UNIVERSITÉ DE MONCTON
CAMPUS DE MONCTON

Breakfast-Wednesday April 06, 2016

NB Innovation Research Chair in Biosciences

Marc Surette, PhD
Professor
Department of Chemistry and Biochemistry
Université de Moncton

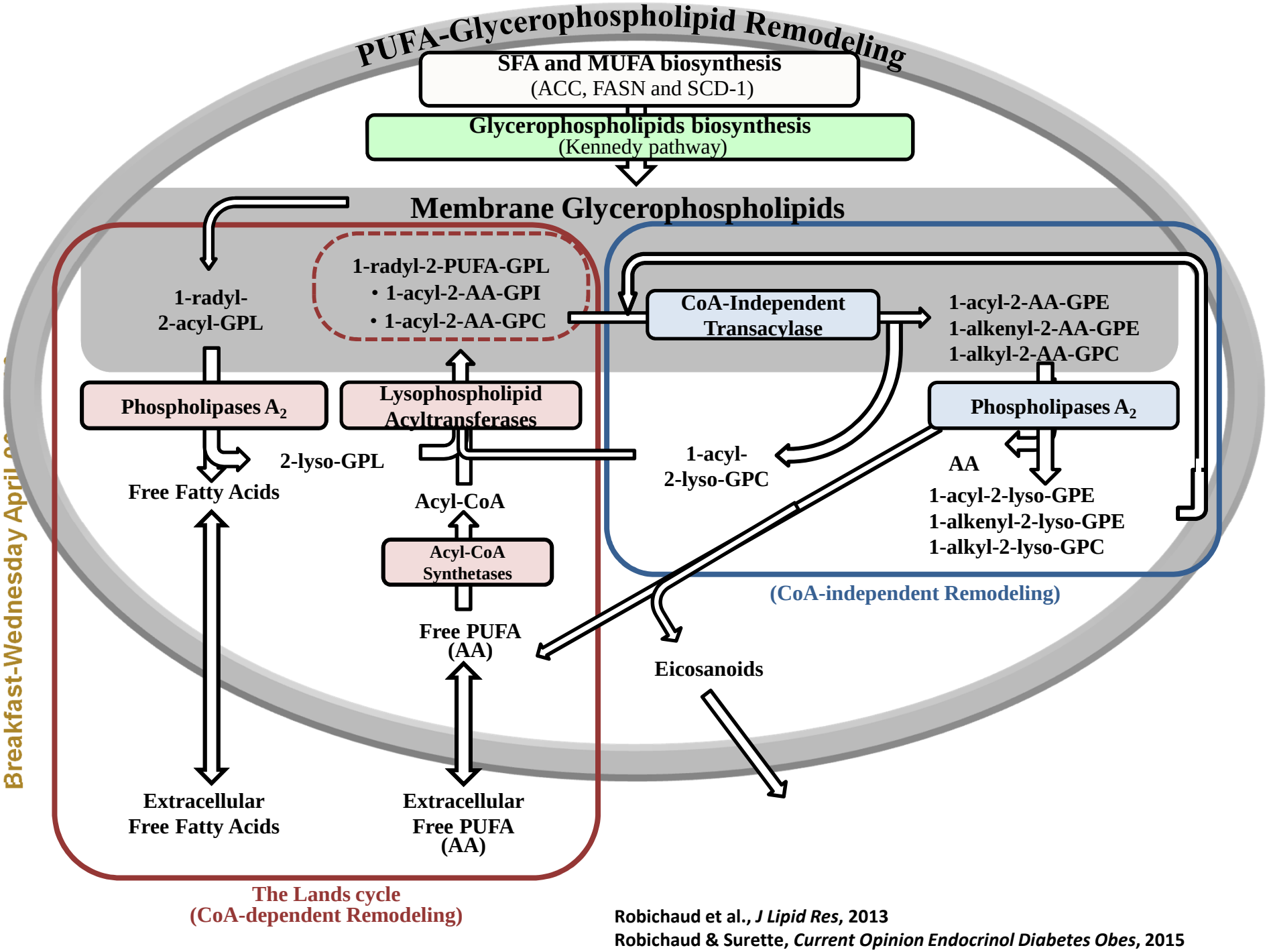
Research Themes

- Lipid metabolism
  1. Discovery research on the control of cellular lipids
  2. Investigation and development of new sources of omega-3 fatty acids
  3. Development of new anti-inflammatory agents

