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# PLANNING YOUR BUSINESS

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Creating a new venture, either a new business or a new product, requires three key elements:

- Innovative idea
- Entrepreneurial drive
- Resources to go to market

Let's assume you have your innovative idea for a good hard cider product. The next element is entrepreneurial drive. At the end of this chapter is a self quiz to help you evaluate your entrepreneurial aptitude. (See Exhibit A) If you have any doubts, additional resources are listed under Exhibit B.

So now, all that's left are the resources. What are they? Time. Money. Property, plant and equipment. Labels and other intellectual property. People. These can be significant items.

The first thing to realize is that you cannot do all of this alone. You will need a management team that will include yourself, perhaps employees/partners, family members, consultants and others. You will also need to convince people outside your business organization that your innovative idea is financially sound – likely bankers or other sources of financing. You need a business plan! The business plan is your sales brochure to convince others that you have a good innovative idea and the entrepreneurial drive to succeed. The specific sections are:

- Executive Summary
- Mission Statement, History, and Objectives
- Business Organization/Operations
- Marketing Plan
- Management/Human Resources
- Financial Plan
- Supporting Documents

Executive Summary is the first part of the business plan but the last section to write. It is a brief (one or two page) synopsis that tells the story of the proposal. It is commonly called the "elevator pitch." Imagine that you are getting on an elevator on the first floor of a bank building and the loan officer who can provide you money for the project gets on with you. You have the time it takes for elevator to go to the fifth floor to present your idea to the loan officer. That is your Executive Summary.

Mission Statement, History, and Goals and Objectives contains general information about your business. The mission statement is a concise description of your core business values. The history should emphasize the experience of you and your management team to accomplish the plan. You will need four or five general goals that can be a combination of financial, marketing, operations, and production. Objectives under each goal are specific strategies to achieve the goal. These should extend over the first five years of your business.

Business Organization/Operations includes:

- Organizational structure for your business (single proprietor, partnership, corporation, or cooperative)
- Reasons you elected to organize under this structure
- Business controls

You can include information about the accounting system you will use and who, on your management team will be responsible for accounting (you could also hire an outside accounting firm). If your business includes processing products, be sure to include an overview of the process and who will be responsible for controlling various aspects of the process, such as raw product purchasing, supplies purchasing, sanitation, food safety, etc.

The Marketing Plan needs to be extensive as this is how you will convert your hard work and planning into dollars that will pay you, your employees and partners, and your banker. You will need to clearly explain who will patronize your business and why. To determine this you will need market research to identify:

- Size of the industry in which you are competing
- Other businesses that will compete with you
- Relative size of those businesses in relation to your business
- Where the product(s) you are marketing are normally sold
- Relative volumes through those outlets.

Once you have this knowledge you can:

- Identify your target market(s) and the sizes of those markets either in number of consumers or dollars of sales or both
- Explain how and why your business will attract that market segment
- Identify the businesses that are most likely to compete for your market segment, anticipate how they might react to your entry into the market and strategize how you will address that reaction

You can include a SWOT analysis (strengths, weaknesses, opportunities and threats) for your business. Finally a detailed marketing strategy that explains how you can differentiate your business from your competitors' and how that will attract your target audience to your business. The budget for marketing should also be included.

Management/Human Resources should include

- Résumé for each of the members of the management team, emphasizing qualifications to manage the business
- Job descriptions for the critical positions in the business should be included
- Organizational chart, showing the number of employees in each position.

The Financial Plan should state the assumptions you used in developing your business plan. These could include average selling prices per unit, production costs, cost of goods, sales targets, and more. The following statements should be part of this section of your plan:

- Balance sheet, preferably projecting 5 years (first year monthly, then annual)

- Profit and loss, preferably projecting 5 years (first year monthly, then annual)
- Cash flow, preferably projecting 5 years (first year monthly, then annual)

You may need to include your personal financial statements. Separate schedules showing start up costs, production budgets, marketing budget, distribution costs, etc. should be part of this section. A breakeven analysis should appear here. A sensitivity test in the form of expected case, worst case and best case scenarios with a description of the assumptions inherent in each scenario will prove useful.

