



January, August & Final Reports

REPORTS

Part 1 - Summary Details

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January Report: Due 29-Jan-01
August Report: Due 03-Aug-01
Final Report: Due within 3 months of project completion

Project Title: Travel Grant: Keystone Symposium on Plant Foods for Human Health: Manipulating Plant Metabolism to Enhance Nutritional Quality, Colorado, USA.

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Research Program: Plant Breeding and Biotechnology

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Travel Grant Final Report (CSP133C)

Research funded by CRDC project grant CSP105C was presented in abstract and poster format at an international conference held in Colorado, USA, as part of the Keystone Symposium series. The conference was entitled "Plant Foods for Human Health: Manipulating Plant Metabolism to Enhance Nutritional Quality". The speaker list included researchers leading the field in plant metabolism and engineering, and also included speakers whose expertise were in the fields of nutrition and assessing solutions for world hunger. The key plant metabolic pathways discussed at the meeting were broad and often overlapping and included vitamin E, folate, vitamin C, iron, zinc, calcium oxalate, lipids and fatty acids, amino acids, terpenoids, sterols, carotenoids (vitamin A), isoflavonoids and lignans, alkaloids and phytonutrients.

An important issue highlighted at the conference was the enormous potential of genetic engineering to modify plant metabolic pathways for specific downstream applications. Examples of these include nutritional applications such as altering fatty acid profiles for healthier vegetable oils which could reduce cardiac problems, a pharmaceutical application may be the diversion of glucosinolate pathways in poppy for controlled production of morphine or codeine, and an industrial application may be the overproduction of monoterpenoid oils from mint species for use as fragrances. The research conducted as part of CRDC project CSP105C has multiple applications. Modifying terpenoid biosynthesis in transgenic cotton could result in plants with increased tolerance to diseases and insect feeding, reducing gossypol levels in the seeds would improve the quality of cottonseed for use as stock feed and edible oils, and overproduction of gossypol may provide a market opportunity if gossypol is proven to be a safe and effective male contraceptive. The conference highlighted just how achievable these goals are since several other pathways have been successfully modified using genetic engineering approaches.

The poster presentation of CRDC funded research, entitled Genetic manipulation of cotton defense chemicals – Insights into a terpene cyclase multigene family, was very well received. Numerous participants from industry and non-industry institutions were interested in the research results, and promoted discussion, particularly in relation to the observed specificity of cadinene synthase gene family members for different channels of the cotton sesquiterpene pathway.

Several new developments were presented in the area of terpenoid biosynthesis and associated genes which could prove useful in the design of future experiments with cotton terpenoids. In particular, Rodney Croteau of Washington State University, highlighted the interactions between the mevalonate and non-mevalonate pathways in the production of terpenoids and how these interactions, along with subcellular compartmentation, metabolite trafficking, deposition of end-products could prove to be important considerations when altering pathway flux. Croteau's research in isolating mint epidermal glands was a useful tool in generating an enriched cDNA library of genes expressed in this tissue and found that lipid transfer proteins (LTPs), ATP binding pumps, and proteins with steroid binding domains were common and may serve the role of metabolite trafficking between organelles. By functionally expressing all the isolated genes involved in the carveol pathway, this group has been able to produce this monoterpenoid in bacteria, using useful tricks in enzyme expression such as the fusion of a cytochrome P450 and its

associated reductase. One surprising suggestion made by Croteau was that he felt that diverting carbon metabolism away from primary metabolism would not be too great a sacrifice to the plant – however I suspect this may not hold true with a high yielding crop such as cotton, where the oils are a separate commercial and biological entity to the fibre.

Other interesting work mentioned by Joe Chappell of the University of Kentucky and presented in a poster by Peter Brodelius of the University of Kalmar in Sweden, involved the coupling of a typically low turnover rate terpene cyclase with the cytochrome P450 hydroxylase that catalyses the next reaction with the resulting kinetics of the multiple reactions being much faster and efficient than each individual reaction step. By fusing a terpene synthase with the cyclase catalysing the next step also increases the turnover rate but there is a tradeoff between specificity and rate.

Overall the Keystone Symposium was found to be very informative, with a small number of participants which facilitated discussions with researchers whose work related to my field of interest. The conference was very focussed and had all the leaders in each field presenting their most recent work. The major downside to this symposium is the associated cost but this is generally balanced by the high quality of the presentations.