A BASIC OVERVIEW OF MAKING HARD CIDER FROM JUICE

For the purposes of this document, "cider" refers to hard cider, or fermented apple juice. Juice, must, or sweet cider may be used interchangeably to refer to unfermented apple juice.

1. ACQUIRE JUICE

- Ensure that the juice doesn't have preservatives; sorbate, sorbitol, sulfite, things of that sort. Ascorbic acid / vitamin C is just fine.

2. TEST AND ADDITIONS

- If the juice is cloudy, add pectic enzyme at the rate of 1/2 tsp per gallon.
- If the juice is unpasteurized, add a small amount of sulfite (1/4 tsp potassium metabisulfite per 5 gallons or 1 crushed Campden tablet). Blend with a little juice to dissolve, then add to the bulk of the batch.
- Add yeast nutrient. Wyeast Wine or Beer Nutrient, or generic Yeast Nutrient. Roughly 1/4 tsp per gallon is a good starting point. Be prepared to add more once fermentation is well under way.
- Check the gravity with a hydrometer or refractometer. Record the result. This number will help determine the alcohol by volume of the cider, as well as act as a window into the fermentation process.
- **OPTIONAL:** Chaptalize (add sugar). If you'd like a stronger cider, add a simple sugar at this time. The sugar will ferment out entirely, increasing alcohol content, thinning the body, and amplifying acidity. Partially refined and darker sugars are more prone to affect the flavor. One pound of sugar in five gallons will add approximately one percent alcohol by volume. Belgian candi sugars, honeys, or plain corn sugar all work well and have unique effects.
- **OPTIONAL:** Add acid. Most juice, especially juice made from later season apples, will have a lot of sweetness, but little acid. Acid helps to balance the cider by adding sharp, crisp character. Small amounts of malic acid can be added to taste, up to one tablespoon in five gallons. To ensure more accuracy and repeatability, consider measuring the pH or using an acid titration kit to determine approximate acid content. Remember, it's always possible to add a little more, so err on the side of caution.
- **OPTIONAL:** Add tannin. Tannin helps the cider's "grip" and structure. These are sensations more than flavors, but can add wonderful complexity to the finished product. Start small, as it doesn't take much to get the desired effect. Liquid or dry tannin can be used to equal effectiveness. Remember, it's always possible to add a little more, so err on the side of caution.

3. ADD YEAST

- "Cider" yeast works well and is available in liquid form from White Labs and Wyeast. The Wyeast strain tends to be cleaner and quicker, while the White Labs strain is a little slower and tends to preserve the character of the apples better.
- Wine yeasts, such as Lalvin EC-1118 or 71B-1122, Red Star Premier Cuvee or Cote des Blancs are also popular. They are alcohol and nutrient tolerant, work quickly and relatively cleanly, and are not sensitive to temperature.
- Beer yeast and characterful wine yeasts can impart specific character. Wyeast 3724 Belgian Saison or 3944 Witbier will contribute spicy black pepper phenolics, while Wyeast 4783 Rudesheimer and Wyeast 4242 Chablis will preserve the delicate character of the apples and add their own aromatic complexity. Fermentation temperature can also have a big impact on yeast character.
- Experiment and determine what you like most.

4. FERMENTATION

- Allow the cider to ferment to dryness.
- If the fermentation seems sluggish, smells like rotten eggs or burning matches; add yeast nutrient, 1/4 tsp at a time, up to 1 tbsp per 12 hours. Use caution when adding nutrient, as the trapped CO2 in the cider can react with the added powder, causing an overflow of liquid.
- When the gravity is reliably stable, usually around 0.996-1.010, the cider is almost ready to be racked. Allow it to sit on the yeast sediment for a little longer - at least one day, up to three weeks or so, to help clean up any off-flavors that were produced during fermentation.

5. CONDITIONING / SECONDARY FERMENTATION

- Rack the cider into a sanitized carboy or similar vessel that will accommodate the volume with no or minimal head space. At this point, the process is largely dependent upon taste. As the cider ages, the flavors will mellow and come into condition, the yeast and other sediment will slowly settle out, and everything will generally improve.

