```
In [4]: from chemostat_report import *
        from citrate import *
```

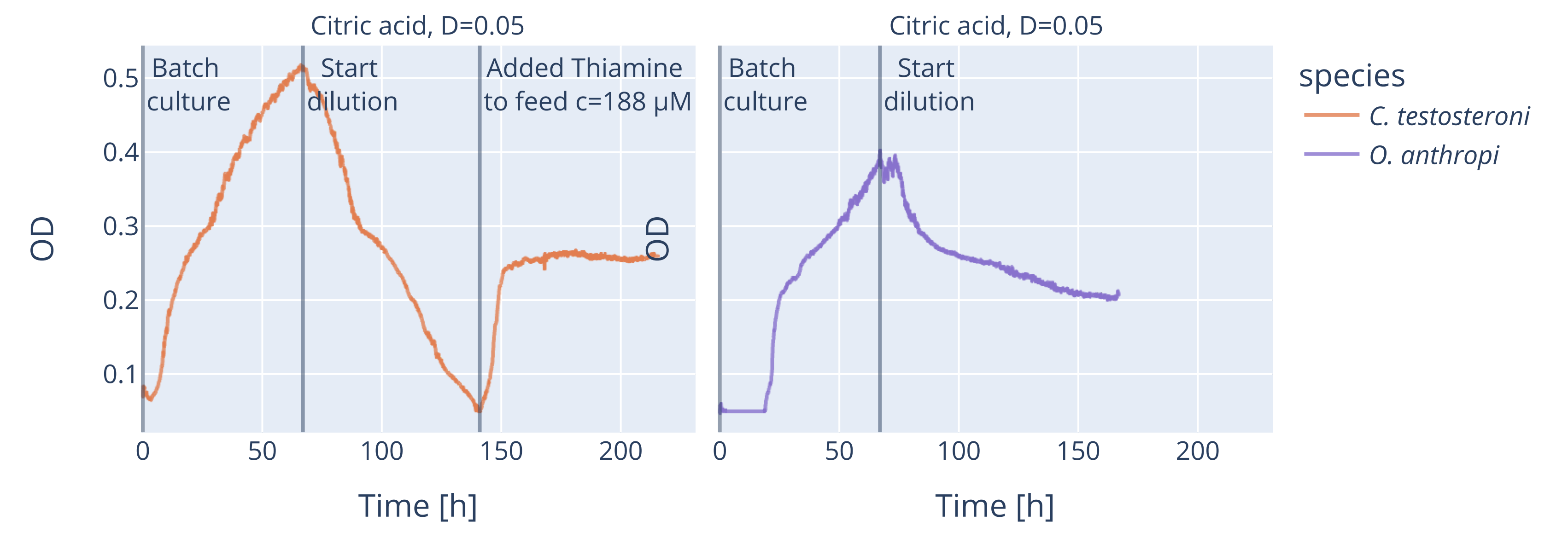
Labmeeting 04.19.2023

Citric acid Chemostat experiments

Mono-cutlure experiments

Mono culture experiments with 10 mM citric acid.

```
In [2]: fig = ct_oa()
        fig.show()
        #D: Dilution rate [1/h]
```



Steady state measurements

$\mu_{max} = 0.1$

$K_C = S^*(\mu_{max} - D)/D$
K_C: Monod constant [µM], D: Dilution rate [1/h] S^*: Citric acid conc. steady state [µM]

