

The Good From the Ugly: Fermentation Optimization for Hagfish Protein Production

Simon Hulme, Zachary Hyde, Caeman Nicholas, Ben Florschutz *Utah State University* | Dr. Justin Jones *Utah State University*

Introduction

When under attack the noble hagfish produces a protective slime that rapidly expands in water to clog the gills of their attacker. The protein threads that hold the slime together caught the eye of Dr. Jones' Lab here at USU.

These proteins, alpha and gamma, have properties very similar to spider silk making them a material of interest to the US Navy. While the Jones lab has already genetically engineered a strain of *E. coli* to produce these filament proteins the process has not been optimized.

This group plans to increase protein production by 20% (from 8 g/L to 9.6 g/L) by optimizing the production process. This will reduce cost significantly for the US Navy and the Jones Lab.

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Zachary Hyde
Utah State University
Biological Engineering
zachary.s.hyde@gmail.com

Methods

Fermentations will be conducted with the following parameters to decrease negative acetate effects within the fermenter:

1. Glycerol will replace glucose during cell growth with feed concentration at 20g/L
2. Glucose starvation which will limit acetate anabolic pathways and require to cell to metabolize any produced acetate

The project's methodology is subject to change depending on production results

Figure 1 – Hagfish



Results

We expect our results to show a protein production increase of 20%. The 20% increase would increase the yield from 8 g/L to 9.6 g/L of the hagfish protein. Since the purification process is the same no matter the amount of protein this additional yield will essentially be cost free.

Figure 2 details acetate concentrations. Glycerol batches 72% and 60% reduction in acetate concentration at 5 hours and 6 hours, respectively.

Figure 2 – Acetate Concentration vs Time

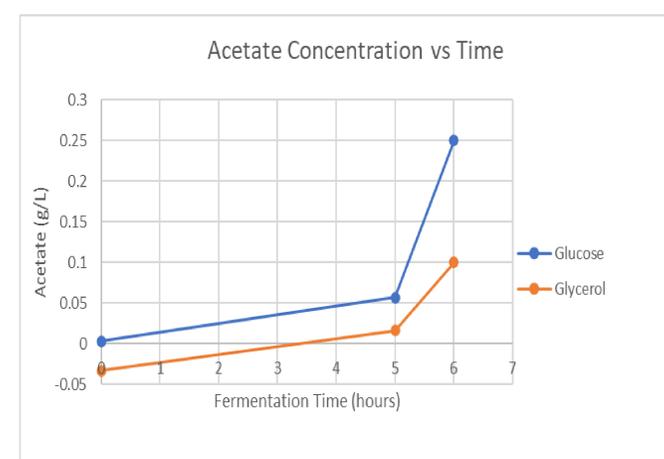
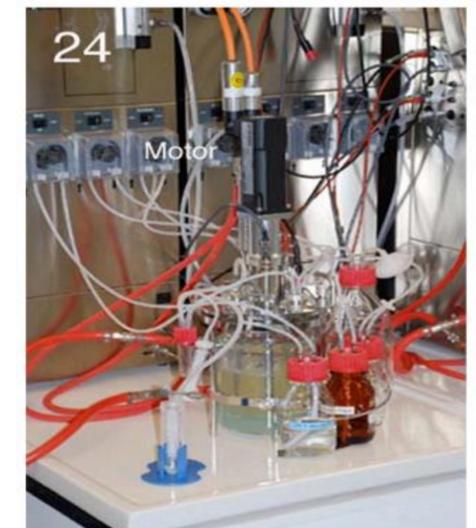


Figure 3 – Fermentation System for Protein Production



Conclusions

In conclusion, we are using fermentation methods to increase the yield of proteins. We expect to improve the yield by 20% (approximately 2 g/L increase). To accomplish this goal, we will be using Glycerol instead of glucose for the initial feed batch and glucose starvation for the second feed batch. As expected, glycerol batches produced less acetate than glucose batches.