SBML Model Report

Model name: "Wang2008 - Mimicking the inhibitory effect of riluzole on membrane conductance in skeletal fibres"

May 17, 2018

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by Matthew Grant Roberts[1] at March 21st 2018 at 2:33 p. m. and last time modified at March 21st 2018 at 4:32 p. m. Table 1 provides 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	27
events	0	constraints	0
reactions	0	function definitions	0
global parameters	55	unit definitions	3
rules	36	initial assignments	0

Model Notes

Wang2008 - Mimicking the inhibitory effect ofriluzole on membrane conductance in skeletal fibres

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This model is described in the article:Riluzole-induced block of voltage-gated Na+ current and activation of BKCa channels in cultured differentiated human skeletal muscle cells.Wang YJ, Lin MW, Lin AA, Wu SN.Life Sci. 2008 Jan; 82(1-2): 11-20

Abstract:

Riluzole is known to be of therapeutic use in the management of amyotrophic lateral sclerosis. In this study, we investigated the effects of riluzole on ion currents in cultured differentiated human skeletal muscle cells (dHSkMCs). Western blotting revealed the protein expression of alpha-subunits for both large-conductance Ca2+-activated K+ (BK(Ca)) channel and Na+ channel (Na(v)1.5) in these cells. Riluzole could reduce the frequency of spontaneous beating in dHSkMCs. In whole-cell configuration, riluzole suppressed voltage-gated Na+ current (I(Na)) in a concentration-dependent manner with an IC50 value of 2.3 microM. Riluzole (10 microM) also effectively increased Ca2+-activated K+ current (I(K(Ca))) which could be reversed by iberiotoxin (200 nM) and paxilline (1 microM), but not by apamin (200 nM). In inside-out patches, when applied to the inside of the cell membrane, riluzole (10 microM) increased BK(Ca)-channel activity with a decrease in mean closed time. Simulation studies also unraveled that both decreased conductance of I(Na) and increased conductance of I(K(Ca)) utilized to mimic riluzole actions in skeletal muscle cells could combine to decrease the amplitude of action potentials and increase the repolarization of action potentials. Taken together, inhibition of I(Na) and stimulation of BK(Ca)-channel activity caused by this drug are partly, if not entirely, responsible for its muscle relaxant actions in clinical setting.

This model is hosted on BioModels Database and identified by: BIOMD0000000693.

To cite BioModels Database, please use: Chelliah V et al. BioModels: ten-year anniversary. Nucl. Acids Res. 2015, 43(Database issue):D542-8.

2 Unit Definitions

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

2.1 Unit volume

Name volume

Definition ml

2.2 Unit time

Name time

Definition ms

2.3 Unit `substance`

Name substance

Definition mmol

2.4 Unit `area`

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

Definition m^2

2.5 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
`Skeletal_Muscle_Cells`	Skeletal Muscle Cells		3	1	litre	☑	

3.1 Compartment `Skeletal_Muscle_Cells`

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

Name Skeletal Muscle Cells

4 Species

This model contains 27 species. The boundary condition of 27 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 7 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
`Vm`	Vm	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`m`	m	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`h`	h	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`n`	n	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`Vt`	Vt	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`d`	d	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`o`	o	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`c`	c	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`cer`	cer	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`INa`	INa	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`IT`	IT	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`IKCa`	IKCa	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`ICa`	ICa	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`IL`	IL	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`IK`	IK	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`Stimulus`	Stimulus	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`beta_n`	beta_n	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`beta_m`	beta_m	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`beta_h`	beta_h	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑
`alpha_n`	alpha_n	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	$\boxminus$	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
`alpha_m`	alpha_m	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`alpha_h`	alpha_h	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`w`	w	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`jmem`	jmem	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`jleak`	jleak	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`jserca`	jserca	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑
`jer`	jer	`Skeletal_Muscle_Cells`	$\mathrm{mmol} \cdot \mathrm{ml}^{-1}$	⊟	☑

