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MATRIC NO: 18/MHS02/132

DEPARTMENT: MEDICAL LABORATORY SCIENCE

LEVEL: 200LVL

COURSE: MICROBIOLOGY

ASSIGNMENT

1. Discuss microbial variation and hereditary in bacteria
2. Explain microbial recombination

**ANSWER**

1) When a bacterial cell divides, the two daughter cells are generally indistinguishable. Thus, a single bacterial cell can produce a large population of identical cells or clone. On solid medium, a clone is manifested as an easily isolated colony. Occasionally, a spontaneous genetic change occurs in one of the cells. This change (mutation) is heritable and passed on to the progeny of the variant cell to produce a subclone with characteristics different from the original (wild type) parent. This is termed vertical inheritance. If the change is detrimental to the growth of the cell, the subclone will quickly be overrun by the healthy, wild type population. However, if the change is beneficial, the subclone may overtake the wild type population. This is an example of how evolution is directed by natural selection. MID 7 Spontaneous mutations are of two classes: point mutation, or change of a single nucleotide, and DNA rearrangement, or shuffling of the genetic information to produce insertions, deletions, inversions, or changes in structure. DNA rearrangements can affect a few to several thousand nucleotides. Both types of mutations generally occur at a low frequency (roughly once in 106 to 108 cells for any particular gene) and lead to a continuous, slow evolution of bacterial populations. Bacterial variation can also occur by horizontal transfer of genetic material from one cell to another. Consider two cells from different populations: bacterium B has features distinct from those of bacterium A. There are three possible mechanisms for transferring a trait from B to A: transformation, release and uptake of naked DNA; transduction, packaging and transfer of bacterial DNA by viruses, and conjugation, bacterial mating in which cells must be in contact. For all three process, the transferred DNA must be stably incorporated into the genetic material of the recipient bacterium. This can occur in two ways: recombination, or integration of the transferred DNA into the bacterial chromosome; or establishment of a plasmid, i.e., the transferred material essentially forms a mini chromosome capable of autonomous replication. Mutation and gene transfer work together to accelerate the rate of bacterial evolution. The spontaneous changes required to produce a new function (e.g. antibiotic resistance) may occur at a low frequency. However, once the function has developed, it can readily spread to other bacterial populations. The limitation is the probability and efficiency of gene exchange between different bacteria. Under certain conditions, gene exchange is very efficient.

2)Microorganisms have the ability to acquire genes and thereby undergo the process of **recombination.** In recombination, a new chromosome with a genotype different from that of the parent results from the combination of genetic material from two organisms. This new arrangement of genes is usually accompanied by new chemical or physical properties.

In microorganisms, several kinds of recombination are known to occur. The most common form is **general recombination**, which usually involves a reciprocal exchange of DNA between a pair of DNA sequences. It occurs anywhere on the microbial chromosome and is typified by the exchanges occurring in bacterial transformation, bacterial recombination, and bacterial transduction.

A second type of recombination, called **site-specific recombination,** involves the integration of a viral genome into the bacterial chromosome. A third type is **replicative recombination**, which is due to the movement of genetic elements as they switch position from one place on the chromosome to another.

The principles of recombination apply to prokaryotic microorganisms but not to eukaryotic microorganisms. Eukaryotes exhibit a complete sexual life cycle, including meiosis. In this process, new combinations of a particular gene form during the process of crossing over. This process occurs between homologous chromosomes and is not seen in bacteria, where only a single chromosome exists. Much of the work in microbial genetics has been performed with bacteria, and the unique features of microbial genetics are usually those associated with prokaryotes such as bacteria.