SBML Model Report

Model name: "Chassagnole2001_Threonine Synthesis"

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by the following two authors: Jacky L Snoep[1] and Harish Dharuri[2] at August 29th 2006 at 10:11 a. m. and last time modified at May 16th 2012 at 10:20 a. m. Table 1 shows an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	11
events	0	constraints	0
reactions	7	function definitions	0
global parameters	0	unit definitions	7
rules	0	initial assignments	0

Model Notes

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SBML level 2 code generated for the JWS Online project by Jacky Snoep using PySCeS
Run this model online at http://jjj.biochem.sun.ac.za
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Biomodels Curation: The model reproduces Fig 2f of the paper. The Vmax values for different reactions are obtained by multiplying the specific activites given in Table 3 of the paper with the protein concentration and an assay correction factor that was provided by the authors. The protein concentration is 202 mg/litre. The specific activities that need to be taken into consideration are those given for „variable threonine„ in Table 3. The following are the assay correction factors provided by the authors: vak1=1.49; vak3=1.12; vasd=1.14; vhsd=1.42; vts=1.15; vhk=1.13. The model was successfully tested on MathSBML and Jarnac

2 Unit Definitions

This is an overview of ten unit definitions of which three are predefined by SBML and not mentioned in the model.

2.1 Unit `substance`

Name millimole

Definition mmol

2.2 Unit `time`

Name min

Definition 60 s

2.3 Unit `mM`

Name mM

Definition $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

2.4 Unit `mM_per_min`

Name mM_per_min

Definition $\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$

2.5 Unit litre_per_mg_per_min

Name litre_per_mg_per_min

Definition $1 \cdot \mathrm{mg}^{-1} \cdot (60\ \mathrm{s})^{-1}$

2.6 Unit millimole_per_mg_per_min

Name millimole_per_mg_per_min

Definition $\mathrm{mmol} \cdot \mathrm{mg}^{-1} \cdot (60\ \mathrm{s})^{-1}$

2.7 Unit mg_per_litre

Name mg_per_litre

Definition $\mathrm{mg} \cdot \mathrm{l}^{-1}$

2.8 Unit volume

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.9 Unit area

Notes Square metre is the predefined SBML unit for `area` since SBML Level 2 Version 1.

Definition m^2

2.10 Unit length

Notes Metre is the predefined SBML unit for `length` since SBML Level 2 Version 1.

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`compartment`			3	1	litre	☑	

3.1 Compartment `compartment`

This is a three dimensional compartment with a constant size of one litre.

4 Species

This model contains eleven species. Section 6 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
aspp	Aspartyl phosphate	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
asa	Aspartate beta-semialdehyde	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hs	Homoserine	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hsp	O-Phospho-homoserine	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
phos	Phos	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
thr	Threonine	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
asp	Aspartate	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
nadp	NADP	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
nadph	NADPH	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
adp	ADP	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
atp	ATP	compartment	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Reactions

This model contains seven reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 4: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	vak	Aspartate Kinase	$\mathrm{atp} + \mathrm{asp} \overset{\mathrm{thr}}{\rightleftharpoons} \mathrm{aspp} + \mathrm{adp}$	
2	vasd	Aspartate semialdehyde dehydrogenase	$\mathrm{nadph} + \mathrm{aspp} \rightleftharpoons \mathrm{nadp} + \mathrm{phos} + \mathrm{asa}$	
3	vhdh	Homoserine dehydrogenase	$\mathrm{nadph} + \mathrm{asa} \overset{\mathrm{asp,\ thr}}{\rightleftharpoons} \mathrm{hs} + \mathrm{nadp}$	
4	vtsy	Threonine synthase	$\mathrm{hsp} \rightleftharpoons \mathrm{thr} + \mathrm{phos}$	
5	vhk	Homoserine kinase	$\mathrm{hs} + \mathrm{atp} \overset{\mathrm{thr}}{\rightleftharpoons} \mathrm{hsp} + \mathrm{adp}$	
6	vnadph_endo	Endogenous consumption of NADPH	$\mathrm{nadph} \rightleftharpoons \mathrm{nadp}$	
7	vatpase	ATPase	$\mathrm{atp} \rightleftharpoons \mathrm{adp} + \mathrm{phos}$	

5.1 Reaction vak

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name Aspartate Kinase

Reaction equation

$$\mathrm{atp} + \mathrm{asp} \overset{\mathrm{thr}}{\rightleftharpoons} \mathrm{aspp} + \mathrm{adp} \tag{1}$$

Reactants

Table 5: Properties of each reactant.

