: clover, citrus, mesquite, eucalyptus, apple, peach, to name a few. The choice for fermentation would depend on the winemakers taste, pocketbook and the availability of a specific type of honey. In order to have absolute control over the honey from the beehive to the fermenter, the meadmaker needs to deal directly with the beekeeper. This is ideal but quite often not possible. Honey companies, such as Dutch Gold Honey, Inc., in Lancaster, Pennsylvania, are owned and operated by people who have spent a life time as beekeepers and are dedicated to preserving the quality and integrity of each type of honey. Minimum processing, pasteurization temperature and time, and optimum storage temperature are stressed. There is a willingness and even an eagerness on the part of the honey producers to work with meadmakers to satisfy their need to preserve the delicate nature of each varietal.

There are many hundreds of different types, classifications and varieties of honey. Care is taken by each processor to select only a few that can be reasonably monitored in order to give the assurance that at least 51% of the honey is as the label states: Clover, Eucalyptus, Orange Blossom, Alfalfa, Blueberry, Sage, Tupelo, Avocado, Safflower or whatever. This endless variety of honey offers the meadmaker a wide choice to select from. Much of the varietal character of the honey carries through to the finished mead.

Great care has to be given to the entire meadmaking process if the delicate nature of a specific honey is to be preserved. The final mead depends a great deal on the handling and, perhaps even more important, the mishandling by the winemaker.

Honey has a great deal going for it in the health food stores, but very little to recommend it in the fermentation process. There are a lot of empty calories. What little protein there is can be easily digested by bees and humans but not by yeast. Some of the protein comes from the pollen. The protein that is produced by the bee is primarily proline, which is the one amino acid that the yeast cannot use unless it is in the presence of a lot of air. The little nitrogen that is present is reduced or bound even further by the milliard reaction when the honey is stored in a warm place. This reaction can be detected by the darkening of the honey with age. Pasteurization coagulates the albumins and colloids and denatures some of the protein which causes them to precipitate out of solution, further reducing the available fermentable nitrogen. Ideally, fresh honey with no boiling or heat treatment will produce the best

Many of the essential vitamins -- inositol, biotin, pantothenic acid, and thiamine -- are either missing or present in insufficient quantities to allow for a healthy fermentation. Minerals, such as calcium, magnesium, potassium, phosphorus and zinc, are required by the yeast for growth and they enter into the metabolic process of converting the sugars to alcohol and the hundreds of other by-products that contribute to the tastes and aromas associated with fermented products and are not present in the raw honey. Most of the minerals are not present in sufficient quantities to give the yeast very much help. They are also part of the buffering system in any fermentation. When these minerals are absent or are present in very low levels, especially potassium and calcium, the carbonic acid and organic acids that are produced by the yeast can rapidly lower the pH to 2.5-2.9, placing excessive stress on the yeast cells. The yeasts never reproduce in the numbers that are required to do an adequate job and those that do reproduce are never healthy. The sugar to alcohol conversion rate is slow. Fermentations become protracted and often stick. Less than the best flavor and aroma profiles develop.

One of the visual characteristics of honey is its clarity. It delights the eye to see light rays sparkle through the amber nectar. It is like the clarity that is expected in good wine, both white and red. However, yeasts do not have eyes and cannot appreciate the lack of particulate matter that gives the honey this clarity. Yeasts are tactile creatures. They love to touch and cling to something. If they did have eyes, they would prefer not to see forever. They would rather have a cloudy, murky environment that would give them support and keep them up where the action is. Otherwise many of them settle to the bottom, form their own little, unpleasant microenvironment, get stressed out, and rebel by putting out unpleasant flavors and aromas and frequently dying before their time. The new yeasts that are struggling to grow receive nourishment from the corpses of their dead and dying comrades. This is not the best way to go. It is long and laborious, taking many months to do the job.

Wine has been made from honey throughout the ages with little or no assistance from man. It just happens naturally over a period of time when honey is diluted with water. It may be that the winemaker was not on any kind of schedule. Perhaps the consumer was not overly critical. Two months, six months, nine months, and even longer was the time expected to complete the fermentation. After all, the gods were at work, and who had the audacity to interfere with them? Today the winemaker is on too tight a schedule and the consumer is too demanding to forgive too many flaws. In addition, there are many other beverages to choose from.

There are too many formulas for making wine from honey to even begin to address each: mead, melomel, metheglin, pyment and hippocras. However, a general guideline for the production of a healthy fermentation can be applied to any fermentation that has honey as the base for the wine.

