KEEVING KIT™ Instructions for Fresh-Pressed, Unfrozen, Unpasteurized, Untreated Juice

The purpose of keeving is to remove yeast-supporting nutrients from juice so wild yeast will run out of nutrients and fermentation stops before all sugar is consumed. What remains is a natural semi-sweet cider with great mouth feel, fragrance, superb flavors, and just enough alcohol to prevent spoilage. Where the correct apples, process, and in-bottle fermentation is used; a sought-after high priced keeved-cider can be attained. Consistently keeved ciders are the medal winners in competitions. Remember, should your keeve fail, in most all cases the juice is racked into a fresh container, commercial yeast is added, and a typical dry cider results. **We recommend 5 and 10 gallon trials in clear glass demijohns or carboys until you get familiar with the process.**

Please also see the photos in Illustrated Keeving Instructions at http://CiderSupply.com

1. **Before you start**, refer to the SPECIFICATIONS page, and read and understand Safety and Handling.

2. **Select your apples or juice**. For centuries it has been clearly documented that the majority of the latest-ripening bittersweet, bittersharp, sweet-sharp, and vintage apples make the best hard cider. These types typically have a high specific gravity (a more viscous juice), high pectin for keeving, tannins, balanced acid, and high sugar. Smaller thick-skinned bittersweet apples, wild apples, some crab apples, and low-nitrogen apples from trees in decline often make the best hard-cider. Keep in mind that high-sugar dessert apples while having an excellent sweet-tart flavor and great aroma, will often make a lower quality thin, tart, high alcohol, and extra dry cider if used alone. If you are lucky enough to get low-pectin and low-SG juice from dessert apples to keeve; the cider will still be on the tart-acidic side. You can still use this cider, but to cut the acid and improve body and mouth feel sonly blend in other keeved ciders. Blending in cider made from a commercial yeast will undo your keeving because the aggressive yeast will overrun your keeved cider with a new fermentation.

   IMPORTANT! To determine if your juice contains pectin and may keeve, do a simple pectin test. Using Claude Jolicoeur's ratio (the author of "The New Cider Maker's Handbook"), in a test tube; mix a 4 ml sample of strained somewhat clear juice with 16 ml of 99% isopropyl alcohol. If pectin exists, shortly thereafter a gelatin clump should form at the bottom, middle, or top of the container. If after 24 hours no clumping occurs, the juice is too low in pectin and won't keeve. But keep in mind, if clumping did occur this not a guarantee that the juice will keeve.

3. **Make a Jump-Start mix a couple of days before you plan to mill and press your apples**. Press and mill a gallon or so of juice from the very best and cleanest washed apples that will be used for keeving. Next, to help prevent mold growth; check and adjust the pH of your juice. **DO NOT ADD ANY YEAST**. Allow this batch to begin a full ferment on its own wild yeast (usually a good yeast). This will be your jump-Start Mix. The reason for making this mix, is that if during the keeving process the juice has a stuck ferment, you can jump-start your fermentation with the natural apple yeast before the bad off-flavored yeasts or molds take over. Many organisms are racing to take over your whole batch of cider. So at the right time you may have to at some of the jumpstart mix to win. **DO NOT** add wine or beer yeasts for keeving or jump-starting. Remember, the goal is to have the non-aggressive wild apple yeasts die-off early, so residual sugar remains. Other yeasts are far too aggressive for this process and will eat all the residual sugar until it is gone, resulting in a dry high-alcohol cider.

4. **Verify that your apples are fully ripe**. Many varieties are said to be ripe for eating when picked or when they drop from the tree; however, for making first-class hard cider, crisp, crunchy, and sweet can indicate they are not ripe enough for pressing and the keeving process. A rule of thumb is that when the apple is a bit soft, overripe, and not the most appealing to bite into, it is a good indicator that the cider apple is fully ripened and ready for pressing. At this point, most of the available starches have converted into sugars, and unwanted nitrogen hopefully has fully depleted. If you have a large supply of apples, a starch test can be done to test for ripeness.

5. **Sweat your apples if required**. To fully ripen your apples, you can do what is called Sweating the Apples. Some apple varieties especially late harvest and winter apples must sit for up to a month until the skin feels oily, the flesh is somewhat soft, and there is a very noticeable apple aroma. To sweat the apples, allow the picked apples sit in large baskets, slatted crates, or in piles on plastic or concrete where slight air circulation exists but where insects, farm animals, and rodents cannot taint or contaminate the fruit. Sorting will be required to discard some apples that have gone rotten from bruising or our little wormy friends. When all starches have turned to sugar washing and milling can begin.