Supporting Documents will include legal documents relating to your business organization. Letters of intent from suppliers, customers, critical partners and others should be included here. Any details about assumptions made in the business plan that were not explained in the appropriate sections could be inserted here. You may need to include proof of insurance to satisfy a banker or any other documents that might increase the chances for success.

SUMMARY

The business plan is essential for communicating to partners, investors and financiers that you have an economically viable business idea. It will serve as your "sales brochure" for you new business or product.

## SMALL BUSINESS SUCCESS QUIZ

Thinking of owning and managing your own business? It's a good idea-provided you know what it takes and you have what it takes. Are you the kind of person who can get a business started and make it go? Under each question, check the answer that says what you feel or comes closest to it. Be honest with yourself.

### Are you a self-starter?

- ❑ I do things on my own. Nobody has to tell me to get going.
- ❑ If someone gets me started, I can keep going.
- ❑ Easy does it. I don't put myself out until I have to.

### How do you feel about other people?

- ❑ I like people. I can get along with just about anybody.
- ❑ I have plenty of friends; I don't need anybody else.
- ❑ Most people irritate me.

### Can you lead others?

- ❑ I can get most people to go along when I start something.
- ❑ I can give the orders if someone tells me what we should do.
- ❑ I let someone else get things moving, then I help if I feel like it.

### Can you take responsibility?

- ❑ I like to take charge of things and see them through.
- ❑ I'll take over if I have to, but I'd rather let someone else be responsible.
- ❑ There's always an eager beaver around wanting to show how smart they are. I say, let them.

### Are you a good organizer?

- ❑ I like to have a plan before I start. I'm usually the one that gets things lined up when the group wants to do something.
- ❑ I do all right unless things get too confusing. Then I quit.
- ❑ Something always comes along and presents problems to your set-up, so I just take things as they come.

### How good of a worker are you?

- ❑ I can keep going as long as needed. I don't mind working hard for something I want.
- ❑ I'll work hard for a while, but when I've had enough, that's it.
- ❑ I can't see that hard work gets you anywhere.

### Can you make decisions?

- ❑ I can make up my mind in a hurry, if necessary, and everything usually works out.
- ❑ I can make up my mind if I have plenty of time. If I have to make a quick decision, I later question my judgment.
- ❑ I don't like to be the one deciding things.

### Can people trust what you say?

- ❑ You bet they can. I don't say things that I don't mean.
- ❑ I try to be on the level most of the time, but sometimes I just say what's easiest.
- ❑ Why bother when the other person doesn't know the difference.

### Can you stick with it?

- ❑ If I make up my mind to do something, I don't let anything stop me.
- ❑ I usually finish what I start - if all goes well.
- ❑ If it doesn't go right, immediately, I quit. Why beat a dead horse?

### How good is your health?

- ❑ I am never run down!
- ❑ I have enough energy for most things that I want to do.
- ❑ I run out of energy sooner than most of my friends seem to.

### Now count the checks that you made.

How many checks are there beside the first answer to each question? _____

How many checks are there beside the second answer to each question? _____

How many checks are there beside the third answer to each question? _____

If most of the checks are beside the first answers, you probably have what it takes to run a business. If you chose mostly second answers, you're likely to have more trouble than you can handle by yourself. It may be best to find someone to assist on the points on which you are weak. If many checks are beside the third answer, not even a good partner will be able to shore you up.

### Now think about *why* you want to own your own business.

| | YES | NO |
|---|---|---|
| Do you want a business badly enough to keep working long hours without knowing with how much money you'll earn? | _____ | _____ |
| Have you worked in a business like the one you want to start? | _____ | _____ |
| Have you worked for someone else as a foreman or a manager? | _____ | _____ |
| Have you had any business training in school? | _____ | _____ |
| Have you saved money? | _____ | _____ |

## RESOURCES

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4700 S Hagadorn Road, Suite 210
East Lansing, MI 48823
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Michigan Small Business and Technology Development Center
Grand Valley State University
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# Cider Making
# From traditional to modern

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## History of cider

Hard cider is the one of the fastest growing segment of the liqueur industry and it is considered by many to be the drink of the future. Sweet or hard cider was the drink of America's past. Between 1870 and 1892, cider consumption rose a healthy 200 percent to become the most popular drink in America. Enjoyed by many notable historical figures cider was the outstanding American beverage.

