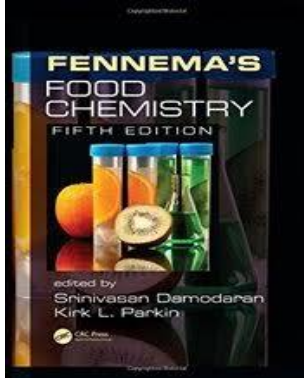


# Food Chemistry I

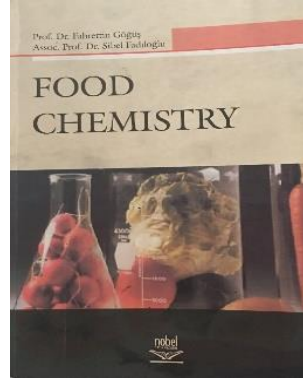


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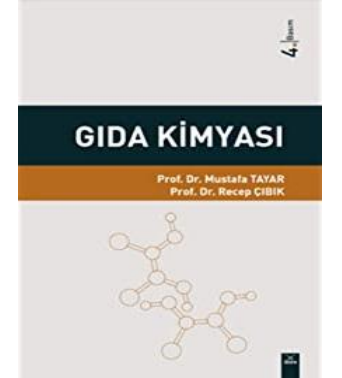
1.



2.



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# CHEMICAL REACTIONS OF CARBOHYDRATES

- \* Hydrolysis reactions of carbohydrates
- \* Oxidation of Monosaccharides
- \* Reduction of Monosaccharides
- \* Esterification and Etherification
- \* Nonenzymatic Browning Reactions
  - The Maillard Reaction
  - Caramelization
  - Browning of Ascorbic Acid
  - Polyphenols Browning

## Hydrolysis reactions of carbohydrates

The chemical breakdown of carbohydrates by taking water takes place in the catalyst of acids and enzymes.

## Oxidation of Monosaccharides

Oxidation of a sugar may yield different products such as aldonic acids and aldono-lactones. Complete oxidation will yield  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .

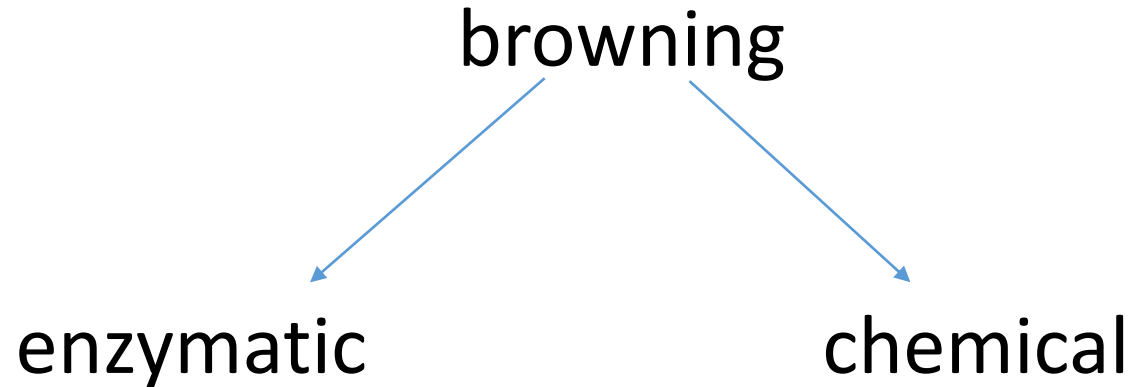
## Reduction of Monosaccharides

The carbonyl groups of monosaccharides can be reduced to the hydroxyl group.

## Esterification and Etherification

Due to the presence of hydroxyl groups, sugars can be esterified by organic acids or some inorganic acids. Sugars can also be etherified, but naturally occurring sugar ethers are not as diverse as sugar esters.

# Browning Reactions



## Chemical:

\* maillard reaction

\* caramelization

\* sugar breakdown  
(pyrazine formation)

## Enzymatic:

\*the natural tissue is damaged \*some compounds are converted into different compounds with certain enzymes under suitable conditions

# Nonenzymatic Browning Reactions

The two main forms of nonenzymatic browning are **caramelization** and **Maillard reaction**.