5 Parameters

This model contains 55 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
gNa_max	gNa_max		0.900		☑
gcabar	gcabar		0.050		☑
gk_max	gk_max		0.420		☑
gL_max	gL_max		0.002		☑
gKca	gKca		0.500		☑
ENa	ENa		50.000		☑
EK	EK		-70.000		☑
EL	EL		-75.000		☑
ECa	ECa		50.000		☑
En	En		-40.000		☑
Em	Em		-42.000		☑
Eh	Eh		-41.000		☑
Ct	Ct		0.040		☑
Cm	Cm		0.009		☑
Rs	Rs		15.000		☑
Am	Am		200.000		☑
alpha_n_max	alpha_n_max		0.023		☑
beta_n_max	beta_n_max		0.096		☑
v_alpha_m	v_alpha_m		10.000		☑
v_alpha_n	v_alpha_n		7.000		☑
v_alpha_h	v_alpha_h		14.700		☑
alpha_m_max	alpha_m_max		0.208		☑
beta_m_max	beta_m_max		2.081		☑
v_beta_n	v_beta_n		40.000		☑
v_beta_m	v_beta_m		18.000		☑
v_beta_h	v_beta_h		7.600		☑
alpha_h_max	alpha_h_max		0.016		☑
beta_h_max	beta_h_max		3.382		☑
kd	kd		0.180		☑
alpha	alpha		$4.5 \cdot 10^{-6}$		☑
kpmca	kpmca		0.200		☑
pleak	pleak		$5 \cdot 10^{-4}$		☑
kserca	kserca		0.400		☑
d1	d1		0.840		☑
d2	d2		1.000		☑
k1	k1		0.180		☑

Id	Name	SBO	Value	Unit	Constant
k2	k2		0.011		☑
bbar	bbar		0.280		☑
abar	abar		0.480		☑
fer	fer		0.010		☑
vcytver	vcytver		5.000		☑
fcyt	fcyt		0.010		☑
Stimulus_Period	Stimulus_Period		50.000		☑
Stimulus_Magnitude	Stimulus_Magnitude		2.000		☑
Stimulus_Start	Stimulus_Start		5.000		☑
Stimulus_Duration	Stimulus_Duration		1.000		☑
alp	alp		0.004		☐
beta	beta		0.267		☐
tau	tau		3.699		☐
ooinf	ooinf		0.013		☐
dinf	dinf		0.011		☐
taud	taud		141.867		☐
alphad	alphad		$8.05558916679958 \cdot 10^{-5}$		☐
betad	betad		0.007		☐
gca	gca		-3.751		☐

6 Rules

This is an overview of 36 rules.

6.1 Rule IK

Rule IK is an assignment rule for species IK:

$$\text{IK} = \text{gk\_max} \cdot [\text{n}]^4 \cdot ([\text{Vm}] - \text{EK}) \tag{1}$$

6.2 Rule INa

Rule INa is an assignment rule for species INa:

$$\text{INa} = \text{gNa\_max} \cdot [\text{m}]^3 \cdot [\text{h}] \cdot ([\text{Vm}] - \text{ENa}) \tag{2}$$

6.3 Rule Stimulus

Rule `Stimulus` is an assignment rule for species `Stimulus`:

$$\text{Stimulus} = \begin{cases} \text{Stimulus\_Magnitude} & \text{if } (\text{time} \geq \text{Stimulus\_Start}) \wedge \left(\text{time} - \text{Stimulus\_Start} - \left\lfloor \frac{\text{time} - \text{Stimulus\_Start}}{\text{Stimulus\_Period}} \right\rfloor \cdot \text{Stim} \right. \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