The word cider, in most parts of the world, refers to the fermented, alcoholic beverage made from pressed apple juice. In North America the term for this alcoholic beverage is hard cider (Clause 2003). Hard cider is believed to have roots from the winemaking technology in the Basque country of northern Spain. The cider-making technology was spread throughout the northern coast of Europe by Celts as they traveled from Spain to England and Ireland (National Honey Board 2003). Colonists who brought apples and cider-making technology with them introduced hard cider to the New World.

Hard cider was the preferred beverage during the colonial period. By the time of the American Revolution, cider consumption per capita was as high as 40 gallons (Cone 1997). Two important factors affected the popularity of hard cider: the mass production of beer during the American industrial revolution and prohibition. Currently, hard cider is making a strong comeback and there is increasing awareness and appreciation of this traditional beverage (National Honey Board 2003). Furthermore, it is expected that sales of hard cider to exceed 75 million cases in less than 10 years (Fabricant 1997).

All cider goes through at least three basic stages. In autumn, the ripe fruit is crushed; then the juice is pressed out. The juice may be fermented for weeks or months, but usually by late winter the finished cider is bottled.

## Steps in cider making

A critical step in the manufacture of hard cider is the apple selection. The apple varieties grown in the United States are over 2,500, however only a small portion of these is suitable for producing traditional cider. The cider maker has a large choice to select from to reach certain styles of cider (Cone 1997). There is a wide diversity of cider styles in Europe. In the United Kingdom (UK) cider is clear and carbonated with different degrees of sweetness. The UK legal limits for alcohol content are between 1.2-8.5%, and UK cider does not exceed these limits. Today, many UK ciders contain only 30-50% apple juice in the finished product because the trend is to add sugar syrups before fermentation. For this reason the flavor is generally lighter in comparison with the cider available previous to the 1970's. There is a diversity of UK cider styles: high alcohol white ciders, colored or flavored cider, cloudy or naturally conditioned ciders, lightly carbonated full juice ciders with more complex flavor characteristics. The French cider is a sparkling, light beverage with low-alcohol content and characterized by sweetness and by tannic and apple-like flavors (Lea and Drilleau 2003). Dry and acidic with high alcohol content is a characteristic of German and Swiss ciders. In Spain and Austria consumers expect cider made with distinct vinegar like flavor.

There are up to 12 steps (Figure1) in cider making: the harvest, "sweating", washing, grinding, pressing, blending, testing, fermentation, racking off, filtering or fining, bottling, storage. Each step has its importance in the overall "image" of the final product (Proulx and Nichols 2003).

In modern plants, the apples are crushed in a grater type mill made of stainless steel. Next, the pulp is crushed to extract the juice using a cider press. In modern plants, mechanic-hydraulically operated plate presses are used. The freshly pressed juice may be fermented straight away or concentrated and stored for later conversion to cider, in which case it is extensively treated to pasteurize and remove pectin.

Apple juice concentrate (AJC) is widely used in English cidermaking and to a limited extent in Franch cidermaking. The advantage of a 70 °Brix concentrate to the cidermaker is that it may be stored for months or years with relatively little deterioration compared to fresh juice, which compliments just-in-time (JIT) business practices. Hard cider production in Europe generally

utilizes AJC in a controlled fermentation process using deliberate addition of selected yeast and malolactic bacteria, which both help to control fermentation rates and ensure uniform product quality (Lea and Drilleau 2003).

