

References

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APPENDICES

ศูนย์วิทยทรัพยากร
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Appendix A

Instruments, materials, chemical reagent and media

1. Instruments and materials

- Analytical balance: Mettler Toledo model AG204, Urdorf, Switzerland.
- Autoclave: Tomy model SS-325, Tokyo, Japan.
- Centrifuges: Beckman Superspeed Centrifuge model Avanti J25, U.S.A Eppendorf model 5430, Germany, and Sorvall: Superspeed Centrifuges model RC-5C, Plus and tabletop Centrifuges model RC-5C Plus, Newtown, USA.
- Circulating Water Bath: Techre model TE8 A, Cambridge, UK.
- Freezer Dryer: Savant model Super Modulya 233, New York, USA.
- Hot plate and stirrer: Thermolyne Crimarec2, Iowa, USA.
- Incubator: Memmert model BE500 (30°C, 37°C, 45°C, 50°C, and 55°C), Germany.
- Incubator shaker: New Brunswick Scientific model innova4300, U.S.A
- Magnetic stirrer: Ika model RO-10, Selangor, Malaysia.
- Microwave: Sanyo model EM-815FW, Japan.
- Oven: Contherm Digital Series incubator, Lower Hutt, New Zealand.
- Petridishes Sterile 90 mm: Millionant, SA.54, Paris, France.
- pH Meter: Mettler Toledo model CH-8603, Switzerland.
- Pipettoman: Gilson, Villiers-Le-Bel, France.
- Precision balance: Mettler Toledo model PB3002, Urdorf, Switzerland.
- Refrigerator: Sharp model FC27 (-20°C), Japan and Deep Freezer REVCO model ULT1790-7-V12 (-80°C), USA.
- Shaking Water Bath: Memmert, model WB22 +SV1422, Germany.
- Spectrophotometer: Sherwood Scientific model 259, Cambridge, UK.
- Stomacher:
- Vortex mixer: Barnstead/Thermolyne model M37610-26, Iowa, USA.

2. Chemicals

| Chemicals | Company | Grade |
|--|--------------|------------|
| Folin-Ciocalteu's pshenol | Merck | Analytical |
| Copper (II) sulfate pentahydrate | Sigma | Analytical |
| Gucese | Merck | Analytical |
| Hydrochloric acid | Merck | Analytical |
| Sodium carbonate | Merck | Analytical |
| Sodium citrate | Merck | Analytical |
| Sodium hydroxide | Merck | Analytical |
| Sodium potassium tartate | Merck | Analytical |
| Trichloroacetic acid | Merck | Analytical |
| tri-sodium citrate dihydrate | Merck | Analytical |
| Ethylene diamine tetraacetic acid (EDTA) | Merck | Analytical |
| Phenol red | Merck | Analytical |
| Tyrosine | Sigma | Analytical |
| Magnesium sulfate heptahydrate | Sigma | Analytical |
| Sodium chloride | Carlo Erba | Analytical |
| Trisma base | Merck | Analytical |
| Sodium dodecyl sulfate | Fluka | Analytical |
| Phenol | Carlo Erba | Analytical |
| Chloroform | Mallinckrodt | Analytical |
| Acetone | Merck | Analytical |
| Methanol | Merck | Analytical |
| Ethanol | Carlo Erba | Analytical |
| L-arginine monohydrochloride | Fluka | Analytical |
| L-glutamic acid sodium salt | BDH | Analytical |
| Bovine serum albumin | Sigma | Analytical |

Appendix B

Culture media

All media were dispensed and sterilized in autoclave for 15 min at 15 pounds pressure (121 °C) except for acid from carbon sources test which was sterilized at 10 pounds for (110 °C) 10 min.

1. Halobacterium medium JCM No. 168

| | | |
|--------------------------------------|--------|---|
| yeast extract | 5 | g |
| Casamino acid | 5 | g |
| Sodium glutamate | 1 | g |
| Tri-sodium citrate | 3 | g |
| MgSO ₄ .7H ₂ O | 20 | g |
| KCl | 2 | g |
| NaCl | 150 | g |
| FeCl ₂ .4H ₂ O | 0.362 | g |
| MnCl ₂ .4H ₂ O | 0.0362 | g |
| Agar | 20 | g |
| Distilled water | 1 | L |

Adjust pH 7.2 with NaOH

2. Marine oxidation-fermentation medium (MOF)

| | | |
|---|-----|---|
| Casitone(Difco) | 1 | g |
| Yeast extract | 0.1 | g |
| Ammonium sulfate | 0.5 | g |
| Tris buffer | 0.5 | g |
| Phenol red 0.001%(1.0 ml of 0.1%aqueous per 100 ml of medium) | | |
| Artificial sea water | 1 | L |

Adjusted pH to 7.5

3. L-arginine agar medium

| | | |
|---------------------------------|------|----|
| Peptone | 1.0 | g |
| NaCl | 100 | g |
| K ₂ HPO ₄ | 0.3 | g |
| Phenol red, 1.0% aq. solution | 1.0 | ml |
| L(+)-arginine hydrochloride | 10.0 | g |
| Agar | 3.0 | g |
| Distilled water | 1 | L |

Dissolve the solids in the water, adjust to pH 7.2, distribute into tubes or screw-capped (6mm) bottles to a depth of about 16 mm (3.5ml).

4. Aesculin broth

| | | |
|----------------|-----|---|
| Aesculin | 1 | g |
| Ferric citrate | 0.5 | g |
| NaCl | 100 | g |
| Peptone water | 1 | L |

Adjust pH 7.4

Dissolve the aesculin and iron salt in the peptone water and sterilized at 115 °C for 10 min.

5. Gelatin agar

| | |
|------------------------------------|----------------|
| JCM NO. 168 agar medium containing | 10% (w/v) NaCl |
| Gelatin | 12% (w/v) |

Dissolve and adjust pH 7.2.

6. Starch agar

| | |
|------------------------------------|----------------|
| JCM NO. 168 agar medium containing | 10% (w/v) NaCl |
| Starch | 1% (w/v) |

Dissolve and adjust pH 7.2.

7. Tyrosine agar

JCM NO.168 agar medium

omitted casamino acid containing 10% (w/v) NaCl

Starch 1% (w/v)

Dissolve and adjust pH 7.2.

8. Deoxyribonuclease (DNase) media

DNase test agar (Difco) 42 g

Distilled water 1 L

Adjust pH 7.3 ± 0.2 and heat to boiling to dissolve completely.

9. Tryptone water

Tryptone 5% (w/v)

NaCl 10% (w/v)

Adjust pH 7.2.

10. Nitrate broth

Beef extract 10 g

Peptone 10 g

NaCl 5 g

Distilled water 1 L

Dissolve and adjusted pH to 7.2.

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Appendix C

Reagents

1. Determination of protein and soluble peptide

The protein and soluble peptide content was measured by the method of Lowry *et al.* (1951) with bovine serum albumin and tyrosine as standard, respectively.

1.1 Reagents

A: 2% sodium carbonate in 0.1N NaOH

B: 0.5% CuSO₄ .5H₂O in 1% sodium citrate

C: 1 N Folin-Ciocalteu's phenol reagent

(2N Folin Phenol was diluted with distilled water to the final concentration in 1N, the solution should be freshly prepared before use.)

D: 1 ml Reagent B + 50 ml Reagent A (or similar ratio) Make up immediately before use.

1.2 Procedure

1. Place 0.1 ml of proper dilution of culture broth (for protein determination) or clear supernatant of reaction mixture (for soluble peptide determination)

2. Add 1 ml of Reagent D into the tube and vortex immediately. Incubate at room temperature for 10 min. 3. After the 10. min incubation, add 0.1 ml of Reagent C to sample and vortex immediately. Incubate 30 min at room temperature.

