Assignment 6

Structures

Roll No : 2018113003

Question

Examine the structure of the RNA (PDB ID: 1Y26) and identify all base pairing interactions. List each of them with illustrations.

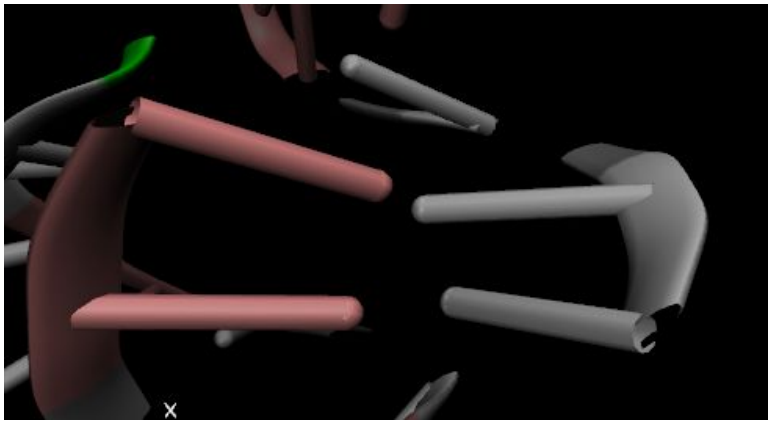
Answer

For getting the answer, the molecule was colored using the residue name, thus giving each residue a specific color and thus making each molecule easier to identify. The colors given by VMD are :

- Adenine: Pink
- Uracil: White
- Cytosine: Grey
- Guanine: Green

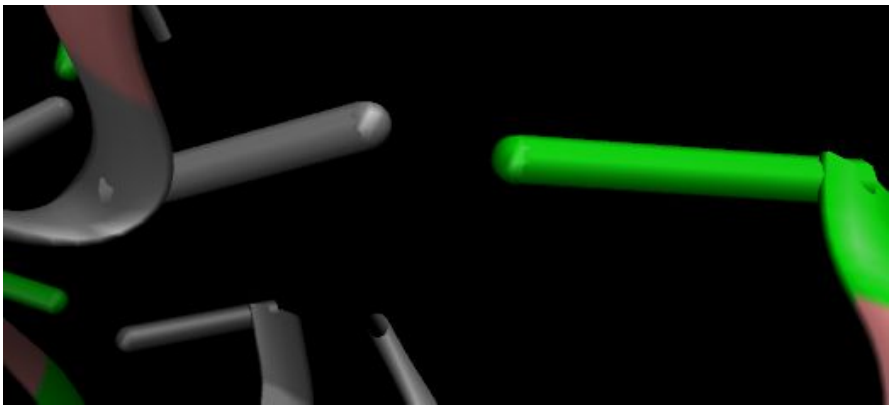
The base pair interactions that are present are :

1) A-U pair



1 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

2) G-C pair



Other base pair interactions do not exist.

Question

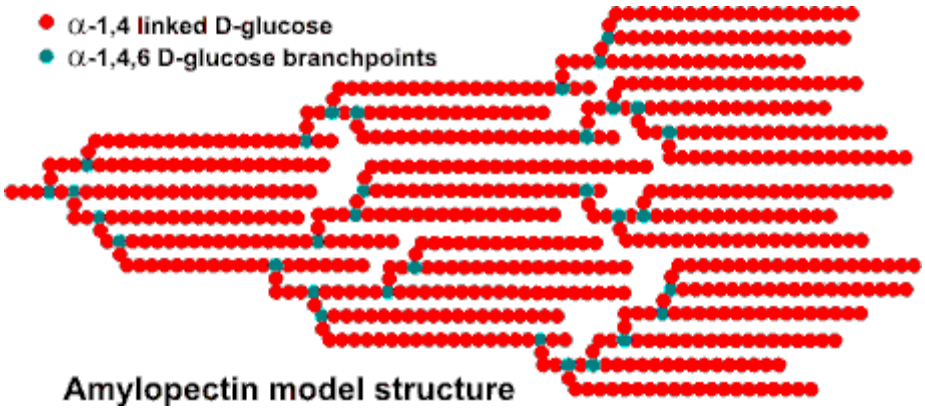
Discuss the structure of amylopectin in detail with illustrations

Answer

Amylopectin is a polymer of anhydroglucose with both 1,4 and 1,6 linkages between the monomers.

It has short chains consisting of 1,4 linkages held together by 1,6 linkages. So the structure is branched.

