Modelling Glucose Transport and Population Growth

Below are the model equations defined by the class. First, an equation accounting for uptake of glucose in solution by the yeast population, with a potential correction term for osmotic back-flow from the cells:

$$\dot{g}_o = \underbrace{-\alpha\ g_o y}_{\text{uptake}} \quad + \quad \overbrace{\gamma\ (g_i - g_o) y}^{\text{osmosis}}, \tag{6}$$

and another equation describing changes in internal glucose in the population (which is *not* changed by budding - the buds still have the same glucose as their parents):

$$\dot{g}_i = \overbrace{\alpha\ g_o y}^{\text{uptake}} \quad - \quad \underbrace{\gamma\ (g_i - g_o) y}_{\text{osmosis}} \quad - \quad \underbrace{\beta\ g_i y}_{\text{respiration}}. \tag{7}$$

The class accounted for yeast population growth using a per-capita growth model, with growth rates inhibited by the presence of alcohol:

$$\dot{y} = \overbrace{\epsilon\ y g_i}^{\text{budding}} \quad - \quad \underbrace{\omega\ a y}_{\text{alcohol inhibition}}. \tag{8}$$

Finally, production of alcohol as a waste product must be accounted for using a proportionality-to-respiration argument:

$$\dot{a} = \delta\ g_i y. \tag{9}$$

Together, equations (6 - 9) form a complete model for the yeast-sugar system.

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