THE CRAFT CIDER REVIVAL

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Some Technical Considerations

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SOME THINGS TO THINK ABOUT

- Orcharding and fruit selection
- Full juice or high gravity fermentations
- Yeast and sulphiting
- Keeving
- Malo-lactic maturation
- Style of finished product

What is your overall USP?

How are you differentiated?

CRAFT CIDER IS NOW SPREADING

Cidermaking was once widespread over the whole of Southern England
There are signs that it may be returning eg Kent, Sussex and East Anglia
So regional styles may be back in favour eg higher acid /less tannic in the East

CHOICE OF CIDER FRUIT

The traditional classification
(Barker, LARS, 1905)

	Acid %	'Tannin' %
Sweet	< 0.45	< 0.2
Sharp	> 0.45	< 0.2
Bittersharp	> 0.45	> 0.2
Bittersweet	< 0.45	> 0.2
Finished Cider	*~ 0.45*	*~ 0.2*

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
This is still true today!

"VINTAGE QUALITY" LIST (1988)

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

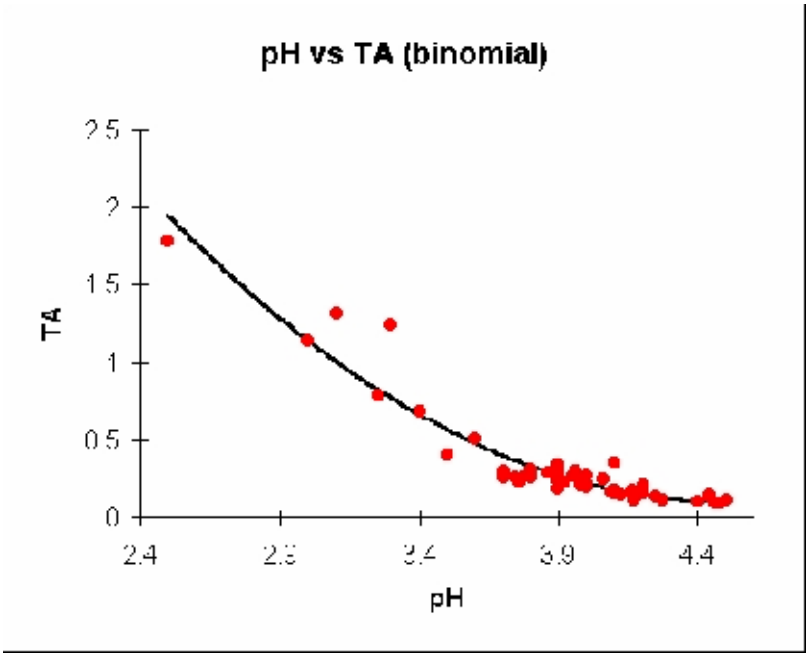
Bittersweets
Ashton Brown Jersey
Harry Masters Jersey
Dabinett
Major
White Jersey
Yarlington Mill
Medaille d'Or

Pure Sweets
Northwood
Sweet Alford
Sweet Coppin

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 sensorially unbalanced unless ameliorated with dilution or added acid

RELATIONSHIP BETWEEN pH AND TITRATABLE ACID IS NOT EXACT



Most bittersweet juices are > pH 3.8 or < 0.4% titratable acidity. Above pH 3.8 or lower than 0.4% acid is a tricky area for microbial safety.

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

LARS Data Pot Grown Dabinett

	Fed	Unfed
Leaf N %	2.34	2.00
Leaf K %	1.4	1.2
Juice SG	1.057	1.057
Juice pH	4.25	4.25
Tannin %	0.30	0.35
Yield (kg)	33	21
Juice N (mg/100ml)	6.8	3.3
Days Fermenting	32	70

FRUIT STORAGE?