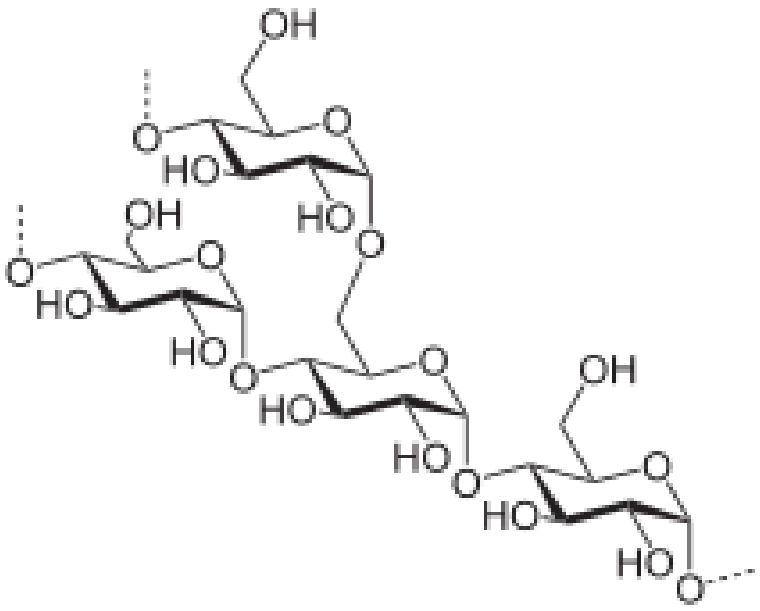
Amylopectin Structurewith linkages



2 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

Due to its high branching nature, it is a molecule which is degraded easily due to its many end points where enzymes can latch on to.

Detailed Structure of Amylopectin



In the above structure, glucose is in its boat structure with the branched molecule being connected by 1,6 linkage and others being a 1,4 linkage.

Each amylopectin molecule contains up to two million glucose residues in a compact structure with a hydrodynamic radius of 21-75 nm.

The molecules are oriented radially in the starch granule. As the radius increases, so does the number of branches required to fill up the space, with the consequent formation of concentric regions of alternating amorphous and crystalline structure.

There are three types of chains in a amylopectin molecule :

- A Chain

  Leads toward terminating end

- B chain

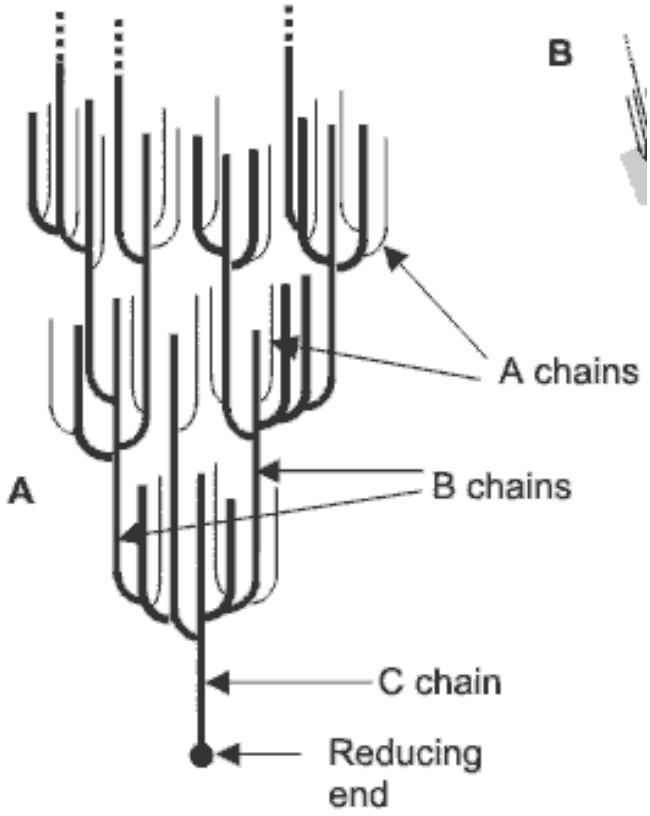
  Main chains that hold the molecule together

3 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

- C chain

The final terminating chain, that leads towards a reducing end

Chains in amylopectin molecule



Question

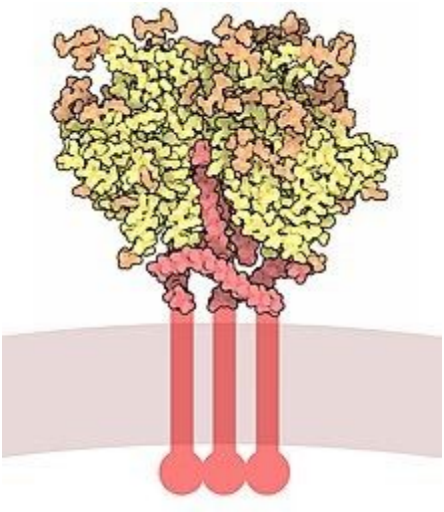
What are glycoproteins? Take a protein whose experimental structure is known, discuss the structural features and its functional aspects.

