Craft Cidermaking

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Beyond the Basics

Andrew Lea
With acknowledgement to
Charles W Radcliffe Cooke MP
Cider Enthusiast and Promoter
who wrote “A Book about Cider and Perry”
here at Hellens in 1898

President of NACM
Founder Benefactor of Long Ashton Research Station 1903
Author of ‘Cider’ article in Encyclopaedia Britannica 1911
What do you do?

Who here already makes their own cider?

Hobby?
Commercial?
More than 70 hL?

Just starting out?
The Basics!

Step by Step Guide

• Select and collect your apples
• Mill the apples to a pulp
• Press out the Juice
• Let the juice ferment
• Rack and store the cider
• Drink and Enjoy!!
Let’s dig a bit deeper!

- Fruit selection and blending
- Yeast and sulphiting
- Malo-lactic maturation
- Carbonation
- Sweetening
- “Keeving”
- Style of finished product
- Faults
Choice of cider fruit
The traditional classification (Barker, LARS, 1905)

<table>
<thead>
<tr>
<th>Type</th>
<th>Acid %</th>
<th>Tannin %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet</td>
<td>&lt; 0.45</td>
<td>&lt; 0.2</td>
</tr>
<tr>
<td>Sharp</td>
<td>&gt; 0.45</td>
<td>&lt; 0.2</td>
</tr>
<tr>
<td>Bittersharp</td>
<td>&gt; 0.45</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Bittersweet</td>
<td>&lt; 0.45</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Finished Cider</td>
<td>~ 0.45</td>
<td>~ 0.2</td>
</tr>
</tbody>
</table>

……Blending is the cidermaker’s art!
Choice of “vintage quality” fruit

Term devised by Hogg 1886

Adopted by Barker 1910 to embrace superior qualities that could not be determined by analysis
UK “Vintage Quality” List (1988)

**Sharps / Bittersharps**
- Dymock Red
- Kingston Black
- Stoke Red
- Foxwhelp
- Browns Apple
- Frederick
- Backwell Red

**Bittersweets**
- Ashton Brown Jersey
- Harry Masters Jersey
- Dabinett
- Major
- White Jersey
- Yarlington Mill
- Medaille d’Or

**Pure Sweets**
- Northwood
- Sweet Alford
- Sweet Coppin
Choice of Orchard Type

- A **traditional** orchard
  - 30 standard trees per acre
  - Sheep or cattle graze underneath
  - Higher landscape value
- An **intensive** orchard
  - 300 bush trees per acre
  - Grass cover with herbicide strip
  - No livestock
Influence on Cider Quality?

- Standard trees (especially in old orchards) tend to lower nitrogen levels
- They tend to ferment more slowly
- This may be beneficial to ultimate cider quality
Fruit Storage?

• Not all apples are ripe when picked

• Mid /late season apples mature when stored
  – Starch converts to sugar
  – Volatile flavour develops

• Practical considerations are important too
  – e.g. protection from pests
Blending or Single Varietals?

• Blending before fermentation can ensure good pH control (< 3.8)
• High pH (bittersweet) juices prone to infection
• Single varietals may be unbalanced
  – unless ameliorated with dilution or added acid
pH vs Titratable Acid

- Inverse relationship is not exact
- Measure using narrow range test strips or a pH meter
- < pH 3.8 is a good place to be before fermentation (> 0.4% TA)
Fermentation (old and new)

Yeasts wild or cultured?
Wild Yeast

- Wild yeasts are everywhere
- The inoculum stays on fruit, cloths and equipment
- A succession of yeasts grow and ferment during traditional cider fermentation

- *Kloeckera apiculata* starts; dies at 4% alcohol
- *Saccharomyces cerevisiae* slowly build up to finish
- This may take 3 – 4 months
The main protagonists

K. apiculata

S. cerevisiae
Pure Culture Yeasts

• Defined strains of monoculture wine yeasts
  – *Saccharomyces cerevisiae* and *S. bayanus*
    • e.g. 71B, V1116, EC1118, AWRI 350

• Pitch large inoculum into sulphited juice
  – fast fermentation in as little as 2 weeks
Yeast Comparison

