

## Reference Card

*ratB, sivH & shdA*

### Molecular and Phenotypic Analysis of the CS54 Island of *Salmonella enterica* Serotype Typhimurium: Identification of Intestinal Colonization and Persistence Determinants.

Robert A. Kingsley, et al. *Infect Immun.* 2003 February; 71(2): 629-640.

The *shdA* gene is carried on a 25-kb genetic island at centisome 54 (CS54 island) of the *Salmonella enterica* serotype Typhimurium chromosome. In addition to *shdA*, the CS54 island of *Salmonella* serotype Typhimurium strain LT2 contains four open reading frames designated *ratA*, *ratB*, *sivI*, and *sivH*. The *shdA* and *ratB* deletion strains exhibited a shedding defect in mice, whereas the *sivH* deletion strain resulted in reduced colonisation of the host organs.

These data suggest that the genes *ratB*, *sivH* and *shdA* allow the *Salmonella* bacterium to adhere to and colonise the gut of host organisms. Such genes therefore play an important role in gastrointestinal disease.



# Build a bug

## Gene Facts

*ratB, sivH & shdA*

- *ratB*, *sivH* and *shdA* are found on the *Salmonella* Typhimurium chromosome.
- It is thought that these genes allow the *Salmonella* bacterium to adhere to and colonise the gut of host organisms.
- The ability to invade and colonise the gut of a host causes symptoms such as diarrhoea and gastroenteritis.



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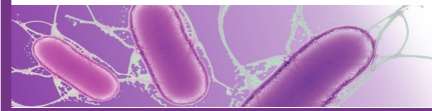
## Reference Card

*Pseudogenes*

### Complete genome sequence of a multiple drug resistant *Salmonella enterica* serovar Typhi CT18

J. Parkhill, et al. *Nature.* 2001 Oct 25;413(6858):848-52

The whole genome sequence of *Salmonella* Typhi, the causal agent of typhoid fever, has revealed some interesting features. Approximately 4% of protein coding genes have been degraded, resulting in the formation of 'pseudogenes' which no longer have gene function. This is in stark contrast to *Salmonella* Typhimurium, one of the causal agents of gastroenteritis, which contains almost no pseudogenes. Therefore pseudogenes may be involved in the ability of *Salmonella* to cause typhoid fever.

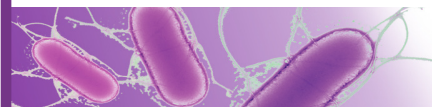


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## Gene Facts

*Pseudogenes*

- Approximately 4% of protein coding genes of *Salmonella* Typhi, (the causal agent of typhoid fever) have been degraded. This has resulted in the formation of 'pseudogenes', genes which no longer function. In other words they have been inactivated.
- *Salmonella* Typhimurium (the causal agent of gastroenteritis), contains almost no pseudogenes. Therefore it is thought that pseudogenes may be involved in the ability of *Salmonella* to cause typhoid fever.



# Build a bug

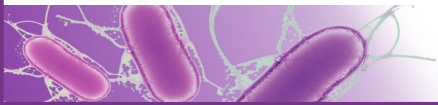
## Reference Card

*SPI-7, SPI-8, SPI-10*

### Invasive Salmonellosis in Humans

G. Langridge, et al.

*Salmonella* pathogenicity islands (SPIs) are clusters of genes on the chromosome which perform related functions. Some SPIs are found across all *Salmonella*, for example SPI-1 and SPI-2. Others are unique to particular serovars, for example *Salmonella* Typhi, the causative agent of typhoid fever, is the only *Salmonella* that encodes SPI-7, SPI-8 and SPI-10.



## Build a bug

## Gene Facts

*SPI-7, SPI-8, SPI-10*

- *Salmonella* pathogenicity islands (SPIs) are clusters of genes on the bacteria's chromosome which perform related functions.
- Some SPIs are found across all *Salmonella* species, for example SPI-1 and SPI-2. Others are unique to particular serovars (groups of microorganisms), for example *Salmonella* Typhi, (the causative agent of typhoid fever), is the only *Salmonella* that encodes SPI-7, SPI-8 and SPI-10.



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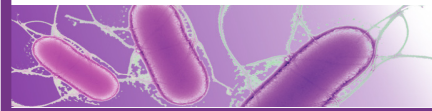
## Reference Card

*Fimbrial genes*

### Contribution of Fimbrial Operons to Attachment to and Invasion of Epithelial Cell Lines by *Salmonella* Typhimurium

A J. Baumler et al. *Infection and Immunity* 1996 May: 64(5): 1862–1865

The role of the *Salmonella* Typhimurium fimbrial operons, *lpf*, *fim*, and *pef*, in adhesion to and invasion of epithelial cell lines was investigated. A *Salmonella* Typhimurium *lpfC* mutant was unable to adhere to or to invade HEp-2 cells, while a *Salmonella* Typhimurium *fim* deletion mutant did not attach to or enter HeLa cells. These results suggest that adhesion is a prerequisite for invasion and that distinct fimbrial adhesins select different target cells for invasion by *Salmonella* Typhimurium.

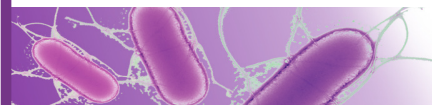


## Build a bug

## Gene Facts

*Fimbrial genes*

- Fimbriae are small hair-like projections from the surface of the bacterium. These protein projections (encoded by fimbrial genes) help the bacteria to adhere to each other, surfaces and host cells.
- *Salmonella* Typhimurium has distinct fimbrial operons that are used to stick to specific target cells in the digestive system.
- Fimbrial proteins are necessary for *Salmonella* bacteria to attach to and invade its host's cells.



