

!"#\$!%& '\$!& () * + "#& ,& - !& + . /%+& 0 (! 1 " ! 2& / . * % /% (% " & '\$! &) / 3 ! \$ 0 / + 4&
0 / \$ % " 3 5 . \$ 4 \$ 1 6& + . - &) "% + 1 " . \$) / 3 * & 7 /) 0) 8 2& (. / 9 " ! * /% 6& \$ ' & % 5 " & : " * % " ! . &
3 + # " 2& + 3 % / 9 /% / " * &) + ! 3 5& ; < ; = & % \$ & - " 3 ") 0 " ! & ; < ; ; &

&

&

#! \$ > " 3 % & % / % 4 " ? &

&

&

3 \$ 4 4 + 0 \$! + % \$! * ? & &



&

. @ AB

&

#! \$ > " 3 % & ! + % / \$. + 4 "

Escherichia coli

#! \$ > " 3 % & + /) ? &

! \$ > " 3 % & \$ (% 3 \$) " * ? &



!"!#\$%&'()*#*+,-./%0-12#

32%(45-5#1.#06)#5%&'()-#2#7*!89:\$##

!"#\$%&'()*+,-./0'123456!'(/78'78&'#&789-'\$:9;/-&'")#&*7/9*&-/'*78&'7"<%&'="*-'
-/)%)\$"+&- '1234'>8:9#"790:"#"'')-&\$/>7&-/'*?/0.:&'=@A9')\$&&-'. \$'78&'\$:&%/#/*:+'*"%+))B'
#&789-'(')'#9-/?/&'")89(*/*'7"<%&'C'79')89:7&*78&'&7&*7/9*7/#&'79'CD'#/*7&)%'E/0.:&'C'
:&\$:&)*7)'78&'1234'>8:9#"790:"# '9<7'/*&- ('/78'78&'#9-/?/&- '#&789-@''

!"#\$%&'() *#+\$%&, - ".%&/0''1+%23. &4. %I&5*0&3-%&6789:) ;&. <.3%=&*>*2.+3+2/&*5&?@&) +\$\$+:A&"2I&
BC'D&5*0=+& ">+I&"2I&E@&">%3*2+30+\$%&"2I&BC'D&5*0=+& ">+I&C&'FB&==&*>*4=2&G". &4. %I&C&&

; -&)<&-2+0)5=#	>(1?<&(@&-2=#	3 A #	BA #
F*7/'%"'	G@H'	=GG'	G'
HG'	G@H'	HG'	IG'
HG@G='	G@H'	J'	KJ'
HD@G='	G@H'	J'	KJ'
HD@GC'	G@H'	=GG'	G'
LC@G='	G@H'	=GG'	G'

!"#\$%&'H() *#+\$%&, - ".%&/0''1+%23. &4. %I&5*0&3-%&6789:) ;&. <.3%=&*>*2.+3+2/&*5&?@&) +\$\$+:A&"2I&
BC'D&5*0=+& ">+I&"2I&E@&">%3*2+30+\$%&"2I&BC'D&5*0=+& ">+I&C&FB&==&*>*4=2&G". &4. %I&C&&

; -&)<&-2+0)5=#	>(1?<&(@&-2=#	3 A #	BA #
F*7/'%"'	G@D'	KJ'	J'
G@MG'	G@D'	KJ'	J'
C@GG'	G@D'	IG'	HG'
D@JG'	G@D'	CJ'	IJ'
I@GG'	G@D'	J'	KJ'
M@JG'	G@D'	KJ'	J'

I+/40%k'(k6789k>-0*="3*/0"=k*#3"+2%Ikg+3-k3-%k=%3-*Ik=%23+*2%Ikg+2k!"#\$%&'Ck'FBk==k>*\$4=2k
G".k4.%Ikg"21k3*3"\$k042k3+=%kG".k.JHCB'k=+243%kG+3-k3-%k5\$*GkO''3%k*5kBCK=\$k,%Ok=+243%k

