OLIGOSACCHARIDES

Products of condensation of two-ten monosaccharides, connected by glycosidic bond.

Glycosidic bond is formed:

- by hemi-acetal hydroxyl (at anomeric carbon of monosaccharide)
- and whichever hydroxyl of further monosaccharide (if formating disaccharides),
- hydroxyl longer or shorter saccharide chain (if formating oligo- or polysaccharides)

Glycosidic bond is cleaved:

- easily by hydrolysis (in acids)
- enzymatically (significant enzymatic specifity)

DISACCHARIDES

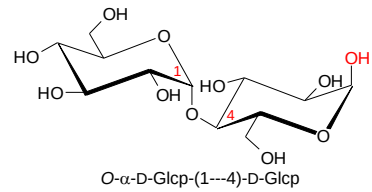
The way of formation of glycosidic bond enable to divide disaccharides into two groups:

- Reducing
- Non-reducing

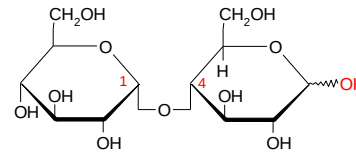
DISACCHARIDES

Reducing

The glycosidic bond enters hemi-acetyl hydroxyl of one sugar only. The other hemi-acetyl-hydroxyl is free, disaccharide possesses reducing power, can mutarotate and can formate glycosides. These disaccharides are known as „maltose type"



O-α-D-Glcp-(1---4)-D-Glcp



4-*O*-α-D-glukosyl-D-glucose

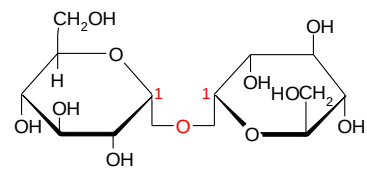
DISACCHARIDES

Non-reducing

The glycosidic bond enter hemi-acetyl hydroxyl groups of both reacting monosaccharides. These sachcharides do not mutarotate, do not make osazones. Trehalose is found in fungi and other non-photosynthetising organisms.

„Blood sugar of insects"

„Trehalose type"



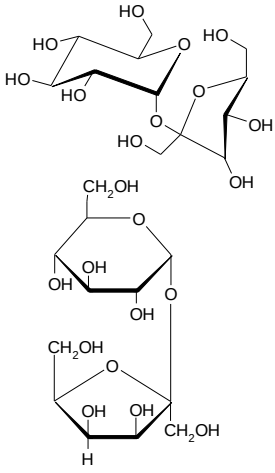
O-α-D-Glcp-(1---1)-α-D-Glcp

DISACCHARIDES

The only non-reducing disaccharide of industrial importance is sucrose (saccharose).
World production more than 150 millions tons, ¾ from sugar cane
SACCHAROSUM CL 2009

Saccharum officinarum L. – sugar cane (Poaceae)

- perennial C_4-plant (product of CO_2 fixation is malate or aspartate)
- stem (haulm) is solid with *internodia* terminated with panicle of flowers
- Juice of crushed stems – removal of proteins, filtration, and concentration, crystallization of raw „brown" sugar. The brown sugar is further refined.
- Asia, South America and Caribbean islands are main producers, cca 100 millions tons/year



O-α-D-Glcp-(1---2)-β-D-Fruf

SACCHAROSE

Beta vulgaris L. – sugar beet (Chenopodiaceae)

- biennial plant cultivated as annual, from the beginning of 19th century used as raw material of production of sucrose.
- contains 16 – 17 % of sucrose, cca 77 % of water
- Tubers are sliced to sugar beet „cossettes", extracted with hot water, the obtained juice is purified. Concentration, crystallization (the residue is molasses). Rafination.
- 1000 kg of sugar beet → 130 kg sucrose

Acer saccharophorum (A. saccharum) C. Koch – sugar maple (Aceraceae)

- three of eastern part of North American continent
- saccharose excreted from leaves and from rupture of bark (three courted by bees)

Phoenix dactylifera L. – date palm (Palmae)

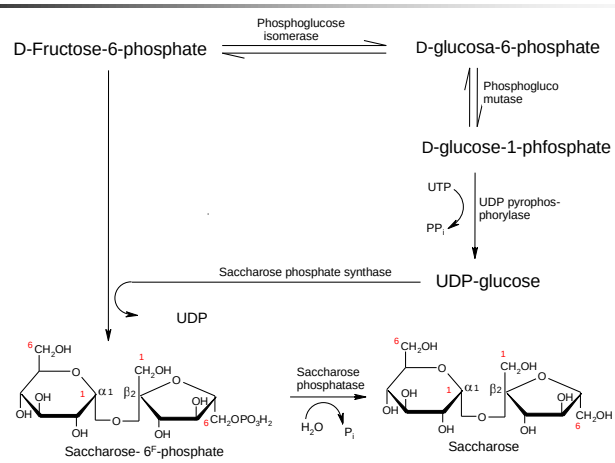
- Fruits are rich on sucrose

http://www.food-info.net/images/sugarcane2.jpg

http://www.recipetips.com/images/glossary/b/beets_sugar.jpg

http://wahyuinqatar.files.wordpress.com/2009/06/16062009692.jpg

Saccharose biosynthesis



DISACCHARIDES

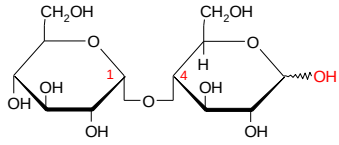
as degradation products of oligomers and polymers

