

PP22. PLANT LIGNINS AND THEIR APPLICATION

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Lignin is the second-most abundant plant polymer on Earth after cellulose and the first among aromatic biopolymers. Natural lignins are unique organic polymers that hold the plant body together.

Lignin performs a number of functions, such as transporting water, strengthening seed coats, protecting from mechanical damage, ultraviolet rays, drought, microorganisms, viruses, insects, and animals.

The biosynthesis of lignin begins with the formation of glucose during photosynthesis, glucose is converted into shikimic acid - the most important intermediate compound in the so-called shikimic acid pathway, two aromatic amino acids are formed as final compounds along this path: L-phenylalanine and L-tyrosine, are amino acids that serve as starting materials for the enzymatic synthesis of phenylpropanoid compounds, which leads through activated cinnamic acid derivatives to three cinnamic alcohols. Cinnamic alcohols are synthesized in the cytoplasm and transported to the cell wall, where lignin is formed, which is called lignification. The network macromolecule of lignin is built from derivatives of guaiacyl (G), syringyl (S), and p-hydroxyphenyl (H) units.

They are interconnected by simple ether bonds, such as (C-O-C) alkyl-O-aryl β -O-4, α -O-4, aryl-O-aryl (4-O-5), alkyl-O-alkyl (γ -O- γ) and carbon-carbon bonds such as (C-C) alkyl-aryl β -5, aryl-aryl 5-5, alkyl-alkyl β - β .

Lignin is also a multifunctional polymer that contains -OCH₃, -OH (carboxylic, phenolic, and aliphatic), -CO, -COOH.

Lignin in plant cells has a spatial structure chemically associated with hemicellulose. The chemical bonds between lignins and carbohydrates have been ester, phenyl glycosidic, and hemiacetal bonds. In fact, lignin is just as interesting a raw material as soil, but unlike the latter, it is a renewable resource. Lignin and its modifications are used in the food, pharmaceutical, cosmetic, agricultural, polymer, construction, and other industries.

In nature, humus is a breakdown product of lignin. Products similar to humus can be synthesized from it to improve soil fertility.