

Don't let sleeping dogmas lie

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MARCH 2018

A selection of topics

Raw materials

- D.P. – you need high D.P. malts not to have conversion issues
- Malt nitrogen levels – low nitrogen is best
- The perfect malt specification

Yeast

- Premature yeast flocculation – is it a psychological problem?
- Viability vs. vitality – its just a pumpable slurry
- Yeast foods – the missing ingredients and large F.V's

Taste

- You have to be qualified brewers (and male) to taste!

Brands

- Teasing out the essentials
- Heritage vs. brewing practice

Malt quality assessment is full of Dogma

- High T.N. Malt is of poorer quality
- You need high levels of D.P. and alpha-amylase for brewing with adjuncts

Definition of D.P.

The number of grams of Maltose produced by 100 gms of malt after 30 minutes at a temperature of 20 °C and pH of 4.3

Effect of temperature on D.P. values

Temperature °C	D.P. (W.K. Units)
20	100
30	238
40	295
50	448
60	327

Relationship of D.P. to sugar formation in laboratory scale mashes

D.P. (W.K.)	Total glucose formed (g/100 mL)	Total maltotriose formed (g/100 mL)	Total maltose formed (g/100 mL)	Proportion of total maltose (%) formed after given time (minutes)				
				10	30	40	90	120
				56 °C	56 °C	64 °C	64 °C	76 °C
65	1.1	2.5	8.4	48	74	80	94	100
107	1.2	2.6	8.5	52	77	82	96	100
161	1.1	2.5	8.3	58	80	85	97	100
202	1.0	2.2	8.2	54	75	81	95	100
240	1.2	2.6	8.2	50	72	80	96	100

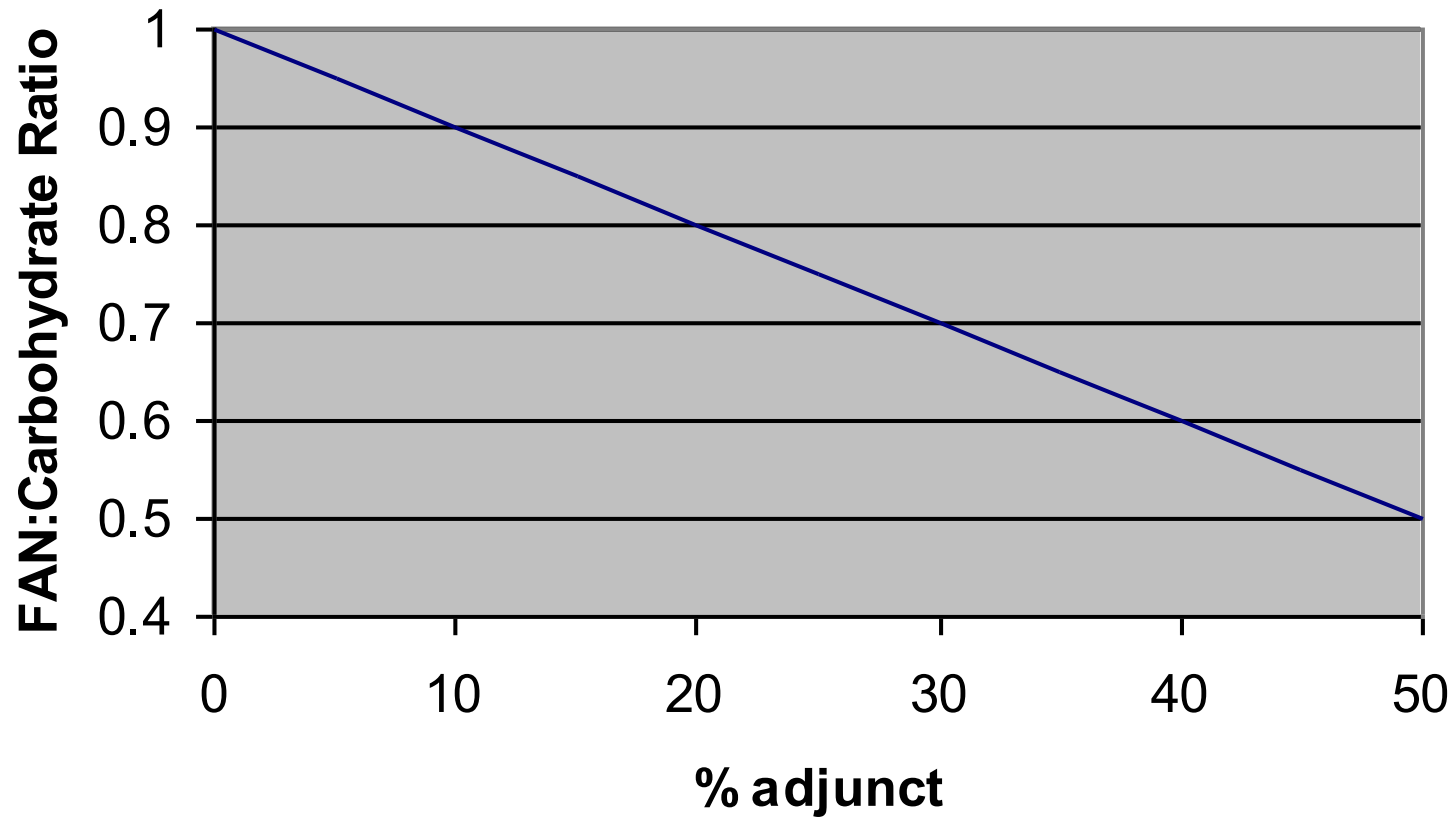
Why is it?

German brewers like 'under modified' malts, whereas North American brewers want 'over modified' malts?

Why is it?

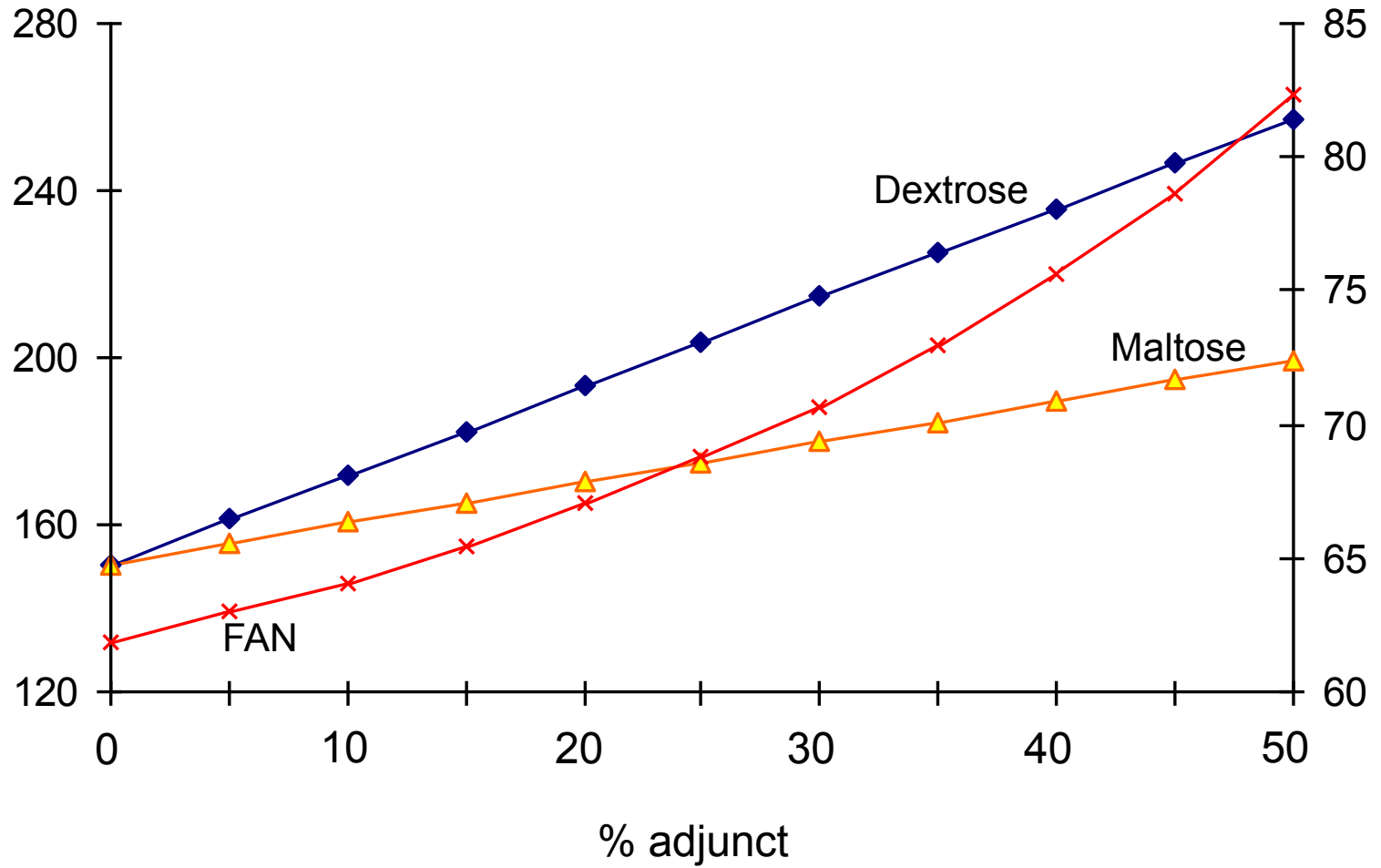
- For fermentation you need a carbon/nitrogen balance.
- As you increase the amount of adjunct, you dilute your nitrogen content.