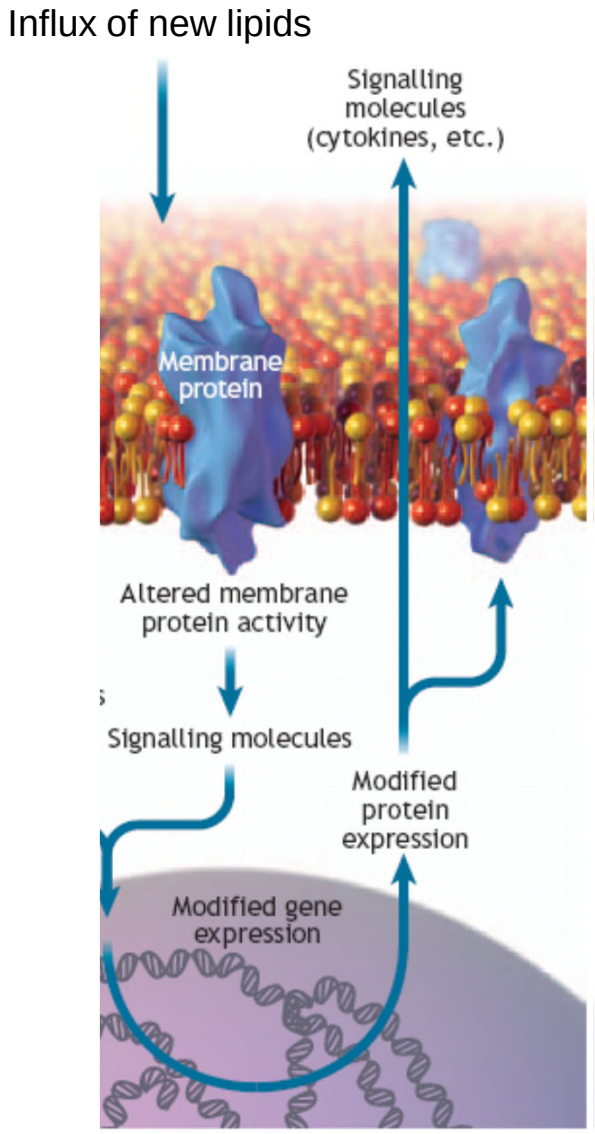
Theme 1

Discovery Research on the Control of Cellular Lipids

Funding sources: Canadian Institutes of Health Research (CIHR)
Canadian Breast Cancer Foundation (CBCF)
NB Health Research Foundation (NBHRF)


PUFA-Glycerophospholipid Remodeling
SFA and MUFA biosynthesis
(ACC, FASN and SCD-1)
Glycerophospholipids biosynthesis
(Kennedy pathway)
Membrane Glycerophospholipids
1-radyl-
2-acyl-GPL
1-radyl-2-PUFA-GPL
• 1-acyl-2-AA-GPI
• 1-acyl-2-AA-GPC
CoA-Independent
Transacylase
1-acyl-2-AA-GPE
1-alkenyl-2-AA-GPE
1-alkyl-2-AA-GPC
Phospholipases A2
Lysophospholipid
Acyltransferases
Phospholipases A2
2-lyso-GPL
1-acyl-
2-lyso-GPC
AA
Free Fatty Acids
Acyl-CoA
1-acyl-2-lyso-GPE
1-alkenyl-2-lyso-GPE
1-alkyl-2-lyso-GPC
Acyl-CoA
Synthetases
(CoA-independent Remodeling)
Free PUFA
(AA)
Eicosanoids
Extracellular
Free Fatty Acids
Extracellular
Free PUFA
(AA)
The Lands cycle
(CoA-dependent Remodeling)
Robichaud et al., J Lipid Res, 2013
Robichaud & Surette, Current Opinion Endocrinol Diabetes Obes, 2015

Les lipides cellulaires



Surette ME, *Canadian Medical Association Journal*, 2008

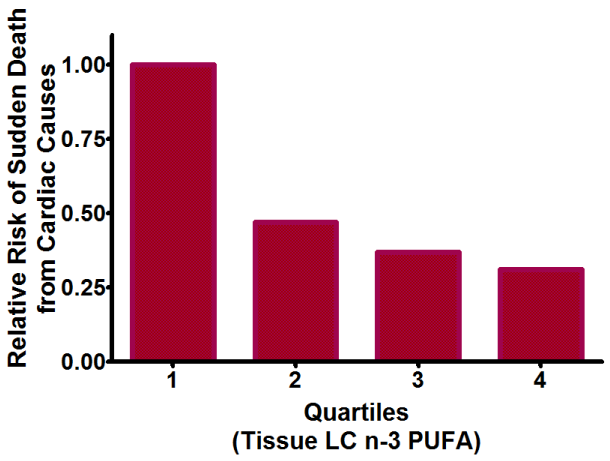
Theme 2

Investigation and Development of New Sources of Omega-3 Fatty Acids

Funding sources: **Atlantic Innovation Fund (AIF)**
NB Innovation Foundation (NBIF)
Technology Crops International Inc.

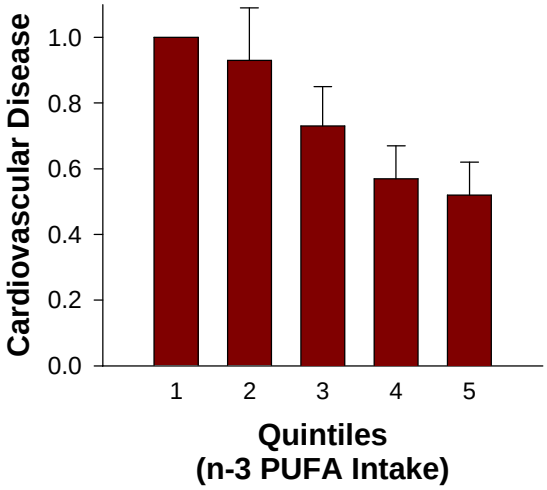
Omega-3 Fatty Acids and Cardiovascular Disease

Risk of Sudden Cardiac Death in Men



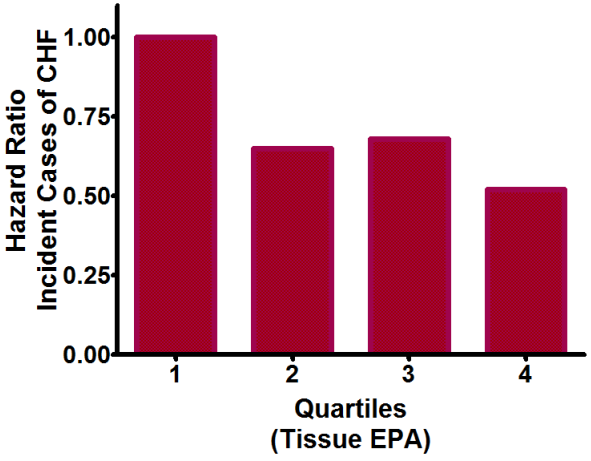
Albert et al., N. Engl. J. Med., 2002

Coronary Heart Disease in Women (Nurse's Health Study, n=84,688)