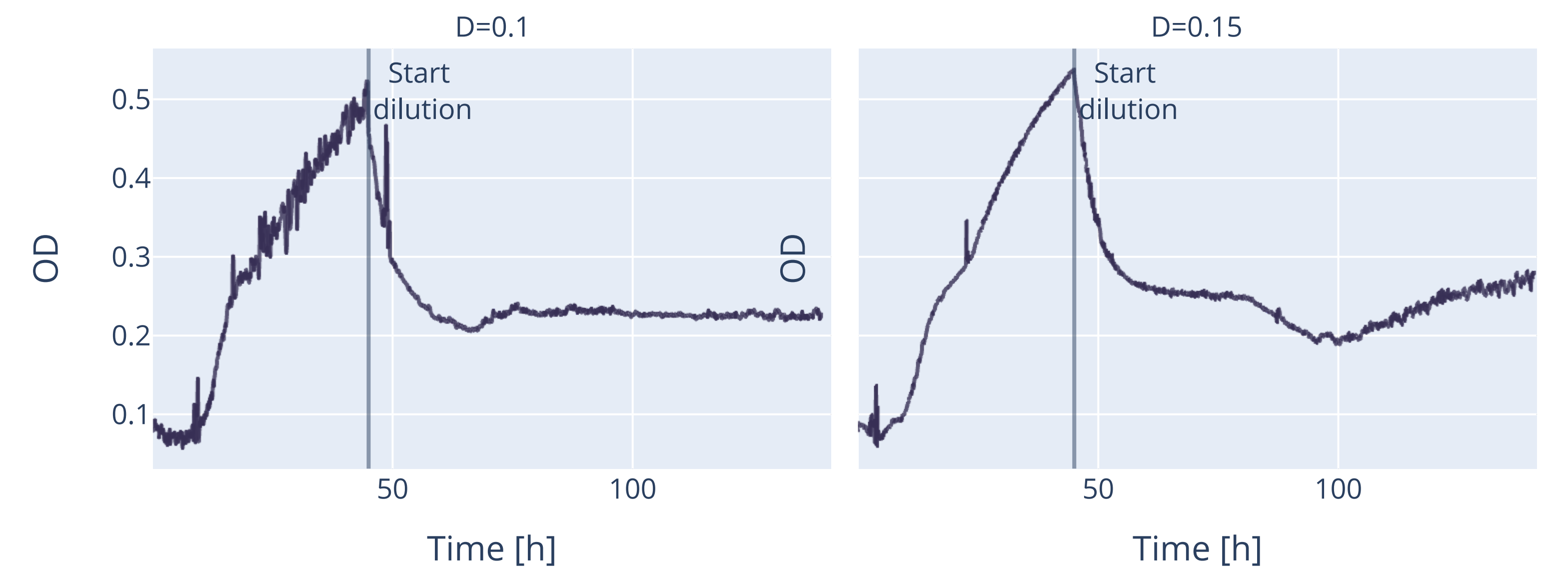
$Y_C = \frac{N^*}{S_0 - S^*}$

Y_C: Yield Cells/mL/µM] N: Population sice [CFUs/mL] S_0: Citric acid concentration citric acid feed [µM]

| Species | CFUs/mL | Citric acid [µM] | Citric acid feed [µM] | K_C [µM] | Y [Cells/mL/µM] | |-----------------|---------|-----------------|-----------------------|-------|-----------------| | C. testosteroni | 2.7E9 | 6874 | 9844 | 6874 | 909280 | | O. anthropi | 1.3E10 | 7027 | 10112 | 7027 | 4321535 |

Community experiments

```
In [11]: od_citric_acid_comm()
```



Species abundance

D=0.1

| Species | CFUs/mL | Relative abundance | |-----------------|---------|--------------------| | C. testosteroni | 2.5E9 | 0.45 | | O. anthropi | 3.1E9 | 0.55 |

D=0.15

| Species | CFUs/mL | Relative abundance | |-----------------|---------|--------------------| | C. testosteroni | 3E9 | 0.75 | | O. anthropi | 1E9 | 0.25 |

Modelling

$J^{upt}_{C,Ct} = \mu_{Ct}\frac{C}{K_{C,Ct}+C}$

$J^{upt}_{C,Oa} = \mu_{Oa}\frac{C}{K_{C,Oa}+C}$

$J^{upt}_{T,Oa} = \mu_{Oa}\frac{T}{K_{T,Oa}+T}$

C: Citric acid concentration [µM]
T: Thiamine concentration [µM]

$\frac{dC}{dt} = D(M_C - C) - J^{upt}_{C,Ct}\frac{Ct}{Y_{C,Ct}} - J^{upt}_{C,Oa}\frac{Oa}{Y_{C,Oa}}$

