b)

i) acetate
Objective value: -1
Balanced?: yes

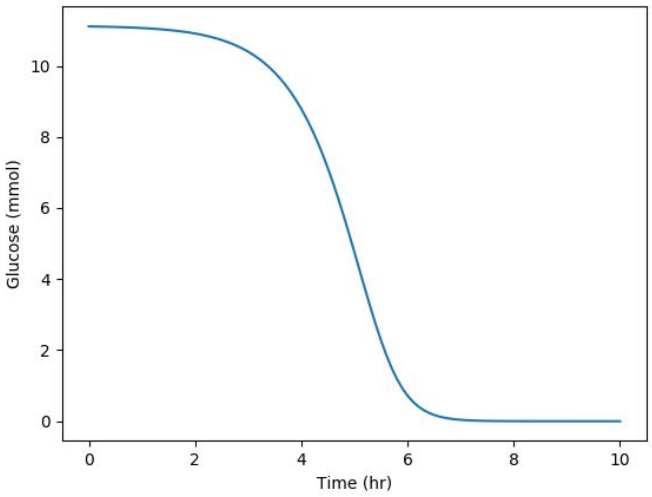
ii) formate
Objective value: -1
Balanced?: no

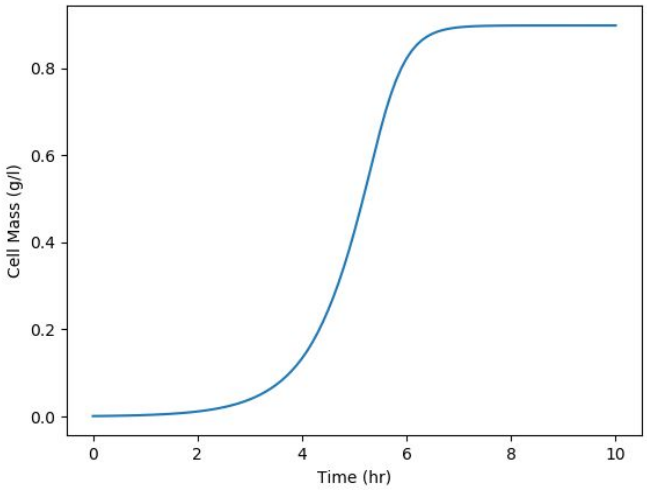
iii) ethanol
Objective value: -1
Balanced?: yes

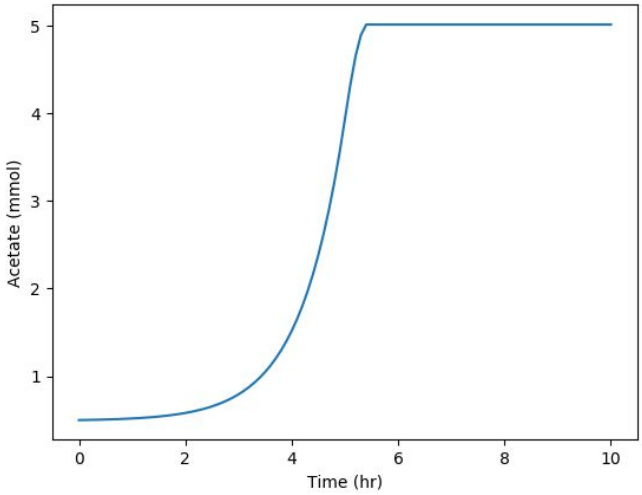
iv) ATP
Objective value: -4.25
Balanced?: yes

Formate optimization in the current model, by an inward flux of approximately 0.4 C, 0.3 H, and 0.4 O, which may be going into biomass.

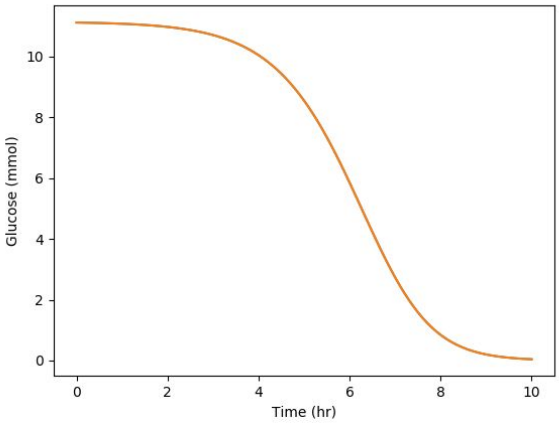
c) Figure 7 occurred under aerobic conditions