Hu et al., JAMA, 2002

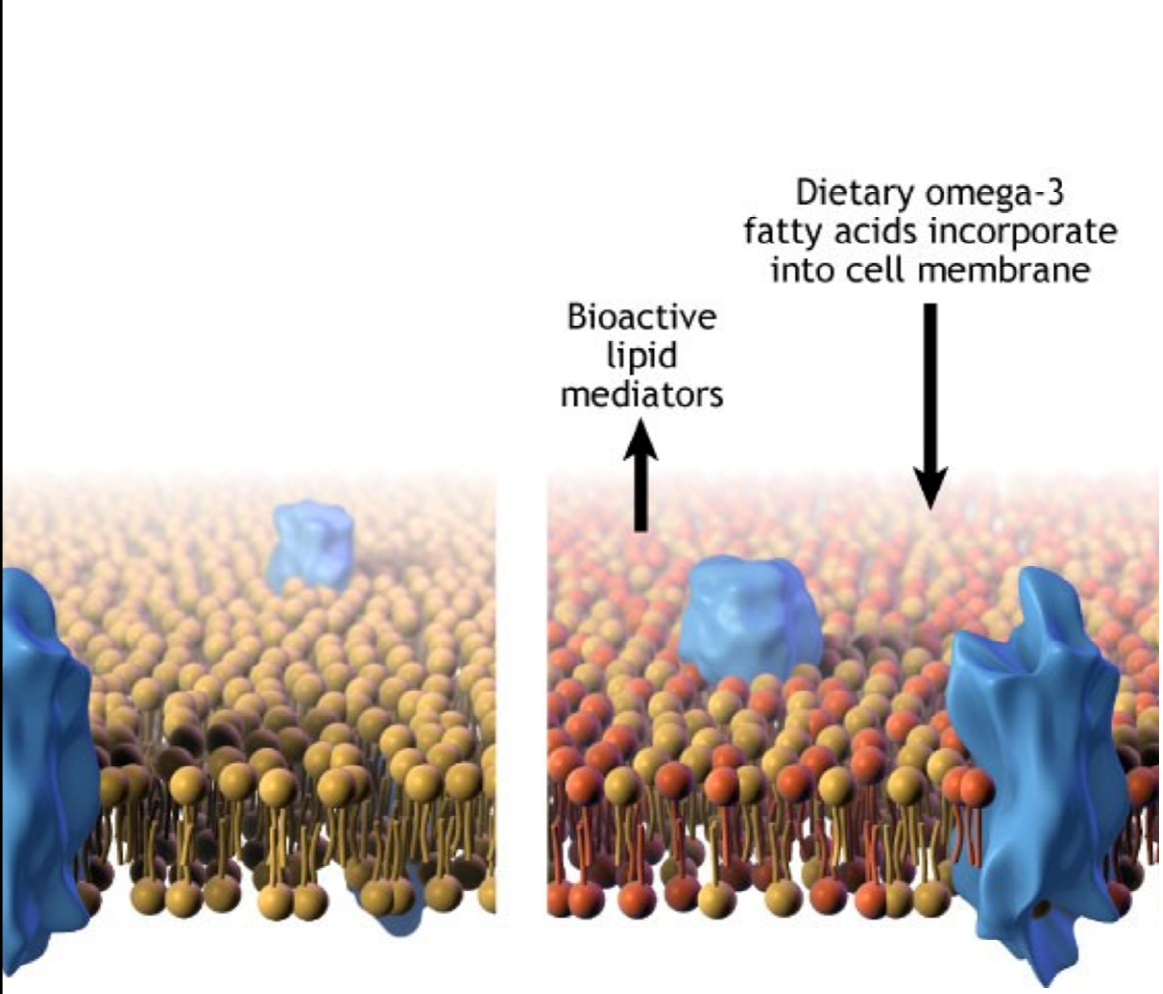
Risk of Congestive Heart Failure in Older Adults