Answer

Glycoproteins are proteins which contain oligosaccharide chains covalently attached to amino acid side-chains. The carbohydrate is attached to the protein in a cotranslational or posttranslational modification.

4 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

That means that they have carbohydrates groups attached to the polypeptide chain. They also contain a sphingosine backbone in the structure.

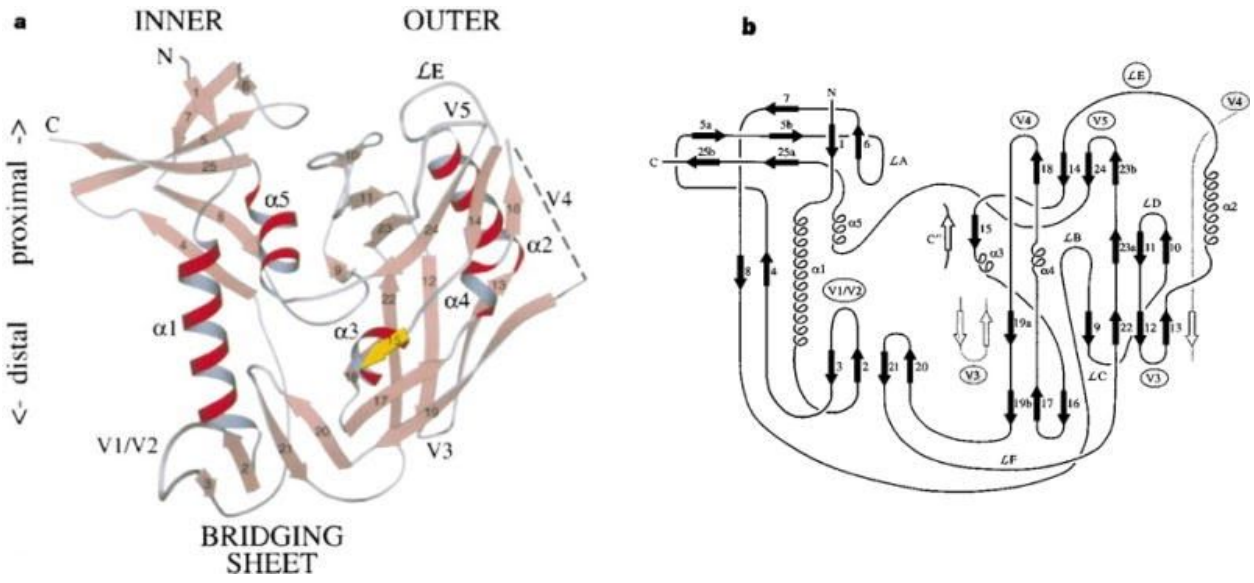


GP 120

GP120 is a glycoprotein which is found on the surface of HIV envelopes. It is vital for virus entry into the cells, as it is important in attachment to specific cell surface receptors.

5 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

The figure above is the ribbon diagram in which gp120 is in red and the molecules it is interacting with are also present there.



Detailed structure of GP120

In the figure above, a more detailed representation of GP120 is given. As seen above, the structure is divided into two parts, inner and outer.

The glycoprotein contains carbohydrates in its structure, which have many functions. One of which is immune evasion, that is performed by carbohydrate attached at asparagine 386 (HIV 1). The details are taken from this article [The carbohydrate at asparagine 386 on HIV-1 gp120 is not essential for protein folding and function but is involved in immune evasion]

