Guide to Mead Making

A MoreManual!™ by Shea A.J. Comfort

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Hello, and welcome to *MoreFlavor!*'s Mead Making Manual. The goal of this manual is to give a complete, yet, easily accessible overview of what is needed to make great mead the first time out. We will begin by taking a look at some important technical aspects that are unique to mead making, because this will show us what is needed for a successful fermentation. From there, we will look at a simple, yet elegant solution that incorporates these considerations into a straight-foreward, step-by-step process for preparing the mead for fermentation that does not require heating and is done in around 30 minutes! Finally, we will look at how to make different styles of mead, such as sparkling mead and how to incorporate fruit. Every so often in life we come across something that requires very little effort on our part, yet winds up being extremely rewarding and mead making is one of those things! Enjoy the process and welcome to mead making!

Let's Begin With A Quick Word About Honey Quality And It's Handling

As with most things in life, when making mead, what you put into it determines the quality of what you get out of it. The quality of the honey most definitely matters. The best mead will be made from a honey that has undergone as little processing as possible, i.e.: "raw", "unfiltered", & "unpasteurized". In addition, it's important to be aware of the fact that elevated storage temperatures over a prolonged period of time can adversely effect honey quality, especially in the presence of oxygen. In extreme cases, the end result is that honey at higher temperatures (whether stored or heated) can lose much of its' delicate complexities, with the aroma and flavour over time degrading to a flat-lined, generic something more fit for a bear-shaped dispenser than as base for creating the nectar of the gods! In short, use the good stuff, both you and your mead will be happy that you did.

> ***Important Note:*** *While heat is bad, honey that gets cold often becomes crystallized but this has no detrimental effect on the overall quality. It only poses the problem of gently warming it up to get it to liquefy again (the potential "problem" being that if too much heat is applied, then as pointed out above, you start to lose some of the more subtle aromas and flavours). Again, if you decide to heat the honey, tread lightly.*

Important Points To Touch Upon *Before* Starting The Fermentation

1) *Meadmaking is winemaking, and white winemaking at that.* By this I mean that all of the usual techniques that one is hoping to employ for a quality white wine apply here, as well, namely:

- yeast strain selection (they all have quite different qualities)
- proper care and feeding of the yeast (extremely important for a mead, more later)
- pH & TA% monitoring (also very critical for a successful fermentation)
- controlling the fermentation's temperature, if possible (55° F to 75° F)
- complete absence of oxygen after the primary fermentation has completed

Understanding and incorporating each of these above elements into your meadmaking as a whole is important because they are the very steps needed to avoid a prolonged, stuck fermentation, avoid hydrogen sulphide problems, and to ensure (as well as to preserve) the best, possible flavour and aroma profile for your meads.

2) *Honey, while being very fermentable from a sugar standpoint, is extremely poor in nutrients.* This is important to be aware of because, just like we humans require nutrients to stay healthy, yeast also need a balanced diet to perform at their peak. It basically all comes down to cell wall maintenance: yeast is very much like a small balloon, and it survives by both taking food into itself and passing waste products out via a permeable, two-way, selective membrane. This membrane, or cell wall, is also the barrier that regulates the yeast's internal pressure to maintain an osmotic balance between itself and the environment it needs to survive in, namely the fermenting *must* (diluted honey mixture). This is a dynamic process, and throughout the entire fermentation as the sugars drop and the alcohol level rises, the yeast is constantly adapting itself as it tries to maintain the efficiency of its cell wall transport mechanisms within this changing environment.

What it needs in order to do this are nutrients. If the yeast have the proper nutrients they need, then they will successfully be able to keep their cell walls fluid: food can come in, waste can go out and they will remain healthy well until the end of the fermentation. However, if the yeast do not have the required nutrients, then the cell walls become "leather-like" and the ability to bring in food and push out toxic by-products starts to become exacerbated. The yeast now have to struggle harder to survive, they become stressed and the fermentation has a greater likelihood of becoming sluggish, possibly even stopping before the desired attenuation has been reached. And, as if this wasn't already bad enough, the stressed yeast will often "act out" by producing off-flavours and aromas, namely H_2S & VA i.e.: "rotten egg" and "vinaigre" aromas and flavours. This cause and effect of a nutrient deficient must on a yeast population is especially evident during the latter stages of a fermentation, as it is often only at this point that you begin to realize that something is wrong as in: "what's that smell"...!

