The present study is centered on the production of lignin peroxidase using indigenous white rot fungi, *Pleurotus ostreatus*. The mushroom was cultured on PDA by dissecting its inner tissues. Solid-state fermentation (SSF) was employed with a primary focus on the optimization of various fermentation parameters to achieve maximum lignin peroxidase activity. Kirk basal salt medium was used for maintaining moisture content of substrate. Different substrates, i.e., sugarcane bagasse, wheat straw, corncob, and sawdust, were assessed, with the highest LiP activity of 13.81±0.14 IU/ml on sugarcane bagasse. A range of incubation temperatures (20°C, 25°C, 30°C, 35°C, 40°C, 45°C) was analyzed with optimal LiP activity i.e., 16.10±0.10 IU/ml, occurring at 35°C. Fermentation cultures were incubated for varying durations i.e., 7, 9, 12, 14, 16 and 18 days and maximum LiP activity of 17.71±0.14 IU/ml was achieved at 12th day. Different inoculum volumes ranging from 1 to 6 ml were examined with maximum LiP activity i.e., 18.94±0.10 IU/ml, recorded with inoculum volume of 5 ml. Various ratios of substrate (sugarcane bagasse) to Kirk medium (for moistening) were tested and maximum LiP activity of 18.90±0.11 IU/ml was recorded with a ratio of 1:3.5 (5 g:17.5 ml). The results of this study provide valuable insights into optimizing LiP production, with implication for sustainable and environmentally friendly applications, particularly in biopulping, bioremediation and biofuel production. However, it's worth noting that production challenges and limited commercial availability remain important considerations in this field.