I+/40%kH(k6789k,% "LkG+3-k3-%k=%3-*Ik=*I+5+%Ikg*%kO%I4>%k3-%kO%3%23+*2k3+=%k3*kMCFk=+2CkFBk==k
>*\$4=2kG".k4.%Ikg"21k3*3"\$k042k3+=%kG".k.MCFk=+243%kG+3-k3-%k5\$*GkO''3%k*5kBCN=\$k,%Ok=+243%k

"

,

32%(45-5#1.#06)#5%&'()#-2#*,.)'9C*!8#

A8&')89:7' # &789-' (")'7:"*)?&::&-'79'2:&\$5N234'79'8";&'78&':&7&*7/9*'7/#&'9?'CD' #/* .7&'")'
 -/) \$%" +&-'/*'7"<%&'H@'48:9# "790:" # '0?/0. :&'HP')89 (&-'78"7'>&:7"/*'>9# \$9* &*7)'9?'78&') # \$%&'
)"7. : "7/*0'78&' -&7&>79: @'A9'0&7'78&'099-' -&7&>79: ':&)\$9*)&B'?%9 ('>&%%' (") '>8"*0&-'79'9* &' (/78'
 G@J # # '\$"78'%&*078@'A8&'>8:9# "790:" # '9<7"/* &-' (/78'*& ('?%9 ('>&%%B'?/0. :&'LB')89 (&-'*9'
)"7. : "7/9*'9?' -&7&>79: '<.7'78&'\$&"Q' - .&'79'"7&:'&% .7/*0'>9# \$9* &*7)'0 (8/>8"" :&'9. :.)" # \$%&)'9?'
 /*7&:&)'>9*?/: # &-'<+': . **/*0'/*' 6 !P'":&')9') # ""'78"7'78&+'":&'<":&'+';/)/<%&'/*'78&'
 >8:9# "790:" # @'

"

,

,

$I_{+}/40\%K(9-0^{*}="3^{*}/0"=50^{*}=70\%, :O789CP4\%3^{*}-+/-k"=*423.k*5k>*23"=11.0K23k, 0\%. \%23k+2k0k'=\text{g}5$

"

#

* ,)0,) %0&)20#1.#06)#5%&' ()#

A8&'>9 # \$%&U/7+'9?'78&') " # \$%&' (")'?:)7') / # \$%/?/&- ' .) / * 0' & U7: ">7/9* ' # & 789 - @ ' D G V ' ; W ; "' > & 79* / 7: / % & ' / * ' (" 7&: ' (") "' - - & - ' 79' 78&') " # \$%&' " * - ') 9* / > " 7& - ' ? 9: ' H G ' # / * . 7&) @ ' A 8 & ') " # \$%&' (") ' 78&* ' > & * 7: / ? . 0 & - ' " 7' = C G G U 0 ' ? 9: ' J ' # / * . 7&) @ ' A 8 & ') " # \$%&' (") ' 9 <) & : ; & - ' 79') & \$ " : " 7& ' / * ' 7 (9 ' % " + & :) X ' . \$ \$ & : ' > % & " : ' % " + & : ' (/ 78') 9 # & ' 9 ? ' 78& ' - /)) 9 % ; & - ') " # \$%&' " * - ' % 9 (& : ' ; /) > 9 .) " % " + & : ' (/ 78' . * - /)) 9 % ; & - ') " # \$%&' @ ' A 8 & ' . \$ \$ & : ' % " + & : ' (") ' > 9 % % & > 7 & - B ' " * - ' % 9 (& : ' % " + & : ' (") ' "