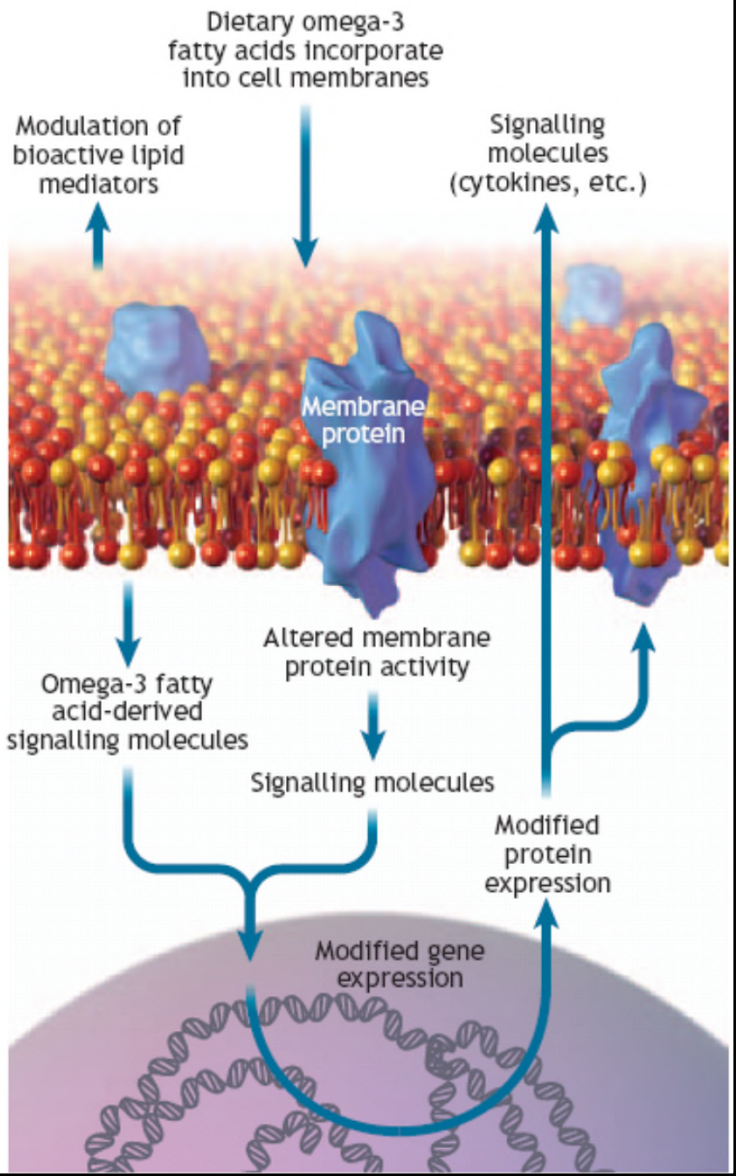


Mozaffarian et al., Ann Intern Med., 2013

Breakfast-

Les lipides cellulaires



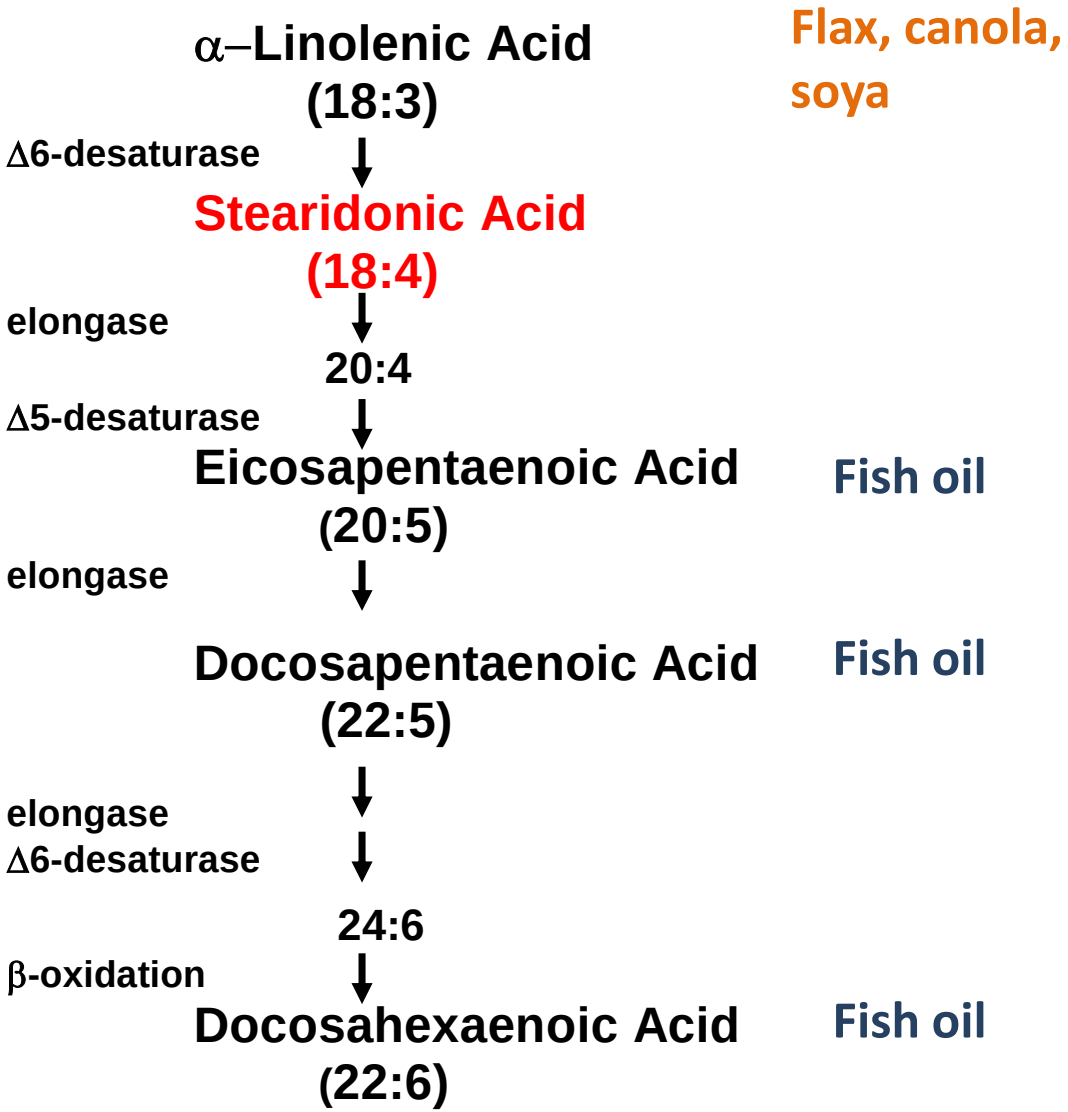


Surette ME, *Canadian Medical Association Journal*, 2008

Sources of omega-3 Fatty Acids

- Global demand for fish oils is expected to exceed supply – not a sustainable resource
- Agriculture may provide sustainable, effective and affordable alternatives
- Plant sources
  - Not the same omega-3 fatty acids as fish oils
  - Health benefits not as established as fish oils

Omega-3 Fatty Acids



Innovative omega-3 vegetable oils: A concerted research-driven strategy to develop and commercialize plant-derived oils with unique polyunsaturated fatty acid profiles