6. **Inspect, wash, and discard the apples as required to ensure what you use is the best**. Discard apples that are rotten, have worm holes, bruised, punctured, or have other mechanical damage. The fermenting process kills the bad organisms and sterilizes the cider so obsessive washing is not really required for basic ciders, but for keeving make a diligent effort in only using your best apples.

7. **If possible, schedule to mill and press your apples when the weather will be cold** (approximately between 34º- 41ºF (1º-5º C) for a few days). Cool temperatures prevent early fermentation from occurring. Fermentation before the cap has risen means that the keeve won't occur.

8. **Make extra effort to wash and sanitize all of your equipment**, and don't mill and press on a windy day. Doing so allows for all sorts of nasty spores, yeasts, and bacterium to find their way into your vulnerable pre-keeved and pre-fermented juice. The result can be a ferment of the wrong yeast, mold growth, or poor cider flavor in the end.

9. **Mill the apples to a pulp and place into sanitized buckets and seal tightly**.

10. **Macerate the pulp**. Let the pulp sit refrigerated between 34º- 39ºF (1º- 4º C) for 12-24 hours. This allows the pulp to release as much pectin as possible from the apple skins). Pectin is key in allowing a successful keeve to take place. In some years the pectin in your apples will be low, and in other years it will be high. Impossible to accurately predict and adding pectin gives a false keeve and does not work.

11. **After maceration, press the pulp and extract the juice into your keeving tank or barrel**. Pre dilute your PME in a cup of juice, and stir into your main tank. **NOTE:** If a tank or barrel is used, it should give access for ladling-off the brown cap that forms from keeving, in some cases every few days. Otherwise, if using a glass carboy or demijohn you can siphon out the clear juice instead of ladling off the cap.

12. **Check the juice density** or SG (Specific Gravity). **At 60º F (15º C), the SG should be 1.055 or above**, or the cap is less likely to rise because the juice density is too thin in nature.
⇨If low, raise the density by adding juice with high SG, or a sterilized-solution of cane sugar and juice.

13. **Check the juice sugar level** or °Bx (Degrees Brix). **At 60º F (15º C), the °Bx should be 13.5 or above**. If too low, the resulting cider may have alcohol level that is below 4% and spoil in storage.
⇨If too low, raise °Bx by adding juice with high °Bx, or a sterilized-solution of cane sugar and juice.

14. **Check the acidity level (pH).**

⇨If using pH Strips (litmus paper) for a quick estimate of pH (but not really good to check all acid levels), make sure the pH range is designed for winemaking between 2.8 and 4.4 or similar. Don't use 'Universal type' pH strips because the pH range is too broad and not accurate, to include the ones for fish tanks, and ones given in garden soil test kits.

⇨If using a wine making 'Titration Acid Test Kit' these are quite accurate, use it interpret the readings against a white-paper background in sunlight.

⇨If using an electronic pH tester make sure it is calibrated with the required solution, and the batteries are new. Don't use the electronic garden soil pH test meters, they do not work for what you are doing.

15. **Adjust the pH if required**. The goal is to have a pH reading between **3.4 - 3.6**. Read up on these corrections because this is where mistakes are commonly made.

⇨If the pH is too high, you can blend-in a more acidic apple juice, or add Malic Acid (natural acid from apples) to lower the pH.

⇨If the pH is too low (the juice is very acidic), blend in some non-acidic apple juice, distilled water, or precipitated chalk to reduce the acid level and raise the pH.

16. **Sulfite the juice (Optional)**. The higher the pH reading the greater chance mold will take over your juice.

⇨If you over-sulfite the juice, you will also kill off the wild yeast. This means that the juice will have to sit far too long for keeving to form and float the cap to the surface and mold will grow on top of the juice within a few days. If not racked immediately you likely will lose the juice.

Tip: Some cider makers choose not sulfite the juice and to lay their bets on the chance that the good apple yeast levels are high enough and the good yeast will dominate and kill off all the others. I have done this option and most of the time all works out well, with high success rate.

Tip: Other cider makers, choose to sulfite to kill off the bad yeasts (at the same time killing off the good yeasts), and laying their bets on the chance that there will still be enough good yeasts left over to take over and dominate before the bad yeasts can multiply and take over.

Tip: Other cider makers, including myself once or twice, just guessed at the pH and sulfited the juice using the 'Crystal-Ball-Method' resulting in killing everything in the cider (chemically pasteurizing) thus creating a perfect growing solution for mold. And boy does it grow fast to fail a keeve, but most of the time when this occurs, if racked immediately and you add a commercial yeast the cider can be salvaged.

