Ecuaciones deterministas del sistema de QS de P. aeruginosa

Alejandro Castellanos Sánchez

2 de mayo de $2022\,$

Esquema del circuito

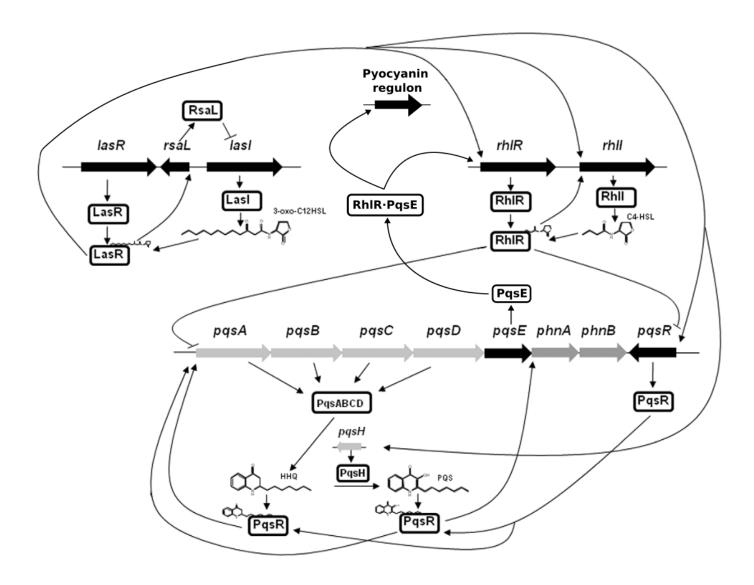


Figura 1: Representación esquemática del circuito de QS de P. aeruginosa.

Ecuaciones deterministas

LasR/LasI

$$[lasR] = \kappa_{lasR} - [lasR]\gamma_{lasR} \tag{1}$$

$$[LasR] = [lasR]\kappa_{LasR} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI_1} - [AI_1][LasR]\mu_{LasR \cdot AI_1} - [LasR]\gamma_{LasR}$$
(2)

$$[lasI] = \alpha_{lasI} + \frac{\beta_{lasI}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_1}\right)^{h_1}} - [lasI]\gamma_{lasI}$$
(3)

$$[LasI] = [lasI]\kappa_{LasI} - [LasI]\gamma_{LasI}$$
(4)

$$[\dot{A}I_{1}] = [LasI]\kappa_{AI1} + [LasR \cdot AI_{1}]\sigma_{LasR \cdot AI1} - [AI_{1}][LasR]\mu_{LasR \cdot AI1} - (d(AI_{1} - AI_{1ext})) - [AI_{1}]\gamma_{AI1}$$
 (5)

$$[A\dot{I}_{1ext}] = (N \cdot d(AI_1 - AI_{1ext})) - [AI_{1ext}](\gamma_{AI1ext} + d_{away})$$

$$\tag{6}$$

$$[Las\dot{R}\cdot AI_1] = [AI_1][LasR]\mu_{LasR\cdot AI_1} - [LasR\cdot AI_1](\sigma_{LasR\cdot AI_1} + \gamma_{LasR\cdot AI_1})$$
(7)

LasR/LasI y RhlR/RhlI

$$[lasR] = \kappa_{lasR} - [lasR]\gamma_{lasR} \tag{1}$$

$$[LasR] = [lasR]\kappa_{LasR} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI_1} - [AI_1][LasR]\mu_{LasR \cdot AI_1} - [LasR]\gamma_{LasR}$$
(2)

$$[lasI] = \alpha_{lasI} + \frac{\beta_{lasI}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_1}\right)^{h_1}} - [lasI]\gamma_{lasI}$$
(3)

$$[LasI] = [lasI]\kappa_{LasI} - [LasI]\gamma_{LasI}$$
(4)

$$[\dot{AI_1}] = [LasI]\kappa_{AI1} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI1} - [AI_1][LasR]\mu_{LasR \cdot AI1} - (d(AI_1 - AI_{1ext})) - [AI_1]\gamma_{AI1}$$
 (5)

$$[A\dot{I}_{1ext}] = (N \cdot d(AI_1 - AI_{1ext})) - [AI_{1ext}](\gamma_{AI1ext} + d_{away})$$

$$\tag{6}$$

$$[Las\dot{R}\cdot AI_1] = [AI_1][LasR]\mu_{LasR\cdot AI_1} - [LasR\cdot AI_1](\sigma_{LasR\cdot AI_1} + \gamma_{LasR\cdot AI_1})$$
(7)

$$[r\dot{h}lR] = \alpha_{rhlR} + \frac{\beta_{rhlR}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_2}\right)^{h_2}} - [rhlR]\gamma_{rhlR}$$
(8)

$$[R\dot{h}lR] = [rhlR]\kappa_{RhlR} + [RhlR \cdot AI_2]\sigma_{RhlR \cdot AI_2} - [AI_2][RhlR]\mu_{RhlR \cdot AI_2} - [RhlR]\gamma_{RhlR}$$
(9)

