Difference Between HFR and F+ Strains

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Key Difference - HFR vs F+ Strains

Bacterial conjugation is a method of sexual reproduction in bacteria and is considered as one mode of horizontal gene transfer in bacteria. It is possible between two bacteria in which one bacterium possesses fertility factor or F plasmid and second bacterium lacks F plasmid. During bacterial conjugation, F plasmids are generally transferred to the recipient bacterium, not the entire chromosome. Bacteria which possess the F plasmids are known as F+ strains or donors. They are capable of forming sex pili and transferring plasmids into other bacteria which receive them. F plasmid is free in the cytoplasm. Sometimes, F plasmid integrates into the bacterial chromosome and produce recombinant DNA. Bacteria which possess F plasmid integrated into their chromosomes are known as high frequency recombinant strains or Hfr strains. The key difference between F+ strains and Hfr is that **F+ strains have F plasmids in the cytoplasm freely without integrating into bacterial chromosomes** while **Hfr strains have F plasmids integrated to their chromosomes.**

What are F+ Strains?

Some bacterial strains possess F plasmids in addition to their chromosomes. These strains are known as F+ strains. They act as donor cells or males in bacterial conjugation. Bacterial conjugation is a sexual reproduction mechanism shown by bacteria which facilitates horizontal gene transferring between bacteria. F plasmids can replicate independently and contain fertility factor coding genes. Hence these extrachromosomal DNA (plasmids) are named F plasmids due to the F factor or fertility factor. Fertility factor coding genes are essential for transfer or conjugation. Bacterial strains which receive F plasmids from F+ strains are known as F- strains or recipient strains or females. F+ strains can donate their genetic material or extrachromosomal DNA to another bacterium.

Bacterial conjugation starts with the production of sex pili by F+ strains to contact with F- bacterium. Sex pilus facilitates the cell to cell communication and contact by forming a conjugation tube. This formation is governed by the fertility factor genes borne by F+ strain. F+ replicates its F plasmid and makes a copy of it to transfer into F- strain. The copied F plasmid is transferred to the F- strain via conjugation tube. Once it transfers, conjugation tube dissociates. The recipient strain becomes F+. During the bacterial conjugation, only the F plasmid is transferred from F+ strain to F- strain; the bacterial chromosome is not transferred.

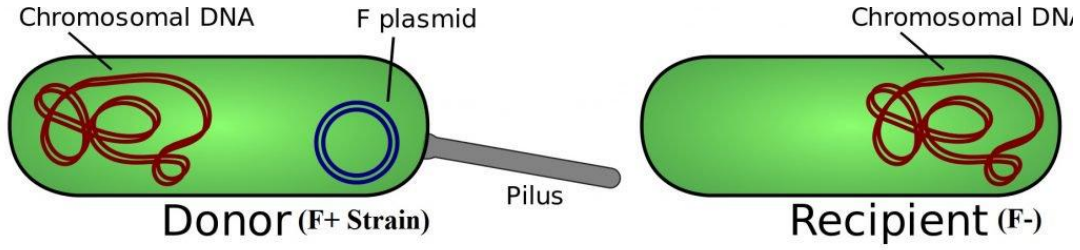

Figure 01: F+ strain and F- strain

What are HFR Strains?

Bacterial strains which have F plasmid integrated into the chromosomes are called **high-frequency recombination strains** or **Hfr strains**. In Hfr strains, F plasmid does not exist freely in the cytoplasm. F plasmid combines with bacterial chromosome and exists as one unit. This recombined DNA is known as high-frequency DNA or Hfr DNA. In other words, it is a bacterial strain which possesses Hfr DNA as a Hfr strain. Since Hfr strain has F plasmid or fertility factor it can act as a donor or male bacterium in bacterial conjugation. These Hfr strains attempt to transfer the entire DNA or a big part of DNA to recipient bacterium through a mating bridge. Some parts of bacterial chromosome or the entire chromosome can also be copied and transferred to the recipient bacterium when Hfr strain is involved is conjugation. Such Hfr strains are very useful in studying gene linkage and recombination. Hence, molecular biologists and geneticists use Hfr strain of bacteria (often E. coli) to study genetic linkage and map the chromosome.

High-frequency recombination occurs when a recipient bacterium receives three types of DNA after mating with Hfr strain through bacterial conjugation. These three types are, its own chromosomal DNA, F plasmid DNA and some parts of donor's chromosomal DNA. Due to this reason, such bacteria are named as Hfr strains. HFr strains can also be defined as derivatives of F+ strains.

F plasmids can integrate into bacterial chromosome and disintegrate back from the host chromosome. During disintegration, F plasmid can pick some genes near it from the host chromosome. Hfr bacterial strains which disintegrate with some host genes next to F plasmid integration sites are known as F' strains.

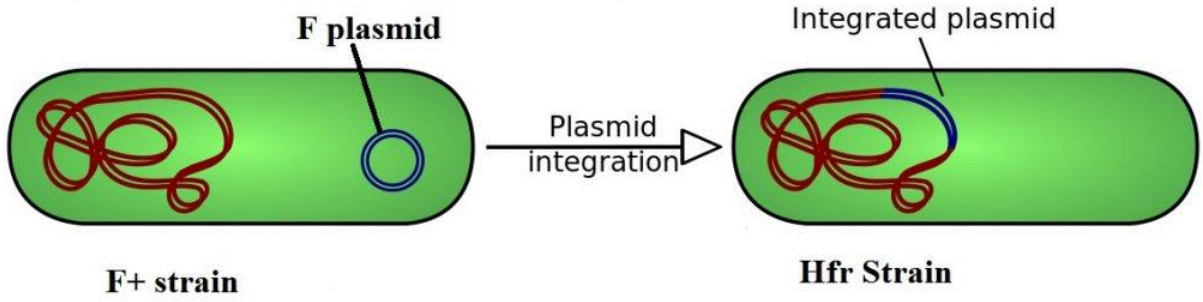

Figure 02: Hfr strain

What is the difference between HFR and F+ Strains?

HFR vs F+ Strains	
HFr strains are bacterial strains with Hfr DNA or F plasmid DNA integrated into bacterial chromosomes.	Bacterial strains which contain F plasmids are known as F+ strains. F plasmids contain fertility factor coding genes.
Fertility Factor	
The fertility plasmid is integrated into the host cell chromosomal DNA in Hfr cells.	Fertility plasmid is independent of chromosome in F+ cells
Efficiency	
Hfr are very efficient donors.	F+ cells are less efficient compared to Hfr strains.

Summary - Hfr and F+ Strains

Bacterial strains which have F plasmids are characterized as F+ strains. F plasmids contain a fertility factor or F factor which is essential for bacterial conjugation. These bacteria are able to transfer their F plasmid into bacteria which lack F plasmids. Once these F plasmids enter into recipient bacterium, it can exist independently or it can integrate with bacterial chromosome. Integrated F plasmid DNA and chromosomal DNA is known as Hfr DNA. Bacterial strains which bear Hfr DNA or F plasmid DNA integrated into bacterial chromosomes are known as HFr strains. This is the main difference between F+ and Hfr strains.

Reference:

1. Griffiths, Anthony JF. "Solved Problems." An Introduction to Genetic Analysis. 7th edition. U.S. National Library of Medicine, 01 Jan. 1970. Web. Available here. 01 June 2017.
2."Hfr cell." Wikipedia. Wikimedia Foundation, 30 Dec. 2016. Web. Available here. 01 June 2017.

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