

# Difference Between Ribose and Ribulose

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## Key Difference – Ribose vs Ribulose

Carbohydrates are the main macronutrients present in the body. They are composed of carbon (C), hydrogen (H) and oxygen (O). Carbohydrates can be monosaccharides, disaccharides, and polysaccharides. The H:O ratio is 2:1. The most basic units of carbohydrates are monosaccharides. They are known as simple sugars. Since they are considered to be the simplest compounds, they cannot be further hydrolyzed. Monosaccharides give rise to various other compounds such as disaccharides and polysaccharides. Ribose and ribulose are considered as monosaccharides and are pentose sugars containing 5 carbon atoms. **Ribose is more commonly known as aldopentose sugar due to the presence of an aldehyde (-CHO) functional group. Ribulose contains a ketone (-C=O) functional group and is referred to as a ketopentose sugar.** This is the key difference between ribose and ribulose.

## What is Ribose?

Ribose is a pentose sugar with the molecular formula  $C_5H_{10}O_5$ . It is more commonly known as **aldopentose sugar** due to the presence of an aldehyde functional group. The carbon atoms in the ribose structure are numbered from C1 to C5; this numbering starts from the carbon atom attached to the functional group OH. Deoxyribose and ribose sugars are closely related. Their difference is mainly due to the OH group; OH group is attached to C2 in deoxyribose; hydrogen atom is connected to C2 in ribose.

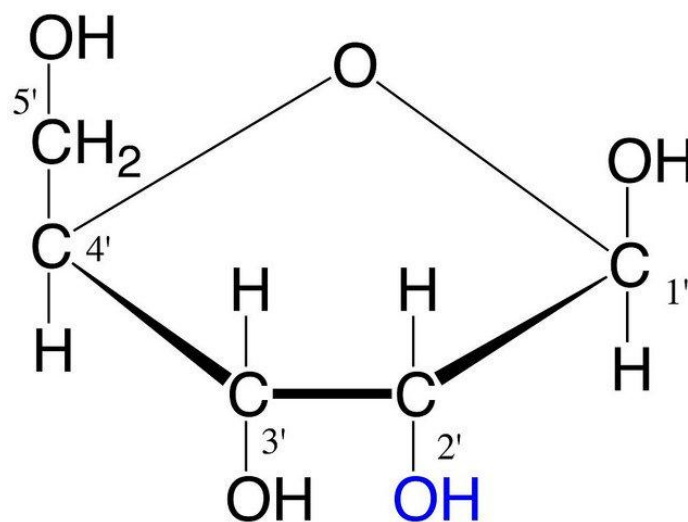
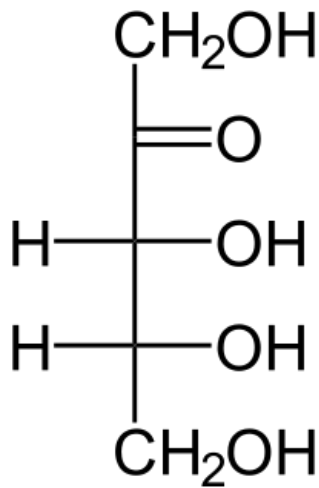


Figure 01: Ribose

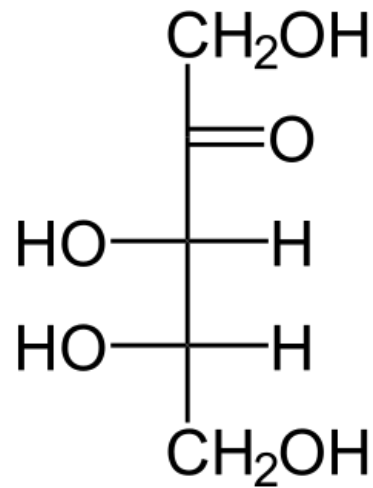
Ribose is an important sugar that is involved in the synthesis of [nucleotides](#). The backbone of ribonucleic acid (RNA) is composed of ribose sugar which alternates with the [phosphate](#) groups. The formation of the backbone is completed once it binds to the nitrogenous bases. Ribose phosphates are considered to be the major components of nucleotide [coenzymes](#). Microorganisms utilize this in order to synthesize the amino acid histidine. Ribose is not only found in RNA; it is present as a major component of [ATP](#) (Adenosine triphosphate). ATP is considered as the energy currency of all cells. In humans, during strenuous exercise workouts, energy is depleted excessively. In order to enhance protein synthesis and regain the depleted energy requirements, ribose supplements are recommended.

## What is Ribulose?

Ribulose, being a ketopentose, is a monosaccharide which contains five carbon atoms along with ketone functional group. There are two possible enantiomers of ribulose. They are D-ribulose (D-erythro-pentulose) and L-ribulose (L-erythro-pentulose). Ribulose is synthesized through the pentose phosphate pathway and plays an important role in the formation of numerous bioactive substances. The pentose phosphate pathway is a metabolic pathway which is parallel to glycolysis, and it consists of two distinct pathways. Here, NADPH is generated in the oxidative phase whereas pentose is generated through the non-oxidative phase. D-ribulose is considered as an example as it is an intermediate in the fungal pathway which helps in the production of D-arabitol. Furthermore, D-ribulose and 1,5-bisphosphate combines with carbon dioxide initially in the [photosynthesis](#) process in green plants. Ribulose 1,5-bisphosphate (RuBP) is a colourless anion and a double phosphate ester of the ketopentose; Ribulose. Ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) carries out the catalysis of the reaction between RuBP and carbon dioxide during photosynthesis. This is the initial step of carbon fixation; thus, carbon dioxide is converted to energy-rich molecules such as glucose. In the [Calvin cycle](#), RuBP is produced through the phosphorylation of ribulose-5-phosphate by ATP.



D-Ribulose



L-Ribulose

Figure 02: Ribulose

### What are the similarities between Ribose and Ribulose?

- Both ribose and ribulose are monosaccharides.
- They are pentose sugars containing 5 carbons.
- They share a common chemical formula,  $\text{C}_5\text{H}_{10}\text{O}_5$
- Both are structural isomers.

### What is the difference between Ribose and Ribulose?

<b>Ribose vs Ribulose</b>	
Ribose is an aldose sugar-containing an aldehyde group (-CHO).	Ribulose contains a ketone group (-C=O) and is referred to as a ketose sugar.
<b>Double Bond</b>	
In ribose, the first carbon consists of a double bond.	In ribulose, the double bond is on the second carbon.
<b>Function</b>	
The backbone of ribonucleic acid (RNA) is formed by ribose.	In the Calvin cycle (dark reaction) of photosynthesis, ribulose biphosphate is the initial $\text{CO}_2$ acceptor.

## Summary – Ribose vs Ribulose

Carbohydrates are the major macronutrients present in the body. Monosaccharides are simple sugars that have the ability to synthesize different compounds such as disaccharides and polysaccharides. Ribose and Ribulose are two monosaccharides. Both are pentose sugars. Ribose consists of an aldehyde functional group and is commonly referred to as aldopentose sugar. Ribulose is known as ketopentose sugar due to the presence of a ketone functional group. This is the difference between Ribose and Ribulose. Due to these structural differences, ribose and ribulose have varied functions in the living system.

### References:

1. Reid, Danielle. "Aldose vs. Ketose Sugars." Study.com. [Available here](#). Accessed 18 Aug. 2017.
2. Arrington, Derrick. "What is Ribose? – Structure, Overview." Study.com. [Available here](#). Accessed 18 Aug. 2017.

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