



Aalto University
School of Chemical
Technology

CHEM-E1150
BIOMASS PRETREATMENT AND FRACTIONATION

HEMICELLULOSE CHEMISTRY

Herbert Sixta, 2018

Learning Outcomes

Heteropolysaccharides with different structures in

1. Softwood

2. Hardwood

3. Annual Plants

Hemicelluloses from Softwood

1. Galactoglucomannan
2. Arabinoglucuronoxylan
3. Arabinogalactan

Galactoglucomannan (GGM)

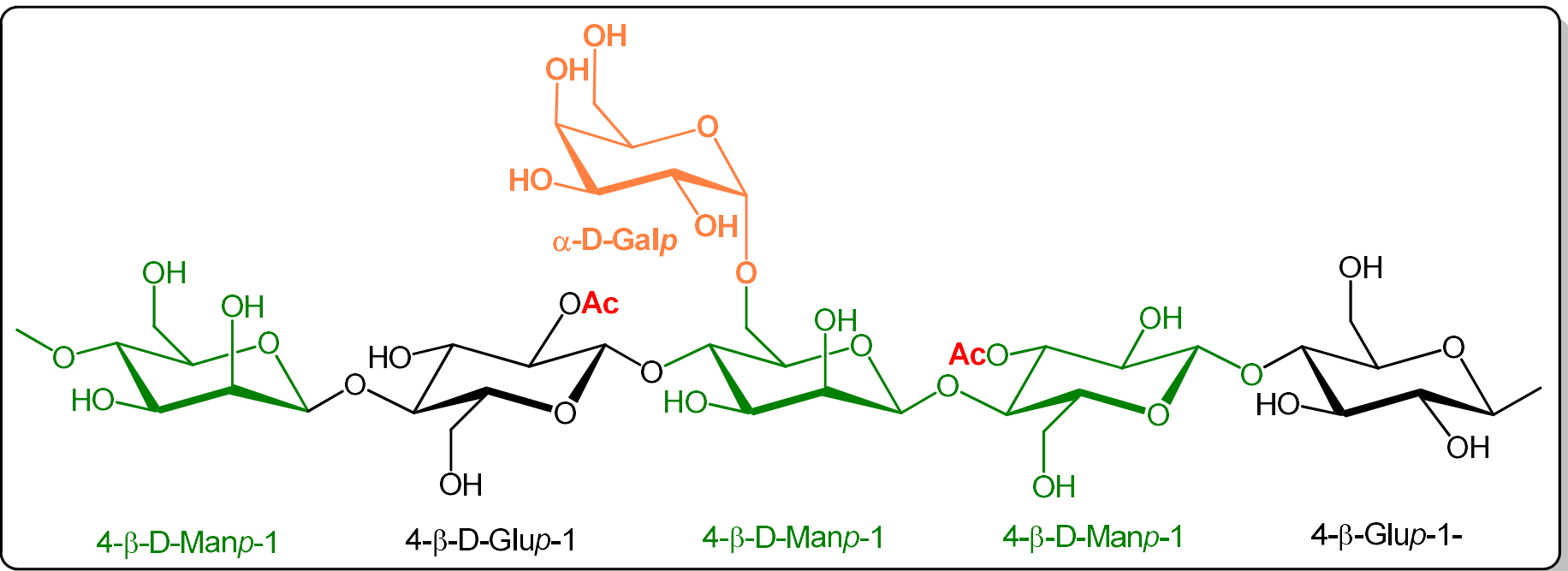
Occurrence: 5-15 Gew%

Two fractions with different content of galactose:

Gala: Glu: Man = 0.1 : 1 : 4 or 1 : 1 : 3.

