Abstract

The Western Ghats region of Karnataka, India, is an unhabituated area where native micro-organisms have been known to degrade lignin. Among such micro-organisms, white-rot fungi are well reported for their ability to degrade lignin by the production of extracellular laccases and peroxidases. Brown rot fungi partially modify the lignin. Also, bacteria are well reported to degrade lignin. In the current study, the ability of the "native bacteria" has been explored to degrade lignin via the production of extracellular enzymes and to explore the genomics of the best-known lignin degrader of the study.

Lignin, a complex heteropolymer, is one of the renewable organic sources present on the earth that plays a vital role for the growth and survival of the plants. On the other hand, when it comes to the application of the lignocellulosic biomass, the whole fraction of lignin is considered as waste. In most of the cases, lignin which is obtained as a by-product via various industrial processes is burnt as a source of energy or released into water bodies creating an unfavourable condition to aquatic life. Though several researchers had made efforts to valorize the lignin to value-added chemicals but its adoption at the industrial level is awaited. In nature, microbial depolymerization and degradation of lignin is a common process through which they convert lignin to various intermediates, finally to acetyl CoA as a feeding molecule of the TCA cycle. The most common lignin-degrading microbes are white-rot basidiomycetes, brown-rot basidiomycetes, and bacteria. During the processes of lignin depolymerization, degradation and assimilation, several intermediates are produced which are of economic importance such as vanillin, catechol, and propionic acid, etc. Though the fungal biodegradation of lignin is extensively studied, but only a small population of lignin-degrading bacteria are explored. There is always a scope to determine new pathways of lignin degradation and intermediate compounds of high value. Hence, the ambition of the authors through this study is to focus on

the bacterial lignin depolymerization and degradation pathways and further possible route of high-value chemicals.

In the thesis, bacterial isolates were isolated from the soil samples of the Western Ghats, Karnataka region. These isolates were screened and checked for their ability to degrade Kraft lignin. Further, the selected isolates were characterized for their ability to produce high value compounds as well as their ability to utilise aromatic monomers. The best lignin degrader of the study, which is *Streptomyces griseorubens* CRDT-EB-21.6, was studied for its enzyme and the enzyme was further purified and characterized. The enzyme was found to be stable over a large spectrum of environmental conditions, thereby proves its capability to match the needs of industrial applications. The whole genome study of the isolate was also studied confirming the presence of lignin degrading enzyme, Dyp-like peroxidase. The presence of CDS encoding the xenobiotic biodegradation terpenoids and polyketides metabolic pathways, along with the presence of genes coding for β-ketoadipate, Phenol catabolism, and Gentisate pathway, clearly indicated that the bacteria, *Streptomyces griseorubens* CRDT-EB-21.6 is a potential lignin degrader, and a dynamic research material for future studies as well.