PROCESS CONTROL FOR YEAST VIABILITY & VITALITY: JUST FAN!

FAN 101

Proline & asparagine are two largest components of [FAN].

FAN (+), minimum of 144 ppm in 15°P.

FAN = free amino acids plus small peptides - yeast can uptake very small peptides!

Yeast cannot use proline – go figure, too easy, eh?!

HPLC study of peptides: during fermentation, [wort mono, di & tri peptides] drops over the first 0-24 hours, then rises between 20-24 (evidence of extracellular yeast protease activity in creating new peptides!) before gradually declining through to 67 hours, before rising again (via autolysis?) to the end of fermentation.

Group A amino acids (fast uptake): glutamate, aspartate, asparagine, glutamine, serine, threonine, lysine and arginine.

Group B amino acids (intermediate absorption): valine, methionine, leucine, isoleucine, histidine.

Group C amino acids (slow uptake): glycine, phenylalanine, tyrosine, tryptophan, alanine and ammonia.

Group D amino acids (little or no uptake): proline.

Design

Happo-Shu (14°P/100 ppm FAN control) studies:
a) keep [glucose] < 3.5°P of extract to prevent inhibition of MT and MTT uptake.
b) adding aspartate (2,000 ppm = 200 ppm FAN) in fed-batch manner most impact on speeding fermentation....inorganic N virtually no effect.

Boulton: CCV's typically do not have mechanical agitators, relying on convection currents and CO_2 evolution to achieve mixing – study with Abers at eight locations in a 1,500 hL CCV proved the temperature and [yeast cell #] profile from top to bottom are NOT homogeneous!!!

Mash tun vs. Meura: …….latter see 20-40% reduction in total nitrogen during fermentation vs. 80-90% reduction using Steineker mash tun.

All malt vs. adjunct wort…...2,200 ppm total nitrogen vs. 1,200 ppm total nitrogen…….all NH_3 used by yeast in both…….in all malt see a 7% decrease in [FAN] vs.17% reduction in adjunct fermentation.

Effect on Yeast Viability & Vitality

Addition of 0.5 g/L of **yeast extract** supplementation increases number of generations possible before senescence by 1-2 in presence of added H_2O_2, especially ale yeast....postulate antioxidant, not nutritive effect.

Total [amino acids] @ 1,300-1,600 ppm excluding proline.....FAN [amino acids] @ 180-220 ppm. Former calculates based on total amino acids in proteins, not just the **"available"** portion measured in FAN assays.

Sapporo: QTL analyses of malting barley varieties shows that proteinase activity, Kolbach Index & soluble nitrogen in malt links to chromosomes 3H, 4H and especially 5H.

Mixtures of non-peptide & peptide nitrogen better as yeast foods than simple sources & organic or inorganic N.

Nigeria & **malted sorghum**…… sprouts a rich source of nitrogen and minerals….as is or peptonized.

FAN Sources

Roasted/Hi-Dried/Crystal malts: less FAN contributed to wort – slower fermentations e.g. 1.1°P drop per day in dark wort vs. 1.7°P drop/day in 100% pale. Also are inhibitory melanoidins in dark malts!

"HF3" yeast extract: prepare by treating yeast slurry 20 hours at 100°C…..resuspend in water…..centrifuge…..treat supernatant with 15% acetic acid…..precipitate recovered and fractionated by solubility at different pH's …. "F3" fraction (most soluble at pH > 7.0, representing @ 7% of the original precipitate) is hydrolysed with 6N HCl acid at 100°C to form the "HF3" supplement. When add to high gravity worts at 30 ug/ml, see significant improvements in fermentation performance without altering flavor profile.

Wort supplemented with L-methionine: inhibits yeasts, slows from 96 to 103 hours, prevents uptake of Group C amino acids, but less VDK due to diminished total growth vs. control.
Wort supplemented with Lysine: stimulates yeast, reduces fermentation time from 96 to 48 hrs, more VDK than control due to elevated growth in cell numbers.

Ale yeasts have higher FAN needs than lager. With lager yeast, get about 55 g dry yeast/g FAN utilized.

FAN Sources

Avoid urea as a yeast food: urea + Ethanol yields ethyl carbamate!

30% of wort FAN is typically mono/di/tri amino acids.

Adding **YPC** (**Y**east **P**eptide **C**omplex) in HGB improves yeast vitality and viability.

Yeast YPC ...low MW, structure similar to insulin mediators...increases [intracellular] of glycogen/lipids/proteins and promotes mitochondrial development.

YPC (Yeast Peptide Complex)…an ethanolic extract of yeast which when added to wort renders the yeast more resistant to the adverse effects of HGB and high ethanol [ ]'s over multiple pitchings…enhances glycolytic pathway enzymes and stimulates mitochondrial enzymes - showing the crucial role of mitochondrial energy-generating systems in the resistance of stress (Asp,Glu,Gly & Cys enriched).

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