Synthesis of Lignin Depolymerization Detection Probe

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Introduction

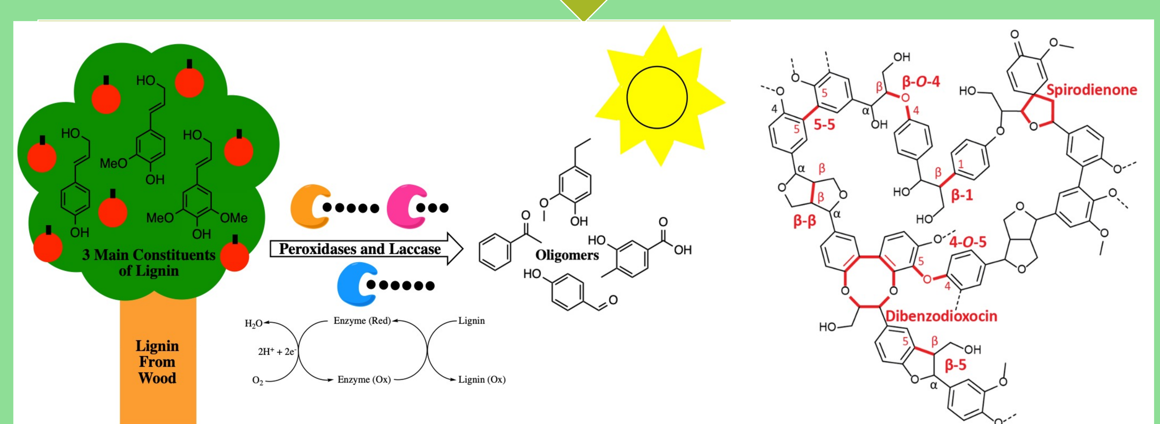
130 million tons of biomass (paper/pulp industry)

38% of that biowaste is lignin

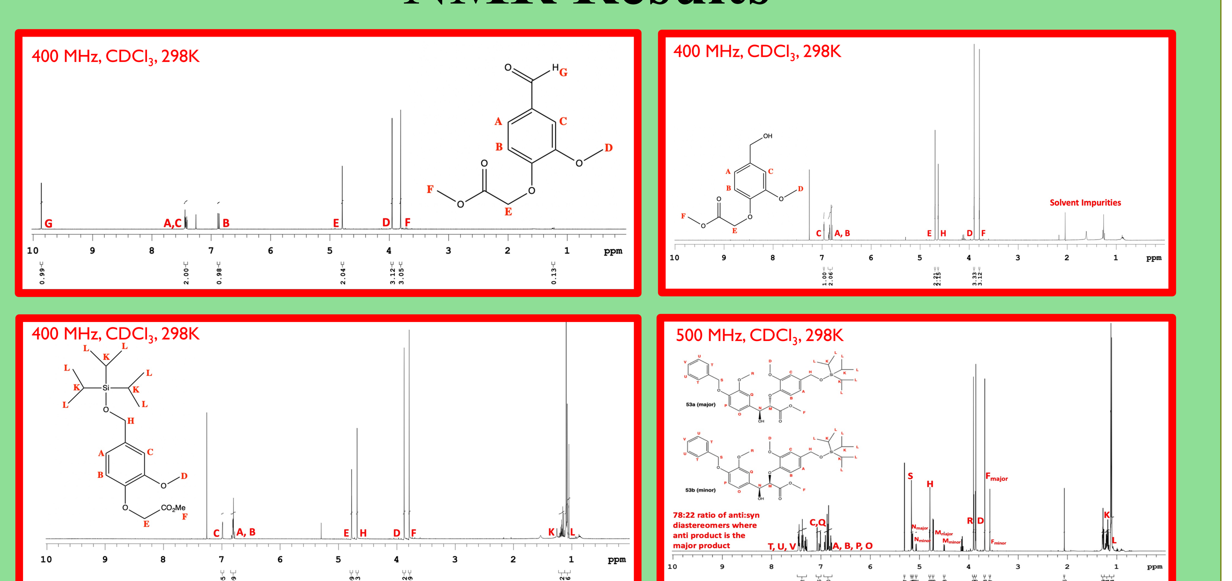
Lignin is linked to cellulose and hemicellulose

Through radical polymerization, three monomers polymerize to create lignin: p-coumaryl alcohol, coniferyl alcohol and sinapyl alcohol.

These three monomers are crosslinked into large, rigid polymers with various bonds such as β-O-4, β-β, β-5,5-5, 4-O-5, etc. Due to the complexity of the lignin structure, lignin is difficult to break down.



NMR Results



Discussion & Future Directions

- A third of the synthesis is complete
- The β-O-4 linkage was successfully synthesized, including the major diastereomer (anti) from aldol addition reaction

Future work involves:

- Separating the diastereomers produced from the aldol addition reaction
- Increasing overall yield throughout the synthesis