However, once you've already reached this stage it doesn't help to just throw some nutrients or DAP (inorganic nitrogen) at the yeast with the hopes that they will take it up and suddenly become revived enough to finish the fermentation. In fact, not only are they now weakened and in overall bad shape, but after around 10% alcohol the yeast actually stop taking-up nutrients, and so this last minute feeding is rarely successful. In short, it's already too late...Therefore, based on this information, it can be seen that the yeast need to be fed in a more "pre-emptive" rather than "reactive" fashion. The idea is that you prepare the yeast as much as possible during the first half of the fermentation by feeding them while they are still able to take-up and effectively use the nutrients they need to stay healthy. By doing this, when they finally do get to the latter stages of the fermentation and are no longer taking-up nutrients, they will still be in good health and therefore better able to handle the upcoming tougher conditions.

This nutrient feeding schedule is generally broken-up into two steps: once at the beginning of the fermentation, and again at the 1/3 to 1/2 waypoint (this usually equates to an 8–10° drop from the original starting Brix):

> ***1st feeding:*** The first feeding at the beginning of the fermentation is done to ensure that as large of a percentage as possible of your initial yeast-pitch will get off to a great start, so that the fermentation begins with a robust population of healthy, viable cells. Because of the fact that the yeast's state of health at these early stages will directly determine the quality of the fermentation (and of the subsequent finished wine, as well), this first feeding can be thought of as laying your "foundation".
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> ***2nd feeding:*** However, at around the 8–10° Brix drop the yeast will have already used up most if not all of the first nutrient set they were given and they may, in fact, ultimately require more than what they have left-over in order to optimally finish the fermentation. Therefore, very much akin to the way a bear stores up food before it goes into hibernation: a second feeding is needed as a way of replenishing the yeast before they begin the final stages of the fermentation. This second feeding is done to hedge against the possibility of the yeast becoming stressed from a potential lack of nutrients once they are in the latter stages of the fermentation and are no longer taking them up, and can therefore be thought of as a very real "insurance policy" for a successful fermentation!

As there was a lot of information given in this last section, a quick summing-up might be in order: The cure for a stuck fermentation, and/or a stinky wine is often elaborate, time consuming at worst, and damage control at best (either way both you and the wine lose). Therefore, the best defense in avoiding this scenario is an understanding of how to avoid it in the first place and the best way to do this is to provide your yeast with a balanced nutrient regimen made up of a fermentable nitrogen source as well as various micros and amino acids. This feeding is best made during the earlier stages of the fermentation, before the yeast begin to shut down and no longer take-up nutrients.

3) *The pH of a mead fermentation should be taken into account, and preferably earlier than later!* Honey is naturally acidic and often attains a pH of 3.5–5.0 once diluted to typical mead-must densities (usually around 21–24° Brix). However, it has very little in the way of natural buffers, and this means that as the fermentation gets underway, with the rise of carbonic acid (CO_2) along with the various organic acids produced by the yeast themselves, the pH of the must can quickly drop to 2.6–2.8 in a 24–36 hour period. This is well past the desired, lower-end threshold for a wine yeast fermentation (which is around pH 3.2). This low pH, if left uncorrected, will cause the yeast to become stressed and the resulting fermentation will often become sluggish or even stuck.

To avoid these potential problems, the answer lies in correcting the pH upwards by the use of a carbonate about a day or so after the must has been inoculated to maintain a pH of around 3.4–3.5 (potassium carbonate is a good choice for this). Later, once the fermentation has ceased, you can then fine-tune the final TA% with an acid blend or more carbonate if needed.

