Killer Yeast Vs. Sensitive Yeast

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Proposal

The differential equation we may use for modeling the growth of yeast is the same as that used for bacterial growth in a chemostat:

$$\frac{dN}{dt} = K(C)N - \frac{FN}{V},$$
$$\frac{dC}{dt} = -\alpha K(C)N - \frac{FC}{V} + \frac{FC_0}{V},$$

where N and is the number of yeast in the chamber in units number/volume, C is the concentration of nutrient in the chamber with units mass/volume, C_0 is the concentration of nutrient in the reservoir, F is the in/out flow rate with units volume/time, V is the volume of the chamber, α is a unitless inverse of the yield constant, and $K(C)$ is the reproduction rate for yeast in units 1/time with possible formula chosen such that $\lim_{C\to\infty} = K_{max}$, the maximum possible reproduction rate:

$$K(C) = \frac{K_{max}C}{K_n + C}.$$

We are also provided with some data for the problem for two separate runs, along with the concentration of nutrient in the reservoir, $C_0 = 0.02$.

1 K1 Run

Vessel One :

Volumes/Hr	0.028	0.099	0.142	0.207	0.269	0.287	0.352	0.403
Optical Density at Steady State	0.144	0.151	0.099	0.069	0.045	0.02	0.003	0

Vessel Two :

Volumes/Hr	0.054	0.11	0.141	0.199	0.257	0.296	0.348	0.397	0.41
Optical Density at Steady State	0.164	0.151	0.11	0.092	0.072	0.023	0.006	0.002	0.004

2 Sensitive Run

Vessel One :

Volumes/Hr	0.041	0.099	0.167	0.223	0.266	0.328	0.356	0.401	0.462
Optical Density at Steady State	0.54	0.494	0.459	0.395	0.229	0.019	0.006	0.003	0

Vessel Two :

Volumes/Hr	0.0571	0.126	0.196	0.263	0.313	0.383
Optical Density at Steady State	0.385	0.456	0.363	0.197	0.044	0.004