A partnership with Nature's Crops International

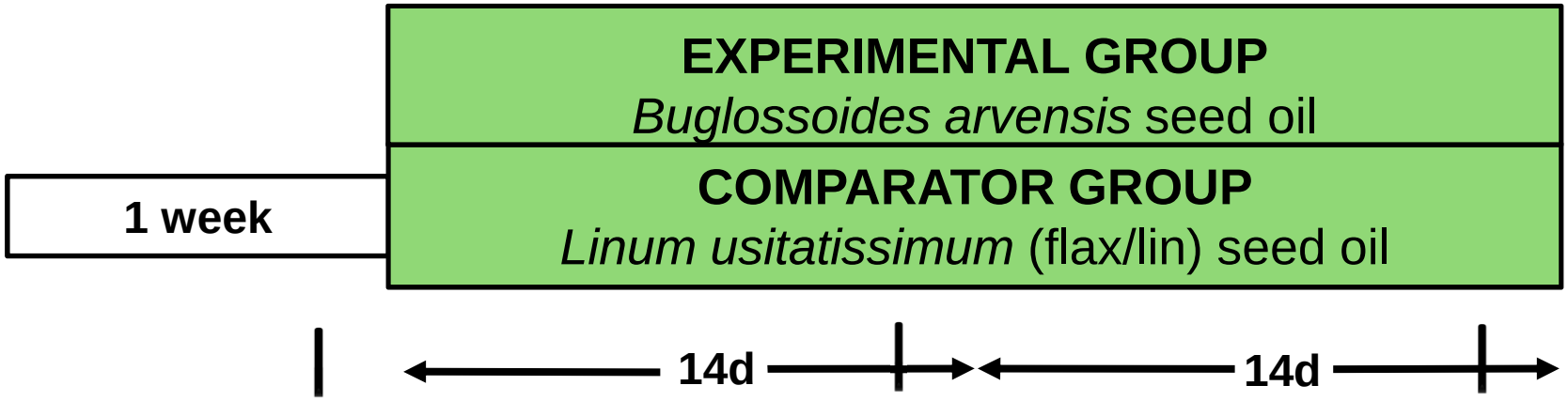
Buglossoides arvensis (Ahiflower™)

- Corn Gromwell
- Family: Boraginaceae

Clinical Trial 1

- Single center
- Double-blind
- Comparator-controlled
- Randomized

ClinicalTrials.gov Identifier: NCT02226354
Health Canada: HC-NHPD-196699



- **Consent**
- **Screening**
- **Vitals**
- **Blood draw (safety)**

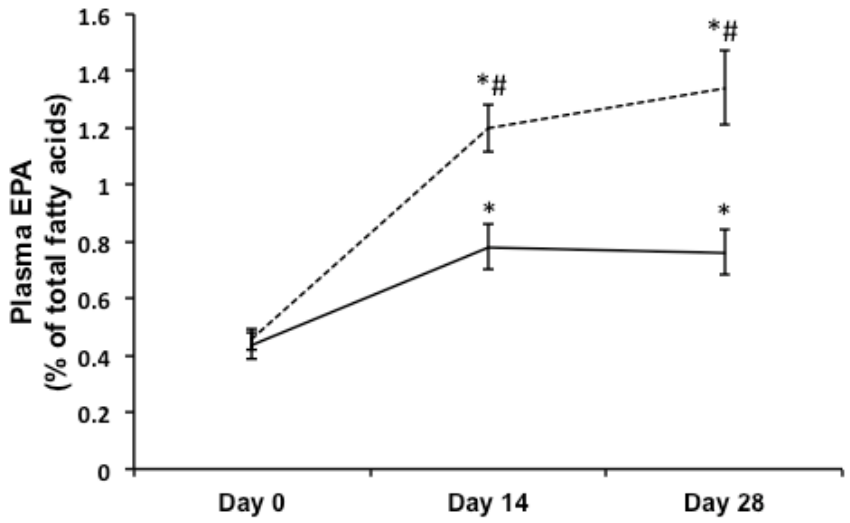
- **Blood draw**
- **Dispensing of Buglossoides or flaxseed oil**

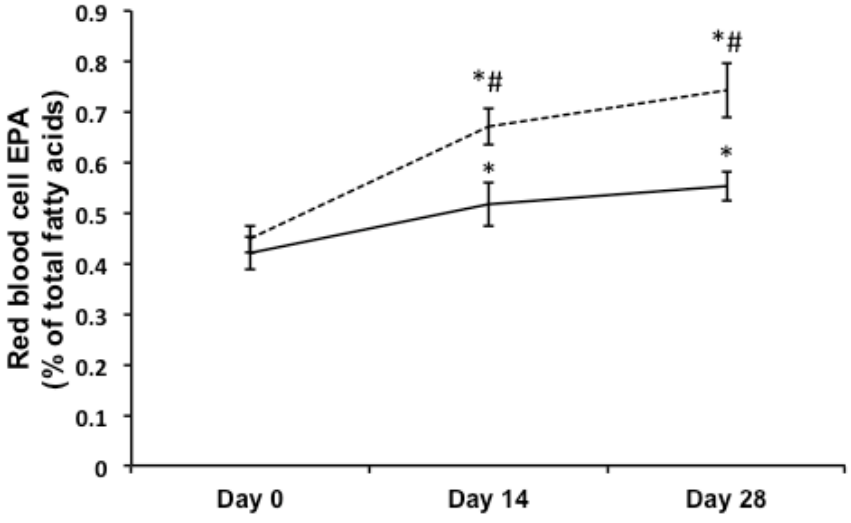
- **Blood draw**
- **Compliance**
- **Adverse events**

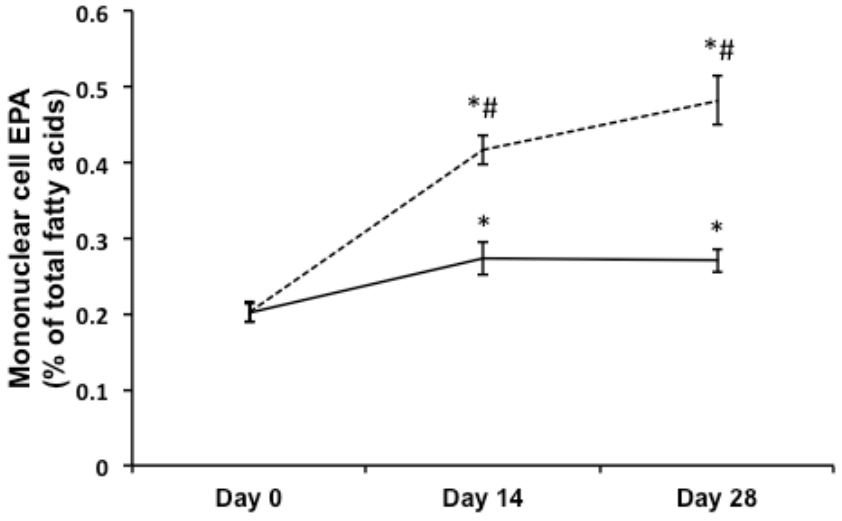
- **Blood draw**
- **Vitals**
- **Compliance**
- **Adverse events**