> ***Note:*** *that as each honey will have a different elemental make-up, each honey must will therefore naturally differ in the exact amount needed to achieve the desired pH adjustment. However, if you don't want to take the time and do a proper bench-trial in order to find the precise amount needed, around 0.45 grams per gallon of carbonate is usually a good "ball-park" figure. (That being said, a bench trial is truly the best way).*

4) *The goal of any successful fermentation is to have only the organisms that you want do all of the fermentation, while minimizing the contribution of any of the so-called "bad-guys" (indigenous yeast and spoilage bacteria).* This is done to maximize on the positive attributes that come with a known, selected yeast strain (mouthfeel, complexity, reinforcement of a desired flavour profile, etc., not to mention having dependable fermentation characteristics), while avoiding any of the off-flavours, bad aromas and weak fermentation characteristics that can often come with an unknown strain of "wild" yeast and/or bacteria. Therefore, the first step in preparing a must for fermentation is to create an environment that wipes-out, or contains a severely limited population of the potential "bad guys". This goal of achieving a "clean slate" for your chosen yeast strain has traditionally been accomplished either by:

> ***Pasteurization:*** heating the must until a high enough temperature has been reached in order to kill-off the bad guys and then subsequently cooling it down until a safe pitch-

ing temperature has been reached, or

Chemically: usually with some form of sulphite,often referred to as "SO_2", at a high enough concentration to kill the unwanted yeast and bacteria, but still low enough not to inhibit the more SO_2 tolerant cultured yeasts from doing their job.

There are pros and cons to using either of the two methods mentioned above, and it's true that good mead can be made using either of them. However, the following should be noted: while pasteurization works, the heat does indeed drive-off some of the more delicate compounds from the must, and these don't come back. As for the SO_2, even thought it is necessary on many levels, it still is somewhat of a 'necessary evil' and its use should be kept to the bare minimum whenever possible. Therefore, with this in mind, it would seem that an ideal way of preparing the must would be to avoid heating it and minimizing (or leave out entirely!) the use of SO_2 at this stage if at all possible. Yet, is there a way to do this and still be able to selectively control the start of the fermentation? In short, the answer is "yes", but it's all dependent on how we structure and carry-out a set series of steps right from the very beginning of the fermentation...

The "No-Heat", No So_2 Method Of Preparing Mead For Fermentation:

Basically, honey in its pre-diluted form is too dense for anything to grow in it (that's one of the reasons why you can store it for so long and it never goes bad). Yet, as soon as it gets diluted to must levels, it's 'open season' for any yeast or bacteria that find their way into it, and now the clock starts ticking. So, the goal here is to pitch a large quantity of healthy, viable yeast as soon as the honey becomes diluted so that they can rapidly colonize the must completely and thereby overrun any smaller populations of undesired organisms before they have a chance to establish themselves in the must. So, how do we do this? Timing: Since it takes around ½ an hour to correctly hydrate the yeast and about 5 minutes to dilute* the honey, it would make sense to first prepare the yeast, then deal with the honey. Once the starter is ready, you quickly dilute the must and then immediately pitch the yeast into it. That should do it!

****Note:** that the dilution water should be clean and fresh, and that it need only be around 10° F warmer than the honey itself in order for it to easily dissolve the honey into solution. Constant stirring with a sanitized spoon in a sanitized bucket while gradually adding the honey will assure a complete and even dilution.*

Important Elements To Be Aware Of When Using The No-Heat, No-So_2 Technique

- Good, standard sanitization practices must be employed in order to avoid potential contamination, and this goes for anything that will touch the mead and yeast at any stage of the process, i.e. buckets, spoons, bowls, carboys, thieves, racking-canes, hydrometers, and so on.
- In order for the yeast to be able to dominate the fermentation, the starting population of yeast must be healthy and robust, which means that they need to be correctly hydrated using "Go-Ferm" and then properly fed during the fermentation using "Fermaid-K" (see *MoreWine!*'s manual: "Yeast Hydration and a Recommended Nutrient Regimen" for complete instructions).

