**Homopolysaccharides (homoglycans)**

Homopolysaccharides (homoglycans) are formed from uniform monosaccharides. Chemically homopolysaccharides are glucans (amylose, amylopectin, glycogen, chitin), fructans (inulin), galactans (agar, carrageenan).

**Cellulose-containing medicinal plants**

Cellulose is the primary building material for plants. It consists of many glucose dimers – cellobiose, which molecules joined into filament structure. All filaments are joined by hydrogen and micellar and the interspaces between them are filled by polymer compound of phenolic nature- lignin.Cellulose is not digested by enzymes and bacteria. It is used as bandaging material, because it has a capability for water adsorption. Cellulose forms absorption mass in intestine, which irritates the receptors mechanically and enhances the intestine motility. Celloluse is introduced into the organism with rough vegetables – beetroot, turnip, radish, carrot and oth. Therefore, it should figure prominently in the diet of patients with chronic constipation.

The main mass of plant cell wall is composed of polysaccharide- cellulose. It is supposed, that molecule of cellulose molecule of various plants consists of glucose residues (1400 to 10 000). Cellulose is hydrolyzed to glucose by boiling with concentrated sulfuric acid. Oligosaccharide – cellobiose is formed in more mild hydrolysis.

Cellulose is the most common organic compound in nature. It is the primary structural polysaccharide of plants. Cellulose represents more than half of organic compounds of biosphere. Cellulose represents 50-70% of the total woody part of plants. Cotton fibers contain the largest amount of cellulose (90%). It is expected that cellulose molecule consists of β-d-glucose (glucopyranose) in various plants. Glucopyranose residues are linked by β-1,4-glycosidic bonds. Cellulose is an unbranched chain with a molecular weight 400 000 to 3,3 millions. It is appropriate for 2500-20 000 glucose residues. Fragments consisting of 1 pair β-d-glucose of cellulose molecule are appropriate for the structure of disaccharide molecule, called cellobiose. Cellulose is formed from this polysaccharide by partial hydrolysis, and β-d-glucose is formed by complete hydrolysis. In the view of some scientists according to the number of “n” and the size of a molecule the molecules of cellulose consist of more glucose residues and have a more molecular weight than starch.

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*Cellulose*

Radiological examination of cotton, flax and other fibers consisting of cellulose molecules demonstrates that chains of cellulose molecules is connected together due to the presnece of additional valence and form micelle bundles. These micelle bundles lie parallel to each other and they are weaved and form chain. In the result fibers form crystalline and amorphous areas. From chemical point of view cellulose is polyatomic alcohol. Each residue of glucose molecule contains three hydroxyl groups. That’s why cellulose formula simply can be written as (C6H7O2(OH)3)n. Oxygen atoms attached to anomeric carbon atom of linear chains of cellulose molecule are tended to form hydrogen bonds. Intra- and interchain hydrogen bonds impart strength to cellulose. Cellulose does not give a characteristic reaction of aldehydes and does not reduce Fehling’s reagent. Cellulose is insoluble in water, it is not destoyed by digestive enzymes and digested by human organism. But the presence of cellulose in nutritious food is important, because the absence of cellulose in food violates the process of faecal matter formation. Wood chips are boiled under pressure with sodium hydroxide for cellulose production. In result xylan is destroyed, lignan is dissolved in alkaline, and cellulose remains unchanged. Cellulose is washed and whitened and convert to paper. This method is used for filter paper production in industry. Hydrogen of hydroxyl group of glucose is replaced by CH2-COOH group during the spraying of alkaline cellulose by sodium salt of chloroacetic acid and carboxymetylcellulose is formed. Carboxyethylcellulose is often used in oil industry for increasing the durability of drilling engine, as an additional component for detergent and soap production, for the produciton of cosmetic preparations and in other industries. Cellulose is important from a practical point of view. Firewood are used as combustile material, wood as a building material, cotton, flax fibers as a textile material. In addition, it is used in the manufacturing of products such as explosives, lacquers, synthetic fibers, plastic materials and oth.

Dextrines are low-molecular-weight glucans, formed as a result of partial destruction of starch or glycogen under the action of ferments, acids, at the temperature above 200°C. Dextrines are synthesized by bacteria *Leuconostos mesenteroides* from sucrose, á-D-glucopyranose residues linked in a linear manner by á- 1-6 bonds and in a branched manner by 1-3,1-4 links with molecular weight of107-108. Partially hydrolyzed dextrans used for clinical purposes have average molecule weights of 40,000 to 80,000 and are used as plasma expanders in a solution in cases if shock or pending shock caused by hemorrhage, trauma or severe burns, because their osmolarity and viscosity resemble those of plasma.

**Starch-containing medicinal plants**

Starch is storage nutritional compound of plants and main source of hydrocarbons for human organism. Starch is mostly found in potatoe, cereals and fruits of legumes and products obtained from them. They differ in structure and properties in various plants, even in plants of different species of the same genus. Molecule of any starch consists of glucose (glucopyranose) units and forms 2 polysaccharides – amylose and amylopectin due to the glycosidic bond. Amylose has a linear chain structure, it readily dissolves in hot water and forms low - viscosity solution. Amylopectin has a branched- chain structure, it constitutes approximately 80% of the starch and forms a gel in water. Molecular weight of starch ranges from 50 000 up to several million and it is stored in plants in grains. They are hydrolyzed to glucose and disaccharides by pancreatic amylase in intestine. Then they are splitted by disaccharidase of digestive glands. Starch (especially rice starch) is used to make powders and kissels. Kissel has nutritional value and it is also used in the treatment of gastrointestinal diseases as ambients, especially in pediatric and geriatric. Polyphenolic compounds containing in the berries (blueberry, lingonberry, black-currant) protect and strengthen mucus membranes. In some plants inulin is synthesized as a storage hydrocarbon instead of starch. The molecular mass of inulin is 5000-6000. In contrast to starch inulin is formed from 34 fructose units and one glucose unit. Most of the inulin is present in various organs of topinambur, chicory, juniper, dandelion and oth.