17. **If required, grind and dilute Campden tablets** (Potassium metabisulfite, $K_2S_2O_5$) at the following ratio per gallon of juice:

⇨ Low pH is 3.3 and below (Acid is too High): no sulfite required, juice is too acidic. Refer back to step *15* for correction.

⇨ Medium pH is 3.4 to 3.6 (Acid is Balanced): you can use up to ¾ tablet, but we usually don't sulfite unless pH is at 3.5 to 3.6.

⇨ High pH is 3.7 to 4 (Low Acid): you should add up to 1½ tablet per gallon, or Refer back to step ***15*** for correction.

18. **Allow the juice to sit overnight 24-36 hours** in sealed containers at about 41º F (5º C) for the PME to do its work. If you have very high pectin juice, periodically swirling the juice will increase efficiency of the PME even further because enzymes are not self propelled and rely on random contact to do their work.

19. **The next day**, dissolve the $CaCl_2$ (PART B) with some juice in a shaker until completely dissolved and foamy. Stir into to the tank for several minutes. Now you will wait for the keeve, you are the controller! Without moving the container of cider or causing agitation in any way, you may have to accelerate and retard the developing fermentation by slowly raising or lowering the cider temperature by 10 - 15 degrees. Your goal is to retard fermentation long enough to allow the cap to form. When formed and the juice is fairly transparent; slowly bring the juice to room temperature as to slowly start fermentation in the cap and build its buoyancy. It may rise as one piece, or many separate chunks. If you create a fermentation too quickly; the cap will be destroyed before it rises, it won't keeve, and you will have to allow the juice to ferment out as a normal cider. You can readjust the temperature as required by cycling the refrigerator ON and OFF, use a slight drip of warm or cold water on a towel draped over the container, or even use a fan blowing warm air. The temperature should only increase a couple of degrees per hour.

Main Concept Review:

(1) Delay ferment long enough for PME and Calcium Chloride to settle the juice nutrients to the bottom of the tank or container.
(2) Use temperature control and create a very slow and slight ferment to float the settled nutrients, PME, and Calcium Chloride as a cap.
(3) Accomplish the keeve fast enough before too much mold forms on the surface and takes control of the cider.

20. **Check the juice every day for evidence of the cap forming**. Initially a gel may form on the surface, or a cap may be seen slowly rising to the surface. For keeving to occur and the cap to rise, it may take up to 18 days. This is where the correct pH will save the day and prevent mold. REMEMBER! **Without moving the container of cider**, raising or lowering juice temperature to control keeving rate often is required.

Tip: If after three or four days a cap is seen forming at the bottom but it does not raise, you may want to carefully introduce more natural yeast. Without agitating the juice, lees, or sediment, add the jump-start mix previously created.

Tip: If you add your wild-yeast jump-start mix too soon, you run the risk of starting the ferment before keeving can form and float the cap to the surface. This means that the forming cap will be obliterated during turbulent fermentation, keeving will not occur.

Tip: If mold does form on the top of the cider after a week contamination has occurred. So at this point the mold has beat the wild yeast to the finish line. Siphon out the clear cider, add commercial yeast, yeast energizer if desired, and allow the ferment to progress normally.

21. **After keeving**, rack the clear cider into your long term fermentation container, apply the air lock, and keep the cider at room temperature until fermentation has clearly begun. This is to make sure sufficient yeast population has built up before you place juice in long-term cold ferment.

22. **When fermentation of the wild yeast is clearly seen as active** (tiny bubbles in the juice, and some clean minor foaming on the surface of the cider) refrigerate the juice: for fast-aggressive yeast use 34º F (1.2º C), for slow-humble yeast use 40º F (4.4º C). With temperature adjustments; refrigerated ferment must take several months and is critical to lock-in the maximum amount of fragrance, flavor, and stability. The juice may look as if it has a stuck ferment, but after observing with a strong magnifying glass you should see micro-bubbles ascending. If the juice does become stuck, allow the juice to come to room temperature for a few days until fermentation resumes. Then re-refrigerate the juice. **DO NOT** add any commercial yeast, or reintroduce nutrients or yeast energizer of any kind! Doing so will ruin the benefits of keeving.

23. **In the coming weeks, rack juice several times** to eliminate enough yeast so fermentation stops and a residual sugar is attained. Take SG readings to calculate final alcohol level, and decide when to bottle for a still cider or bottle for a naturally carbonated cider. If you avoid racking your cider during its cold fermentation, it usually will naturally proceed to a dry keeved cider.

