6. POLYSACCHARIDES

glycans
main building units (book 1, tab. 4.18)
content (book 1, tab. 4.19)

pentoses, hexoses, sugar acids and other derivatives
furanoses, pyranoses

> 10 to 10^3-10^6monosaccharides

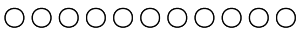
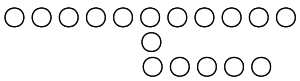
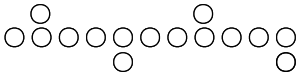
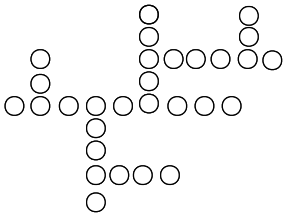
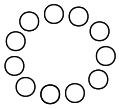
classification
according to origin

- natural — plant and animal glycans
- food additives — glycans of algae, fungi, microorganisms, modified plant glycans

according to basic functions

- reserve — glycogen; starch, nonstarch glycans
- structural — chitin; cellulose and associated glycans
- with other functions (protection of wounded tissues) — arabic gum, okra

according to type of chain

lineární	nevětvené	amylosa, celulosa	
	větvené		
	jednou větvené	amylopektin	
	substituované	dextran	
	několikrát větvené	guarová guma	
cyklické		cyklodextriny	

according to bound monosaccharide

- homopolysaccharides (homoglycans) — amylose, cellulose
  - glucans
    - α-glucans — amylose
    - β-glukans — cellulose
  - fructans
- heteropolysaccharides (heteroglycans)
  - arabinoxylans

according to use in nutrition

- utilisable — starch, glycogen
- non-utilisable (3 kJ/g vs. 17 kJ/g) — fiber

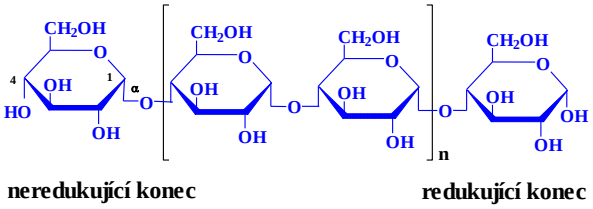
composition, content (book 1, tab.4.20, 4.21)
utilisation (book 1, tab.4.22)

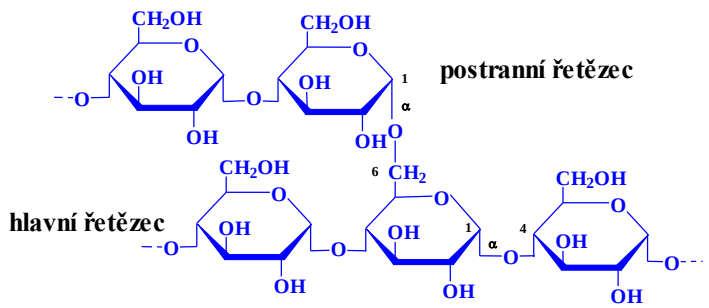
main food polysaccharides

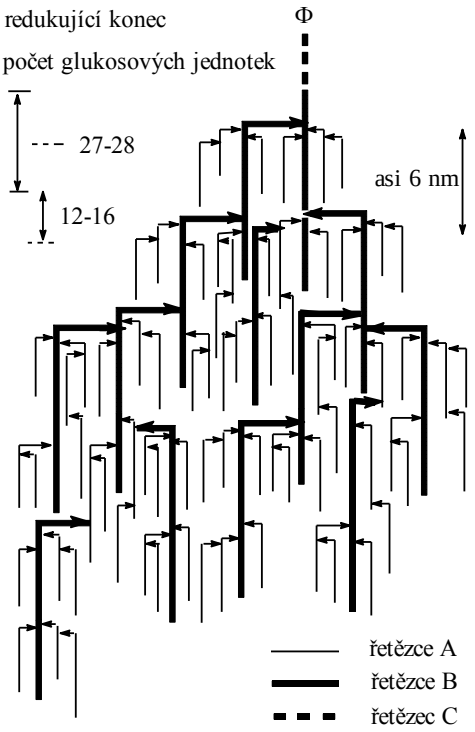
meat	glycogen, complex sugars
cereals	starch
	cellulose
	hemicellulose
	arabinoxylans
	β-glucans
vegetables, fruits and root crops	starch
	fructans
	cellulose
	hemicellulose
	xyloglucans
	pectin
fruits	cellulose
	hemicellulose
	xyloglucans
	pectin
additive glycans	
natural modified	starch, cellulose, chitin, pectin
seeweed	agars, carageenans, alginates
plant gums	arabic gum, guaran, tragacanth
microorganisms	gellan

gels
viscous liquids

starch
structure
mixture of 2 glycans: amylose and amylopectin







schematic structure of amylopectin

sources (book 1, tab. 4.25)

