Difference Between Topoisomerase I and II

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Key Difference - Topoisomerase I vs II

DNA is needed by a cell in order to divide into two daughter cells by cell division. DNA is duplicated by DNA replication. So, there should be a special mechanism in order to replicate the highly wound spiraled DNA. Topoisomerase is an enzyme that can cut DNA at a particular point and unravels the DNA twist and relieves the DNA supercoil nature. It is the enzyme that participates in winding and unwinding the DNA. The winding problem of DNA is raised due to the intertwined structure of double-stranded DNA. These types of topological problems created in the DNA doubled strands can be corrected by topoisomerases. They usually cut the DNA phosphate backbone either one or both strands and allows the DNA supercoil structure to be unwound. Later DNA backbone is resealed again. Bacterial and human topoisomerases are having similar mechanisms. Topoisomerase I and II are methods of dealing with supercoiled DNA. **Topoisomerase I cuts one strand in the double-stranded DNA and no ATP is required for its function. On the other hand Topoisomerase, II cuts both strands in DNA and needs ATP for its activity**. This is the **key difference** between Topoisomerase I and II.

What is Topoisomerase I?

Topoisomerase I is a class of enzyme that involves the regulation of DNA supercoiling. They manage the supercoiling in the DNA by creating single-stranded breaks and relegating the DNA strands. Their role is highly important for DNA replication and transcription. They are further subdivided into type IA and type IB. Type IA topoisomerases are referred to as prokaryotic topoisomerases I. On the other hand, type IB topoisomerases are referred to as eukaryotic topoisomerases I. Type IA and type IB topoisomerases are functionally different. The prokaryotic topoisomerase I can only relive the negative DNA supercoils. And eukaryotic topoisomerase I can introduce positive DNA supercoils, also they separate the DNA of daughter chromosome after replication, and relaxing this DNA.

