Difference Between Type I and Type II Restriction Enzyme

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Key Difference – Type I vs Type II Restriction Enzyme

A restriction enzyme, more commonly referred to as a restriction endonuclease, has the ability to cleave DNA molecules into small fragments. This cleaving process occurs near or at special recognition site of the DNA molecule called a restriction site. A recognition site is typically composed of 4-8 base pairs. Depending on the site of cleavage, restriction enzymes can be of four different types; Type I, Type II, Type III and Type IV. In addition to the site of cleavage, factors such as composition, the requirement of co factors and the condition of the target sequence are taken into consideration when differentiating restriction enzymes into four groups. During the cleavage of DNA molecule, the cleaving site can be either at the restriction site itself or at a distance from the restriction site. During the process of cleavage of DNA, the restriction enzymes create two incisions through each of the sugar phosphate backbones in the double helix of DNA. Restriction enzymes are mainly found in Achaea and bacteria. They utilize these enzymes as a defense mechanism against the invading viruses. The restriction enzymes cleave the foreign (pathogenic) DN, but not its own DNA. Its own DNA gets protected by an enzyme known as methyltransferase which makes modifications in the host DNA and prevents cleavage. **Type I restriction enzyme possesses a cleaving site which is away from the recognition site. Type II restriction enzymes cleave within the recognition site itself or at a closer distance to it.** This is the key difference between Type I and Type II restriction enzyme.

What is Type 1 Restriction Enzyme?

Type I restriction enzymes are pentameric proteins composed of three multi subunits: restriction subunit, methylation subunit, and DNA sequence recognition subunit. These subunits are non-identical. They were initially identified in two different forms of *Escherichia coli.* The cleavage site of these restriction enzymes is present at different random points, typically 1000 base pairs away from the recognition site. These restriction enzymes require ATP, Mg^{2+} and S-adenosyl-L-methionine for its activation. Type I restriction enzymes possess both methylase and restriction activities. Bacteria use restriction enzymes as a cellular defense mechanism from invading viruses. Restriction enzymes cleave viral DNA and destroy them. But in order to prevent the cleavage of its own host DNA, type I restriction enzyme provides a methylation

protection. This modifies host DNA and prevents cleavage. Even though these restriction enzymes are biochemically important, they are not used widely since they do not provide discrete restriction fragments or gel binding patterns.

What are Type II Restriction Enzymes?

Type II restriction enzymes contain two identical subunits within their structure. Homodimers are formed by type II restriction enzymes with the recognition sites. The recognition sites are typically palindromic and are undivided. It has a length of 4-8 base pairs. Unlike type I, Type II restriction enzyme's cleavage site is present at the recognition site or present at close distance to the recognition site. These restriction enzymes are biochemically significant and are widely available commercially. For its activation, it requires only Mg^{2+}. It doesn't have a methylation activity and only provides the function of restriction activity. These restriction enzymes bind to the DNA molecules as homodimers and have the ability to recognize symmetrical DNA sequences as well as asymmetrical sequences.