I+/40%N(6789, %'L*5d3-%k. "=, \$%k. %, "0"3%I&G+3- &NBDSQTQUk ">%3*2+30+\$%k+2&G"3%0Ck; "=, \$%k
I+..*\$Q%I&+2&NBDSQTQUk ">%3*2+30+\$%k+2&G"3%0k "2I&>%230+54/%I&5*0&F&=+243%. &"3k 'HBB&V/C&
62I+..*\$Q%I&. "=, \$%. &k. %, "0"3%I&". &\$*G%0&\$ "<%0&G". &+. *\$ "3%I& "53%0&5+Q%&0*42I. &*5&G". -+2/0&
"2"\$<W%I& "2I&5*42I&3* &>*23" +2&2* &*0&Q%0<&\$+33\$%&*40k. "=, \$%. &*5&+23%0%. 3C&

***+,-./%0-12#1.#7' '),#\$+',2%0%20#!%4),#+5-2D#*,)'9C*!8#**

Y?&:'>9*?/: #/*0' (/8' 1 2 3 4 5 6 !'78"7'9.:)' # \$%&)'9?/*7&:&)7'8";&'<&&*>9# \$%&7&%+':&>9; &:&- /'*'
.\$\$&:'). \$&:*"7"*7%" +&:'?&:'?9.:':9. *-)'9?' (")8/*0B'/7' (")'78&*'\$.:/?/&-'.)/*0'2:&\$5N234@'
T":/9.)?:">7/9*)' (&:&'>9%%&>7&- "'*-' (&:&'")9""%" +, &- '9*78&""%" +7/>"%' 1 2 3 4 5 6 !'79'
-&7&: #/*&' (8/>8'?: ">7/9*)'79'.)&'?9:'?.:78&:'\$.:/?/>"7/9*9?'78&'>9# \$9. *-)'9?/*7&:&)7@!'9#&'
?: ">7/9*)'>9*7'/*&- '#9:&'78"*9*&)' # \$%&)'9?/*7&:&)7' (8/>8'). 00&)7)'78"7')&>9*-'\$. :/?/>"7/9*'/)'
*&&-&-@''

I+/40% X(70%, :O789<-0*="3*/0"=d*5t>*\$\$%>3%I4, ,%0d\$ "<%0Ck I\$*Gt>%\$\$t*5t, "3-d\$%2/3-dHk==d
G".d4.%ICdY"0+*4. d50">3+*2.dG%0%>*\$\$%>3%I3*d"2"\$<W%>*2t"2"\$<3+>"\$d 6789:) ;C&d