Maltose

Degradation product of starch

Malt sugar

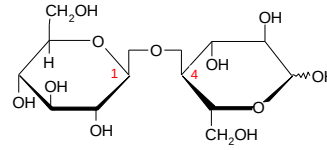
Reducing disaccharide



4-*O*-α-D-glucopyranosyl-D-glucose

Celobiose

Degradation product of cellulose



4-*O*-β-D-glucopyranosyl-D-glucose

DISACCHARIDES

reducing disaccharides as part of glycosides, especially flavonoids

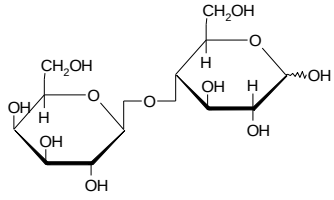
- RUTINOSE O-α-L-Rhap-(1→2)-D-Glcp
- NEOHESPERIDOSE O-α-L-Rhap-(1→6)-D-Glcp
- MALTOSE O-α-D-Glcp-(1→4)-D-Glcp

- CELLOBIOSE O-β-D-Glcp-(1→4)-D-Glcp
- SOPHOROSE O-β-D-Glcp-(1→2)-D-Glcp
- LAMINARIBIOSE O-β-D-Glcp-(1→3)-D-Glcp
- GENTIOBIOSE O-β-D-Glcp-(1→6)-D-Glcp
- LACTOSE O-β-D-Galp-(1→4)-D-Glcp
- SCILLABIOSE O-β-D-Galp-(1→3)-α-L-Rhap
- SAMBUBIOSE O-β-D-Xylp-(1→2)-D-Glcp
- PRIMEVEROSE O-β-D-Xylp-(1→6)-D-Glcp

DISACCHARIDES

Lactose

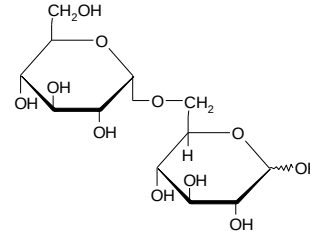
The most important sugar in mammalian mother milk (6 %). Mother milk contains also cca 0,3 % of oligosaccharides.



O-β-D-Galp-(1→4)-D-Glcp

Isomaltose

Product of starch hydrolysis in place of branching of linear chain



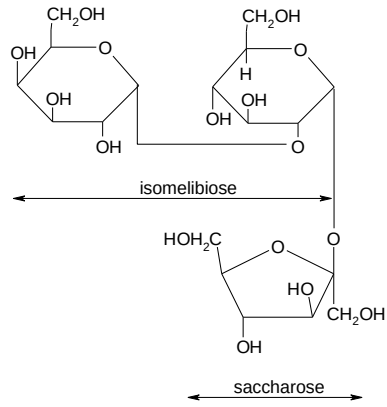
O-α-D-Glcp-(1-6)-D-Glcp

HIGHER OLIGOSACCHARIDES

TRISACCHARIDES

UMBELLIFEROSE

α-D-Galp-(1→2)-α-D-Glcp-(1→2)-β-D-Fruf



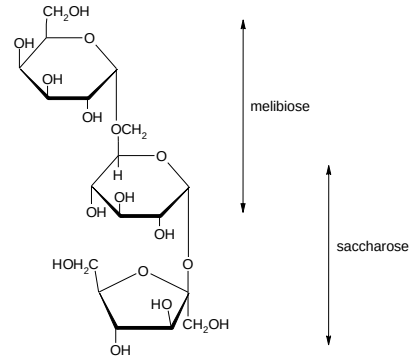
HIGHER OLIGOSACCHARIDES
TRISACCHARIDES

RAFINOSE

α-D-Galp-(1→6)-α-Glcp-(1→2)-
-β-D-Fruf

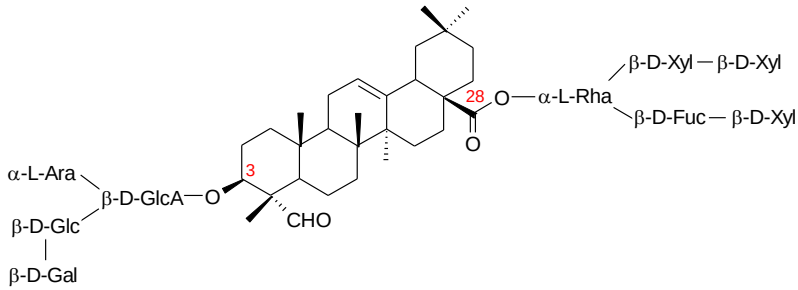
Part of molasses

Present is seeds of Fabaceae plants → flatulence



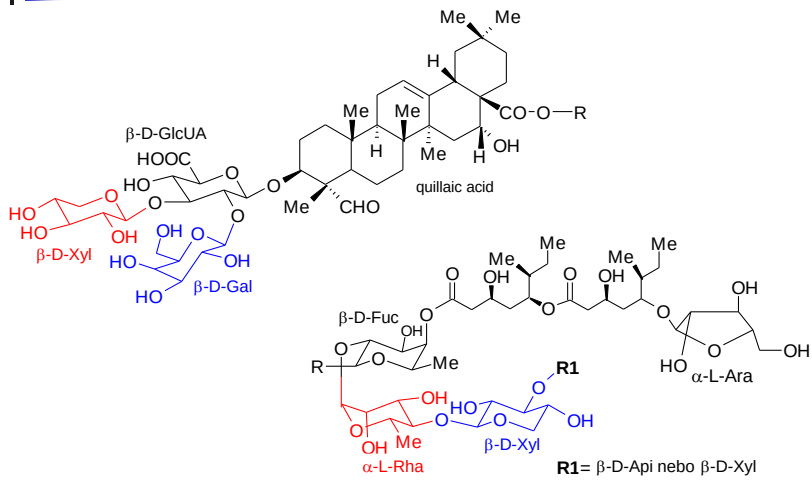
RAMIFIED OLIGOSACCHARIDE

GYPSOSIDE A, *O*-glycoside (C-3), ester of (C-28) triterpenoid aglycon gypsogenine
Gypsophila paniculata L. – baby´s breath (Caryophyllaceae)



