ARTICLE

WILEY BIOTECHNOLOGY & BIOENGINEERING

Escherichia coli

[redacted] [1] [redacted] [1] [redacted] [2] [redacted] [1]

[1] L r r r l l ,J r l r L r r l & l l , l L l , J U r , , l l C. l l l r r l r L r r, r C. l& l l r r (1 r r), r r r C. r, r r C. r, r C. r, , - , , l r

- , L r r r l l ,J r l r L r r l & l l , l L l , J U r , 00 C. , , 00 0, l l C. l. . .

l r l C. , r r. 1 0 1 l r l r r C. , r r. 01 0 0 00

l

r r l l rr l- r ll l l r r r l r l l . , r r r r r r l l . r, r r r r r l l r , r r r l l . r r r l l r r r , r r l l l , l 17 l. r -r r r r r l , r r ll r r r r l r r r l r r ( ) r r r r . r r r r r , r l l l r r r r . , r r r l l l r , l r l l r . r l r , r l r r l l l . r r r , l r r r r r ll l r l r l r . / r r r r r r . r r r r r r r r , r ll l l r r r l r l r r r .

r, l 17 l, r , ,r , l

1 | l - l - ll l l -r r r r r r (l., 01). r r , r - r , l l l r l r r ll l l r l ′- r l r , r ll l r ll- l l r r r l l (& r r, 00 l r r r l l., 01). , r , r l r l r

2

2.1

1, - r , r , 1, - r r-
, 1, - r r r
., L . (, J). r r r
r r r . r r-
r r ., L (,).
r r r r
(,). r , r
, r , r r r
r (,).

2.2

r r r 1. r r
r r r . r
r , r r , r r
r , r . r
r r .

2.3

r r r ,
3- r r r
r r r . r r r
“ ” r r , r
r r r r
r . r r r
1 L 0 µ l^{-1}
( ), r r r r
r. r r r 100- 00
r L - r r (r
., L , ,).
00 r r 0 r. r ( ) r
(, 0) r r -
r r r (r , r ,). r r r r r rr r l-
. r r r r r
r r r r r .

2.4

r r. 1 r r
L - r r r
. r r r L
, .0 r r r r
, 0. -µ r r r r r .
r , r r r r
r r . r r (0. l)
r rr 0- r r r 0 L
0 r . r 0. –0. ,
r r (100 µl) r
r - r L
r . r
r 0.01– 0 r
00 r r 0 r. r r r
r r r r r r .
r . 1 r r
r r r r r r
. L , , .
(L^{-1}). , 1 . , ,
0. ,1 ,0. 1 , 0.011 , .

. r r
r , .0, r r
r r r r . r
r L , r r r r
r r . r
, r r r
r r L , r rr 0- r r
r 0 r , r
0. –0. r r r .
r r , r r r
, 1 r 10 ,
,r - r r ,
r r . r r
r r r r, r
r r r r r r.
-r r r r r r
r L
. r r r r r r r
r r r . r r
r r 0.001 100 r
r r r , r
r r r r r
L 10 0 r, r r .

2.5

1 r r
r r r r .
r r r L
r , r 1.100 r 0
, r 0 r r 0. –1.0,
r r r r r. r
r r rr ~ *10 r
1 , r r10 , r r r r r
r r r r r .
r r r r
r r r , . .3 . 1 - -1 .0 .

TABLE 1

10	
α	
1	
0	1
1	1
1	1
0	1
	1
	1
	1
	1
	,
	,
*	,
*	,
*	,
10	,
-	, 1
	, 1
	, 1
	, 1
	, 1
L	, 1
L	, 1
	, 1
	, 1
	, 1
	, 1

2.6

TABLE 2 [illegible]

[illegible]	[illegible] (5′ [illegible] 3′)
	[illegible]
	[illegible]
1	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
L	[illegible]
L	[illegible]
L	[illegible]
L	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
I	[illegible]
I 1	[illegible]

(Continued)

TABLE 2 (continued)

(5′ 3′)
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]

2.7 | [illegible]

[illegible]

3 | [illegible]

3.1 | [illegible]

[illegible]

3.2 | [illegible]

[illegible]