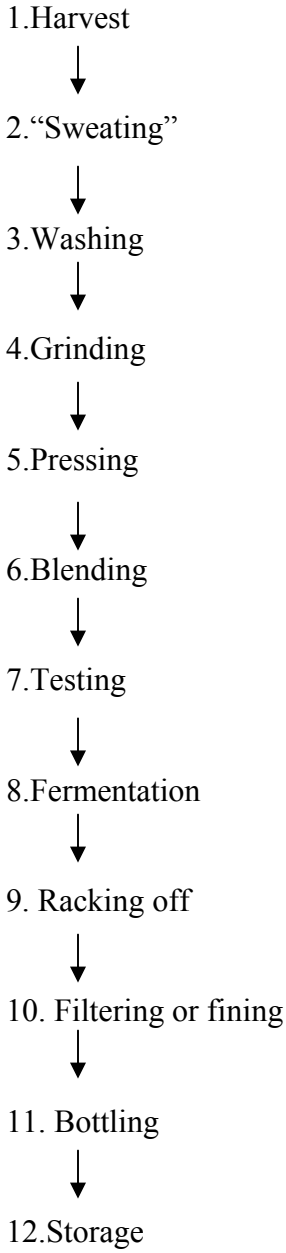


**Figure 1** Schematic diagram of the basics steps in cider making

## The harvest

This step involves the harvest of the prime material that makes a good cider: ripe apples of several varieties to make a balanced cider blend. Green or immature apples make a poor cider, however some may be added to increase the acid content (tartness). Rotten apples should not be mixed up with the good quality cider apples; also windfalls apples harbor *acetobacter*, the active bacteria in vinegar making.

Although there are technical aspects and personal preferences involved, essentially all that is need is apple – nothing added, nothing taken away – to make the delicious sweet cider that when allowed to ferment will create a sparkling hard cider that rivals the finest of champagne. However, a good business plan, sufficient capitalization and hard work are necessary to initiate a successful commercial operation (See Planning your business).

Most ciders are a blend of juices from several apple varieties. A representative blend of apples would include approximately 50% sweet apples, 35% acidic apples and 5% astringent apples (National Honey Board 2003). Although juice from any apple can be made into cider, the cider makers suggest that apple should have certain characteristics: relatively high sugar content for alcohol production, a fibrous tissue to facilitate juice extraction, tannin to provide a bitter or astringent taste and a pleasant apple taste and aroma (Cone 1997). Here are some example of the most used apple varieties in making cider in North America: Baldwin, Ben Davis, Cortland, Cox's Orange Pippin, Delicious, Golden Russet, Jonathan, McIntosh, Newtown, Rhode Island Greening etc. In Michigan there are more than 20 varieties of apples that can be used such as: Paula Red, McInthosh, Jonathan, Empire, Ida Red, Gala, Jonagold, Rome, Fuji, Honeycrisp, Red Delicious, Golden Delicious, Northern Spy. The varieties used frequently in cider making are McInthosh and Jonathan. For more information about apple varieties and Michigan varieties check Appendix 2.

One of the reasons why the cider is made from a variety of apples is to achieve the balance of sugar, acid and tannin required for a successful product (Lea and Drilleau 2003). For cider

making cider apples with more than 115 grams of sugar per liter of juice, and low amount of nitrogenous material should be used (Proulx and Nichols 2003).

According to Long Ashton Research Station (Proulx and Nichols 2003), where the world's primary cider research is carried on, cider apples are classified as follows:

**Table 1** Cider apples classification according to acid and tannin content

| **Apple Group** | **Acidity (G Malic Acid/100ML)** | **Tannin (G/100ML)** |
|---|---|---|
| Sweets | <0.45 | <0.2 |
| Bittersweets | <0.45 | >0.2 |
| Sharps | >0.45 | <0.2 |
| Bittersharps | >0.45 | >0.2 |

Source (Proulx and Nichols 2003)

One step of great importance in cider making is to obtain fine-flavored, well-ripened apples with good levels of acid and tannin. Important parts of the apple in cider making are the skin and pulp.

Apple skin. In the composition of apple skin there are some essential oils and odorants (aroma), acids, tannins, certain bitter substances, yeast and pigments (contribute very little to the color of the cider). Odorants trapped in the skin will give the apple its distinctive aroma, which is way it is important to use only ripe apples for cider.

Apple pulp. The cidermaker's prime raw material is represented by apple pulp. It makes up 95% of the total weight of an apple, soluble and insoluble parts:

- Soluble part becomes the "must". Composition: 75-90% water, sugars (glucose, levulose and saccharose), malic acid, tannins, pectins, starch, oils, ash, nitrogenous material and trace elements
- Insoluble part composition: starch, pectin, cellulose, nitrogenous material, and ash

The fibrous tissues (3% of the pulp) together with the skins, seeds, and other insoluble substances are known as the pomace or *marc*.

## "Sweating"

Apples should be stored on a concrete or wooden platform about a week to ten days until a good firm squeeze leaves finger impressions on the fruit signals that they are ready for grinding.