6. FINING

- If the cider is still cloudy and you prefer it to be clear, use a wine fining agent, such as Super-Kleer or Sparkolloid, to help it clarify. Follow the directions provided by the manufacturer.

7. BOTTLING

- If you'd like sparkling cider, ensure that the gravity is stable, and add an amount of priming agent equivalent to priming a batch of beer. NB's Fizz Drops, priming sugar, honey, or similar sweeteners can be used. Refer to the Northern Brewer priming calculator at northernbrewer.com/priming for more information.
- If you'd like still cider, add a small amount of sulfite, usually 1/4 tsp per five gallons. This will ensure that the yeast doesn't come back to life.

Congratulations, you've made cider! Consider reading on to learn about more advanced techniques and tips, and be sure to check northernbrewer.com for more resources.

GLOSSARY OF TERMS

- **ACETIFICATION:** Process which causes alcohol to turn into acetic acid, aka vinegar.
- **ACIDITY:** A measurement of sharpness in juice or cider, measured by titration or pH. Acidity brings "bright," "tingly," "fresh" character, and directly offsets the perception of sweetness.
- **ASCORBIC ACID:** A chemical virtually identical to vitamin C. it has natural antioxidant properties, which means it reduces the potential for oxidation. Usually added at racking or packaging to help reduce oxidation processes.
- **CAMPDEN TABLETS:** A form of potassium metabisulfite, encapsulated in convenient tablet form. Should be crushed before being added to liquid, usually used for killing wild yeast and bacteria.
- **CHAPTALIZATION:** A term from winemaking, referring to the process of adding simple sugars to a must or juice to increase the amount of sugar present before the start of fermentation.
- **CIDERY/CIDERIES:** What a brewery is to beer, a cidery is to cider.
- **ENTERIC BACTERIA:** The kind of bacteria commonly found in mammalian digestive systems. Often associated with spoilage of unfermented juice or must.
- **HYDROMETER:** A glass instrument used to determine the density of a liquid as compared to the density of water. Liquids with a higher density have more dissolved sugar, liquids with a lower density have less. It does not directly measure alcohol content, but can help determine approximate alcohol with a little math.
- **KEEVING:** Technique used in traditional French cider production where enzymes in the apple juice concentrate the sugar content and precipitate pectic sediment and excess nutrient. The result is a nutrient-deficient must that ferments very slowly, naturally finishing sweet or semi-sweet.
- **MALIC ACID:** The main acid found in apples and their juice.
- **MALOLACTIC FERMENTATION (MLF):** An almost imperceptible fermentation conducted by specific bacteria at an elevated temperature to convert slightly harsh malic acid into softer lactic acid. More common with grape winemaking, it can be used to good effect with cider as well.
- **METABISULFITE, SULFITE:** Commonly used terms to refer to sodium or potassium metabisulfite, a chemical that is highly effective at killing wild yeast and bacteria by releasing sulfur dioxide in the vessel - be sure to let it escape via an airlock.
- **MUST:** A winemaker's term for unfermented, sweet juice - akin to "wort" in brewing.
- **PASTEURIZATION:** A method of holding liquids at around 162F for a period of time in order to preserve them. Most commonly used with dairy products, it helps to reduce or eliminate bacteria and other spoilage organisms. Has a minimal effect on the organoleptic qualities of cider or juice.
- **PECTIN:** Natural carbohydrate found in apples and other fruits, pectin enables jams to set and contributes to haze of various degrees in apple-based liquids.
- **PECTOLYTIC OR PECTIC ENZYME:** An enzyme that helps to precipitate pectin from juice or cider, by binding to it and causing it to settle.
- **TANNIN:** A substance present in apples, grapes, and various other fruits and plants that imparts astringency and "grip" to the cider. Can be added naturally with high-tannin apple varieties, or with liquid or dry tannin additives.
- **WINDFALLS:** Apples that were knocked off of a tree by the wind or other natural phenomenon. Usually rotten/rotting, or containing toxins that may be harmful. Best relegated to non-consumption uses.