4. Absorbance (OD) of samples was measured at 750 nm. Concentrations of the samples were compared to the standard curve for determination of values. Distilled water was used instead of sample as a blank.

1.3 Preparation of standard curve of tyrosine

Standards of 0, 0.1, 0.2, 0.3, 0.5, 0.7 and 1.0 mM were prepared from tyrosine. The reactions were carried out with the same procedure as

described previously. Absorbance was plotted against various concentrations of standards.

1.4 Preparation of standard curve of protein

Standards of 0, 0.1, 0.2, 0.3, 0.5, 0.7 and 1.0 mg/ml were prepared from bovine serum albumin. The reactions were carried out with the same procedure as described previously. Absorbances were plotted against concentrations of standards.

2. Flagella staining

| | | |
|-------------------|-----|---|
| Basic fuchisin | 0.5 | g |
| Tannic acid | 0.2 | g |
| Aluminium sulfate | 0.5 | g |

Solvent was composed of a mixture of 2.0 of 95% ethanol, 0.5 ml of glucerol, and 7.5 ml of tris(hydroxymethyl)aminomethane(tris)buffer.

3. Kovacs'reagent

| | | |
|-----------------------------|----|----|
| p-dimethylaminobenzaldehyde | 5 | g |
| Amyl alcohol | 75 | g |
| Conc. HCl | 25 | ml |

Dissolve the aldehyde in the alcohol by gently warming in a water bath (about 50-55 °C). Cool and the acid with care. Protect from light and store at 4 C

4. Nitrate test reagent

Solution A

0.33% sulphanilic acid in 5 N- acetic acid

Dissolve by gentle heating

Solution B

0.6% dimethyl- α -naphthylaminein 5 N-acetic acid

Dissolve by gentle heating

Appendix D

Reagent for DNA extraction and purification, DNA-DNA hybridization, and DNA base composition

1. Saline –EDTA(0.15m NaCl + 0.1 M EDTA)

| | | |
|------|-------|---|
| NaCl | 8.76 | g |
| EDTA | 37.22 | g |

NaCl and EDTA were dissolved in 1 L ultra pure water and adjusted the pH 8.0 by adding N HCl and then steriled by autoclaving at 121 °C, 15 pounds/inch pressure, for 15 min.

2. Phosphate-buffer saline (PBS)

| | | |
|--|------|---|
| NaCl | 8.00 | g |
| KCl | 0.20 | g |
| KH ₂ PO ₄ | 0.12 | g |
| Na ₂ HPO ₄ (anhydrous) | 0.91 | g |
| Distilled water | 1 | L |

Steriled by autoclaveing at 121 °C, 15pounds/inch 2 pressure, for 15 minutes

3. 20 x SSC (20 x standard saline citrate)

| | | |
|-----------------|------|---|
| NaCl | 17.5 | g |
| Sodium citrate | 8.8 | g |
| Distilled water | 1 | L |

Adjusted pH to 7.0 and steriled by autoclaveing at 121 °C 15 pounds / inch² pressure, for 15 minutes

4. 100 x Denhardt solution

| | | |
|----------------------------------|---|----|
| Bovine serum albmin (Fraction V) | 2 | g |
| Polyvinylpyrrolidone | 2 | g |
| Ficoll 400 | 2 | ml |

Dissolve in 100 ml ultra pure water and was stored at 4 °C until used.

5. Salmon sperm

| | | |
|------------------|----|-----------|
| Salmon sperm DNA | 10 | mg per ml |
|------------------|----|-----------|

Salmon sperm DNA 10 mg was dissolved in 10 Mm Tris + EDTA buffer pH 7.6 volume 1 ml, boiled for 10 min and then immediately cooled in ice. Sonicated salmon sperm DNA solution for 3 min and was stored at 4 °C until used.

6. Prehybridization solution

| | | |
|---------------------------|----|----|
| 100x Denhardt solution | 2 | ml |
| 10 mg/ml Salmon sperm DNA | 1 | ml |
| 20x SSC | 10 | ml |
| Formamide | 50 | ml |
| Distilled water | 34 | ml |

All of ingredients were dissolved in ultra pure water sterilized and kept at 4 °C

7. Hybridization solution

| | | |
|------------------|-----|----|
| Prehybridization | 100 | ml |
| Dextran sulfate | 5 | g |

Dissolved dextran sulfate in Prehybridization solution and keep at 4 °C

8. Solution 1

| | | |
|-----------------------------------|------|----|
| Bovine serum albumin (Fraction V) | 0.25 | g |
| Triton X – 100 | 50 | μl |
| PBS | 50 | ml |

All of ingredients were mixed and keep at 4 °C

9. Solution 2

| | | |
|-----------------------------|---|----|
| Streptavidin –POD conjugate | 1 | μl |
| Solution1 | 4 | ml |

Dissolved Streptavidin- POD conjugate in solution 1 before used. The solution 2 was freshly prepared.

10. Solution 3

| | | |
|--|-----|----|
| 3,3',5,5' Tetramethylbenzidine (TMB) (10 mg/ml in DMFO) | 100 | ml |
| 0.3% H ₂ O ₂ | 100 | ml |
| 0.1 M citric + 0.2 M Na ₂ HPO ₄ buffer pH 6.2 in 10% DMFO | 5 | ml |

All of ingredients were mixed and used. The solution 3 was freshly prepared.

11. Nuclease P1 solution

Dissolved Nuclease P1 0.1 mg or 40 units/ml of 40 mM CH₃COONa + 12mM ZnSO₄, pH 5.3 store at 4 °C .

12. Alkaline phosphatase solution

Alkaline phosphatase solution 2.4 units/ml of 0.1 M Tris-HCl, pH 8.1

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Appendix E

Comparison of 16S rDNA nucleotide sequences between the *Virgibacillus* sp. and other genera

CILUSTAL X (1.83) multiple sequence alignment.

| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 5 | 15 | 25 | 35 | 45 |
| X55060 | CGGCGGACGG | GTGAGTAACA | CGTGGGTAAC | CTGCCCATAA | GACTGGGATA |
| X60629 | CGGCGGACGG | GTGAGTA-CA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| X68416 | CGGCGGACGG | GTGAGTAACA | CGTGGGTAAC | CTGCCTGTAA | GACTGGGATA |
| X60646 | CGGCGGACGG | GTGAGTAACA | CGTGGGTAAC | CTGCCTGTAA | GACTGGGATA |
| AB127980 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AY057394 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTACCTGTAA- | GACTGGGATA |
| X60627 | CAACGGACGG | GTGAGTAACA | CGTGGGCAAC | CTACCTGTAA | GACTGGGATA |
| AJ012667 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| SS1Contig | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| PR5-1Contig | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AY543169 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AJ315060 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AJ009793 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GATTGGGATA |
| BN1-1 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| Y11603 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AJ316302 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GATTGGGATA |
| AJ315056 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTACCTGTAA | GATTGGGATA |
| X82436 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| AF036922 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTACCTGTAA | GACTGGGATA |
| X62174 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACCGAATA |
| AJ310149 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GATCGGAATA |
| AJ238042 | CGGCGGACGG | GTGAGTAACA | CGTGGGCAAC | CTGCCTGTAA | GACTGGGATA |
| D78457 | CGGCGGACGG | GTGAGTAACA | CGTAGGCAAC | CTGCCTCTCA | GACCGGGATA |

