

# PROCESS CONTROL FOR YEAST VIABILITY & VITALITY: JUST ZINC!

## Fermentation/Formulation Attributes

**Walker:** zinc levels decrease during mashing, lautering and kettle boil by complexing and precipitating in trub.....when pitched into wort, both ale and lager yeast very quickly (first 2-3 hours) take up zinc via **metabolically driven mechanisms**, not cell surface bioabsorption.....increases cellular zinc levels up to **10 fold.....@ 30% of zinc found in cell walls**.....level then remains constant during fermentation, diluting out as cells bud and pass on zinc to daughter cells.....levels of free zinc in wort/beer fall virtually to zero.

### Negative Zinc Effects:

- a) Even at 0.15-0.20 ppm, increases secretion of MCFA & soapy flavors.
- b) Can be toxic, as low as 0.60 ppm in some strains, however added [Mn] can reduce toxicity.

BEWARE: adding too much zinc can trigger enhanced and/or early flocculation leading to problems with yeast pushing and/or incomplete attenuation.

### Positive Zinc Effects:

- a) Co-factor for alcohol dehydrogenase.
- b) Stimulates maltose & MTT CHO uptake.
- c) Stimulates ester production.
- d) Induces flocculation in ale strains.
- e) Faster fermentations.
- f) Better flocculation.
- g) Stabilizes enzymes, protein and membrane systems.

Acid addition to mash (e.g. phosphoric) increases release of Zn, Mg, MN and Ca from malt e.g. 100 uL of acid to 50 g of malt increases Zn and Mn from 278 & 254, to 409 and 557 ppb, respectively (+)

U of S: malts made from barley lines with low-phytase gene expressions yields a wort with significantly higher concentrations of zinc and magnesium (e.g. for zinc see 2-3.5 ppm vs. traditional @ 0.2 ppm)

**"Mineral Yeast"**.....provides more "bioavailable" zinc than inorganic salts. Product itself is 10-70,000 ppm zinc - add to wort at 0.3 ppm to decrease fermentation times.

Zinc deficiency switches off *MAL1*, *ADH1*, rRNA genes...arrests growth (-)

At normal [Zn], no improvement if increase [Mn] to 0.35 from 0.05 ppm.

Adding zinc as  $ZnCl_2$  or  $ZnSO_4$  (+)

Mn, at 0.05-0.10, protective at very high [Zn] (+)

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### Scottish Courage:

- a) Zinc not well absorbed by yeast during acid washing.
- b) **Best process site to add zinc (0.2 ppm) is immediately prior to, or at the exact time of, pitching.**
- c) Addition of zinc ions to hot wort/kettle is the *worst site* due to chelation with trub via bonding with amino acids or polyphenols.

**Timing/Location of Zinc Addition & Hours to Reach End Gravity.....:** studied Zn added to yeast slurry 3 hours before pitching (179 hrs to end attenuation) or 2 hrs (156 hrs) or 1 hr (148 hrs) or 0 hr (133 hrs) vs. hot wort (215 hrs) vs. cold wort (138 hours) .....**Bottom Line: do not add zinc to kettle or whirlpool.....add at cold wort.**

**Yeast need zinc as essential nutrient...[ ] in wort usually sub-optimal...chelation with proteins and polyphenols can make free zinc unavailable..Scottish Courage suggests adding zinc during acid washings to maximize availability.**

**"Zinc is the only cation commonly deficient in wort and is always completely removed by yeast."**

Trub binds zinc, thus add latter to fermenter not kettle or whirlpool to make available to yeast. Yeast use **chelation of metals as a protection mechanism**, therefore **bioavailability** is a big issue....**Servomyces** grows yeast in presence of zinc & magnesium, and when dried and killed provides these in a **more bioavailable manner than the free salts.**

**Servomyces** can have up to  $10^5$  and  $10^3$  bacteria and wild yeast, respectively, per gram of product. Yeast used is a single culture of *Saccharomyces cerevisiae* from Weihenstephan collection. Best added to kettle 10 minutes before knock-out....add 1 g/100 L wort for fermentation, double that for yeast propagation. Product itself is 50,000 – 55,000 ppm zinc.

**Zinc (+/-), optimal up to 0.6 ppm. Some claim not toxic until 50 ppm. Minimum need 0.1-0.15 ppm.**

**Servomyces:** .... a Lallemand yeast food...is an active, dried yeast rich in zinc and other yeast cell constituents.....as these yeast "sacrifice" themselves for the good of the pitched yeast, coined the term "Servant Yeast", leading to the name "Servomyces". Cute. Supplement to increase wort zinc levels an additional 0.2-1.0 ppm.

**Servomyces:** ...suggest adding to kettle at 1g/hL.....speeds up fermentation time, yielding higher ADFs, without altering esters and higher alcohols volatiles profile (did not examine sulfur). Superior impact compared to same level of increase in zinc as achieved by the addition of  $ZnCl_2$ . as minerals are more "efficacious" when incorporated into a living tissue rather than presented as a salt.

## Effect on Yeast Viability & Vitality

Czech study with "**Servomyces**" and "**Yeast Life Extra**" ...latter resulted in improved VDK reduction, former accelerated primary attenuation by 12 hours.

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