DANGER: RESIDUAL YEAST AND SUGAR PRESENTS AN EXPLODING BOTTLE HAZARD! DO NOT ATTEMPT TO CARBONATE YOUR FINISHED CIDER IN BOTTLES, OR BOTTLE YOUR CIDER UNTIL YOU ATTAIN THE CORRECT TRAINING, UNDERSTAND WHAT YOU ARE DOING, AND TAKE THE CORRECT MEASURES TO LIMIT THE RISKS INVOLVED. IF YOU IGNORE THIS WARNING YOU CAN CREATE BOTTLES THAT CAN EXPLODE WITHOUT WARNING AND CAN CAUSE SEVERE INJURY TO YOU AND OTHERS.

SPECIFICATIONS

Safety and Handling: This and any enzyme dust may cause irritation if inhaled. Unnecessary contact with the product and inhalation of dust should be avoided. In case of spillage or contact with eyes or skin, rinse affected area promptly with plenty of water. Refer to Material Safety Data Sheets, for general advice, disposal, and safe handling of enzymes.

Description: This cider PME is a purified pectin methyl esterase (PME) powder produced by controlled Solid State Fermentation of a non-GMO strain of Aspergillus niger. It de-esterifies pectin molecules by randomly hydrolyzing ester bonds that link methyl groups to carboxylic acid groups on individual galacturonic acids. It is a food grade, kosher certified enzyme that contains no preservatives and virtually no side activities due to its purity.

Usage: This PME is very effective at conditioning, clarifying, and preserving natural sweetness of apple cider and other raw juices. In order to reduce levels of yeast nutrients in raw apple or pear juice to slow fermentation, this PME should be used in conjunction with a food-grade calcium chloride ($CaCl_2$).

When the yeast nutrients are lowered in the juice, the rate at which fermentation takes place is slowed leaving more of a fruity flavor and fresh fruit aroma in the juice. When fermentation is complete and stops, the yeast will have run-out of nutrients instead of consuming all of the sugar. As a result, a wonderfully aromatic-tasty cider or perry with alcohol levels from 3 to 8.5% can be achieved along with a pleasing residual sweetness.

If hydrometer readings were properly recorded from the beginning, and by following SAFE bottling-for-carbonation procedures, a natural CO_2 carbonation can be attained instead of losing flavor from the bitter taste of artificial CO_2 carbonation. The result can be a true French Normandy-style sparkling cider or perry.

Benefits:
Works well with the typical pH of fruits and high tannin levels of cider apples and perry pears.
Effective over a broad temperature range 32º - 140º F (0º - 60º C)
Conditions, clarifies and preserves the natural sweetness of hard apple cider and perry (hard pear cider).

Enzyme Properties: Color White Powder Optimal pH 4.5 - 5.0
Most active Temperature 104º - 113ºF (40º - 45º C), but not recommended for keeving.

Quality Specifications: This Cider PME is manufactured under a quality management system consistent with International Quality System Standard ISO 9001:2000. Purity specifications comply with FAO/WHO JECFA, FCC and IFOAM recommended standards for food-grade enzymes.

Storage: If stored sealed and in a cool dry place out of light, the PME should not lose more than 10-15 % activity in 12 months from the date of purchase (extra PME has been added to compensate for the first year). After the second year, add 10-15% extra PME to compensate for loss in activity. For optimal stability, store at 4º C in low humidity.

Typical Hard Cider Apple List

Most Hard Cider Apples are for blending to control the levels of tannin, acid, astringency, sugar and alcohol in the finished beverage. Blending can be accomplished pre-or-post ferment. Some apples are called 'Vintage Apples' (**V**) because they make a well-balanced Hard Cider alone. Keep in mind that synonyms exist for most of these listed, and that North American-named 'Cider Apples' are typically only 'Juice Apples' for juice. European-named 'Cider Apples' are for what we call here 'Hard Cider' (many listed below). French Cider apples often keeve without using keeving kits.

