A mathematical modeling toolbox for ion channels and transporters across cell membranes

Shadi Zaheri[a], Fatemeh Hassanipour[a,*]

[a]Department of Mechanical Engineering, The University of Texas at Dallas, Richardson, TX, 75080, USA

The following supplementary material is from " A mathematical modeling toolbox for ion channels and transporters across cell membranes" manuscript. It contains an overview of all equations related to Ion channels, Pumps, Cotransporters, and Symporters, organized in a table form. The detailed transporters along with the descriptions of their equatuons can be found from here.

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*Corresponding author

Email addresses: shadi.zaheri@utdallas.edu (Shadi Zaheri), fatemeh@utdallas.edu (Fatemeh Hassanipour)

3.4. *Sodium Bicarbonate Symporter (NBC)*

Sodium Bicarbonate Symporter (NBC)	**Ref**
$$\boxed{\begin{aligned} J_{NBCe} &= P_{NBCe} \times \\ &\frac{\left(\frac{[Na]_{bl}[HCO3]_{bl}^{n}}{K_{Na}K_{HCO3}^{n}} \times \phi_1 - \frac{[Na]_{c}[HCO3]_{c}^{n}}{K_{Na}K_{HCO3}^{n}} \times \phi_2\right)}{\left(\phi_2 + g'\left(\frac{[Na]_{bl}[HCO3]_{bl}^{n}}{K_{Na}K_{HCO3}^{n}}\right)\right)\left(1 + \frac{[Na]_c}{K_{Na}} + \frac{[Na]_{c}[HCO3]_{c}^{n}}{K_{Na}K_{HCO3}^{n}}\right)} \\ &-\left(\phi_1 + g'\left(\frac{[Na]_{c}[HCO3]_{c}^{n}}{K_{Na}K_{HCO3}^{n}}\right)\right)\left(1 + \frac{[Na]_c}{K_{Na}} + \frac{[Na]_{bl}[HCO3]_{bl}^{n}}{K_{Na}K_{HCO3}^{n}}\right)\end{aligned}} \tag{135a}$$ $$\phi_1 = exp\left(\frac{-(1-n)FV_m^{M-N(bl)}}{2RT}\right) \tag{135b}$$ $$\phi_2 = exp\left(\frac{(1-n)FV_m^{M-N(bl)}}{2RT}\right) \tag{135c}$$	[34, 55]

Table 22: The corresponding equations describing the flux transported via sodium bicarbonate symporter across the cell membrane

Sodium Bicarbonate Symporter (NBC)	Ref
$$\boxed{J_{NBCe} = g_{nbc}(V_m - E_{nbc})} \quad (136)$$ Where $$E_{nbc} = \frac{RT}{F(n-1)} ln \frac{[Na]_i[HCO3]_i^n}{[Na]_o[HCO3]_o^n} \quad (137)$$	[28, 34]
$$\boxed{J_{NBCn}^{M,N(net)} = [E]_t \frac{(g_{ENaHCO_3}^M Na^M HCO_3^M)g_E^N - (g_{ENaHCO_3}^N Na^N HCO_3^N)g_E^M}{R_M R_{NN} + R_N R_{MM}}} \quad (138a)$$ $$\boxed{J_{Na,NBCn}^{M,N(net)} = J_{NBC}^{M,N(net)}} \quad (138b)$$ $$\boxed{J_{HCO_3,NBCn}^{M,N(net)} = J_{NBC}^{M,N(net)}} \quad (138c)$$ where $[E]_t = [E]_M + [ENa]_M + [ENaHCO_3]_M + [ENaHCO_3]_N + [ENa]_N + [E]_N$ $Na^M = \frac{[A]_M}{K_{Na}^M}, HCO_3^M = \frac{[HCO_3]_M}{K_{NaHCO_3}^M} \mid Na^N = \frac{[Na]_N}{K_{Na}^N}, HCO_3^N = \frac{[HCO_3]_N}{K_{NaHCO_3}^N}$ $R_M = (1 + Na^M + Na^M HCO_3^M) \mid R_N = (1 + Na^N + Na^N HCO_3^N)$ $R_{MM} = (g_E^M + g_{ENaHCO_3}^M Na^M HCO_3^M) \mid R_{NN} = (g_E^N + g_{ENaHCO_3}^N Na^N HCO_3^N)$	[34, 56]
$$\boxed{J_{NBCn} = n''_{NBCn} \frac{k_5^+ k_6^+ [Na^+]_{cell(i)}[HCO3^-]_{cell(i)} - k_5^- k_6^- [Na^+]_e[HCO3^-]_e}{k_5^+[Na^+]_i[HCO3^-]_i + k_5^- k_6^+ + k_6^-[Na^+]_e[HCO3^-]_e}} \quad (139)$$	[6, 34]

Table 23: The corresponding equations describing the flux transported via sodium bicarbonate symporter across the cell membrane