Clustal Consensus *

```

.....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      55      65      75      85      95
X55060 ACTCCGGGAA ACCGGGGCTA ATACCGGATA ACATTTTGAA CCGCATGGTT
X60629 ACTTCGGGAA ACCGAAGCTA ATACCGGATA GGATCTTCTC CTTTCATGGGA
X68416 ACTCCGGGAA ACCGGGGCTA ATACCGGATG CTTGATTGAA CCGCATGGTT
X60646 ACTCCGGGAA ACCGGGGCTA ATACCGGATG GTTGTTTGAA CCGCATGGTT
AB127980 ACTCCGGGAA ACCGGGGCTA ATACCGGATG ATGTCTTTCC TCGCATGAGG
AY057394 ACTCGTGGAA ACGCGAGCTA ATACCGGATA ACACTTCTGG CTGCATGGCC
X60627 ACTCCGGGAA ACCGGGGCTA ATACCGGATG ATACATATCG TCGCATGACG
AJ012667 ACTCCGGGAA ACCGGGGCTA ATACCGGATA ATACGTTTTTC TTGCATAAGG
SS1Contig ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTTCA TCACCTGATG
PR5-1Contig ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTTCA TCACCTGATG
AY543169 ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTTCA TCACCTGATG
AJ315060 ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTCTT TTGCATAAAG
AJ009793 ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTTCG TTGCATAACG
BN1-1 ACCCCGGGAA ACCGGGGCTA ATACCGGATA ATACTTTTCG TTGCATAACG
Y11603 ACCCCGGGAA ACCGGGGCTA ATACCGGATA ACACTTTTTTG T-ACATGCAA
AJ316302 ACCCCGGGAA ACCGGAGCTA ATACCGAATA AYACTTTTTTA TCACATGGTA
AJ315056 ACCCCGGGAA ACCGGAGCTA ATACCGAATA ATACTTTTTTA TCACATGGTA
X82436 ACTCCGGGAA ACCGGGGCTA ATACCGGATA GTACTTTGGT TCATAGGAAC
AF036922 ACTCCGGGAA ACCGGGGCTA ATACCGGATA GAGTTTCCTC TCGCATGAGA
X62174 ACCCCGGGAA ACCGGGGCTA ATGCCGG-TA ACACCTACCT TCACCTGAAG
AJ310149 ACCCCGGGAA ACCGGGGCTA ATGCCGGGTA ATACTTTCTT TCGCATGAAG
AJ238042 ACTCCGGGAA ACCGGGGCTA ATACCGGATA ACACATCGGT TCGCATGAAC
D78457 ACATAGGGAA ACTTATGCTA ATACCGGATA GGTTTT-GGA TCGCATGATC

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Clustal Consensus ** **** ** ***** ** * *

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

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.....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      105      115      125      135      145
X55060 CGAAATTGAA AGGCGG-CTT C-GG-CTGTC ACTTATGGAT GGACCCGCGT
X60629 GATGATTGAA AGATGG-TTT C-GG-CTATC ACTTACAGAT GGGCCCGCGG
X68416 CAATCATAAA AGGTGG-CTT TTAG-CTACC ACTTACAGAT GGACCCGCGG
X60646 CAAACATAAA AGGTGG-CTT C-GG-CTACC ACTTACAGAT GGACCCGCGG
AB127980 GAAGGCTGAA AGACGG-CCT TTGTGCTGTC ACTTACAGAT GGGCCCGCGG
AY057394 GGGAGTTGAA AGGCGG-CAT AAGCTGCG-C ACTCACAGAT GGGCCCGCGG
X60627 AGATGTTGAA AGGCGG-CAT AT-G-CTGTC ACTTACAGAT GGGCCCGCGG
AJ012667 AGACGTTAAA AGGCGG-CGC AA-G-CTGTC ACTTACAGAT GGGCCCGCGG
SS1Contig GAAAGTTGAA AGGTGG-CTT CTTG-CTACC ACTTACAGAT GGGCCCGCGG
PR5-1Contig GAAAGTTGAA AGGTGG-CTT CTTG-CTACC ACTTACAGAT GGGCCCGCGG
AY543169 AGAAGTTGAA AGGTGG-CTT TTAG-CTACC ACTTACAGAT GGGCCCGCGG
AJ315060 GAAAGTTGAA AGGCGG-CTT C-GG-CTGTC ACTTACAGAT GGGCCCGCGG
AJ009793 AGAAGTTGAA AGGCGG-CTT TTAG-CTGTC ACTTACAGAT GGGCCCGCGG
BN1-1 AGAAGTTGAA AGGCGG-CTT TTAG-CTGTC ACTTACAGAT GGGCCCGCGG
Y11603 -GAAGTTGAA AGGCGGCTT TTTGGCTGTC ACTTACAGAT GGGCCCGCGG
AJ316302 GAAAGTTGAA AGGCGG-CTT TTG--CTGTC ACTTACAGAT GGGCCCGCGG
AJ315056 GAAAGTTGAA AGGCGG-CTT TTG--CTGTC ACTTACAGAT GGGCCCGCGT
X82436 CGAAGTGGAA AGGTGG-CGC AA-G-CTACC ACTTACAGAT GGGCCCGCGG
AF036922 GGAATCGGAA AGGCGG-CTT CG-G-CTGTC ACTTACAGAT GGGCCCGCGG
X62174 GAAGGTTAAA AGATGG-CTT CTCG-CTATC ACTTACAGAT GGGCCCGCGG
AJ310149 GAAAGTTGAA AGATGG-CTT CTAG-CTATC ACTTACAGAT GGGCCCGCGG
AJ238042 CGATGATGAA AGATGG-CTT CTTG-CTATC ACTTACAGAT GGGCCCGCGG
D78457 CGAAAAGAAA AGGCGG-CTT CGG--CTGTC ACTGGGAGAT GGGCCTGCGG

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Clustal Consensus

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| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 155 | 165 | 175 | 185 | 195 |
| X55060 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCGTAG |
| X60629 | TGCATTAGCT | -GTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCATAG |
| X68416 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCGA | CGATGCGTAG |
| X60646 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCGTAG |
| AB127980 | CGCATTAGTT | AGTTGGTGAG | GTAAGAGCTC | ACCAAGGCGA | CGATGCGTAG |
| AY057394 | CGCATTAGTT | AGTTGGTGAG | GTAAGAGCTC | ACCAAGGCCA | CGATGCGTAG |
| X60627 | CGC-TTAGCT | -GTTGGTGAG | ATAAA-GCTC | ACCAAGGCG- | CGATGCGTAG |
| AJ012667 | CGCATTAGCT | AGTTGGTGGG | GTAAGAGCCT | ACCAAGGCGA | CGATGCGTAG |
| SS1Contig | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCGTAG |
| PR5-1Contig | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCGTAG |
| AY543169 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCGTAG |
| AJ315060 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCGA | CGATGCGTAG |
| AJ009793 | CGCATTAGCT | AGTTGGTAAG | GTAACGGCTT | ACCAAGGCGA | CGATGCGTAG |
| BN1-1 | CGCATTAGCT | AGTTGGTAAG | GTAACGGCTT | ACCAAGGCGA | CGATGCGTAG |
| Y11603 | CGCATTAGCT | AGTTGGTAGG | GTAACGGCCT | ACCAAGGCAA | CGATGCGTAG |
| AJ316302 | CGCATTAGCT | AGTTGGTGGG | GTAATGGCCT | RCCAAGGCGA | CGATGCGTAG |
| AJ315056 | CGCATTAGCT | AGTTGGTGGG | GTAATGGCCT | ACCAAGGCGA | CGATGCGTAG |
| X82436 | TGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCAA | CGATGCATAG |
| AF036922 | CGCATTAGCT | AGTTGGTGGG | GTAATGGCTC | ACCAAGGCAA | CGATGCGTAG |
| X62174 | CG-ATTAGCT | AGTTGGTGAG | GTAATAGCTC | ACCAAGGCGA | CGATGCGTAG |
| AJ310149 | CGCATTAGCT | AGTTGGTGAG | GTAACGGCTC | ACCAAGGCGA | CGATGCGTAG |
| AJ238042 | CGCATTAGCT | AGTTGGTGGG | GTAACGGCCT | ACCAAGGCAA | CGATGCGTAG |
| D78457 | CGCATTAGCT | AGTTGGTGGG | GTAACGGCCT | ACCAAGGCGA | CGATGCGTAG |

Clustal Consensus * **** * ***** * ** ** ***** ***** **

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      .....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      205      215      225      235      245
X55060 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X60629 CCGACCTGAG AGGGTA--TG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X68416 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X60646 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AB127980 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AY057394 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X60627 CCGACCTGAG AGGGT-ATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ012667 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CRGCCCCAGAC
SS1Contig CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
PR5-1Contig CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AY543169 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ315060 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ009793 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
BN1-1 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
Y11603 CCGACCCGAG AGGGTGATCG GCCACACTGG GACTAAGAAA GGGCC--AAC
AJ316302 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ315056 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X82436 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AF03692 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
X62174 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ310149 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
AJ238042 CCGACCTGAG AGGGTGATCG GCCACACTGG GACTGAGACA CGGCCCCAGAC
D78457 CCGACCTGAG AGGGTGACCG GACACACTGG GACTGAGACA CGGCCCCAGAC

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Clustal Consensus ***** ** ***** * * ***** ***** ** * ** **

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จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------------|-------------|-------------|-------------|-------------|-------------|
| | 255 | 265 | 275 | 285 | 295 |
