

Can Carbohydrates be used to Dictate Structure in Native Lignins?

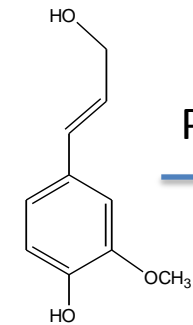
Towards a more Homogeneous Technical Lignin.

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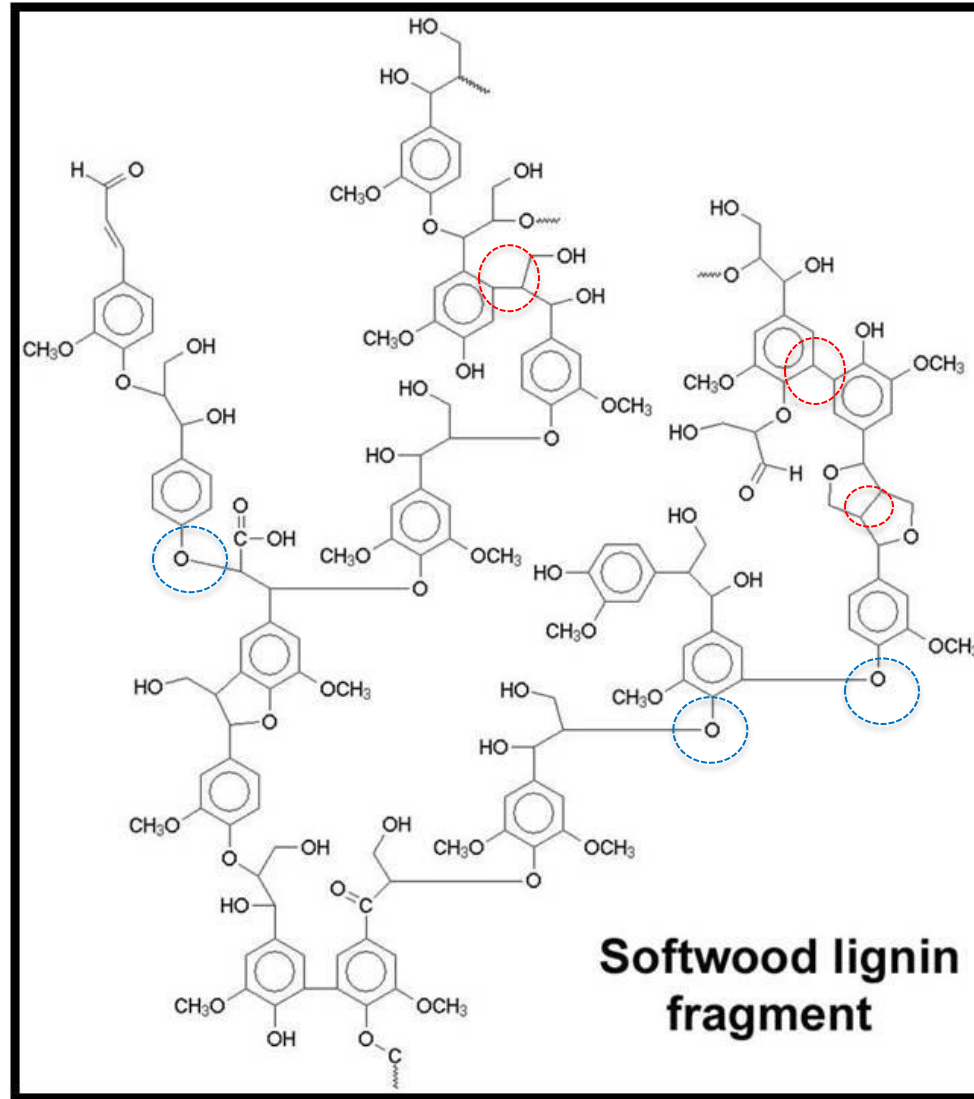
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Structural motif of Native Lignin