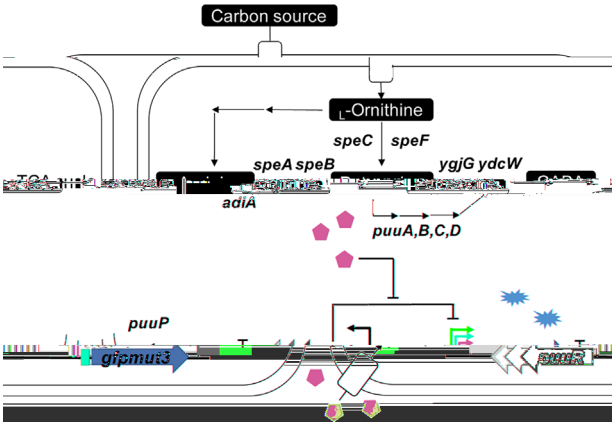

FIGURE 1

3.3

3.4

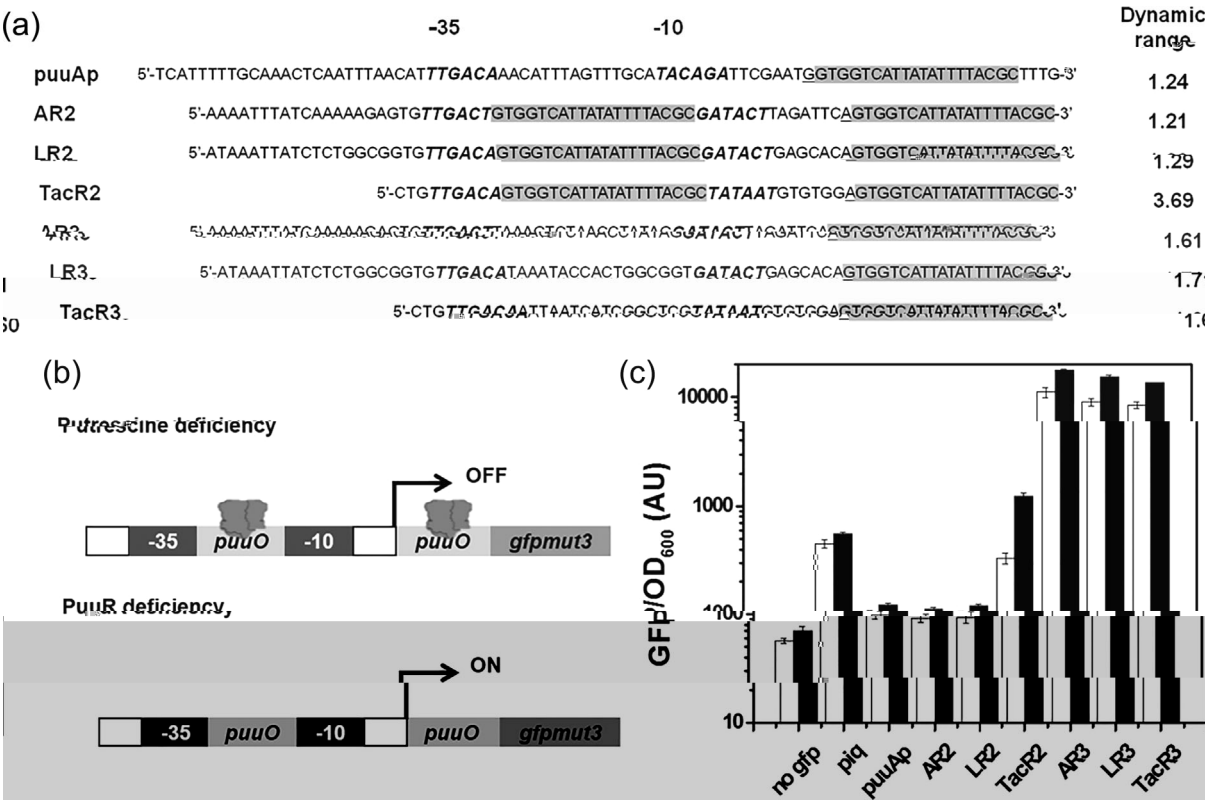

FIGURE 2 I -r r r . (ı) r r r r ( ). I r r −10 − r . r r r rl . r r r I . ( ) r II I r r I r , r r ( ) r r *I 3* r r . , r r II " ," r r I r r . (ı) r r r r r II " " . I r r *I 3*-r r r r r r . *I* 1 r r (I) r (II I). ◖ II r r L ◖ I r r 0 r. r r r r I r r r (0 ◖) r r , , *I* r I r r . II *I 3* r I r I , r II r *I 3* r 7 r r (*I*) r r I

