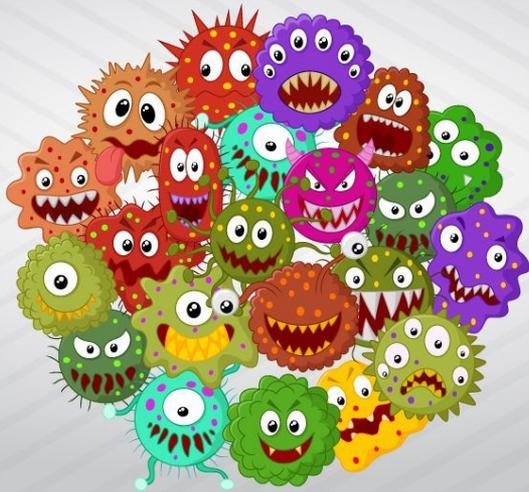
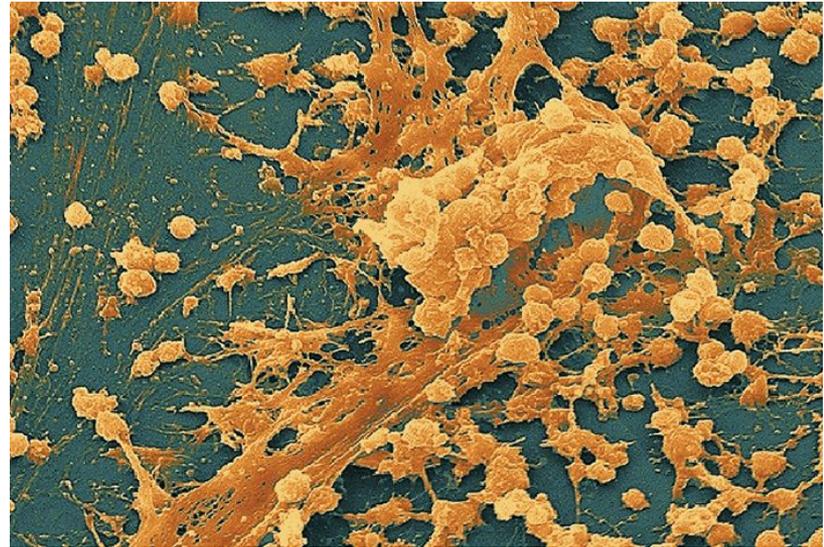


Modeling Biofilm Growth Through iDynoMics

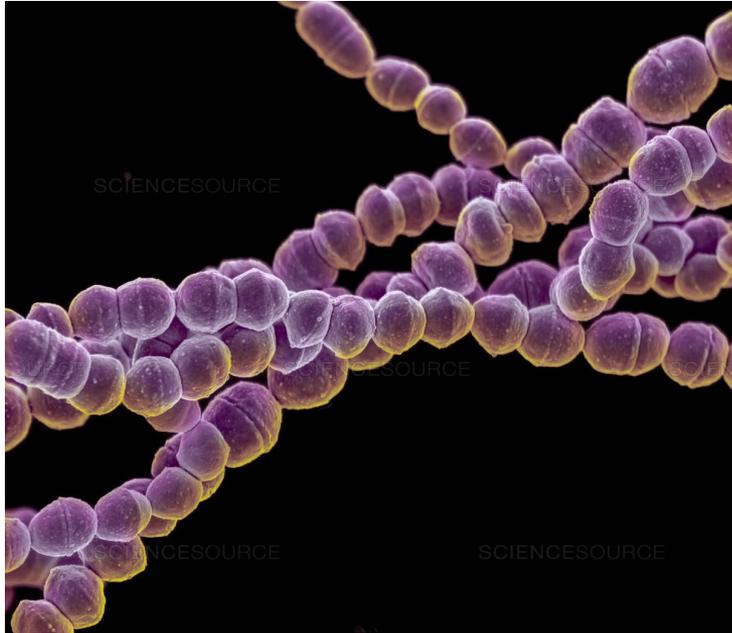
WHAT IS BIOFILM?



