2017/2018 Summer Studentship Project Application Form

Send to: Research Office, University of Otago Christchurch, PO Box 4345, Christchurch, by 5pm on 3 July 2017

Supervisor Information (First named supervisor will be the contact):	
First Supervisor's Name and Title: Prof Margreet Vissers	
Department - UOC &/or CDHB (if applicable): Pathology	
First Supervisors Phone: 364 1524	First Supervisors Email: margreet.vissers@otago.ac.nz
First Supervisors Mailing Address: Centre for Free Radical Research, Pathology Department, University of Otago, Christchurch.	
Co-Supervisors Name and Title(s): Dr Juliet Pullar, Dr Anitra Carr	

Research Category (Choose one category only **– to be used for judging the students' presentations):**		
Clinical	Laboratory X	Community

Project Title (20 words MAXIMUM):

Comparing the bioavailability of liposomal and water-soluble vitamin C

Project Description:

Introduction:

Most living things make vitamin C, and in almost all animals synthesis occurs in the liver or kidneys, with distribution to other cells in the body via the bloodstream [1]. However, humans and a few other species, are unable to synthesise vitamin C and must therefore obtain it from the diet [1, 2]. How much vitamin C is required for optimum health remains a matter of debate and, in addition, there is speculation as to the most effective formulation to ensure easy delivery to the circulation [1]. Vitamin C is highly water-soluble, which makes its transport via the circulation easy, but this property also results in rapid turnover, hence the need for daily replenishment from the diet.

Plasma vitamin C levels are regulated by a balance between uptake from the diet, turnover in the tissues and removal via the kidneys. These processes are generally tightly controlled and plasma levels do not generally increase above 100 μM [3]. Maintaining these saturating plasma levels, which are considered optimal for good health, is challenging when people are unwell, especially with acute respiratory or infectious diseases [4, 5]. In these situations, increased turnover of the vitamin due to its oxidation and removal, appears to be responsible for the decreased plasma and tissue content.

To overcome this challenge, a number of formulations of vitamin C have been developed to increase its stability and bioavailability. One of these products is Lypo-spheric vitamin C, where the vitamin is encapsulated into liposomes with the aim being better delivery to the tissues and extended stability in the circulation. However, few studies have directly compared the bioavailability of vitamin C in this form with vitamin C in a water-soluble form.

Aim:

In this study we will compare the uptake of vitamin C into the plasma and blood cells following dietary supplementation with either liposomal or water-soluble vitamin C. We will recruit ten individuals with low vitamin C status and will monitor uptake into the plasma and cellular blood compartments following a single dose of vitamin C in either formulation.

Possible impact (in lay terms):

This study will help determine whether there is a bioavailability advantage when taking oral vitamin C encapsulated into liposomes. This information will be of value for clinical decision-making when supplementary vitamin C is recommended, and will provide evidence to support dietary advice given to people who are considering purchasing liposomal vitamin C.

Method:

We aim to recruit ten healthy individuals with plasma vitamin C status below 40 μM. Exclusion criteria for participation in the study will include: smoker, taking prescription medication, fear of needles. A clinical study design will be submitted for ethics consideration with the aim being to carry out a cross-over study with either liposomal or a standard vitamin C tablet. Participants will be randomized to receive either vitamin C formulation for a week, followed by a four-week washout period before taking the second formulation for a second week, with repeated protocol.

We will monitor changes in plasma, red blood cell and white blood cell status over an 8 hour period following a single dose of 1 g vitamin C (bioavailability), and also after a week of daily intake of 1 g vitamin (status study).

Blood samples will be collected on ice, plasma separated by centrifugation and removed. The cellular fraction will be separated into red and white cell populations and both will be stored for vitamin C analysis. All fractions will be acidified with perchloric acid/DTPA to stabilize the vitamin C, which will be quantified by HPLC with electrochemical detection [6, 7], the gold standard for monitoring vitamin C in biological samples.

References:

1. Carr, A.C.; Vissers, M.C. Synthetic or food-derived vitamin C-are they equally bioavailable? *Nutrients* 2013, *5,*4284-4304.
2. Carr, A.C.; Pullar, J.M.; Moran, S.; Vissers, M.C. Bioavailability of vitamin C from kiwifruit in non-smoking males: determination of 'healthy' and 'optimal' intakes. *J Nutr Sci* 2012, *1,*e14.
3. Levine, M.; Conry-Cantilena, C.; Wang, Y.; Welch, R.W.; Washko, P.W.; Dhariwal, K.R.; Park, J.B.; Lazarev, A.; Graumlich, J.F.; King, J.; Cantilena, L.R. Vitamin C pharmacokinetics in healthy volunteers: evidence for a recommended dietary allowance. *Proc Natl Acad Sci U S A* 1996, *93,*3704-3709.
4. Hemila, H.; Louhiala, P. Vitamin C for preventing and treating pneumonia. *Cochrane Database Syst Rev* 2007,CD005532.
5. Bonham, M.J.; Abu-Zidan, F.M.; Simovic, M.O.; Sluis, K.B.; Wilkinson, A.; Winterbourn, C.C.; Windsor, J.A. Early ascorbic acid depletion is related to the severity of acute pancreatitis. *Br J Surg* 1999, *86,*1296-1301.
6. Carr, A.C.; Bozonet, S.M.; Vissers, M.C. A randomised cross-over pharmacokinetic bioavailability study of synthetic versus kiwifruit-derived vitamin C. *Nutrients* 2013, *5,*4451-4461.
7. Carr, A.C.; Bozonet, S.M.; Pullar, J.M.; Simcock, J.W.; Vissers, M.C. A randomized steady-state bioavailability study of synthetic versus natural (kiwifruit-derived) vitamin C. *Nutrients* 2013, *5,*3684-3695.

Student Prerequisites (eg. Medical Student) if applicable:

This project is suited to a student with a strong science background and who has an interest in health and nutrition. Good laboratory skills would be an advantage, and as the project will require screening for and liaising with study participants, a pleasant demeanour and good interpersonal skills would be a requirement.

Administration Details

1. Is ethical approval required? Yes

   If Yes: please circle or tick one of the following:

   a) Applied for (provide application #)

   b) Approved (attach a copy of the letter of approval from the ethics committee or application #)

   c) (To be done)

2. Are you able to provide the funding for this project (ie. $5,000 for the student, incidental expenses should be met from departmental or research funds) Yes

If Yes: Please provide name of the funder LivOn Pharmaceuticals

If No: Please provide ideas of possible funding sources, including past funding agents and topics often associated with this research area, for the Research Office to contact.

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If Yes: You will be sent a request for more information.

3. Medical Records or Decision Support accessed No

4. Health Connect South or other DHB records No

5. Signatures:

- I have read the 2017/2018 Summer Studentship programme handbook.
- I am prepared to supervise the project and will be available to the student during the studentship (including Christmas/New Year break if the student is working during this time).
- I agree to assume responsibility for the submission of the student's reports to the Research Office by the due date 29 January 2018.
- I agree that the project lay report may be available to local media for publicity purposes.

Signature of Project Supervisor(s):	Date:

- I understand that I am responsible for hosting the Summer Student chosen for this project and will meet any costs incurred. I agree that incidental expenses will be met from departmental or research funds.

Signature of Head of Department: (Print Name)	Date:
Signature of Clinical Director: (if applicable) (Print Name)	Date: