Nitric oxide detoxification in legume-associated endosymbiotic bacteria

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Nitric oxide (NO) is a signal molecule involved in diverse physiological processes in animals and plants which can become very toxic under certain conditions determined, for example, by its rate of production and diffusion and the redox state of the cell. Several studies have clearly shown the production of NO in early stages of rhizobia-legume symbiosis and in mature nodules. In functioning nodules, it has been demonstrated that NO which has been reported as a potent inhibitor of nitrogenase activity can bind Lb to form nitrosylleghemoglobin (LbNO) complexes. These observations have led to the question of how nodules overcome the toxicity of NO. In the bacterial side, one candidate for NO detoxification in nodules is the respiratory NO reductase (Nor) which catalyses the reduction of NO to nitrous oxide. However, knocking-out Nor does not affect the level of NO within nodules, leading to the suggestion that other systems may be involved in NO detoxification. In addition, flavohemoglobins and single-domain hemoglobins which dioxygenate NO to form nitrate are candidates to detoxify NO in rhizobial species under free-living and symbiotic conditions. In the plant side, symbiotic and non-symbiotic plant hemoglobins have been proposed to play important roles as modulators of NO levels in the rhizobia-legume symbiosis. In this work, current knowledge on NO detoxification by legume-associated endosymbiotic bacteria is summarized.