Managing A Successful Fermentation

- It is highly recommended to oxygenate the must just after the yeast has been pitched into it. This will help the yeast build-up their cells walls and get off to a great start. ***Note:*** *oxygen can be introduced by gently agitating (sloshing/rocking) the fermenter at 1 minute intervals, 2–3 times before fermentation starts. An even better solution is to use an oxygenation system made up of an oxygen tank and a stainless steel diffusion stone.*
- If you have an oxygenation system, this oxygenation can then be repeated after a 5° Brix drop from the starting gravity (this usually equates to a day or so after the first signs of fermentation are visible).
- Throughout the fermentation, it is a good idea to stir the lees back up into solution once a day, especially towards the latter stages when things begin to slow down. This allows a greater percentage of the yeast to have access to the needed nutrient sources in the must and it also avoids the scenario where yeast are being buried alive, become starved and then react by producing H_2S. In short, stirring the yeast helps everything and hurts nothing.
- Try to keep the fermentation temperatures from becoming too high, i.e.: do not ferment above 85° F. Above this and this and the yeast will begin to become stressed and they will produce less than ideal flavours and aromas. In general, 55–65° F will produce a more focused and delicate mead, while 65–75° F will produce a more complex and "heady" one. This has to do with the fact that the same yeast will produce different esters and other compounds at varying temperatures but it is also strain-dependant, as well.

Recommended Step-by-Step Guideline to Making Mead

1) Sanitize everything that will be used to prepare the yeast and mead mixture: *buckets, bowls, fermenters, spoons, hydrometer and sample jar, thermometers, stoppers, airlocks, etc. We recommend using Star-San CL26.*

2) Prepare the yeast:

- **Dry yeast:** hydrate with "Go-Ferm" in 104° F water, as per the instructions. Use 1 gram of yeast per gallon for starting gravities up to 24° Brix, and 1.25 grams of yeast per gallon for those above this (more yeast is needed if the starting Brix will be over 24°).

- **Liquid yeast:** is ready to go "as is" and is used at a rate of 1 vial per 5 gallons. This being said, doing a "Go-Ferm" soak using the same process for the dry yeast hydration (outlined above) will also benefit a liquid yeast before a mead fermentation.

3) Once the yeast has begun soaking, set a timer for 30 minutes. While you are waiting, prepare the must (diluted honey mixture):

- In a sanitized vessel, hydrate the honey using clean, fresh water (filtered water is great, but do not use distilled as the lack of minerals will actually harm the yeast). The water need be only around 10° F warmer than the honey for an easy dilution.

  Note: *that all honeys have slightly different sugar levels, therefore it may be useful to check the gravity from time to time during the hydration process with a hydrometer to accurately achieve a specific, desired starting gravity.*

- Add 0.45 g/gal Potassium Carbonate to the must and mix it in thoroughly.

4) Pitch the prepared yeast into the must as soon as possible*:

- ***Important:*** Once the 30 minute hydration-time is up and you are ready to pitch the yeast, if the difference in temperature between the yeast starter and the must itself is greater than 15° F, then you will need to take the following steps in order to avoid thermally shocking the yeast: Add a portion of the cooler must to the yeast starter at a ratio of **.5 : 1**, as shown here: *Example: If there is 120 mL in the yeast starter, then add 60 mL of the must into the starter, for a total volume of 180 mL.*
- Once this is done, mix thoroughly and wait another 15–30 minutes. Repeat this process at 15–30 minute intervals until your yeast's starter temperature is within 15° F of the honey mixture before pitching the starter into the must. This intermediary step allows the yeast to begin adjusting to the new temperature (as well as the TA%, pH, and °Brix) of the must incrementally rather than all at once, and thereby limits the possibility of it becoming shocked by potential temperature extremes.

5) Once the yeast have been pitched, oxygenate the must:

- This can most effectively be done using an oxygenation set-up, which is made-up of a diffusion stone along with a tank of oxygen and a mini-regulator (*FE376*),
- or by agitating the must as much as possible (i.e.: gently shake/rock the carboy for 1 minute so the liquid sloshes around, repeat 2–3 times).