Starch (Amylum) (C6H10O5)n is not a chemically individual substance. Starch is homopolysaccharide and reserve nutritional substance, that is stored in seeds, roots and tubers. Starch is synthesized in the chloroplasts, which contain the chlorophyll. Synthesized primary starch is called assimilated. Mono- and disaccharides are formed by the enzyme –diastase and turned into starch grains specific for each plant species. They consist of 96,1-97,6 % polysaccharides, which are hydrolyzed to form glucose. The content of mineral compounds is from 0,2% to 0,7%, they are mainly represented by phosphoric acid. High-molecular fatty acids are also found in starch – palmitic, stearic and oth., their content reaches 0,6. Hydrocarbon component of starch consists of two polysaccharides – amylose and amylopectin.

Amylose forms inner central part of starch grains. It is a linear glucan, in which glucose units are linked via α-1,4 -glycosidic bonds. The molecular mass of amylase is 32 000 – 160 000, it is highly soluble in water and gives low-viscosity solutions.

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Амилоза

Amylose

Amylopectin is a branched glucan, it is located in outer layers of starch grains, in addition to 1,4 –glycosidic bonds of glucose units there are also 1,6-glycosidic linkages. Amylopectin is soluble in water under heating conditions and gives high-viscosity solutions. Molecular weight of amylopectin reaches thousand million.

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Amilopektin

Lugol solution (a solution of potassium iodide with iodine in water) dyes a starch into blue colour. At low temperature the colour is weakened, at 100 C – the colour dissapears, on cooling- it appears again. Blue colour is explained by the interaction of starch and iodine and formation of complex and adsorbation compounds (sax reaction).

In plants starch is present as granules of different sizes and shapes. The size and shape of starch granules are species-specific. and they are used for indentification of material and starch.

The starch swell in the presence of warm water. It forms viscous colloid solution under the heat, which called starch paste. Potatoe, wheat, corn, rice and oth. starches are used in medical practice. Starch is used for making fixed bandages in surgery. Starch is widely used in pharmaceutical industry as shape-forming and filling substance for tabletting, and also it is widely used for production of antiseptic powders, ointments, paste with zinc oxid and talc. Starch as demulcent is used internally in the treatment of gastro-intestinal diseases.

 **Inulin-containing medicinal plants**

Inulin (polyfructose) is homopolysaccharide and consists of fructose monomers. It is a storage nutritional substance of some plants, especially plants of sunflower family, in which inulin replaces starch. The properties of inulin are studied in detail. Number of fructose residues linked by 1,2- glycosidic bonds in inulin molecule is 34. Macromolecule is ended by α-D- glucopiranose residue.

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Inulin (fragment)

Inuliin is highly soluble in water, it is precipitated by alcohol from aqueous solutions, rotates the plane of polarization to the left. It does not reduce Fehling’s reagent. Frucofuranose and some amount of glucopyranose are formed upon the acid hydrolysis..

Inulin is detected by Molisch’s reagent in plant material. When α-naphthol and concentrated sulfuric acid are applied on the surface of plant roots of sunflower family the violet colour is formed.

In large quantities inulin is found in the plant roots of sunflower and bellflower families, in which it replaces stacrh.

Inulin-containing plants are used to obtain fructose.

**Galactans.**

**Agar-containing medicinal plants**

Sulfated galactans, polysaccharides of algae of *Rhodobiota (Gracilaria,  Gelidium spp)*, are used for medicinal purposes. These algae grow along the eastern coasts of Asia, coasts of North America & Europe. Sodium alginate is the purified carbohydrate product extracted from brown seaweeds (*Rhaeophyceae*), using dilute alkali and is a suspending agent. Alginic acid is used as a tablet binder and thickening agent.

 Agar is a dried hydrophyllic colloidal substance and is composed of polysaccharides agarose  and agaropectin. Agar is used as a suspending agent, an emulsifier, as a gel in bacteriologic culture media. It is used for electrophotoretic separation of proteins and for techniques, involving gel filtration and gel chromatography.

Agar-agar is obtained from red algae Ahnfeltia, it is used for solid culture media in biotechnological production and bacteriology, in the confectionery industry for jelly, pastille, marmalade and jam production.

Agar-agar is high-molecular weight polysaccharide, its structure has not been fully researched. It is expected, that agar-agar consists of a mixture of two polysaccharides – agarose and agaropectin. Agarose consists of D-galactose residues and 3,6-anhydro-L-galactose, linked together through alpha- 1,3- and β-1,4-glycosidic bonds. In agaropectin molecule part of 3,6-anhydro-L-galactose residues is replaced by 6-sulfate-L-galactose residues. Polysaccharides of Ahnfeltia, Laminaria, Ficus and oth. seaweeds are used in medical practice.

Carrageenan is a hydrocolloid, obtained from various red algae on seaweeds *Chondrus crispus*(and related species), *Gigartina, Hypnea spp*. These algae are commonly used as irish moss. Carrageenan is a linear sulfated polysaccharide consisting of D-galactopyranose residues, combined by á 1,3 & â 1,4 links alternately. Carrageenans are widely used to form gels and to give stability of emulsions and suspensions.