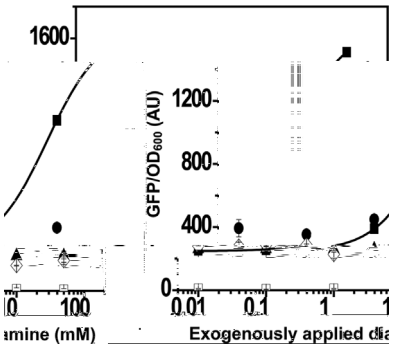

FIGURE 3 r . I r r . . *I* 1 r r I r ◖ L 1, - r (II r I), r (II r), 1, - (II r I) r 1, - ( ). ◖ II I r r 0 r r . II r r r r r I r I (r). - r II I

r L , I r r II I r r I II r r . r r, I r I I r - r II r I r r II , r r L . r , r - r II I r I I r I r II r I (r), I r r r I . r I , r r r r , r r r r I r. ◖ I rl , r I I r r r r II . r r I r r I I r (I). r, r I r I I rr I r I r .

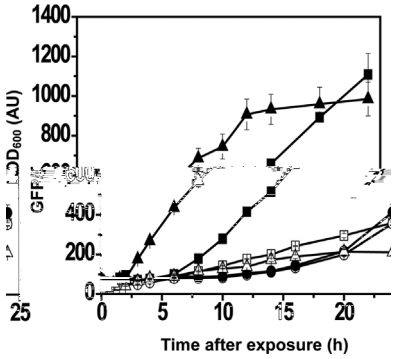

FIGURE 4

3.5

3.6

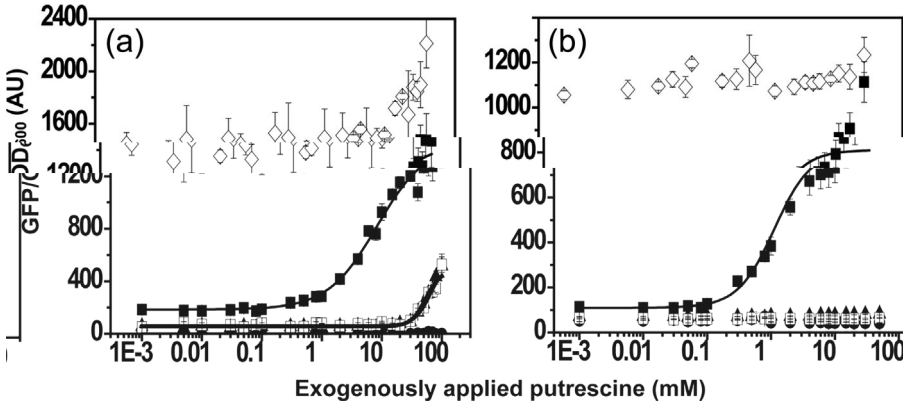

FIGURE 5

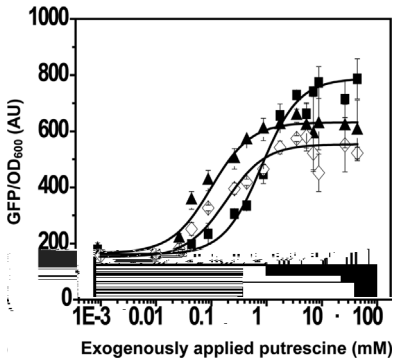
1000
800
600
400
200
0
GFP/OD600 (AU)
1E-3
0.01
0.1
1
10
100
Exogenously applied putrescine (mM)