MAKING CIDER FROM APPLES

FROM TREE TO FERMENTOR

Making alcoholic cider from apples allows complete control of the blend of apples used. It is the only way to make some of the most distinctive, unique ciders that have come about through centuries of agricultural knowledge. Cider apple varieties principally come from northern France or southwestern England, where cider production has been going on since the middle ages.

The biggest obstacles to making cider from apples are:

- Access to the right types of apples
- Equipment for crushing
- Equipment for pressing

We will address each of these important factors with a few approaches, and then bring the whole affair together for an overview of the process, from tree to glass.

ACCESS TO APPLES

Juice used for the production of cider traditionally has a blend of three flavor concepts: **SWEETNESS, ACIDITY, AND TANNIN**. By balancing or unbalancing these three factors, vastly different types of cider can be produced. Cider apples are usually divided into two broad categories: bittersweet and bittersharp. From these two categories, they are also sometimes divided into pure sweet and pure sharp. However, it makes more sense to think of these divisions as points along a continuum, rather than independent, highly-specific groupings. “Sharp” equates to acid content, and “bitter” means tannic - the language of cider can at times be quirky.

Evaluating apples for **SUGAR** content is relatively simple: a hydrometer or refractometer can give you a good idea of the apple’s sugar content. High **ACID** apples will have a sharply sour flavor, though not necessarily because they have less sugar - it is an abundance of malic acid that gives these apples their acidity. **TANNIN** is more of a sensation than a flavor - akin to the experience of sucking on tea bags, the leathery, drying texture is indicative of high tannin content. Often, tannin and acid are found simultaneously and can be easily confused. Red delicious, for example, has low acid but slightly elevated tannin, so it tends to have a puckering, drying effect when eaten.

Apples can be tested for acid and tannin by titration or similarly intensive methods, but taste is often as good an indicator. Acid content is usually measured by inference, such as its effect on the pH of the juice. However, there are also winemaking tests that measure the malic acid levels in juice. Either method of measurement will yield useful information, but tasting the juice is equally valid. Remember that fermentation eliminates most or all sugar, so the acid and tannin will be amplified, relative to the overall balance of the cider.

Tannin content is an important consideration when dealing with North American apple varieties. If desired, liquid or dry wine tannin can be used, or a small amount of crab apples can be added to the overall mix. If you don't have access to an easy source of tannin, consider using oak at some point in the process - barrel fermentation provides structure and grip, while long conditioning on cubes, staves, chips, or other forms adds aroma and complexity. Try a blend of techniques, depending upon your preference.

COMING UP WITH A BLEND

Here is a partial list of some popular American apple varieties that make great cider: American Pippin, Baldwin, Bullock, Cortland, Esopus Spitzenberg, Golden Russet, Gravenstein, McIntosh, Red Delicious, Roxbury Russet, Smith Cider, Sops of Wine, Wagener, and Winesap. All of these varieties are usually classified as sweet or sweet-sharp. Generally a base juice will be the first consideration - by weight, this will be 40-70 percent of the blend. Acid-focused/sharp apples are usually 10-20 percent, "aromatic" and dessert varieties are also 10-20 percent, and bitter/tannic apples 5-20. These wide ranges are more indicative of tradition than anything else. Remember that manipulation of the blend is easiest before fermentation, but that the character will change as the cider ferments and matures.

An example blend we'd recommend:

- 75% Neutral Base - Cortland, Red Delicious, Baldwin, Rambo
- 10% Aromatic - Golden Russet, McIntosh, Gravenstein
- 10% Acidic/Tart - Newton, Northern Spy, Winesap
- 5% Bitter/Tannic - Lindel, Dolgo Crab, Siberian Crab

CRUSHING

Prior to crushing, be sure to clean the apples with fresh water. Discard windfalls, rotten, moldy, or severely bruised apples. Cleaning the apples removes excessive concentrations of soil and enteric bacteria, but does not necessarily remove all wild yeast, which some cider makers value. The crushing method, used to prepare the apples for pressing, can vary, but the end result is the same; the apples need to be crushed so that they can be spread in flat, uniform layers. Small scale operations will do this by hand, first quartering or cutting the apples, then bashing them with a log, dowel, or similar pummeling device. An apple crusher is a modest investment that can decrease the amount of manual labor required. In either case, the end result should be similar: a pulpy sluice of apple, relatively uniform in size.