- cereals
- potatos
- pulses
- others (amaranth, cassava)

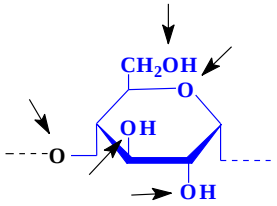
amylocultivars, wax cultivars (barley, corn)

starch granules (book 1, tab. 4.23) in plastides (chloroplasts, amyloplasts)
other components of starch granules

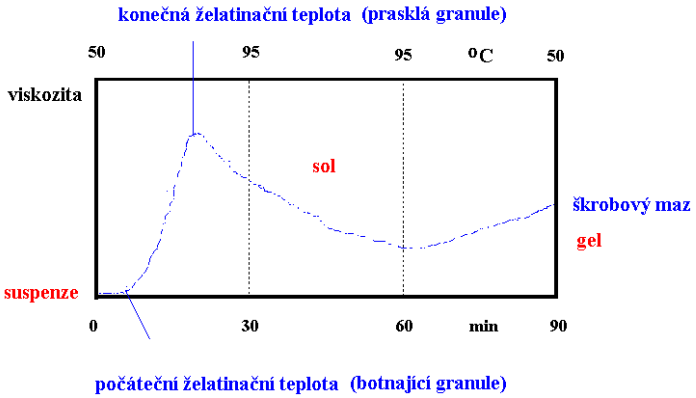
- lipids (book 1, tab. 4.24) (in wheat 0,4-0,7 %, mostly lysophospholipids)
- proteins (book 1, tab. 4.24) (in wheat friabiline, 0,3 %)

behaviour in water during heating

- water content 13 % (wheat), 18-22 % (potato)
- insoluble in cold water, suspension
- income ≅ 30 % without changes of shape and size (imbibition)



- during heating swelling (disconnection of H-bonds), sol
- viscosity increases (book 1, tab. 4.27),
  gelatination temperature (book 1, tab. 4.26) ≅ 52-64 °C (wheat), 50-68 °C (potato)
- amylose into medium, weak decrease of viscosity, sol (starch sol)
- during cooling gel (gelatination, new bonds amylose / amylopectin)
- ageing, retrogradation (syneresis), release of water
- re-gelatination (association of amylose)



behaviour during bread production

application

- modified starches
- dextrins DE ≤ 20
- starch sirups, (maltose sirups), glucose sirups (book 1, tab. 4.29)
- fructose sirups (glucoisomerase)

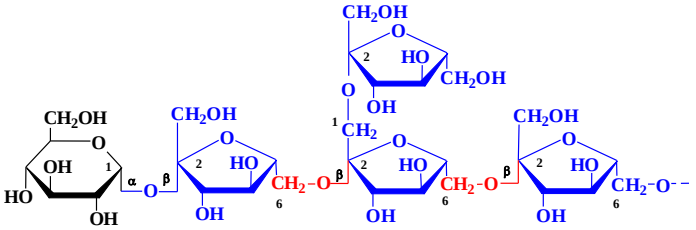
fructosans

fructans, glucofructans

content (book 1, tab. 4.31)

structure

♦ inulin, chicory:	Jerusalem artichoke	β-(1→2)
♦ levans (fleins):	juice beet, *Bacillus subtilis*	β-(1→6)
♦ with mixed bonds:	cereals, vegetables	β-(1→2), β-(1→6)



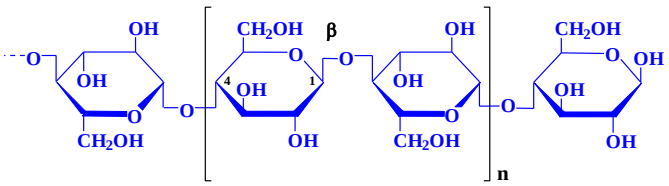
glucofructan of levane type

uses

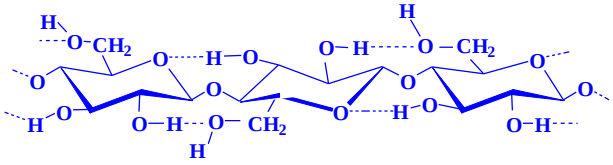
fructose sirups

cellulose

structure



≅ 15 000 molekules, β-(1→4)



stabilisation by H-bonds, fibres (microfibriles)

