

A **research project** for a **senior undergraduate research student** in Biology (Bio 440 or Bio 490) has just come up, working with Dr Sweeney-Nixon (Biology) and Dr Fofana (Agriculture & Agri-Foods Canada), September 2009 - April 2010. The research is in the area of **chemistry of functional foods and their role in health**. This student project is designed for **4th year Biology majors** with lab research skills and interest in health sciences, nutrition, biochemistry and agriculture.

Title: Characterization of seleno-proteins and seleno-compounds in field crops.

Background:

With an aging population and changes in eating habits and lifestyles, the incidence of chronic diseases is increasing worldwide. In 2008, 166,400 new cases of cancers were diagnosed in Canada and more than 5% Canadians have been diagnosed with diabetes. Generally, both cancer incidence and mortality, and prevalence of diabetes are higher in Atlantic Canada, than the rest of the country (www.cancer.ca, www.phac-aspc.gc.ca). Despite progress achieved by conventional medicine in fighting these diseases, **prevention measures have become the top priority for consumers and the public health systems** [1]. Recently, increasing interest has been expressed in plant natural products as preventative agents [2-4]. Plant antioxidant compounds fall into two broad classes, the polyphenolic anthocyanins/flavonoids and the carotenoids, both abundant micronutrients in human and animal diets, and evidence for their role in preventing chronic diseases is emerging [5, 6].

Similar to plant polyphenols, selenium as a nutritional supplement shows promise in the prevention of chronic diseases [7]. Selenium is essential for humans and animals [8, 9] and has been found to be an effective antioxidant against aging [10], certain cancers [11], and arthritis [12]. Selenium deficiency can lead to heart disease, hyperthyroidism and a weakened immune system [13]. Selenium is provided to humans through the food chain by plants and is absorbed, metabolized via sulphur assimilation pathways [14]. It is incorporated into the plant's sulphur-containing amino acids such as methionine, cysteine, and seleno-compounds including methylselenic acid. However, Prince Edward Island's soil is low in selenium [15]. Thus, increasing the selenium level in field crops in PEI and testing the interactive effects between seleno-compounds and other bioactive metabolites in chronic diseases would be of high interest. To this end, we have been able to increase the **total** selenium content in cereals, potato, soybean and flax, in field conditions, by 2-260 fold compared with control conditions. **However, the proportion of selenium that is incorporated into proteins is unknown.** This project will measure the selenium level found in seed proteins which have been digested and analyzed by HPLC-ICP-MS [16].

Outline of work

- 1) Literature searching and writing of a research proposal.
- 2) Lab work: extract proteins from selenium-enriched and control seeds/tubers, and measure the total selenium concentrations.
- 3) Dissemination results (written, oral presentation)

If you are interested in working on this research project, please **apply** by emailing msweeney@upei.ca. Describe your interest in this area, any research experience you have, and whether you want to be considered for Bioloty 440 or 490. Please call 566-0633 for more information.

References

- [1] Bemis BL, Capodice JL, Desai M, Buttyan R, Katz AE (2004) A concentrated aglycone isoflavone preparation (GCP) that demonstrates potent anti-prostate cancer activity in vitro and in vivo. *Clin Can Res* 10: 5282-5292.
- [2] Garbisa S, Sartor L, Biggin S, Salvato B, Benelli R, Albini A (2001) Tumor gelatinases and invasion inhibited by the green tea flavonol epigallocatechin-3-gallate. *Cancer* 91:822– 32.
- [3] Winther K, Apel K, Thamsborg G (2005) A powder made from seeds and shells of a rose-hip subspecies (*Rosa canina*) reduces symptoms of knee and hip osteoarthritis: a randomized, double blind, placebo-controlled clinical trial. *Scand J Rheumatol* 34: 302-308.
- [4] Matchett MD, Shawna L. MacKinnon, Marva I. Sweeney, Katherine T. Gottschall-Pass, Robert A.R. Hurt (2006) Inhibition of matrix metalloproteinase activity in DU145 human prostate cancer cells by flavonoids from lowbush blueberry (*Vaccinium angustifolium*): possible roles for protein kinase C and mitogen-activated protein-kinase-mediated events. *Journal of Nutritional Biochemistry* 17 (2006) 117– 125.
- [5] Manach C, Scalbert A, Morand C, Remesy C, Jimenez L (2004) Polyphenols: food sources and bioavailability. *Am J Clin Nutr* 79: 727-747.
- [6] Lee K-R, Kozukue N, Han J-S, Park J-H, Chang E-Y, Baek E-Y, Chang J-S, Friedman M (2004) Glycoalkaloids and metabolites inhibits the growth of human colon (HT29) and liver (HepG2) Cancer cells. *J. Agric Food Chem* 52:2832-2839.
- [7] **Duffield-Lillico AJ, Dalkin BL, Reid ME, Turnbull BW, Slate EH, Jacobs ET, Marshall JR, Clark LC** (2003) Selenium supplementation, baseline plasma selenium status and incidence of prostate cancer: an analysis of the complete treatment period of the nutritional prevention of cancer trial. *BJU Int* 91: 608-612.
- [8] Rayman MP (2000) The importance of selenium to human health. *Lancet* 356: 233-241.
- [9] Grant CA, Bukley WT, Wu R (2007) Effect of selenium fertilizer source and rate on grain yield and selenium and cadmium concentration of durum wheat. *Can J Plant Sci* 87:703-708.
- [10] Tang Y-L, Wang S-W, Lin S-M (2008) Both inorganic and organic selenium supplements can decrease brain monoamine oxidase B enzyme activity in adult rats. *Brit J Nutri* doi: 10.1017/S0007114508911594 1-6.
- [11] Whanger PD (2004) Selenium and its relationships to cancer. *Br J Nutr* 91:11-28.
- [12] **Hagfors L, Leanderson P, Sköldstam L, Andersson J, Johansson G.** (2003) Antioxidant intake, plasma antioxidants and oxidative stress in a randomized, controlled, parallel, Mediterranean dietary intervention study on patients with rheumatoid arthritis. **Nutr J.** 30:2-5.
- [13] Combs GF Jr (2000) Food system-based approaches to improving micronutrient nutrition: the case for selenium. *Biofactors* 12:39-43.
- [14] Ellis Dr, Salt DE (2003) Plants, selenium and human health. *Curr Opin Plant Biol.* 6:273-279.
- [15] Gupta UC and Winter KA (1975) Selenium content of soils and crops and the effects of lime and sulphur on plant selenium. *Can J Soil Sci* 55: 161-166.
- [16] Lyi SM, Heller LI, Rutske M Welch RM, Kochian LV, Li L (2005) Molecular and biochemical characterization of the selenocysteine Se-methyltransferase gene and Se-methylselenocysteine synthesis in Broccoli. *Plant Physiol* 138: 409-420.
- [17] Li H-F, McGrath SP, Zhao F-J (2007) Selenium uptake, translocation and speciation in wheat supplied with selenate or selenite. *New Phytologist* 178:92-102.