PRESSING

Pressing can also take on many forms - at the simplest, it is the process that separates the seeds, peel, and larger pieces of apple flesh from the resultant juice. A screw or similar ratcheting device is attached to a stationary plate that applies pressure to the sluice being pressed. The juice is expressed from the fruit and runs into a collection vessel. Using a mesh fiber to keep the apples condensed and keep the pressure steady is useful, as slow, even pressure ensures thorough extraction of juice. Some cideries will add pectic enzyme to the un-pressed fruit - the pectinase enzyme helps to break cell walls of the fruit, resulting in higher juice yields. Any vessel that touches the pre-fermented juice should be sanitized beforehand to minimize the accumulation of bacteria and other detriments. Regardless of the pressing method, the juice will usually be muddy or brownish - this is normal, and can be addressed through the use of a small amount of sulfite or ascorbic acid. Simply dissolve a quarter teaspoon in every 5 gallons, to reduce browning.

POST-PRESSING, PRE-FERMENTATION

At this point, some traditional cider makers will simply gather the juice, possibly blend different pressings, and pitch yeast. The exception is treating for wild yeast and other organisms. Treating cider for wild yeast can be done by adding sulfites, in the form of potassium metabisulfite or Campden tablets. If you want to ensure a fermentation with no wild yeast or bacteria, add sulfites according to the directions on the package. Make sure to wait at least 24 hours before pitching yeast. Some cideries will add a large pitch of yeast, and half the amount of sulfites, to ensure that the yeast dominates the most active part of fermentation, but some of the bacteria survive to add complexity over time.

FERMENTATION

Before pitching yeast, consider taking a few basic measurements. Sugar content (measured as "gravity") can be determined with a hydrometer or refractometer, and is highly recommended. It is the easiest way to get a window into the fermentation process, to see how it is progressing. When the gravity stabilizes, it's usually a good indication that the cider is safe to bottle. It also means that minimizing head space becomes more important, as acetification is the most common way cider becomes spoiled (by acetic acid/vinegar bacteria). Measuring gravity tells the cider maker whether they should consider chaptalization, the addition of sugar to the juice. Sugar addition can be done with a variety of sugar sources, usually determined by preference or tradition. Measuring sugar content allows the cider maker to dial in the post-fermentation balance between alcohol, sugar, tannin, and acidity.

The second measurement that is sometimes taken is the acidity of the juice. This can be done with titration, a single-use testing apparatus or strip, or a pH meter. Regardless of the method used, measuring acid before fermentation and throughout aging can help ensure that no acetification is occurring. It is also helpful for determining whether an acid addition would be helpful. Acid is an often overlooked aspect of cider that helps flavors "pop." It adds brightness and crispness to a cider, but should always be balanced against other taste influences, such as sugar and tannin. Some cider makers do not actively measure acidity, but go by taste. This is a valid method, but has inherent limitations.

With measurements and notes taken, the juice is now ready for yeast. Choosing a cider yeast is an often debated step that some choose to overlook. Champagne-type yeasts are commonly used for cider production since they are highly tolerant of the range of fermentation conditions that may come about. However, because of their tolerance for all conditions, they rarely contribute a large amount of yeast character to the cider. White or red wine yeasts are often used to different effect. White wine yeasts, fermented cool, tend to emphasize and preserve delicate fruity aromas, akin to those found in German and Austrian white wines. Red wine yeasts can be pushed into higher temperature ranges, resulting in spicy and expressive ciders with notes of black pepper and anise. Even phenolic-heavy beer yeasts such as those used for German weizen or Belgian saison are used. Regardless of the yeast you choose, be sure to treat it well by adding a little (usually 1/4 tsp per 5 gallons) yeast nutrient at inoculation.