FIGURE 6

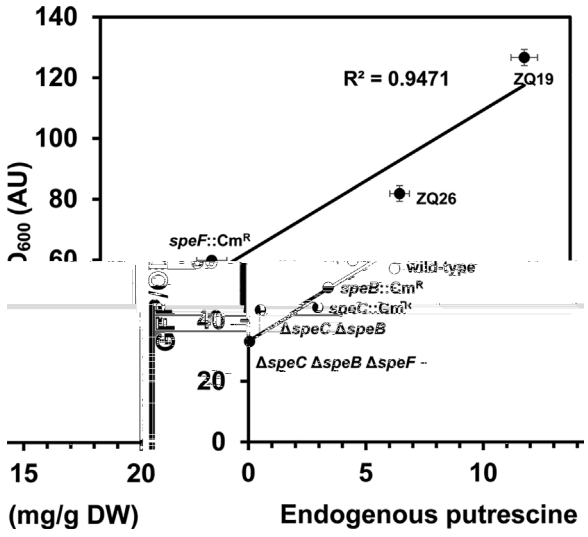

FIGURE 7 U r r r r ll l r r . l r r l - . . / 1 r r r r r . r r r r r l r r ll 00 r 0. ~1.0, r ll l r r l l r r L r . r r l l r r r l r r . r l l rr r l r , ll r r r ll l r r . l r r , r r r (r l l) r l r l ll , r r r r r ll l r r l l r r . r ll, r l r r r l r r r r l r r .

4 | - l -

, r r , r , r r r- r r r r . / . r l r r , r r r -r r - r r r ll rr r r. r r r r r r r r ll l r l 1 - l - r l 0. % r (r r l., 00).U r l , r r r l l r r r (r), r r r r l r r - r r r . l - r r , r r r r r r , r r r r r r r r r r r r r r r r r r l r r r . l , r l – –10 r r r r r r r r r . r l. (1), 1 - r l r r r . / r r l r ll rr r r r 1 1 . , r r l r r r r l 1 0- . 0 r r – –10 r r r r r l r r , r r 7 r r l 7 2 r r r l r (r). r l l r l , r r r r l l r l r r r r r .

r r r l - ll r r r l r (L , , & , 01). r

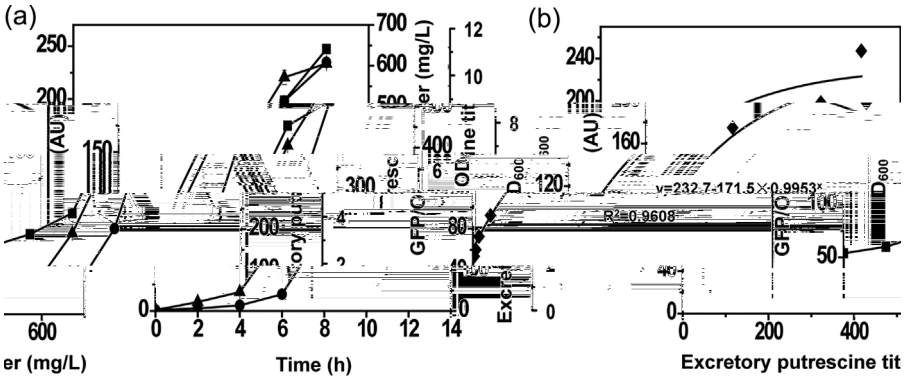

FIGURE 8 U r r r r r ll l r r . r r r r r, . . / 1 r r r r l l / (l) ll l r (ll r), 00 (ll r l), r r r r (ll r l) r r r 1 r. ( ) r r r r ll l r r l . 1- l r rr l ll l r l r r r r, l r r ll l r r ll l r r l l r r ll r

r l r l l r
r l - ll r l r l r .
r r r r r r
r r r r r r l
, r r r l
l r (r). r r
(00), . / l r ( ) r
r r (. ., r r),
r r r r r r r
r rr r r . r l r

r , J. ., , .L., l , ., & l , J. . (01). r r r- r l r r l ll- l l . , 2(1), – .

, ., , ., , J., , ., , ., ... , . . (01). r - r - ll r l r l l r , l /. , 33, 1– 1.

J , . ., , ., , J. ., , .J., , ., , ., ... L , . . (01). - r -l r l . - , 10 (10), – .

r r, ., l , U., , ., & r , . (1). l r r . r r r ll r . , (11), – 000.

r r , ., , ., , ., , . ., , ., , ., & , . (00). l r l l - l l r , 2 0( ), 0 – 0 .

r r , ., , ., , ., , . ., , ., , ., & , . (00). γ- l l r r l , 2 3( ), 1 1–1 0.