Monolignol

Polymerization



Carbon-Carbon Bonds

Ether bonds

Heterogeneous branched Biopolymer



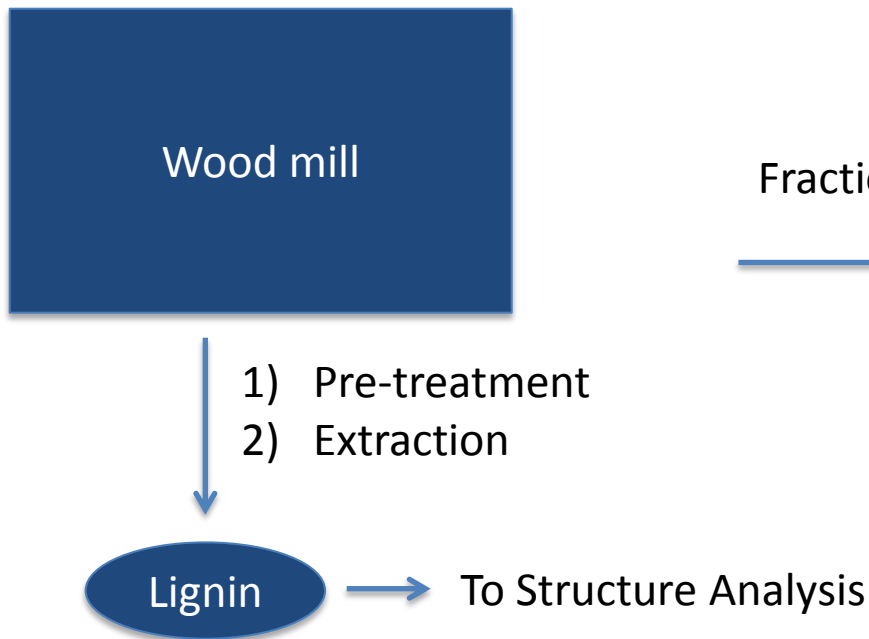
Selective degradation of lignin to a uniform polymer with respect to structure and molar mass is a challenge



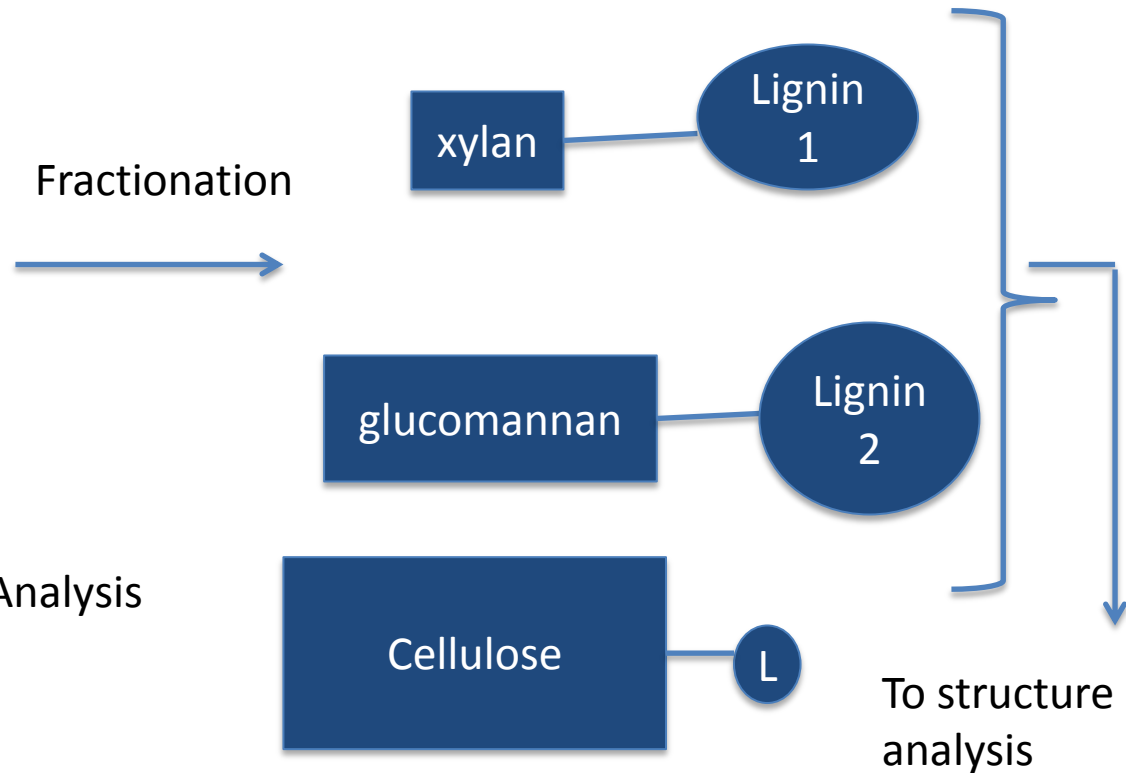
The utilization of lignin as a raw material for new products requiring specific properties could be a technical challenge.

Is this presented structural motif truly representative of Native Wood Lignin?