Adding pectic enzyme at this point can be helpful, as it binds to the water-soluble pectins and turns them into larger insoluble pectins which will settle out with the yeast, helping to promote a clearer cider. Beyond fermentation, standard beer or wine making practices apply, depending upon how simple or intricate a process the maker is interested in.

EXCEPTIONS TO STANDARD FERMENTATION

THERE ARE SPECIAL PROCESSES USED BY SOME CIDER MAKERS, EITHER DURING OR AFTER FERMENTATION, THAT CAN ALTER THE CHARACTER OF THE CIDER CONSIDERABLY.

The first method is to starve the fermentation by depriving it of nutrients. This can be accomplished in a few different ways with varying levels of success, and requiring varying levels of intervention. Nitrogen is the principal nutrient source that is utilized by yeast during fermentation. Some apple growers grow their fruit without the use of nitrogenous fertilizer or pesticide, products that protect the fruit from pests and increase the size and yield of the apples on the tree, respectively. By avoiding the use of nitrogen, the apples have very little of the nutrient contained in their juice.

Juice with low nitrogen levels ferments very slowly, often with the help of many types of cultures, from the common saccharomyces to the "wild" brettanomyces, lactobacillus, pediococcus, and other yeasts and molds that are naturally present in and around orchards, though it is possible to encourage a "clean" fermentation by monitoring temperature and pH. In any case, the end result is usually a naturally sweet finished product - eventually, the yeast simply gives up and settles out. The cider maker then removes the cider from the spent yeast, yielding a cider with naturally present residual sugar. This technique can be extrapolated to an extent by simply not adding nutrient to a fermentation, and allowing it to stay in contact with the yeast for a long period of time.

The second method involves keeving, a technique that relies upon pectic enzymes naturally present in apples to settle out large amounts of nutrient. The basic technique is to start with bittersweet fruit, high in tannin but low in nutrient. The apples are kept in storage until the temperature is in the low 40s. They are then crushed and packed into vessels to macerate, which leaches pectic enzyme from the fruit. After roughly 24 hours of maceration, the pulp is pressed as normal, and the juice is run into a sanitary container. By keeping the temperature of the expressed juice low, there is a slow natural fermentation that begins - the pectin binds with calcium and settles to the top or bottom, along with yeast nutrient. The juice is then racked from between the two layers and fermented as normal. Fermentation proceeds very slowly, but yields natural residual sweetness as well. Some producers add calcium carbonate and sodium chloride to help the process; calcium chloride is more effective and can be used in smaller doses.

The final method is a hybrid of sorts - the biggest problem with starving a fermentation is that it takes time and can produce unpleasant off-flavors. Most apple juice from normal fruit will have a reasonable level of nutrient in it, enough to get the fermentation off to a healthy start. After some time, the yeast will run out of readily available nutrient and begin releasing sulfur and other off-aromas. At this point, the cider can be "splash-racked" from the yeast - mechanically separated from the majority of yeast cells present, and splashed on the receiving vessel's end, to help drive off the sulfur and other volatiles that are produced in a slightly unhealthy fermentation. This splash-racking should be paired with cold crashing for best results - once the racking is complete, the fermentation should be chilled down to 40F or lower, which will cause the yeast to slow or stop.

THE SPECIAL CASE OF PERRY

Perry is a fermented beverage made from pear juice. In many ways it is substantially similar to cider, but in some ways it is radically different. In England and France, where perry has managed to hold on commercially, special perry pears are used to make the juice that is fermented into perry. In the US, dessert pears such as Comice, Bosc, and Seckel are more common. French and English perry pears tend to have high acid and tannin content, and make extraordinarily distinctive perry.

Regardless of where your fruit or juice comes from, all pear juice contains a natural sweetener called sorbitol, which creates a unique situation as it relates to fermentation. Sorbitol is a complex enough sugar that it is hard for yeast to ferment. It lends a pleasant sweetness, and means that most pear-dominant musts will finish between 1.004-1.020. It also means that supplementary nutrient is usually a good idea - double the nutrient addition that you'd normally use for cider. Blending apple and pear juice can yield excellent results, as the delicate character of the pears tends to hide behind that of the apples. This is an easy way to get a bit of residual sweetness in a batch of cider.