Comparative FAN:Carbohydrate ratio vs % adjunct



FAN required
(Analytical In Malt)

Achievable
RDF



Axcell's equation

$$\text{Kolbach Index} = \frac{\text{TSN} \times 100}{\text{T.N}}$$

$$\text{FAN} = \text{TSN} \times 230$$

$$\text{Therefore TN} = \frac{\text{FAN}}{2.3 \text{ KI}}$$

So...

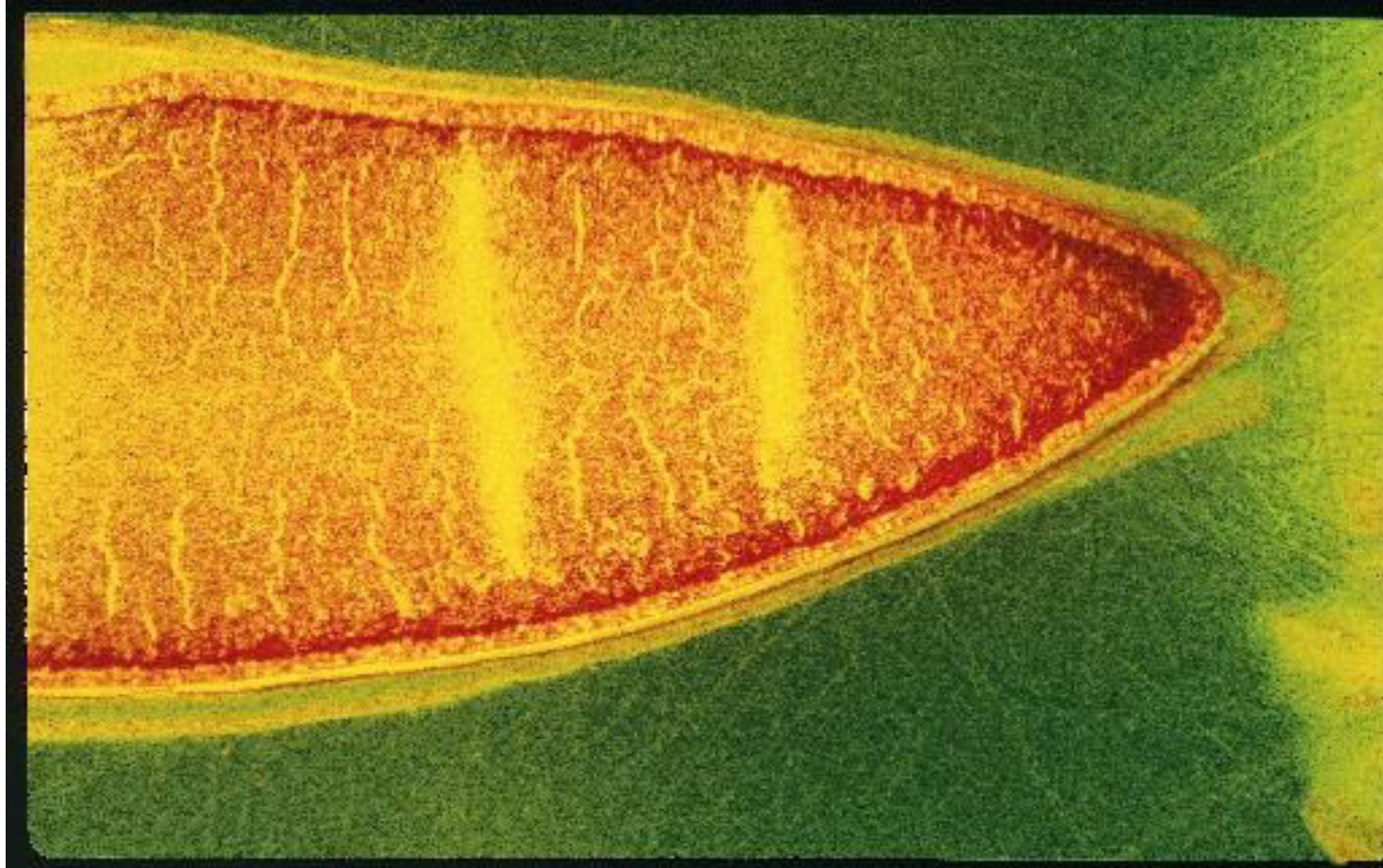
For the “German Brewer” using 100% malt and requiring a FAN of 135 and a K.I. of 38, the required malt nitrogen would be 1,54%

For the “American Brewer”, a 40% adjunct requires a FAN of around 220. If the malt available has a nitrogen level of 2,0%, then the required K.I. is 48.