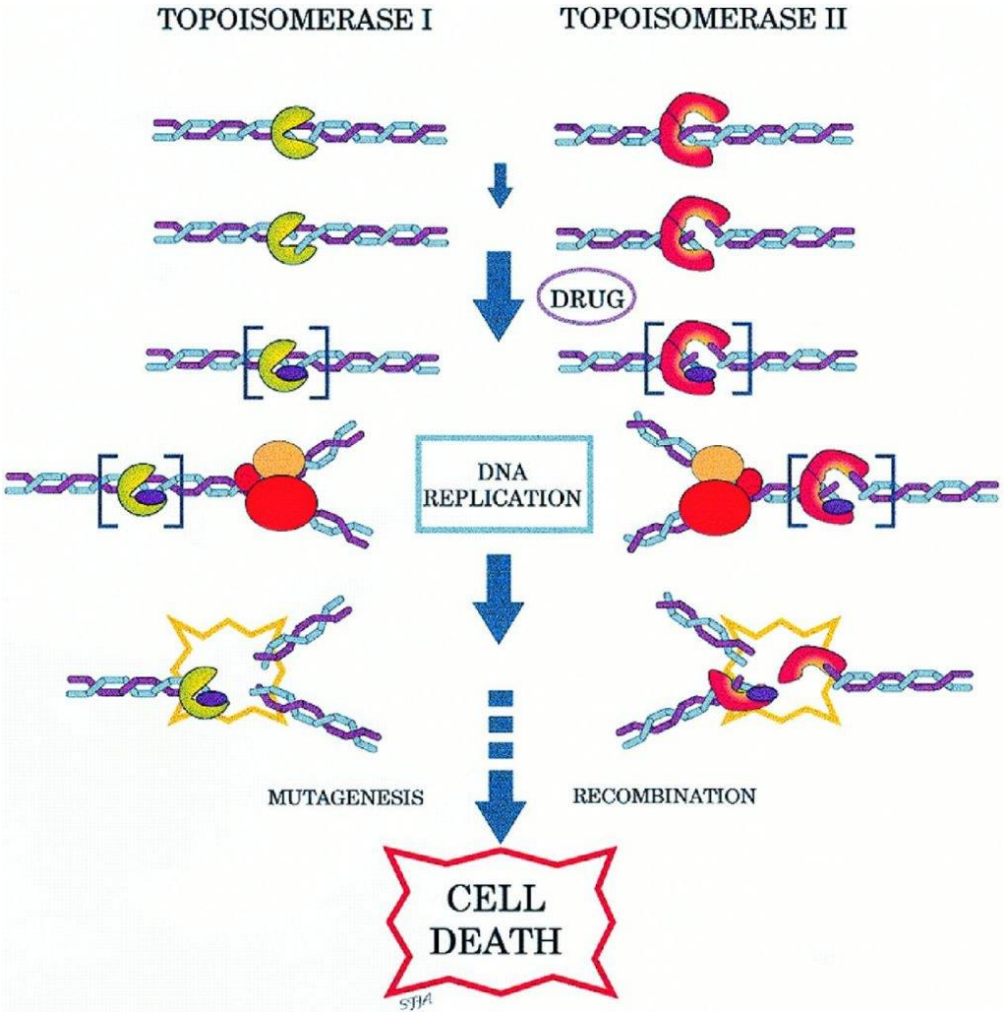

Figure 01: Topoisomerase I and II

The *Ecoli* topoisomerase I is a holoenzyme with three Zn (II) atoms in the tetracysteine motifs near its carboxy terminus. It is 97 kDa in weight. Topoisomerase I has several unusual features. It does not need ATP hydrolyzing to catalyze the topological rearrangement of DNA. The exiting feature of the topoisomerase I is, it is a fully functional monomer while most enzymes that involve the complex DNA topological rearrangements are oligomeric in nature.

What is Topoisomerase II?

In order to manage the DNA tangles and supercoils, the type II topoisomerase cut both the DNA strands simultaneously. They need ATP hydrolyzing for this activity. Type II topoisomerase change the linking number of circular DNA by ± 2. They are broadly classified into two categories namely, Type II A and Type IIB.

