

# REBASE—restriction enzymes and methylases

Richard J. Roberts\* and Dana Macelis

New England BioLabs, 32 Tozer Road, Beverly, MA 01915, USA

Received October 27, 1998; Accepted October 28, 1998

## ABSTRACT

**REBASE is a comprehensive database of information about restriction enzymes and their associated methylases, including their recognition and cleavage sites and their commercial availability. Also included is a listing of homing endonucleases. Information from REBASE is distributed via monthly electronic mailings as well as through anonymous ftp and the World Wide Web. The REBASE web site (<http://www.neb.com/rebase>) contains a web page for every enzyme, reference and supplier. Additionally, there is a search facility, help and NEWS pages, and a complete description of our various services. Specialized files are available that can be used directly by many software packages.**

## INTRODUCTION

The restriction enzyme database, REBASE, is a comprehensive collection of information about restriction enzymes and DNA methylases. Since the last description of the contents of REBASE (1), 99 new restriction enzymes have been added. These include nine Type II enzymes with new specificities as shown in Table 1. Among the 3015 restriction enzymes now known, there are 19 fully characterized Type I specificities, 221 different Type II specificities and four different Type III specificities. A total of 484 different Type II restriction enzymes are commercially available representing 143 different specificities. Homing endonucleases (2) are also listed in REBASE and seven of the 37 known are commercially available. REBASE currently stores 4692 published references, with abstracts, and 562 unpublished observations.

REBASE is updated daily. Each month, a set of REBASE data files are released publicly and distributed to the scientific community, at no charge, via Email. They can also be retrieved by anonymous ftp ([www.neb.com](http://www.neb.com), in `pub/rebase`) or through the World Wide Web (<http://www.neb.com/rebase>). On the web, each enzyme, reference and supplier have their own page, with links to all related information. A sample enzyme page is shown in Figure 1. Also, we provide datafiles designed for use with a variety of software packages such as GCG, IGSuite, GENEPRO, Staden, DNA Strider, Pro-Cite, PC/Gene, SEQAIDII, GENE-TYX, DNASIS, CAD Gene, Gene Runner, MacVector, EndNote, Readasoft Plasmid, Molecular Biology Insights' OLIGO Primer Analysis Software, PREMIER Biosoft International's Primer

Premier and Plasmid Premier, Clone Manager, and Reference Manager. Other data files include a complete set of references, including abstracts, to papers on restriction enzymes and methylases; a list of all commercial suppliers of restriction enzymes and methylases, complete with contact information and a listing of enzymes they currently sell. New data files are constantly being added and each release of REBASE includes a monthly newsletter indicating that the files at the `www` and `ftp` sites have been updated, and listing new enzymes, newly available formats, enzyme name changes, etc. To join the mailing list or for more information, contact either author (Email: [macelis@neb.com](mailto:macelis@neb.com) or [roberts@neb.com](mailto:roberts@neb.com); telephone, +1 978 927 3382; fax, +1 978 921 1527).

**Table 1.** New Type II restriction enzymes

Enzyme <sup>a</sup>	Recognition sequence <sup>b</sup>	Reference <sup>c</sup>
<i>Bbv</i> CI <sup>\$</sup>	CC <sup>^</sup> TCA_GC	Ge,L., Krotee,S., Ganatra,M. and Grandoni,R.
<i>Bse</i> SI	GKGC MC	Steponaviciene,D., Petrusyte,M., Kairaitiene,R., Kiuduliene,E., Butkus,V. and Janulaitis,A.
<i>Btr</i> I <sup>\$</sup>	CAC↓GTC	Abdurashitov,M.A., Belichenko,O.A., Lebedeva,N.A., Dedkov,V.S. and Degtyarev,S.K.
<i>Bts</i> I	GCAGTG	Pan,X.S. and Morgan,R.
<i>Hae</i> IV	GAYNNNNNRTC	Piekarowicz,A.
<i>Hpy</i> 178III	TCNNGA	Xu,Q. and Blaser,M.
<i>Hpy</i> 188IX	TCNGA	Xu,Q. and Blaser,M.
<i>Ppi</i> I	GAGNNNNNGTTC	Vitkute,J., Kairaitiene,R., Kiuduliene,E., Petrusyte,M., Butkus,V. and Janulaitis,A.
<i>Psi</i> I <sup>\$</sup>	TTATAA	Abdurashitov,M.A., Belichenko,O.A., Lebedeva,N.A. and Degtyarev,S.K.

<sup>a</sup>The endonucleases are named in accordance with the proposal of Smith and Nathans (3). \$ means the enzyme is commercially available.

<sup>b</sup>Cleavage sites are indicated as ↓ when cleavage is at the identical position on both strands, ^ indicates cleavage on the strand shown and \_ indicates cleavage on the complementary strand. K = G or T; M = A or C; N = any base; Y = C or T; R = A or G.

<sup>c</sup>All references are currently unpublished.

\*To whom correspondence should be addressed. Tel: +1 978 927 3382; Fax: +1 978 921 1527; Email: [roberts@neb.com](mailto:roberts@neb.com)

**REBASE Enzymes**

**Ppil**  
Type II restriction enzyme

**REBASE search...**

**Recognition Sequence:**  
GAGRRRRNGTTC  
(cleavage site is unknown)

Prototype: Ppil	# sites on
Source: V. Butkus	Adeno2: 4
Microorganism: <i>Pseudomonas putida</i> Jo 4-731	Lambda: 5
Growth Temperature: 37 °	pBR322: 2
Comment: originally UbaLI	phiX174: 0
	sV40: 1

Ppil is **NOT** commercially available.  
Try contacting -  
V. Butkus  
Fermentas MBI  
Graicuno 8, Vilnius 2028 Lithuania  
Phone: 370 2 641279  
Fax: 370 2 643436  
Email: [butkus@fermentas.lt](mailto:butkus@fermentas.lt)

No other Type II restriction enzyme recognizes the same pattern.

**Related References:**  
[Vilkute J., Kairaitiene, R., Kiuduliene, E., Petrusyte, M., Butkus, V., Janulaitis, A. Unpublished observations.](#)

**Figure 1.** The home page for *Ppil* (<http://www.neb.com/rebase/enz/Ppil.html>).

We request that authors use this article to cite REBASE as a general reference for the complete listing that is available electronically.

#### ACKNOWLEDGEMENTS

Special thanks are due to the many individuals who have so kindly communicated their unpublished results for inclusion in

this compilation. This database is supported by the National Library of Medicine (LM04971).

#### REFERENCES

- 1 Roberts,R.J. and Macelis,D. (1998) *Nucleic Acids Res.*, **26**, 338–350.
- 2 Belfort,M. and Roberts,R.J. (1997) *Nucleic Acids Res.*, **25**, 3379–3388.
- 3 Smith,H.O. and Nathans,D.J. (1973) *Mol. Biol.*, **81**, 419–423.