**Advantages of "sweating"**:

- Makes the apples easier to grind
- Increases the sugar in the juice
- Allows good flavor to develop

**Disadvantages of "sweating"**:

- Not beneficial for some varieties: Jonathan, Newtown and Rome Beauty; these varieties should be pressed ripe and freshly picked.

## Washing

The purpose of washing is to remove leaves, twigs, harmful bacteria, insects, and any spray residues. This step can be done in a clean tub or vat filled halfway with clean water.

## Grinding

In order to extract the maximum amount of juice the fruit should be ground or milled to a fine pulp. Apples may be ground whole, including cores and skin. The finer the consistency of the pomace, the greater the yield of juice.

## Pressing

Based on the type of press used, the pulp may be dumped onto press cloths, which are folded over and built up in many layers within a series of racks, or poured into a bag that fits inside the slated pomace container of a "tub press". As pressure is applied, the juice flows out. The time of pressing is about half an hour or overnight if one uses a home press. The effect of air on the juice is that gives cider a brown color. Clean collecting vessels made of plastic or stainless steel are recommended to avoid off-flavors and colors. Copper, aluminum, iron,

galvanized metal or chipped enamel containers should not be used. The juice should not to be exposed to air or insects but funnel into fermentation containers as soon as the pressing is over. The juice now is called “must”.

## Blending

A well-balanced cider is a cider that includes different varieties of apples.

**Table 2** Proportions of juice used in cider:

| **Juice type** | **Percent of Juice Total** |
|---|---|
| Neutral base | 30-60 |
| Tart | 10-20 |
| Aromatic | 10-20 |
| Astringent | 5-20 |

Source (Proulx and Nichols 2003)

Blending stages can be done at any of the following stapes:

1) Before grinding
2) Before fermentation – after pressing
3) After fermentation – blending at this step gives the greatest control over the quality of the finished cider.

## Testing

Sugar and acid levels are very important in the cider. During the fermentation the sugar is going to convert into alcohol. The amount of sugar in the fresh juice gives the information on the alcoholic strength on the final product. The acid level should drop. If the cider is contaminated by acetobacter the acetic acid (vinegar) is manufactured.

## Fermentation

Natural fermentation of cider takes can take place in two stages:

1) The yeast flora are "feed" by the natural hexose sugars and the products of fermentation are: alcohol and carbon dioxide ($CO_2$). Depending on the temperature and the juice constituents this type of fermentation can last for weeks or even months as long as the sugar is available to the yeast. When sugar is no longer available for yeast, the fermentation slows and then stops.
2) The lactic acid bacteria ferment the natural malic acid found in apples into $CO_2$ and lactic acid. A malo-lactic fermentation (usually occurs spontaneously) is desirable if the cider is harsh and acidic at the end of the first fermentation; it also results in a smoother and gentle cider. However, while malolactic fermentation may be helpful with European apples, Michigan desert apple fermentations do not stand to gain much from this step.

In terms of chemical reactions, alcoholic fermentation can be described as a three-step process (Margalit 2003):

a) Glucose and fructose (six carbon molecules) are beaked down into phosphoglyceraldehyde (three carbon molecule) by phosphorylation
b) Phosphoglyceraldehyde (three carbon molecule) is transformed into carbon acetaldehyde and carbon dioxide (source of $CO_2$ for fermentation) by decarboxylation
c) Acetaldehyde is reduced to ethyl alcohol as an end product.

Most UK cidermakers take the view that a complete 'dry' fermentation 10-12% alcohol in as little as two weeks is a desirable objective (Lea and Drilleau 2003). Incomplete fermentation can be obtained by removing the yeast halfway throughout the process, thus retaining less alcohol and more fermentable sugars than 'dry' hard ciders. In the U.S, commercial hard ciders usually contain about 5.5% alcohol and most are carbonated (Proulx and Nichols 2003).

Fermentation is temperature dependent. The first law to bear in mind is that the transformation of sugar gets faster with a rise in temperature. For example wine fermentation is much faster at

30 ºC than at 25 ºC and at 25 ºC than at 20 ºC and its speeds double for each 10 ºC variation (Peynadau 1984).

