

# S1: Plasmodium vivax strain Pvdibbt-1 dihydrofolate reductase (dhfr) gene, partial cds

GenBank: KC121333.1

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LOCUS KC121333 582 bp DNA linear INV 06-FEB-2013  
DEFINITION Plasmodium vivax strain Pvdibbt-1 dihydrofolate reductase (dhfr) gene, partial cds.  
ACCESSION KC121333  
VERSION KC121333.1 GI:444792510  
KEYWORDS .  
SOURCE Plasmodium vivax (malaria parasite P. vivax)  
ORGANISM [Plasmodium vivax](#)  
Eukaryota; Alveolata; Apicomplexa; Aconoidasida; Haemosporida; Plasmodium; Plasmodium (Plasmodium).  
REFERENCE 1 (bases 1 to 582)  
AUTHORS Sorosjinda-Nunthawarasilp,P., Rattaprasert,P., Suntornthiticharoen,P., Markwardt,R.A. and Wihokhern,B.  
TITLE Direct Submission  
JOURNAL Submitted (01-NOV-2012) Fundamentals of Public Health, Faculty of Public Health, Burapha University, 169 Longhard Bangsean Road, Muang, Chonburi 20131, Thailand  
COMMENT ##Assembly-Data-START##  
Sequencing Technology :: Sanger dideoxy sequencing  
##Assembly-Data-END##  
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## S2: Plasmodium vivax strain Pvachtk-1 dihydrofolate reductase (dhfr) gene, partial cds

GenBank: KC121334.1

### [FASTA Graphics](#)

#### [Go to:](#)

LOCUS KC121334 582 bp DNA linear INV 06-FEB-2013  
DEFINITION Plasmodium vivax strain Pvachtk-1 dihydrofolate reductase (dhfr) gene, partial cds.  
ACCESSION KC121334  
VERSION KC121334.1 GI:444792512  
KEYWORDS .  
SOURCE Plasmodium vivax (malaria parasite P. vivax)  
ORGANISM [Plasmodium vivax](#)  
Eukaryota; Alveolata; Apicomplexa; Aconoidasida; Haemosporida; Plasmodium; Plasmodium (Plasmodium).  
REFERENCE 1 (bases 1 to 582)  
AUTHORS Sorosjinda-Nunthawarasilp,P., Rattaprasert,P., Suntornthiticharoen,P., Markwardt,R.A. and Wihokhern,B.  
TITLE Direct Submission  
JOURNAL Submitted (01-NOV-2012) Fundamentals of Public Health, Faculty of Public Health, Burapha University, 169 Longhard Bangsean Road, Muang, Chonburi 20131, Thailand  
COMMENT ##Assembly-Data-START##  
Sequencing Technology :: Sanger dideoxy sequencing  
##Assembly-Data-END##  
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### S3: Plasmodium vivax strain Pvachtk-2 dihydrofolate reductase (dhfr) gene, partial cds

GenBank: KC121335.1

#### [FASTA Graphics](#)

#### [Go to:](#)

LOCUS KC121335 582 bp DNA linear INV 06-FEB-2013  
DEFINITION Plasmodium vivax strain Pvachtk-2 dihydrofolate reductase (dhfr) gene, partial cds.  
ACCESSION KC121335  
VERSION KC121335.1 GI:444792514  
KEYWORDS .  
SOURCE Plasmodium vivax (malaria parasite P. vivax)  
ORGANISM [Plasmodium vivax](#)  
Eukaryota; Alveolata; Apicomplexa; Aconoidasida; Haemosporida; Plasmodium; Plasmodium (Plasmodium).  
REFERENCE 1 (bases 1 to 582)  
AUTHORS Sorosjinda-Nunthawarasilp,P., Rattaprasert,P., Suntornthiticharoen,P., Markwardt,R.A. and Wihokhern,B.  
TITLE Direct Submission  
JOURNAL Submitted (01-NOV-2012) Fundamentals of Public Health, Faculty of Public Health, Burapha University, 169 Longhard Bangsean Road, Muang, Chonburi 20131, Thailand  
COMMENT ##Assembly-Data-START##  
Sequencing Technology :: Sanger dideoxy sequencing  
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FEATURES Location/Qualifiers  
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**S4:** *P. vivax* malaria parasites originally isolated from SG DNAs of *An. dirus* and *An. aconitus* that possesses DHFR homolog with recently emerging haplogroup G as compared to haplogroups A to F

