Production of Omega-3 Polyunsaturated Fatty Acids in Arabidopsis

Olga Sayanova, Monica Venegas-Caleron, Richard Haslam, and Johnathan Napier

Crop Performance and Improvement, Rothamsted Research, Harpenden, AL5 2JQ, UK

The therapeutic benefits of dietary *n*-3 fatty acids have been well documented. Results from recent studies indicate that such very long chain polyunsaturated fatty acids (VLC-PUFAs) such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) present in fish oils have beneficial impact in the treatment of a wide range of human disorders. Considering growing pressure on global fish stocks the most promising and cost-effective solution for large-scale production of VLC-PUFAs would be the engineering of plants to synthesize high levels of EPA and DHA. A variety of strategies have been used to express the VLC-PUFAs metabolic pathways in oil crops, utilizing desaturases and elongases genes involved in different biosynthetic routes for EPA and DHA accumulation. However, all these studies have demonstrated the presence of several bottlenecks which limit the production of *n*-3 VLC-PUFAs in the seed oil of transgenic plants. One of these limiting factors is a "substrate dichotomy" caused by the fact that desaturation reactions occur in the phospholipid pool whereas chain elongation occurs in the acyl-CoA pool. Therefore, acyltransferases might play a crucial role in efficient shuttling the unusual fatty acids between the two pools enabling (or preventing) high levels of accumulation of these fatty acids in transgenic plants. One approach to overcome this bottleneck is to investigate Arabidopsis T-DNA knockout mutants lacking acyl-chanelling activities such as PDAT and CPT, expressing conventional and alternative pathways for the production of *n*-3 VLA-PUFAs. In addition, we are looking for new activities to improve the transgenic synthesis of EPA and DHA. This presentation will review our current progress.