Differential Equation System

Lactonase Production

KULeuven

1 Global Parameters

Parameter	Value	Value Units
k_{B0032}	0.16667	
k_{open}	1.5	
$k_{gesloten}$	100	

2 Rate Laws

2.1 Reaction 1

Species

Reactants	Products
Gene_lactonase pT7_tag	closed_mRNA_lactonase Gene_lactonase pT7_tag

Reaction Rate

$$v_1 = k_{max} \cdot Gene_{lactonase} \cdot \frac{pT7_{tag}}{(K_{T7} + pT7_{tag})} \tag{1}$$

Parameters

Parameter	Value	Value Units
k_{max}	0.044	
K_{T7}	421	

2.2 Reaction 2

Species

Reactants	Products
open_mRNA_lactonase open_mRNA_lactonase_complex	lactonase open_mRNA_lactonase open_mRNA_lactonase_complex

Reaction Rate

$$v_2 = k_{B0032} \cdot (open_{mRNA\_lactonase} + open_{mRNA\_lactonase\_complex}) \tag{2}$$

Parameters

Parameter	Value	Value Units

2.3 Reaction 3

Species

Reactants	Products
lactonase	sa30_degraded

Reaction Rate

$$v_3 = d_{lva} \cdot lactonase \tag{3}$$

Parameters

Parameter	Value	Value Units
d_{lva}	0.0002814	

2.4 Reaction 4

Species

Reactants	Products
closed_mRNA_lactonase	open_mRNA_lactonase

Reaction Rate

$$v_4 = k_{open} \cdot closed_{mRNA\_lactonase} - k_{gesloten} \cdot open_{mRNA\_lactonase} \quad (4)$$

Parameters

Parameter	Value	Value Units

2.5 Reaction 5

Species

Reactants	Products
closed_mRNA_lactonase	sa38_degraded

Reaction Rate

$$v_5 = d_{gesloten\_mRNA\_lactonase} \cdot closed_{mRNA\_lactonase} \quad (5)$$

Parameters

Parameter	Value	Value Units
$d_{gesloten\_mRNA\_lactonase}$	0.004621	

2.6 Reaction 6

Species

Reactants	Products
open_mRNA_lactonase	sa37_degraded

Reaction Rate

$$v_6 = d_{open\_mRNA\_lactonase} \cdot open_{mRNA\_lactonase} \quad (6)$$

Parameters

Parameter	Value	Value Units
$d_{open\_mRNA\_lactonase}$	0.0023105	

2.7 Reaction 7

Species

Reactants	Products
open_mRNA_lactonase_complex	csa5_degraded

Reaction Rate

$$v_7 = d_{open\_mRNA\_lactonase\_complex} \cdot open_{mRNA\_lactonase\_complex} \quad (7)$$

Parameters

Parameter	Value	Value Units
$d_{open\_mRNA\_lactonase\_complex}$	0.0023105	

2.8 Reaction 8

Species

Reactants	Products
mRNA_RIBOKEY closed_mRNA_lactonase	open_mRNA_lactonase_complex

Reaction Rate

$$v_8 = k_{complex1} \cdot mRNA_{RIBOKEY} \cdot closed_{mRNA\_lactonase} - k_{dis1} \cdot open_{mRNA\_lactonase\_complex} \quad (8)$$

Parameters

Parameter	Value	Value Units
$k_{complex1}$	57	
k_{dis1}	100	

3 Equations

3.1 Species: sa38_degraded

$$\frac{d[sa38_{degraded}]}{dt} = +v_5 \tag{9}$$

3.2 Species: closed_mRNA_lactonase

$$\frac{d[closed_{mRNA\_lactonase}]}{dt} = +v_1 - v_4 - v_5 - v_8 \tag{10}$$

3.3 Species: Gene_lactonase

$$\frac{d[Gene_{lactonase}]}{dt} = +v_1 - v_1 \tag{11}$$

3.4 Species: sa37_degraded

$$\frac{d[sa37_{degraded}]}{dt} = +v_6 \tag{12}$$

3.5 Species: open_mRNA_lactonase

$$\frac{d[open_{mRNA\_lactonase}]}{dt} = +v_2 - v_2 + v_4 - v_6 \tag{13}$$

3.6 Species: sa30_degraded

$$\frac{d[sa30_{degraded}]}{dt} = +v_3 \tag{14}$$

3.7 Species: lactonase

$$\frac{d[lactonase]}{dt} = +v_2 - v_3 \tag{15}$$

3.8 Species: csa5_degraded

$$\frac{d[csa5_{degraded}]}{dt} = +v_7 \tag{16}$$

3.9 Species: pT7_tag

$$\frac{d[pT7_{tag}]}{dt} = +v_1 - v_1 \tag{17}$$

3.10 Species: mRNA_RIBOKEY

$$\frac{d[mRNA_{RIBOKEY}]}{dt} = -v_8 \tag{18}$$

3.11 Species: open_mRNA_lactonase_complex

$$\frac{d[open_{mRNA\_lactonase\_complex}]}{dt} = +v_2 - v_2 - v_7 + v_8 \tag{19}$$

4 Compartments

4.1 Lactonase Production

Species	Initial Amount	Initial Amount Units
sa38_degraded	0	
closed_mRNA_lactonase	0	
Gene_lactonase	1	
sa37_degraded	0	
open_mRNA_lactonase	0	
sa30_degraded	0	
lactonase	0	
csa5_degraded	0	
pT7_tag	0	
mRNA_RIBOKEY	0	
open_mRNA_lactonase_complex	0	