| Haplo-group | Protein Accession | Genome Accession | Source | <sup>a</sup> Mutation of haplotype |    |    |                                |  |     |     |     |     |  |
|-------------|-------------------|------------------|--------|------------------------------------|----|----|--------------------------------|--|-----|-----|-----|-----|--|
|             |                   |                  |        | 33                                 | 57 | 58 | 61                             | ΔIndel   | 105 | 117 | 145 | 173 |  |
| A           | ABC02004          | DQ244111         | PG2005 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | CAA66805          | X98123           | 1996** | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABC02002          | DQ244109         | PH2005 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | AAV41263          | AY772075         | ID2004 | P                                  | F  | S  | T                              | NTSGGD   | D   | S   | V   | I   |  |
|             | ADD37866          | GU224157         | KR2009 | P                                  | F  | S  | T                              | NTSGGD   | D   | S   | V   | I   |  |
|             | AAV41266          | AY772078         | ID2004 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | CAA05915          | AJ003157         | MM1997 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABG73611          | DQ679978         | IN2006 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | CAA05848          | AJ003075         | DJ1997 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | ABH05711          | DQ789665         | IN2006 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | ABC02015          | DQ244122         | VN2005 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABH05713          | DQ789667         | IN2006 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>   <a href="#">NTHGGD</a>  NTHGGD                          | D   | S   | V   | I   |  |
|             | AAV24546          | AY942925         | MM2005 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | AAV41262          | AY772074         | ID2004 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | ABH05718          | DQ789672         | IN2006 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | CAA05846          | AJ003073         | KM1997 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | BAI79254          | AB547457         | IR2010 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>   <a href="#">NTHGGD</a>  NTHGGD                          | D   | S   | V   | I   |  |
|             | CAA05847          | AJ003074         | SR1997 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABV59163          | EU145907         | IN2007 | P                                  | F  | S  | T                              | NTHGGD   | D   | S   | V   | I   |  |
|             | AAO16082          | AF525814         | TH2002 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | AAV41265          | AY772077         | PG2004 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>   <a href="#">NTSGGD</a>   <a href="#">NTHGGD</a>  DTHGGD | D   | S   | V   | I   |  |
|             | ABG73610          | DQ679977         | IN2006 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABV59199          | EU145943         | IN2007 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>   <a href="#">NTHGGD</a>  NTHGGD                          | D   | S   | V   | I   |  |
|             | BAI79255          | AB547458         | IR2010 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABV59200          | EU145944         | IN2007 | P                                  | F  | S  | T                              | NTSGGD   | D   | S   | V   | I   |  |
|             | ABH05704          | DQ789658         | IN2006 | P                                  | F  | S  | T                              | NTSGGD   | D   | S   | V   | I   |  |
| ABV59203    | EU145947          | IN2007           | P      | F                                  | S  | T  | <a href="#">NTSGGD</a>  NTHGGD | D  | S   | V   | I   |     |  |
| B           | CAA05830          | AJ003054         | KM1997 | L                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | N   | S   | V   | I   |  |
|             | CAA05829          | AJ003053         | MG1997 | L                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | AAO16081          | AF525813         | TH2002 | L                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | CAA05849          | AJ003076         | MG1997 | L                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABY25360          | EU168426         | MG2007 | L                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |
|             | ABY25361          | EU168427         | MG2007 | P                                  | F  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | N   | V   | I   |  |
|             | ABY25365          | EU168431         | MG2007 | P                                  | F  | R  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | N   | V   | I   |  |
|             | ADD37867          | GU224158         | KR2009 | P                                  | L  | S  | T                              | <a href="#">NTSGGD</a>  NTHGGD   | D   | S   | V   | I   |  |

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| <b>C</b> | AAV41255 | AY772067 | ID2004   | P      | L | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | F |
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|          | ABC02013 | DQ244120 | VU2005   | P      | L | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | T | V | F |
|          | ABC02014 | DQ244121 | VU2005   | P      | L | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | T | V | F |
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|          | ABV59183 | EU145927 | IN2007   | P      | L | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | F |
|          | CAA05826 | AJ003050 | TH1997   | P      | L | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | I |
|          | <b>D</b> | AAO16084 | AF525816 | TH2002 | P | F | R | T   | NTSGGD                         | D | N | V |
| ADD37869 |          | GU224160 | TH2009   | P      | F | R | T | NTSGGD  | D                              | N | V | I |
| ABC02001 |          | DQ244108 | TL2005   | P      | F | R | T | <a href="#">NTSGGD</a>  NTSGGD                          | D                              | N | V | I |
| ABH05707 |          | DQ789661 | IN2006   | P      | F | R | T | NTSGGD  | D                              | N | V | I |
| AAV41253 |          | AY772065 | ID2004   | P      | F | R | T | NTSGGD  | D                              | S | V | I |
| AAV41270 |          | AY772082 | ID2004   | P      | F | R | T | <a href="#">NTSGGD</a>  NTSGGD                          | D                              | N | V | I |
| ABC02017 |          | DQ244124 | VN2005   | P      | F | R | T | NTSGGD  | D                              | N | V | I |
| AAV24553 |          | AY942932 | MM2005   | P      | F | R | T | NTSGGD  | D                              | N | V | I |
| BAI79252 |          | AB547455 | IR2010   | P      | F | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | N | V | I |
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| ADD37863 |          | GU224154 | KR2009   | P      | F | S | T | NTSGGD  | D                              | N | V | I |
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|          | ABC02010 | DQ244117 | VU2005   | P      | F | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | N | V | I |
|          | ABC02003 | DQ244110 | PH2005   | P      | F | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | N | V | I |
|          | ABV59165 | EU145909 | IN2007   | P      | F | S | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | N | V | I |
|          | <b>F</b> | ABC02006 | DQ244113 | PG2005 | P | L | S | T   | <a href="#">NTSGGD</a>  NTHGGD | D | S | V |
| AAV41268 |          | AY772080 | PG2004   | P      | L | R | T | <a href="#">NTSGGD</a>   <a href="#">NTHGGD</a>  NTHGGD | D                              | S | V | I |
| AAO16083 |          | AF525815 | TH2002   | P      | L | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | I |
| ABH05716 |          | DQ789670 | IN2006   | P      | L | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | I |
| ADD37865 |          | GU224156 | KR2009   | P      | L | R | T | NTSGGD  | D                              | S | V | I |
| CAA05850 |          | AJ003077 | ID1997   | P      | L | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | I |
| BAI79250 |          | AB547453 | IR2010   | P      | L | R | T | <a href="#">NTSGGD</a>  NTHGGD                          | D                              | S | V | I |