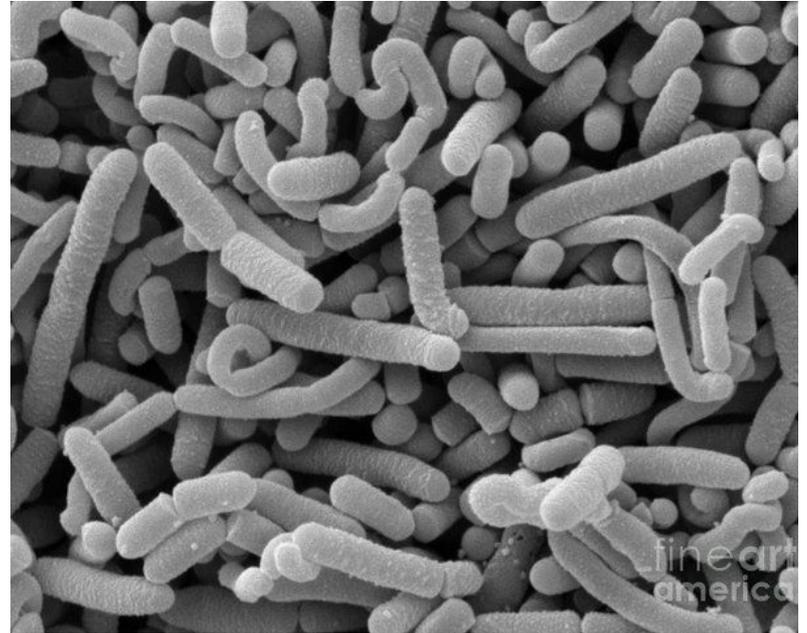
<https://drjaydavidsen.com/biofilm-lymes-shield/>



<https://www.hfmmagazine.com/articles/3372-identifying-and-eradicating-biofilm>



<https://www.sciencesource.com/archive/Streptococcus-gordonii--SEM-SS21693571.html>



<https://fineartamerica.com/featured/5-lactobacillus-acidophilus-and-l-casei-scimat.html?product=poster>