Bittersweet	Avrolles
Bittersweet	Bramtot
Bittersweet	Domaine
Bittersweet	Frequin Rouge
Bittersweet	Frequin Tardive de la Sarth
Bittersweet	Golden Hornet Crab
Bittersweet	Kermerrien
Bittersweet	Avrolles
Bittersweet	Bramtot
Bittersweet	Domaine
Bittersweet	Frequin Rouge
Bittersweet	Frequin Tardive de la Sarth
Bittersweet	Kermerrien
Bittersweet	Metais, Mettais, Mottais
Bittersweet	Amere de Berthecourt
Bittersweet	Ashton Brown Jersey (v)
Bittersweet	Bedan (v)
Bittersweet	Bedan des Partes (v)
Bittersweet	Binet Rouge
Bittersweet	Binet Violet (v)
Bittersweet	Brown Snout (v)
Bittersweet	Brown Thorn
Bittersweet	Bulmers Norman
Bittersweet	Chisel Jersey
Bittersweet	Cimitiere
Bittersweet	Coat Jersey
Bittersweet	Cremiere
Bittersweet	Dabinett
Bittersweet	Ellis Bitter
Bittersweet	Fillbarrell
Bittersweet	Grise Dieppois
Bittersweet	Gros-Frequin
Bittersweet	Harry Masters Jersey (v)
Bittersweet	Improved Dove
Bittersweet	Jouveaux
Bittersweet	Major (v)
Bittersweet	Marechal
Bittersweet	Medaille d'Or (v)
Bittersweet	Michelin
Bittersweet	Muscadet de Bernay
Bittersweet	Muscadet de Dieppe (v)
Bittersweet	Muscadet de Lense (v)
Bittersweet	Nehou
Bittersweet	Noel Deschamps
Bittersweet	Redstreak (v)
Bittersweet	Reine des Hâtives
Bittersweet	Reine des Pommes
Bittersweet	Saint Martin
Bittersweet	Somerset Redstreak (v)
Bittersweet	Stembridge Jersey
Bittersweet	Sweet Alford (v)
Bittersweet	Tardive Forestiere
Bittersweet	Tremblett's Bitter (UK)
Bittersweet	Vilberie
Bittersweet	White Jersey
Bittersweet	Yarlington Mill

Sharp	Brown's Apple (v)
Sharp	Court Pendu Plat
Sharp	Court Pendu Rose
Sharp	Cox Orange Pippin
Sharp	Crimson King
Sharp	Geneva Crab apple
Sharp	Grenadier
Sharp	Haralson
Sharp	Harrison
Sharp	Stembridge Cluster
Sharp	Tom Putt
Sharp	Brown's Apple
Bittersharp	Breakwell's Seedling
Bittersharp	Cap of Liberty
Bittersharp	Dolgo Crab
Bittersharp	Duffilin
Bittersharp	Dymock Red
Bittersharp	Foxwhelp (v)
Bittersharp	Kingston Black (v)
Bittersharp	Judor
Bittersharp	Golden Hornet Crab
Bittersharp	Porter's Perfection
Bittersharp	Red Vain Crab
Bittersharp	Redfield (v)
Bittersharp	Skyrmes Kernel
Bittersharp	Stoke Red (v)
Bittersharp	Tremblett's Bitter (Geneva)
Sweetsharp	Baldwin
Sweetsharp	Bramley's Seedling
Sweetsharp	Calville Blanc
Sweetsharp	Eargmont Russet
Sweetsharp	Golden Harvey
Sweetsharp	Grindstone
Sweetsharp	Hewe's Crab
Sweetsharp	James Grieve
Sweetsharp	Rubenette
Sweetsharp	Wickson Crab
Sweet	Ashmeads Kernel
Sweet	Black Twig
Sweet	Bouteille de Liseux
Sweet	Calvin
Sweet	Champlain
Sweet	Claygate Pearmain
Sweet	Court Royal (v)
Sweet	Crow Egg
Sweet	Doux Normandie
Sweet	Doux Tardiff
Sweet	Frequin Audievre
Sweet	Frequin Lacaille
Sweet	Fryberg
Sweet	Gilpin
Sweet	Golden Nobel
Sweet	Golden Russet
Sweet	Granniewinkle
Sweet	Grimes Golden (v)
Sweet	Honey Gold
Sweet	James Grieve
Sweet	Karmijn de Sonnaville
Sweet	Kerry Pippen
Sweet	King David
Sweet	King of the Pippins
Sweet	Lady
Sweet	Margil
Sweet	Marin Onfroy (v)
Sweet	Milo Gibson
Sweet	Northern Spy
Sweet	Northwood (v)
Sweet	Orleans Reinette
Sweet	Peau de Vache
Sweet	Red Sause
Sweet	Reine des Reinettes
Sweet	Roxbury Russet
Sweet	Sam Young
Sweet	Smith's Cider
Sweet	Smokehouse
Sweet	Stayman's Winesap
Sweet	Sweet Coppin (v)
Sweet	Taylor
Sweet	Tollman Sweet
Sweet	Wheelers Golden Russet
Sweet	Whitney Crab
Sweet	Zabergau Rinett

Note:
To attain the genetic material to make your own multi-variety cider apple tree, or to add to your orchard, for hundreds of cultivars go to:

www.AppleScions.com