

*Bombus ignitus* Cu,Zn Superoxide Dismutase (SOD1): cDNA Cloning, Gene Structure, and Up-regulation in Response to Paraquat, Temperature Stress or Lipopolysaccharide Stimulation

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A Cu,Zn superoxide dismutase (SOD1) gene was cloned from the bumblebee, *Bombus ignitus*. The SOD1 gene of *B. ignitus* spans 1317 bp and consists of three introns and four exons coding for 151 amino acid residues. The *B. ignitus* SOD1 (BiSOD1) possesses the typical metal binding ligands of six histidines and one aspartic acid common to SOD1s. The deduced amino acid sequence of the BiSOD1 cDNA showed 82% identity to *Apis mellifera ligustica* SOD1 and 68% - 64% to SOD1 sequences from other insects. Northern blot analysis revealed the presence of BiSOD1 transcripts in all tissues examined. When paraquat (methyl viologen), a free radical-inducing agent, was injected into the body cavity of *B. ignitus* workers, BiSOD1 mRNA expression was up-regulated in the fat body. In addition, the expression levels of BiSOD1 mRNA in the fat body significantly increased when *B. ignitus* workers were exposed at low (4°C) or high (37°C) temperatures, or injected with lipopolysaccharide (LPS), which suggests that the BiSOD1 possibly protects against oxidative stress caused by extreme temperatures and bacterial infection.