Id	Name	SBO
atp	ATP	
asp	Aspartate	

Modifier

Table 6: Properties of each modifier.

Id	Name	SBO
thr	Threonine	

Products

Table 7: Properties of each product.

Id	Name	SBO
aspp	Aspartyl phosphate	
adp	ADP	

Kinetic Law

Derived unit contains undeclared units

$$
\begin{aligned}
&v_1 \\
&= \mathrm{vol}\,(\mathrm{compartment}) \\
&\cdot \left(\frac{\mathrm{vm11} \cdot \left([\mathrm{asp}] \cdot [\mathrm{atp}] - \frac{[\mathrm{aspp}] \cdot [\mathrm{adp}]}{\mathrm{keqak}} \right)}{\left(\frac{\mathrm{k11} \cdot \left(1 + \left(\frac{[\mathrm{thr}]}{\mathrm{k1thr}} \right)^{\mathrm{nak1}} \right)}{1 + \left(\frac{[\mathrm{thr}]}{\mathrm{alpha} \cdot \mathrm{k1thr}} \right)^{\mathrm{nak1}}} + \frac{\mathrm{k11} \cdot [\mathrm{aspp}]}{\mathrm{k1aspp}} + [\mathrm{asp}] \right) \cdot \left(\mathrm{k1atp} \cdot \left(1 + \frac{[\mathrm{adp}]}{\mathrm{k1adp}} \right) + [\mathrm{atp}] \right)} \right. \\
&\left. + \frac{\mathrm{vm13} \cdot \left([\mathrm{asp}] \cdot [\mathrm{atp}] - \frac{[\mathrm{aspp}] \cdot [\mathrm{adp}]}{\mathrm{keqak}} \right)}{\left(1 + \left(\frac{\mathrm{lys}}{\mathrm{k1lys}} \right)^{\mathrm{nak3}} \right) \cdot \left(\mathrm{k13} \cdot \left(1 + \frac{[\mathrm{aspp}]}{\mathrm{k13aspp}} \right) + [\mathrm{asp}] \right) \cdot \left(\mathrm{k13atp} \cdot \left(1 + \frac{[\mathrm{adp}]}{\mathrm{k13adp}} \right) + [\mathrm{atp}] \right)} \right)
\end{aligned}
\tag{2}
$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vm11			0.150	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
keqak			$6.4 \cdot 10^{-4}$	dimensionless	☑
k11			0.970	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k1thr			0.167	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
nak1			4.090	dimensionless	☑
alpha			2.470	dimensionless	☑
k1aspp			0.017	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k1atp			0.980	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k1adp			0.250	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
vm13			0.072	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
lys			0.460	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k1lys			0.391	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
nak3			2.800	dimensionless	☑
k13			0.320	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k13aspp			0.017	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k13atp			0.220	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k13adp			0.250	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

5.2 Reaction vasd

This is a reversible reaction of two reactants forming three products.

Name Aspartate semialdehyde dehydrogenase

Reaction equation

$$\text{nadph} + \text{aspp} \rightleftharpoons \text{nadp} + \text{phos} + \text{asa} \tag{3}$$

Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
nadph	NADPH	
aspp	Aspartyl phosphate	

Products

Table 10: Properties of each product.

Id	Name	SBO
nadp	NADP	
phos	Phos	
asa	Aspartate beta-semialdehyde	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{vol}\left(\text{compartment}\right) \cdot \frac{\text{vm2f} \cdot \left([\text{aspp}] \cdot [\text{nadph}] - \frac{[\text{asa}] \cdot [\text{nadp}] \cdot [\text{phos}]}{\text{k2eq}}\right)}{\left(\text{k2aspp} \cdot \left(1 + \frac{[\text{asa}]}{\text{k2asa}}\right) \cdot \left(1 + \frac{[\text{phos}]}{\text{k2p}}\right) + [\text{aspp}]\right) \cdot \left(\text{k2nadph} \cdot \left(1 + \frac{[\text{nadp}]}{\text{k2nadp}}\right) + [\text{nadph}]\right)} \tag{4}$$

Table 11: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vm2f			0.181	$\text{mmol} \cdot \text{l}^{-1} \cdot (60\ \text{s})^{-1}$	☑
k2eq			56.415	dimensionless	☑
k2aspp			0.022	$\text{mmol} \cdot \text{l}^{-1}$	☑
k2asa			0.110	$\text{mmol} \cdot \text{l}^{-1}$	☑

Id	Name	SBO	Value	Unit	Constant
k2p			10.000	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k2nadph			0.029	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k2nadp			0.144	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

5.3 Reaction vhdh

This is a reversible reaction of two reactants forming two products influenced by two modifiers.

