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FACULTY OF ENGINEERING AND  
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## DNA Forms

The most common form of DNA which has right handed helix and proposed by Watson and Crick is called B-form of DNA or B-DNA. In addition, the DNA may be able to exist in other forms of double helical structure. These are A and C forms of double helix which vary from B- form in spacing between nucleotides and number of nucleotides per turn, rotation per base pair, vertical rise per base pair and helical diameter (Table 5.3).

### 1. The B-Form of DNA (B-DNA):

Structure of B-form of DNA has been proposed by Watson and Crick. It is present in every cell at a very high relative humidity (92%) and low concentration of ions. It has antiparallel double helix, rotating clockwise (right hand) and made up of sugar- phosphate back bone combined with base pairs or purine-pyrimidine.

The base pairs are perpendicular to longitudinal axis of the helix. The base pairs tilt to helix by  $6.3^\circ$ . The B-form of DNA is metabolically stable and undergo changes to A, C or D forms depending on sequence of nucleotides and concentration of excess salts.

### 2. The A-Form of DNA (A-DNA):

The A-form of DNA is found at 75% relative humidity in the presence of  $\text{Na}^+$ ,  $\text{K}^+$  or  $\text{Cs}^+$  ions. It contains eleven base pairs as compared to ten base pairs of B-DNA which tilt from the axis of helix by  $20.2^\circ$ . Due to this displacement the depth of major groove increases and that of minor groove decreases. The A-form is metastable and quickly turns to the D-form.

### 3. The C-Form DNA (C-DNA):

The C-form of DNA is found at 66% relative humidity in the presence of lithium (Li<sup>+</sup>) ions. As compared to A- and B-DNA, in C-DNA the number of base pairs per turn is less i.e.  $2\frac{2}{3}$  or  $9\frac{1}{3}$ . The base pairs show pronounced negative tilt by  $7.8^\circ$ .

### 4. The D-Form of DNA (D-DNA):

The D-form of DNA is found rarely as extreme variants. Total number of base pairs per turn of helix is eight. Therefore, it shows eight-fold symmetry. This form is also called poly (dA-dT) and poly (dG-dC) form. There is pronounced negative tilt of base pairs by  $16.7^\circ$  as compared to C form i.e. the base pairs are displaced backwardly with respect to the axis of DNA helix.

### 5. The Z-Form of DNA (Z-DNA) or Left Handed DNA:

In 1979, Rich and coworkers at MIT (U.S.A.) obtained Z-DNA by artificially synthesizing d(C-G)<sub>3</sub> molecules in the form of crystals. They proposed a left handed (synistral) double helix model with zig-zag sugar-phosphate back bone running in antiparallel direction.

Therefore, this DNA has been termed as Z-DNA. The Z-DNA has been found in a large number of living organisms including mammals, protozoans and several plant species.

#### **There are several similarities with B-DNA in having:**

- (i) Double helix,
- (ii) Two antiparallel strands, and
- (iii) Three hydrogen bonds between G-C pairing.

#### **In addition, the Z-DNA differs from the B-DNA in the following ways:**

- (a) The Z-DNA has left handed helix, while the B-DNA has right handed helix.
- (b) The Z-DNA contains zig-zag sugar phosphate back bone as compared to regular back bone of the B-DNA.

## The differences of ssDNA from the dsDNA are as below:

- (a) The dsDNA absorbs wavelength 2600 Å of ultra violet light constantly from 0 to 80°C, thereafter rise sharply, whereas in ssDNA absorption of UV light increases steadily from 20° to 90°C.
- (b) The dsDNA resists the action of formaline due to closed reactive site, while the ss DNA does not resist it due to exposed reactive sites.
- (c) Base pair composition in dsDNA is equal i.e. A=T and G=C, in ssDNA the composition of A, T, G, C is in proportion of 1:1.33:0.98:0.75.
- (d) The dsDNA always remains in linear helical form, while the ssDNA remains in circular form; however, it becomes double stranded only during replication (i.e. replicative form).

## 7. Circular and Super Helical DNA:

Almost in all the prokaryotes and a few viruses, the DNA is organised in the form of closed circle. The two ends of the double helix get covalently sealed to form a closed circle. Thus, a closed circle contains two unbroken complementary strands. Sometimes one or more nicks or breaks may be present on one or both strands, for example DNA of phage PM2 .

Histone like proteins appear to help the organization of bacterial DNA into This a coiled chromatin structure with the result of nucleosome like structure, folding and super coiling of DNA, and association of DNA polymerase with nucleoids. Several histones like DNA binding proteins have been described in bacteria