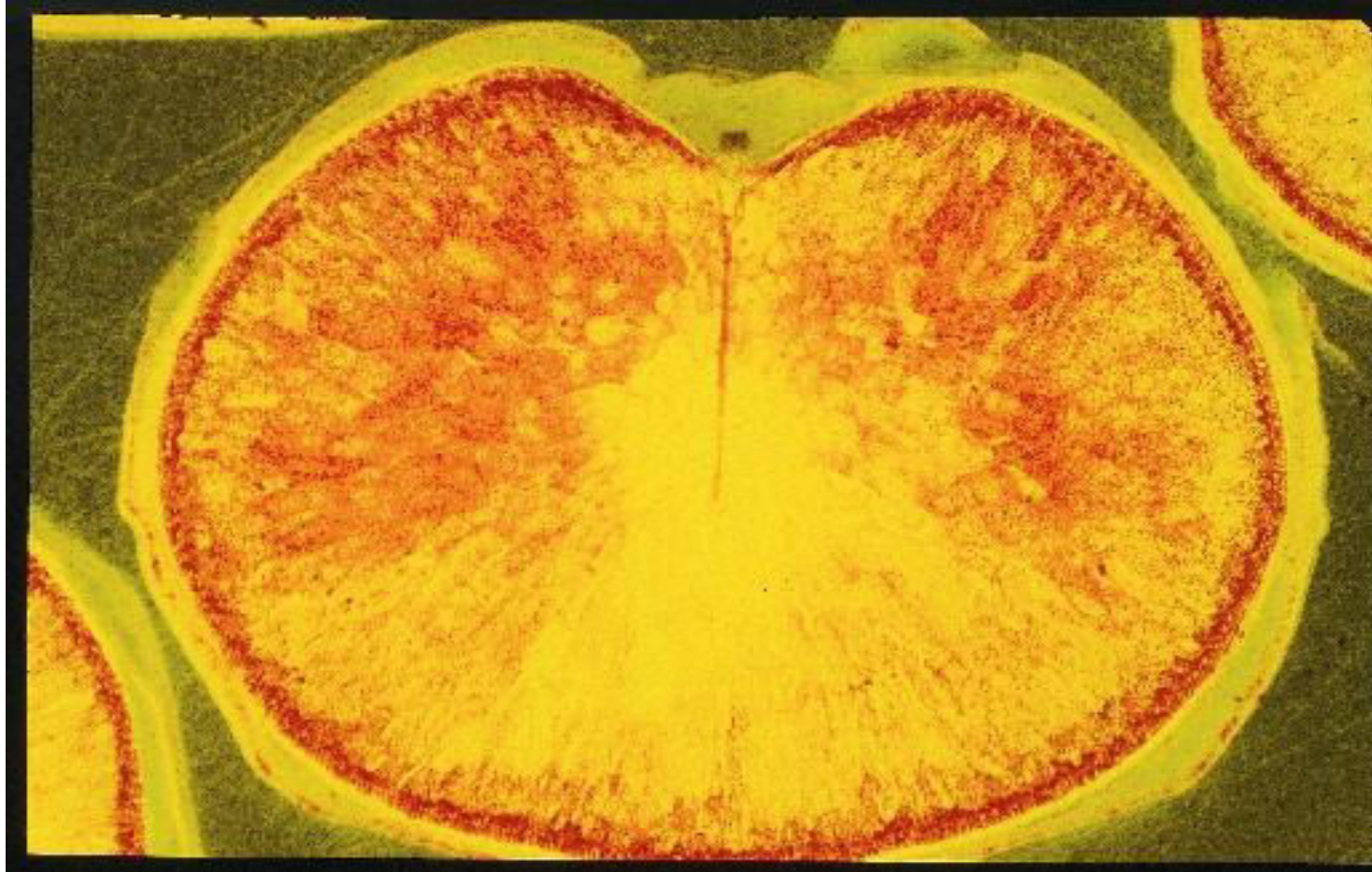
Malt nitrogen

- Nitrogen accumulated under drought or heat is mainly in the form of hordein.
- Hordein is not a storage protein!
- It is a stress protectant.
- 50% consists of two amino acids:
 - Glutamine
 - Proline (actually an imino acid).
- Highly convoluted because of the proline.

Protein location in Barley (longitudinal section)



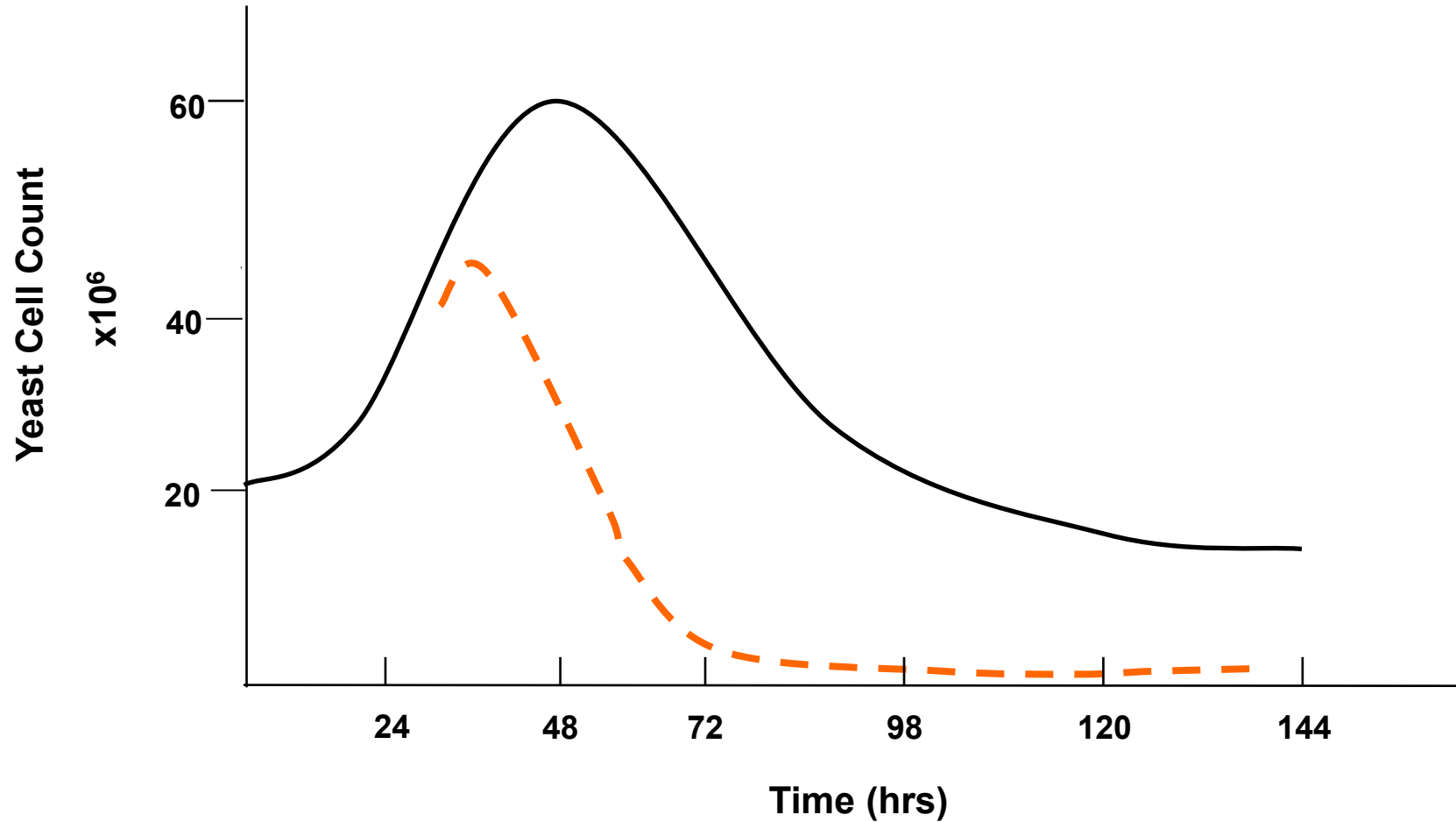
Protein location in Barley (transverse section)



The perfect malt specification

- One specification for all brands
- Often conflicting parameters
 - (low K.I. vs high FAN)
- Tight T.N. range