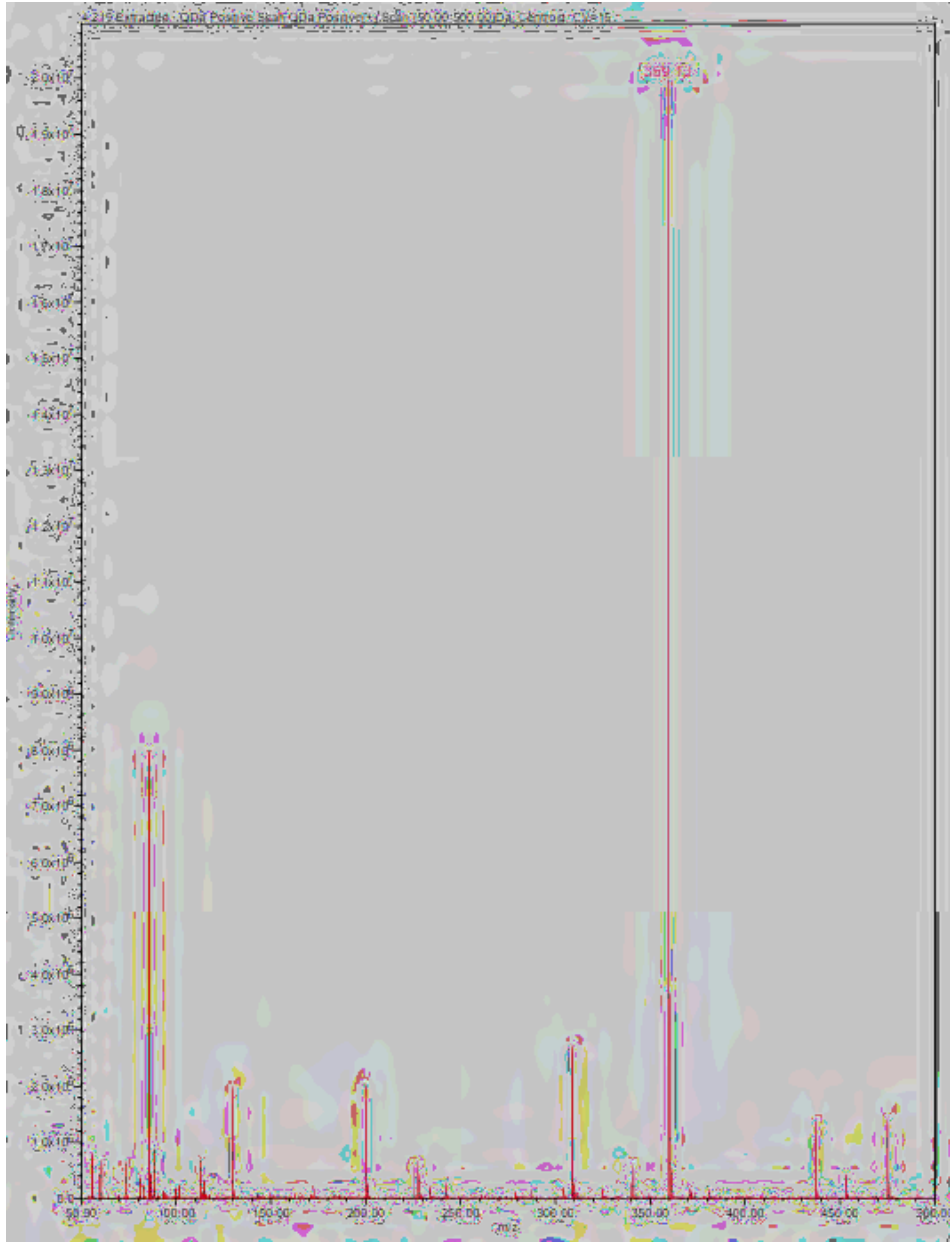
,

,

,

,

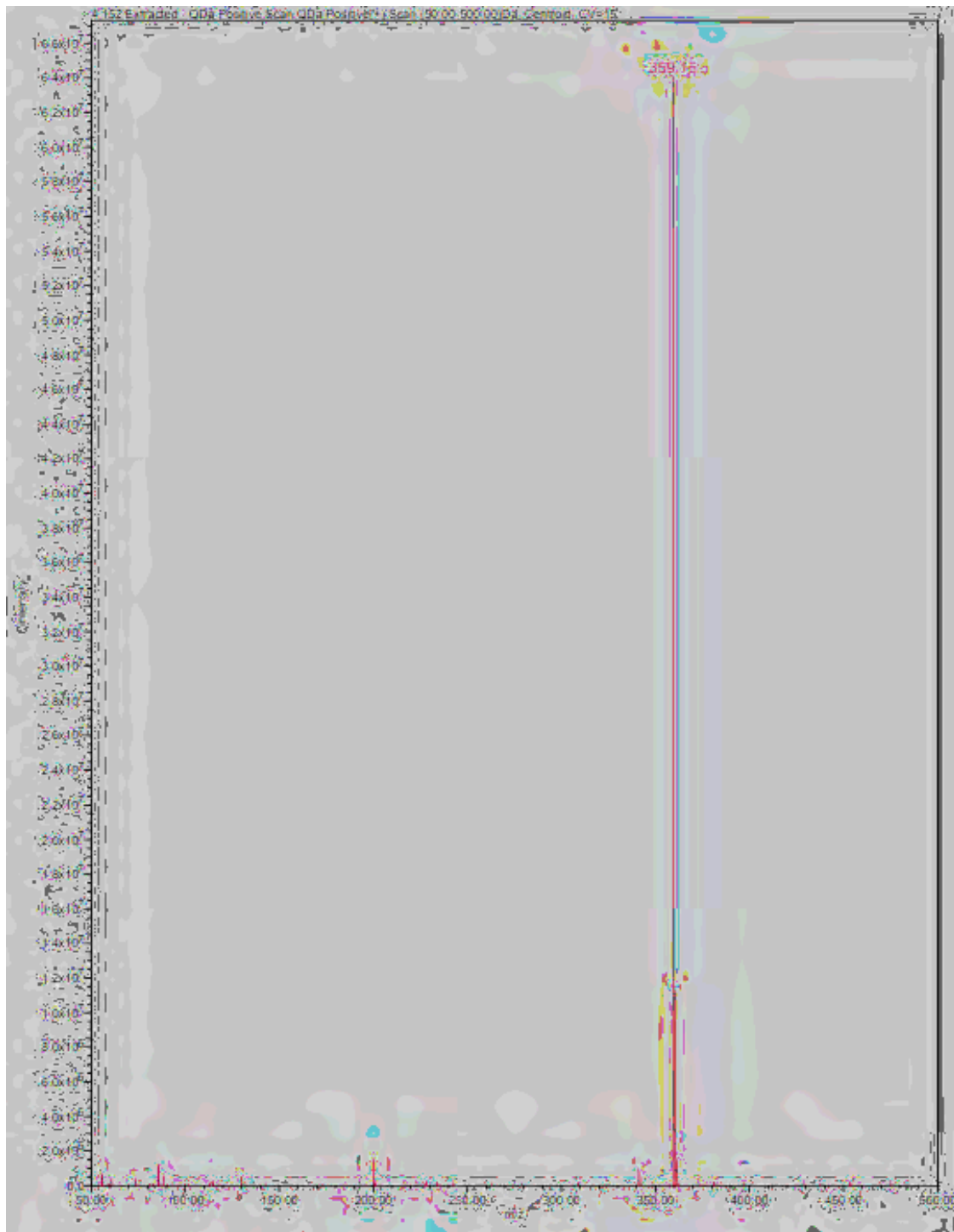
$I_{+}/40\%M(6789 > -0* = "3*/0" = k*5d50" > 3+*2k' d. - *G+2/k, \% "Lk*5k = TWZkKF[C' Kk$



$I + \frac{40}{100} \times I_{max}$; t_r , $\% > 30$ " V_{30} " > 3 % I_{50} * $= 1.50$ " > 3 * 2 " t_r * 5 $> *$, * 421 $G+3$ - $d3$ - $\%d0\%3\%23+$ * 2 $d3+$ $=\%$ d * 5 d $JCHH$ d $=+243\%$ d

"

I+/40%k



$I + / 40\%k''(k)$; $k, \% > 30\%V30'' > 3\%I \& 50 * = \& 50'' > 3 + * 2 \& H \& * 5 \& > * = , * 421 \& G + 3 - \& 3 - \% \& 0 \% 3 \% 23 + * 2 \& 3 + = \% \& * 5 \& JCHM' \&$
 $= + 243\% \& k$

$I + /40\%k 'H(k) ; k. , \%>30''k\%V30''>3\%I&50*=\&50''>3+*2&H&*5k>*=\ , *42I&G+3 - \&3 - \%&0\%3\%23+*2&3+=%&k*5&JCJFX&$
 $=+243\%Ck$

I+/40%K(6789>-0*="3*/0"=550">3+*2Kd.-*G+2/d,%L.d*5d=TWZKF[CHBC"21d=TWZKMFC'[d

"

$I + \frac{40}{100} J(k) ; k. , \% > 30 " k \% V 30 " > 3 \% I k 50 * = k 50 " > 3 + * 2 k K k * 5 k > * = , * 4 2 1 k G + 3 - k 3 - \% k 0 \% 3 \% 2 3 + * 2 k 3 + = \% k * 5 k J ' F [k$
 $= + 2 4 3 \% k$

"

