



Controlling contamination during yeast fermentation

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Contamination Control 1

- Using yeast in anaerobic or aerobic fermentation often has problems with bacterial contamination.
- In ethanol fermentation, the most common contaminating bacteria are *Lactobacillus fermentum* and *Lactobacillus vini*.
- The main contamination control in Brazil is the Melle-Bionot technique of yeast recycling with a sulphuric acid wash (U.S. Patent 2,230,318, 1936) (cell-recycle batch fermentation)
- This is expensive, dangerous, has water disposal problems, and is capital-intensive, but allows months-long continuous fermentation

Contamination Control 2

- Antibiotics are also widely used for contamination control, including in Brazil, but lead to antibiotic resistance in people if it enters the food chain.
- Sulfite is sometimes used for contamination control, but can't enter the food chain, reducing the value of residual yeast as fodder.
- Control of bacterial contamination permits continuous fermentation for long periods, which is much more economical than batch fermentation.

Contamination Control 3

- Fermentation with yeast is easily contaminated by both bacteria and contaminating yeasts, during aerobic and anaerobic fermentation.
- Bacteria need nickel to grow on urea (needed by the urease enzyme). Bacteria don't have the urea amidolyase enzyme.
- Yeasts need biotin to grow on urea (needed by the urea amidolyase enzyme). *Candida utilis* and *Yarrowia lipolytica* are biotin prototrophic (make their own biotin) but other yeasts, need added biotin.

Contamination Control 4

- *Saccharomyces cerevisiae* grows much faster than common contaminating yeasts such as *Dekkera bruxellensis* when urea is the nitrogen source.
- The fastest growth of *S. cerevisiae* and *Candida utilis* is when growing using urea as the nitrogen source.
- Testing of this contamination control technique has been successfully completed and the patent application is being examined in US, RU, CN, BR, IN.

Problems & Solutions 1

- 1) If urea is added faster than consumed by yeast, the yeast will secrete ammonia into the broth, allowing growth of bacteria.
- Solution: Reduce the rate of addition of urea when pH increases (a sign of ammonia).
- 2) Stainless steel leaches nickel into the broth in an acidic solution containing chloride ions, and the nickel allows growth of bacteria using urea.
- Solution: Use titanium in heat exchangers and possibly polymeric (plastic) food-safe coatings inside fermenters.

Problems & Solutions 2

- 3) Urea and ethanol form ethyl carbamate at high temperatures, especially during distillation. This is a known carcinogen.
- Solution: Ensure that all urea is consumed by yeast before sending a portion of the broth to the fermenter.
- 4) Some sugar sources don't contain enough biotin for yeast to use the urea.
- Solution: Biotin costs \$350/kg, need 2 micrograms per liter, so added biotin costs only \$0.0007 per 1000 liters.

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NOTIFICATION

about the positive result of the formal examination invention applications

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(71) Applicant(s) HAMRICK Edward Bryan, US

(54) Title of the invention Control of infection when growing yeast

Patent Status

“CONTAMINATION CONTROL WHEN GROWING YEASTS”

U.S. Patent App. No. 18/532,043, filed on December 7, 2023

International Patent App. No. PCT/US2023/083031, filed on
December 8, 2023

Некоторые патенты компании

- «Aerobic fermentation using pneumatic foam», application number 63/530,954
- «Contamination control when growing yeasts», application number 63/534,123
- «Methods and systems for producing fermentation products from carbohydrate-rich substrates», US9428772B2
- «Method for producing ethanol from sugar beets», application number 62/585,560
- «Methods and apparatus for separating ethanol from fermented biomass,»
WO2018182874A1
- Method for fermenting stems of the Poaceae family, ES2689944T3

РСТ подается в Россию, США, Китай, Индию, Бразилию, ЕС, Катар



Спасибо за внимание!

Задавайте любой вопрос

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