RAMIFIED OLIGOSACCHARIDE

Extremely effective adjuvant, QS-21A increasing effectiveness of antigen administered to body to provoke immune response, allows to decrease dosage of vaccine with higher effect



POLYSACCHARIDES

HIGH-MOLECULAR, LINEAR OR RAMIFIED POLYCONDENSATES, WIDESPREAD IN PLANTS, WHERE THEY POSSESS DIFFERENT FUNCTION:

- SUPPORTING (cellulose)
- RESERVE (starch)

PHARMACEUTICALLY IMPORTANT POLYSACCHARIDES

- cellulose and its derivatives
- starches
- gums and mucilages
- pectins (polyuronides)
- polysaccharides from microorganisms and fungi
- Polysaccharides of animal origin, mucopolysaccharides

POLYSACCHARIDES – GLYCANS

HOMOGENIC
Composed from large number of the molecules of the same sugar unit

HETEROGENIC
Produced by condensation of molecules of different sugar types

- Hexoses
- Pentoses
- Anhydrohexoses
- Sugar ethers
- Sugar sulphates
- Aminosugars

LINEAR
RAMIFIED

TYPES OF POLYSACCHARIDES

POLYSACCHARIDES WITH REGULAR SEQUENCE (amylose, cellulose ….)

- β-(1→4), shape – very prolonged strip
- α-(1→4), polymer can be spiral-shaped (for example amylose)
- conformation is free, flexible, for example (1→6)

DISRUPTED SEQUENCE OF POLYSACCHARIDES

- areas with precise regularity alternate heterogeneous areas
- potential interaction „polymer – polymer" enables the formation of gel

POLYSACCHARIDES COMPLETELY HETEROGENOUS

- interaction of „polymer – solvent" can be found

ISOLATION AND STRUCTURAL ANALYSIS

ISOLATION

- water solvents
- Possibility of acid or salt addition

PURIFICATION

- Gel filtration
- Extraction with organic solvent

FRACTIONATION

- Precipitation techniques (change of pH)
- Chromatography (active char coal, ion exchange)

PURITY VALIDATION

- Optical rotary power
- Molecular weight
- Electrophoresis

STRUCTURAL ANALYSIS

Physical methods:

- spectrometry
  - MS, NMR

Chemical methods

- partial hydrolysis
- derivatives formation
- controlled degradation

POLYSACCHARIDES OF MICROORGANISMS AND FUNGI

Utilization of biotechnologies, increased number of production organisms and products

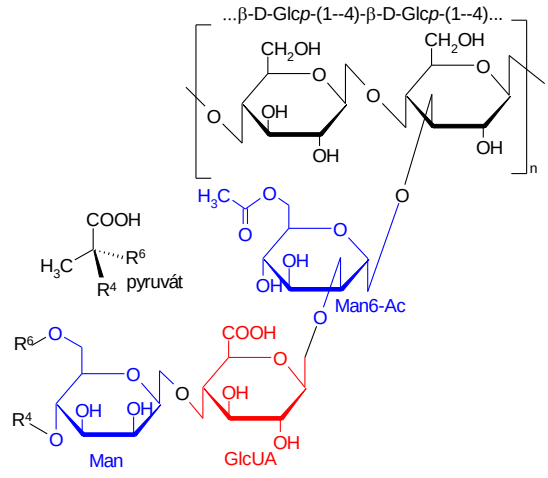
DEXTRANS

- *Leuconostoc*, *Lactobacillus*, *Streptococcus*
- Polymers of glucose from α-D-glucopyranosyl units (bonds predominantly 1-6, less often 1-3 and 1-2), high-molecular 40-50 × 10^6
- Synthesis with help of specific enzyme (exocellular, transfer of Glc from saccharose)
- Adjustment by partial hydrolysis to 40000-75000 (acid hydrolysis, sonication, bacteria)

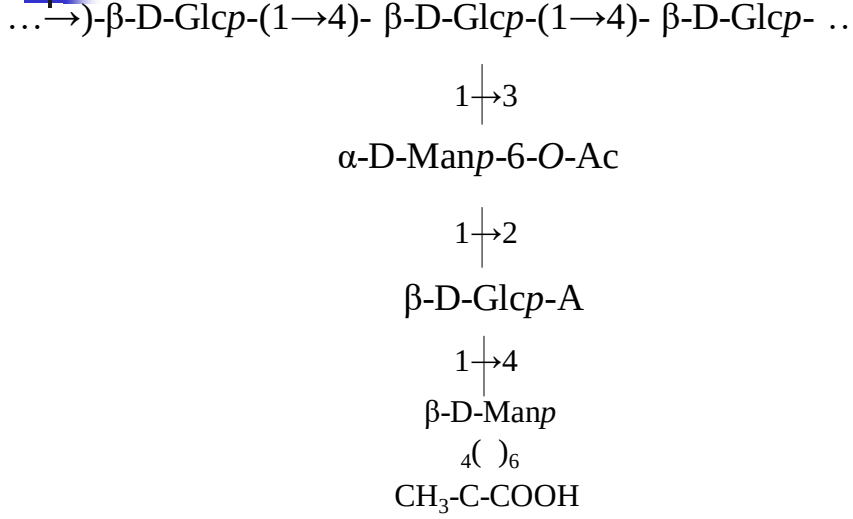
XANTHANI GUMMI - XANTHAN GUM (ČL 2009)

- high-molecular anionic polysaccharide, in form of natrium, potassium or calcium salt
- produced during the sugar fermentation (glucose or sucrose) with help of microorganic species *Xanthomonas campestris*
- composed from main chain derived from β(1→4)- bonded D-glucose units with trisaccharide secondary chains (at exchanging anhydroglucose units) composed of glucuronic acid between two mannose units. Majority of terminal units is substituted with pyruvic acid and mannose neighboring the main chain can bee C-6 acetyled
- molecular weight approximately 1×10^6
- properties: white or yellowish loose powder; well dissolve-able in hot and cold water (making highly viscous solution), viscosity does not change with changing temperature
- insoluble in organic solvents; resistant to enzymes, rare incompatibilities, tolerate up to 50 % of alcohol
- E number E415.