6.4 Rule IL

Rule `IL` is an assignment rule for species `IL`:

$$\text{IL} = \text{gL\_max} \cdot ([\text{Vm}] - \text{EL}) \tag{4}$$

6.5 Rule IT

Rule `IT` is an assignment rule for species `IT`:

$$\text{IT} = \frac{[\text{Vm}] - [\text{Vt}]}{\text{Rs}} \tag{5}$$

6.6 Rule beta_n

Rule `beta_n` is an assignment rule for species `beta_n`:

$$\text{beta\_n} = \text{beta\_n\_max} \cdot \exp\left(\frac{\text{En} - [\text{Vm}]}{\text{v\_beta\_n}}\right) \tag{6}$$

6.7 Rule alpha_n

Rule `alpha_n` is an assignment rule for species `alpha_n`:

$$\text{alpha\_n} = \frac{\text{alpha\_n\_max} \cdot ([\text{Vm}] - \text{En})}{1 - \exp\left(\frac{\text{En} - [\text{Vm}]}{\text{v\_alpha\_n}}\right)} \tag{7}$$

6.8 Rule beta_h

Rule `beta_h` is an assignment rule for species `beta_h`:

$$\text{beta\_h} = \frac{\text{beta\_h\_max}}{1 + \exp\left(\frac{\text{Eh} - [\text{Vm}]}{\text{v\_beta\_h}}\right)} \tag{8}$$

6.9 Rule beta_m

Rule `beta_m` is an assignment rule for species `beta_m`:

$$\text{beta\_m} = \text{beta\_m\_max} \cdot \exp\left(\frac{\text{Em} - [\text{Vm}]}{\text{v\_beta\_m}}\right) \tag{9}$$

6.10 Rule alpha_m

Rule alpha_m is an assignment rule for species alpha_m:

$$\text{alpha\_m} = \frac{\text{alpha\_m\_max} \cdot ([\text{Vm}] - \text{Em})}{1 - \exp\left(\frac{\text{Em} - [\text{Vm}]}{\text{v\_alpha\_m}}\right)} \tag{10}$$

6.11 Rule alpha_h

Rule alpha_h is an assignment rule for species alpha_h:

$$\text{alpha\_h} = \text{alpha\_h\_max} \cdot \exp\left(\frac{\text{Eh} - [\text{Vm}]}{\text{v\_alpha\_m}}\right) \tag{11}$$

6.12 Rule w

Rule w is an assignment rule for species w:

$$\text{w} = \frac{[\text{c}]^5}{[\text{c}]^5 + \text{kd}^5} \tag{12}$$

6.13 Rule IKCa

Rule IKCa is an assignment rule for species IKCa:

$$\text{IKCa} = \text{gKca} \cdot [\text{o}] \cdot [\text{w}] \cdot ([\text{Vm}] - \text{EK}) \tag{13}$$

6.14 Rule jleak

Rule jleak is an assignment rule for species jleak:

$$\text{jleak} = \text{pleak} \cdot ([\text{cer}] - [\text{c}]) \tag{14}$$

6.15 Rule jserca

Rule jserca is an assignment rule for species jserca:

$$\text{jserca} = \text{kserca} \cdot [\text{c}] \tag{15}$$

6.16 Rule jer

Rule jer is an assignment rule for species jer:

$$\text{jer} = [\text{jleak}] - [\text{jserca}] \tag{16}$$

Derived unit $\text{mmol} \cdot \text{ml}^{-1}$

6.17 Rule alp

Rule `alp` is an assignment rule for parameter `alp`:

$$\text{alp} = \frac{\text{abar}}{1 + \frac{\text{k1} \cdot \exp\left(\frac{\frac{2 \cdot \text{d1} \cdot 96.485 \cdot [\text{Vm}]}{8.313424}}{310}\right)}{[\text{c}]}} \tag{17}$$

6.18 Rule beta

Rule `beta` is an assignment rule for parameter `beta`:

$$\text{beta} = \frac{\text{bbar}}{1 + \frac{[\text{c}]}{\text{k2} \cdot \exp\left(\frac{\frac{2 \cdot \text{d2} \cdot 96.485 \cdot [\text{Vm}]}{8.313424}}{310}\right)}} \tag{18}$$