Name Homoserine dehydrogenase

Reaction equation

$$\mathrm{nadph} + \mathrm{asa} \overset{\mathrm{asp,\ thr}}{\rightleftharpoons} \mathrm{hs} + \mathrm{nadp} \tag{5}$$

Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
nadph	NADPH	
asa	Aspartate beta-semialdehyde	

Modifiers

Table 13: Properties of each modifier.

Id	Name	SBO
asp	Aspartate	
thr	Threonine	

Products

Table 14: Properties of each product.

Id	Name	SBO
hs	Homoserine	
nadp	NADP	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{vol}\,(\mathrm{compartment}) \cdot \frac{\mathrm{vm3f} \cdot \left([\mathrm{asa}] \cdot [\mathrm{nadph}] - \frac{[\mathrm{hs}] \cdot [\mathrm{nadp}]}{\mathrm{k3eq}}\right)}{\frac{1+\left(\frac{[\mathrm{thr}]}{\mathrm{k3thr}}\right)^{\mathrm{nhdh1}}}{1+\left(\frac{[\mathrm{thr}]}{\mathrm{alpha3} \cdot \mathrm{k3thr}}\right)^{\mathrm{nhdh1}}} \cdot \left(\mathrm{k3asa} + [\mathrm{asa}] + \frac{[\mathrm{hs}] \cdot \mathrm{k3asa}}{\mathrm{k3hs}}\right) \cdot \left(\mathrm{k3nadph} \cdot \left(1 + \frac{[\mathrm{nadp}]}{\mathrm{k3nadp}}\right) + [\mathrm{nadph}]\right)} \tag{6}$$

Table 15: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vm3f			1.001	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
k3eq			3162.278	dimensionless	☑
k3thr			0.097	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
nhdh1			1.410	dimensionless	☑
alpha3			3.930	dimensionless	☑
k3asa			0.240	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k3hs			3.390	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k3nadph			0.037	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k3nadp			0.067	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

5.4 Reaction vtsy

This is a reversible reaction of one reactant forming two products.

Name Threonine synthase

Reaction equation

$$\mathrm{hsp} \rightleftharpoons \mathrm{thr} + \mathrm{phos} \tag{7}$$

Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
hsp	O-Phospho-homoserine	

Products

Table 17: Properties of each product.

Id	Name	SBO
thr	Threonine	
phos	Phos	

Kinetic Law

Derived unit $0.0010\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_4 = \frac{\mathrm{vol}\,(\mathrm{compartment}) \cdot \mathrm{vm5} \cdot [\mathrm{hsp}]}{[\mathrm{hsp}] + \mathrm{k5hsp}} \tag{8}$$

Table 18: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vm5			0.043	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
k5hsp			0.310	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

5.5 Reaction vhk

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name Homoserine kinase

Reaction equation

$$\mathrm{hs} + \mathrm{atp} \overset{\mathrm{thr}}{\rightleftharpoons} \mathrm{hsp} + \mathrm{adp} \tag{9}$$

Reactants

Table 19: Properties of each reactant.

Id	Name	SBO
hs	Homoserine	
atp	ATP	

Modifier

Table 20: Properties of each modifier.

Id	Name	SBO
thr	Threonine	

Products

Table 21: Properties of each product.