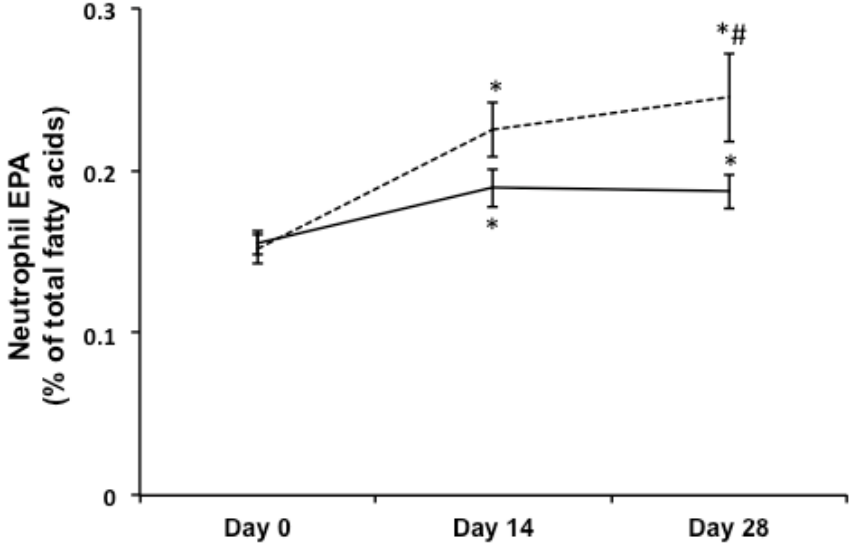
Lefort et al., Journal of Nutritional Sciences, 2016

Ahiflower Oil Augments EPA in Plasma and Circulating Cells of Healthy Humans









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Lefort et al., Journal of Nutritional Sciences, 2016

Implications

- Ahiflower oil is a safe and effective source of dietary omega-3 PUFA
- Health outcomes associated with fish and fish oil consumption may be attainable with a plant-derived dietary oil
- Sustainable alternative to fish oils for enrichment of tissues with long chain omega-3 fatty acids

Key Accomplishments

- NCI established a presence in Canada –
  - Oil extraction & processing facility constructed in PEI, 30+ employees (HQP), contracts for farmers
- Clinical trials
  - Two clinical studies completed
- Regulatory dossiers
  - Regulatory approval by FDA in United States (Jan 2015)
  - Novel Food approval in Europe (July 2015)
  - Approval pending with Health Canada, other jurisdictions
- Identification of novel bioactive compounds with potential pharmaceutical applications

Theme 3

Development of New Anti-Inflammatory Agents

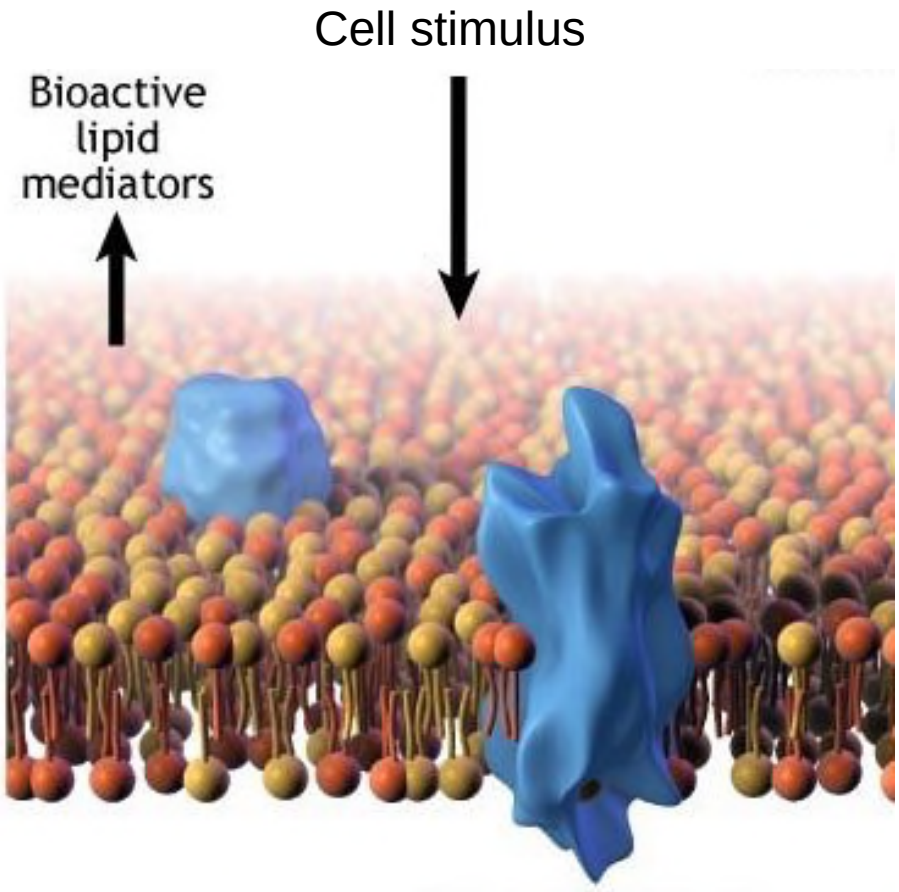
Funding sources: Natural Sciences and Engineering Research Council of Canada (NSERC)