The second fermentation (*malo-lactic fermentation*) converts L(-)-malic acid to L(+)-lactic acid and carbon dioxide and is carried out by lactic acid bacteria present in the apple juice. The malo-lactic fermentation can occur concurrently with the yeast fermentation but more often it is delayed until a few months later. However, hard cider prepared from typical Michigan desert apples varieties do not benefit much from *malo-lactic fermentation*.

Yeasts

Since the 1980s, specific cultured yeasts have been used in cider making. Inoculum mixes of active dried wine yeasts of S. *uvarum* and S. *bayanus* are widely used as the former provides a speedy start while the latter copes better with fermentations to dryness since some yeast types are not tolerant to high alcohol concentrations (Lea and Drilleau 2003). The vitality and viability of cultured cider yeasts under high stress conditions (i.e. higher alcohol concentrations and different types of alcohol) have recently been investigated (Seward and others 1996).

If the cider is prepared the traditional way of processing, no additional yeast will be necessary. The internal fruit microflora together with inocula from pressing cloths and equipment can give sufficient yeast counts to initiate fermentation within the few hours if the temperature of the juice is above 10 º C (Lea and Drilleau 2003). Hence, in a traditional cider fermentation where no yeast is added and no sulfite is used, the first few days are dominated by the non-*Saccharomyces* spp., which multiply quickly to produce a rapid development of gas and alcohol. While the alcohol level rises (2-4%) these species die out and their place is taken over by other *Saccharomyces* spp. that completes the conversion of all the sugars to alcohol and generates a more wine-like flavor. Once all the available sugar is consumed the final alcohol level is unlikely to exceed 8% from single strength juice (non-concentrated).

*Saccharomyces* spp. are yeast species present in the juice mostly due to the contamination from the press cloths and factory equipment. They also are found on the skins of apples. In addition, this yeast species generate a distinctive range of flavors (Lea and Drilleau 2003).

In the commercial cideries where the equipment was disinfected with chemicals to defeat the bacteria that cause cider sickness, the chance of natural fermentation is low because yeast are killed at the same time with the unwanted bacteria. The same situation is encountered when a cider maker uses new equipment and a small amount of apples for making cider for the first time. Therefore, the addition of laboratory-grown "wine-yeast" of known, reliable characteristics is necessary.

Temperature profile of the cider fermentation is strongly linked with yeast population dynamics of the predominant yeast species, present within the fermentation (Morissey and others 2004). In a recent study on Irish hard cider (Morrissey and others 2004) it was reported that very rapid fermentation could be obtained in early season fermentation when ambient temperatures were higher with fresh "must" temperatures of 14-16 ºC and higher yeast numbers present. In addition, rapid increase in sugar utilization, temperature rise and ethanol production observed between days 4 and 8 was accompanied by rapid growth of *Saccharomyces* species during the same period. Lower temperatures that can be reached later in the production season can determine much longer fermentation with very different yeast profiles. Fermentation temperature is very important because it influences both the overall fermentation performance and the organoleptic properties of the final product.

Here are some examples of which yeast to use:

- champagne yeast
- wine yeast: Johanisberger, Tokay, Rhine; the most widely used in North America is: Burgundy-descended "Montrachet" yeast
- homemade yeast; raisins contain a lot of wine yeasts on their skins.
- yeasts starter – usually commercial white wine yeasts (dry or liquid) added for flavor purposes (to obtain champagne flavor)
- yeasts nutrients (ammonium and thiamine) – added at the same time with commercial yeast or when the fermentation slows (sometimes this happens due to low nitrogen levels in the cider)

For more information on yeast types and fermentation check Appendix 2 – Fermentation Handbook.

The addition of yeast directly to untreated juice may intensify the natural yeast, ending up with a good fermentation. However, the unwanted microorganisms will continue to increase in the cider and give serious trouble before the final product is ready, particularly if a low-acid juice is produced. In order to avoid these problems many cidermakers add sulfur dioxide ($SO_2$) to the juice before fermentation starts.

Sulfur dioxide ($SO_2$) – also named "the sterilizer" is added to the freshly press juice before fermentation. Period of time to stand is 24 hours. Its role is to kill bacteria and undesirable yeasts (the good yeast necessary in the fermentation process will survive).