L , . ., & , . (01). r l r r r l - ll r . , 112( ), 0– .

L , ., , ., & l , J. L. (01). l r r- l . , (10), 10 –10 .

L , ., , ., & , . (01). l l r r l r . , 31, – .

L , ., , ., , . ., & , . (01). r l r l l- r- r. , ( ), 1 –1 0.

L , ., & r , . (1). r l r r l , 2 ( ), 1 0 –1 10.

r, ., & r , J. (01). r r r- r l . rr r r . , 100(1), – 0.

, . ., L , ., , ., & ru , . . (01). l r l r r r - r- l r . , (10), 1 1–1 .

r ll , ., & r r, J. . (01). l l l r r r l r r r r r . , (1), – .

r, ., r , ., , J., L , ., & , . (01). r r r l . , 2(10), 1 – .

, ., r r, ., l r, ., , ., & r , J. (01). l l l - ll r r L- r - . , 1 ( ), – .

, ., r r , ., r , ., , ., , ., & , . (01). rr l r l r r r . , 1 (1), – .

, . , r, J., , . ., & , . . (01). r r r r . l r , ( ), 11– 1.

r , J. ., r , . ., , .J., , .U., , . ., & L , . . (01). l r l r l r . , , 10 .

, . ., , . ., & L , . . (00). l r r . r r . , 10 ( ), 1– .

, . ., , . ., & L , . . (011). l r r r . r . , 10 (1), –10 .

, ., r , J. ., l r, . ., & r , . . (01). l - . , 111(0), 1 0 –1 0 .

, J. L., r - , ., l - r , . J., , ., , ., , ., ... , . (00). l r r l r r . l , ( ), – .

r, L. (00). r l l lr l , 1 –1 .

r , J. ., & r , . . (01). ll r l r l- r l r . , 113( ), – .

, ., & r r, . . (00). r r l l r l - r . , 0 – .

l r , ., , ., , ., r r, ., l r, ., , ., r, ., ... l , L. (01). r l r r l. U r l ll r l r . , 3(1), 1– .

l r, ., l , . ., ll , ., r , J., & , . . (01). l r l -r r r l r l r r , 21, – .

, . L., , ., l r , . ., r , ., r r, ., , . J., ... l , J. . (01). r r r r r l r . , 12(11), 1– .

, . J., , ., , J., , ., , . ., & , . (01). l r l r . , 1 ( ), 1 –1 .

, . , l , . ., r, ., , ., r , ., & , . (01). r r r r r r r l l . , 10( ), –10 .

r, , ., & r, . (1). l r r . l l , (1), 1– .

, . ., & r , . (011). l l - r r l r r . , 0( ), 10 –10 .

, . ., l , ., & r , . (00). r r l r r l r r . , 130(1), – 1.

, . ., , ., r , ., r , ., r ll, J. ., & r , . (01). r r r l r r r r l r r r. , 13 ( ), 100 –1010 .

, ., L , ., & , . (01). r r ll l r- l - /r l r , 113(1), 0 – 1 .

, ., , ., L , ., & , . (01). l ll- - ll r r . , 12( ), – .

, ., L , L., , ., l , ., & , . (01). r r r r l l r l. l , 111(1), 11 –11 0 .

, J., , . ., J , ., , . ., L , ., , . ., & J , . . (01). l l - r r . , 1 1 .

, ., C r r , J. ., & l , J. . (01).
r-r l r r r l l r
r . Z / / . , 30( ), – .
, J., r , J. ., r , ., , . L., , ., & l , J. .
(01). l r r r- l r.
. / / . , ( ), – .
, J., J , . ., & l , J. .(01). l r
r l l r . / / /
/ / Z / / . , 2 , 1– .
, J., , ., l, . ., r , . ., J , . ., &
l , J. .(01). r / +r r
. / / . , (1), 1 –1 .
, L. ., & , . .(01). l r l r r l
l r l r L-l / . Z / /
Z / / . / / . , ( ), – .

l r r l
r r r r l .

l l . C - , - , L , - .
r l r r r r
/ / Z / / l l .
01 11 .101 –10 . .// . r /10.100 / . 1