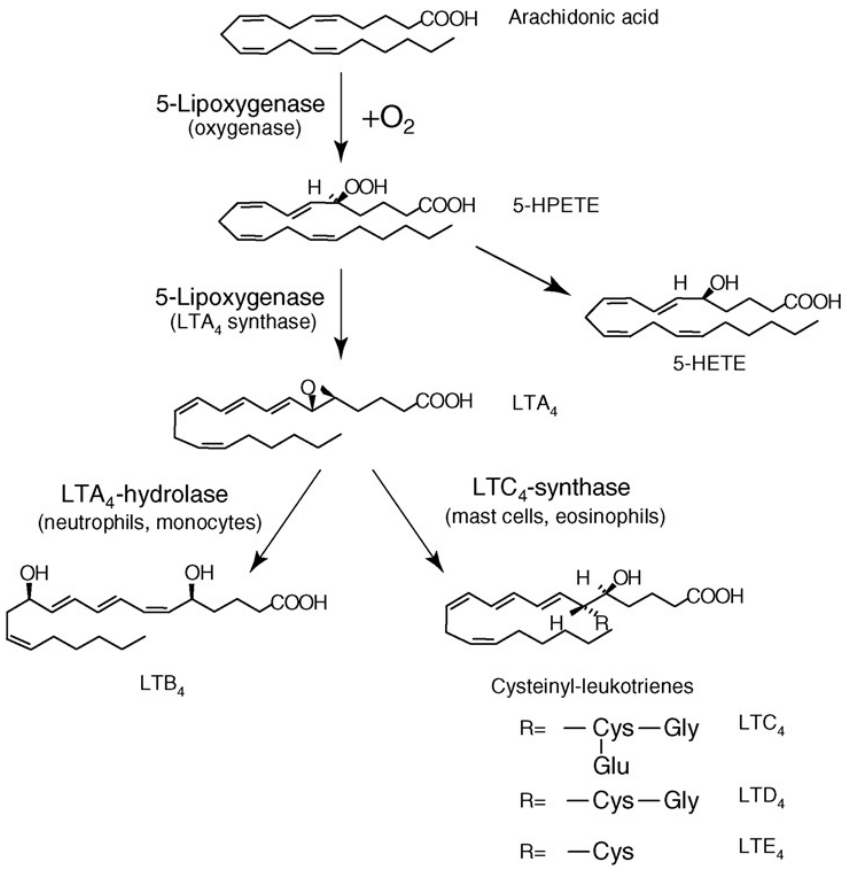
NB Health Research Foundation (NBHRF)

NB Innovation Foundation (NBIF)

Springboard Atlantic

Lipid Mediators of Inflammation





Surette ME, Canadian Medical Association Journal, 2008

Radmark et al., Trends in Biological Sci, 2008

Leukotrienes and disease

Allergic diseases
- Asthma*
- Allergic rhinitis*
- Rhinosinusitis
- Atopic dermatitis†
- Urticaria†

Fibrotic diseases
- Airway remodeling in asthma
- Bronchiolitis obliterans after lung transplantation
- Idiopathic pulmonary fibrosis‡
- Scleroderma
- Asbestosis

Other pulmonary syndromes
- Acute lung injury or adult respiratory distress syndrom
- Viral bronchiolitis†
- Obstructive sleep apnea†
- Chronic obstructive pulmonary disease†‡
- Cystic fibrosis§ and other forms of bronchiectasis
- Bronchopulmonary dysplasia

Other local inflammatory diseases
- Arthritis (including osteoarthritis and gout)
- Glomerulonephritis
- Interstitial cystitis†
- Psoriasis
- Inflammatory bowel disease¶

Singulair (Merck)
Accolate (Astra Zeneca)
Zyflo (Chiesi)

Systemic inflammatory diseases
- Rheumatoid arthritis†
- Vasculitides (systemic lupus erythematosus,† Churg–Strauss syndrome, Henoch–Schonlein purpura)
- Transplant rejection

Cancer
- Solid tumors (including melanoma, mesothelioma, and pancreatic, lung,‡ esophageal, prostate, and colon cancers)
- Leukemias
- Lymphomas

Cardiovascular disease
- Atherosclerosis†
- Aortic aneurysm
- Sickle cell crisis
- Ischemia–reperfusion injury
- Pulmonary arterial hypertension
- Sepsis

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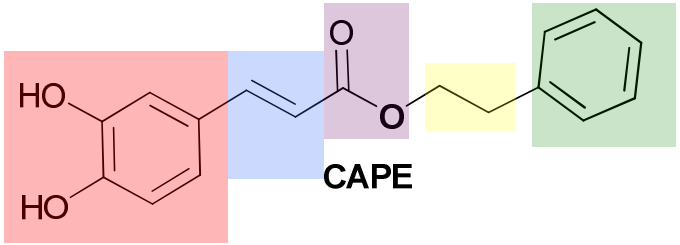
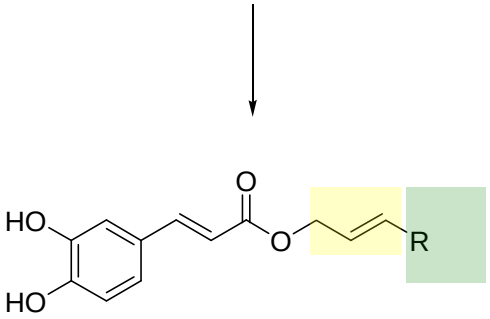
Peters-Golden and Henderson, N Engl J Med. 2007

Development of Leukotriene Synthesis Inhibitors

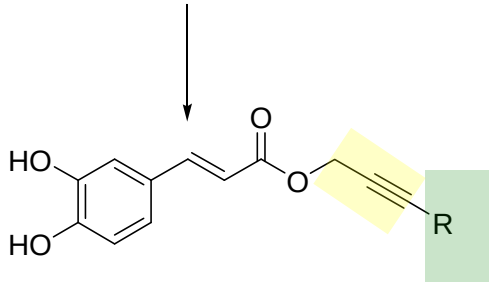


Caffeic acid phenethyl ester

Propolis



R = PhMe (4-Me)
R = PhOMe (4-OMe)
R = Ph (4-NO_2)
R = PhF (4-F)
R = Naph (1$^-$)
R = PhPh
R = 4$^-$(CH=CHCH$_2$Caffeoyl)-Ph