| X55060 | TCCTACGGGA | GGCAGCAGT- | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| X60629 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| X68416 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| X60646 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AB127980 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AY057394 | TCCTACGGGA | GGCAGCAGTA | GGGAATCATC | CGCAATGGAC | GAAAGTCTGA |
| X60627 | TCCTACGGGA | GGCAGC-GTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ012667 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| SS1Contig | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCCGA |
| PR5-1Contig | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | C-CAA--GGC | GAAAGTCCGA |
| AY543169 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ315060 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ009793 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| BN1-1 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| Y11603 | TCCTACGGGA | GGCAGCAGTG | GGGAACCGAC | CTCAA-AGAC | GAAAGCC-GA |
| AJ316302 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ315056 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| X82436 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AF036922 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| X62174 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ310149 | TCCTACGGGA | GGCAGCAGTA | GGGAATCTTC | CGCAATGGAC | GAAAGTCTGA |
| AJ238042 | TCCTACGGGA | GGCAGCAGTA | GGGAATCATC | CGCAATGGAC | GAAAGTCTGA |
| D78457 | TCCTACGGGA | GGCAGCAGTA | GGGAATTTTC | CACAATGGAC | GAAAGTCTGA |
| Clustal Consensus | ***** | ***** ** | ***** | * * * * * | * * * * * |

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| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 305 | 315 | 325 | 335 | 345 |
| X55060 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGCT | TTCGGGTCGT | AAAACCTCTGT |
| X60629 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGCT | T-CGGGTCGT | AAAACCTCTGT |
| X68416 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| X60646 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAGCTCTGT |
| AB127980 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTC | TTCGGATCGT | AAAACCTCTGT |
| AY057394 | CGGTGCAACG | CCGCGTGAGT | GATGAAGATT | TTCGGATCGT | AAAACCTCTGT |
| X60627 | CGGAGCA-CG | CCGCGTGAGT | GATGAAGGT- | TTCGGATCGT | AAA-CTCTGT |
| AJ012667 | CGGAGCAACG | CCGCGTGAGT | GAAGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| SS1Contig | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAGCTCTGT |
| PR5-1Contig | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAGCTCTGT |
| AY543169 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAGCTCTGT |
| AJ315060 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| AJ009793 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| BN1-1 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| Y11603 | CGGAGCAAC- | -CGC-TGAGT | -ATGAAGGTT | TTTGATCGT | AAAACCTCTGT |
| AJ316302 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| AJ315056 | CGGAGCAACG | CCGCGTGAGT | GATGAAGGTT | TTCGGATCGT | AAAACCTCTGT |
| X82436 | CGGAGCAACG | CCGCGTGAAC | GAAGAAGGTT | TTCGGATCGT | AAAGTTCTGT |
| AF036922 | CGGAGCAACG | CCGCGTGAAC | GAAGAAGGTT | TTCGGATCGT | AAAGTTCTGT |
| X62174 | CGGAGGAACG | CCGCGTGAAC | GATGAAGGTC | TTCGGATCGT | AAAGTTCTGT |
| AJ310149 | CGGAGCAACG | CCGCGTGAAC | GATGAAGGTC | TTCGGATCGT | AAAGTTCTGT |
| AJ238042 | CGGTGCAACG | CCGCGTGAGT | GAGGAAGGTC | TTCGGATCGT | AAAGCTCTGT |
| D78457 | TGGAGCAACG | CCGCGTGAAC | GATGAAGG-C | TTCGGATTGT | AAAGTTCTGT |

Clustal Consensus ** * * * *** ** * **** * ** * * * * * *****

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| | | | | | |
|-------------------|-------------|-------------|-------------|-------------|-------------|
| | 355 | 365 | 375 | 385 | 395 |
| X55060 | TGTTAGGGAA | GAACAAGTGC | TAGTTGAATA | AGCTGGCACC | T-GACGGTAC |
| X60629 | TGTTAGGGAA | GAACAAGTAC | A----GAGTA | ACTCTGT-CC | TTGACGGTAC |
| X68416 | TGTTAGGGAA | GAACAAGTAC | CGTTCGAATA | GGGCGGTACC | TTGACGGTAC |
| X60646 | TGTTAGGGAA | GAACAAGTAC | CGTTCGAATA | GGGCGGTACC | TTGACGGTAC |
| AB127980 | TGTCAGGGAA | GAACAAGCGT | GGTTCGAACA | GGGCCATGCC | TTGACGGTAC |
| AY057394 | TGTCAGGGAA | GAACACGTGC | TGTTTCGAATA | GGACAGTACC | TTGACGGTAC |
| X60627 | TGTTAGGGAA | GAACA-GTGC | CATTTCGAATG | -GTTGGCACC | T-GACGGTAC |
| AJ012667 | TGTTAGGGAA | GAACAAGTGC | CGTTCAAATA | GGGCGGCACC | TTGACGGTAC |
| SS1Contig | TGTTAGGGAA | GAACAAGTGC | CGTTCGAATA | GGGCGGCACC | TTGACGGTAC |
| PR5-1Contig | TGTTAGGGAA | GAACAAGTGC | CGTTCGAATA | GGGCGGCACC | TTGACGGTAC |
| AY543169 | TGTTAGGGAA | GAACAAGTGC | CGTTCGAATA | GGGCGGCACC | TTGACGGTAC |
| AJ315060 | TGTTAGGGAA | GAACAAGTTG | GGTAGTAACT | GACCCA-ACC | TTGACGGTAC |
| AJ009793 | TGTCAGGGAA | GAACAAGTGC | CGTTCAAATA | GGGCGGCACC | TTGACGGTAC |
| BN1-1 | TGTCAGGGAA | GAACAAGTGC | CGTTCAAATA | GGGCGGCACC | TTGACGGTAC |
| Y11603 | TGTTAGGGAA | GAACAAGTGC | CGTTCAAATA | GGGCGGCACC | TTGACGGTAC |
| AJ316302 | TGTTAGGGAA | GAACAAGTAT | CGTTCGAATA | GGGCGGTACC | ATGACGGTAC |
| AJ315056 | TGTTAGGGAA | GAACAAGTAT | CGTTCGAATA | GGGCGGTACC | ATGACGGTAC |
| X82436 | TGTTAGGGAA | GAACAAGTAC | CGTTCGAATA | GGGCGGTACC | TTGACGGTAC |
| AF036922 | TGTTAGGGAA | GAACAAGTAC | CGTTTGAATA | AGGCGGTACC | TTGACGGTAC |
| X62174 | TGTTAGGGAA | GAACAAGTAC | CGTACGAACA | CAGCGGTACC | TTGACGGTAC |
| AJ310149 | TGTTAGGGAA | GAACAAGTAC | CGTGCGAATA | GAGCGGTACC | TTGACGGTAC |
| AJ238042 | TGTTAGGGAA | GAACAAGTCC | CGTTCGAATA | GGACGGGGCC | TTGACGGTAC |
| D78457 | TGTTAGGGAC | GAATAAGTAC | CGT-CGAATA | GGGCGGTACC | TTGACGGTAC |
| Clustal Consensus | *** ***** | *** * * | * | ** ***** | |

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      ....|....| ....|....| ....|....| ....|....| ....|....|
      405      415      425      435      445
X55060 CTA-CCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
X60629 CTAACCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTA-TACGT
X68416 CTAACCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
X60646 CTAACCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AB127980 CTGACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AY057394 CTGACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
X60627 CTACCGA--A AGCCCCGGCT A-CTACGTGC CAGCAGCCGC GGTA-TACGT
AJ012667 CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
SS1Contig CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
PR5-1Contig CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AY543169 CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ315060 CTAACCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ009793 CTGACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
BN1-1 CTGACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
Y11603 CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ316302 CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ315056 CTAACCAGAA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
X82436 CTATCGAGGA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AF036922 CTATCGAGGA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
X62174 CTAACGAGGA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ310149 CTAACGAGGA AGCCCCGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
AJ238042 CTAACCAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT
D78457 CTGACGAGAA AGCCACGGCT AACTACGTGC CAGCAGCCGC GGTAATACGT

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Clustal Consensus ** * * * **** * ***** ***** **** *****

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| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 455 | 465 | 475 | 485 | 495 |
