Lecture 3

CARBOHYDRATES

Carbohydrates

- Accounts for a large portion of animal's daily food supply
- Are made up of C, H, O with an empirical formula $C_n(H_2O)n$
- Includes sugars, starch and cellulose
- Very little occurs as such in animal body
- Form largest (3/4) of plant dry weight
- Formed by photosynthesis in plants
- Digested into crude fibre (cellulose, hemicelluloses, lignin) which are poor digested and nitrogen free extract (soluble sugars and starches) which are readily digested
- Stored in animal body by converting its fats
- Functions mainly as energy supply, heat production and building stones for other nutrients.

The major function of carbohydrate in metabolism is as a fuel to be oxidized and provide energy for other metabolic processes. Carbohydrate is utilized by cells mainly in the form of glucose.
The three principal monosaccharide resulting from the digestive processes are glucose, fructose and galactose. Fructose may result from high intake of sucrose while galactose is of major significance when lactose is the principal carbohydrate in the diet (lactation), however, fructose and galactose are readily converted to glucose by the liver.
The intermediary metabolisms of carbohydrate in the mammalian organisms are as follows:

(1) Glycolysis – oxidation of glucose or glycogen to pyruvate and lactate by the Embden – Meyerhof pathway

(2) Glycogenesis – The synthesis of glycogen from glucose

(3) Glycogenolysis – the breakdown of glycogen to glucose in liver and to pyruvate and lactate are main products in muscle

(4) Oxidation of pyruvate to Acetyl – COA – this is a necessary step prior to the entrance of the products of glycoysis into the citric acid cycle, which is the final common pathway for the oxidation of carbohydrate, fat and protein

(5) Gluconeogenesis – formation of glucose or glycogen from non carbohydrate sources mainly in the citric acid cycle and glycolysis. Substrate for gluconeogenesis are glucogenic amino acids, lactate, glycerol and in the ruminant propionate.

(6) Hexose Monophosphate Shunt (pentose phosphate pathway) – is an alternative pathway to the Embden-Meyerhof pathway for the oxidation of glucose.

CLASSIFICATION

Carbohydrates are the ultimate source of most of our food – we act starch-containing grain or tubers or feed it to animals to be converted into meat and fat which we then eat.

A carbohydrate that cannot be hydrolysed to simpler compounds is a Monosaccharide.

A carbohydrate that can be hydrolysed to two monosaccharide molecules is a Disaccharide.

A carbohydrate that can be hydrolysed to many monosaccharide molecules is called a Polysaccharide.

Sweet carbohydrates – contained in large quantities in many foods – confectioneries, soft drinks, cakes because of the sweet taste e.g. refined sugar which supplies only energy. Excessive consumption of sweet carbohydrate causes dental decay especially in children. Others are fructose in fruit, honey, lactose in milk and malt.

Non-sweet carbohydrates – not sweet at all e.g. starch, it is the bulk in our food as in yams, bread, beans and cereals. Contains other valuable nutrients.

The main types of food/feed carbohydrates, their monosaccharide composition and their most common sources are listed below:

Table displaying the common food carbohydrates, types, composition and sources

Type	**Composition**	**Sources**
Polysaccharides		
Starch, dextrins	D-glucose	Cereals, roots, tubers, plantains
Cellulose	D-glucose	Cereals, fruits, vegetables
Glycogen	D-glucose	Liver, animal tissue, sweet corn
Hemicelluoses	L-Arabinose, D-xylose	Cereals, fruits, vegetables
Gums	L-Rhamnose, D-galactose, mannose, glucose, glucuroni	Cereals, legumes, nuts, seaweeds
Pentosan	L-Arabinose, D-xylose	Fruits, vegetables
Oligosaccharides		
Raffinose, Stachyose	D-gal, D-glu,	Legume seeds, cereals
Maltooligosaccharides	D-Glu	Starch syrups, malt
Dissacharides		
Sucrose	D-glu, D-fru	Sugarcane fruits, vegetables
Maltose	D-glu	Starch syrups, malt, honey
Lactose	D-gal, D-glu	Milk, dairy products