For the home winemaker, the neat thing about making wine from honey is that he or she has complete control over the initial level of sugar and eventually the alcohol to be produced since the Bureau of Alcohol, Tobacco and Firearms regulations do not cover the home winemaker. The choice can range from a very mild beverage with less than 9% alcohol up to a TNT cocktail of 20% alcohol. As a rule, a 1 ^{o} Brix (or 1% sugar) will produce 0.6% alcohol by volume, i.e., a 20 ^{o} Brix must will produce 12% alcohol by volume. This could be a little less if the fermentation temperature is over 85^{o} F and a little more when fermented below 60 ^{o} F. Yeast strain selection plays a role in the sugar to alcohol conversion efficiency. Some strains divert small quantities of sugar to byproducts such as glycerol and succinic acid more readily than others at the expense of alcohol. It should be noted that, as the initial sugar increases, the levels of nutrient and yeast inoculations must also be increased.

BATF regulations, however, do cover the commercial production of honey wine. A quantity of water can be added to honey to facilitate fermentation, but the density of the mixture of honey and water cannot be reduced below 22 ^{o} Brix. A formula must be submitted to the BATF for approval. However, the BATF does allow for the production of mead with more than 14% alcohol or production from diluted honey at less than 22 ^{o} Brix. Again, a formula has to be submitted and the permission granted will be to label it as other than standard. The BATF suggests that anyone interested in producing a mead with a lower alcohol content petition for inclusion in the class of "Light Mead." There is no aversion to adding a new class of mead. Meadmakers only have to express enough interest. The technology is available now to produce a mead with up to 20% alcohol by direct fermentation in less than one month which opens the door for a line of cocktail-type meads. Again, it is necessary to submit a formula to the BATF for approval to produce, label and market.

"Hospital cleanliness and eternal vigilance" is a great motto. The extra effort in cleaning, scrubbing and sanitizing is a must. Spoilage organisms in the form of both bacteria and wild yeasts are just waiting for the opportunity to get a foothold. An axiom well worth remembering is that unwanted bacteria and yeast always grow at a much faster rate than the yeast that you want to grow. Use hot water, steam, detergent, sanitizers and scrub brushes generously. Honey is delicate and easy to taint.

Heat always improves chicken and steak but never juices or honey. Using a heat treatment to eliminate unwanted organisms in the preparation of the diluted honey may give the winemaker some degree of security, but takes its toll on the flavor of the honey. However, there are ways to avoid heat. Ultra-filtration is proving to be very successful in not only sterilizing the product but also clarifying and stabilizing it.

Another way to get around using heat is to overwhelm any bacterial and wild yeast that might be present in the raw honey with large numbers of a selected yeast. What would be required is a 2-4 million yeast cells per milliliter inoculum or 1-2 pounds of properly rehydrated wine yeast per 1000 gallons of must. An added step that will give even more assurance that the yeast will overwhelm any spoilage organisms present would be to prepare a small volume of honey must, about 5-10% of the final volume, the night before and add the full amount of the yeast and a third of the total nutrients to be used. Letting this ferment in the presence of air overnight will get the yeast through the lag phase and well into the growth phase. The next day prepare the full amount of honey must and inoculate. The actively growing yeast will immediately continue their growth without the usual 5-10 hour lag phase and rapidly provide enough alcohol to eliminate any unwanted organisms. This added step is especially warranted if the fermentation temperature is to be less than 60^o F.

Initial pH adjustment is optional. Most honey musts will drop in pH from an average of 5.0 to the mid to low 3s or lower during the first few hours. Caution has to be taken that the pH does not drop too low. If the honey is low in natural buffers, potassium or calcium carbonate can be added at the beginning of the fermentation. Alternatively, the pH can be monitored several times during the first 24 hours and the pH maintained around 3.5 with one of the above. About one pound of a carbonate per 1000 gallons of diluted honey is a safe amount to begin with. The exact amount cannot be predicted because of the varying buffer capacity of the honey and the hardness of the dilution water. Some waters are very hard and will require little or no adjustment for the acids produced by the yeast. BATF regulations do not allow sodium carbonate or bicarbonate because of the health issue of added sodium in the diet.