Id	Name	SBO
hsp	O-Phospho-homoserine	
adp	ADP	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\,(\mathrm{compartment}) \cdot \frac{\mathrm{vm4f} \cdot [\mathrm{hs}] \cdot [\mathrm{atp}]}{\left(1 + \frac{\mathrm{lys}}{\mathrm{k4lys}}\right) \cdot \left([\mathrm{atp}] + \mathrm{k4atp} \cdot \left(1 + \frac{[\mathrm{hs}]}{\mathrm{k4ihs}}\right)\right) \cdot \left([\mathrm{hs}] + \mathrm{k4hs} \cdot \left(1 + \frac{[\mathrm{thr}]}{\mathrm{k4thr}}\right) \cdot \left(1 + \frac{[\mathrm{atp}]}{\mathrm{k4iatp}}\right)\right)} \tag{10}$$

Table 22: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vm4f			0.100	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
lys			0.460	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4lys			9.450	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4atp			0.072	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4ihs			4.700	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4hs			0.110	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4thr			1.090	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
k4iatp			4.350	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

5.6 Reaction vnadph_endo

This is a reversible reaction of one reactant forming one product.

Name Endogenous consumption of NADPH

Reaction equation

$$\text{nadph} \rightleftharpoons \text{nadp} \tag{11}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
nadph	NADPH	

Product

Table 24: Properties of each product.

Id	Name	SBO
nadp	NADP	

Kinetic Law

Derived unit $(60\ \text{s})^{-1} \cdot \text{mmol}$

$$v_6 = \text{vol}(\text{compartment}) \cdot \text{prot} \cdot \text{knadph} \cdot [\text{nadph}] \tag{12}$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
knadph			$5.4 \cdot 10^{-6}$	$1 \cdot \text{mg}^{-1} \cdot (60\ \text{s})^{-1}$	☑
prot	Protein		202.000	$\text{mg} \cdot \text{l}^{-1}$	☑

5.7 Reaction vatpase

This is a reversible reaction of one reactant forming two products.

Name ATPase

Reaction equation

$$\text{atp} \rightleftharpoons \text{adp} + \text{phos} \tag{13}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
atp	ATP	

Products

Table 27: Properties of each product.

Id	Name	SBO
adp	ADP	
phos	Phos	

Kinetic Law

Derived unit $\text{mmol} \cdot (60\ \text{s})^{-1}$

$$v_7 = \text{vol}\,(\text{compartment}) \cdot \text{prot} \cdot \text{katpase} \tag{14}$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
katpase			$4.1 \cdot 10^{-5}$	$\text{mmol} \cdot \text{mg}^{-1} \cdot (60\ \text{s})^{-1}$	☑
prot	Protein		202.000	$\text{mg} \cdot \text{l}^{-1}$	☑

6 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

6.1 Species aspp

Name Aspartyl phosphate

Initial concentration $0\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in vasd and as a product in vak).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aspp} = v_1 - v_2 \tag{15}$$

6.2 Species asa

Name Aspartate beta-semialdehyde

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in vhdh and as a product in vasd).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{asa} = v_2 - v_3 \tag{16}$$

6.3 Species hs

Name Homoserine

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in vhk and as a product in vhdh).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hs} = v_3 - v_5 \tag{17}$$

6.4 Species hsp

Name O-Phospho-homoserine

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in vtsy and as a product in vhk).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hsp} = v_5 - v_4 \tag{18}$$

6.5 Species phos

Name Phos

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in vasd, vtsy, vatpase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{phos} = v_2 + v_4 + v_7 \tag{19}$$

6.6 Species thr

Name Threonine

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a product in vtsy and as a modifier in vak, vhdh, vhk).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{thr} = v_4 \tag{20}$$

6.7 Species asp

Name Aspartate

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in vak and as a modifier in vhdh).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{asp} = -v_1 \tag{21}$$

6.8 Species nadp

Name NADP

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in vasd, vhdh, vnadph_endo).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{nadp} = v_2 + v_3 + v_6 \tag{22}$$

6.9 Species nadph

Name NADPH

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in vasd, vhdh, vnadph_endo).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{nadph} = -v_2 - v_3 - v_6 \tag{23}$$

6.10 Species adp

Name ADP

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in vak, vhk, vatpase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{adp} = v_1 + v_5 + v_7 \tag{24}$$

6.11 Species atp

Name ATP

Initial concentration $10\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in vak, vhk, vatpase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{atp} = -v_1 - v_5 - v_7 \tag{25}$$

SBML2LaTeX was developed by Andreas Dräger[a], Hannes Planatscher[a], Dieudonné M Wouamba[a], Adrian Schröder[a], Michael Hucka[b], Lukas Endler[c], Martin Golebiewski[d] and Andreas Zell[a]. Please see http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX for more information.

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