Side chains: 1→6- α -D-galactopyranose unit

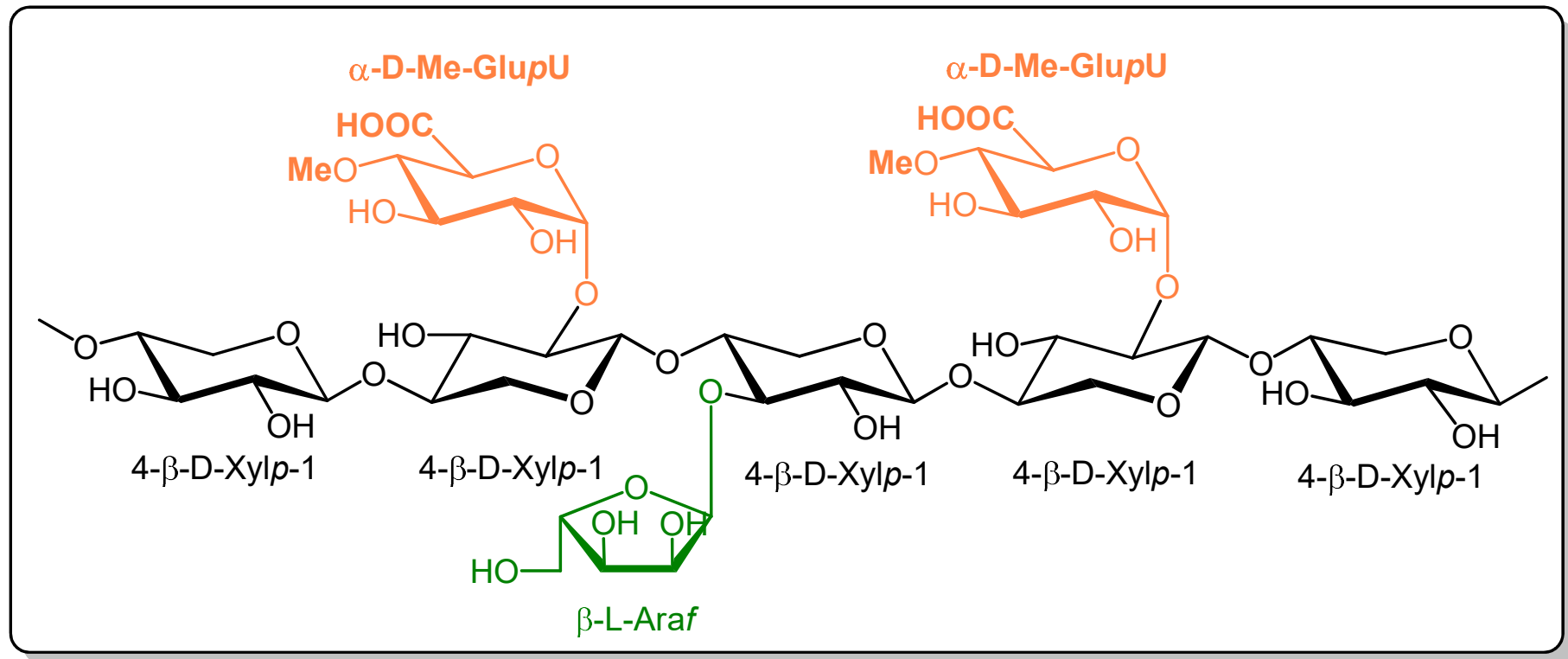
Mannose is **acetylated at C-2 und C-3**.



Arabinoglucuronoxylan (AX)

