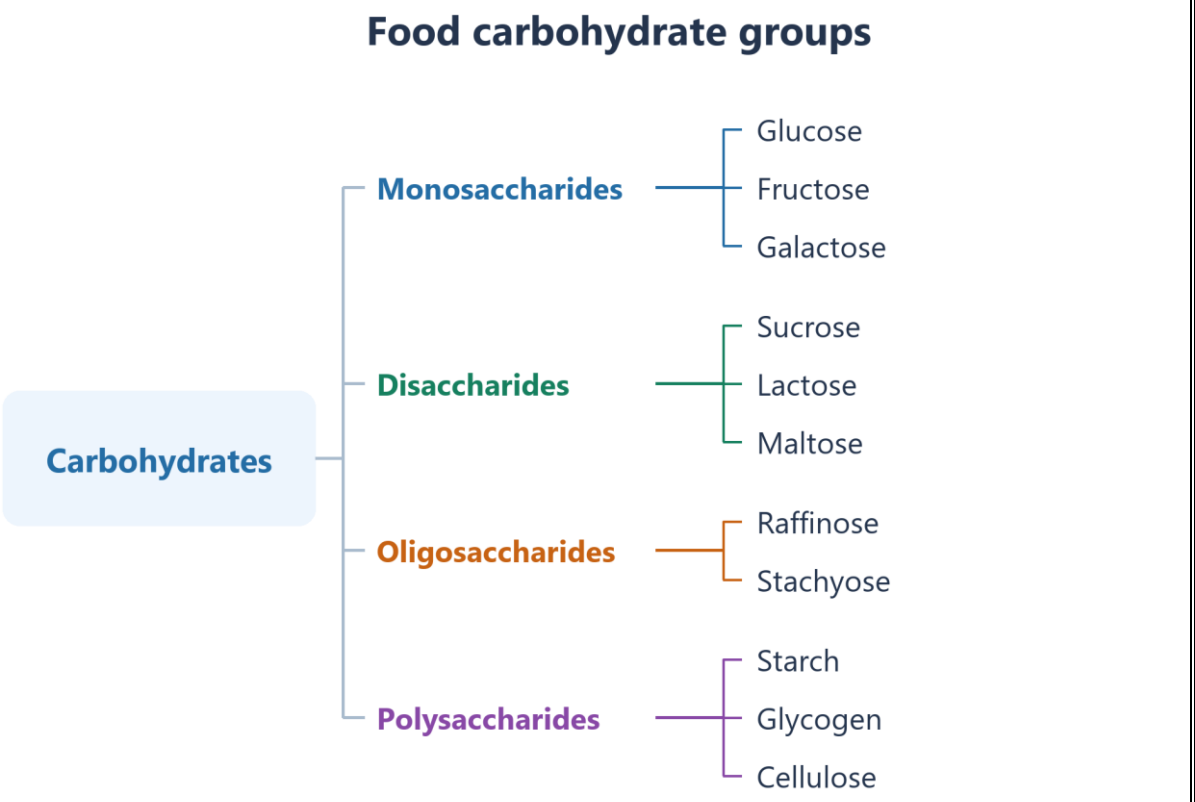
Carbohydrates

Classification and Properties of Food Carbohydrates

- Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen.
- Carbohydrates are the major source of energy in the human diet.
- They are found in foods such as cereals, fruits, vegetables, milk, legumes, and sugars.

Classification of Food Carbohydrates



Carbohydrates are classified by the number of sugar units in their structure.

A. Monosaccharides

- Monosaccharides are the simplest form of carbohydrates and cannot be broken down into smaller carbohydrate units.
- They are rapidly absorbed by the body.

Examples

- Glucose is the main source of energy for body cells.
- Fructose is commonly found in fruits and honey.
- Galactose is a component of milk sugar.

B. Disaccharides

- Disaccharides consist of two monosaccharide units joined together by a glycosidic bond.

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Examples

- Sucrose is composed of glucose and fructose.
- Lactose is composed of glucose and galactose.
- Maltose is composed of two glucose molecules.

C. Oligosaccharides

- Oligosaccharides contain three to ten monosaccharide units.
- They are present in legumes, onions, garlic, and certain vegetables.

Examples

- Raffinose and stachyose are common oligosaccharides.