XANTHANI GUMMI - XANTHAN GUM (ČL 2009)



XANTHANI GUMMI - XANTHAN GUM



XANTHANI GUMMI - XANTHAN GUM (ČL 2009)

USAGE (E415)

Pharmacy: stabilizer of emulsions, adjuvant

Does not contain gluten, used in gluten-free bakery (makes the dough adhesive).
Coeliac disease – gluten intoleration (shorter protein cuts – gliadin in wheat, secalin in rye, hordein in barley, avenin in oat)

Food industry: Stabilisators, thickener of products based on water (milk products, dressings, dips, sauces, instant soups, sirups), ice-creams (prevent formation of ice crystals); Activia, Pribináček, Tartar sauce, Tisíc ostrovů, Křemílek, Thai Kari, Hermelin salad and others.

Cosmetics: creams, tooth pasts (stabilizer)

POLYSACCHARIDES OF FUNGI

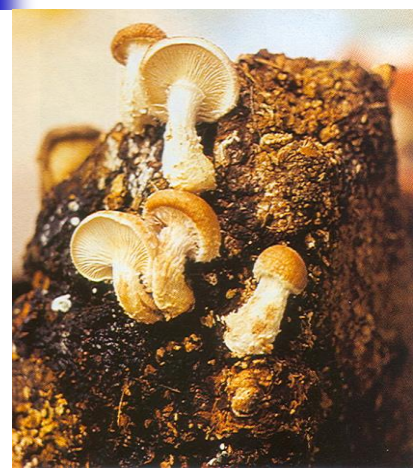
Lentinan (*Lentinus edodes* – SHIITAKE)

Homogenous polyglucan

- β-(1-3) bonds, rarely 1-6 bonds
- Immune-modulating effects
- Antitumor activity
  - human clinical studies showed higher survival rate, higher quality of life, and lower recurrence of cancer
    (1) prevention of onset of cancer by oral consumption of mushrooms or their preparations
    (2) direct inhibition of growth of various types of cancer cells
    (3) immuno-stimulating activity against cancers in combination with chemotherapy
    (4) preventive effect on spreading or migration of cancer cells in the body

Basidiomycetes:

Pachymaran
Schizophyllan
Krestin *(Coriolus versicolor)*



POLYSACCHARIDES OF ALGAE

- *Phaeophyta*
  Alginic acids (alginate), fucans
- *Rhodophyta*
  Sulphated galactans (agar, carrageen)
- *Chlorophyta*
  Complex polysaccharides, often sulphated

POLYSACCHARIDES OF ALGAE

Phaeophyceae
chlorophyll A and C, β-carotene, fucoxanthine (xanthophylls), alginates, 15–40 % of drug dry weight

***Laminaria* spp.**
Brown alga, seacoast of France and England
Industrial processing, colloid chemistry

Macrocystis pyrifera
Californian kelp, giant algae of Pacific

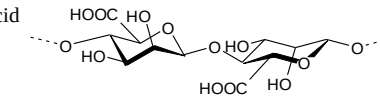
Fucus serratus, F. vesiculosus
Seacoast of England

Laminaria digitata *Fucus vesiculosus* *Macrocystis pyrifera*

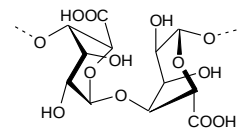
http://diver.net/californiadiveboats.com/OceanOdyssey/2008.02.23/
http://www.dermaxime.com/seaweed-extracts.htm

Alginic acid, alginates

Mixture of uronic acids, 19-25 % of carboxyls
Linear polymer of D-mannuronic acid-β(1→4)-L-guluronic acid
Blocks of same acids alternate in linear chain
In form of salt (Na, Mg, Ca)



block of mannuronic acids



block of guluronic acid

Properties

- Salts with Na and Mg → colloid solution
- Salts with Ca → elastic gel

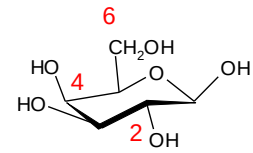
Usage

- Antacids in combination with $NaHCO_3$ a $Al(OH)_3$
- Haemostatic - stomatology, superficial wounds
- Pharmaceutical technology
- Food industry E400-405

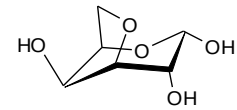
CARRAGEENAN – Karagen, Irish moss syn. Alga carrageen, *Chondrus crispus* and *Gigartina mamillosa* (Gigartinaceae)

Polymers of D-galactose, anionic character, sulphated, molecular weight 10^5-10^6

- Bonds 1→3 (A unit) and 1→4 (B unit)
- Sulphatation at positions **2 and 6** or **2 and 4**
- Different structural subtypes
- Properties
  - Based on subtype
  - Usually soluble in hot water
  - Some of them produce gel
- Usage:
  - Technology
  - Laxative
  - Cosmetics
  - Additives of food



