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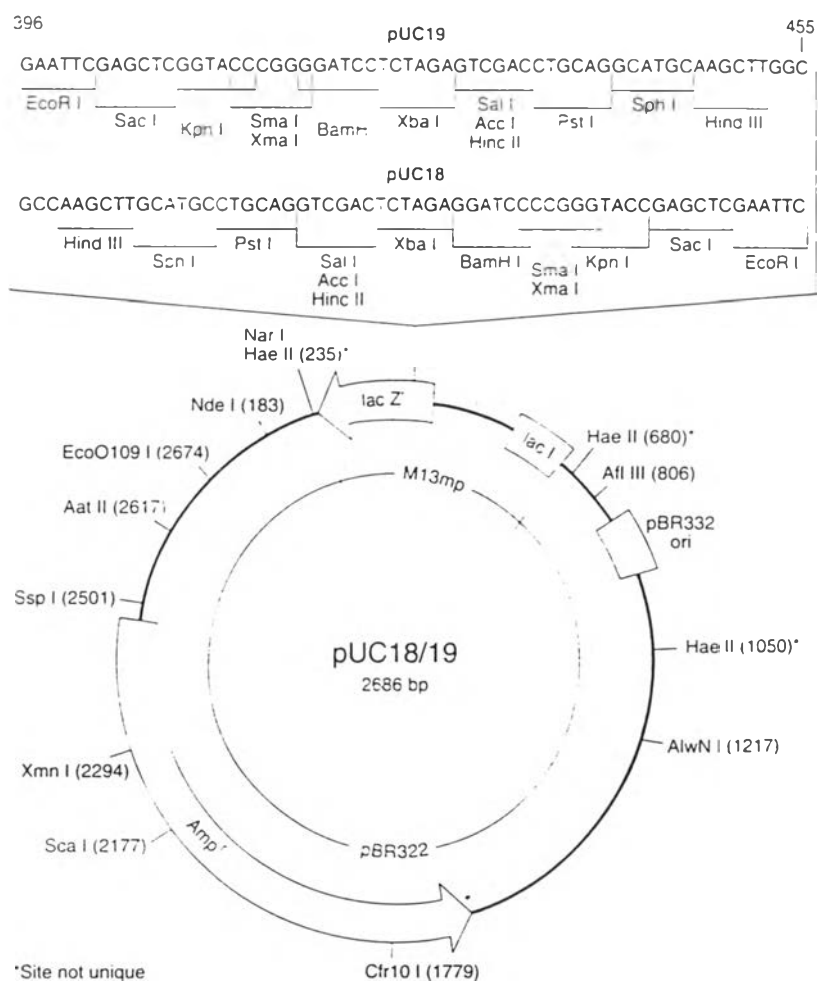
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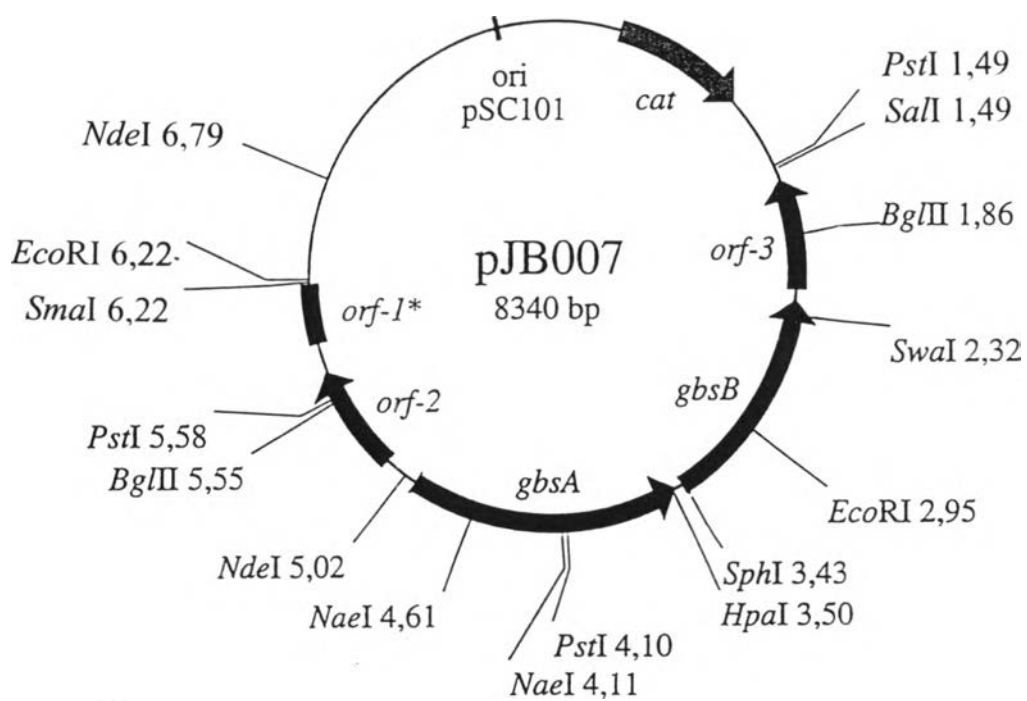
APPENDIX 1

