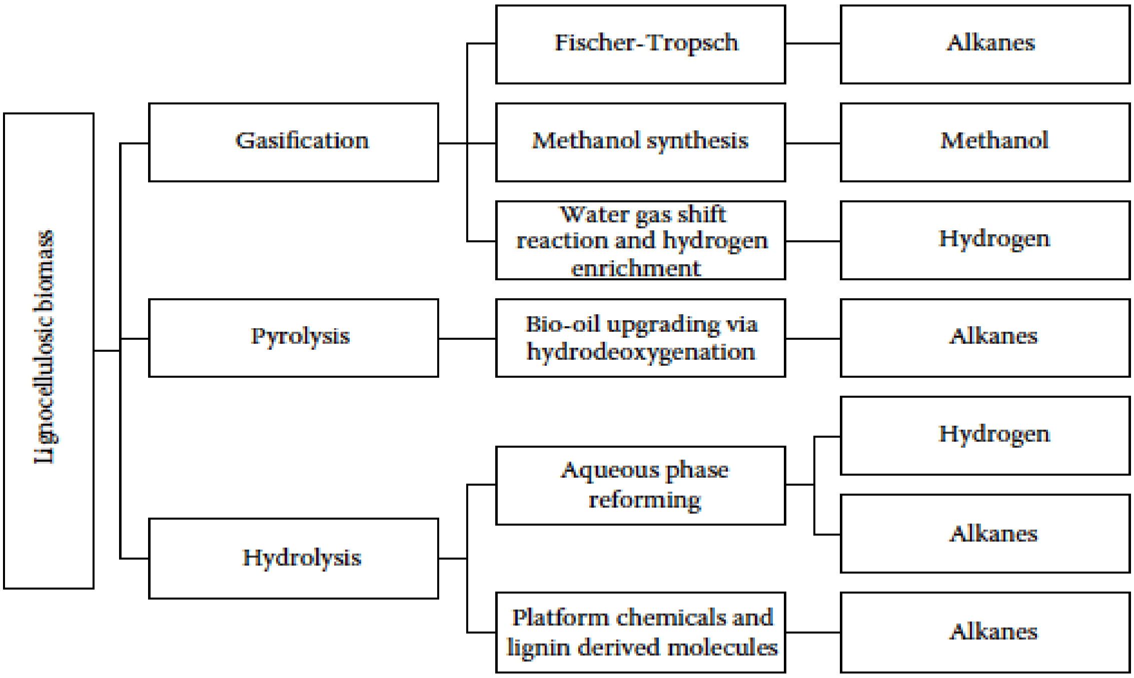
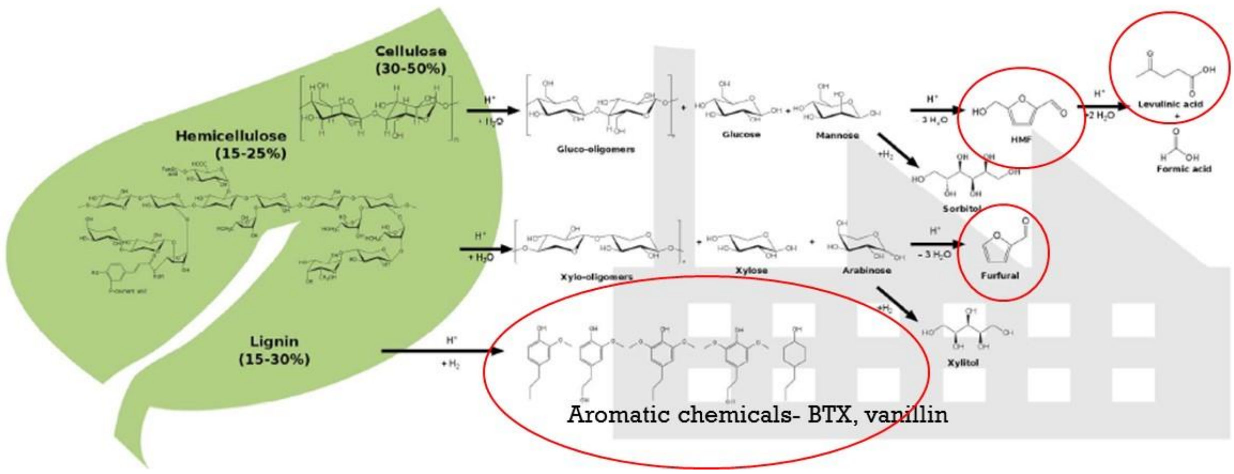
THERMOCHEMICAL PROCESSES

Major routes involving **catalytic** conversion of lignocellulosic biomass to biofuels