|          |           |          |         |   |   |   |   |                                       |   |   |   |   |
|----------|-----------|----------|---------|---|---|---|---|---------------------------------------|---|---|---|---|
|          | ADD37871  | GU224162 | TH2009  | P | L | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | S | V | I |
|          | AAV41256  | AY772068 | PG2004  | P | L | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | S | V | I |
|          | AAV41258  | AY772070 | PG2004  | P | F | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | S | V | I |
|          | ABV59198  | EU145942 | IN2007  | P | F | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | S | V | I |
|          | BAI79251  | AB547454 | IR2010  | P | L | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | N | V | I |
|          | AAV24548  | AY942927 | MM2005  | P | L | R | M | NTSGGD                                | D | N | V | I |
|          | AAV24550  | AY942929 | MM2005  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | N | V | I |
| <b>G</b> | AAO16085  | AF525817 | TH2002  | P | F | R | T | NTSGGD                                | D | T | V | I |
|          | AAV24547  | AY942926 | MM2005  | P | F | R | T | NTSGGD                                | D | T | V | I |
|          | ADD37864  | GU224155 | KR2009  | P | F | S | T | NTSGGD                                | D | T | V | I |
|          | AAV41271  | AY772083 | ID2004  | P | F | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | AAV24554  | AY942933 | MM2005  | P | I | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | AAO16087  | AF525819 | TH2002  | P | I | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ADD37870  | GU224161 | TH2009  | P | I | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | AAO16089  | AF525821 | TH2002  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ADD37872  | GU224163 | PG2009  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD NTHGGD | D | T | V | I |
|          | AAO16086  | AF525818 | TH2002  | P | L | R | T | NTSGGD                                | D | T | V | I |
|          | AAV41272  | AY772084 | ID2004  | P | L | R | T | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ABC02008  | DQ244115 | PG2005  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD NTHGGD | D | T | V | I |
|          | Pvachtk-2 | KC121335 | TH2012* | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | Pvachtk-1 | KC121334 | TH2012* | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | N | T | L | I |
|          | AAV24549  | AY942928 | MM2005  | P | L | R | M | NTSGGD                                | D | T | V | I |
|          | AAV41275  | AY772087 | ID2004  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ABG73608  | DQ679975 | IN2006  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ADD37868  | GU224159 | TH2009  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ABH05714  | DQ789668 | IN2006  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | Pvdibbt-1 | KC121333 | TH2012* | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | AAV41254  | AY772066 | ID2004  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | S | V | I |
|          | AAV24551  | AY942930 | MM2005  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |
|          | ABV59182  | EU145926 | IN2007  | P | L | R | M | <a href="#">NTSGGD</a>  NTHGGD        | D | T | V | I |

Based on the phylogenetic analysis of the representative *Pvdhfr* haplotypes shown in **Figure 3**, *P. vivax* DHFR homologs possess the potential point mutations (blue-color highlighted)<sup>a</sup> or amino acid substitutions at positions Phe57Leu/Ile, Ser58Arg, Thr61Met and Ser117Asn/Thr and, additionally, Pro33Leu, Asp105Asn, Val145Leu, and Ile173Phe/Leu.

<sup>a</sup>Indel shows one short tandem repeat of wild type haplotype (NTHGGD) or prone haplotype (NTSGGD)<sup>a</sup> that possesses the substitution at position His99Ser. Additional short tandem repeats<sup>a</sup> are blue-color highlighted.

\*3 haplotypes of *P. vivax* originally isolated from the same 2 *An. aconitus* and one *An. dirus* SG DNA isolates were used in the phylogenetic analysis.