D-galactose



anhydro-D-galactose

CARRAGEENAN

types

A unit	**B unit**	**Type**
D-galactose-4-sulphate	D-galactose-6-sulphate	μ
	D-galactose-2,6-disulphate	υ
	3,6-anhydro-D-galactose	κ
	3,6-anhydro-D-galactose-2-sulphate	ι
D-galactose-2-sulphate	D-galactose-2-sulphate	ζ
	D-galactose-2,6-disulphate	λ
	3,6-anhydro-D-galactose-2-sulphate	θ

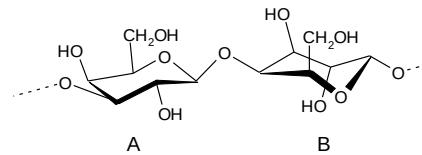
Chondrus crispus – Irish moss

- Karageenans
- Chlorophyll A and D
- Fycoerythrin
- Starch typical for red algae

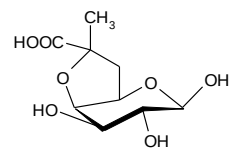
POLYSACCHARIDES OF ALGAE

Agar

- Different Rhodophyceae (red algae)
  - Mostly *Gelidium*
- Chemical properties
  - Complex galactan
    - Agarose and agaropectin
    - Agarose
      - Linear polymer
      - $(AB)_n$ 1→3 and 1→4 bond
      - A – partially methylated D-galactose
      - B – L-galactose (3,6 anhydroform)
      - Sulphated poorly
    - Agaropectin
      - ramified



A B



  - **Properties:**
  - Soluble in hot water
    - Jellifying around 30-35°C, around 80°C liquefying
  - Agarose formates double helix, formates 3D structure by bounding water units
  - It is not metabolized, it is not toxic
- Usage
  - Laxative, nutritive medium for microbiology, chromatography, electrophoresis, E406

Gelidium amansii

http://www2.naris.go.kr/v2/naris_search/search_result_detail.jsp?inst_id=1165083

POLYSACCHARIDES OF HIGHER PLANTS

- Starches
- Cellulose
- Polyfructosans
- Dietary fibre

AMYLA (starches)

Macromolecules formed by glucose units

- Amylose (20-30 %)
  - 250-300 Glc residues; (1→4)-α-D-glykosidic bond
  - Basic building block is maltose
- Amylopectin (70 %)
  - 1000 Glc residues; (1→4)-α-D-glycosidic bond and (1→6)-α-D-glycosidic bond – branching cca after 25 units of Glc

Physico-chemical properties of starch

Insoluble in cold water and organic solvents

Swelling in cold water

Soluble in hot water → formation of wheatpaste – colloid starch solution

According to the origin grains of different shape, size and structure

Careful hydrolysis gives arise to dextrins

MODIFIED STARCHES

Physical modification
- Boiling and dehydration

Chemical modification
- Oxidation
- Esterification
- Cationisation or anionisation
- Etherification
- Hydrogenation

Controlled depolymerisation
- Partial hydrolysis
- Enzymatically
- Debranching enzymes

STARCH UTILIZATION

- Pharmaceutical additive
- Reagent for production of dextrin
- Textile industry
- Paper mills

NATURAL SOURCES OF STARCH

Oryza sativa (Poaceae), rise – *Oryzae amylum*

Triticum aestivum (Poaceae), wheat – *Tritici amylum*

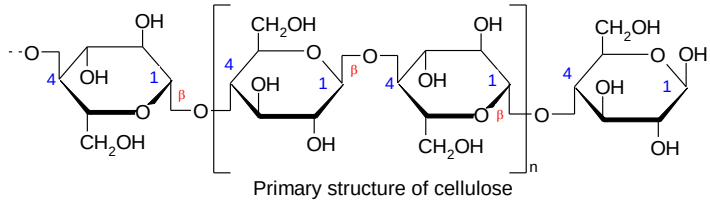
Solanum tuberosum (Solanaceae), potatoe – *Solani amylum*

Zea mays (Poaceae), corn – *Maydis amylum*

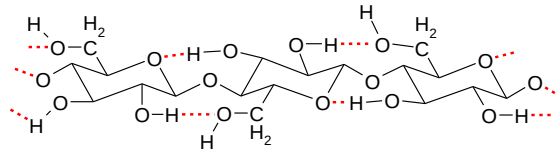
CELLULOSUM – CELLULOSE

High-molecular linear polymer of D-Glc units bonded β-(1→4)

- Basic building block – cellobiose
- Native cellulose – degree of polymeration up to 15000