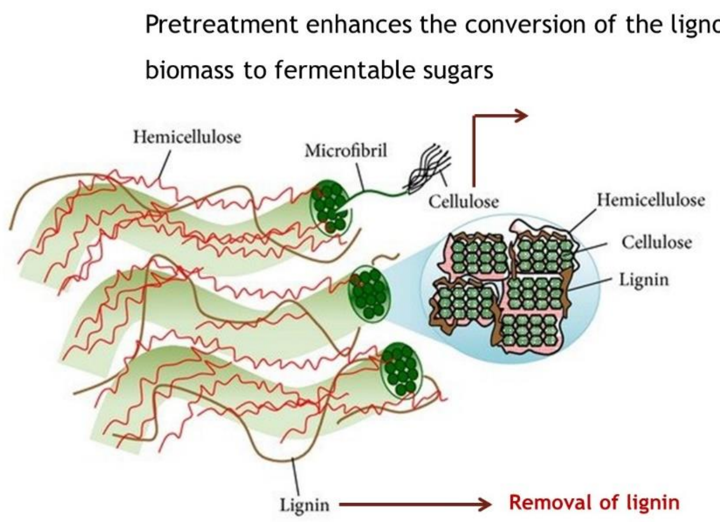
The three portions are processed together through strategies like gasification and pyrolysis, offering simplicity of operation, and lower operating costs. The alternative approach is to separate the three fractions of lignocellulose from each other by adopting various pretreatment strategies and process them separately.

Lignocellulosic biomass ⟶ Platform Chemicals



https://pubs.rsc.org/en/content/articlelanding/2014/gc/c4gc01160k#!divAbstract

Catalytic strategies used for the valorization of biomass-derived molecules target the production of higher alkanes and platform molecules to replace diesel/gasoline range fuels and crude oil–based intermediates, respectively.



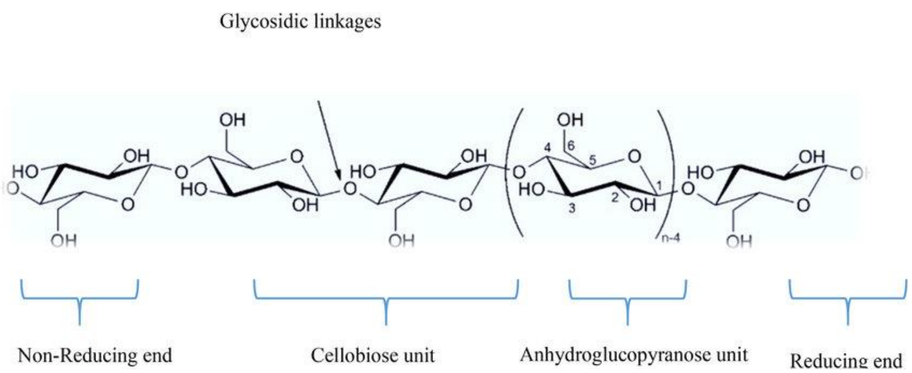
https://www.hindawi.com/journals/tswj/2014/631013/fig2/

During pretreatment, researchers maily target on removal of lignin and distruption of the crystalline structure of cellulose.

Obviously you can use acidic reagents to distrupt the crystalline structure of cellulose and alkaline reagents to remove reagents or you can employ a combination of two or more methods to fractionate the biomass. However none of them would be environmenattly benign approaches.

Cellulose and Hemicellulose

Cellulose is a linear polymer composed of glucose units connected by β-(1,4) glycosidic bonds, providing the structure with rigid crystallinity that is recalcitrant to hydrolysis. These β-glycosidic bonds are cleaved upon the addition of water, forming glucose molecules. The fibrous cellulose is covered by hemicellulose, an amorphous, branched polymer generally composed of five different sugar monomers: D-xylose (the most abundant), L-arabinose, D-galactose, D-glucose, and D-mannose.



https://www.researchgate.net/figure/Chemical-structure-of-microcrystalline-cellulose_fig3_316146815

Being the most abundant organic polymer on earth but also for being the major raw material in cellulosic ethanol production

Composed of glucose ($C_6H_{12}O_6$) monomers which are linked to each other by the β-1,4 glycosidic bonds.

The chemical structure of cellulose is shown on the left.

The interchain (between the chains) and intrachain hydrogen bonds (within the chains) between glucose subunits form an organized network. This hydrogen bonded network includes mainly the crystalline regions which hardly get deconstructed by enzymatic attack and some amorphous regions that are more susceptible to the enzymatic attack.

Owing to its adverse effect on enzymatic accessibility of cellulose, crystalline structure of cellulose has been monitored via numerous types of characterization techniques such as XRD