6) At the first signs of fermentation — Add 1 gram per gallon of Fermaid-K + 1–2 grams per gallon of DAP to the must:

"Go-Ferm" by itself does not provide enough of the nitrogen and nutrients needed by the yeast in a honey must (honey is very poor in both), so DAP and Fermaid-K are added to make-up what's needed. Fermaid-K provides a well-balanced, complete source of miconutrients, sterols, organic Nitrogen, and unsaturated fatty acids. Fermaid-K has some Nitrogen (24 ppm N for every 1 g/gal) but this is still not enough to supply the amount needed by the yeast. The rest of the required Nitrogen is made-up using DAP (50 ppm N for every g/gal).

Mix the required amounts of Fermaid-K and DAP with just enough warm, clean water to dissolve the white crystals of the DAP and thoroughly stir it into the fermenting must.

Note: *that the reason why the DAP and Fermaid-K are added now at the first signs of fermentation instead of at the beginning during yeast hydration or must preparation is two-fold:*

1. During the hydration process the yeast's cell walls are not yet fully formed and at this early stage the form of nitrogen in the DAP (***note:*** *Fermaid-K also contains DAP)* can actually burn the cell before it becomes fully formed. Later, once the cell wall has become fully formed and stabilized, it will then be able to handle the presence of the DAP.
2. The DAP and Fermaid-K could very well have been added as soon as the yeast was ready to be pitched into the must, however, other organisms could have used it as an energy source to gain a stronger foothold before the yeast had a chance to dominate the environment. To avoid this scenario, it is advisable to wait until the first signs of fermentation are visible, then add the nutrients. This way you are assured of feeding only the "guests" you actually invited to the party...

6) At 1/3 sugar depletion — Add another 1 gram per gallon of Fermaid-K + 1–2 grams per gallon of DAP to the must:

This is the "mid-ferment" nutrient addition. At this stage, the yeast will have used up the first set of nutrients we added earlier getting to this point. This second addition will keep them healthy as they finish the second half of the fermentation. Mix the required amount of nutrients with just enough warm, clean water to dissolve the white crystals of the DAP and thoroughly stir it into the fermenting must.

7) For the remainder of the fermentation:

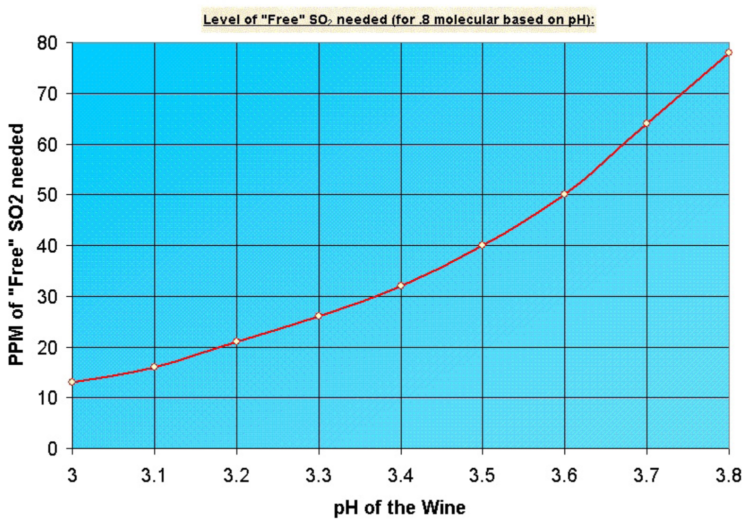
- Stir the lees back-up into the wine every day
- Make sure the temperature doesn't fluctuate too much
- At the end of the fermentation, the activity will decrease significantly, including the production of CO_2. This means that every time the vessel is opened for a stirring

or a sample testing/tasting, then it may be possible to gain a little oxygen exposure (even the 1” space below the stopper in a topped-up carboy can potentially be problematic). It is a good idea to flush the entire headspace with inert gas each time the vessel is opened.

Once the fermentation is over

1a) If you want a still mead (non-carbonated): Add SO_2:

It is important to stabilize the wine as soon as possible, and that means adding SO_2 to protect the mead from oxidation and to hinder potential spoilage organisms (acetobacter, for example). The amount needed is the same as for a white wine, and varies according to the pH of the mead (see the chart below). However, if you do not know the pH of the mead, then adding circa 50ppm (1/4 tsp per 5 gallons) is a good “down & dirty” method to adding the sulphite.



