Unsaturated fatty acids in selective lignin degradation by the white-rot fungus, *Ceriporiopsis subvermispora*

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Unsaturated fatty acids (UFAs), such as linoleic acid (18:2n-6) and α-linolenic acid (18:3n-3), have crucial roles as structural components of biological membranes, cellular energy source, and cell signaling molecules. UFAs in phospholipids increase the membrane fluidity necessary to maintain the proper function of biological membranes. In the biosynthesis of UFAs, fatty acid desaturases are key enzymes that are responsible for the insertion of double bonds into alkyl chains, following the abstraction of two hydrogen atoms. These enzymes are almost universally found in microbial, plant, and animal cells, where they play important roles in a wide range of physiological processes.

It is well known that many poikilothermic organisms adapt to cold temperatures by increasing fatty acid desaturation to restore the fluidity of cold-rigidified membranes. Moreover, it have been gradually revealed that fatty acid desaturase genes are inducibly expressed by the ability of membrane-bounded proteins to sense a decrease in membrane fluidity generated either by a temperature downshift or by restricted availability of UFAs [1] [2].

In a budding yeast *Saccharomyces cerevisiae*, *OLE1*, encoding a Δ9-fatty acid desaturase to insert a double bond into the Δ9 position at stearic acid (18:0) and palmitic acid (16:0), is highly expressed during ethanol fermentation as well as under lower temperatures. The higher *OLE1* expression leads to increases in fatty acyl chain length and the proportion of UFA [3] [4]. These observations suggest that fatty acid deaturases may be inducibly expressed in the physical and chemical stress conditions, which drastically alter the membrane fluidity.

A selective lignin-degrading fungus, *Ceriporiopsis subvermispora*, can selectively degrade lignin without intensive damage of cellulose. We have demonstrated that extracellular lipid peroxidation by manganese-dependent peroxidase (MnP) occurred in the selective lignin degradation by *C. subvermispora*. At an incipient stage of cultivation on extractive-free wood meal cultures, this fungus produced MnP and large amounts of linoleic acid and palmitic acid, and MnP oxidized them to aldehydes. In prolonged cultivation period after 2-weeks, however, the amount of these fatty acids decreased with increasing organic hydroperoxide and the accumulation of lipid peroxidation products reacting with thiobarbituric acid (TBARS) in organic extracts from wood meal cultures. These observations suggest that UFAs might act as a precursor of lipid peroxidation that is a key reaction of the selective lignin degradation [5].

Because lipid peroxidation is the process whereby free radicals abstract electrons from the lipids, it is very likely to damage cell membranes of *C. subvermispora* even if lipid peroxidation takes place extracellularly. Moreover, exposure to free radical species generated by lipid peroxidation and aldehydes produced by MnP may lead to induce the expression of fatty acid desaturase genes. Therefore, we focus on the molecular relationship between lipid peroxidation and the biosynthesis of UFA, and we successfully cloned fatty acid desaturase genes from *C. subvermispora*. We are now trying to study biochemical and genetic bases of fatty acid desaturases and lipid-related metabolites involved in the selective lignin degradation by *C. subvermispora*.

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