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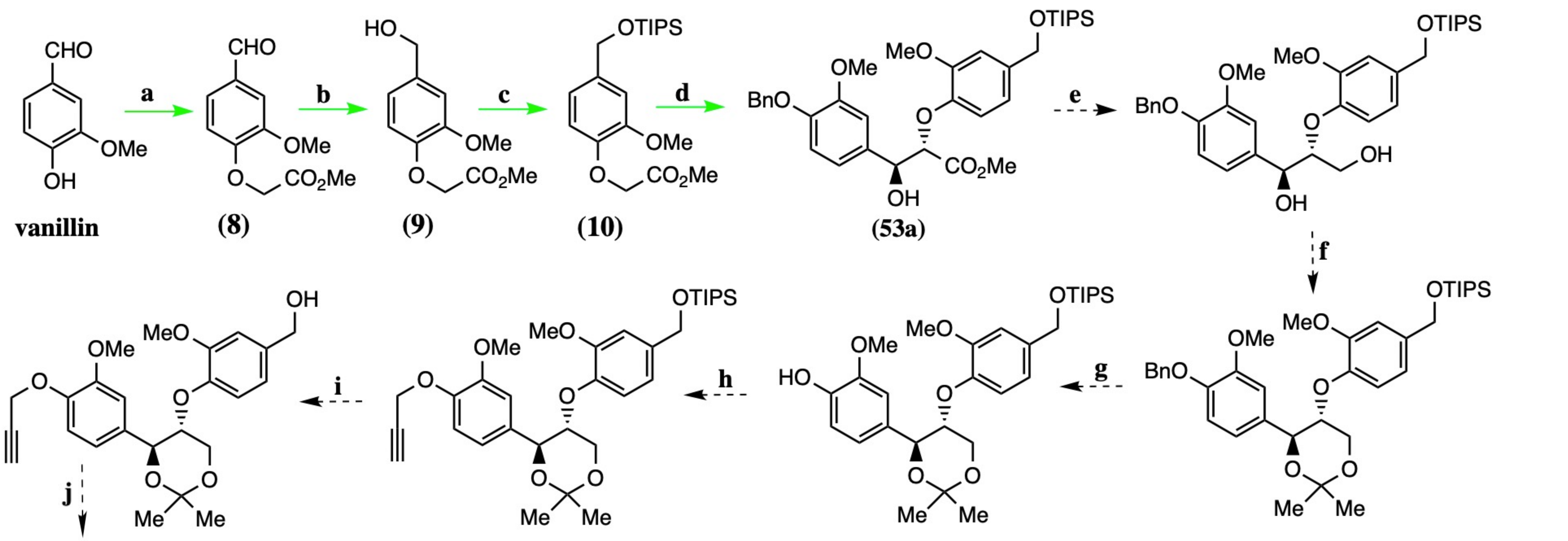

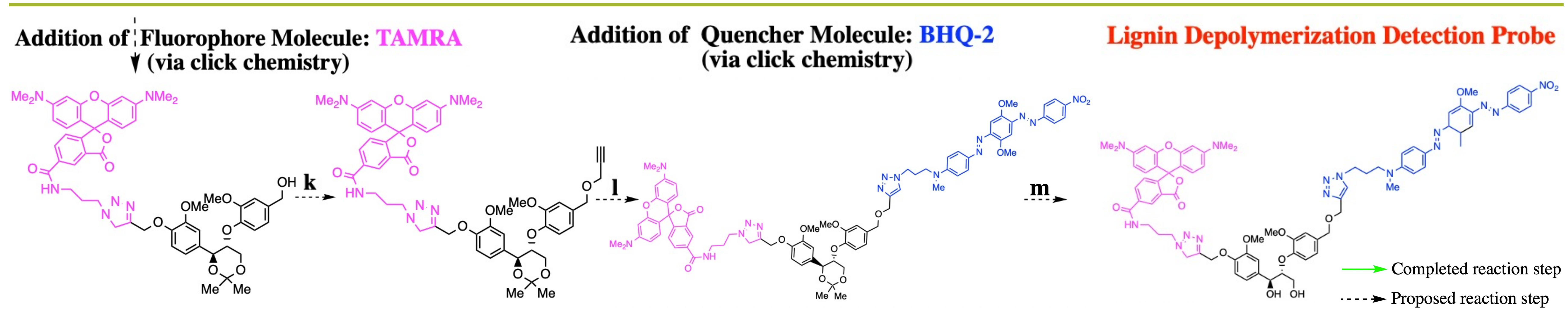

Pinpointing the location of ligninolytic enzymes in the digestive tract of microorganisms (i.e., termites) will allow for further investigation behind these enzymes so that the world may one day utilize them to degrade lignin to use for biofuel and fine chemical production.

Reagent and Reaction Conditions: (**a**) vanillin, methyl α-bromoacetate, K_2CO_3, acetone, reflux (56˚C), 2 hours, **82.6% yield**, (**b**) $NaBH_4$, methanol, N_2, room temperature, 40 min., **54% yield**, (**c**) TIPS-Cl, imidazole, dry DMF, room temperature, 4 hours, **88% yield**, (**d**) i) LDA, anhydrous THF, N_2, -78˚C, ii) benzylvanillin, N_2, **25.2 % yield**, (**e**) $NaBH_4$, 3:1 THF/H2O, N_2, room temperature, (**f**) anyhydrous p-TsOH, acetone, N_2, room temperature, (**g**) 10% Pd/C, H_2, ethanol, (**h**) propargyl bromide, anhydrous K_2CO_3, anhydrous acetone, N_2, reflux (56˚C), (**i**) TBAF, anhydrous THF, N_2, 0˚C/room temperature, (**j**) $CuSO_4$, sodium ascorbate, TAMRA-N_3, 3:1 THF/H_2O, N_2, room temperature, dark, (**k**) propargyl bromide, anhydrous K_2CO_3, anhydrous acetone, N_2, reflux (56°C). (**l**) BHQ-2-N_3, copper sulfate pentahydrate, sodium ascorbate, 3:1 THF:H_2O, N_2, room temperature, darkness, overnight. (**m**) $NaBH_4$, 3:1 THF/H_2O, room temperature.

SCAN ME

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