If the initial pH adjustment is part of the routine, it is advisable not to use citric acid. This acid interferes with the metabolic process of the yeast by inhibiting the EMB pathway enzymes. Further, some of the spoilage bacteria can metabolize the citric acid into acetic acid which will cause a slight to strong hint of vinegar. Citric acid, after fermentation, balanced with malic and/or tartaric acid, will chelate any iron originating from the honey, diluting water and equipment and prevent a casse or haze that can form later.

The naturally formed organic acids produced by the yeast along with the carbonic acids produced by CO_2 are often sufficient to give the desired acidity in the finished mead as well as being pleasing to the taste. It is worth sampling before adding more acid.

Generous amounts of nutrients in the form of nitrogen, minerals, trace metals and vitamins are needed. For each 1000 gallons of must add 2-4 pounds of a well-balanced nutrient formula, 1-2 pounds of autolyzed yeast or yeast extract, and 5-10 pounds of diammonium phosphate. This will provide just about enough nutrients for a healthy, robust fermentation.

One to two pounds of a properly rehydrated, selected strain of active dried wine yeast per 1000 gallons of must should provide the right number of yeast cells to do a superior job of completely converting all the sugars to ethanol in addition to producing the essential organic compounds that are associated with fermentation and good wines. The fermentation will proceed at a rate that can be controlled by the winemaker with the judicious use of temperature: 50-55^{o} F for less than 21 days, or 80-85^{o} F for less than 5 days. The low temperature fermentation will tend to produce and retain more fruity esters while the higher temperature fermentation will produce more heady esters.

The large number of new, commercial yeast strains that are available allows the winemaker a wide choice in achieving a variety of sensory tones. The common champagne type yeast is an excellent fermenter. However, it is a champagne yeast because it is a strong, neutral yeast. Honey needs the added sensory compounds produced by yeast. Other possibilities are the aromatic yeasts that are considered important in the production of nouveau-style wines, brandy, cognac, pisco, rum and a variety of other beverages. There are also yeast that produce different levels of glycerol, succinic acid, manoproteins and 90,000-200,000 molecular weight polysaccharides which can provide noticeable mouth feel and flavor profiles. There is a whole world of new yeast to explore.

The yeast will need air, somewhere around the fourteenth hour of fermentation, to provide the oxygen necessary for the yeast to produce the lipids in the cell wall that are required for maximum cell reproduction and, later, for protection against alcohol toxicity. Careful attention should be given to the introduction of air. It is very beneficial during the early hours of fermentation but presents a big oxidation problem later in the fermentation. The amount of air required by the yeast is very small, less than one volume of air per volume of must per hour. Sometimes a gentle roll will suffice. Leaving the air lock off for the first 24-48 hours should also be enough, especially if there is agitation to bring the oxygen down into the liquid. Diluted honey can be very deficient in oxygen at the start of fermentation if the winemaker pasteurizes or adds SO_2 to the diluted honey before inoculating with yeast. After the first 48 hours, the usual precautions must be taken such as the use of an air lock to maintain an oxygen-free atmosphere.

Gentle agitation should be applied throughout as much of the fermentation process as possible. Otherwise, gravity will settle out a large number of the yeast cells, taking them out of the active arena where they cannot be of any benefit to the fermentation. This layer of inactivity at the bottom of the fermenter can result in sluggish fermentation with the potential of off-flavors and aromas produced by the yeast and also by any bacteria that may have had a change to get a foothold.

A well-controlled fermentation will allow the winemaker to choose the length of time the mead should remain on the lees, rather than face a slow, sluggish or stuck fermentation. In order to retain fresh, fruity aromas and flavors, the lees should be removed immediately after the fermentation is completed. If a heavy body and earthy tones are required, the mead can be left on the lees for as long as the winemaker finds necessary. This process lends itself to barrel aging.

The Ames Clinitest is an excellent tool to monitor the sugar near and at the end of fermentation. For pennies a test and five minutes of work, it takes the guesswork out of trying to determine when the fermentation is completed or has reached the desired residual sugar level. The two-drop method will give a good reading at less than 5% sugar, while the five-drop method begins below 2%. Most pharmacies will handle this product.

Natural clarification by settling and racking is common. If time is a factor, however, the use of Bentonite or Sparkolloid can speed up the process to be followed by the filter of choice.

Sanitation is the first consideration in bottling. Protective agents such as sorbates and/or SO_2 can be used following the guidelines recommended for wine. The dosage can be increased if the mead is to be sweet.

Finally, a wassail is in order: "Here’s to your good health," or a toast of your own.