

Meeting abstract

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## Glutathione-dependent formaldehyde dehydrogenase/GSNO reductase from *Arabidopsis*. Expression pattern and functional implications in phytoremediation and pathogenesis

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The glutathione-dependent formaldehyde dehydrogenase (FALDH) is the main enzyme of the formaldehyde detoxification system in eukaryotes. In *Arabidopsis* FALDH is coded by a single gene, which is constitutively expressed [1]. By immunolocalization experiments on *Arabidopsis* root and leaf sections, we demonstrate that the pattern of expression of the enzyme is cell specific. By using tobacco BY-2 cell cultures we show that FALDH co-localizes with tubulin on the cortical microtubules and the microtubules figures (preprophase band, mitotic spindle and phragmoplast), which suggests a role for FALDH in some plant-specific function during cell division. Overexpression of FALDH in *Arabidopsis* plants results in a 25% increase in the efficiency of elimination of exogenous formaldehyde, whereas plants with reduced levels of FALDH, bearing antisense constructs, show a reduced ability and slower rate in formaldehyde elimination [2]. These results confirm the central role of FALDH in formaldehyde metabolism in plants and have important implications in the phytoremediation of environmental formaldehyde.

The importance of FALDH has been greatly increased by the discovery of its potent activity toward S-nitrosoglutathione, the condensation product of glutathione and nitric oxide (NO) [3-5]. NO and NO-related metabolites, such as S-nitrosothiols (SNOs) play a central role in signal transduction and host defense [6]. We have investigated the gene response to mechanical wounding and plant hormones involved in the signal transduction pathway, showing that the gene is down-regulated by wounding in a JA-dependent pathway, and that it is transcriptionally activated by salicylic acid [7]. This is the first time that reg-

ulation of FALDH in response to signals associated with plant defense has been demonstrated.

### References

1. Martínez MC, Achkor H, Persson B, Fernández MR, Shafqat J, Farrés J, Jönvall H, Parés X: **Arabidopsis formaldehyde dehydrogenase: molecular properties of plant class III alcohol dehydrogenase provide further insights into the origins, structure and function of plant class P and liver class I alcohol dehydrogenases.** *Eur J Biochem* 1996, **241**:849-857.
2. Achkor H, Díaz M, Fernández MR, Biosca JA, Parés X, Martínez MC: **Enhanced formaldehyde detoxification by overexpression of glutathione-dependent formaldehyde dehydrogenase from *Arabidopsis thaliana*.** *Plant Physiol* 2003, **132**:2248-2255.
3. Jensen DE, Belka GK, Du Bois GC: **S-Nitrosoglutathione is a substrate for rat alcohol dehydrogenase class III isoenzyme.** *Biochem J* 1998, **331**:659-668.
4. Liu L, Hausladen A, Zeng M, Que L, Heitman J, Stamler JS: **A metabolic enzyme for S-nitrosothiol conserved from bacteria to humans.** *Nature* 2001, **410**:490-494.
5. Sakamoto A, Ueda M, Morikawa H: **Arabidopsis glutathione-dependent formaldehyde dehydrogenase is an S-nitrosoglutathione reductase.** *FEBS Lett* 2002, **515**:20-24.
6. Wendehenne D, Pugin A, Klessig DF, Durner J: **Nitric oxide: comparative synthesis and signaling in animal and plant cells.** *Trends Plant Sci* 2001, **6**:177-183.
7. Delledonne M, Xia Y, Dixon RA, Lamb C: **Nitric oxide functions as a signal in plant disease resistance.** *Nature* 1998, **394**:585-588.
8. Huang X, Stettmaier K, Michel C, Hutzler P, Mueller MJ, Durner J: **Nitric oxide is induced by wounding and influences jasmonic acid signaling in *Arabidopsis thaliana*.** *Planta* 2004, **218**:938-946.
9. Díaz M, Achkor H, Titarenko E, Martínez MC: **The gene encoding glutathione-dependent formaldehyde dehydrogenase/GSNO reductase is responsive to wounding, jasmonic acid and salicylic acid.** *FEBS Letters* 2003, **543**:136-139.