# The Tn*7* transposon

The Tn*7* transposon was originally discovered by Barth *et al*., (1976) on the plasmid R483 (IncIα) as an element carrying the resistance genes trimethoprim ($Tm^R$) and streptomycin/ spectinomycin ($Sm^R$/ $Sp^R$), which could be transposed to other replicons (note; in some earlier papers the Tn*7* transposon is named TnC).

The Tn*7* transposon is 14 kb. It contains five genes (Fig. 1), involved in the transposition process, and two resistance genes as described above. These genes are flanked by the ends of the transposon, named the left (Tn*7*L) and the right (Tn*7*R) end (Barth *et al*., 1976; Lichtenstein and Brenner, 1982; Rogers *et al*., 1986). Note; in the literature the names of the ends have not been used consistently. In the following the names used for the ends are as indicated in Fig. 1.

The Tn*7* transposition process has been studied intensively in *Escherichia coli* in which Tn*7* inserts with high efficiency and unique orientation into one specific location named the *att*Tn*7* site (Lichtenstein and Brenner, 1981; McKnown *et al*., 1988). This site of insertion is located just downstream of the coding region, in the transcriptional terminator, of the *glmS* gene (Gringauz, *et al*., 1988). The transposon genes required for specific insertion into the *att*Tn*7* site, are *tnsABCD*, and they function *in trans*. Thus, sequences located in the 3'end of the coding region of *glmS* are recognised by transposase proteins and directing the actual insertion into the *att*Tn*7* site, down-stream of the *glmS* gene (McKnown *et al*., 1988; Baiton *et al*., 1993). However, if this site is unavailable the transposon can insert into other sites with low frequency (Rogers *et al*., 1986; Kubo and Craig, 1990).

The Tn*7* transposon recognises a sequence located in the terminal part of the *glmS* gene, but it inserts just downstream of this and thereby it does not disrupt the gene (Gringauz, *et al*., 1988). The *glmS* gene encodes a glucosamine synthetase, which is required for cell wall synthesis (Volger *et al*., 1989). It is conserved among many bacteria and therefore Tn*7* is likely to have the same specific insertion site in many different bacteria, some have already been tested (Table 1). Detailed information about the Tn*7* transposon mechanisms can be found in the literature, two recommendable reviews are Craig (1989) and Peters and Craig, (2001).

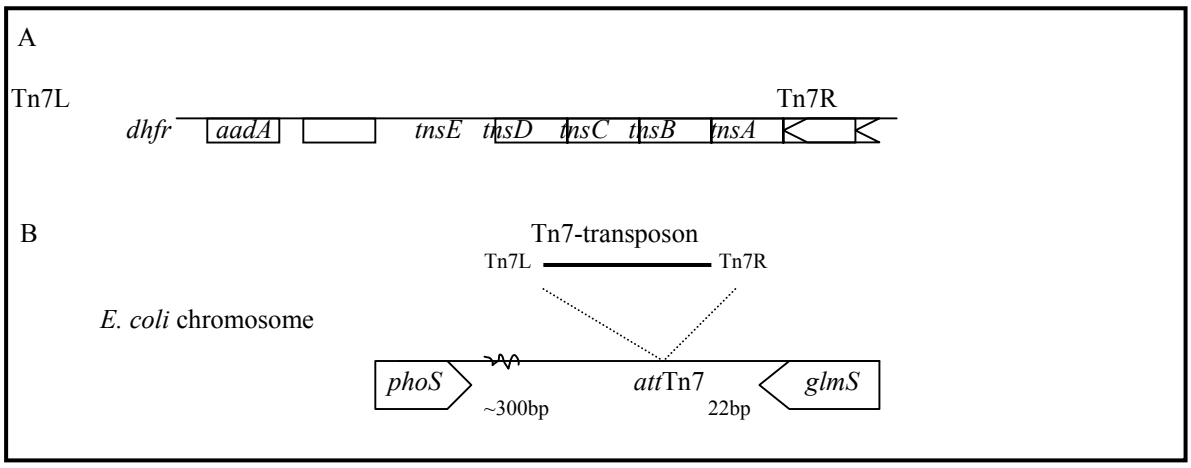


**Fig. 1.** Map of transposon Tn*7* (A) and its insertion site *att*Tn7 in *Escherichia coli* (B). The gene *dhfr* encodes dihydrofolate reductase providing trimethoprim resistance and *aadA* encodes adenylyltransferase, which provides resistance to streptomycin and spectinomycin (the figures are redrawn from Craig *et al*., 1989).