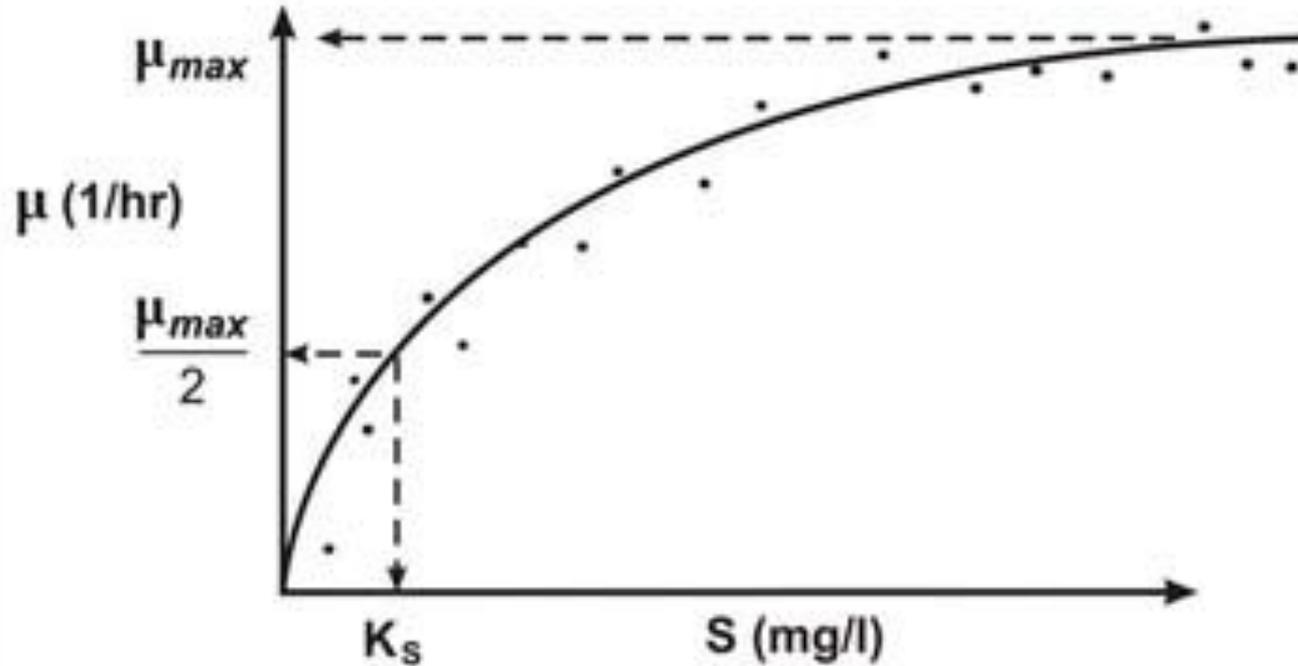
Idynamics



Parameter	Symbol	Value	Units	Source
Maximal growth rate	μ_H^{max}	0.25	h^{-1}	BM3
Biomass yield	Y_H	0.63	g COD-X/g COD-S	BM3
EPS yield	Y_H^{EPS}	0.2	$\text{g COD} \cdot \text{g COD}^{-1}$	Assumed
Saturation constant for COD	K_{COD}^H	$4 \cdot 10^{-3}$	$\text{g COD} \cdot \text{L}^{-1}$	BM3
Saturation constant for O_2	$K_{\text{O}_2}^H$	$0.2 \cdot 10^{-3}$	$\text{g O}_2 \cdot \text{L}^{-1}$	BM3
Saturation constant for NO_3^-	$K_{\text{NO}_3}^H$	$0.5 \cdot 10^{-3}$	$\text{g N} \cdot \text{L}^{-1}$	ASM
Maintenance rate for Lag-5 species	b_{H1}^m	0.0133	h^{-1}	BM3
Maintenance rate for Lag-3 species	b_{H2}^m	0.0176	h^{-1}	Assumed
Maintenance rate for Lag-1 species	b_{H3}^m	0.0399	h^{-1}	Assumed
Inactivation rate	b_H^i	0.0033	h^{-1}	BM3
Switch threshold	$S_{\text{O}_2}^T$	$0.2 \cdot 10^{-3}$	$\text{g O}_2 \cdot \text{L}^{-1}$	YM
Biomass and inert density	ρ_X	150	$\text{g COD} \cdot \text{L}^{-1}$	Assumed
EPS density	ρ_{EPS}	30	$\text{g COD} \cdot \text{L}^{-1}$	Assumed

Sources for the values were: BM3 (Noguera and Picioreanu, 2004; Rittmann *et al.*, 2004), ASM (Henze, 2000) and YM (Ye *et al.*, 1995; Matsumoto *et al.*, 2007b).

Monod Growth



$$\mu = \mu_{max} \left(\frac{S}{S+K_s} \right) \quad (5)$$

Extracting Parameters from Literature

Streptococcus gordonii:

Biofilm formation by the oral pioneer colonizer

Streptococcus gordonii: an experimental and numerical study (Rath, Feng, Neuweiler, Stumpp, Nackenhorst, Stiesch)

$\mu_{\max} = 0.108 \text{ h}^{-1}$

$K_s = 0.878 \text{ g/L}$

Lactobacillus casei: Mathematical modelling of cell suspension in high cell density conditions

Application to L-lactic acid fermentation using Lactobacillus casei in membrane bioreactor (Boudrant Menshutina, Skorohodov, Guseva, Fick)

$\mu_{\max} = 0.46 \text{ h}^{-1}$

$K_s = 0.12 \text{ g/L}$

Days: 2

Parameters:

Glucose: 0.5 g/L

❖ Strep:

Initial Count:

10

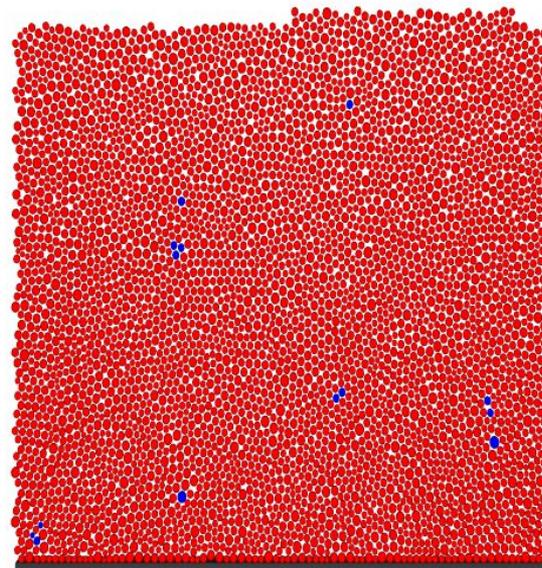
Final Count:

14

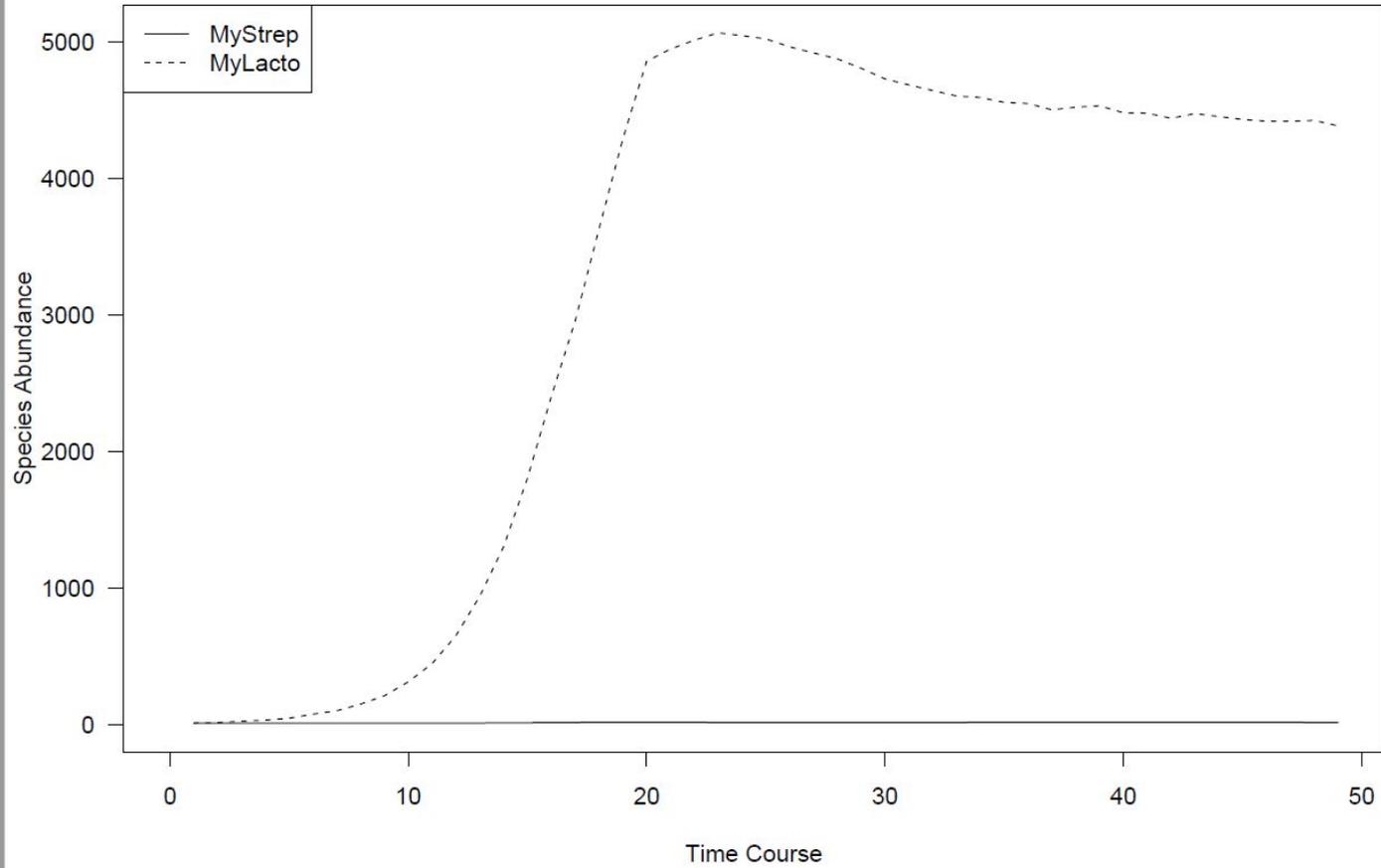
❖ Lacto:

10

4387



Individual abundances per species



Days: 2

Parameters:

Glucose: 5e-3 g/L

	Initial Count:	Final Count:
❖ Strep:	10	12
❖ Lacto:	10	24

Glucose: 1 g/L

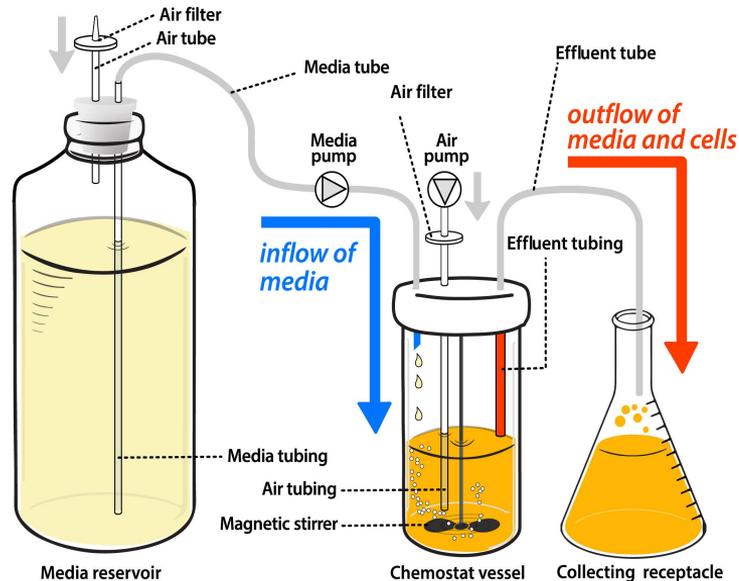
	Initial Count:	Final Count:
❖ Strep:	10	18
❖ Lacto:	10	4403

Glucose: 1 g/L

	Initial Count:	Final Count:
❖ Strep:	100	148
❖ Lacto:	10	4320

Future Tasks

- Simulate growth of biofilms in chemostat
- Validate literature results of the interactions between streptococcus and lactobacillus



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