<table>
<thead>
<tr>
<th>Wild</th>
<th>Cultured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow but may tolerate \sim 4\degree C</td>
<td>Fast but need &gt; 10\degree C</td>
</tr>
<tr>
<td>Succession gives more complex flavour development</td>
<td>Ferment dry and wine-like</td>
</tr>
<tr>
<td>Some risk of acetic / sulphidic flavours persisting</td>
<td>Flavours generally clean but may need nutrients to ensure this</td>
</tr>
<tr>
<td>Flocculation may be poor</td>
<td>Flocculation typically good</td>
</tr>
<tr>
<td>Benefit from good pH control and use of SO\textsubscript{2}</td>
<td>Benefit from good pH control and use of SO\textsubscript{2}</td>
</tr>
</tbody>
</table>
“Lay Brimstone on a Rag, and by a Wire let it down into the Cider-Vessel, and there fire it; and when the Vessel is full of the Smoak, the Liquor speedily pour’d in, ferments the better”
Sulphur Dioxide in the 21st Century

- Controls adverse bacterial and yeast infection
- Added most conveniently as 10% metabisulphite solution (5% SO₂) or as Campden tablets
- Binds to juice components especially from rotten fruit
- Its equilibrium is very pH dependent
- Active range is 0.5 - 1 ppm (mg/l) molecular SO₂
- To achieve 1 ppm active molecular SO₂, up to 200 ppm total might need to be added at pH 3.8
- Lag phase while wild S. cerevisiae multiplies may be 2 weeks or longer; cultured yeasts are much quicker
Sulphite Addition Chart for Apple Juice Before Fermentation
(assuming typical binding components)

…..or at least try “1 Campden tablet per gallon”!!
Cider Maturation

• Traditional ciders finish fermenting in the spring
• As the weather warms up and the trees bloom, the cider starts to ‘work’ again and becomes less harsh in flavour
• Evidently the cider and the trees are somehow in sympathy!
This is the Malo-Lactic Change

- Malic is the principal acid in apple. It is decarboxylated by lactic acid bacteria to give CO₂ and lactic acid
  \[
  \text{HOOC.CHOH.CH}_2\text{COOH} \quad \rightarrow \quad \text{HOOC.CHOH.CH}_3 + \text{CO}_2
  \]
- Hence the acidity falls by 50% and the cider becomes slightly carbonated
- Other interesting flavour changes occur too particularly the spicy / old horse note
Wooden Vats

• Old oak vats largely provide an inoculum for malo-lactic organisms...

• …unlike wine where oak flavours are transferred from new barrels

• Wood can be a USP
  • but also a false friend!
Not all malo-lactic bacteria are good

- Ropiness
- Mousiness
- Excess acid loss
- Danger of working at pH > 3.8 without SO$_2$
# Controlling Malo-Lactic Change

<table>
<thead>
<tr>
<th>Promote</th>
<th>Inhibit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old wooden casks</td>
<td>Use sterilised tanks</td>
</tr>
<tr>
<td>Higher pH</td>
<td>Keep pH down</td>
</tr>
<tr>
<td>Stand on lees</td>
<td>Rack off lees</td>
</tr>
<tr>
<td>No $\text{SO}_2$ on storage</td>
<td>Add $\text{SO}_2$ for storage</td>
</tr>
<tr>
<td>Add a bacterial culture</td>
<td>Use lysozyme</td>
</tr>
</tbody>
</table>
Use of Malo-Lactic Cultures

- Cultures have been selected for the wine industry from well-behaved *Oenococcus oeni*
- An exciting and under-explored area for cider-makers especially those using dessert or cull fruit whose ciders are too sharp
- Now relatively pH and sulphite tolerant
- Can lower acidity from 1% - 0.5% at > 15°C
- But no spicy notes from this organism!
Storing Bulk Cider

“L’air est l’ennemi mortel du cidre”

French cidermaking leaflet

• Keep tight!
• Keep full!
• CO₂/N₂ blanket if part-filled
• Use SO₂ (50 ppm)
Finished Cider - Dry or Sweet?

• Dry cider does not appeal to all
  – sugar / acid / tannin balance
  – SG 1.005 - 1.020 is preferred range (as sugar)

• Added sugar risks refermentation unless pasteurised. Permitted alternatives are
  – Saccharin
  – Acesulfame-K (aspartame isn’t stable long-term)
  – Sucralose (becoming widely used by small makers)

• Alternatives lack ‘body’ compared to sugar
Finished Cider - Fizzy or Flat?