**Table 1. Literature overview of bacteria tested for insertion of Tn7**

| Bacterium | Specific insertion | Test | Sequence of insertion site | Numbers of base pairs downstream of *glmS* [1] | System tested[2] | Comments | References |
|---|---|---|---|---|---|---|---|
| *Caulobacter crescentus* | Yes | Southern | - | - | RP4::Tn7[3] | 9 isolates tested | Ely *et al*., 1982 |
| *Desulfovibrio desulfuricans* G20 | Yes | Southern | U46080 | 28 | RK2073::Tn7[3] | 15 out of 16b had specific insertion | Wall*et al*., 1996 |
| *Escherichia coli* | Yes | Southern | AE000450 | 22 | ColE1::Tn7[3] | Tested many times by different scientists | Lichtenstein and Brenner, 1981; 1982 |
| *Escherichia coli* BE6 | - | - | - | - | Grinter's system | Stable insertion | Grinter, 1983 |
| *Erwinia chrysanthemi* EC16 | Yes | Southern | | | Monsanto's system | *lux*-based reporter system | Shen *et al*., 1992 |
| *Klebsiella pneumonia* | - | - | - | - | - | - | In Caig 1989: Qadri *et al* personal communication |
| *Methylophilus methylotrophus* | - | - | - | - | Grinter's system | Stable insertion | Grinter, 1983 |
| *P. fluorescens* CHA0 | Yes | Southern | - | - | Bao's system | Specific insertion, no effect on growth rate was observed | Højberg *et al*., 1999; Zuber *et al*., 2003 |
| *Pseudomonas* DS-S73 | Yes | - | - | - | Bao's system | Specific insertion | Koch *et al*., 2002 |
| *Pseudomonas* S108 | Yes | - | - | - | Bao's system | Specific insertion | Koch *et al*., 2002 |
| *Pseudomonas aeruginosa* PAC and PAO1161 | Yes | Southern | - | - | CAM-OCT::Tn7[3] | 17 of 18 tested were similar | Caruso and Shapiro, 1982 |

- not tested or described in the article.
[1] Number of base pairs were calculated from the stop codon to the middle base of the five base pairs that are duplicated upon insertion.
[2] Named according to the name of the original tagging system on which the used helper plasmid and delivery plasmids are based.
[3] Wild type Tn7 transposon located at the plasmid.

| Bacterium | Specific insertion | Test | Sequence of insertion site | Numbers of base pairs downstream of *glmS* [1] | System tested[2] | Comments | References |
|---|---|---|---|---|---|---|---|
| *Pseudomonas aeruginosa* PAO1 | Yes | Southern | - | - | Bao´s system | - | Klausen *et al*., 2003 |
| *Pseudomonas aeruginosa* PAOE1A | - | - | - | - | Grinter's system | Stable insertion | Grinter, 1983 |
| *Pseudomonas corrugate* strain 2140 | - | Southern | - | - | Barry's system | Strains was not changed after 4 years in soil | Choi *et al*., 2003 |
| *Pseudomonas fluorescens* 701E1 | Yes | Southern | - | - | Monsanto's system | Four isolates tested. Growth not affected, stability tested | Barry, 1986 |
| *Pseudomonas fluorescens* DR54 | Yes | PCR | AJ276127 | 29 | Bao's system | | Koch *et al*., 2001 |
| *Pseudomonas putida* KT2440 | Yes | PCR, Southern | [4] | 25 | Bao's system | Growth not affected, many isolates tested, stable and specific insertion | Lambertsen *et al*., 2003 |
| *Pseudomonas putida* GR12-*2* | Yes | Southern | | | Monsanto's system | | Staley *et al*., 1997 |
| *Pseudomonas putida* R20 | No | Southern | | | Monsanto's system | | Staley *et al*., 1997 |
| *Pseudomonas putida* PH6 | No | Southern | | | Monsanto's system | | Staley *et al*., 1997 |
| *Pseudomonas solanacearum* | Yes | Southern | - | - | pAS8Rep-1::Tn7[3] | 16 isolates tested, suicide system used | Boucher *et al*., 1985 |
| *Pseudomonas syringae* pv. glycinea PsgR4 | Yes | Southern | | | Monsanto's system | *lux*-based reporter system | Shen *et al*., 1992 |
| *Rhodospirillum rubum* | - | Southern | - | - | Bao's system | Stable, stability tested for 50 generations | Bao, 1991 |

[4] Sequenced PCR product of the region between Tn*7*R and *glmS*: CAGTTGATCAACACCTGACTACCCG

| **Bacterium** | **Specific insertion** | **Test** | **Sequence of insertion site** | **Numbers of base pairs downstream of *glmS*** [1] | **System tested**[2] | **Comments** | **References** |
|---|---|---|---|---|---|---|---|
| *Salmonella thyphimurium* | - | - | - | - | - | - | In Caig 1989: Mak and Craig, unpub observation |
| *Serratia marcescens* | - | - | - | - | - | - | In Caig 1989: Qadri *et al*., personal communication |
| *Sphingomonas yanoikuyae* B1 | Yes | Southern | U37523 | 93 | RKTV14::Tn7 | - | Wang and Lau, 1996 |
| *Xanthomonas campestris* pv. *campestris* NC PPB 1145 | Yes | Southern | - | - | pRK2013:: Tn7 | 10 tested | Turner *et al*, 1984 |

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