1) Principle of Traditional Analytical Lignin Preparation Methods

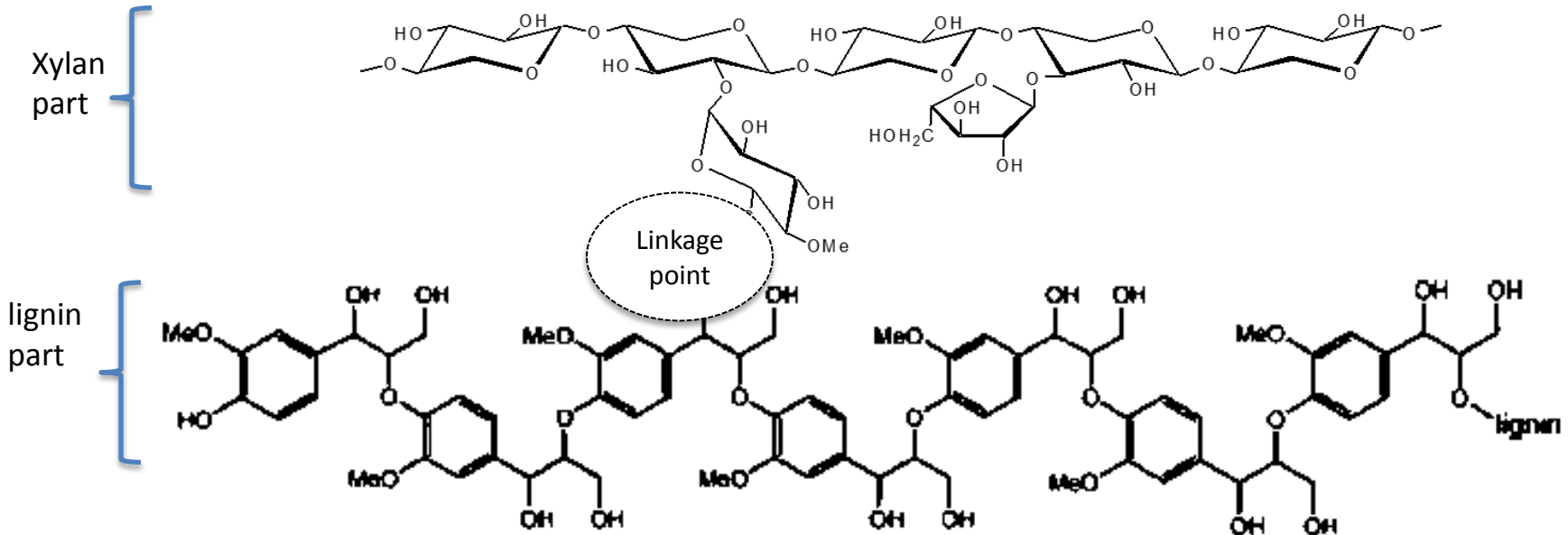


2) New Method of Lignin Preparation. Utilizes the knowledge that Lignin is Chemically linked to Carbohydrates