Restriction map of pUC18



APPENDIX 2

Restriction map of pJB007



APPENDIX 3

Media Preparation

Turk Island Salt solution + modified BG₁₁ medium

1. Preparation of Turk Island Salt solution

Stock solution A :	KCl	33.3	g
	MgCl ₂ .6H ₂ O	275.0	g
	CaCl ₂ .2H ₂ O	73.3	g

and made up to 5 liters with distilled water

Stock solution B :	MgSO ₄ .7H ₂ O	374	g
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and made up to 5 liters with distilled water

2. Composition of modified BG₁₁ medium (BG₁₁ medium + NaNO₃ solution)

150	g/l	NaNO ₃	50	ml
32	g/l	KH ₂ PO ₄	5	ml
60	g/l	MgSO ₄ .7H ₂ O	5	ml
28.8	g/l	CaCl ₂	5	ml
16	g/l	Na ₂ CO ₃	5	ml
4.8	g/l	citric acid	5	ml
0.8	g/l	EDTA.Na ₂	5	ml
4.8	g/l	MgSO ₄ .7H ₂ O	5	ml

* Trace element A₅ solution + Co contained the following component in gram per liter ; H₄BO₄ (2.86), ZnSO₄.7H₂O (0.22), CuSO₄.5H₂O (0.08), MnCl₄.4H₂O (1.81), Na₂Mo₄.2H₂O (0.39) and Co(NO₃)₂.6H₂O (0.049).

Culture medium of *A. halophytica* was prepared by adding all solution of item 2 at indicated volume to 500 ml of Stock solution A and 500 ml of Stock solution B. To this mixture 140.8 g NaCl was added and adjusted pH to 7.6 by slowly adding 2 M NaOH then adjusted the final volume to 5 liters with distilled water. The medium was sterilized by autoclaving at 151 lb/in² for 15 minutes.

LB medium

per liter

tryptone	10	g
yeast extract	5	g
NaCl	10	g

M63 medium

10X M63 stock, per liter

KH_2PO_4	30	g
K_2HPO_4	70	g
$(\text{NH}_4)_2\text{SO}_4$	20	g
FeSO_4	5	mg

Before use, dilute concentrated media to 1X with sterile water and add the following sterile solutions, per liter :

1	ml	1 M $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
10	ml	20% glucose
0.1	ml	0.5% vitamin B ₁ (thiamine)
5	ml	20% casamino acids

APPENDIX 4

Sequence comparison of the genes coded for betaine aldehyde dehydrogenase from bacteria: *E. coli* and *B. subtilis*. Identical nucleotides are marked by asterisks.