Premature Yeast Flocculation

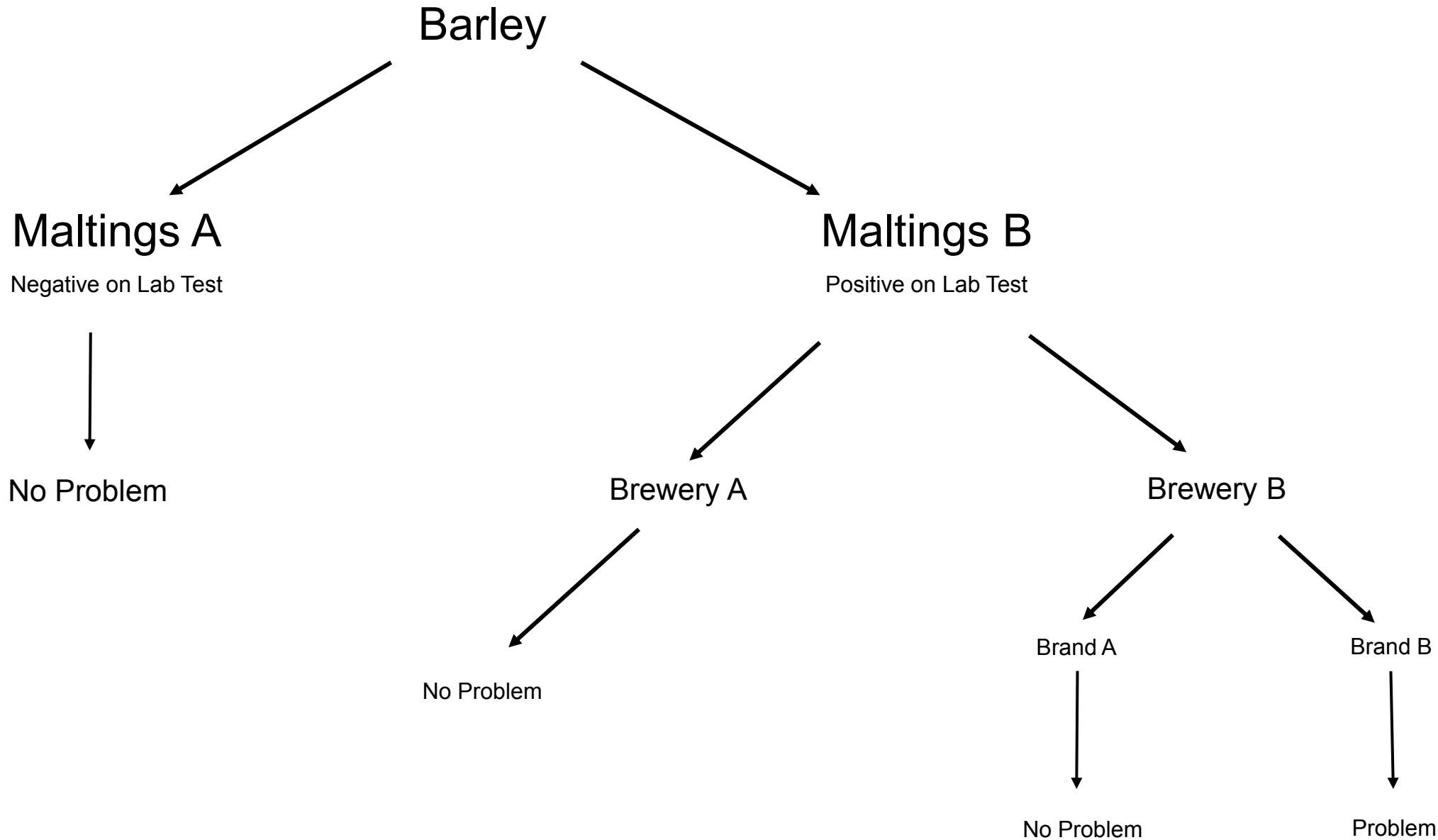


History of PYF Factors

Date	Author	Nature of Factor
1958	Kudo et al.	Type of humic acid
1959	Kudo et al.	Polysaccharide (glucose, arabinose and xylose)
1975	Fujii et al.	Protein - Polysaccharide
1976	Fujino et al.	Protein – Acid polysaccharide
1986	Axcell et al.	High mol, wt polysaccharide (arabinose + xylose + glucose)
2000	Axcell et al.	2 components – Polysaccharide with uronic acid residues and an antimicrobial peptide
2004	Koisumi et al.	Polysaccharide of 40 kDa
2007	Kojima et al.	Less than 5 kDa Polysaccharide – pectin-like action

Some initial findings

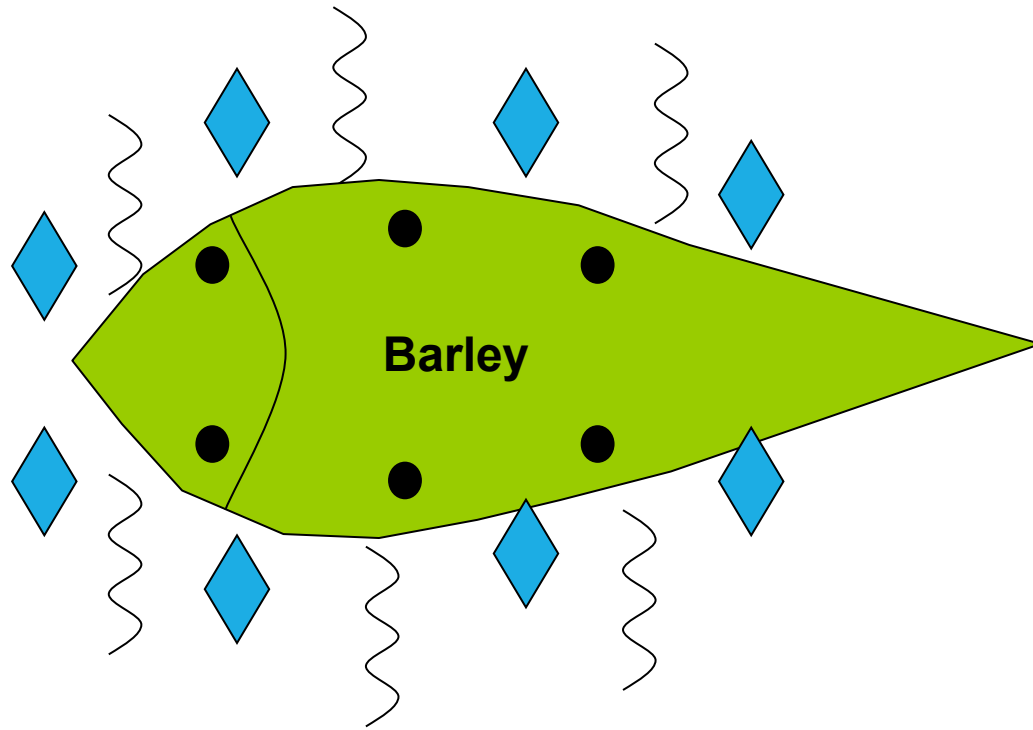
- Occurs on the husk of some malts – can be washed off with H₂O
- Can be found at lower levels on the barley husk
- Malting process (mainly steeping) can exacerbate or minimise the problem
- Appears seasonal
- Brewery design has an impact
- Is heat stable
- Attempts to purify resulted in loss of activity



Was the PYF factor from barley/malt or from bacteria/fungi?

- Barley husk consists of Arabinoxylan and Cellulose (>90%)
- Extracellular fungal extracts from a variety of *Aspergillus* and *Fusarium* species caused PYF
- Boiled fungal extracts had no effect
- Addition of Xylanase from *Trichoderma longibrachiatum* created PYF
- Sometimes PYF was accompanied by problems of sugar uptake
- Were different factors responsible for this?

Hypothesis to explain PYF and sugar uptake inhibition



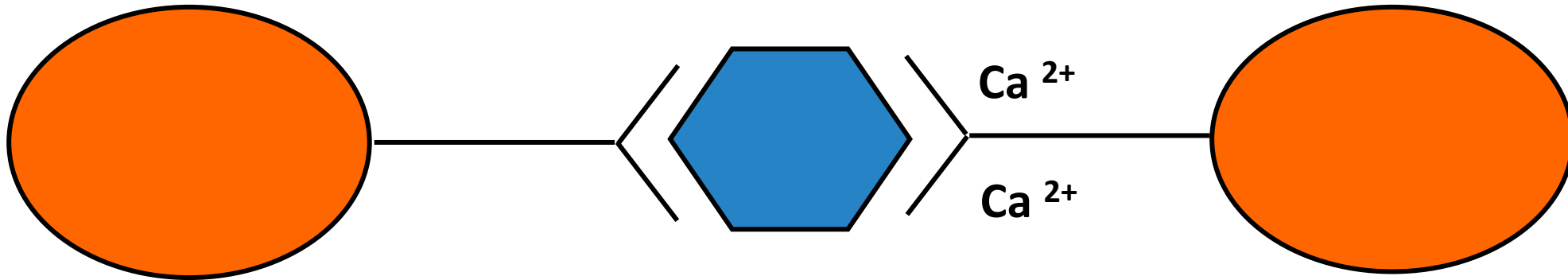
Antimicrobial peptides and barley

- Okada et al. (1970) isolated peptides that inhibited respiration, fermentation and sugar uptake in *Saccharomyces cerevisiae* at 0.4 µg/mL
- Possibly a ns LTP
- Thionins (around 5 kDa) have been isolated from various barley tissues
- We had evidence of a 5 kDa peptide from malts that cause PYF with sugar uptake inhibition (From LC-EMS analysis)