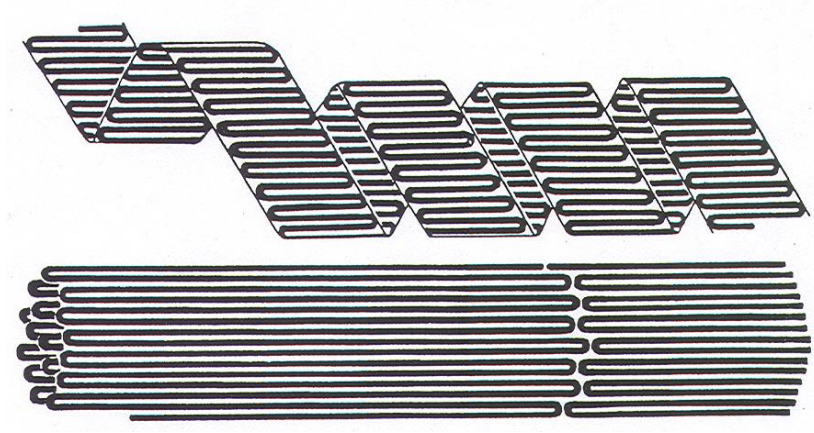
Primary structure of cellulose



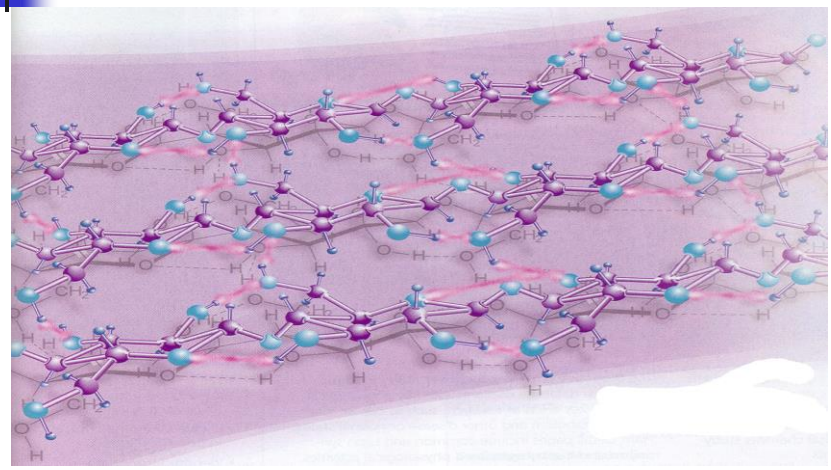
Linear cellulose chain stabilized by hydrogen bridges

CELLULOSUM – CELLULOSE

Diagram of micelle structure of cellulose



CELLULOSUM – CELLULOSE



CELLULOSUM

Almost pure cellulose

- Cotton wool fibers – trichomes from seeds of plants from *Gossypium* species

Technical cellulose

- wood of conifers
- Purification from lignin and admixtures

Acetobacter xylinum

Lana gossypii depurata – bandage cotton wool purified from cotton seeds

Gossypium spp. – cotton plant (Bombacaceae)

Gossypium spp.

- Asian variety
  G. arboreum and *G. herbaceum*
- American variety
  G. hirsutum and *G. barbadense*

Uni-cellular fibers

- 15-40 mm long
- 12-25 microns in diameter
- During ripening their distortion – textile quality

Processing

- Seeds separated mechanically
- Sorting according to the quality

Cellulosum ligni – bandage cellulose

Bleached cellulose from wood of Coniferae trees

Delignification in acid or under neutral conditions

Possibility of esterification

- Nitrate, acetate (different utilization)
- Soluble in water
- Solubility depends on degree of esterification DS 0-3

FURTHER PLANT FIBERS

Kapok – *Ceidra pentandra* (Malvaceae)

Flax fibers – *Linum usitatissimum* (Linaceae)

Hemp fiber – *Cannabis sativa* (Cannabaceae)

Jute – *Corchorus capsularis* (Tiliaceae)

DEXTRIN

Mixture of polysaccharides

Produced by mild hydrolysis of starches

- Heating
- Mineral acids

INULINUM - INULIN

Plant polyfructosan (furanoid form)

Bond β-(2→1) between D-fructose units

Less than 100 units of Fru

Well soluble in water

Occurrence – storage organs of Asteraceae plants and Poaceae plants

- *Inula helenium*
- *Cichorium intybus*
- *Helianthus tuberosus*

DIETARY FIBERS

- Dietary, chemical, physiological definitions
  - Plant (vegetables) residues of non-digestible by enzymes of GIT of human
  - Macromolecules of cell wall and intracellular polysaccharides
    - Lignin
    - Polysaccharides of different type than α-glucans
      - cellulose
      - pectins (glycano-galactans)
    - Hemicelluloses
      - galactomannans, heteroxylans, pentosans
    - Glycoproteins
- Sources: fruits, vegetables, dried fruits, brans

DIETARY FIBERS

- Physiologic effects:
  - Gastro-intestinal tract
    - Increase of faeces volume (insoluble fraction)
    - Affection of food passage through guts (insoluble fraction)
    - Effect of intestinal microflora
  - Possible prevention of creation of colorectal carcinoma
  - Affection of metabolic activity
    - Interaction with intake of mineral compounds
    - Level of blood cholesterol
    - Level of blood sugar

GUMS AND MUCILAGES

Under term gums and mucilages can be found:

- Macromolecules of polysaccharides
- More or less soluble in water, usually format colloid solutions or gels

Today under naming „plant hydrocolloids“

Plant hydrocolloids are of interest in health care and industry.

Mucilages – protectives of mucose layers, expectorants/antitussics, laxatives

Gums – laxatives, anobesics, emulgators, stabilizers

MUCILAGES

Mucilages – normal content compounds pre-existing in specialized histological formations (cells or tubules), which are generally found in external covers of seeds.

Widely distributed, mostly in *Malvales* (acidic mucilages) and *Fabales* (neutral mucilages of endosperm)

Swelling in water – active role in seed germination.

MUCILAGES

Mucilages – high-molecular polysaccharides

- strongly swelling in water (micellar solubility)
- dissolving into viscose colloid hydrophilic solutions
- Insoluble in ethanol and organic solvents

Hydrolysis

- hexoses and pentoses (mostly galactose and arabinose)
- sugar derivatives (anhydrides, uronic acids, esters with sulphuric acid)

DRUGS CONTAINING MUCILAGES

- Althaeae radix – marshmellow root (ČL 2009)
- Althaeae folium – marshmallow leaf (ČL 2009)
- Farfarae folium – coltsfoot leaf
- Foenugraeci semen – fenugreek sead
- Lichen islandicus – island lichen (ČL 2009)
- Malvae sylvestris folium – mallow foilum
- Malvae sylvestris flos – mallow flower (ČL 2009)
- Plantaginis folium – plantain leaf
- Plantaginis ovatae semen – oval plantain seed (ČL2009)
- Plantaginis ovatae testa – testa of oval plantain (ČL 2009)

Cyamopsidis seminis pulvis (ČL 2009)

Cyamopsis tetragonolobus – Guar (Fabaceae)

Annual plant planted in USA, India, Pakistan

Commercial product is grinded endosperm (not exudate)

White powder, with water formats a mucilage of different viscosity, insoluble in EtOH.