D. Polysaccharides

- Polysaccharides contain many monosaccharide units linked together.
- They are usually complex carbohydrates.

Examples

- Starch is the main storage carbohydrate in plants.
- Glycogen is the storage carbohydrate in animals.
- Cellulose is a structural carbohydrate found in plant cell walls.

Properties of Food Carbohydrates

1. Sweetness

- Simple sugars generally have a sweet taste.
- Fructose is sweeter than glucose and sucrose.

2. Solubility

- Monosaccharides and disaccharides dissolve easily in water.
- Most polysaccharides have limited solubility.

3. Reducing Ability

- Some carbohydrates can act as reducing agents.
- Glucose, lactose, and maltose are reducing sugars.

4. Fermentability

- Certain carbohydrates can be fermented by microorganisms.
- Fermentation produces substances such as acids, alcohol, and gases.

5. Viscosity and Gel Formation

- Some polysaccharides increase the thickness of foods.

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- Starch and pectin contribute to gel formation.

6. Water-Holding Capacity

- Carbohydrates can absorb and retain water.
- This property influences food texture and shelf life.

General Methods of Analysis of Food Carbohydrates

- Carbohydrate analysis is performed to determine the type and quantity of carbohydrates present in food.
- These methods help evaluate nutritional value, quality, and compliance with food standards.

Objectives

- To measure total carbohydrate content.
- To identify specific sugars and starches.
- To ensure food quality and labeling accuracy.
- To detect adulteration and contamination.

Methods of Analysis

1. Calculation by Difference Method

- Total carbohydrate content is commonly estimated by subtracting the percentages of moisture, protein, fat, ash, and fiber from 100.

Formula

  - Total carbohydrates (%) = 100 − [Moisture + Protein + Fat + Ash + Fiber]

2. Chemical Methods

Reducing Sugar Tests

  - These methods measure sugars that have reducing properties.

Examples

  - Benedict's method is used to detect reducing sugars.
  - Fehling's method is used to estimate reducing sugars quantitatively.
  - Lane-Eynon titration is commonly used in food analysis.

3. Spectrophotometric Methods

- These methods measure the intensity of color produced by a chemical reaction.

Examples

  - The phenol-sulfuric acid method is used for total carbohydrate estimation.

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- The anthrone method is used for determining carbohydrate concentration.

4. Chromatographic Methods

- These methods separate individual carbohydrates for identification and measurement.

Examples

- High-performance liquid chromatography (HPLC) is widely used for sugar analysis.
- Gas chromatography (GC) can be used after suitable sample preparation.
- Thin-layer chromatography (TLC) is useful for qualitative analysis.

5. Enzymatic Methods

- Specific enzymes are used to measure particular carbohydrates.
- These methods provide high accuracy and specificity.

Importance

- Carbohydrate analysis supports food quality control.
- It helps ensure compliance with nutritional labeling regulations.
- It assists in food research and product development.

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Changes in Food Carbohydrates During Processing

- Food processing can alter the structure, composition, and functional properties of carbohydrates.
- These changes affect the taste, texture, color, digestibility, and nutritional value of foods.

Types of Changes



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1. Gelatinization of Starch

- Gelatinization occurs when starch is heated in the presence of water.
- Starch granules absorb water, swell, and lose their crystalline structure.

Effects

- The texture of food becomes softer and thicker.
- Digestibility of starch increases.

2. Retrogradation

- Retrogradation occurs when gelatinized starch cools and reassociates into a more ordered structure.

Effects

- Bread becomes stale over time.
- Water may separate from gels.

3. Caramelization

- Caramelization occurs when sugars are heated at high temperatures.

Effects

- Brown color develops.
- Characteristic flavors and aromas are produced.

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4. Maillard Reaction

- The Maillard reaction occurs between reducing sugars and amino acids during heating.

Effects

- Desirable flavors and brown color are produced in baked and roasted foods.
- Excessive reactions may reduce nutritional quality.

5. Hydrolysis

- Complex carbohydrates can be broken down into simpler sugars by acids or enzymes.

Effects

- Sweetness increases.
- Digestibility improves.

6. Fermentation

- Microorganisms convert carbohydrates into products such as alcohol, acids, and gases.

Examples

- Bread, yogurt, and fermented beverages are produced through fermentation.

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