PYF – The polysaccharide theory

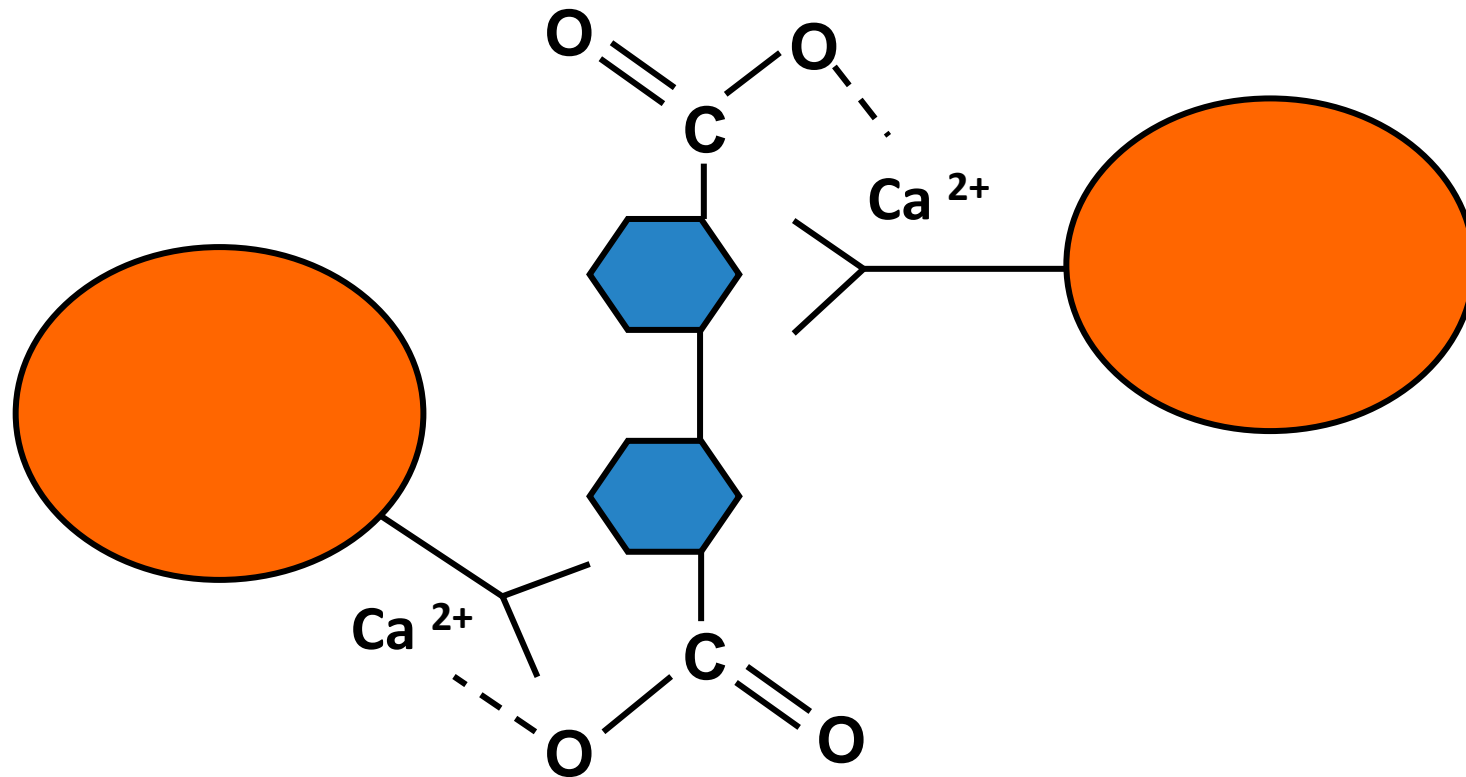
Stratford proposed that premature flocculation occurs when:

“multivalent wort polysaccharides overcome sugar inhibition by binding to several cell wall lectins simultaneously”



PYF – The polysaccharide theory

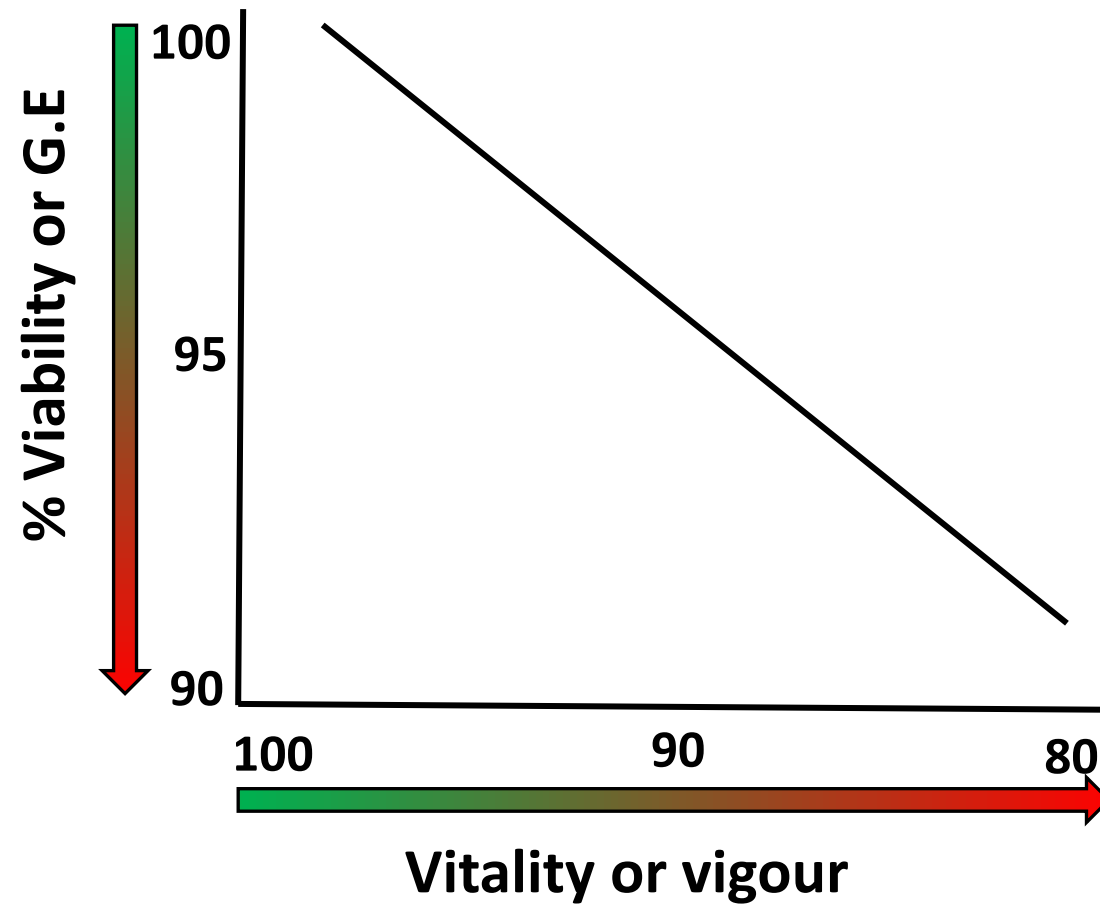
Kojima proposed a pectin-like mode of action



