QUANTITATIVE REAL-TIME PCR ANALYSIS OF THE UTILIZATION OF AN IRON-CONTAINING NANOMATERIAL BY A DICOT MODEL PLANT

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Since plants represent the primary source of iron in human consumption, iron deficiency is among the most common nutritional disorders. Due to suboptimal soil conditions (alkaline pH or high carbonate content) iron can precipitate in the soil that reduces its availability for plants in many agricultural areas. The applications of iron-containing nanoparticles such as nanoferrihydrite (NH) as fertilizer ingredients could be effective to treat iron deficiency of plants. NH is thought to be effective in increasing the available iron content of soils, providing a stable but efficient iron supply even at alkaline pH, similarly to commercial chelates and complexes like Fe-EDTA and Fe-citrate, respectively. Moreover, testing the utilisation of a new substance requires a reliable system. Molecular biological methods contribute testing the utilisation of the nanoparticles in the iron uptake of plants. Quantitative real-time PCR (qRT-PCR) is found appropriate for measuring the gene expression of key components of the iron uptake system. Here we focused on the root iron uptake system in a dicot model plant, cucumber (*Cucumis sativus* L. cv. Joker F1). A key enzyme of this system is the ferric-chelate oxidoreductase (FRO1) – an iron deficiency inducible membrane bound enzyme that is responsible for the reduction of iron at the root surface. We identified the homolog of *Arabidopsis Fro2* gene in cucumber genome. Furthermore, to investigate the bio-utilisation of iron content of NH by cucumber roots, changes in the expression of *CsFro1* were monitored by qRT-PCR upon NH treatment. The results indicate that the expression of *CsFro1* is enhanced by iron deficiency but upon NH treatment it started to decrease and the tendency for decrease has become apparent within thirty minutes. This proves that the utilization of the iron content of NH has been carried out in a very short time frame. Moreover, molecular methods can be successfully used in testing the effects of nanomaterials and thus the results contribute to adjusting the proper dosage of the material, which can successfully cure iron deficiency of plants.

This work has been supported by the grants NKFIH-OTKA K1 115913 and K115784. Á. Solti was also supported by the Bolyai János Research Scholarship of the Hungarian Academy of Sciences (BO/00207/15/4).