- **Ascorbic acid** is involved in nonenzymatic browning under certain conditions.

**Phenols** are important components in some foods and these compounds readily undergo autooxidation to yield brown color.

## *Effects of Nonenzymatic Browning on Foods*

The reaction yields multiple volatiles and nonvolatile compounds, which significantly influence the color, aroma, taste, nutrition, and safety of foods.

## ***The Maillard Reaction***

Good examples of foods in which desirable colors, flavors, and aromas are formed by Maillard browning reactions are French fries and baked bread.

## **Caramelization**

Caramelization yields hundreds of flavor compounds and these compounds impart foods with pleasant color and flavor.

## **Nonenzymatic Browning of Ascorbic Acid**

Ascorbic acid is a well-known natural antioxidant. It can be readily oxidized and its product (2,3-diketogulonic acid (DKG)) can participate in the Maillard reaction, leading to the formation of brown pigments.

## **Polyphenols Browning**

Some plant-derived foods contain high levels of phenolic compounds. The phenolic hydroxyl group of polyphenols is very susceptible to oxidation, especially in alkaline conditions.

# Properties of Carbohydrates

## Water Solubility

Although some of the carbohydrates are very easily dissolved in water, some are not. This difference in solubility often depends on the size of its molecules.

## Degree of Sweetness

Sweetness is a typical property for small soluble carbohydrates, mainly found in fruits, herbs and other natural foods.

## Fermentation Property

Carbohydrates can be altered by the action of mold, bacteria or fungi enzymes. This event is called fermentation and can take place in two ways:

- Aerob fermentation (if it occurs in the presence of oxygen)
- Anaerobic fermentation (if it occurs in an oxygen-free environment)

## Gelling Property

Some polysaccharides (Pectin, agar-agar, alginate, gum arabic and starch) have the ability to form jelly by solidifying when they intake water. The gelling properties of these polysaccharides are due to the fact that they contain few or many ester groups.

## CARBOHYDRATE SOURCES

**Vegetal sources:** cereal and cereal products, dried legumes, dried fruits, honey, molasses, jam, and tahini halva. Also, cellulose, hemicellulose, pectin and lignin are herbal foods.

**Animal sources:** Milk, dairy products and honey. Carbohydrates in meat are not important for nutrition.



***Foods can be classified under three groups according to their carbohydrate content;***

- 1.** Carbohydrate rich foods (Honey, sugar, various confectionery and chocolates, tahini halva, grape molasses, fruit pulp etc.)
- 2.** Carbohydrate poor foods (Various fresh vegetables and fruits, various meat products, eggs, liver, juices etc.)
- 3.** Foods that do not contain carbohydrates or contain traces (butter, margarine, various animal and vegetable oils, alcoholic beverages).

## **STARCH AND STARCH BASED PRODUCTS**

- \* The second biggest type of sweetener after sucrose in the world; starch based sugars (SBS) obtained from plants containing starch such as corn, wheat, rice, potatoes.
- \* Starch-based sugars are derived from starch isolated from the plants in question, mainly containing glucose and / or isoglucose (fructose).
- \* The main products of the starch-based sugar industry are natural and modified starches and glucose and fructose syrups.
- \* The starch sector uses corn as the main raw material.
- \* The first product obtained by hydrolysis of starch is glucose syrup. With the isomerization process of glucose, fructose syrups known as isoglucose are obtained.

## Functions of carbohydrates in the body;

1. The most important task is to provide the body with energy.
2. Carbohydrates such as cellulose, hemicellulose, and lignin facilitate the movement of the intestines and , prevent constipation, cancer, and reduce the amount of unwanted fat and sugar in the blood.
3. They keep the water and electrolytes in balance in the body.
4. Since the only source of energy the brain uses is glucose, it is necessary for cognitive functions.
5. They provide the use of proteins for maintenance and repair.

## Disorders in Carbohydrate Deficiency

In carbohydrate insufficiency:

- \* The energy needs of the body are met from proteins.
- \* When carbohydrates are not taken enough, fats cannot be fully oxidized either.
- \* When insufficient carbohydrates are taken the burning of fats begins for energy supply.
- \* It is difficult to remove harmful waste from the body.