**Advantages of using $SO_2$.** The addition of $SO_2$ in cider making has some advantages: a good start with "must" bacteria-free, decrease loss of the batch and a better fermentation. $SO_2$ is used as an antioxidant and an inhibitor of oxidizing enzymes. Furthermore, $SO_2$ combines with products of previous oxidation and prevents darkening (Herrero and others 2003).

**Disadvantages of using $SO_2$:** It is useful mentioning that some people are allergic to $SO_2$ at even very low concentrations. However, the use of $SO_2$ in cidermaking has been considered extremely necessary. Because of the health concerns International Organizations (Joint FAO/WHO Expert Committee on Food Additives) recommended its total elimination or at least reductions. Nevertheless, the legal permitted limit is 200 ppm (U.S. Food and Drug Administration and European Commission). In order to achieve a better microbial stability without using $SO_2$, alternative methods have been proposed such as: apple juice storage under $N_2$ atmosphere (to avoid $O_2$ contact that is the cause of oxidation and microbial spoilage), the use of ascorbic acid, and yeast inoculation (Herrero and others 2003).

Sugars – honey or white sugar may be added to unfermented juices. Sugar is added to increase the amount of alcohol in the final product. Addition of sugar can be at the same time with yeast and yeast nutrients or when the natural fermentation has settled. Information in table 3 shows the amount of sugar necessary to be added to the juice.

**Table 3** Amount of carbohydrates necessary to increase **s**pecific gravity of the juice

| Specific gravity increase | Additional sugar/ gallon | Additional honey/gallon |
|---|---|---|
| 5° | 2¼ oz | 3 oz |
| 10° | 4½ oz | 6 oz |
| 15° | 6¾ oz | 9 oz |
| 20° | 9 oz | 12 oz |

Source (Proulx and Nichols 2003)

The amount of natural sugar in the must is measured with a hydrometer (for measuring the specific gravity of soluble solids in the juice).

**Racking off**

Using a clean plastic tube the cider is drained off into the second fermenting tank or directly into bottles. The preferementation readings should be compared with these acid and alcohol levels.

**Filtering(a) or fining (b)**

This step makes a cider crystal clear. It can be done by:

a) Using a closed filter system avoiding exposing the cider to air (risk of acetic bacteria contamination) or

b) Mixing gelatin, bentonite, and pectic enzyme into the cider.

**Bottling**

Use sterile bottles for cider. For a "in-bottle fermentation" small amount of sugars may be added to each bottle. Cap or cork the bottle and then pasteurize the cider to prevent a further fermentation. To avoid killing the yeast by pasteurization after the addition of sugar, the addition of sulphur is most practiced. Contract packaging facilities can be used if the cider maker does not wish to invest in this equipment.

Hard cider can be carbonated. Carbonation can occur as a result of natural process or it can be done artificially, by dissolving carbon dioxide under pressure (28 psi) into the liquid.

Carbonation is used to improve both the taste and "texture" of the carbonated consumable. Carbonation is sometimes used for reasons other than consumption, to lower the pH (raise the hydrogen ion concentration) of a water solution, for example. Details about carbonation are in Appendix 2 (Sparkling wine production).

**Storage**

The bottles should be kept in a cool, dark storage place for several months for flavor development.

## Cider tasting and judging

Cider tasting can be defined in the same way as wine tasting: “both an ancient art and a modern science ”(Peynaud 1987). Like wine, cider tasting is essential for assessing quality during the process of making cider and for the purpose of buying and selling it. Cider tasting is the interpretation of a sum of sensations perceived either simultaneously or successively by the sense of sight, smell and taste. These are activated by various sensory stimuli, and the touch and temperature sensitive receptors of the mouth are also involved (Peynaud 1987).

People perceive scents, flavors and tastes differently, which is why describing those is not an easy job. People are linked to different sensory memories, and to different culturally acquired food habits.

The following attributes should be consider when evaluating cider:

Sight – the color of cider will vary with the apples used; the effervescence

Smell – the aroma of the apples

Touch – cider should have the right balance of malic acid and tannin

Taste – the degree of sweetness

Sound – range of effervescence (bubbles, carbonation)

## Basic analysis for hard cider

The process of cider making involves some basics analysis that can be done in a small "laboratory" using the same equipment as for wine analysis The basic analyses include: sugar measurement, acidity, alcohol, and sulfur dioxide. Alternatively some of these analyses may be send to commercial laboratory.