R = Ph
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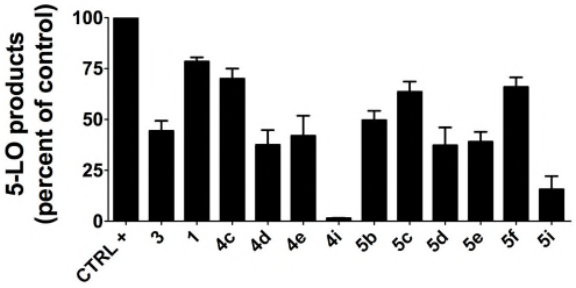
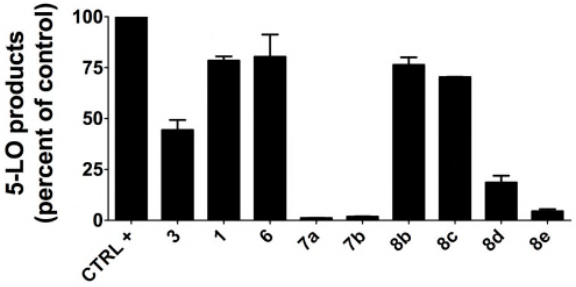
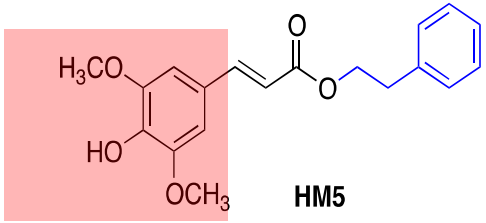
R = Ph (4-NO_2)
R = PhF (4-F)
R = Naph (1$^-$)
R = PhPh
R = 4$^-$(CCCH$_2$Caffeoyl)-Ph







Modulators of Lipoxygenase and Cyclooxygenase Enzyme Activity.

US Patent application no. 62303120

Mohamed Touaibia and Marc Surette, filed March 3, 2016.

Will continue development of most promising drug candidates and seek a commercial development partner.

Biomedical Research in South-East New Brunswick

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16 Senior Biomedical Sciences Investigators at Université de Moncton and at the Atlantic Cancer Research Institute

Fields of Research:

Cancer Biology

Chronic Diseases

Molecular Diagnostics

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Marc E. Surette, PhD (Cornell Univ), Postdoc (Wake Forest Univ)
NB Innovation Research Chair, UdeM

Rodney Ouellette, MD/PhD (Univ Laval)
President and Scientific Director, ACRI

Sandra Turcotte, PhD (UQAM), Postdoc (Stanford Univ)
Canadian Cancer Society Research Chair, UdeM

Stephen Lewis, PhD (Dalhousie Univ), Postdoc (Univ Ottawa)
Assistant Scientific Director, ACRI

Alain Simard, PhD (Univ Laval), Postdoc (Univ Arizona)
Assistant professor, UdeM

Nicolas Pichaud, PhD (Univ du Québec), Postdoc (Univ of Gothenburg)
Assistant professor, UdeM.

David Barnett, PhD (U. Alberta)
Senior Scientist at ACRI

Gilles Robichaud, PhD (Univ Laval), Postdoc (Sherbrooke)
Associate professor, UdeM

Etienne Hébert-Chatelain, PhD (Univ du Québec), Postdoc (Univ Bordeaux)
Assistant professor, UdeM

Pier Morin, PhD (Carleton Univ), Postdoc (Miescher Inst Biomed Res, Basel, Switzerland)
Associate professor, UdeM

Nicolas Crapoulet, PhD (Univ Marseille)
Senior Scientist, ACRI

Mohamed Touaibia PhD (Univ de Paris), Postdoc (UQAM)
Associate professor, UdeM

Jocelyn Paré, PhD (Carleton Univ)
NB Innovation Research Chair, ACRI

Luc Boudreau, PhD (Univ Laval), Postdoc (CHUL)
Assistant professor, UdeM

Luc Martin, PhD (Univ Laval)
Associate professor, UdeM

Anirban Ghosh, PhD (Jawaharlal Nehru Univ), Postdoc (Univ Alberta)
Senior Scientist at ACRI

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Canada Research Chairs | Chaires de recherche du Canada

New Brunswick Health Research Foundation | Fondation de la recherche en santé du Nouveau-Brunswick

Canadian Breast Cancer Foundation | Fondation canadienne du cancer du sein

CIHR IRSC

FI NB IFI INNOVATION

Fondation des maladies du cœur du CANADA — Programmes de recherche

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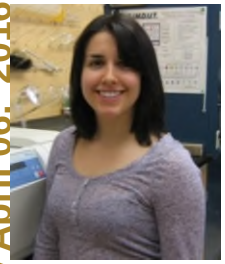
MSc Students



Sabrina Duguay

Yasmina Néchadi

Marco Doucet

PhD Students

Philippe-Pierre Robichaud

Samuel Poirier

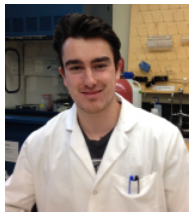
Post-Doc

Natalie Lefort, PhD

BSc Students

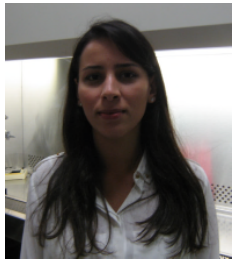
Christy Gnabo

Kristine Gagnon



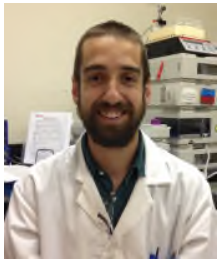
Sébastien Blanchard

Anissa Belkaïd



Marwa Mbarik

Research Assistant



Jérémie Doiron, MSc