Polyphenol oxidases (PPOs) are copper-containing metalloproteins with limited knowledge on their physiological role in plants. PPOs are involved either in hydroxylation of monophenols to o-diphenols (EC 1.14.18.1; cresolases) or in the dehydrogenation of o-diphenols to o-quinones (EC1.10.3.1, catecholases). PPOs are industrially important enzymes as these catalyze the synthesis of many commercially important products using polyphenols as substrate. *Camellia sinensis* polyphenol oxidase (CsPPO) catalyzes the oxidation catechins to yield theaflavins and thearubigins. The present study was carried out with the objectives to clone the PPO from different cultivars of tea, functionally validate the cloned genes in a heterologous system and evaluate their possible physiological role in plants. *CsPPO* cloned from tea cultivars, BS-08, BGP-138, Cs-08, KD-06, T-383, and UPASI-9 had an open reading frame (ORF) of 1800 bp and each encoded a protein of 599 amino acids. *CsPPO* cloned from T-253 had an ORF of 1788 bp encoding a protein of 595 amino acids. The cloned genes had 98-99% identity at the nucleotide level and 91-99% identity at the amino acid level with each other. These were predicted to produce peptides of 66.5-67.3 kDa with pI of 5.98-6.75. *CsPPO* did not exhibited any detectable expression in *E. coli* BL21 (DE3) cells. However, it yielded very low quantity of protein upon heterologous expression in *E. coli* Rosetta™ 2 cells, which could be because of the presence of large number of rare codons in the gene. Hence, synthetically constructed codon-optimized version of *CsPPO* (*CsPPO*syn) was cloned into pET-47b(+) vector and expressed in *E. coli* BL21 (DE3) cells. Ectopic expression of *CsPPO*syn led to the formation of inclusion bodies. Extensive standardization of buffers along with protein refolding processes such as dialysis, on-column refolding, and rapid dilution yielded active CsPPO with copper content of 0.880 ± 0.095 atom/molecule of protein. Maximum activity was obtained in a rapid dilution buffer containing 0.5 M L-arginine. Refolded CsPPO had an optimum pH of 5.0 and K_m values of 3.10, 0.479, and 0.314 mM, and a V_max of 163.9, 82.64, and 142.8 U/mg of protein for catechol, catechin, and epicatechin, respectively.

During drought stress in tea, catechins content was reduced whereas PPO activity was elevated. Also, the electrolyte leakage was evident during drought stress suggesting a high probability of the leakage of catechins from vacuoles due to diminishing membrane integrity.
These could interact with PPO and would synthesize theaflavins and thearubigins. Indeed, the theaflavins content was higher in tea during drought stress.

Substrates (catechins) and the products of PPO catalyzed reactions [theaflavins and thearubigins; commercially available as black tea extract (BTE)] were found to be the enzyme inhibitors since these compounds inhibited the activities of enzymes namely nitrate reductase, glutamine synthetase, and malate dehydrogenase. Moreover, BTE was found to be more potent inhibitor of enzymes. Catechins per se and their condensed products could interact with the biochemical machinery of the cells. Thus, transgenic *Arabidopsis thaliana* plants overexpressing *CsPPO* were analyzed for their response to PEG-induced stress. Analysis of transgenic *Arabidopsis* showed that PPO promotes PCD during PEG-induced stress in the presence of externally supplied ECs.