$$[r\dot{h}lI] = \alpha_{rhlI} + \frac{\beta_{rhlI}}{1 + \left(\frac{[LasR\cdot AI_1]}{K_3}\right)^{h_3}} + \frac{\beta_{rhlI}}{1 + \left(\frac{[RhlR\cdot AI_2]}{K_4}\right)^{h_4}} - [rhlI]\gamma_{rhlI}$$
(10)

$$[RhlI] = [rhlI]\kappa_{RhlI} - [RhlI]\gamma_{RhlI}$$
(11)

$$[\dot{A}I_{2}] = [RhlI]\kappa_{AI2} + [RhlR \cdot AI_{2}]\sigma_{RhlR \cdot AI2} - [AI_{2}][RhlR]\mu_{RhlR \cdot AI2} - (d(AI_{2} - AI_{2ext})) - [AI_{2}]\gamma_{AI2}$$
(12)

$$[A\dot{I}_{2ext}] = (N \cdot d(AI_2 - AI_{2ext})) - [AI_{2ext}](\gamma_{AI2ext} + d_{away})$$
 (13)

$$[Rhl\dot{R}\cdot AI_2] = [AI_2][RhlR]\mu_{RhlR\cdot AI_2} - [RhlR\cdot AI_2](\sigma_{RhlR\cdot AI_2} + \gamma_{RhlR\cdot AI_2})$$
(14)

$$[\dot{p}] = \alpha_p + \frac{\beta_p}{1 + \left(\frac{[RhlR \cdot AI_2]}{K_5}\right)^{h_5}} - [p]\gamma_p \tag{15}$$

$$[\dot{P}] = [p]\kappa_P - [P]\gamma_P \tag{16}$$

Sistema completo

$$[lasR] = \kappa_{lasR} - [lasR]\gamma_{lasR} \tag{1}$$

$$[LasR] = [lasR]\kappa_{LasR} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI_1} - [AI_1][LasR]\mu_{LasR \cdot AI_1} - [LasR]\gamma_{LasR}$$
(2)

$$[lasI] = \alpha_{lasI} + \frac{\beta_{lasI}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_1}\right)^{h_1}} - [lasI]\gamma_{lasI}$$
(3)

$$[LasI] = [lasI]\kappa_{LasI} - [LasI]\gamma_{LasI}$$
(4)

$$[\dot{AI_1}] = [LasI]\kappa_{AI1} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI1} - [AI_1][LasR]\mu_{LasR \cdot AI1} - (d(AI_1 - AI_{1ext})) - [AI_1]\gamma_{AI1}$$
 (5)

$$[A\dot{I}_{1ext}] = (N \cdot d(AI_1 - AI_{1ext})) - [AI_{1ext}](\gamma_{AI1ext} + d_{away})$$

$$\tag{6}$$

$$[Las\dot{R}\cdot AI_1] = [AI_1][LasR]\mu_{LasR\cdot AI_1} - [LasR\cdot AI_1](\sigma_{LasR\cdot AI_1} + \gamma_{LasR\cdot AI_1})$$
(7)

$$[r\dot{h}lR] = \alpha_{rhlR} + \frac{\beta_{rhlR}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_2}\right)^{h_2}} - [rhlR]\gamma_{rhlR}$$
(8)

$$[R\dot{h}lR] = [rhlR]\kappa_{RhlR} + [RhlR \cdot AI_2]\sigma_{RhlR \cdot AI_2} - [AI_2][RhlR]\mu_{RhlR \cdot AI_2} - [RhlR]\gamma_{RhlR}$$
(9)

$$[r\dot{h}II] = \alpha_{rhlI} + \frac{\beta_{rhlI}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_3}\right)^{h_3}} + \frac{\beta_{rhlI}}{1 + \left(\frac{[RhlR \cdot AI_2]}{K_4}\right)^{h_4}} + \frac{\beta_{rhlI}}{1 + \left(\frac{[RhlR \cdot PqsE]}{K_5}\right)^{h_5}} - [rhlI]\gamma_{rhlI}$$
(10)

$$[R\dot{h}lI] = [rhlI]\kappa_{RhlI} - [RhlI]\gamma_{RhlI} \tag{11}$$

$$[\dot{A}I_2] = [RhlI]\kappa_{AI2} + [RhlR \cdot AI_2]\sigma_{RhlR \cdot AI2} - [AI_2][RhlR]\mu_{RhlR \cdot AI2} - (d(AI_2 - AI_{2ext})) - [AI_2]\gamma_{AI2}$$
(12)

$$[AI_{2ext}] = (N \cdot d(AI_2 - AI_{2ext})) - [AI_{2ext}](\gamma_{AI2ext} + d_{away})$$
(13)

$$[Rhl\dot{R}\cdot AI_2] = [AI_2][RhlR]\mu_{RhlR\cdot AI_2} - [RhlR\cdot AI_2](\sigma_{RhlR\cdot AI_2} + \gamma_{RhlR\cdot AI_2})$$
(14)