| X55060 | AGGTGGCAAG | CGTTATCCGG | AATT-TTGGG | CGTAA-GCGC | GCGCAGGTGG |
| X60629 | AGGTGGCAAG | CGT-ATCCGG | AATTATTGGG | CGTAA-GCGC | GCGCAGGCCG |
| X68416 | AGGTGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| X60646 | AGGTGGCAAG | CGTT-TCCGG | AATTATTGGG | CGTAAAGGGC | TGCGAGGCCG |
| AB127980 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| AY057394 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| X60627 | AGGGGGCAAG | CGTTGTCCGG | AATT-TTGGG | CGTAA-GCGC | GCGC-GGCGG |
| AJ012667 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| SS1Contig | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| PR5-1Contig | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| AY543169 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| AJ315060 | AGGTGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | TGCGAGGCCG |
| AJ009793 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| BN1-1 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | CCGCAGGCCG |
| Y11603 | AGGGGGCAAG | -GTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAAGGGG |
| AJ316302 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCG | TGCGAGGCCG |
| AJ315056 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | TGCGAGGCCG |
| X82436 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGTAGGCCG |
| AF036922 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGTAGGCCG |
| X62174 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| AJ310149 | AGGGGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| AJ238042 | AGGTGGCAAG | CGTTGTCCGG | AATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |
| D78457 | AGGTGGCAAG | CGTTGTCCGG | ATTATTGGG | CGTAAAGCGC | GCGCAGGCCG |

Clustal Consensus *** ***** ** ***** * ** ***** ***** * ** ** * **

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| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 505 | 515 | 525 | 535 | 545 |
| X55060 | TTTCTTAAGT | CTGATGTGAA | AGCCCACGGC | TCAACCGTGG | AGGGTCATTG |
| X60629 | TTTCTTAAGT | CT-ATGTGAA | AGCCCACGGC | T-AACCGTG- | AGGGTCATTG |
| X68416 | TTTCTTAAGT | CTGATGTGAA | AGCCCCCGGC | TCAACCGGGG | AGGGTCATTG |
| X60646 | TTTCTTAAGT | CTGATGTGAA | AGCCCCCGGC | TCAACCGGGG | AGGGTCATTG |
| AB127980 | TTTCTTAAGT | CTGATGTGAA | ATCTCGCGGC | TTAACCGCGA | GCGGTCATTG |
| AY057394 | TCTTTTAAGT | CTGATGTGAA | ATCCCACGGC | TCAACCGCGG | GTGGTCATTG |
| X60627 | TCCTTTAAGT | CT-ATGTGAA | AGCCCACGGC | T-AACCGTGG | AGGGCC-TTG |
| AJ012667 | TCTTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGCCATTG |
| SS1Contig | TCCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGTCATTG |
| PR5-1Contig | TCCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGTCATTG |
| AY543169 | TCCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TCAACCGTGG | AGGGTCATTG |
| AJ315060 | TCCTTTAAGT | CTGATGTGAA | ATCTCGCGGC | TCAACCGCGA | ACGGTCATTG |
| AJ009793 | TCCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGCCATTG |
| BN1-1 | TCCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGCCATTG |
| Y11603 | TCCCTTAAGT | CTGATGTGAA | AGCCCACGGT | TCAACCGTGG | ATGGCCATTG |
| AJ316302 | TCTTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGTCATTG |
| AJ315056 | TCTTTTAAGT | CTGATGTGAA | AGCCCACGGC | TTAACCGTGG | AGGGTCATTG |
| X82436 | TTTCTTAAGT | CTGATGTGAA | ATCTTGCGGC | TCAACCGCAA | GCGGTCATTG |
| AF036922 | TTTCTTAAGT | CTGATGTGAA | ATCTTGCGGC | TCAACCGCAA | GCGGTCATTG |
| X62174 | TTCTTTAAGT | CTGATGTGAA | AGCCCACGGC | TCAACCGTGG | AGGGTCATTG |
| AJ310149 | TTCCTTAAGT | CTGATGTGAA | AGCCCACGGC | TCAACCGTGG | AGGGTCATTG |
| AJ238042 | TTCCTTAAGT | CTGATGTGAA | AGCCCACGGC | TCAACCGTGG | AGGGTCATTG |
| D78457 | CTATGTAAGT | CTGGTGTTAA | AGCCCCGGGC | TCAACCCCGG | TTCG-CATCG |

Clustal Consensus

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ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

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.....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      555      565      575      585      595
X55060  G-AAACTGGG AGACTTGAGT GCAGAAGAGG AAAGTGGGAAT TCCATGTGTA
X60629  G-AAACTGGG GAACT-GAGT GCAGAAGAGA AAAGCGGAAT TCCACGTGTA
X68416  G-AAACTGGG GAACTTGAGT GCAGAAGAGG AGAGTGGGAAT TCCACGTGTA
X60646  G-AAACTGGG GAACTTGAGT GCAGAAGAGG AGAGTGGGAAT TCCACGTGT-
AB127980 G-AAACTGGG AGGCTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AY057394 G-AAACTGGA GGACTTGAGT GCAGAAGAGG AGAGTGGGAAT TCCACGTGTA
X60627  G-AAACTGGG GGACTTGAG- -TCGAAGAGG AGAGTGGGAAT TCCACGTGT-
AJ012667 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
SS1Contig G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
PR5-1Contig G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AY543169 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AJ315060 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AJ009793 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
BN1-1    G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
Y11603  G-AAACTGGA GGACTTGAGT ACAGAAGGGG AGAGTGGGAAT TCCACGTGTA
AJ316302 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AJ315056 G-AAACTGGA GGACTTGAGT ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
X82436  G-AAACTGGG GAACTTGAGT ACAGAAGAGG AGAGCGGAAT TCCACGTGTA
AF036922 G-AAACTGGG GAACTTGAGT GCAGAAGAGG AGAGTGGGAAT TCCACGTGTA
X62174  GGAAACTGGG GAACTTGAGG ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AJ310149 G-AAACTGGG GAACTTGAGG ACAGAAGAGG AGAGTGGGAAT TCCACGTGTA
AJ238042 G-AAACTGGG GAACTTGAGT ACAGAAGAGG AGAGCGGAAT TCCACGTGTA
D78457  G-AAACTGTG TAGCTTGAGT GCAGAAGAGG AAAGCGGTAT TCCACGTGTA

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Clustal Consensus * * * * * * * * * * * * * * * * * * * * * * * * * * * *

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

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      ....|....| ....|....| ....|....| ....|....| ....|....|
      605      615      625      635      645
X55060 GCGGTGAAAT GCGTAGAGAT ATGGAGGAAC ACCAGTGGCG AAGGCGACTT
X60629 GCGGT-AAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGCTTT
X68416 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
X60646 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AB127980 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AY057394 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
X60627 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC -CC-GTGGCG AAGGCGACTC
AJ012667 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
SS1Contig GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
PR5-1Contig GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AY543169 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AJ315060 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AJ009793 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
BN1-1 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
Y11603 GCGGTGAAAT GCGTAGAGAT GTCGAGGAAC ACCAGTG-CG AAGGCGACTC
AJ316302 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AJ315056 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
X82436 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGCCTC
AF036922 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
X62174 GCGGTGAAAT GCGTAGATAC GTGGAGGAAC ACCAGAGGCG AAGGCGACTC
AJ310149 GCGGTGAAAT GCGTAGATAT GTGGAGGAAC ACCAGTGGCG AAGGCGACTC
AJ238042 GCGGTGAAAT GCGTAGATAT GTGGAGGAAC ACCAGTGGCG AAGGCGGCTC
D78457 GCGGTGAAAT GCGTAGAGAT GTGGAGGAAC ACCAGTGG-- GAGGCGG-TT

Clustal Consensus ***** * * ***** ** * * ***** *

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ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

