CARBOHYDRATE

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Introduction

- Carbohydrates are organic compounds with the basic structure $C_x(H_2O)_y$.
- Carbohydrates provide energy when consumed.
- Also known as hydrates of carbon, saccharides, polyhydroxy aldehyde/ketones.
- Our bodies break down carbohydrates to extract energy. Carbon dioxide and water are released in the process.
- In plants, energy from the sun is used to convert carbon dioxide and water into the carbohydrate glucose.

Classification of Carbohydrate

3 types of carbohydrates

- Monosaccharides
- Oligosaccharides (Disaccharides Trisaccharides and Tetrasaccharides)
- Polysachharides

- **Monosaccharide's** are simple sugars, or the compounds which possess a free aldehyde (CHO) or ketone(C=O) group and two or more hydroxyl (OH) group.
- They are the simplest sugars and they cannot be hydrolyzed into smaller units.
- Monosaccharides contain a single carbon chain and are classified on the basis of number of carbon atoms they possess, and as **aldoses**(ex:glucose)and **ketoses** (ex: fructose) depending upon their groups.

- The most abundant monosaccharide-glucose(6 C)
- Glucose occures in ripe fruits, flowers, honey, beetroot etc. Glucose in the blood is the source of energy for animals.
- Fructose(levulose) is found in fruits and honey, is the building unit of the polysaccharide, insulin, and is the structural unit of sucrose.
- Galactose, which is not found free in natural food, is a component of milk sugar(lactose) and agar agar.

Structure

Carbohydrates are represented by two types of formulae—

- The Fischer Projection formula
- The Haworth Cyclic Structure

Fischer Projection

D and L Notations

In a Fischer Projection, the –OH group on the

- Chiral carbon farthest from the carbonyl group determines an L or D isomer.
- Left is assigned the letter L and right is assigned the letter D.

L-glucose and D-glucose

Disacharides

- A disaccharide is the sugar formed when two monosaccharides(simple sugars) are joined by glycosidic linkage.
- Soluble in water.
- The monosaccharides within them are linked by a glycosidic bond(or glycosidic linkage), the position of which may be designated α- or β- or a combination of the two.
- Ex: sucrose, lactose and maltose.

Maltose: It is an intermediary in acid hydrolysis of starch and can also be obtained by enzyme hydrolysis of starch.In the body, dietary starch digestion by Amylase in gut yields maltose, which requires a specific enzyme maltase to form glucose. On hydrolysis, Maltose yields two molecules of glucose(1,4 α-glycosidic linkage).It is a reducing sugar.

- **Lactose** is milk sugar and found in appreciable quantities in milk to the extent of about 5 percent and occures at body temperature as an equilibrium mixture of the α and β forms in a 2:3 ratio. It is not very soluble and not so sweet. It is dextrorotatory. The specific enzyme which hydrolyses is **lactase** present in intestinal juice. On hydrolysis it yields **D-glucose** and **D-galactose(1,4 β glycosidic linkage)**.

Sucrose is a table sugar. Also known as **Cane Sugar,** as obtained from sugarcane. Also obtained from sugar beet, sugar maple. Occurs in pineapples and carrots. It is very soluble and very sweet and on hydrolysis yields **Glucose** and **Fructose.** The specific enzyme which hydrolyzes sucrose is **sacrase** present I intestinal juice. As both aldehyde and ketone groups are linked together(α 1-2), it doesnot have reducing properties.

OLIGOSACCHARIDES

Those sugars yield 3 to 10 monosaccharide units on hydrolysis, e.g. Maltotriose.

Oligosaccharides contain same or different monosaccharides or their derivatives.

Trisaccharides's: Raffinose (Glucose, galactose and fructose)

Tetrasaccharides: Stachyose (2 Galactoses, Glucose and Fructose

Pentasaccharides: Verbascose (3 Galactoses, Glucose and Fructose)

Hexasaccharides : Ajugose (4 Galactoses, Glucose and Fructose)

Polysaccharides

These are large number of glucose units linked together by glycosidic bond. They can be classified into two groups:

1. Homo –polysaccharide: are made up of one type of monosaccharide units. Ex: Cellulose, Starch, Glycogen.
2. Hetero –polysaccharide: are made up of two or more types of monosaccharide units. Ex : Fibre, Blood sugar, Muscles, Gums.

Functions of polysaccharide

- **Storage polysaccharide:** polysaccharides such as starch and glycogen are called storage polysaccharides because they are stored in the liver and muscles to be converted to energy later for body functions. Starch is found in plants whereas glycogen is found in animals.
- **Structuaral polysaccharides:** cellulose are structuaral polysaccharides which are found in the cell walls of plants. Another structuaral polysaccharide is chitin.

Sources of Carbohydrate

Honey, Molasses, Potatoes, Rice, Millet, Cereals,

Dairy: Milk, Yoghurt, Ice cream

Fruit: Whole fruit and Fruit juice

Grains: Bread

Cereal: Rice, Bread

Legumes: Beans

Starchy vegetables: Potatoes and Corn

Basic concepts of starch, cellulose, glycogen, pectin, agar-agar

STARCH

- Starch is the predominent food reserve substances in plants and provides 70-80% of the calories consumed by humans.
- Starch constitute most of the digestible carbohydrate in the human diet.
- Sources: Corn, wheat, rice, potato, sweet potato etc.

Features:

- ❖Starch granules are relatively dense ad insolubleand hydrate only in cold water.
- ❖Starch can be dispersed in cold water, producing low viscosity slurry.
- ❖Starch granules are composed of a mixture of two polymers: an essentially linear polysaccharide called amylose, and a highly branched polysaccharide called amylipectin.

PECTINS

- Commercial Pectins are galacturonoglycans{Poly(α-D-galactopyranosyluronic acids) with various esters of methyl ester groups.
- Commercial pectins are obtained from citrus peel and apple pomace.
- Pectins have an unique ability to form spreadable gels.

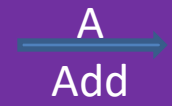
Description

- Appearance : Coarse or fine powder
- Colour: yellowish white
- Odour: odourless
- Taste: Mucilageneous taste.

BASIC IDEA ABOUT GELATINIZATION,RETROGRADATIO N,CARAMELIZATION AND MALLIARD BROWNING

STARCH GELATINIZATION

- Starch gelatinization is the process where starch and water are subjected to heat causing the starch granules to swell.
- As a result, the water is gradually absorbed in an irreversible manner.
- This gives the system a viscous and transparent texture.
- The result of the reaction is a gel, which is used in sauces, puddings, creams.

Raw starch granules(made up of amylose and amylopectin)  Addition of water breaks up amylose crystallinety and disrupts helices Granules Swell 

Addition of heat more water causes more swelling. Amylose begins to diffuse out of granules