Vitality definition

The ability to perform under stress

Viability versus Vitality

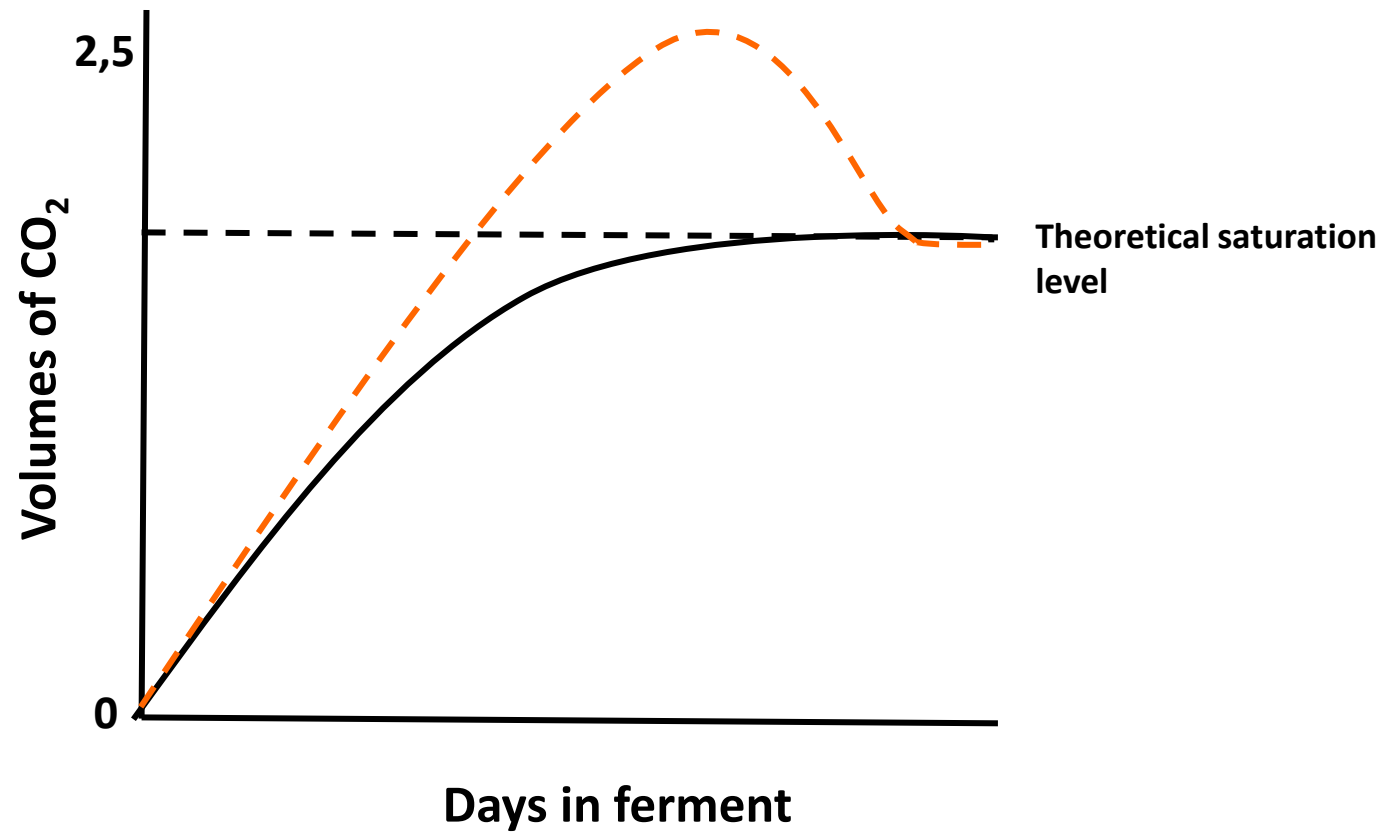


Yeast food

Sometimes a misnomer?

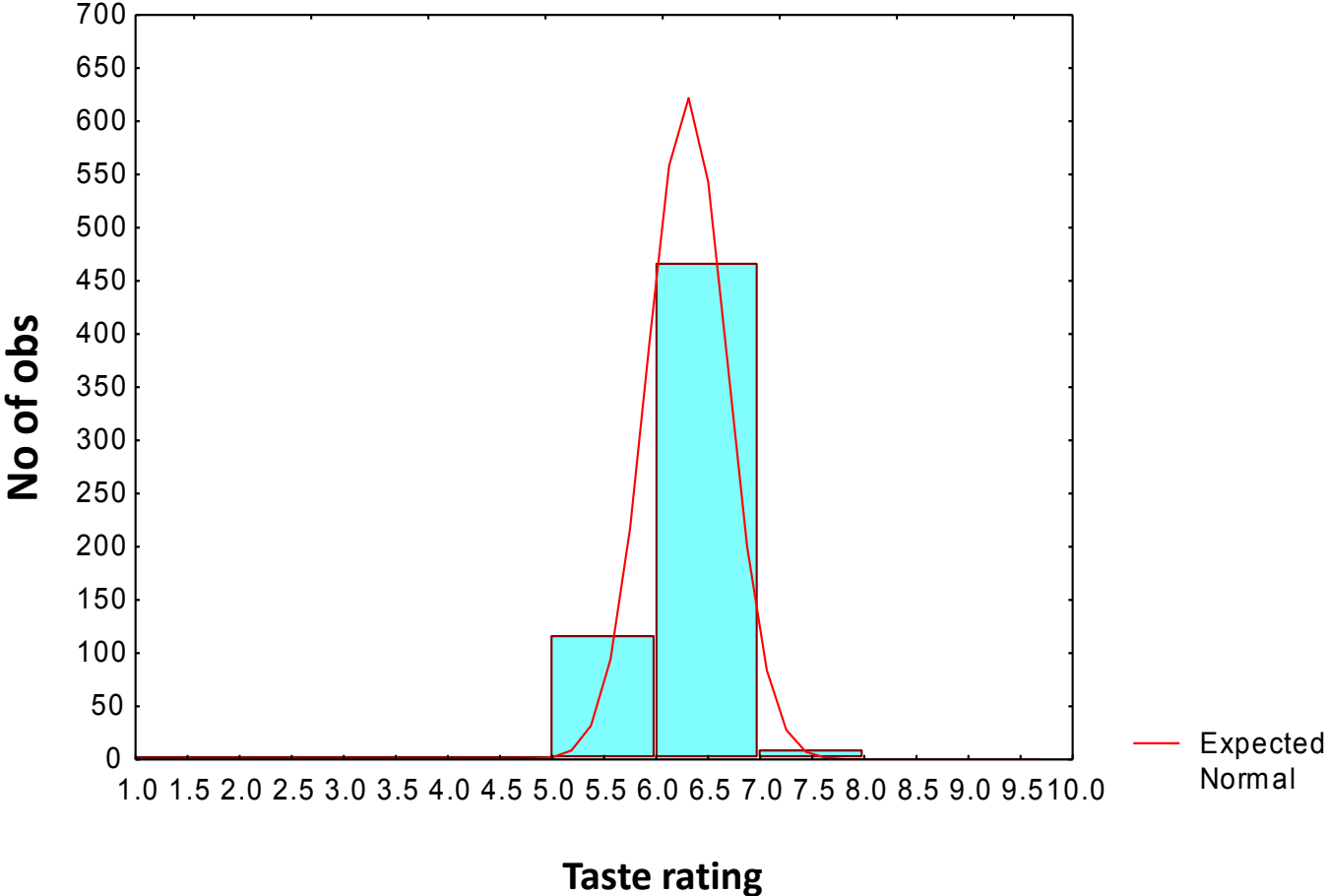
- Sluggish fermentations in large/tall F.Vs
- Adding nutrients did not help
- Nucleation sites
- Supersaturation of carbon dioxide
- Acetaldehyde and sulphur dioxide