1b) If you want a sparkling mead: Do not add SO_2:

If you are looking to make a sparkling mead, then go ahead and bottle the mead without adding any sulphite. However, you will need to make sure that there is just the right amount of residual sugar present at bottling so that the mead will continue to ferment a little while longer after it has been bottled. The best way to do this is to allow the mead to ferment to complete dryness (when it stops bubbling), then add a small amount of sugar back into the wine at bottling, either sucrose or honey, to induce a final burst of fermentation. Because a sealed bottle is a closed system, the resulting CO_2 generated from this renewed fermentation will not be allowed to escape and it will ultimately go into solution, thereby causing the mead to become carbonated (this is referred to as a “natural” carbonation*, and is in fact the basis of the “méthode champenoise” used to carbonate champagne).

****Note** that the mead could also be “force-carbonated” using a keg and a tank of CO_2, just like they do to make many Italian Pro Seccos and Spumantes. If you are force-carbonating, then you do not need to worry about using the yeast to carbonate the mead and we recommend adding SO_2 as soon as the fermentation is over.*

2) The actual amount of residual sugar left in the finished mead also needs to be taken into account. If the desired final RS% will be above 1.0%, then in addition to the sulphites, sorbate and/or sterile filtration (0.45 microns) should be considered as part of the preparation of the mead for bottling.

3) If you will be adding fruit or spices to the mead, it’s generally best to do so at the end of the primary fermentation. Often the sugars from the fruit will cause a slight renewed fermentation but this is not a problem. However, fresh fruit is often a source of spoilage organisms with acetobacter & various lactic bacteria being the most prevalent. Therefore, in order to avoid any contamination, it is usually a good idea to quickly pasteurize any additives before they are introduced into the mead.

4) The pH and TA% may need to be re-adjusted, post-ferment (if you will be adding any fruit or spices, it is best to wait until after the mead has taken on these characteristics before tasting to adjust the pH/TA%):

- If the mead lacks acidity, use tartaric acid or an acid blend to acidify the wine to taste. It is a good idea to add the acid in several small steps, tasting as you go to avoid over doing the addition. *(1 tsp = around 5 grams, and adding 3.8 grams per gallon = +.1% TA).*
- If the mead is too acidic, then use some carbonate (potassium is best) in order to raise the pH. Again, this must be done to taste, and proceeding slowly in several increments is probably best. *(1 tsp = around 6 grams, and adding 3.4 grams per gallon = -.1% TA).*

5) A quick word about oak: Oak can indeed be a part of meadmaking and it is recommended to use the cubes over the chips whenever possible because the cubes have a greater complexity of flavours and a longer, slower extraction time. Barrels can also do lovely things to mead. It is important to keep in mind that oak added during the fermentation will ultimately be less present up front in the finished wine, instead becoming integrated into the final mead in a more complex and “structural” way than if the same amount of oak were to be added to the mead post-fermentation. For complete informaiton on using oak in winemaking, please see *MoreWine!*’s “Oak Information” and “Use and Care of a Barrel” Manuals (available for free on our website).

6) Finally, in general, time and cooler temperatures will be all that is needed to clear-out a mead before bottling. If you like, you can fine, but as fining is by nature non-selective you may be removing positive flavour components, as well. Filtration is probably the better solution for the impatient, however, this comes with two caveats: you should only use the smallest micron size needed to clear the wine; and you will lose valuable contact time with the lees (which gives the mead a greater complexity and fuller mouthfeel) if done too early. For a complete explanation of ageing on the lees, please see *MoreWine!*’s White Winemaking Manual.

In conclusion

While what was offered here is a solid, basic foundation on how to successfully make mead, it should also be pointed out that this paper is in no way a substitute for an actual text devoted to the subject. For further reading, "The Compleat Meadmaker" (*BK710*) is an excellent choice, followed by "Making Wild Wines and Mead" (*BK700*). In addition, the author would like to thank Lallemand's George Clayton Cone for both his paper on the subject: "The Basics of Mead Fermentation" as well as for the many conversations had during the preparation of this document!