Not all apples are ripe when picked

Mid /late season apples mature when stored
Starch converts to sugar so higher potential alcohol
Volatile flavour develops

Practical considerations are important too
e.g. protection from pests, mould

EFFECTS OF MILLING AND PRESSING

Most people press straight away after milling…… but cuvage (pulp storage) may have benefits

Tannin oxidation generates more soluble colour in the first couple of hours
Tannin can be significantly lost overnight if too harsh
These effects depend on pulp layer thickness (ease of access of air)

Soluble pectin increases overnight (useful for later keeving)
Other flavour precursors are developed

FLAVOUR PRECURSOR DEVELOPMENT

Some flavours and precursors are bound as glucosides

These are hydrolysed when pulp stands, producing
eg phenylethanol (floral odour); 1,3 octanediol

The later addition of acetaldehyde to 1,3 octane-diol during fermentation gives dioxolanes with 'green' cidery aromas

CHAPTALISATION ?

Raising SG with sugar to *ca* 1.100 to ferment into high alcohol base cider
This is diluted with water for retail sale
Finished cider has 30-50% juice equivalent
Saves on tank capacity and juice costs
Produces a lighter style of mass-market cider

FULL JUICE CIDER

This is now a selling point for some producers e.g. Henneys, Aspall
The 3CCPA Producers Charter requires a minimum 85% juice content
A useful point of differentiation in the market

SEASONALITY

Mainstream cider is made from concentrate and sugar syrup on a 2 week cycle throughout the year.
Follows brewery practice.

Craft cider is made on an annual seasonal rotation. Follows winery practice.

- Press in autumn.
- Ferment in winter
- Cask or bottle in spring
- Consume in summer (from cask) or at any later time up to 5 years (from bottle)

Craft cider is essentially 'slow food' – another USP!

THE FERMENTING YEAST

Wild yeasts are everywhere - maybe up to 10^4 cells per gram *inside* the apple
The inoculum stays on cloths and equipment - apple juice will ferment spontaneously with great ease
An ecological succession of yeasts takes place during traditional cider fermentation
Kloeckera apiculata starts ; dies at 2% alcohol
Saccharomyces cerevisiae finishes

THIS IS WHAT HAPPENS IN FRANCE

Mixed microflora are still prized

Little SO_2 is used - natural succession
Kloeckera and *Candida* to start
Saccharomyces to finish

Very slow cool seasonal fermentations (4º C)

More complex flavour profile
Kloeckera dominates at low temperatures

PURE CULTURE FERMENTATION

Defined strains of wine yeasts - *Saccharomyces cerevisae* and *S. bayanus*
have been available **dried** for about 25 years (previously as liquid slope cultures)
Pitch at $5 * 10^6$ per ml into sulphited juice
Fast fermentation to high alcohol (~2 weeks) - important with chaptalised musts and for year round fermentations
Require added nutrients to perform effectively
Dependable flocculation
Predictable but arguably bland results

YEAST AND THE CRAFT CIDERMAKER

Are commercial wine yeasts really appropriate?
To work well they need high nutrient input
They work faster than a seasonal product needs
They tend to ferment to absolute dryness (not clear why?)

Ability to ferment high gravities is irrelevant
They are too wine like?

WILD YEAST SUCCESSIONS

Uncontrolled wild yeast fermentations can give very unpredictable results
BUT
Use of SO_2 to control mould, bacteria and to direct the yeast succession has a long history
sulphur candles and "sweetening" of wooden casks

Controlled use of SO_2 in wild yeast cider fermentations was re-introduced by Beech and Burroughs at Long Ashton in the 1960's

FIRE AND BRIMSTONE!

"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"

[Dr Beale FRS in Evelyn's *Pomona* **1664**]

BACK TO THE 60'S!!

The 1660's or the 1960's
Do we need cultured yeasts at all?
If speed is not important, make a virtue of slowness
Revisit Beale, Barker, Burroughs and Beech
Wild does not mean wanton!
A little measured SO_2 keeps things under control and allows beneficial yeasts to develop

