Research Abstracts and Report Databases
2009/10 Research Reports

High value lipids

Previous | Next

Research Leader	Dr Owen Catchpole
Organisation(s)	Industrial Research Limited
Contract Number	C08X0709
Year	2009
Fund/Scheme	PGSF
Output(s)	7.1 - Food & Fibre
Funding 2009/2010	$2,000,000

The aim of the program is to generate new niche high value lipids for export markets, and substantially expand or create new supercritical extraction and associated advanced processing technology industry in NZ to produce these high value lipids. Research is being carried out to generate new lipid products by both extraction and fractionation from end-user supplied biomasses; and by fermentation, chemical and enzymatic synthesis. These lipids are being chemically characterized, and their biological activity and stability determined. Samples of lipid product are being supplied to end-users to supply to their international clients for market evaluation and product formulation. Proof of concept of supercritical extraction and related green processing technologies is being established at a laboratory and pilot scale at IRL, and then transferred to the end-users through mechanisms such as demonstration via IRL's portable supercritical extraction plant "SuperEx" and soon to be constructed pilot scale supercritical chromatograph.

The major science and technology transfer outcomes to date are summarised in the bullet points below:

• Tech transfer pilot plant "SuperEx" and PSFC.

The construction of the CO2 and dimethylether (DME) capable portable

pilot plant "SuperEx", has been completed. The plant was designed to be run by operators with little to no knowledge of supercritical extraction; and to be transported to any site in a standard container. It has a remote control panel so that it can be used in hazardous environments. The plant has been hired by our industry partners to produce pilot scale samples of products, technology transfer for new processes and products, and to train their staff. Two of the products manufactured using SuperEx are being trialled as a functional food ingredients. The use of SuperEx has reduced the product development phase from 6 down to 3 years. SuperEx was placed 2nd in the IPENZ 2009 Engineering Excellence Awards in the category "Food, Bioprocess and Chemical". A pilot scale supercritical chromatograph (PSFC) at a cost of $485 K has been approved for construction. This plant will be used to perform milestones that are being brought forward in the research program, and to assist with rapid technology development to produce very highly pure lipid compounds.

• Integrated fermentation and extraction technologies.

We have re-established capability in the fermentation of lipid-bearing micro-organisms up to a 1000 litre scale. The fermentation of several lipid-bearing micro-organisms has been demonstrated for a diverse range of microorganisms, from extremophiles to fish gut bacteria. A process for the direct extraction of lipids from the wet fermentation biomass using DME has also been demonstrated, and the technology has been licensed to an industry partner for commercialization. A screening method for isolating microbes that produce the high value lipids eicosapentaneoic acid (EPA) and arachidoinic acid, was developed as part of PhD research in collaboration with the University of Canterbury. A library of NZ-sourced marine bacteria and terrestrial fungi has been established and several strains containing significantly concentration of these fatty acids have been identified and are being scaled-up. This method will allow IP to be generated that may have application in the NZ food, nutraceutical and aquaculture industry.

• Isolation and concentration of polyunsaturated fatty acids (LCPUFA)

Six technologies (urea fractionation, enzymatic concentration, fatty acid salt fractionation, ionic liquids, iodolactonisation, preparative HPLC) are under development for the isolation and concentration of LCPUFA. The first process was applied at a pilot scale to produce very highly enriched LCPUFA for industry evaluation. Highly stable lipase enzymes have been used in supercritical fluids to concentrate LCPUFA from fish and plant oils by removing non-PUFA as ethyl esters. Ionic liquids with dissolved silver salts have been found to be extremely

selective for extracting LCPUFA. Iodolactonization has been used to concentrate a variety of LCPUFA up to 90 % concentration level. Preparative HPLC has been used to produce EPA to greater than 90 % purity.

• Lipid chemical synthesis methods for producing N-acylethanolamines (NAEs), new fatty acids, and modified phospholipids (PL).

We have established chemical and/or enzymatic synthesis technologies for producing highly bioactive NAEs, new fatty acids, and modified phospholipids. Highly purified LCPUFA have been converted to the equivalent NAEs using a method that has been recently optimized, and then submitted for brain health bioassays through Otago University. One of the new NAEs showed profound anticonvulsant activity. A new synthesis method was demonstrated for shortening the chain length of PUFA to make new fatty acids. The production of PL with enriched levels of LCPUFA, and the concentration of ether-PL was achieved. A new enzyme sourced from Japan has enabled us to produce a valuable brain health PL at > 60 % purity from a variety of feed materials.

• Isolation, concentration and characterization of glycolipids

Glycolipids (lipids containing a carbohydrate moiety) are the new frontier for lipid research. Many are highly bioactive, and have applications in gut and intestine health, satiety, skin care and anti-cancer agents. The main classes in this category of lipids are gangliosides, cerebrosides, and glyceroglycolipids (GLG). A patent application to concentrate gangliosides has been filed. We have also developed separation technology to fractionate mixtures of GLG. A range of raw materials have been extracted using DME to generate crude mixtures of GLGs, some of which have been supplied for satiety bioassay trials. A new rapid analysis method has been developed to analyze GLGs to replace the standard analysis methods, which are tedious and time consuming.

• NZTE Supercritical Extraction Roadmap and industry engagement

NZTE has identified supercritical extraction and associated products and technologies as an opportunity for economic growth in NZ, and has sponsored a roadmap entitled "The Opportunity for Supercritical Fluid extraction and other advanced extraction technologies in NZ". The roadmap was prepared by external consultants, and has been fully supported by IRL and its industry partners, particularly Nutrizeal. The recommendations include a target industry turnover of at least $ 200

M by 2020. As a result of the roadmap, NZTE has part funded three supercritical-based R&D programs for different industry partners with IRL to produce high value antioxidants; high value apiary bioactives; and functionalized biopolymer products. Co-funding and licensing agreements have been reached with a number of industry partners, which has been channelled into acceleration of technology transfer. A new venture was formed between IRL and a significant industry partner to produce high value omega-3 lipids from NZ-based marine raw materials.

• Science quality.

The science quality and impact of the team has been recognized through the program leader, Dr Catchpole, being nominated for the Pickering Medal; being awarded the 2009 NZIC Industrial Chemistry Prize, being invited to join the editorial board of the Journal of Supercritical Fluids and submit an invited review article for the 20th anniversary year issue; and being invited to become a Fellow of IPENZ. Drs MacKenzie and Vyssotski were awarded collaborative research grants with the NZ-Japan RSNZ-JSPS scientist exchange program for lipid research, which then led to a successful FRST funded International Investment Opportunities Fund project "Beneficial Marine Lipid Ingredients for Functional Foods. So far, the program has generated 15 journal publication submissions, 3 invited book chapters, and 25 conference presentations.

Search Results | Previous | Next