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E. coli      ATGTCCCGAATGGCAGAACAGCAGCTTTATATACATGGTGGTTATACCTCAGCCACCAGC
B. subtilis  -----ATG--AGTCAAACATTATTC-ATTGACGGAGAATGGATCAGAGCCGAAAAA
              *** ** * ** * * * * * * * * * * * * * * * *
E. coli      GGTGCGACCTTCGAGACCATTAACCCGGCCAACGGTAACGTGCTGGCGACAGTGCAGGCC
B. subtilis  GAACAGATCCGCAGTATTATCAACCATTTAATCAAGAAGAAATTGCAACAGTAAGCGAG
              * * * * * * * * * * * * * * * * * * * * * * * *
E. coli      GCCGGGCGGAGGATGTCGATCGCGCCGTGAAAAGCGCCC---AGCAGGAGCAAAA--A
B. subtilis  GGAGGGCGAGAGGACGCCATCAAAGCAATCGCAGCCGCACGTAGAGCATTAGCAAAAGGA
              * * * * * * * * * * * * * * * * * * * * * * * *
E. coli      ATCTGGGCGTCGATGACCGCCATGGAGCGCTCGCGTATTCTGCGTGGGGCGTTGA--TA
B. subtilis  GAATGGTCAATCGCTATCCGGGCTTGAACCGGAAAAATTGTCTGAAAATAGCGGAATTA
              *** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      TTCTG-CGTGAACGCAATGACGAACCTCGCAAACTGGAACCCTCGACACAGGAAAAGCA
B. subtilis  ATCAGACGCGATC---TTGAGGAGCTGGCTGAGCTTGAATCTCTTGATACAGGAAAAACA
              * * * * * * * * * * * * * * * * * * * * * * * *
E. coli      TATTCGAAAACCTCAACCGTCGATATCGTTACCGGTGCGGACGTGCTGGAATACTACGCC
B. subtilis  --CTCGAAGAAAAGCAAG-GCCGATATGGACGATATCGCAAATGTTTTTCAATATTACGCC
              *** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      GGGCTGATCCCGGCGCTGGAAGGCAGCCAGATCCCGTTGCGT--GAAACGAGCCTTTGTGT
B. subtilis  GGCTTGG---CAGACAAAGATGGCGGAGAGATCATTTCATCTCCGATTCCAGATTAGAA
              ** ** * * * * * * * * * * * * * * * * * * * * * *
E. coli      AT---ACCCGCGCGAACCCTGGGCGTAGTGGCAGGGATGGCGCATGAGACTACCCG
B. subtilis  AGCAAAATTATTAGGGAGCCAATCGGGGTTTGGCGCCAGATCACTCCATGAGATTATCCG
              * * * * * * * * * * * * * * * * * * * * * * * *
E. coli      ATCCAGATTGCCCTGTGAAATCCGCCCCGGCGCTGGCGGCAGGCAACGCATGATTTTC
B. subtilis  CTCTTCAAGCGAGCTGAAAATCGCCCCTGCACTGGCCGAGGAAACACATCGTCAATG
              *** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      AAACCGAGCGAAGTTACCCGCTTACCGCGTTAAAGCTGGCTGAAATTTAGCGAAGCG
B. subtilis  AAGCCGAGTGAGATTACGCCGCTGACGACAATCAAAGCTTTAAGCTGATGAGAGAAGCC
              ** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      GGCCTGCCGACGGCGTATTTAACGTGTTGCCGGGCGTGGGCGGGAGACAGGGCAAT-A
B. subtilis  GGTGTTCCAAAAGGTGTCGCAAATCTGTCTTGGACCGGGAGCC-ACAGAGGGCGACGA
              ** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      TCTGACCGAGCATCCGGGCATTGCCAAAGTGCATTTACCGGCGGTGCCAGCGGCAA
