Lignin degradn

Lignin is normally combusted to heat which has
- low value and Underutilized
- Lignin degradn is a central aspect in industrial Utilizn of cellulosic biomass, such as bioethanol prodn and manufacture of cellulose-based chemicals and materials such as paper.
- conversion of lignin into value added products leads to higher energy content than cellulose

Challenge:- Lignin is very complex molecule and recalcitrant to degradation into simpler molecules and generates very high amounts of solid residues (waste)

- Lignin degradn could be useful in various pulp bleaching reactions. Hence a better understanding of the enzymatic mechanisms could facilitate the development of bio-catalysts for pulping.

- Biological treatments have been proposed for detoxification or, specific removal of inhibitors prior to fermentation.
- Lignin degradn methods can be grouped into two major pathways -

(i) Cellulose and hemicellulose can be removed by solubilization, leaving lignin as insoluble residues. Eg - Lignin available as byproduct from a lignocellulosic ethanol fuel biorefinery.

(ii) methods involving dissolution and removal of lignin, leaving cellulose and hemicellulose as insoluble residues, followed by the recovery of lignin from the solution.

Biological degrad^{n} of lignin! -

- main advantage. —
  - Mild reaction conditions
  - Higher product yields
  - Fewer side reactions, and
  - Less energy demand.

- Potential applications for the utilizing. lignin degrading organisms and their enzymes have become attractive, bcz they may provide environmentally friendly technologies for the pulp & paper industry and for the treatment of many xenobiotic compds and dyes.
- The most well characterized enzymes able to degrade the lignin polymer are lignin peroxidase

(Lip), Manganese peroxidase, versatile peroxidase and H_2O_2 generating enzymes such as glyoxal oxidase (GLOX) and aryl alcohol oxidase.

Microbial degradn of Lignin :-

For a complicated process, microbes needs to cope with three major challenges related to lignin str.

- Enzymatic system to degrade the lignin polymer needs to be essentially extracellular, bcz lignin is a large polymer.
- The mechanism of enzymatic degradn should be oxidative and not hydrolytic, since the lignin str comprises carbon-carbon & ether bonds.
- Lignin stereochemistry is irregular, requiring enzymes with less specificity than hydrolytic enzymes required for cellulose / hemicellulose degradation.

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Lignin degradn by fungi :-

Fungi play an important role in the biodegradation of lignin rich lignocellulosic biomass. They produce an extensive array of enzymes responsible for lignin degradn

- Many white-rot basidiomycetes and some actinomycetes are able to produce lignin-degrading enzymes, especially peroxidases.
- Rigidoporus lignosus, is know to secrete two oxidative enzymes, Laccase and Mn peroxidase, responsible for solubilizing the lignin in a synergistic way.
- Phanerochaete chrysosporium and phlebia radiata are well known producers of extracellular peroxidases.
- Coriolus versicolor produces intracellular laccase peroxidase upon the induction by phenolic compds.
- Therefore, methods using these microorganisms for biotechnological purposes are quite promising.