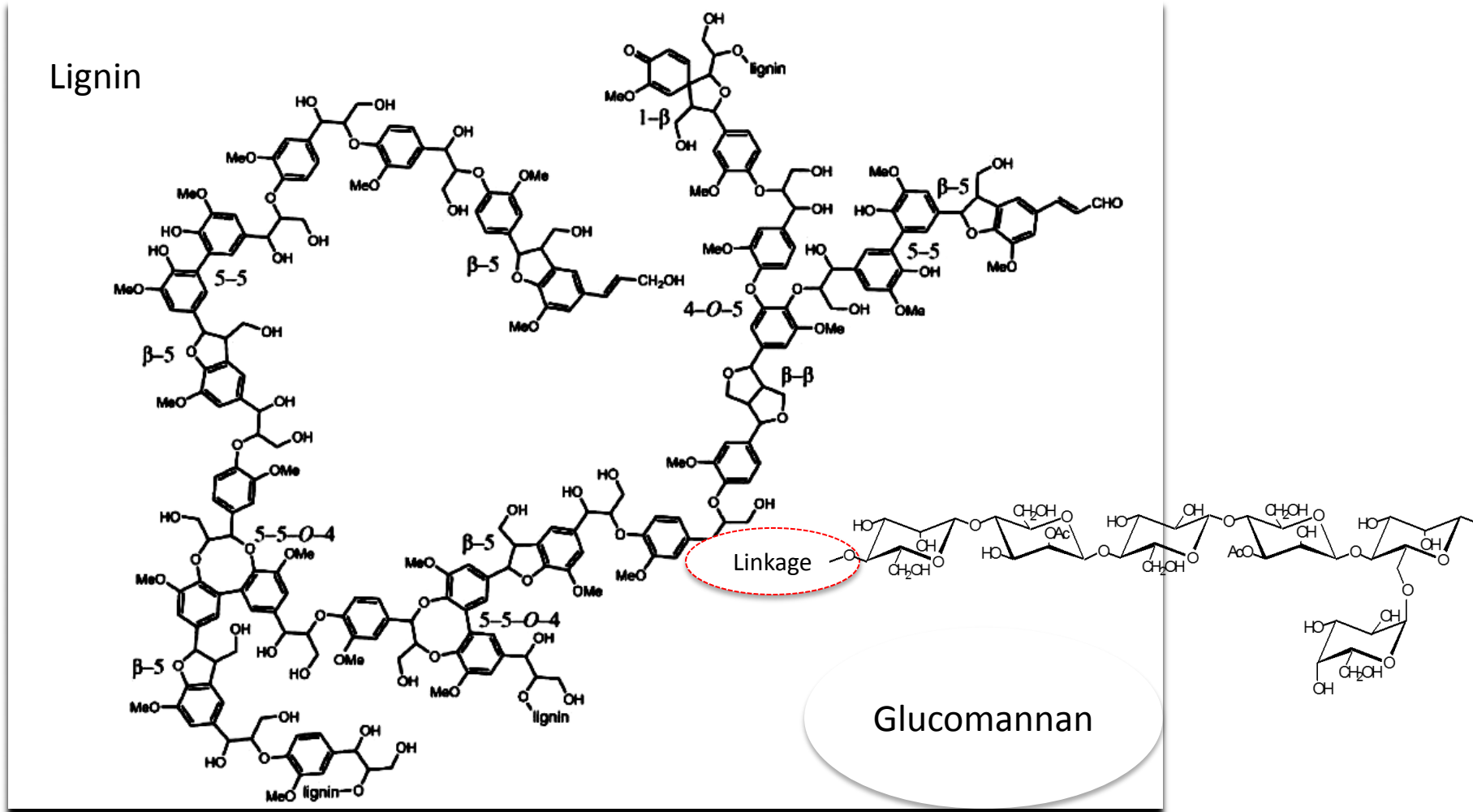
Xylan-Lignin Co-polymer Containing 40% of the Wood Lignin

(Lawoko et al. 2005)



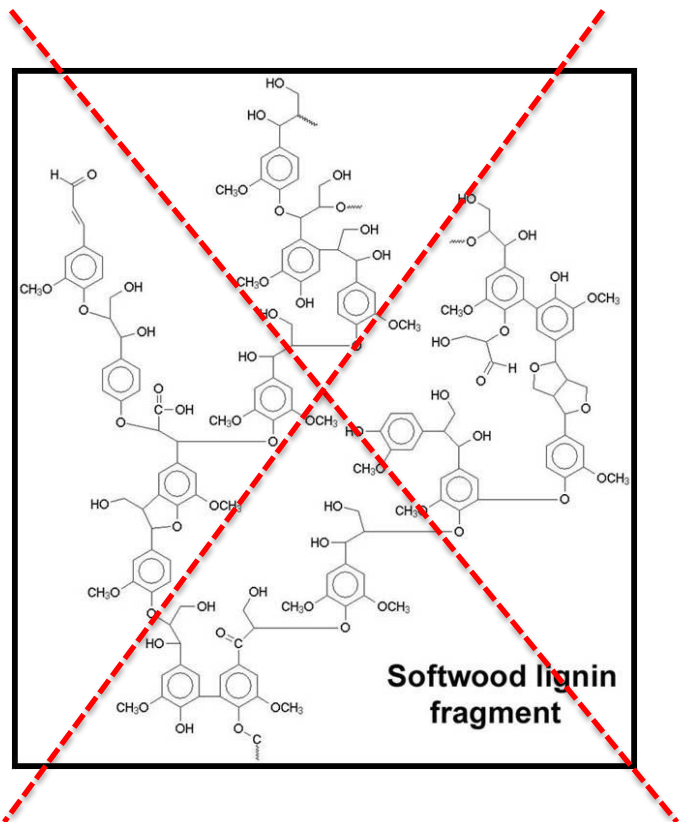
The Lignin is **linear** and **homogeneous** and the monolignol units are connected by (beta aryl) ether linkages

Glucomannan-Lignin Co-polymer containing 48% of the Wood Lignin



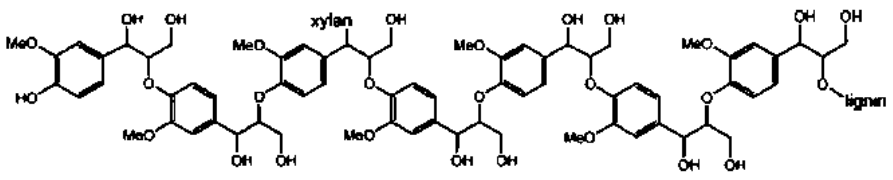
The lignin is highly branched and heterogeneous in structures.

