DRIVERS OF BEER DRINKABILITY: MAKE BEER PROCESS

Brewing

Fermenting

Maltotriose (-).

DMDS, DMTS (-).

Beer FAN (+)

DMS (-)

Low pitching rates (-)

Low wort DO's (-)

Miller: in VCF plants first saw poor flavor stability. Traced to beers having 30-40 ppm SO_2, with adducts releasing papery aldehydes in package after only 4-5 days. Determine yeast growth peaked at 40 vs. 70-80 million cells/ml, hence high SO_2. Realized VCF problems due to: a) lower aeration, b) higher CO_2 back pressure/inhibition (especially critical), c) use of glucose, not maltose adjuncts increasing osmotic pressure.

Consistency in ADF control and routine/reliable fassing.

GPC: Process control over wort FAN/DO/pitching rate/yeast viability/zinc/temperature parameters….keep these KPI's in control and yeast will faithfully produce the same desired volatile profile of esters/acetaldehyde/higher alcohols and medium chain fatty acids - although engineers may yet......

Excessive wort/beer FAN (-)

Czechs: optimum A/E ratio in lagers is 4:1 to 4.7:1 by EBC MOA.

Relative amounts of **hot/cold break removal** or retention in beer...changes beer flavor profile, not necessarily flavor stability. Learning: keep break levels constant!

Lactate (-)

Japan: "smoother" beers result from fermentations with **deeper foam head depth.**...used cameras to measure & correlate with subsequent sensory.

Beers from high gravity worts (+)

P3 iodophor residues (-)

VCF: best "drinkability" from 4-brew VCF if aerate only first two, although "fastest" fermentations observed when aerate all four.....best flavor stability in beer forcing tests when aerate only first.

Real extract:ethanol ratios of 0.85-0.95 (+)

Low attenuation (-)

RDF's over 70% (+)

Residual ozone (-)

Beer pH's over 4.15 (+)

Beer Drinkability

Use of ascorbic acid as an antioxidant (-) as imparts changed mouthfeel to beer.

"Controlled Oxidation" .....in wine process achieve "softening" or "smoothing" of the wine by allowing minute amounts of air into aging product to oxidize and precipitate harsh tannins and phenolics (either by accepted air leakage in oak casks or in more impermeable vessels, with a minute amount directly added intentionally).

Nitrogenated rather than carbonated beer (+)

In one study, beer _less_ preferred for drinkability at 2% CO_2 over 5-6% CO_2.....limit to how low you can go!

High CO_2 (-). Lower CO_2 (+)

If yeast count <500,000/ml, longer maturation times (+)

Miller: More yeast growth in **VCFs vs. horizontal** therefore see:

a) increased levels of higher alcohols, b) reduced levels of esters as is less acetyl CoA available for AATase with more drawn off for growth, c) higher levels of organic acids and d) decreased pH. To match drinkability of traditional beers settled on: 1. VCF height:width ratios of 1.8-3.0 with 60-90 degree cone angles and 2. Fill multibrew VCF in 12 hours with 5 brews, aerating first four brews and all yeast in first.

Draft > packaged beer.

Flash pasteurization for longer times at 60^0C more harmful to flavor stability than shorter time at 84^0C.

Aging Time & University of Guelph study: aging beer beyond 5-7 days had little advantage on improving drinkability.

Maturation time (18 days better than 12, but 35 days worse than 18).

Age (-)

Japanese Patent: treatment of beer with **Zeolite or activated carbon** to selectively remove **purines** .....reduces likelihood of **gout** symptoms!

High D.O. (-)

If package oxygen < 100-200 ppb, pasteurization effect on beer freshness is virtually imperceptible.

Very long maturation times if high yeast counts (-)

SAB & FAN:...FAN levels in **beer** (-)....better fermentations saw more FAN depletion, less FAN left in beer and more drinkable beer based on sensory panels....more FAN remaining in the beer, the less drinkable the beer.

High TIPOs...beer oxidation (-)

CO_2 supplies (+/-)

Aging-Finishing

Packaging

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