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      .....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      655      665      675      685      695
X55060 -CTGGTCTGT AACTGACACT GAGGCGCGAA AGCGTGGGGA GCAAACAGGA
X60629 ----GTCTGT AACTGACGCT -AGGCGCGAA -GCGTGGGGA GCAAACAGGA
X68416 TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGGA GCGAACAGGA
X60646 TCTGGTCTGT AACTGACGCT GAGGAGCGAA AGCGTGGGGA GCGAACAGGA
AB127980 TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGTA GCGAACAGGA
AY057394 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGTA GCGAACAGGA
X60627 TCTG-TCTGT A-CTGACGCT -AGGTGCGAA AGCGTGGG-A GCGAACAGGA
AJ012667 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGTA GCGAACAGGA
SS1Contig TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGGA GCGAACAGGA
PR5-1Contig TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGGA GCGAACAGGA
AY543169 TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGGA GCGAACAGGA
AJ315060 TCTGGTCTGT AACTGACGCT GAGGAGCGAA AGCGTGGGGA GCGAACAGGA
AJ009793 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGGA GCGAACAGGA
BN1-1 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGGA GCGAACAGGA
Y11603 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGGA GCGAACAGGA
AJ316302 TCTGGTCTGT AACTGACGCT GAGGAGCGAA AGCGTGGGGA GCGAACAGGA
AJ315056 TCTGGTCTGT AACTGACGCT GAGGAGCGAA AGCGTGGGGA GCGAACAGGA
X82436 TCTGGTCTGT AACTGACGCT GAGGTCCGAA AGCGTGGGGA GCGAACAGGA
AF036922 TCTGGTCTGT AACTGACGCT GAGGTGCGAA AGCGTGGGTA GCGAACAGGA
X62174 TCTGGTCTGT TTCTGACGCT GAGGTGCGAA AGCGTGGGTA GCAAACAGGA
AJ310149 TCTGGTCTGT TTCTGACGCT GAGGTGCGAA AGCGTGGGTA GCAAACAGGA
AJ238042 TCTGGTCTGT TACTGACGCT GAGGTGCGAA AGCGTGGGGA GCGAACAGGA
D78457 TCTGGTCTGT AACTGACGCT GAGGCGCGAA AGCGTGGGGA GCAAACAGGA

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Clustal Consensus ***** ** ** * ** * ** * ** * ** *

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 705 | 715 | 725 | 735 | 745 |
| X55060 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AAGTGTTAGA |
| X60629 | TTAGATACCC | TGGT-GTCCA | CGCCGTAAAC | GATGAGTGCT | AAGTGTTAGA |
| X68416 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AAGTGTTAGA |
| X60646 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AAGTGTTAGG |
| AB127980 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GTTGAGTGCT | AGGTGTTAGG |
| AY057394 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| X60627 | TTAGATACCC | TG-TAGTCCA | CGCCGTAA-C | GATGAGTGCT | AGGTGTTAGG |
| AJ012667 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| SS1Contig | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| PR5-1Contig | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AY543169 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AJ315060 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AJ009793 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| BN1-1 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| Y11603 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GTTGAGTGCT | AGGTGTTAGG |
| AJ316302 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AJ315056 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| X82436 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AAGTGTTAGG |
| AF036922 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| X62174 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AJ310149 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| AJ238042 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGTGCT | AGGTGTTAGG |
| D78457 | TTAGATACCC | TGGTAGTCCA | CGCCGTAAAC | GATGAGT-CT | AGGTGTTGGG |

Clustal Consensus ***** ** * ***** ***** * * ***** ** * ** * *

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------|------------|------------|------------|------------|------------|
| | 755 | 765 | 775 | 785 | 795 |
| X55060 | GGGTTTCCGC | CCTTTAGTGC | T-AAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| X60629 | GGGTTTCCGC | CCTT-AGTGC | T--CACTAAC | GCAT-AAGCA | CTC-GCCTGG |
| X68416 | GGGTTTCCGC | CCTTTAGTGC | TGCAGCAAAC | GCATTAAGCA | CTCCGCCTGG |
| X60646 | GGGTTTCCGC | CCTTTAGTGC | TGCAGTAA-C | GCATTA-GCA | CTCCGCCTGG |
| AB127980 | GGGTTTCCGC | CCCTTTGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AY057394 | GGGTTTCCAC | CCCTTTGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| X60627 | GG--TTTCGC | CCTTAGTGC | TAAG--TAAC | GC-TTAAGCA | CTCCGCCTGG |
| AJ012667 | GGGTTTCCGC | CCTTTAGTGC | TGCAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| SS1Contig | GGGTTTCCGC | CCCTTAATGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| PR5-1Contig | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AY543169 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ315060 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ009793 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| BN1-1 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| Y11603 | GGGTTTCCGC | CC-TTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ316302 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ315056 | GGGTTTCCGC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| X82436 | GGGTTTCCGC | CCTTTAGTGC | TGCAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AF036922 | GGGTTTCCGC | CCTTTAGTGC | TGGAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| X62174 | GGGCTTCCAC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ310149 | GGGCTTCCAC | CCTTTAGTGC | TGAAGTTAAC | GCATTAAGCA | CTCCGCCTGG |
| AJ238042 | GG-TTCCAC | CC-TTAGTGC | TGCAGTTAAC | GCAATAAGCA | CTCCGCCTGG |
| D78457 | GGTTTCAATA | CCCTCAGTGC | CGCAGCTAAC | GCAATAAGCA | CTCC-CCTGG |

Clustal Consensus ** * ** * *** * * ** * *** ** *****

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 805 | 815 | 825 | 835 | 845 |
| X55060 | G-AGTACGGC | -GCAAGGCTG | AAACTCAAAG | GAATTGACGG | GGGCC-GCAC |
| X60629 | G-AGTACGGT | CGCAAGACT- | AAACTCAAAG | GAATTGACGG | GGGCC-GCAC |
| X68416 | GGAGTACGGT | CGCAAGACTG | AAACTCAAAG | GAATTGACGG | GGGCCCGCAC |
| X60646 | GGAGTACGGT | CGCAAGACTG | AAACTCAAAG | GAATTGACGG | GGGCC-GCAC |
| AB127980 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AY057394 | GGATTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| X60627 | G-AGTACGGC | CGCAAGGCT- | AAACTCAAAG | -AATTGACGG | GGGACCGCAC |
| AJ012667 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGACCCGCAC |
| SS1Contig | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| PR5-1Contig | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AY543169 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AJ315060 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AJ009793 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| BN1-1 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| Y11603 | GGAGTACGGC | CGCAAG-CTG | AAACTCAAAA | GAATT-ACGG | GGGCCCGCAC |
| AJ316302 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AJ315056 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| X82436 | GGAGTACG-C | CGCAGCGGCG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| AF036922 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAA | GAATTGACGG | GGGCCCGCAC |
| X62174 | GGAGTACGGC | CGCAAGG-TG | AAACTCAAAG | GAATTGACGG | GGGCCCGCAC |
| AJ310149 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAG | GAATTGACGG | GGGCCCGCAC |
| AJ238042 | GGAGTACGGC | CGCAAGGCTG | AAACTCAAAG | GAATTGACGG | GGGCCCGCAC |
| D78457 | GGAGTACGCT | CGCAAGAGTG | AAACTCAAAG | GAATTGACGG | GGGCCCGCAC |

Clustal Consensus * * **** * * * ***** **** * * * * *

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