sources

- cell walls of plant cells
- assotiation with hemicellulose, pectin

fruits, vegetables	1-2 %
cereals, legumes	2-4 %
wheat flour	0,2-3 %
bran	30-35 %

usees

- modified celluloses

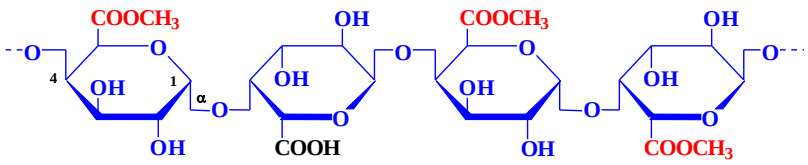
hemicelluloses

- heteroglucans
  - xyloglucans — fruits, vegetables, legumes
  - β-glucans — fruits, vegetables, cereals
- heteroxylans
  - arabinoxylans (pentosans) — cereals

arabinoxylans (pentosans)
wheat flour << rye flour
ability to bind water
viscous structure of rye dough

pectins
structure, content of galacturonic acid (book 1, tab. 4.33 a 4.34)
pectocellulose → protopectins → pectins (soluble)
unripe fruits, ripe fruits

structure
linear domains — D-galacturonic acid (methylester)
hair domains — arabinans, arabinogalactans, L-rhamnose



sources (book 1, tab. 4.35)

- apple marc
- orange albedo

use
gel formation (conditions, types)

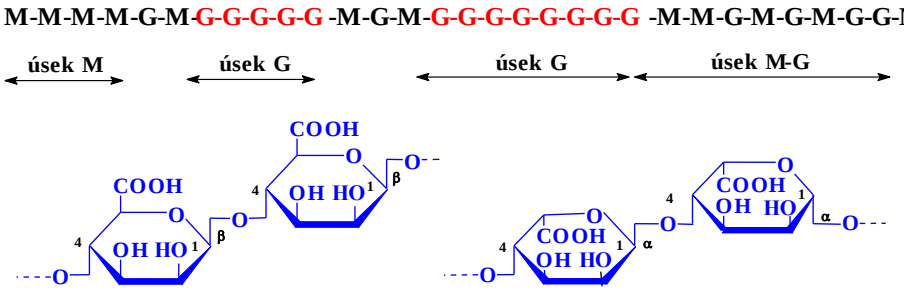
gums and plant mucilages
plant gums, basic composition (book 1, tab. 4.36)
microbial gums

gels are not formed, high viscosity liquids

polysaccharides of seeweeds
building fuction

alginates
alginic acid, salts alginates (commercially: Na)

structure

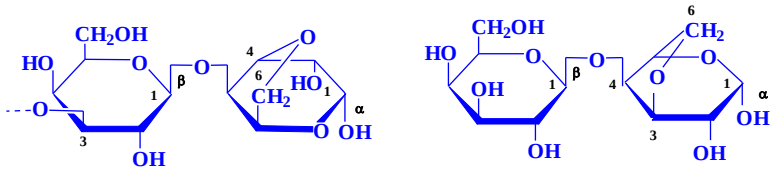


β-D-mannuronic acid α-L-guluronic acid

sources
brown algae *Pheophycae*

uses
thickerners, emulsifiers, stabilisers
essential: presence of Ca^{2+} (see pectins)
modified alginates

agar- agar, carrageenans
structure (book 1, tab. 4.37)



β-D-Gal*p* **3,6-anhydro- α-L-Gal*p*** **β-D-Gal*p*** **3,6-anhydro- α-D-Gal*p***

agarobiosa **karabiosa**

agarose (low quantity of sulfates groups) different carraggenans

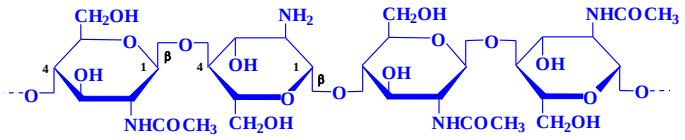
sources
red algae *Rhodophycae*

application
thickerners
carrageenans (superhelixes) presence of neutralization ionts
complexes with caseins

chitin
structure

β-D-glukosamin *N*-acetyl-β-D-glukosamin (chitosamin)

10-30 % 70-90 %



chitobiosa

sources

- food: higher fungi (1 %), yeasts (2,9 %)
- industrially: sea shells

application

modified chitin = chitosan (75-95 % glucosamine)

lignin

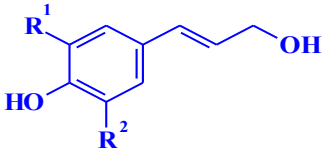
sources

lignified plant cells

- wood 25 %
- bran 8 %
- fruits, vegetables less

structure

polymer of phenylpropane units



p-cumarylalcohol, $R^1 = R^2 = H$

ferulylalcohol (coniferylalcohol), $R^1 = OCH_3$, $R^2 = H$

sinapylalcohol, $R^1 = R^2 = OCH_3$