Carbon dioxide supersaturation

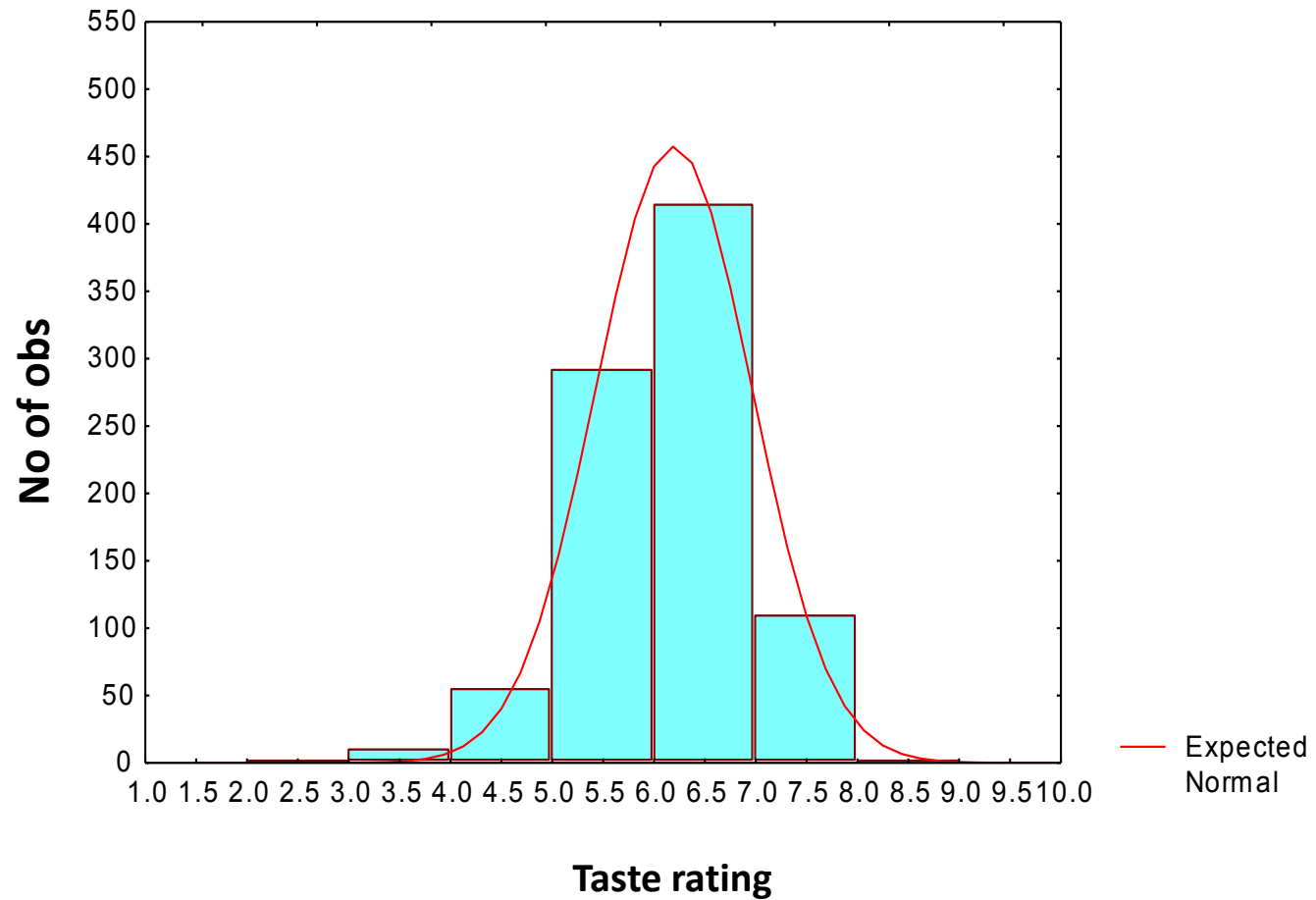


Development of a global tasting system

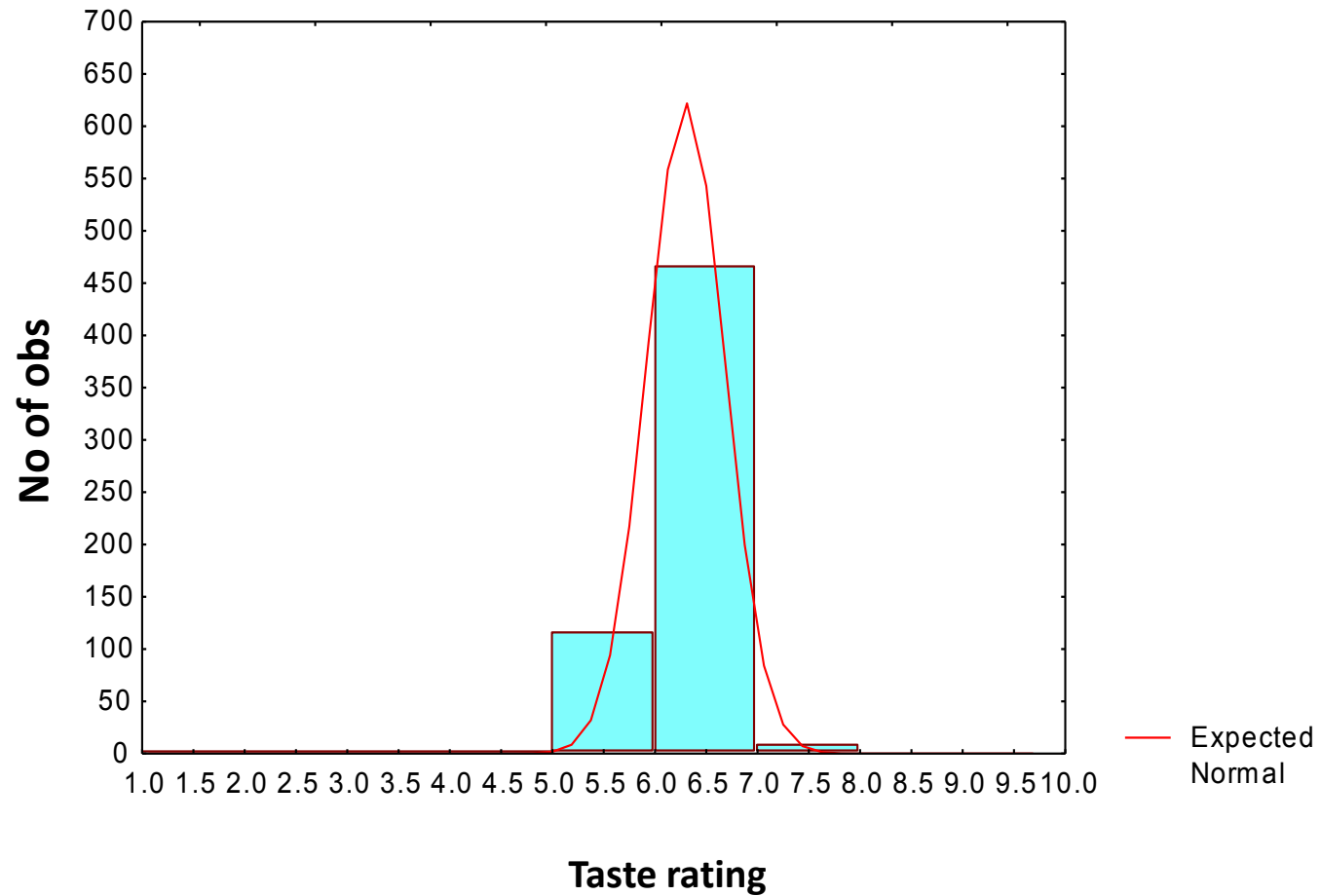
Taste results: 1996



Taste results: All brands 1998



Taste results: All brands 2002



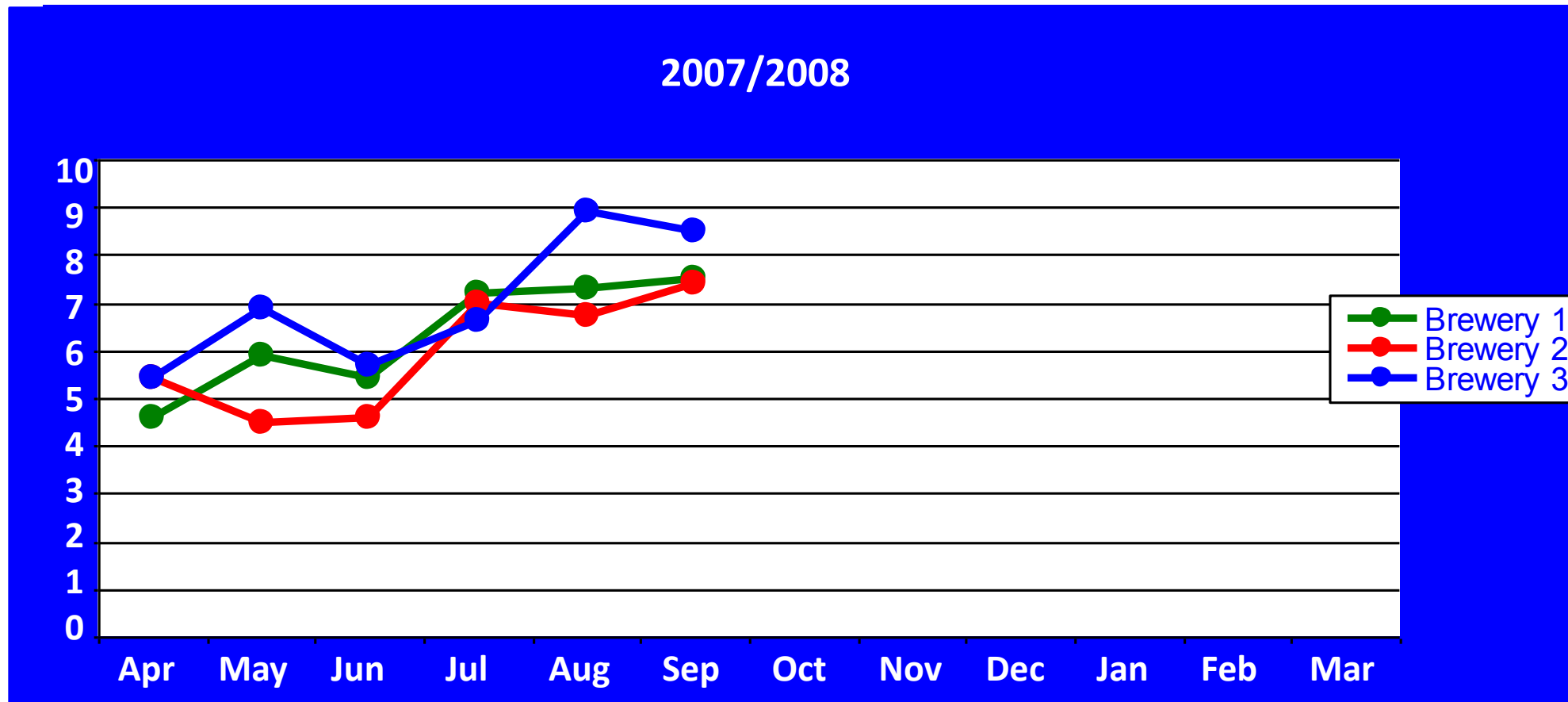
Development of a new taste system

- Avoid normalisation of the taste ratings
- Be relevant to individual brands
- Provide a more rigorous training of tasters
- Allow the whole tasting scale to be used
- Has to have global application