Content compounds: polysaccharides D-galacto-D-mannane (1→4)

Usage:

- hypercholesterolemia (prevention of cardiovascular diseases); lowers the level of serum cholesterol and LDL without affection of other lipoproteins and triglycerides;
- DM2; lowering of hyperglycaemia and post-prandial insulinemia (after food intake)
- In combination with montmorillonite – symptomatic treatment of colonopathy with constipation

Cyamopsidis seminis pulvis (ČL 2009)

Cyamopsis tetragonolobus – Guar (Fabaceae)

MANNOSE DERIVED MUCILAGES (NEUTRAL MUCILAGES)

Rarely pure mannan

- **Glucomannans**
  20-50 % of D-mannose replaced by D-glucose, β-(1→4)
  Amorphophallus konjak
- **Galactomannans**
  Part of D-mannose replaced by D-galactose
  Ceratonia siliqua (Caesalpiniaceae), Annonaceae, Palmae
- **Galactoglucomannans**
  Cercis siliquastrum Caesalpiniaceae

CERATONIAE SEMEN; KARRUBIN; LOCUST BEAN GUM

Ceratonia siliqua (Caesalpiniaceae); Karob tree

Subtropic, evergreen, dioecious caulifloric woody plant. Pods ripen in following year. Seeds are exceptional with regular weight, from ancient times weight for measurement of amount of gold and gems: from Greec *kerátion*→carat = 200 mg

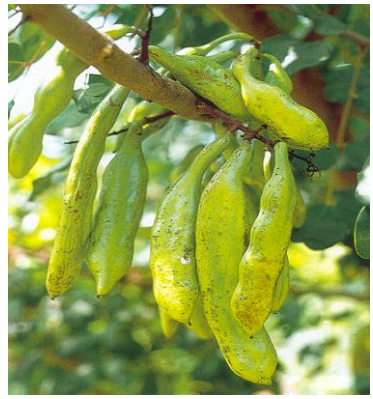
Content compounds:

galactomannan karrubin (up to 80 % of endosperm); flavones, oils with linolenic acid; β-sitosterol

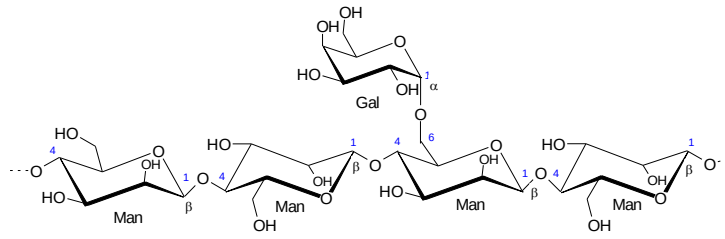
Usage:

- dietary fibers lowers the level of cholesterol, triglycerides, and blood glucose
- retains water in intestinal lumen
- roasted seeds → substitution of coffee, for production of chocolate for allergic people and for dogs
- E410 – thickener, stabilizer of emulsions

Ceratonia siliqua (Caesalpiniaceae)



Karrubin – galaktomannan



MANNOSE DERIVED MUCILAGES (NEUTRAL MUCILAGES)

Trigonella foenum graecum

Fabaceae

Composition

- mucilages - galactomannans
- saponins
- essential oil – sesquiterpens
- lipids, proteins
- flavonoids
- cellulose

Usage

- compress, kataplasmata
- lowering of blood cholesterol
- adjuvant therapy of DM2

ACID HETROGENOUS POLYSACHARIDES (ACIDIC MUCILAGES)

Mucilages of Plantaginaceae

- Psyllium
  - *Planatago afra* (syn. *P. psyllium*)
  - *P. indica* (syn. *P. arenaria*
    - Mediterranian
- Ispaghula
  - *Plantago ovata* (syn. *P. ispaghula*)
    - India

Composition

- heteroxylan (D-xylose (70 %), L-arabinose (10 %), D-galaktose, α-D-galakturonyl-(1→4)-L-xylose)

Usage

- mechanical laxative
- lowering of blood glucose
- lowering of LDL and total cholesterol
- Irritable colon syndrom

Mucilages of Malvaceae

- *Malva silvestris*
- *Althaea officinalis*

Strongly ramified structure

- Similar to pectins
- D-galactose, L-rhamnose, D-glucuronic acid, D-galacturonic acid

Usage

- Symptomatic treatment of constipation
- Symptomatic treatment of cough
- Protective at GIT

Lini semen

Linum usitatissimum (Linaceae)

Containing:

- Oil, proteins
- Ramified mucilage: D-xylose, D-glucose, L-arabinose, D-galactose
- Lignans

Usage

- Laxative
- Mucose layer protective
- Compresses

http://caliban.mpiz-koeln.mpg.de/~stueber/thome/band3/tafel_001.html

GUMS

Gums - clovatins

Common occurrence mainly at Mimosaceae, Rosaceae, Rutaceae, Burseraceae

Characteristics:

Optically active compounds, molecular weight $2 \times 10^4 - 2 \times 10^6$; complex molecules, always heterogeneous and ramified, containing uronic acids together with galactose, arabinose and xylose. Often partially methylated or acetylated. Carboxylic groups can occurre in form of salt.