### a) Sugar measurement (Brix measurement)

The Brix is a chemical term representing the total soluble solids (sugar, organic acids, minerals, proteins phenols and many more) in a liquid (g solid/100g solution). Two methods have been used for Brix measurement in wine making: hydrometry and refractometry. Temperature corrections have to be made in both methods because the calibration reading is usually set at 20 ºC.

**1. Hydrometry** refers to the linear dependence of the density of the liquid on its solid's soluble content. In wine making, the pure sugar content may be given by the following equation:

% Sugar (weight/volume) = (Brix-2.1) x density
Each 1.7% sugar (weight/volume) → 1% alcohol (volume/volume)

A connection of potential alcohol to the Brix-density relation:

%Alcohol (v/v) = 0.58 x (Brix-2.1) x density

**Procedure:**

To measure the sugar content using the hydrometer first thing is to pour the juice up to the top of a cylinder. Then, place the hydrometer in the cylinder (the juice will overflow) and rotate back and forth to make sure that the reading is correct because the $CO_2$ bubbles stick to the hydrometer and change the readings. The reading will be done at the lower point of the meniscus, after rotation when the hydrometer settles.

**2. Refractometry.** The refractometer measurement is based on the refractive index of the sugar and is calibrated to show directly the Brix reading. A refractometer is used to do the reading. A drop of juice is placed on the surface of the refractometer that has to be clean and dry. After the cover is closed the reading is taken by looking into the eyepiece against direct light. Then, the room temperature is measured and the necessary corrections are done. In general, the refractometer measurements are slightly lower than the hydrometer measurements.

**b) Acidity**

Acidity analysis for wines includes:

- total acidity (TA)
- volatile acidity (VA)
- fixed acidity (FA)
- pH

Usually for cider volatile acidity and pH are measured.

**Volatile acidity** is a measurement that serves as an indicator for microbiological spoilage of the cider. This measurement is based on steam distilling of the volatile acids from the cider and titrating the distillate. A source of mistakes may be the $CO_2$ and $SO_2$ presence in the product that can be distilled with the others volatile acids. Therefore, $CO_2$ has to be removed, and $SO_2$ can be determined but its acidic equivalent has to be subtracted from the VA.

The concentration of the volatile acid expressed as acetic acid is:

$VA\ (g/L) = 60 \times (V_b \times N) / V_c \times F)$

Where:

$V_b$ = ml of NaOH used in titration

$V_c$ = ml of cider sample

N = Normality of the NaOH (0.1N)

F = Normality factor in case the NaOH concentration is different from 0.1N.

If N=0.1N and the cider sample is 10ml:

$VA\ (g/L) = 0.6 \times V_b$

**pH**

This measurement represents one of the critical factors in cider and wine making and its measuring starts during the ripening period and continues all the way through the processing. The value of pH is correlated with the acid's concentration in the must or final product. The usual pH for cider is around 3.7. The pH measurement is made using a pH-meter, which measure the potential difference due to proton concentration differences between a glass electrode and a calomel reference electrode. For accuracy in reading the pH-meter should be calibrated before use and the final product free of $CO_2$. The calibration can be done using commercial standard buffer solution of pH=4.00 and pH=7.00. The electrode of pH-meter should be immersed in a buffer solution while not in operation.

**c) Alcohol**

There are a couple of methods to determine the alcohol concentration in cider or wine(can be sent to a laboratory):

- Boiling point
- Distillation
- Oxidation
- Gas-chromatography
- Enzymatic

The most common and suitable methods used are: boiling point and distillation.

-Boiling point can be measured using an instrument named ebullioscope or ebulliometer that contains a thermometer calibrated directly with the alcohol concentration.

-For distillation method, the measurement can be done by a hydrometer and using standard tables or graphs can find the alcohol concentration.

**c) Sulfur dioxide**

The determination of $SO_2$ is done by titration with iodine. Only the free $SO_2$ present in wine or cider participate in the reaction. Since the bound $SO_2$ does not react with iodine, to measure the total $SO_2$ (bound and free) all bound $SO_2$ is hydrolyzed first and then titrated with iodine solution and starch.

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