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Biotechnology for improved hydroxy fatty acid production in oilseed Lesquerella

The conventional source of Hydroxy Fatty Acid (HFA) is from castor (*Ricinus communis*), 90% of castor oil is ricinoleic acid (18:1OH). Ricinoleic acid and its derivatives are used as raw materials for numerous industrial products, such as lubricants, plasticizers and surfactants. The production of castor oil, however, is hampered by the presence of the toxin ricin and hyper-allergic 2S albumins in its seed. Lesquerella (*Physaria fendleri*), is being developed as a new industrial oilseed crop in the southwestern region of the United States, and is valued for its HFA, lesquerolic acid (20:1OH) in seed. As lesquerella does not contain toxic compounds, its oil represents a safe source of HFA. To understand HFA synthesis and regulation in lesquerella, we investigated morphological and physiological changes, as well as temporal details of fatty acid composition and gene expression during seed development. Also, we have developed the 1st lesquerella seed transcriptome that provides a global gene expression profile for identifying key targets for metabolic engineering in lesquerella. We found that the synthesis of 20:1OH is regulated largely by gene expression of *PfKCS3*. By suppressing the expression of *PfKCS3* in leaquerella, 18:1OH was increased from wild-type (wt) 1% to 26% in transgenic seed oil. Castor oil has 90% 18:1OH which occupies all three sn positions of most TAGs, while lesquerella oil contains 60% 20:1OH mostly located at sn-1 and sn-3 of TAGs. In order to improve HFA levels in lesquerella seeds, a castor lysophosphatidic acid acyltransferase 2 gene (*RcLPAT2*) capable of acylating HFA to the sn-2 position of TAGs was introduced into lesquerella. Analysis of transgenic lesquerella seed TAGs showed that *RcLPAT2* was able to incorporate HFA to the sn-2 position of TAG and consequently, oil accumulated more of TAGs with all three sn positions occupied by HFA. The results enhanced our understanding of plant lipid metabolism and provided invaluable guidance for future research not only for enhancing HFA content in lesquerella, but also for HFA production in other oilseed crops.

Biography

Grace Chen has obtained her PhD from University of Wisconsin at Madison and her Post-doctoral studies from University of California, Plant Gene Expression Center. She has published more than 44 papers in reputed journals and is globally recognized as an expert on oilseed biotechnology.

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