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      .....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      855      865      875      885      895
X55060 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
X60629 AAGCGGTGGA GCATGTG-TT TAATTCGAAG -AACGCGAAG AACCTTACCA
X68416 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
X60646 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AB127980 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AY057394 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
X60627 A-GCGGTGGA GC-TGTGGTT TA-TTCGAAG CAACGCGAAG AACCTTACCA
AJ012667 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
SS1Contig AAGCGGTGGA GCATGTGGTT TAATTCGACG CAACGCGAAG AACCTTACCA
PR5-1Contig AAGCGGTGGA GCATGTGGTT TAATTCGACG CAACGCGAAG AACCTTACCA
AY543169 AAGCGGTGGA GCATGTGGTT TAATTCGACG CAACGCGAAG AACCTTACCA
AJ315060 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AJ009793 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
BN1-1 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
Y11603 AAGCGGTGGA GCATGTAGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AJ316302 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AJ315056 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
X82436 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CCACGCGAAG AACCTTACCA
AF036922 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
X62174 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AJ310149 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
AJ238042 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA
D78457 AAGCGGTGGA GCATGTGGTT TAATTCGAAG CAACGCGAAG AACCTTACCA

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Clustal Consensus * ***** ** ** * ** ** * ***** * ***** *****

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 905 | 915 | 925 | 935 | 945 |
| X55060 | GGTCTTGACA | TCCTCTGAAA | ACCCTAGAGA | TAGGGCTTCT | CCTTCGGGAG |
| X60629 | GGTCT-GACA | TCCTCTGACA | ACTCTAGAGA | TAGAGGTT-- | CCTTCGGGGA |
| X68416 | GGTCTTGACA | TCCTCTGACA | ACCCTAGAGA | TAGGGCTTCC | CCTTCGGGGG |
| X60646 | GGTCTTGACA | TCCTCTGACA | ATCCTAGAGA | TAGGACGTC- | --TTCGGGGG |
| AB127980 | GGTCTTGACA | TCCTCTGACA | GCGGCAGAGA | TGCCGTGTTC | CCTTCGGGGA |
| AY057394 | GGTCTTGACA | TCCTCTGATG | GCGGTAGAAA | TACCGTGTTC | CCTTCGGGGG |
| X60627 | GGTCTTGAC- | TCCTCTGACG | CCCCTAGAGA | TAGGGNGTTC | --TTCGGGGG |
| AJ012667 | GGTCTTGACA | TCCTCTGACG | GCCCTAGAGA | TAGGGAGTTC | CCTTCGGGGG |
| SS1Contig | GGTCTTGACA | TCCTCTGCAA | TCGGTAGAGA | TACCGAGTTC | CCTTCGGGGA |
| PR5-1Contig | GGTCTTGACA | TCCTCTGCAA | TCGGTAGAGA | TACCGAGTTC | CCTTCGGGGG |
| AY543169 | GGTCTTGACA | TCCTCTGCAA | TCGGTAGAGA | TACCGAGTTC | CCTTCGGGGG |
| AJ315060 | GGTCTTGACA | TCCTCTGCTA | TTCCTAGAGA | TAGGAAGTTC | CCTTCGGGGA |
| AJ009793 | GGTCTTGACA | TCCTCTGCCA | ATCCTAGAGA | TAGGATGTTC | CCTTCGGGGG |
| BN1-1 | GGTCTTGACA | TCCTCTGCCA | ATCCTAGAGA | TAGGATGTTC | CCTTCGGGGG |
| Y11603 | GGTCTTGACA | TCCTCTGACA | CCCCTAGAGA | TAGGGCATTTC | CCTTCGGGGG |
| AJ316302 | GGTCTTGACA | TCCTCTGACA | GCGATAGAGA | TATCGTGTTC | CCTTCGGGGA |
| AJ315056 | GGTCTTGACA | TCCTCTGATA | GCGATAGAGA | TATCGTGTTC | CCTTCGGGGG |
| X82436 | GGTCTTGACA | TCTTCGGATG | TCCCTAGAGA | TAGGGAGTTC | CCTTCGGGGG |
| AF036922 | GGTCTTGACA | TCTTTGGCCA | TCTCTAGAGA | TAGAGAGTTC | CCTTCGGGGG |
| X62174 | GGTCTTGACA | TCCTTGGACC | ACCCTAGAGA | TAGGTGCTTC | --TTCGGGGG |
| AJ310149 | GGTCTTGACA | TCCTTGGACA | TCCCTAGAGA | TAGGGCTTTC | CCTTCGGGGG |
| AJ238042 | GGTCTTGACA | TCTTTGGACC | ACCCTAGAGA | TAGGGTCTTC | CCTTCGGGGG |
| D78457 | GGTCTTGACA | TCCCCTGACC | GCTCTGGAGA | CAGAGCTTCC | CTTCGGGGCA |

Clustal Consensus ***** ** * * ** * * **

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|-------------|-------------|-------------|-------------|-------------|-------------|
| | 955 | 965 | 975 | 985 | 995 |
| X55060 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| X60629 | CAGAG-TGAC | AGGTGG-GCA | TG--TGTCGT | CAGCT-GTGT | CGTGAGATGT |
| X68416 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| X60646 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AB127980 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AY057394 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| X60627 | CAGAG-TGAC | -GGTGG-GCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ012667 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| SS1Contig | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| PR5-1Contig | CAGAA-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AY543169 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ315060 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ009793 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| BN1-1 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| Y11603 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ316302 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ315056 | CAGAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| X82436 | CCGAA-TGAC | AGGTGGTGCA | TGGT-GTCGT | CAGCTCGTGT | CGTGAGATGT |
| AF036922 | CCAAA-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| X62174 | CCAAGGTGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ310149 | CCAAG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| AJ238042 | CCAAA-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |
| D78457 | -GCGG-TGAC | AGGTGGTGCA | TGGTTGTCGT | CAGCTCGTGT | CGTGAGATGT |

Clustal Consensus **** ***** *** ** ***** ***** ***** *****

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| | | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| | 1005 | 1015 | 1025 | 1035 | 1045 | |
| X55060 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCATCATT |
| X60629 | TGGGT-AAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| X68416 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| X60646 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | GGATCTTAGT | TGCCAGCATT |
| AB127980 | TGGGTTAAGT | CCC | GTAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AY057394 | TGGGTTAAGT | CCC | GTAACGA | GCGCAACCCT | TAATCTTAGT | TGCCAGCATT |
| X60627 | TGGGTTAAGT | CCC | GCAACGA | GCGCA-CCCT | TGATCTTAGT | TGCCAGCATT |
| AJ012667 | TGGGTTAAGT | CCC | GCAACRA | GCGCAACCCT | TGATCTTART | TGCCAGCATT |
| SS1Contig | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| PR5-1Contig | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AY543169 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AJ315060 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AJ009793 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| BN1-1 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| Y11603 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AJ316302 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AJ315056 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| X82436 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| AF036922 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| X62174 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCC | TAATCTTAGT | TGCCAGCATT |
| AJ310149 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCC | TAATCTTAGT | TGCCAGCATT |
| AJ238042 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TGATCTTAGT | TGCCAGCATT |
| D78457 | TGGGTTAAGT | CCC | GCAACGA | GCGCAACCCT | TATCTTAGT | TGC-AGCATT |

Clustal Consensus

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| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|
| | 1055 | 1065 | 1075 | 1085 | 1095 |