$\frac{dT}{dt} = \alpha J^{upt}_{C,Ct}\frac{Ct}{Y_{C,Ct}} - J^{upt}_{T,Oa}\frac{Oa}{K_{T,Oa}} - DT$

$\frac{dCt}{dt} = Ct(J^{upt}_{C,Ct} - D)$

$\frac{dOa}{dt} = Oa(min(J^{upt}_{C,Oa}, J^{upt}_{T,Oa}) - D)$

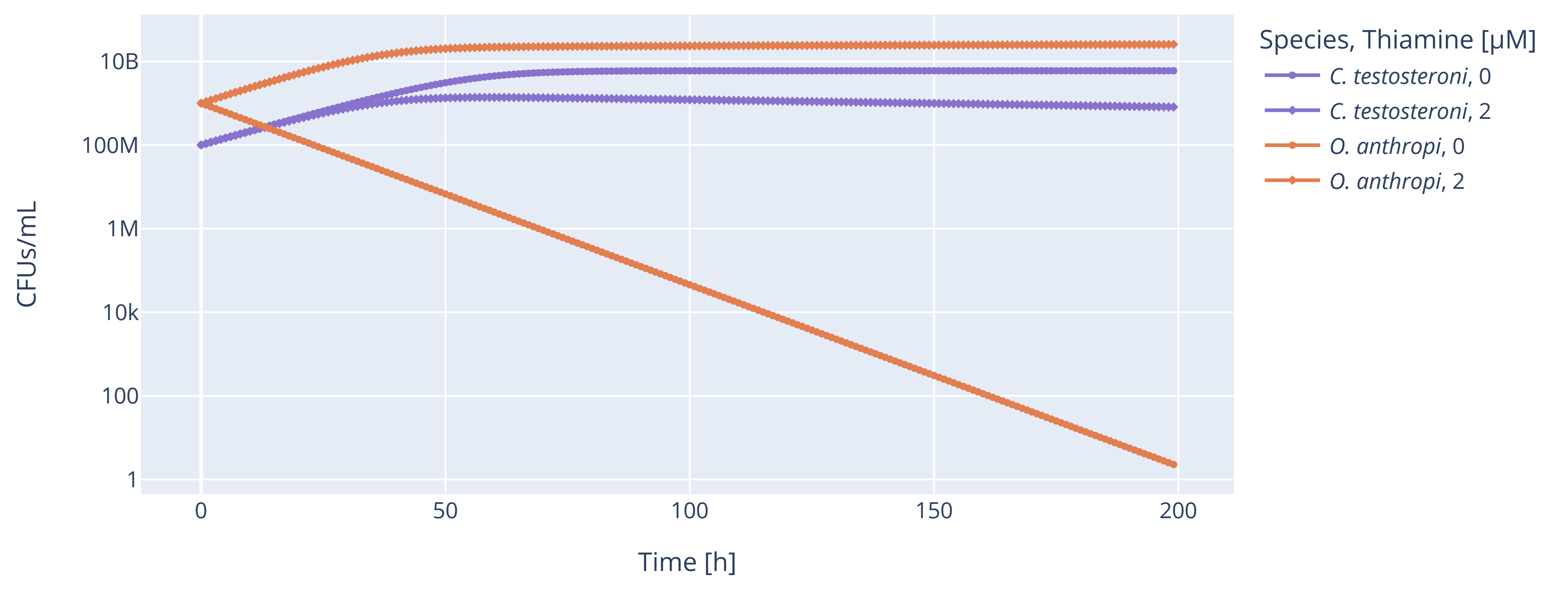
Parmaters

$K_{C,Ct} = 6874$ [µM] Measured
$K_{C,Oa} = 7027$ [µM] Measured
$K_{T,Oa} = 0.015$ [µM] Based on literature
$r_{C,Ct} = 0.3$ [1/h] Estimated
$r_{C,Oa} = 0.32$ [1/h] Estimated
$Y_{C,Ct} = 909280$ [Cells/mL/µM] Measured
$Y_{C,Oa} = 4321535$ [Cells/mL/µM] Measured
$Y_{T,Oa} = 1E15$ [Cells/mL/µM] Based on literature
$\alpha = 5E-6$ Estimated