B. subtilis  GCTTGGCGTAAACAAGACGTCGATTTGATTTCAATTTACGGGCGGAATTGAAACAGGCAA
              ** *** * * * * * * * * * * * * * * * * * * * * * *
E. coli      AAAAGTGATGGCTAACTCGGCGCCTCTTCCCTGAAAGAAGTGACCATGGACTGGGCGG
B. subtilis  AAAAAATCATGCGG---CGGCAAGCGGAAACGTCAAAAAATCGCCCTTGACTTGGCGG
              **** * * * * * * * * * * * * * * * * * * * * * * *
E. coli      TAAATCACCGCTGATCGTTTTTCGATGATGCGGATCTCGATCTCGCCGCGCATATCGCCAT
B. subtilis  GAAAAACCAAATATGTTTTCAAGGACGCGGATTTAGAAGTTGCGGTTGATCAGGCCTT
              *** ** * * * * * * * * * * * * * * * * * * * * * *

```

E. coli GATGGCAAACCTTCTTCAGCTCCGGTCAGGTGTGTACCAATGGCACCCCGGCTTCGTTCC
B. subtilis AAACGCTGTATTTTTCCACGCCGGCCAGTATGCTCTGCAGGTTCCCGCTGCTTGTGA
* * * * *

E. coli GGC-GAAATGCAAAGCCGATTTGAGCAGAAAATTCTGGCGCGGTTGAGTCGATTCCGG
B. subtilis GGATGCCATTCAT-GATCAATTTTTGGCGGAGCTGGTCAAACGGGCAAAAGCATAAAAC
* * * * *

E. coli CGGGCGACGTTTTTCGATCCGCAAACCTAACTTCGGCCCGCTGGTCAGCTTCGCGATCGCG
B. subtilis TCGGAAACGGTTTTTCATGCTGAGACAGAAAGCGGTCCGCTTATTTCCGGCGGAGCACAGGG
* * * * *

E. coli ATAACGTGCTGCGCTATATCGCCAAAGGCAAAGAGGAAGGCGCGCGTATGTGCGGCG
B. subtilis CAAAGGTAGAAAATATGTAGAGATCGGAATAGAGGAAGGCGGAAGCTGAGACAGGAG
* * * * *

E. coli GCGATGACTGAAAGGCGATG-GCTTCGATAACGGCGCATGGTTCACCGACAGTGTTCC
B. subtilis GCAAACGCCCGGAAGATCCTGAGCTTC-AAAACGGCTTTTTCTATGAACTACTATTTTC
* * * * *

E. coli ACCGATTGCAGCGACGATATGACCATCGTGCGTGAAGAGATCTTCGGGCCAGTGATGTCC
B. subtilis TCAAACGTAACTTCGACATGAGAATCGTTCAGGAAGAGGTTTTCGGTCCGTATTGACA
* * * * *

E. coli ATTCTGACCTACGAGTCGGAAGACGAAGTCATTCGCCGCGCTAACGATACGACTACGGC
B. subtilis GTCGAAACCTTCAGCTCTGAAGAAGAGGTAATCGAGCTTGCGAATGATACATCTATGGC
* * * * *

E. coli CTGGCGGCGGGCATCGTGACAGCGGACCT-GAACCGCGGCATCGCGTCACTCATCAGCT
B. subtilis TTGGCTGGAGCGGTATGGTCAAAGACATTGAAAAGTGCG-AACGGGT-ACGAGCCCGCT
* * * * *

E. coli GGA-AGCGGTATTTGCTGGATCAACACCTGGGGCGAATCCCCGGCAGAGATGCCCGTTG
B. subtilis TGAGAATGGGAACCGTTTGGATCAACGATTTTCATCCGTACTTTGCACAAACGCCATGGG
* * * * *

E. coli GCGGCTACAAACACTCCGGCATTGGTCGCGAGAACGGCGTGATGACGCTCAGAGTTACA
B. subtilis GCGGATATAAGCAATCCGGTTCCGACGCGAGCTTGAAAAATAGCCTTGAAGAATACA
* * * * *

E. coli CCCAGGTGAAGTCCATCCAGGTTGAGATGGCTAAATCCAGTCCATAT--TCTAA--
B. subtilis CAGAAGTCAA--CATGTATACCGCAATACAAAACCGGCAGCGGTTAACTGTTTAATTC
* * * * *

E. coli ----
B. subtilis ATAA

APPENDIX 6

Sequence comparison of the genes coded for betaine aldehyde dehydrogenase between *E. coli* and *R. meliloti*. Identical nucleotides are marked by asterisks.