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## Reference Card

### Capsule genes

#### Composition, Acquisition, and Distribution of the Vi Exopolysaccharide-Encoding *Salmonella enterica* Pathogenicity Island SPI-7.

Derek Pickard, et al. *Journal of Bacteriology*, Sept. 2003, p.5055-5065

Many bacteria encode a capsule, which acts as a protective barrier against the surrounding environment. Should the bacterium be present inside a host organism, the capsule provides protection against the host immune system by cloaking pathogen-specific antigen usually found on the bacterial cell surface. In *Salmonella*, the only serovars known to produce a capsule, called the Vi antigen, are *Salmonella* Dublin, Paratyphi C and Typhi.

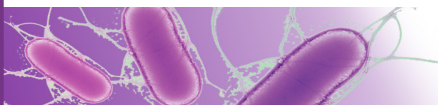


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## Gene Facts

### Capsule genes

- Capsule genes encode proteins which form a capsule a protective layer surrounding the bacteria. The capsule functions like an invisibility cloak allowing the bacterium to go undetected by the host's immune system.
- *Salmonella* Typhi is known to produce a capsule, known as the Vi antigen.



## Build a bug

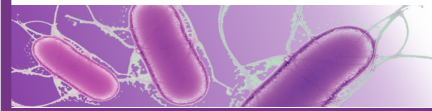
## Reference Card

### Virulence plasmid

#### Systemic infection of mice by wild-type but not Spv deficient *Salmonella* Typhimurium

P. Gulig, et al. *Infect Immun*. 1997 December; 65(12): 5191-5197

The *spv* genes of the virulence plasmid of *Salmonella* Typhimurium (and other nontyphoidal serovars of *S. enterica*) are involved in systemic infection of the host species by increasing the replication rate of the bacteria in host tissues beyond the intestines. The exception is *S. Typhi*, the cause of typhoid fever, which does not contain a virulence plasmid nor any of the *spv* genes.

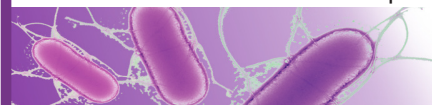


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## Gene Facts

### Virulence plasmid

- A plasmid is a circular piece of DNA found in some bacterial cells that replicates independently of the chromosomal DNA.
- The genes found on the virulence plasmid of *Salmonella* Typhimurium are involved in the infection of the host species by increasing the replication rate of the bacteria in host tissues beyond the intestines.
- *Salmonella* Typhi, the cause of typhoid fever, does not contain a virulence plasmid.



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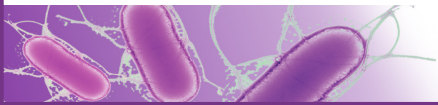
## Reference Card

*STY3258*

**Complete genome sequence of a multiple drug resistant *Salmonella enterica* serovar Typhi CT18.**

*Parkhill, J, et al. Nature. 2001 Oct 25; 413(6858):848-52.*

STY3258 is a putative uncharacterized protein cited in the above paper. However it does not speculate on the proteins role or function.



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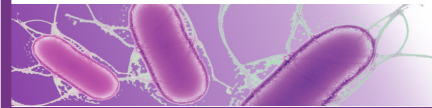
## Reference Card

*STM2133*

**Complete genome sequence of *Salmonella enterica* serovar Typhimurium LT2.**

*McClelland, M. et al. Nature. 2001 Oct 25; 413(6858):852-6.*

STM2133 is a putative cytoplasmic protein cited in the above paper. It does not speculate on the protein's role or function.



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## Gene Facts

*STY3258*

- STY3258 is an uncharacterized protein found on the genome of *Salmonella* Typhi, however there are currently no details of its specific function in the available scientific literature.

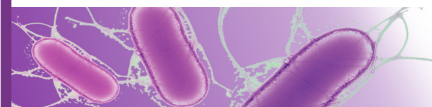


# Build a bug

## Gene Facts

*STM2133*

- STM2133 is an cytoplasmic protein found on the genome of *Salmonella* Typhimurium, however there are currently no details of its specific function in the available scientific literature.



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## Reference Card

*ECK1674*

### Genome sequence of enterohaemorrhagic *Escherichia coli* O157: H7.

Perna, N.T. et al. *Nature*. 2001 Jan 25; 409, 529-533

ECK1674 (also known as ECs1674) is a protein (from the UPF0745 protein family) cited in the above paper. It does not speculate on the protein's role or function.



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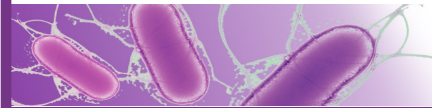
## Reference Card

*ECK4368*

### Genome sequence of enterohaemorrhagic *Escherichia coli* O157: H7.

Perna, N.T. et al. *Nature*. 2001 Jan 25; 409, 529-533

ECK4368 (also known as ECs4368) is a putative transport protein cited in the above paper. It does not speculate on the protein's role or function.



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## Gene Facts

*ECK1674*

- ECK1674 is a protein found on the genome of a strain of *Escherichia coli* however there are currently no details of its specific function in the available scientific literature.

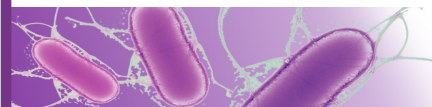


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## Gene Facts

*ECK4368*

- ECK4368 is a transport protein found on the genome of a strain of *Escherichia coli* however there are currently no details of its specific function in the available scientific literature.



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