$$[pqsR] = \alpha_{pqsR} + \frac{\beta_{pqsR}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_6}\right)^{h_6}} + \frac{\beta_{pqsR}}{1 + \left(\frac{[RhlR \cdot AI_2]}{K_7}\right)^{h_7}} - [pqsR]\gamma_{pqsR}$$

$$(15)$$

$$[PqsR] = [pqsR]\kappa_{PqsR} + [PqsR \cdot PQS]\sigma_{PqsR \cdot PQS} - [PQS][PqsR]\kappa_{PqsR \cdot PQS} - [PqsR]\gamma_{PqsR}$$
(16)

$$[pqsABCDE] = \alpha_{pqsABCDE} + \frac{\beta_{pqsABCDE}}{1 + \left(\frac{[RhlR \cdot AI_2]}{K_8}\right)^{h_8}} + \frac{\beta_{pqsABCDE}}{1 + \left(\frac{[PqsR \cdot PQS]}{K_9}\right)^{h_9}} - [pqsABCDE]\gamma_{pqsABCDE}$$
(17)

$$[Pqs\dot{A}BCD] = [pqsABCDE]\kappa_{PqsABCD} - [PqsABCD]\gamma_{PqsABCD}$$
(18)

$$[P\dot{q}sE] = [pqsABCDE]\kappa_{PqsE} + [RhlR \cdot PqsE]\sigma_{RhlR \cdot PqsE} - [PqsE][RhlR]\mu_{RhlR \cdot PqsE} - [PqsE]\gamma_{PqsE} \eqno(19)$$

$$[P\dot{Q}S] = [PqsABCD]\kappa_{PQS} + [PqsR \cdot PQS]\sigma_{PqsR \cdot PQS} - [PQS][PqsR]\mu_{PqsR \cdot PQS} - (d(PQS - PQS_{ext})) - [PQS]\gamma_{PQS} - (d(PQS - PQS_{ext})) - (d(PQS - P$$

$$[PQS_{ext}] = (N \cdot d(PQS - PQS_{ext})) - [PQS_{ext}](\gamma_{PQSext} + d_{away})$$
(21)

$$[PqsR \cdot PQS] = [PQS][PqsR]\mu_{PqsR \cdot PQS} - [PqsR \cdot PQS](\sigma_{PqsR \cdot PQS} + \gamma_{PqsR \cdot PQS})$$
(22)

$$[RhlR \cdot PqsE] = [PqsE][RhlR]\mu_{RhlR \cdot PqsE} - [RhlR \cdot PqsE](\sigma_{RhlR \cdot PqsE} + \gamma_{RhlR \cdot PqsE})$$
(23)

$$[\dot{p}] = \alpha_p + \frac{\beta_p}{1 + \left(\frac{[RhlR \cdot AI_2]}{K_{10}}\right)^{h_{10}}} - [p]\gamma_p$$
(24)

$$[\dot{P}] = [p]\kappa_P - [P]\gamma_P \tag{25}$$

LasR/LasI & RsaL

$$[lasR] = \kappa_{lasR} - [lasR]\gamma_{lasR} \tag{1}$$

$$[LasR] = [lasR]\kappa_{LasR} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI_1} - [AI_1][LasR]\mu_{LasR \cdot AI_1} - [LasR]\gamma_{LasR}$$
(2)

$$[r\dot{sa}L] = \alpha_{rsaL} + \frac{\beta_{rsaL}}{1 + \left(\frac{[LasR\cdot AI_1]}{K_1}\right)^{h_1}} - [rsaL]\gamma_{rsaL}$$
(3)

$$[R\dot{s}aL] = [rsaL]\kappa_{RsaL} - [RsaL]\gamma_{RsaL} \tag{4}$$

$$[lasI] = \alpha_{lasI} + \frac{\beta_{lasI}}{1 + \left(\frac{[LasR \cdot AI_1]}{K_2}\right)^{h_2}} + \frac{\beta_{lasI}}{1 + \left(\frac{[RsaL]}{K_3}\right)^{h_3}} - [lasI]\gamma_{lasI}$$
(5)

$$[LasI] = [lasI]\kappa_{LasI} - [LasI]\gamma_{LasI}$$
(6)

$$[\dot{AI_1}] = [LasI]\kappa_{AI1} + [LasR \cdot AI_1]\sigma_{LasR \cdot AI1} - [AI_1][LasR]\mu_{LasR \cdot AI1} - (d(AI_1 - AI_{1ext})) - [AI_1]\gamma_{AI1}$$
 (7)

$$[A\dot{I}_{1ext}] = (N \cdot d(AI_1 - AI_{1ext})) - [AI_{1ext}](\gamma_{AI1ext} + d_{away})$$

$$\tag{8}$$

$$[Las\dot{R}\cdot AI_1] = [AI_1][LasR]\mu_{LasR\cdot AI_1} - [LasR\cdot AI_1](\sigma_{LasR\cdot AI_1} + \gamma_{LasR\cdot AI_1})$$
(9)