```

B. subtilis -----ATGAGTCAAACATTATTTCATTGACGGAGAATGGATAGTGCCGA
R. meliloti ATGAGAGCCAACCGAAAGCTCGCAC----TTCATCGACGGCGAATATGTGAGGACGC
            * * * * *      * * * * * * * * * * * * * * * *
B. subtilis AAAAGAACAGATCCGCAGTATTATCAACCCATTTAATCAAGAAAGAAATTGCAGCTGTAAG
R. meliloti CGCCGGCACGGTGTATCGAGAGCATCTATCCGGCGACCGGCGAAATCATCGCCGGCTCCA
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis CGAGGGAGGGCGAGAGGACGCCATCAAAGCAATCGCAGCCGCAGTAGAGCATTGACAA
R. meliloti TGCCGCAACGCCTGGGATCGTCGAGAAGGGATCGCCGGCC--AAGCGC--GCGCA
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AGGAGAATGGTCATCGCTATCCGGGCTTGAACCGGAAAAATTGTTCTGAAATTGCGGA
R. meliloti GCCGGAATGGCGGGGATGAGCCGACGGCGCGCCGCATC---CTGAAACGGGCGCC
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis ATTAATCAGACGCGATCTTGAG--GAGCTGGCTGAGCTTGAATCTCTGAACAGGAAA
R. meliloti CGAGCTCATGCGCCAGCTCAACCGCGAGCTTTCGAACTCGAAACGCTCGAACCAGGCAA
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AACACTCGAAGAAAGCAAG--CCGATATGGACGATATCGCCAATGTTTTCAATATTA
R. meliloti GCCGATCCAGGAAACCATCGTCGGCAGCCGACGTCGGCGCCGACAGTTTGAATCTT
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis CGCCGGCTTGGCAGACAAAGATGGCGGAGA-GATCATTTATCTCCGATCTGATTCAG
R. meliloti CGCGGGCTCGGCCCGCCCACTCAACGGCGATTATATCCGCTCGGCGGACTTTCG
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AAAGCAAATTATTAGGAGCCAATCGGGTTTGGCGCCAGATCACTCCATGAATTATC
R. meliloti ---CTATCGAAGCGGGTCCGCTCGGCTCGGTTCGGCATCGGCGCTTGAATATC
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis CGCTCCTCAAGCGAGCTGAAATCGCCCTGCACTGGCCGAGGAAACAAATCGTCA
R. meliloti CGCAGCAGATCGCTGTGGAAGGTGGCCTGCGCTCGTCGCGCAATGAGATGGTGT
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis TGAAGCCGAGTGAGATTACGCCGCTGACGACAATCAAAGTCTTAAGCTGAGGAAGAAG
R. meliloti TCAAGCCTTCGGAAAACACCCCGCTCGGCGCGCTTAAGATCGCCGAAATCTATCGAAG
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis CCGGTGTTCCAAAAGGTGTGCAAAATCTTGTCTTGGACCGGAGCCACAGGGGCGACG
R. meliloti CGGGTCTGCGAAGGCCTGTTCAACGTCATCCAGGGCAGCCGCGGAC--GGGCCGC
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AGCTTGCCGTAAACAAGACGTCGATTTGATTTATTACGGGCGAATTGAAACAGGCA
R. meliloti TCCTCGTCAACCATCCGACGTCGCAAGGTGTCGCTCACCGCTCGTGGAGACGGGCA
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AAAAAATCATGCGGGCGGCAAGCGGAAACGTCAAAAAATCGCCCTTGAACGCGGGGA
R. meliloti AAAAAAGTCGGGGCGCCGCGGCGGAACTCAAGCACGTCACCATGGAGCGGGCGGA
            * * * * * * * * * * * * * * * * * * * * *
B. subtilis AAAACCCAAATATTGTTTTCAAGGACGCGGATTTAGAAGTTGCGGTTGATCGGCCCTAA
R. meliloti AGTCGCCGCTGATCGTCTTCAGCATGCGCATCTCGAAAGCGCATCGGCGCGCCATGC