Previous understanding of lignin
 Structure motif: **Heterogeneous structure**

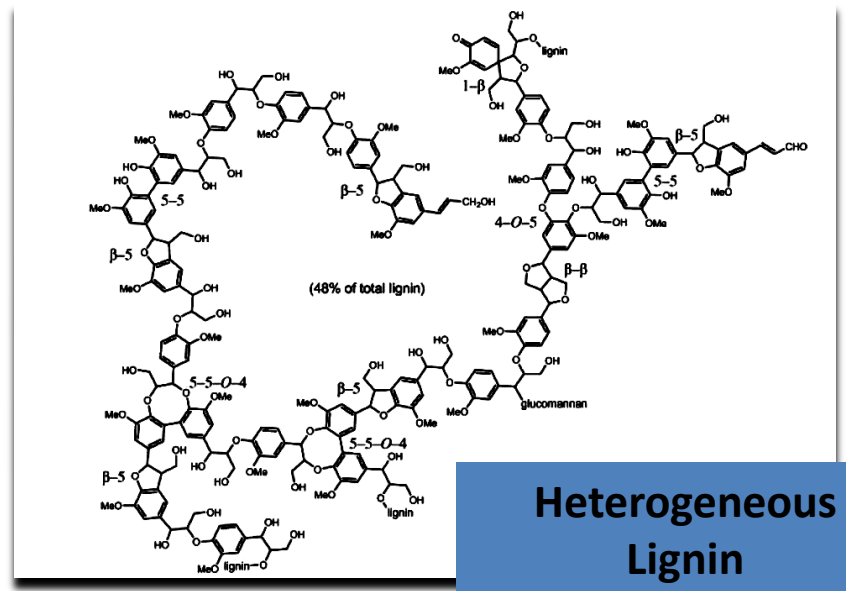


Falls short of some detail!

Our present understanding (Lawoko et al. 2005)
 Consist of **homogeneous structure** as well as **heterogeneous** in almost equal amounts

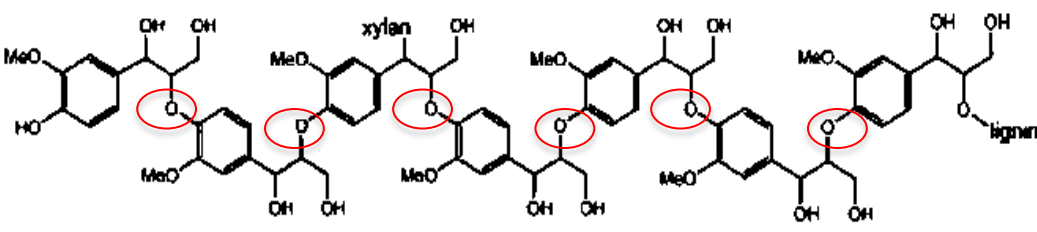


Homogeneous Lignin



Heterogeneous Lignin

Technical impact : Homogeneity in Lignin Structure opens possibilities for lignin utilization in new products.



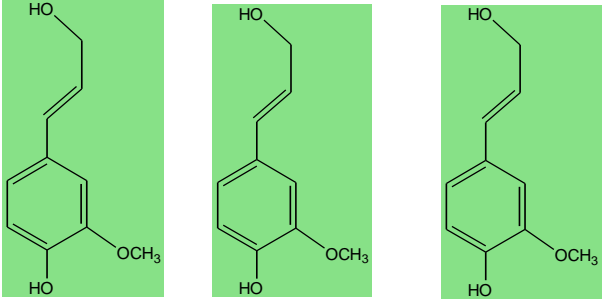
Thermochemical degradation
or Hydrothermal treatment

Bio diesel

Homogeneous Lignin

quantitative cleavage
of ether bonds

Controlled depolymerization for
Functional group enhancement and Mw control



Application as Green polymers in
e.g. Carbon Fibers
Resins, Adhesives, Cross Linkers,
binders

"Green" Phenols

Used as feedstocks for e.g
aromatic-based chemical

Key Scientific Questions

1) Basic science:

Is lignin structure dictated by the carbohydrate type surrounding it during biosynthesis?

If so...



2) Applied Science:

Can genetic engineering of carbohydrate composition be used to tailor a more "technically favorable" lignin?

Thank you for your attention!