Constant Thiamine

$\frac{dT}{dt} = D(M_T - T) - J^{upt}_{T,Oa}\frac{Oa}{K_{T,Oa}}$

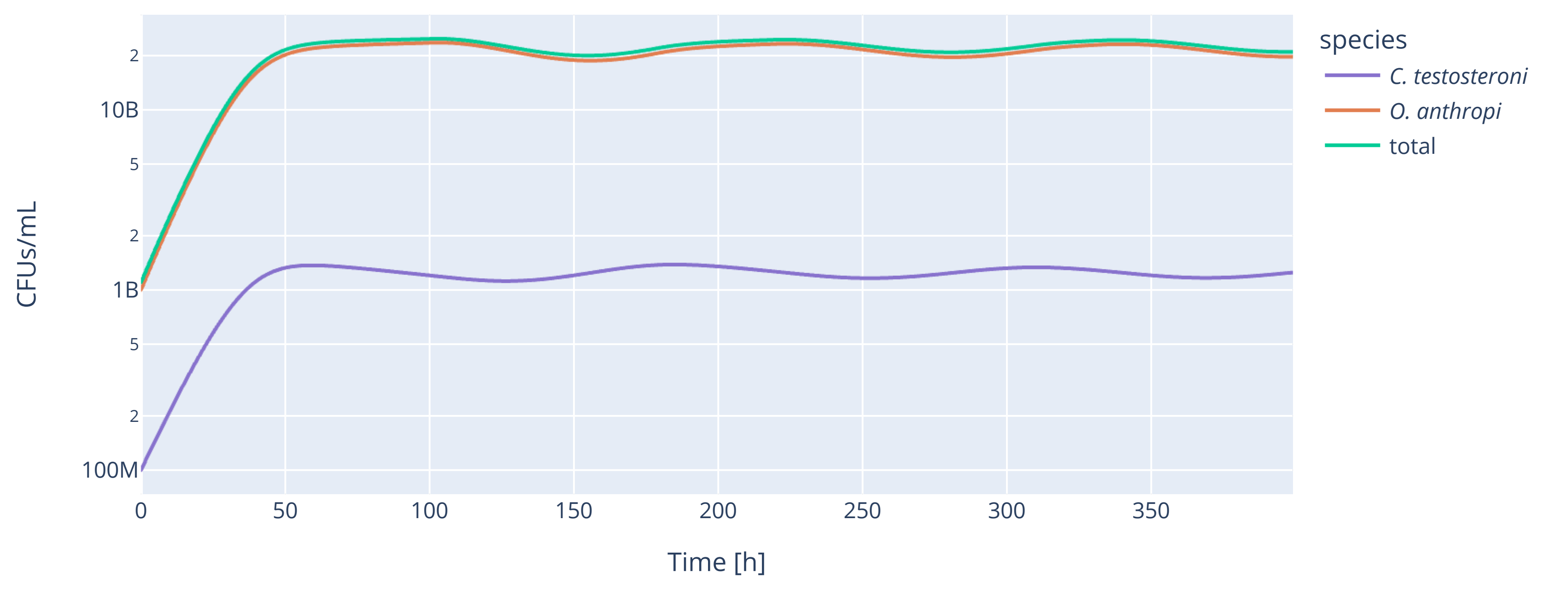
```
In [12]: constant_thiamine()
         # D=0.1 [1/h]
```



Thiamine cross-feeding

$\frac{dT}{dt} = \alpha J^{upt}_{C,Ct}\frac{Ct}{Y_{C,Ct}} - J^{upt}_{T,Oa}\frac{Oa}{K_{T,Oa}} - DT$

```
In [13]: # D=0.1
         fig,fig_T,fig_C,y = thiamine_cross_feeding(0.1,range(400))
```




```
In [14]: #fig_T.show()
```

```
In [15]: #D=0.15
         fig,fig_T,fig_C,y = thiamine_cross_feeding(0.15,range(400))
```