            * * * * * * * * * * * * * * * * * * * * *

```

B. subtilis ACGTGTATTTTCCACG-CCGGCCAAGTATGCTCTGCAGGTTCCCGCTTGTTGTTGAG
R. meliloti TCGGCA-ATTTCTATTCGACCGCCAGGTCTGCTCCAACGGCACGCGCTCTCGTCAA
 ** ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis GATGCCATTCAATGATCAATTTTGGCGGAGCTGGTCAAACGGGCAAAACGCATAAACTC
R. meliloti AGGAAGATCAAGGAGCCTTTCTCGCCCGCTCAAGGAACGCACCGAAGCGATCGTCATC
 ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis GGAAACGGTTTTTCATGCTGAGACAGAAAGCGGTCCGCTTATTTCCGGCGAGATACAGGGCA
R. meliloti GCGACCCCCCTGGACGAGGCGACGCAGCTCGGTCCGATGGTCTCGGCGGCGATAACGCGAC
 ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis AAGGTAGAAAAATATGTAGAGATCGGAATAGAGGAAGGCGGAAGCTGGAGATCAGGAGGC
R. meliloti AAGGTCTTCTCTATATCGGGAAGGGCAAGCGGAAGGCGCCCGCTCGTCTCCGGCGGC
 ***** ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis AAACGCCCGGAAGATCCTGAGCTTCAAACGGCTTTTCTATGAACCTACTATTTTCTCA
R. meliloti GG-CATTCCTCAATAATGTGAGCGCGAA--GGCACCTATATCCAGCCGACCTCTTCCGCC
 * * * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis AACTGTAATTCTGACATGAGAATCGTTCAGGAAGAGGTTTTTCGGTCTGTATGACAGTC
R. meliloti GACGACACCGACGGGATGACGATCGCGCGGAAGAAATCTTCGGACCGGTCTGTGCGGT
 ** * * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis GAAACCTTCAGCTCTGAAGAAGAGGTAATCGAGCTTGCGAATGATACCATCATGAGCTTG
R. meliloti CTCGACTTCGACGACGAGGTGGAAGTCATCGCACGCGCAACGCCACCGAAATCGGCCTT
 ***** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis GCTGGAGCGGTATGGTCAAAGACATTGAAAAGTGCGAACGGGTAGCAGCCCGCTTGAGA
R. meliloti TCGGCGGCGTCTTACCGCGGACCTACCCGCGCCACCGGTCGCGGACCGGCTCGAA
 * * * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis ATGGGAACCGTTTGATCAACGATTTTCATCCGTACTTTGCACAAGCGCCATGGGGCGGA
R. meliloti GCCGGCACGCTCTGGATCAACACCTACAATCTCTGCCCGGTAGAGATCCCCCTTGGCGGG
 ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis TATAAGCAATCCGGTTCGGACGCGAGCTTGAAAAATAGGCCTTGAAGAAATACACAGAA
R. meliloti TCCAAGCAATCGGGTTTCGGGCGGAGAAATCGGTGCGGCGCTCAACCACATACCGAG
 * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** * ** *

B. subtilis GTCAAACATGTATACCGCAATACAAAACCGGACGCGGTTAACTGGTTAATCATATA
R. meliloti CTCAAGACCGTCTATGTGCGCATGGGGCCGGTCGAGGCG--CCGTATTGA-----
 ***** ** * ** * ** * ** * ** * ** * ** * ** *

BIOGRAPHY

Miss Nadthanan Phusi was born on June 20, 1973 in Nakornphathom, Thailand. She graduated with a Bachelor of Science Degree in Biology from Burapha University in 1994. She has further studied for the Master of Science Degree in Biotechnology Program, Chulalongkorn University since 1995.