| X55060 | AAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| X60629 | CAGT-GGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| X68416 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| X60646 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AB127980 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGCGGG |
| AY057394 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGCGGG |
| X60627 | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAA-CCGGA | GGAAGGTGGG |
| AJ012667 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| SS1Contig | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| PR5-1Contig | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AY543169 | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AJ315060 | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AJ009793 | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGCGGG |
| BN1-1 | TAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| Y11603 | GAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AJ316302 | AAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AJ315056 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| X82436 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| AF036922 | AAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| X62174 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGCGGG |
| AJ310149 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGCGGG |
| AJ238042 | CAGTTGGGCA | CTCTAAGGTG | ACTGCCGGTG | ACAAACCGGA | GGAAGGTGGG |
| D78457 | CAGTTGGGCA | CTCTAGAGAG | ACTGCCGTCG | ACAAGACGGA | GGAAGGCGGG |

Clustal Consensus *** ***** ***** * ***** * ***** ***** ***

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จุฬาลงกรณ์มหาวิทยาลัย

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      ....|....| ....|....| ....|....| ....|....| ....|....|
      1105   1115   1125   1135   1145
X55060  GATGACGT-A AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
X60629  GATGACGTCA AATCATCATG CCCCTTATGA CCTGG-CTAC ACACGTGCTA
X68416  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
X60646  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AB127980 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AY057394 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
X60627  GATGACGTCA A-TCATCATG CCCCTTATGA CC--GGCTAC ACACGTGCTA
AJ012667 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
SS1Contig GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
PR5-1Contig GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AY543169 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ315060 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ009793 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
BN1-1    GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
Y11603  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ316302 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ315056 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
X82436  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AF036922 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
X62174  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ310149 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA
AJ238042 GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCAAC ACACGTGCTA
D78457  GATGACGTCA AATCATCATG CCCCTTATGA CCTGGGCTAC ACACGTGCTA

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Clustal Consensus ***** * * ***** ***** ** * * * *****

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จุฬาลงกรณ์มหาวิทยาลัย


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.....|.....| .....|.....| .....|.....| .....|.....| .....|.....|
      1155      1165      1175      1185      1195
X55060 CAATGGACGG TACAAAGAGC TGCAAGACCG CGAGGTGGAG CTAATCTCAT
X60629 CAATGGATGG TACAAAGGGC TGCAAGACCG CGAGGTA-AG CCAATCCCAT
X68416 CAATGGGCAG AACAAAGGGC AGCGAAGCCG CGAGGCTAAG CCAATCCCAC
X60646 CAATGGACAG AACAAAGGGC AGCGAAACCG CGAGGTTAAG CCAATCCCAC
AB127980 CAATGGATGG AACAAAGGGA AGCGAAGCCG TGAGGTGTAG CAAATCCCAT
AY057394 CAATGGATGG AACAAAGGGC AGCGAAGCCG CAAGGTGCAG CAAATCCCAT
X60627 CA-TGGATGG AACAAAGGGC -GCGAAGCCG CGAGGCCAAG CAA-TCCCAT
AJ012667 CAATGGATGG AACAAAGGGC AGCGAAGCCG TGAGGCCAAG CAAATCCCAC
SS1Contig CAATGGATGG AACAAAGGGA AGCAAAACCG CGAGGTCAAG CAAATCCCAT
PR5-1Contig CAATGGATGG AACAAAGGGA AGCAAAACCG CGAGGTCAAG CAAATCCCAT
AY543169 CAATGGATGG AACAAAGGGA AGCAAAACCG CGAGGTCAAG CAAATCCCAT
AJ315060 CAATGGATGG AACAAAGGGA AGCAAAACCG CGAGGTCAAG CAAATCCCAT
AJ009793 CAATGGATGG AACAAAGGGC AGCGAAGCCG CGAGGTCAAG CAAATCCCAT
BN1-1 CAATGGATGG AACAAAGGGC AGCGAAGCCG CGAGGTCAAG CAAATCCCAT
Y11603 CAATGGATGG AACAAAGGGC AGCGAAACCG CAAGTCAAG CAAATCCCAT
AJ316302 CAATGGATGG AACAAAGGGA CGCGAAGCCG CGAGGTGTAG CAAATCCCAT
AJ315056 CAATGGATGG AACAAAGGGA CGCGAAGCCG CGAGGTGTAG CAAATCCCAT
X82436 CAATGGATGG TACAAAGGGC AGCGAAGCCG TGAGGTGAAG CCAATCCCAT
AF036922 CAATGGATGG TACAGAGGGC AGCGAAGCCG CGAGGTGAAG CAAATCCCAT
X6217 CAATGGATGG TACAAAGGGC AGCGAAGCCG CGAGGTGTAG CAAATCCCAT
AJ310149 CAATGGATGG TACAAAGGGC AGCGAAGCCG CGAGGTGTAG CAAATCCCAT
AJ238042 CAATGGATGG TACAATGGGA CGCGAAACCG CGAGGTGAAG CAAATCCCAA
D78457 CAATGGTTGG TACAACGGGA TGCTACCTCG CGAGAGGACG C-AATCTCTT

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Clustal Consensus ** *** * *** * ** * ** * * * * *

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จุฬาลงกรณ์มหาวิทยาลัย

| | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------|
| | 1305 | 1315 | 1325 | 1335 | 1345 |
| X55060 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTTGTA | CACCC |
| X60629 | GCCT-GTACA | CACCGCC-GT | CACACCACGA | GAGTTTGTA | CACCC |
| X68416 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTTGTA | CACCC |
| X60646 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTTGTA | CACCC |
| AB127980 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| AY057394 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| X60627 | GT-TTGTACA | CACCGCC-GT | CACACCACGA | GAGTTGGTAA | CACCC |
| AJ012667 | GTCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| SS1Contig | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| PR5-1Contig | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| AY543169 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| AJ315060 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| AJ009793 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| BN1 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| Y11603 | GCCTTGTACA | CACCGCC--G | TACAACA-GA | GAGTTGGTAA | CACCC |
| AJ316302 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| AJ315056 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| X82436 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| AF036922 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| X62174 | GTCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| AJ310149 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGCAA | CACCC |
| AJ238042 | GCCTTGTACA | CACCGCCCGT | CACACCACGA | GAGTTGGTAA | CACCC |
| D78457 | GCCTTGTACA | CACCGCCCGT | CACACCACGG | GAGTTTGCAA | CACCC |

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Miss Nitcha Chamreonsaksri was born on April 17, 1981. She obtained a Bachelor of Science Degree in Biotechnology from Mahasarakham University, Mahasarakham, Thailand, in 2003.

Poster presentation :

1. Nitcha Chamreonsaksri, Ancharida Acharacharanya, Wonnop Visessanguan and Somboon Tanasupawat. 2005. Screening and characterization of protease - producing halophilic bacteria from Pla-ra. 1st Food fermentatin. March, 23-25 Khonkang University.



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