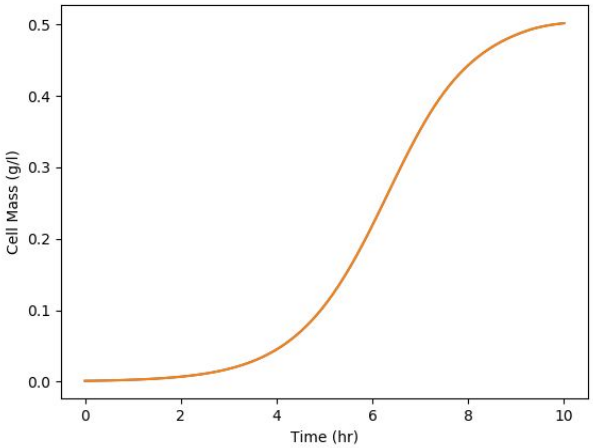


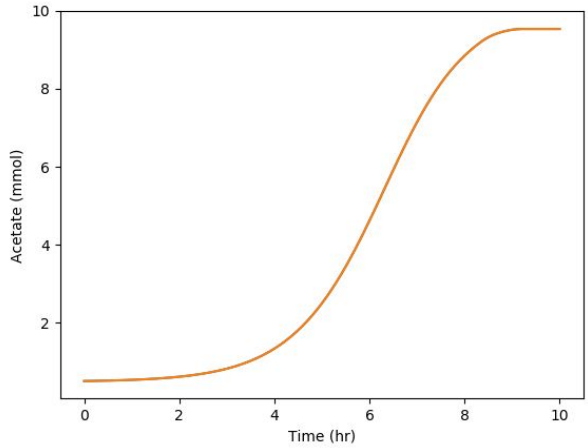

Cell Mass (g/l)
0.0
0.2
0.4
0.6
0.8
0
2
4
6
8
10
Time (hr)

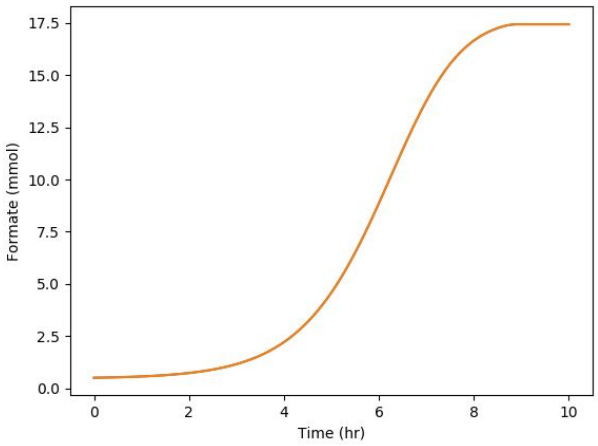

Acetate (mmol)
1
2
3
4
5
0
2
4
6
8
10
Time (hr)

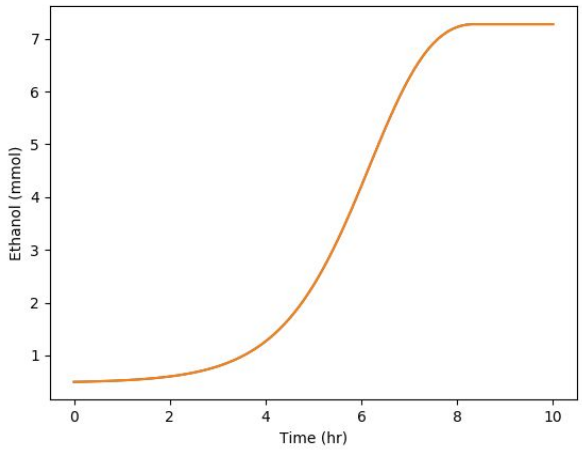
d)


Glucose (mmol)
0
2
4
6
8
10
0
2
4
6
8
10
Time (hr)


Cell Mass (g/l)
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
10
Time (hr)


Acetate (mmol)
2
4
6
8
10
0
2
4
6
8
10
Time (hr)


Formate (mmol)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0
2
4
6
8
10
Time (hr)



e)

The principle difference between the aerobic and anaerobic conditions (Figure 7 and Figure 11) is the oxygen flux, which is allowed to highly negative (-1.7) in the aerobic condition (the cell takes up oxygen), and roughly -0.1 in the anaerobic condition. This results in lower fluxes of glucose and biomass, but higher fluxes of acetate, ethanol, and formate. Acetate, formate, and ethanol are all byproducts of anaerobic respiration, so it makes sense that their fluxes increase under oxygen-deprived conditions. Since the anaerobic condition is less efficient for energy production from glucose, biomass increases at a slower rate, resulting in a lower flux. Glucose uptake is also slowed due to the lower biomass flux.