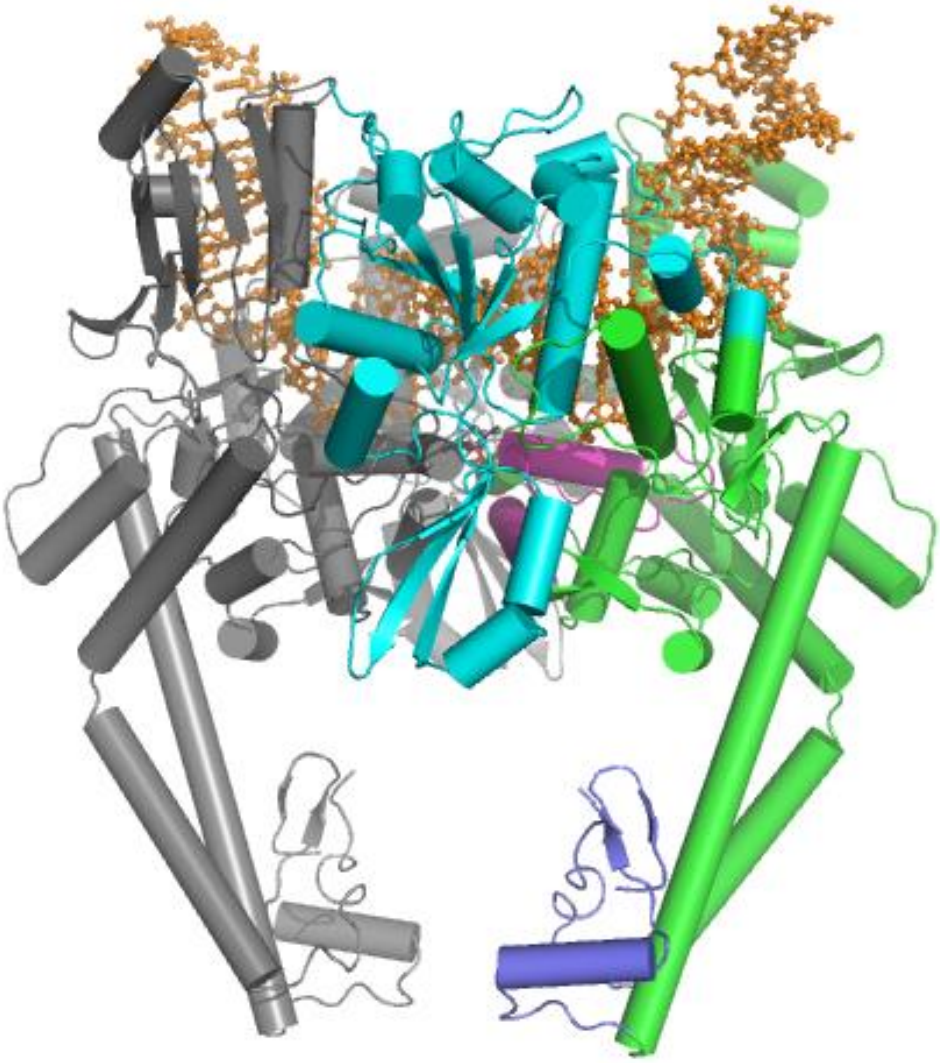

Figure 02: Topoisomerase II

Types II A topoisomerases include bacterial DNA gyrase, eukaryotic topoisomerase II, eukaryal viral topoisomerase alpha & beta and topoisomerase IV. Types II B topoisomerases include topoisomerase VI found in archaea and topoisomerase VI found in higher plants. The function of the topoisomerase II is cutting both strands of one DNA double helix and passes another unbroken DNA helix through it. Finally, the cut ends are relegated again. Inhibitor molecules for topoisomerase II can be found as, Hu-331, ICRF-193, and mitindomide.

What are the Similarities Between Topoisomerase I and II?

- Both are enzymes are involved in relieving supercoils.
- Both are found in prokaryotic organisms as well as in eukaryotic organisms.
- Both the topoisomerase I and II functions are highly important in order to maintain the proper DNA replication and transcription in the living cell.

- Both are protein in nature.

What is the Difference Between Topoisomerase I and II?

Topoisomerase I vs Topoisomerase II	
Type I topoisomerase is an enzyme which changes the degree of supercoiling of DNA by causing single-strand breaks and relegation.	Type II topoisomerase is an enzyme which changes the degree of supercoiling of DNA by causing double strands break and relegation.
ATP Hydrolyzing	
Topoisomerase I does not need ATP hydrolyzing for its function.	Topoisomerase II must need ATP hydrolyzing for its function.
DNA Breaking	
Topoisomerase I does single strand breaks.	Topoisomerase II does double strands break.
Structure	
Topoisomerase I is a monomer.	Topoisomerase II is a heterodimer.
Changing the Linking Number of Circular DNA	
Topoisomerase I is changing the linking number of circular DNA by units of strictly 1 or by multiples of 1(n).	Topoisomerase II is changing the linking number of circular DNA by units of ±2.

Summary - Topoisomerase I vs II

The topoisomerases are the enzymes that are involved in winding or unwinding of the DNA. They relieve the DNA supercoils and facilitate the DNA replication and transcription. These enzymes can be found in almost all organisms such as; humans, bacteria, higher plants, other bacteria, and archaea. Topological DNA rearrangements are done by topoisomerases. The ATP hydrolyzing is not needed for the function of topoisomerase I. Topoisomerase I cuts single strand in the DNA. On the other hand topoisomerase II cuts both strands in DNA and needs ATP for their function or activity. Later these cuts in DNA backbone are resealed again. The bacterial and human topoisomerases are having similar mechanisms in nature. This is the difference between Topoisomerase I and II.

Reference:

1.Topoisomerase I. Available here
2.“Type II topoisomerase.” Wikipedia, Wikimedia Foundation, 6 Nov. 2017. Available here
3.“Type I topoisomerase.” Wikipedia, Wikimedia Foundation, 28 Nov. 2017. Available here

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