• Carbonation lifts the flavour of a cider
  – and provides greater perceived acidity
  – Typically 5 - 12 g/l (1 - 4 atmospheres at 10°C)
  – Usually achieved by ‘force carbonation’

• Saturation solubility of CO₂ is 2.5 g/l at 10°C
  – a sub-saturation carbonation of 1 g/l is normal for still white wines
  – enhances flavour balance and body
  – provides some anti-microbial effect
Natural Ways

Carbonation

Bottle conditioning

@SG 1.005 ‘crown cap’

@SG 1.010 ‘mushroom’

The residual or added yeast produces CO$_2$ in bottle

Retained Sugar

Repeated racking of slow fermentation

requires wild yeast

requires low N$_2$ fruit

Can stabilise at SG 1.010

Can combine the two through ‘keeving’
A diversion through Keeving…

• ‘Keeving’ is the old English and French method
• Still common practice in Devon pre-1939
• Allows production of naturally sweet cider
• The juice stands for several days in the cold
• The ‘flying lees’ or chapeau brun rises spontaneously to the top
• The clear juice below is pumped off to ferment very slowly for the next three months
Science explains tradition!

- Apple pectin is a highly methoxylated polygalacturonic acid which is slowly de-esterified by an endogenous esterase.
- The liberated polygalacturonate (pectate) anion combines with free cations in the juice, notably calcium, asparagine and thiamin.
- This calcium pectate gel rises to the top buoyed up by CO$_2$ from the yeast.
The result...

- Clear juice depleted in amino nitrogen and thiamin
  - they bind to the pectate
- Hence yeast nutrient and vitamin level is very low
- So the fermentation is very slow and traditionally can take 3 - 4 months in the winter
- Repeated racking stops fermentation
- Cider may be filtered and bottled at SG 1.010 – 1.025
- Slight carbonation develops in the bottle
- Disappeared commercially post-1945 in UK
Keeving is obsolete(?) in England

• But is the norm in France as ‘défécation’, where they now use:
  – Added commercial PME  (*Rapidase CME*)
  – Added calcium (as the chloride)
  – Nitrogen bubble flotation in larger factories
  – Fermentation at $ca 4^\circ C$
  – Frequent centrifugation to remove the yeast crop

• This produces a naturally sweet cider of full flavour and low alcohol (a craft cidermaker’s USP?)

• There is a considerable revival of interest in the UK
Finished Cider - Bottle or Cask?

- Cider was first bottled in the 1640’s in the Forest of Dean
- The slight continued fermentation gave ‘natural condition’ and sparkle
- Pre-dates Champagne by at least 50 years!
- The gentry had specially-made glasses to drink from
Bottled ciders

Traditional (conditioned)

• Took cider to new markets in 19\textsuperscript{th} century
• Can keep (and mature?) for years in glass
• Yeast in finished product
  – Risk of exploding bottles at SG $> 1.005$
• Virtually died out after WW2

Modern

• Sweetened, carbonated and pasteurised for stability
• Can be contract packed (in glass)
• Some bottle conditioned ciders are creeping back
  – True “methode champenoise” is also possible (no yeast in finished product)
Finished Cider - Bottle or Cask?

• Cider in traditional cask is difficult to keep well past early summer
• It needs protection from airborne contamination e.g. *Acetobacter* and *Brettanomyces*
• Cider mugs were popular for cask ciders in 18th and 19th century taverns
Cask ciders

Traditional
- Has to be drunk quickly once broached
- Prone to acetification and mousy off-flavours on exposure to air
- Can be ‘re-conditioned’ by adding sugar and yeast
- Haze may be +ve USP

Modern
- Filtered, carbonated, pasteurised and sweetened into kegs
- Beer dispense systems
- Good storage life
- Collapsible bag-in-box
  - If carbonation is not required
  - Can pasteurise B-i-B
When things go wrong

**Problem**
- Stuck fermentation
- Film yeast
- Ropiness (bacterial)
- Sulphury aromas
- Blackening / greening
- Acetification
- Mousiness

**Remedy**
- Use thiamin / nutrients
- Eliminate headspace, use SO$_2$
- Agitate and use SO$_2$
- Use copper? In future add nutrients
- Avoid contact with non SS metal
- Eliminate air, use SO$_2$, re-ferment
- No treatment. Sterilise and start again
Cider Quality depends upon…..

- **Juice Composition**
  - apple juice (source, blending etc.)

- **Fermentation Control**
  - yeast management (sulphite, nutrients etc.)

- **Post fermentation handling**
  - directing maturation
  - preventing oxidation

THE CHOICES ARE YOURS!
More information

Book “Craft Cider Making”

Website www.cider.org.uk
Slides of this talk at www.cider.org.uk/hellens.pdf

Discussion Groups
Cider Workshop www.ciderworkshop.com

Cider Digest www.talisman.com/cider/index.html#Digest