6.19 Rule tau

Rule `tau` is an assignment rule for parameter `tau`:

$$\text{tau} = \frac{1}{\text{alp} + \text{beta}} \tag{19}$$

6.20 Rule ooinf

Rule `ooinf` is an assignment rule for parameter `ooinf`:

$$\text{ooinf} = \text{alp} \cdot \text{tau} \tag{20}$$

6.21 Rule dinf

Rule `dinf` is an assignment rule for parameter `dinf`:

$$\text{dinf} = \frac{1}{1 + \exp\left(\frac{24.6 - [\text{Vm}]}{11.3}\right)} \tag{21}$$

6.22 Rule taud

Rule `taud` is an assignment rule for parameter `taud`:

$$\text{taud} = \frac{80}{\frac{1}{\cosh\left(0.031 \cdot ([\text{Vm}] + 37.1)\right)}} \tag{22}$$

6.23 Rule alphad

Rule `alphad` is an assignment rule for parameter `alphad`:

$$\text{alphad} = \frac{\text{dinf}}{\text{taud}} \tag{23}$$

6.24 Rule betad

Rule betad is an assignment rule for parameter betad:

$$\text{betad} = \frac{1 - \text{dinf}}{\text{taud}} \tag{24}$$

6.25 Rule gca

Rule gca is an assignment rule for parameter gca:

$$\text{gca} = \frac{\text{gcabar} \cdot [\text{Vm}]}{\exp\left(0.117 \cdot [\text{Vm}]\right) - 1} \tag{25}$$

6.26 Rule ICa

Rule ICa is an assignment rule for species ICa:

$$\text{ICa} = \text{gca} \cdot [\text{d}]^2 \tag{26}$$

6.27 Rule jmem

Rule jmem is an assignment rule for species jmem:

$$\text{jmem} = (\text{alpha} \cdot [\text{ICa}] + \text{kpmca} \cdot [\text{c}]) \tag{27}$$

Derived unit $\text{mmol} \cdot \text{ml}^{-1}$

6.28 Rule Vm

Rule Vm is a rate rule for species Vm:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Vm} = \frac{[\text{Stimulus}] - ([\text{INa}] + [\text{ICa}] + [\text{IK}] + [\text{IL}] + [\text{IT}] + [\text{IKCa}])}{\text{Cm}} \tag{28}$$

6.29 Rule m

Rule m is a rate rule for species m:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{m} = [\text{alpha\_m}] \cdot (1 - [\text{m}]) - [\text{beta\_m}] \cdot [\text{m}] \tag{29}$$

6.30 Rule h

Rule h is a rate rule for species h:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{h} = [\text{alpha\_h}] \cdot (1 - [\text{h}]) - [\text{beta\_h}] \cdot [\text{h}] \tag{30}$$

6.31 Rule n

Rule n is a rate rule for species n:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{n} = [\mathrm{alpha\_n}] \cdot (1 - [\mathrm{n}]) - [\mathrm{beta\_n}] \cdot [\mathrm{n}] \tag{31}$$

6.32 Rule Vt

Rule Vt is a rate rule for species Vt:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Vt} = \frac{[\mathrm{Vm}] - [\mathrm{Vt}]}{\mathrm{Rs} \cdot \mathrm{Ct}} \tag{32}$$

6.33 Rule d

Rule d is a rate rule for species d:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{d} = (1 - [\mathrm{d}]) \cdot \mathrm{alphad} - [\mathrm{d}] \cdot \mathrm{betad} \tag{33}$$

6.34 Rule o

Rule o is a rate rule for species o:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{o} = \frac{\mathrm{ooinf} - [\mathrm{o}]}{\mathrm{tau}} \tag{34}$$

6.35 Rule c

Rule c is a rate rule for species c:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{c} = \mathrm{fcyt} \cdot ([\mathrm{jmem}] + [\mathrm{jer}]) \tag{35}$$

6.36 Rule cer

Rule cer is a rate rule for species cer:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{cer} = \mathrm{fer} \cdot \mathrm{vcytver} \cdot [\mathrm{jer}] \tag{36}$$

7 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.