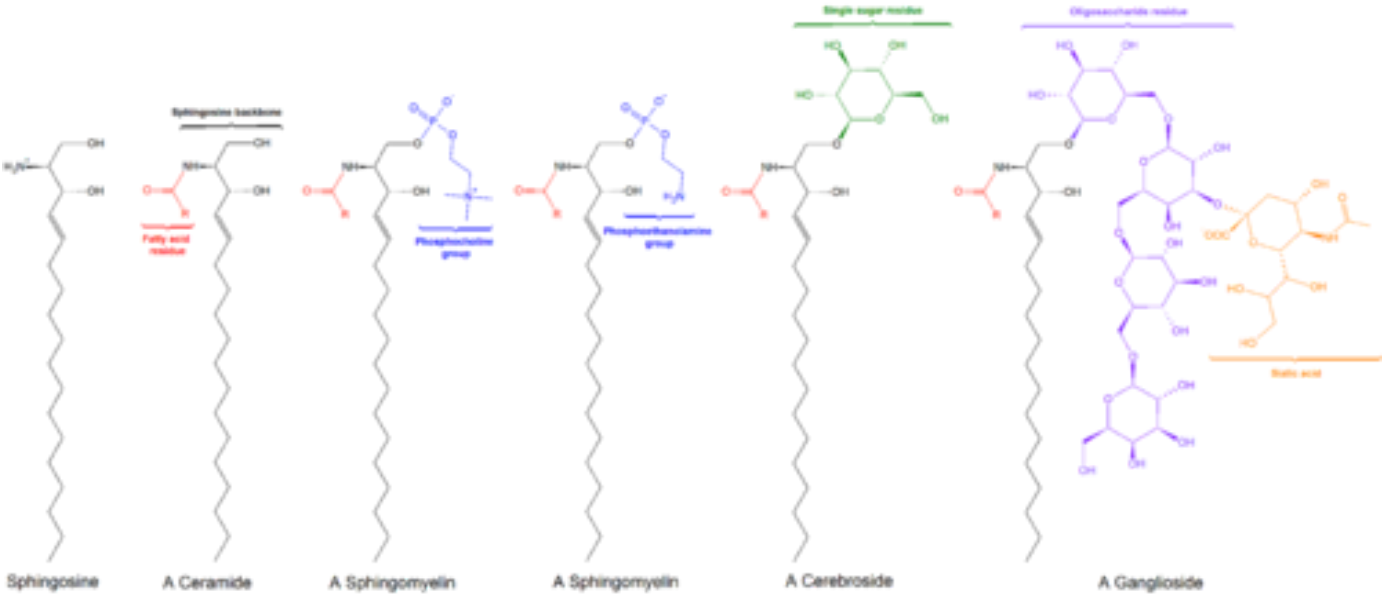
Question

What are sphingolipids?

Answer

They are lipids that contain the backbone of sphingoid bases. They were found in brain extracts in the 1870s. These compounds play important roles in signal transduction and cell recognition (found in brains).

6 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/



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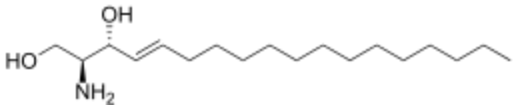
General structures

The structure of a sphingolipid, as can be seen above, is usually a C_{18} or C_{20} bases. Even their substituted products are important and are present above.

Sphingosine is the backbone which is vital in their classification and is an 18-carbon amino alcohol. This is the molecule that is the backbone of the sphingolipid and is hence important to its structure.



Structure of sphingosine

Question

Why does the composition of types of lipid molecules change with respect to cell type? Take some examples and discuss.

7 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/

Answer

Lipids can have varying structures depending on many different reasons. The article followed by me talks in general about lipids as a topic in general and how it is difficult to study them.

It also talks about how it is difficult to predict their structures of lipids in cells where biosynthesis has stopped. This tells me that very acute changes in conditions of cells can completely vary the structure of lipids.

As of currently, lipids are very difficult to work with due to various reasons, one of them being their nomenclature which are not representative of their structure and some molecules which have similar names can have completely different structures or vice versa. That leads to no nomenclature being representative of their function and thus difficult to work with.

Lipids are mainly composed of hydrocarbons in their most reduced form, making them an excellent form of energy storage. As lipids are hydrocarbons in lowest reduced forms, different conditions can affect them severely, as a highly oxidizing environment can change them easily.

They are also primary sources of stored energy and it can depend on their abundance. They also over time can change. Thus depending on when it was formed, the composition and thus the structure might be different.

These are some of the reasons I hypothesized that there can be a reason for differences in lipids with different cells. I could not find any one source that would talk about this exact topic, and I had piece it together using different sources.

8 References :http://www1.lsbu.ac.uk/water/starch.html, https://en.wikipedia.org/wiki/Amylopectin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055261/