I+/40%&'F(&) ;&. , %>30"&%V30">3%I&50*=&50">3+*2&K&*5&>* = , *421&G+3 - &3 - %&0%3%23+*2&3+=%&&*5&JCJ 'J&
=&+243%&

I+/40%k 'N(d6789k>-0*="3*/0"=k*5k50">3+*2kJk. -*G+2/k,% "L. k*5k=TWZKMFCH '@k=TWZkKMXCHJk"21k
=TWZJ'KCHFk

I+/40%k 'X(k) ; k. , %>30" &%V30">3%I&50*=&50">3+*2&J& *5&>* = , *42I&G+3 - &3 - %&0%3%23+*2&3+=%&&*5&JCJH[&
=+243%&

"

I+/40%&'M() ;&. , %>30''&%V30''>3%I&50*=&50''>3+*2&J&*5&>* = , *42I&G+3 -&3 - %&0%&3%23+*2&3+ = %&*5&JCMNK&
=+243%&

"

$I + /40\% \text{ ' } [(\&) ; \& . , \% > 30 \text{ " } \& \% V30 \text{ " } > 3\% I \& 50 * = \& 50 \text{ " } > 3 + * 2 \& J \& * 5 \& > * = , * 42 I \& G + 3 - \& 3 - \% \& 0 \% 3 \% 2 3 + * 2 \& 3 + = \% \& * 5 \& FCBNN \&$
 $= + 243 \% \&$

'

I+/40%kHB(k6789k>-0*="3*/0"=k*5k50">3+*2kFk.-*G+2/k,% "Lk*5k=TWZJ'KCHFk

"

$I + /40\% \text{H}'(k) ; k. , \% > 30'' \text{V}30'' > 3\% I \text{d}50^* = \text{d}50'' > 3+ *2 \text{d}F \text{d}^* 5 \text{d} > * = , *421 \text{d}G+3 - \text{d}3 - \% \text{d}0\%3\%23+ *2 \text{d}3+ = \% \text{d}^* 5 \text{d} \text{FCBJF} \text{d}$
 $= +243\% \text{d}$

,

,

,

>+0+,)# E 1,F5##

!&>9*-'\$.:/?/>"7/9*'9?'78&'?:">7/9*' (9.%-'<&'\$&:?'9:#&-' '*-' '*"%+,&-'9*' '*"%+7/>"%'
 1 2 3 4 5 6 !'"
 Y%%')"# \$%&)' (/%%'78&* '<&'). <L&>7&- '79'""9:&# &*7/9*&- '\$:9>&))'79'\$.:/?+'9.:')"# \$%&)'9?'
 /*7&:&)7@''
 1 \$\$&:' '*-'39 (&:'%"&+&:' (/%%'78&* '<&' '*"%+,&- ' (/8'78&'%9*0' # &789-'78"7' (&'8";&'79'
 >9*?/: # '>9# \$%&7&':&>9;&+:'9?'9.:')"# \$%&)'9?/*7&:&)7@''
 A (9')7&\$'\$.:/?/&- '?:">7/9*)' (/%%'?' '*"%+,&' '*"%+,&- '9*' 1 2 3 4 5 6 !'.)/ *0'%9*0' # &789-'79'
 8";&'<&77&:')&\$": "7/9*'9?'78&'\$&"Q)' '*-' '\$.:/7+'>9*?/: # "7/9*@'

#

G10)H#A8&'%9*0' # &789-' 1 2 3 4 5 6 !'0/;&)'<&77&:':&)9%.7/9*'9? '\$&"Q)'<.7'9:'\$:&#/ #'*":+)7&\$)'9?'
 \$.:/?/>"7/9*'79)\$&&-'. '\$78&' '*"%+))B' (&'& ;&%9\$&-')89:7' # &789-'9*' '*"%+7/>"%' 1 2 3 4 5 6 !'E/*"%'
 '*"%+))'9:'78&'\$.:/?/&-')"# \$%&)'9?/*7&:&)7' (/%%'<&' '*"%+,&- '.)/*0'%9*0' # &789-@''

,