Occurrence: 7-10%

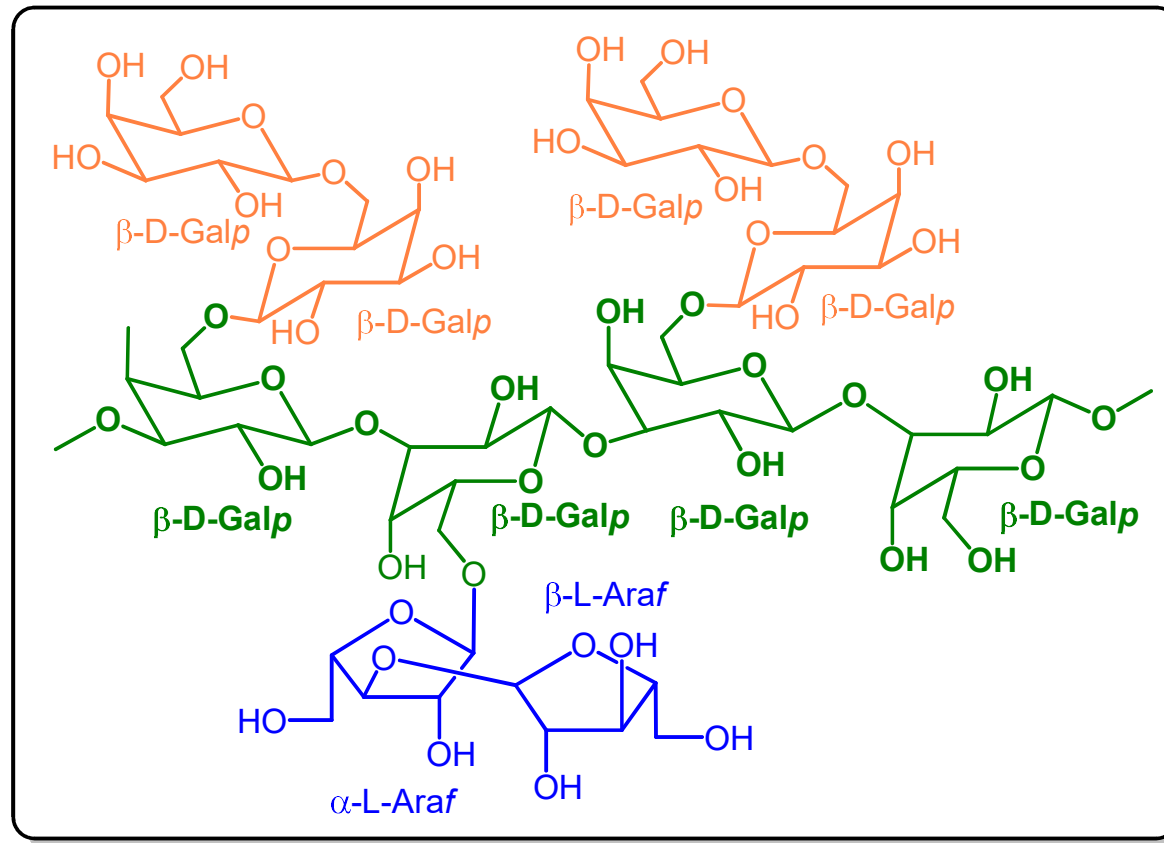
C-2 substituted 4-O-methyl- α -D-glucuronic acid (10:2) and on C-3 with α -L-arabinose (10:1.3).



Arabinogalactan

In larch 5-30%.

1-3-glycosidic β -D-galacto-pyranose units. Almost every monomer is substituted on C-6 with 2 β -D-galacto-pyranose- and L-arabinose units.