7.1 Species Vm

Name Vm

Initial concentration $-75 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule Vm

One rule determines the species' quantity.

7.2 Species m

Name m

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

Involved in rule m

One rule determines the species' quantity.

7.3 Species h

Name h

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

Involved in rule h

One rule determines the species' quantity.

7.4 Species n

Name n

Initial concentration $0.1 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule n

One rule determines the species' quantity.

7.5 Species Vt

Name Vt

Initial concentration $-70 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule Vt

One rule determines the species' quantity.

7.6 Species d

Name d

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

Involved in rule d

One rule determines the species' quantity.

7.7 Species o

Name o

Initial concentration $0.1 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule o

One rule determines the species' quantity.

7.8 Species c

Name c

Initial concentration $0.15 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule c

One rule determines the species' quantity.

7.9 Species cer

Name cer

Initial concentration $200 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule cer

One rule determines the species' quantity.

7.10 Species INa

Name INa

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

Involved in rule INa

One rule determines the species' quantity.

7.11 Species `IT`

Name IT

Initial concentration $-0.333333333333333 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule `IT`

One rule determines the species' quantity.

7.12 Species `IKCa`

Name IKCa

Initial concentration $-0.0716677369048711 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule `IKCa`

One rule determines the species' quantity.

7.13 Species `ICa`

Name ICa

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

Involved in rule `ICa`

One rule determines the species' quantity.

7.14 Species `IL`

Name IL

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

Involved in rule `IL`

One rule determines the species' quantity.

7.15 Species `IK`

Name IK

Initial concentration $-2.1 \cdot 10^{-4} \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule `IK`

One rule determines the species' quantity.

7.16 Species Stimulus

Name Stimulus

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

Involved in rule Stimulus

One rule determines the species' quantity.

7.17 Species beta_n

Name beta_n

Initial concentration $0.230675848267876\,\text{mmol}\cdot\text{ml}^{-1}$

Involved in rule beta_n

One rule determines the species' quantity.

7.18 Species beta_m

Name beta_m

Initial concentration $13.0160326809795\,\text{mmol}\cdot\text{ml}^{-1}$

Involved in rule beta_m

One rule determines the species' quantity.

7.19 Species beta_h

Name beta_h

Initial concentration $0.038137484704699\,\text{mmol}\cdot\text{ml}^{-1}$

Involved in rule beta_h

One rule determines the species' quantity.

7.20 Species alpha_n

Name alpha_n

Initial concentration $0.00543709940740284\,\text{mmol}\cdot\text{ml}^{-1}$

Involved in rule alpha_n

One rule determines the species' quantity.

7.21 Species alpha_m

Name alpha_m

Initial concentration $0.262861215247374 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule alpha_m

One rule determines the species' quantity.

7.22 Species alpha_h

Name alpha_h

Initial concentration $0.467439960739393 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule alpha_h

One rule determines the species' quantity.

7.23 Species w

Name w

Initial concentration $0.286670947619484 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule w

One rule determines the species' quantity.

7.24 Species jmem

Name jmem

Initial concentration $-0.03 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule jmem

One rule determines the species' quantity.

7.25 Species jleak

Name jleak

Initial concentration $0.099925 \text{ mmol} \cdot \text{ml}^{-1}$

Involved in rule jleak

One rule determines the species' quantity.

7.26 Species `jserca`

Name jserca

Initial concentration $0.06\,\mathrm{mmol}\cdot\mathrm{ml}^{-1}$

Involved in rule `jserca`

One rule determines the species' quantity.

7.27 Species `jer`

Name jer

Initial concentration $0.039925\,\mathrm{mmol}\cdot\mathrm{ml}^{-1}$

Involved in rule `jer`

One rule determines the species' quantity.

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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