# Supplementary Table 2

**Overview of kinetic constants used for the construction of the model.**

| Enzyme | EC number | Kinetic parameter | References | Rate Law |
|---|---|---|---|---|
| NADA | 3.5.1.19 | $K_M$:9.6$\mu$M<br>$K_{iP}$:120$\mu$M<br>$k_{cat}$:0.65$s^{-1}$ | [1] | Product inhibition |
| NADS | 6.3.5.1 | $K_M$:190$\mu$M<br>$k_{cat}$:21$s^{-1}$ | [2] | HMM |
| NMNAT | 2.7.7.1/2.7.7.18 | $K_{M_{NaMN}}$:67.7$\mu$M<br>$k_{cat_{NaMN}}$:42.9$s^{-1}$<br>$K_{M_{NMN}}$:22.3$\mu$M<br>$k_{cat_{NMN}}$:53.8$s^{-1}$<br>$K_{M_{NMN}}$:59$\mu$M<br>$k_{cat_{NAD}}$:129.1$s^{-1}$<br>$K_{M_{NaAD}}$:502$\mu$M<br>$k_{cat_{NaAD}}$:103.8$s^{-1}$ | [3][1]<br><br><br><br><br>[4][2]<br><br>[4][3] | Substrate Competition |
| NMNT | 2.1.1.1 | $K_M$:400$\mu$M<br>$K_{iP}$:60$\mu$M<br>$k_{cat}$:8.1$s^{-1}$ | [5]<br><br>[6] | Product inhibition |
| NamPT | 6.3.5.1 | $K_M$:5nM<br>$k_{cat}$:0.0077$s^{-1}$ | [7] | HMM |
| NAPRT | 2.4.2.11 | $K_M$:1.5$\mu$M<br>$k_{cat}$:3.3$s^{-1}$ | [7] | HMM |
| SIRT1 | 3.5.1.- | $K_M$:29$\mu$M<br>$K_{iP}$:60$\mu$M<br>$k_{cat}$:0.67$s^{-1}$ | [8] | Product inhibition |
| NT5 | 3.1.3.5 | $K_{M_{NaMN}}$:3.5mM<br>$k_{cat_{NaMN}}$:2.8$s^{-1}$<br>$K_{M_{NMN}}$:<br>5mM<br>$k_{cat_{NMN}}$:0.5$s^{-1}$ | [9] | HMM |
| PNP | 2.4.2.1 | $K_M$:1.48mM<br>$k_{cat}$:40$s^{-1}$ | [10] | HMM |
| NRK | 2.7.1.173 | $K_M$:3.4$\mu$M<br>$k_{cat}$:0.23$s^{-1}$ | [11] | HMM |

Table 2: The total enzyme concentration was set to 10 for all enzymes except NamPT and NMNAT, for which the concentration was set to 100. Concentration of potential co-substrate was assumed to be constant and not-limiting for the reaction. Thus they were implicitly represented by the maximal velocities given in the table.

[1] Values for NMNAT1 used
[2] Keq used for calculation of turnover rate of reverse reaction
[3] Equilibrium constant used for calculation of turnover rate of reverse reaction

## Kinetic Rate Laws

### Product Inhibition

$$v = \frac{E_T \cdot k_{cat} \cdot S}{K_M + S + \frac{K_M \cdot P}{K_{iP}}} \tag{1}$$

### Henry-Michaelis Menten for irreversible reactions (HMM)

$$v = \frac{E_T \cdot k_{cat} \cdot S}{K_M + S} \tag{2}$$

### Substrate Competition at NMNAT

$$v = E_T \cdot \frac{\frac{k_{cat_A} \cdot A \cdot B}{K_{M_A}} - \frac{k_{cat_P} \cdot P \cdot Q}{K_{M_P}}}{1 + \frac{A}{K_{M_A}} + \frac{B}{K_{M_B}} + \frac{P}{K_{M_P}} + \frac{Q}{K_{M_Q}}} \tag{3}$$

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