THE ROLE OF SULPHUR DIOXIDE

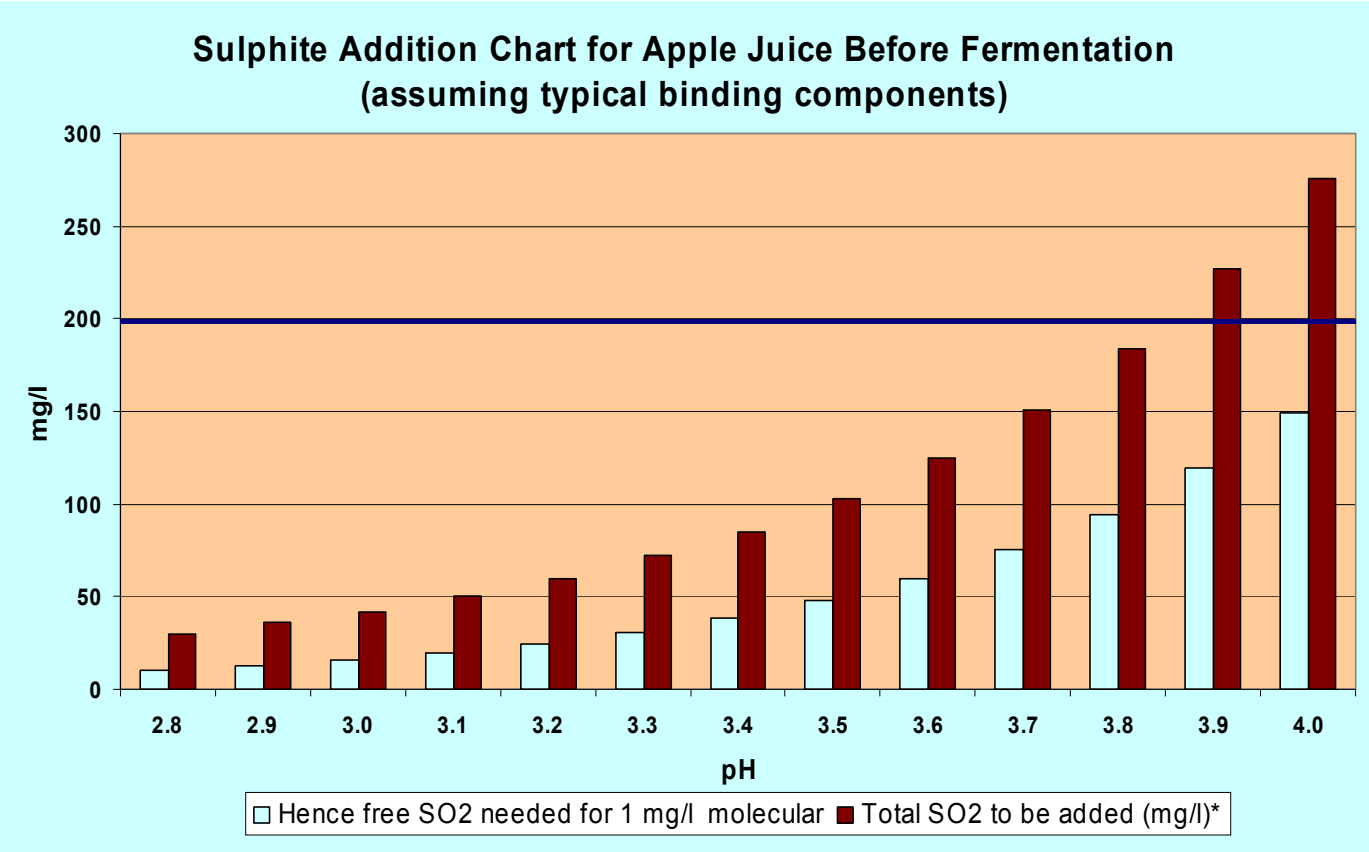
Controls bacterial and fungal infection
Inhibits undesirable yeasts if added with regard to correct concentration for the pH
Is essential if a 'pure culture' yeast is added and is to establish dominance
Less than 1 ppm of 'molecular SO_2' is required to be effective (*equiv* up to 200 ppm total SO_2)

SULPHUR DIOXIDE CAN DO MORE….