Pathologic products – flowing from plants after wounding (with exception of *Tragacantha*).

Formation:

transformation of other polysaccharides (probably also starches)

Characteristics

- amorphous optically active compounds
- soluble in water to format colloid hydrophilic solution, weakly acidic reaction in EtOH
- in organic solvents insoluble
- water solutions tends to glue

CLASSIFICATION OF GUMS

according to the structure and distribution in plant kingdom

A: Gums from *Acacia* plants (Gummi arabicum) contains enzymes

- main chain composed of 1→3 galactan substituted with L-arabinose
- ramification by L-rhamnose, D-xylose, D-glucuronic acid
- compatible with majority of hydrocolloids and majority of alkaloids
- incompatibility with gelatin, phenols (thymol, eugenol, morphine)
- stabilizers of suspensions, emulgator, with proteins formats coacervates

B: Gums similar to pectin, Karaya gum, Sterculia gum

- *Sterculia urens* and *S. tomentosa*
- 1→4 D-galacturonic acid
- branching with L-arabinose, D-glucuronic acid, D-galacturonic acids.
- non-toxic, non-metabolizing, non degraded
- laxative, anobesic, triggers the „feeling of saturation" (contraindication is stenose pylori), adhesive properties utilizable for fixation of tooth prosthetics
- Utilization in pharmaceutical technology, food industry, cosmetics

CLASSIFICATION OF GUMS

according to the structure and distribution in plant kingdom

C:

- Uncommon 1→4 bonded xylans
- Often substitution with monosaccharides (L-Ara, D-Gal, D-GlcUA)

D:

- Main chain formed by repetition of (1→4 and 1→2) D-GlcUA and D-Man
- C3-OH of majority of D-Man substituted with further sugars
- India, Sri Lanka
- Formation of emulsions, stabilizer
- Ghatti gum (*Anogeissus latifolia,* Combretaceae)

Acaciae gummi – Gummi arabicum (ČL 2009)
Acaciae gummi dispersione desiccatum – Arabic gum dried by dispersion (ČL 2009)

Acacia senegal – gum arabic tree (Mimosaceae). African trees (Sudan).

On the air hardened clovatine flowing spontaneously or after cutting of branches and stem, flowing gum desiccates into yellowish or jantar oval pieces friable, opaque, without odor and taste.

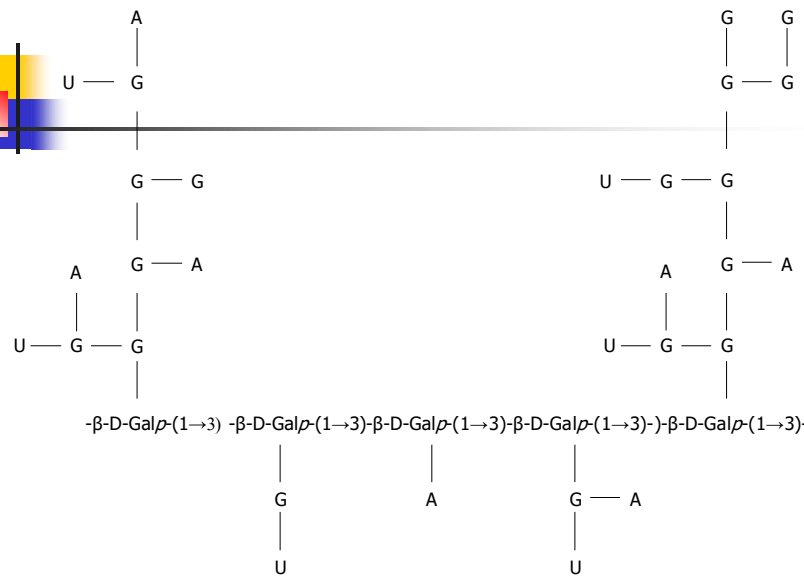
Slowly soluble in doubled amount of water. Obtained liquid is dense, yellowish, showing acidic reaction. Insoluble in ethanol.

Fresh gum is formed from:

- arabin – arabinic acid (salts of Ca, K, Mg), 1→3 galactan, side sugars are: L-Ara, L-Rha, D-Gal, D-GlcUA.
- enzymes – incompatible with glycosides, therefore *Acaciae gummi desenzymatum* is prepared

Utilization: stabilizer of suspensions, emulgator, adhesive. Production of colorants, glues.

Acacia senegal – Arabic gum tree (Mimosaceae)



TRAGACANTHA – TRAGANT

Astragalus gummifer (Fabaceae)

Trees of Western Asia.

Obtained after cutting of branches and stems, flowing gums is without odor, taste. Consists of thin strips (30 × 10 × 1 mm) or their segments.

Fresh gum is formed from:

- tragacanthin (arabinogalactan, neutral, soluble in water and water/alcoholic solvents)
- bassorin (partially methylated glycanogalacturonan, acidic)

Utilization: stabilizer of suspensions; bifunctional emulgator (increases viscosity of water fraction and lowers superficial tension at interface O/W emulsions), E413

Astragalus gummifer (Fabaceae)

Gums similar to pectin
Karaya gum, Sterculia gum

Sterculia urens a *S. tomentosa*

- 1→4 D-galacturonic acid with L-rhamnose
- branching with D-glucuronic acid, D-galaktose
- Non-toxic, non-metabolizing, non-degraded
- laxative, anobesic, triggers the „feeling of saturation“ (contraindication at stenose pylori) adhesive properties utilizable for fixation of dental prosthetics
- Usage in pharmaceutical technology, food industry, cosmetics

http://farm1.static.flickr.com/158/423923943_57dfa989e3.jpg