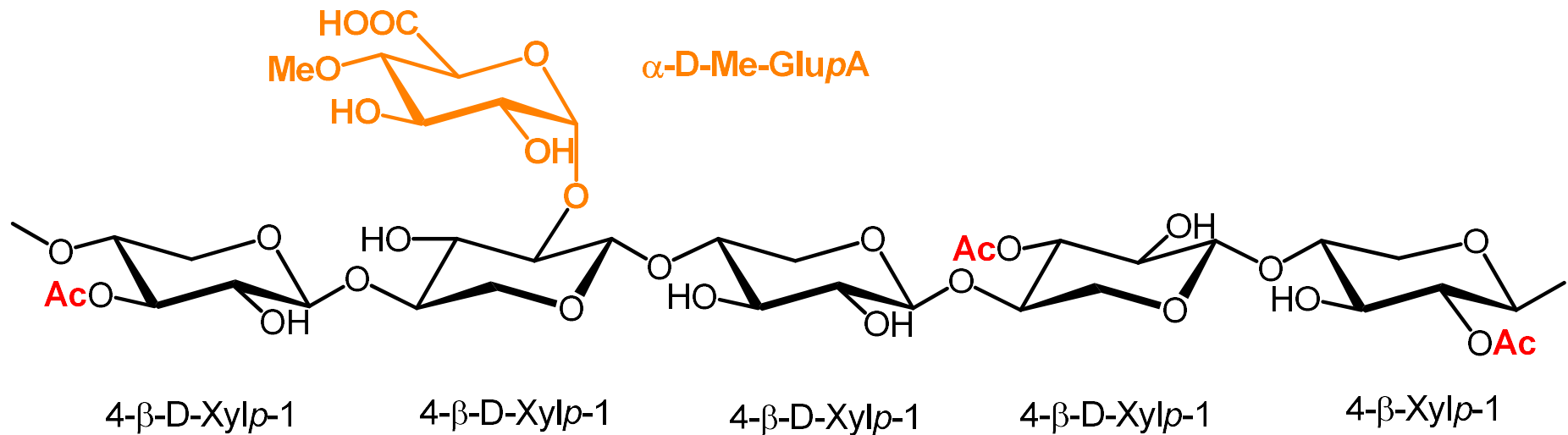


Hemicelluloses from Hardwoods

1. Glucuronoxylan

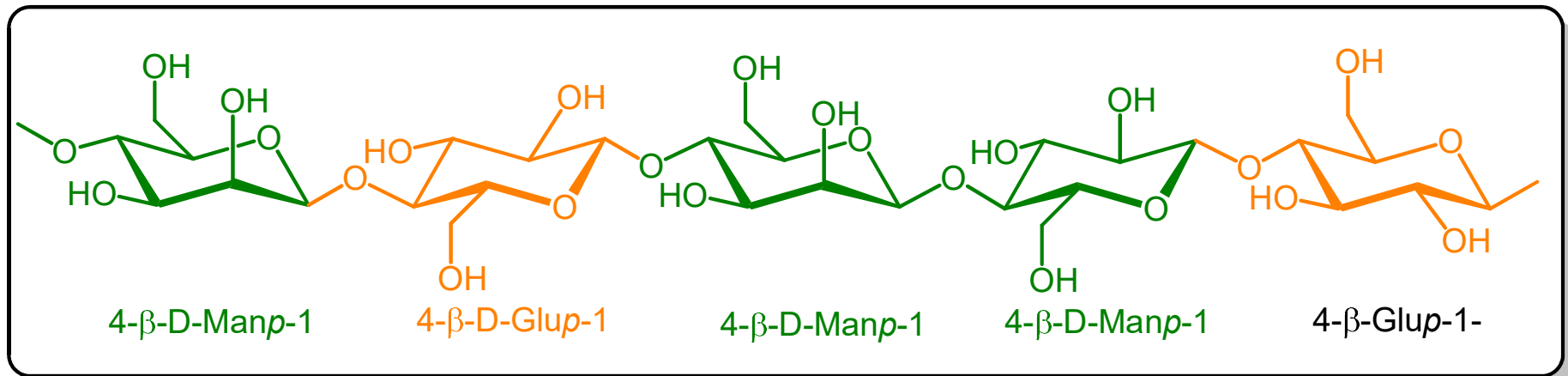
2. Glucomannan

Glucuronoxylan



O-Acetyl-4-O-Methylglucurono- β -D-xylan

Glucomannan



Occurrence of Pectin in Wood

Present in bark in an early development stage

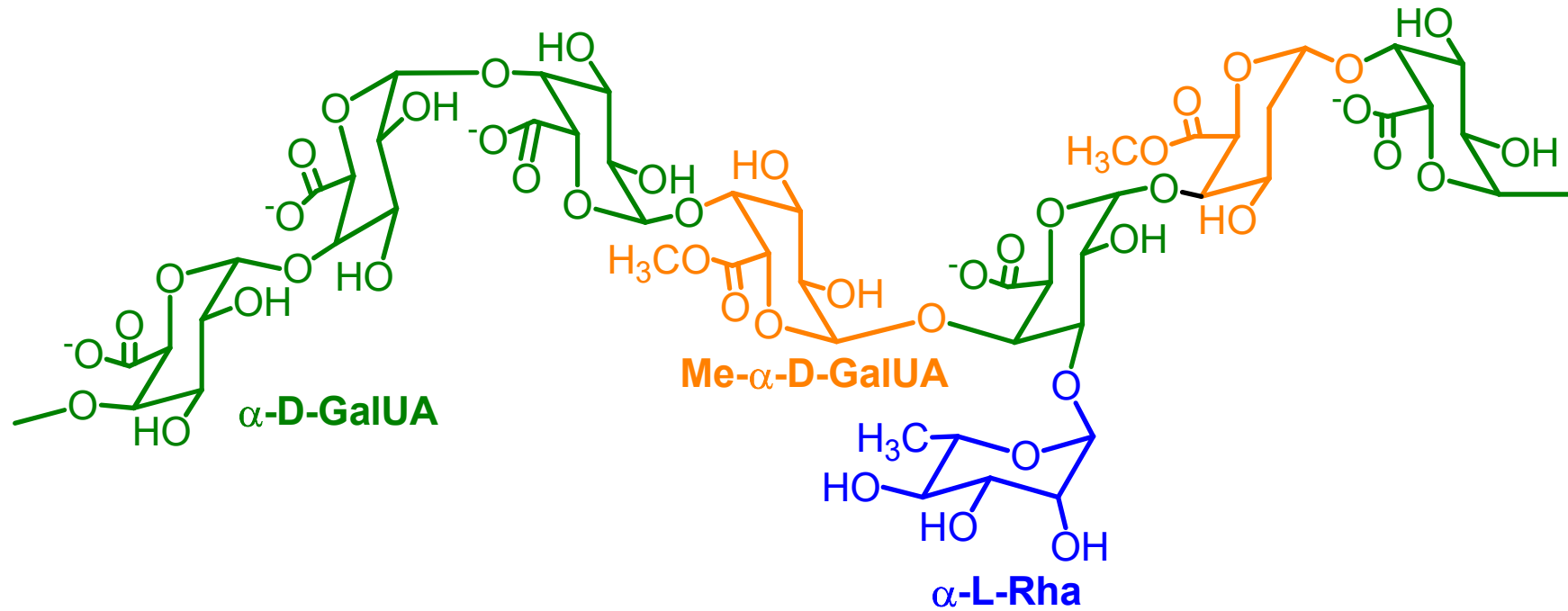
Also in fresh wood, particularly in Eucalyptus.

Linear chain of **α -1-4 D-galacturonic acids** with D-galactose, L-arabinose and L-rhamnose side chains.

Hydrolysis results in galacturonic acids and small amounts of arabinose and galactose.

Most of the galacturonic acids are esterified with methanol.

Chemical Composition of Pectins



WAXS measurement

Sample preparation: pressing the sample powders by hand into metal rings of a thickness of 1.5 mm and covering them on both sides with Mylar foil.

X-ray generator: UltraX18S, Rigaku with a rotating copper anode. The beam was monochromated with a Si(111) crystal and a totally reflecting mirror, thus, singling out the Cu KR radiation (λ) 1.541 Å).

Scattered radiation: detected with an image plate detector (MAR345) in perpendicular transmission geometry. Each sample was measured for 30 min in room temperature.