Acts as an antioxidant /reducing agent (SO_2 to SO_4)
Blocks haze formation by nucleophilic addition to 'tannin' polyphenols, preventing polymerisation and haze formation
But cannot be added during active fermentation since it binds strongly to acetaldehyde
Acts as an antimicrobial / antioxidant in storage (50 ppm is typically added there irrespective of pH)

USING SULPHUR DIOXIDE BEFORE FERMENTATION

Added most conveniently as 10% metabisulphite solution (5% SO_2)
Binds to juice components especially from rotten fruit – hence total SO_2 always $_{exceeds}$ free SO_2
Its chemical equilibrium is very pH dependent (pH 3.8 is practical limit) – so dose also depends on pH
Active range is 0.5 - 1 ppm (mg/l)
To achieve 1 ppm active molecular SO_2, up to 200 ppm might need to be added at pH 3.8
Lag phase while *S. cerevisiae* multiplies may be 2 weeks or longer.
Warning - If too much SO_2 is added at a low pH, **all** yeasts may be killed – so follow the chart!



(Note 200 ppm total SO2 is legal limit.)

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 (vitamin B1) - which bind to the pectate gel
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 naturally sweet 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° 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 revival of interest in the UK and USA
Keeving 'kit' (chloride and enzyme) can be bought from Standa-Industrie in Caen

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 e.g. *Leuconostoc oenos* to give CO_2 and lactic acid

$$\mathbf{HOOC.CHOH.CH_2.COOH \rightarrow HOOC.CHOH.CH_3 + CO_2}$$

Hence the acidity can fall by 50% and the cider becomes slightly carbonated

Other interesting flavour changes occur too

e.g. Bacterial conversion of hydroxy-cinnamic acids
to smaller simple spicy phenols to give the "bittersweet aroma"
Likewise butteriness in Chardonnay

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. Some may cause
Ropiness
Mousiness
Excess acid loss
Danger of working at pH > 3.8 without SO_2

CONTROLLING MALO-LACTIC CHANGE

Promote
Old wooden casks
Higher pH
Stand on lees
No SO_2 on storage
Add a commercial bacterial culture

Inhibit
Use sterilised tanks
Keep pH down
Rack off lees
Add SO_2 for storage
Use lysozyme to destroy the bacteria

FINING AND FILTRATION

Some ciders will 'drop bright'
If not, add …..
Egg white
Ox blood
Gelatin (+/- bentonite)
Chitosan

(all are positively charged and work by neutralisation of negative charged particles in juice)

Followed by
Sheet or powder filter or centrifuge
And finally submicron membranes - 'The Magic of the Millipore'

Nowadays cross-flow ultrafiltration replaces fining?

CIDER STORAGE

"L'air est l'ennemi mortel du cidre" (as the French say)

Keep all vessels closed and full at all times. Use SO_2 and or CO_2 / nitrogen blankets

FINISHED CIDER - DRY OR SWEET ?

Dry cider does not appeal to all (punters talk dry but buy sweet!)
sugar / acid / tannin balance
SG 1.005 - 1.020 is preferred range

Added sugar risks refermentation unless pasteurised. Alternatives are
Saccharin (bitter aftertaste)
Acesulfame-K (aspartame isn't stable long-term)
Sucralose (clean aftertaste)
These 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) is used for sparkle

Saturation solubility of CO_2 is 2.5 g/l at 10°C
A sub-saturation carbonation of 1 g/l is normal for many still white wines
This level enhances flavour balance and body without any evident bubbles
Provides some anti-microbial effect

FINISHED CIDER - BOTTLE OR CASK? (I)

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
Took cider to new markets (Bulmers 1900)
Can keep (and mature?) for years in glass
Yeast was often present in finished product
Risk of exploding bottles at SG> 1.005 (unless slack corks are used as in French *cidre bouché* today)
Virtually died out in UK after WW2

Modern
Sweetened, carbonated and pasteurised for stability
Life in PET is quite short (oxygen in, CO2 out!)
Some bottle conditioned ciders are creeping back
True *"méthode champenoise"* is also possible (no yeast in finished product)

FINISHED CIDER - BOTTLE OR CASK? (II)

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 a positive USP

Modern
Filtered, carbonated, pasteurised and sweetened into kegs
Beer dispense systems
Good storage life
Collapsible bag-in-box now available if carbonation is not required

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!