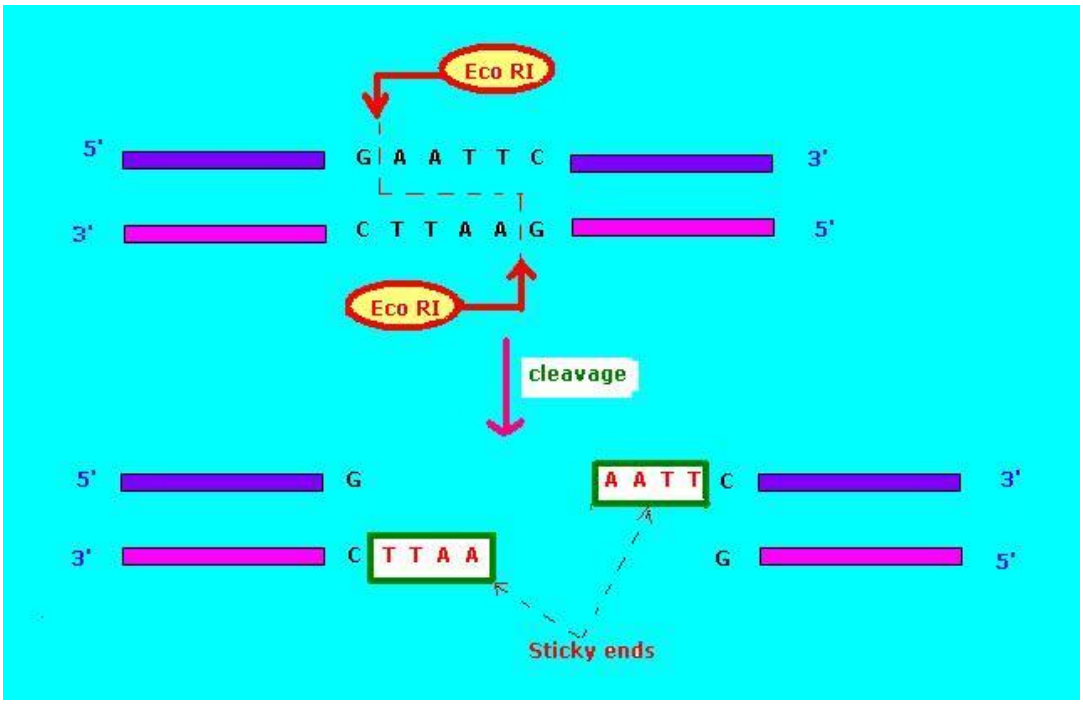

Figure 02: Type II Restriction Enzymes

What are the similarities between Type I and Type II Restriction Enzymes?

- Type I and Type II restriction enzymes are types of enzymes are restriction endonucleases which involve in the cleavage of DNA molecules into smaller fragments.
- Both are useful in Molecular biological techniques.

What is the difference between Type I and Type II Restriction Enzyme?

Type I vs Type II Restriction Enzyme	
Type I restriction enzyme is a DNA restriction enzyme which cleaves DNA at random sites far from its recognition site.	Type II restriction enzyme is a DNA restriction enzyme which cleaves DNA at defined positions close to or within the recognition site.
Composition	
Type I restriction enzyme is a complex enzyme which is made up of three (03) nonidentical sub units.	Type II restriction enzyme is a simple enzyme which is composed of two identical subunits.
Molecular Weight	
Type I restriction enzyme weighs 400,000 daltons.	Type II restriction enzyme has a weight range of 20,000 – 100,000 daltons.
Sequence of Cleavage	
Cleavage sequence is non specific in type I restriction enzyme.	Type II restriction enzyme has a specific sequence of cleavage.
Site of cleavage	
The site of cleavage is 1000 nucleotides away from the recognition site in type I restriction enzymes.	The site of cleavage is present at the recognition site or within a short distance from the recognition site in type II restriction enzyme.
Cofactors for Activation	
Type I restriction enzyme requires ATP, Mg^{2+} and S-adenosyl-L-methionine for its activation.	Only Mg2+ is required to activate type II restriction enzyme.
Methylation Activity	
The type I enzyme provides protection to	No methylation activity in Type II

the DNA by methylation.	restriction enzymes.
Activity of the Enzyme	
Type I restriction enzyme provides both endonuclease (restriction) and methylation activities.	Type II restriction enzyme provides only restriction activity.
Examples	
EcoK, EcoB	Hind II, EcoRI

Summary – Type I vs Type II Restriction Enzyme

Restriction enzymes are referred to as biological scissors which cleave DNA molecules into smaller substances. Restriction enzymes are differentiated into 04 different categories according to the location of the cleavage site with respect to the recognition site, co factors present, composition and condition of the target sequence. For its activation, Type I restriction enzymes require ATP, $Mg^{2+,}$ and S-adenosyl-L-methionine. The cleavage site of type I restriction enzyme is present typically 1000 base pairs away from the recognition site and provide the methylase protection to DNA. Type II restrictions enzymes only require Mg^{2+} for its activation. The cleavage site is present at the recognition site or close to it. It doesn't have a methylation activity and is widely available commercially. This is the difference between type I restriction enzyme and type II restriction enzyme.

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