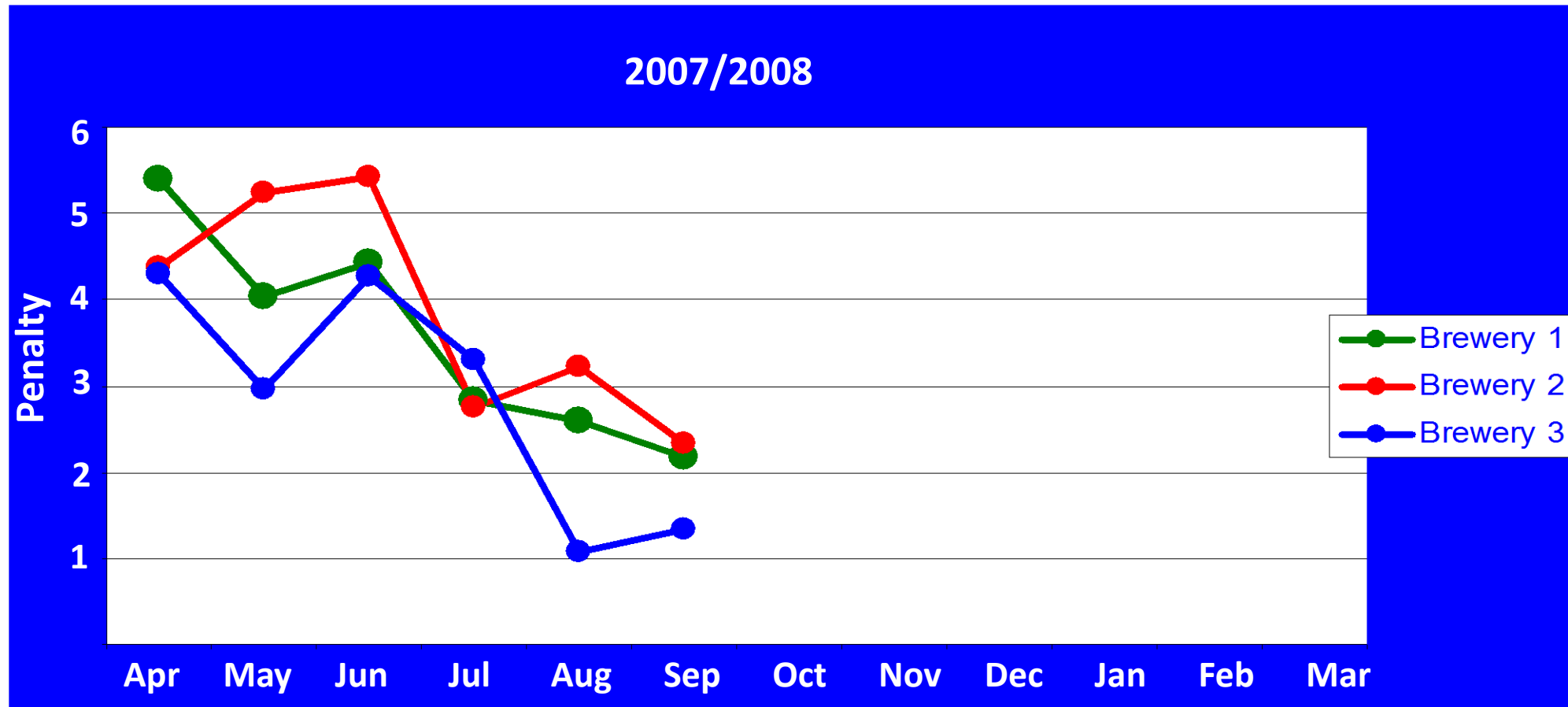
Development of a new taste system

- Tasters rate levels of flavours
- Male and female volunteers from all backgrounds assessed for ability to identify flavours and determine levels
- Algorithms for individual brands developed
- System based on brand design. If beers have the right levels of on-flavours and no off-flavours and the correct bitterness, sweetness, body and ester profiles, they will achieve maximum scores

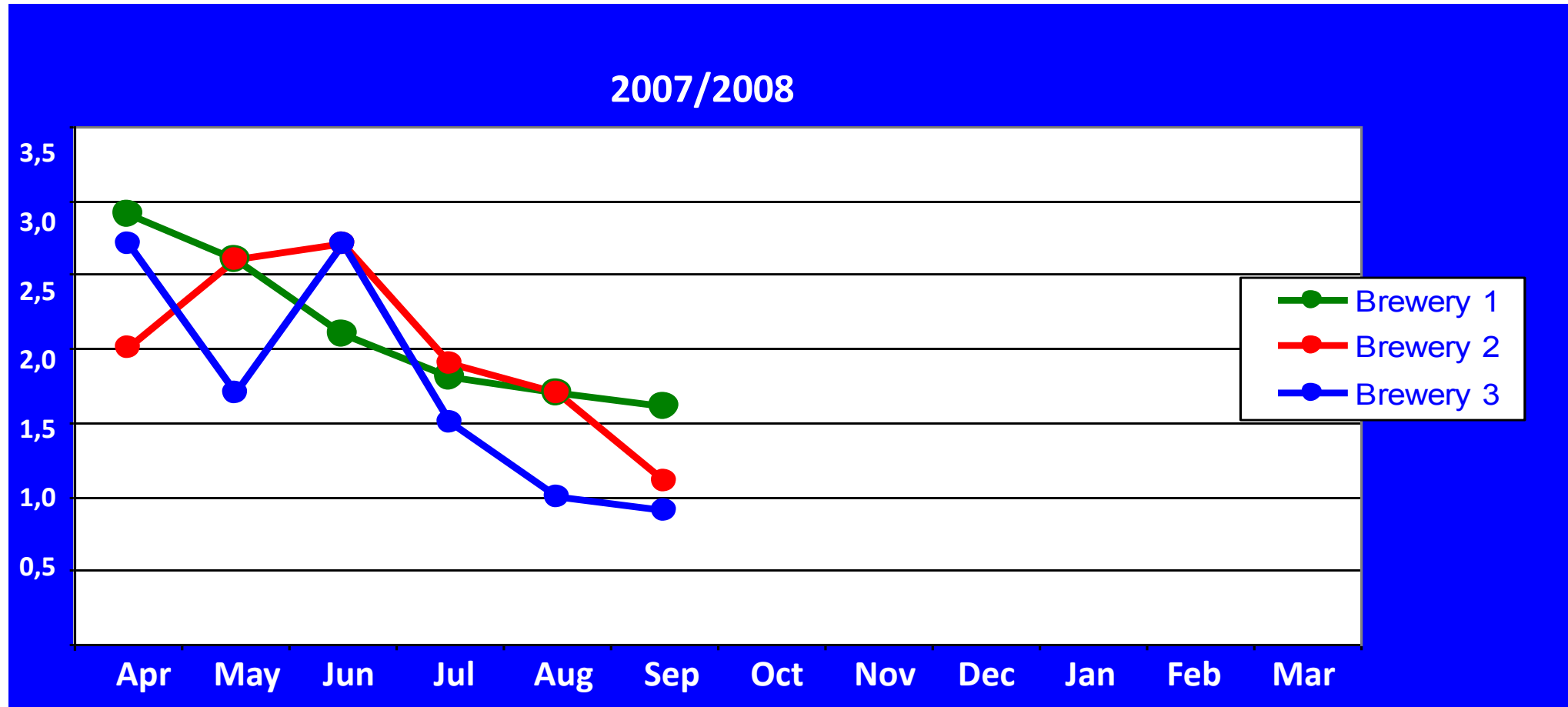
Taste Score – Africa Lager



Off-flavour penalty – Africa Lager



Sulphury – Africa Lager



Brands

- Teasing out the essentials
- What is sacrosanct? (raw materials, yeast, profiles etc.)
- Codify to prevent drift
- Consumer feedback loop into the system

Heritage vs. poor brewing practice

- Existence of original recipes
- Deviations over time – expediency!

Beer is not a commodity!

Beer is about brands and creating
interest