The New Zealand Institute for Plant & Food Research Limited

Sports performance & recovery – the science

Roger Hurst
Science Group Leader, Food & Wellness
Food Innovation

Sports products – what can berries offer?

Consumer benefits in sports products:

- Controlling Stress
- Less Damage/Pain
- Speedier Recovery
- Train for Longer/Harder
- Enhanced Performance
- Reduced Risk of Infection

‘Enhancing the natural benefits of exercise’

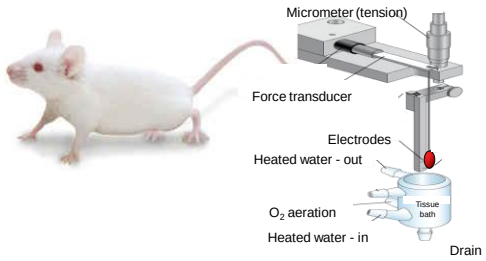
Sports performance & recovery – approach

Cultivar Composition

Cell Screening

Human Trials

***Ex Vivo* Functionality**



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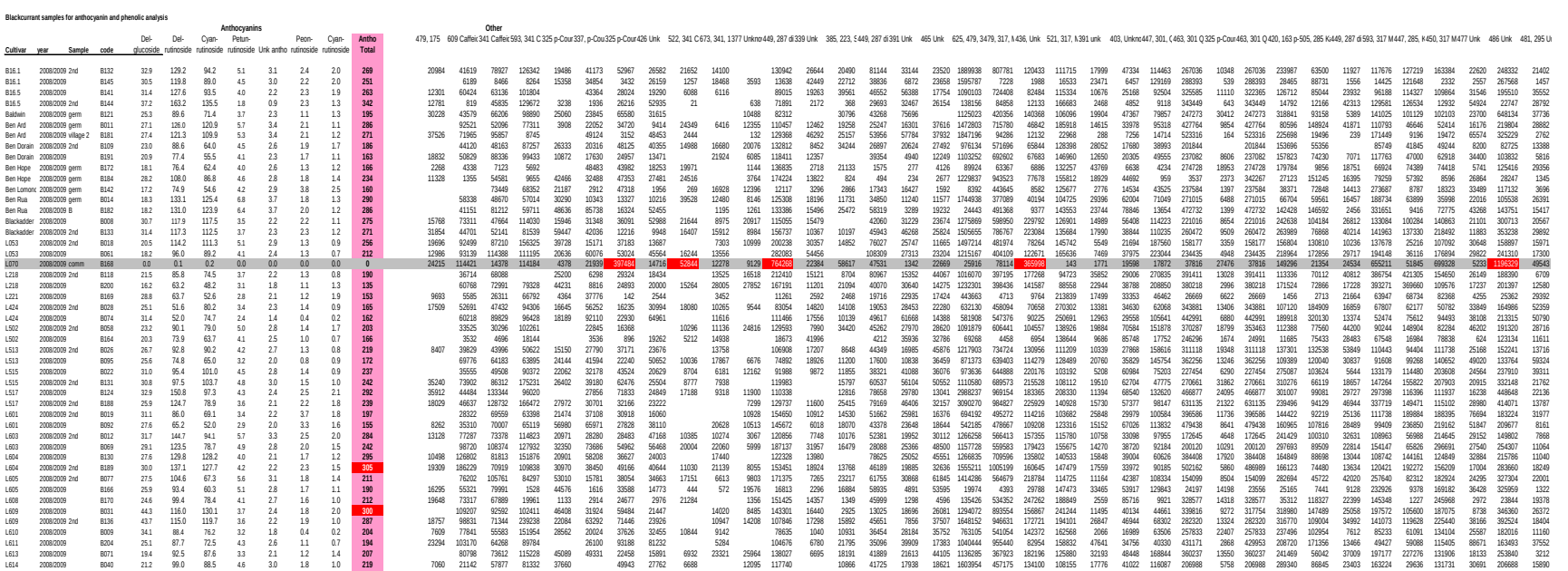
Berryfruit crop – an opportunity ?



Over 1000 berryfruit cultivars analysed : Total anthos, % anthos, Total phenolics (Hplc &Folin), ORAC, FRAP, Vit C

Underpinning future opportunities – unique cultivars, unique products

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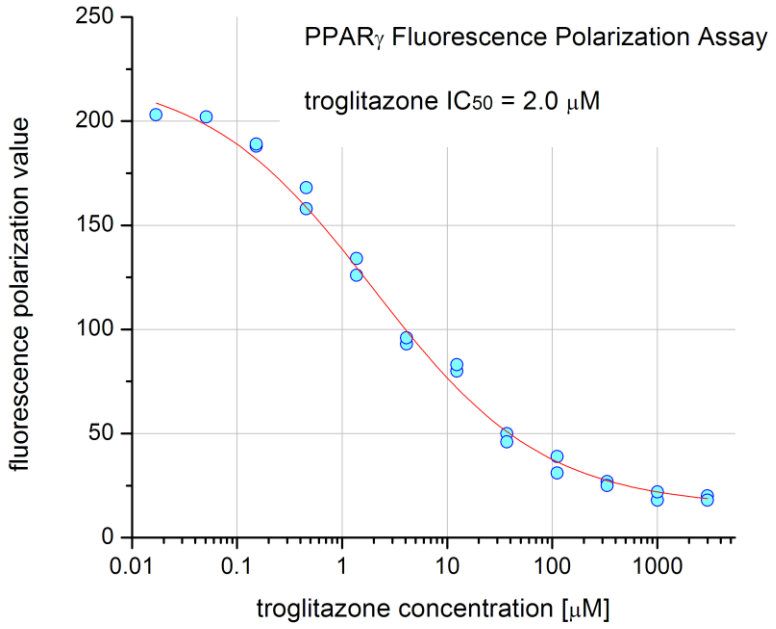
Cell-based assays – physical health

Physical health assays:

- Direct toxicity to muscle cells
- Oxidative stress protection
  – protection against ox stress
- Oxidative protection
  – heat shock protein expression
- Oxidative protection
  – mitochondrial ROS
- Anti-inflammatory assay
  – IL6 and TNF generation
- Adaptive anti-oxidative measures
  – e.g. SOD, catalase



A platform for cell-based physical health 'evaluation'

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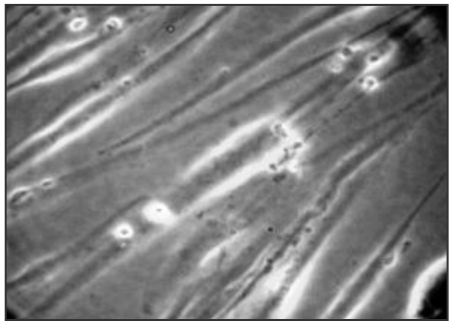
Cell-based assays – immunity and inflammation

Immunity/Inflammation assays:
(cell, whole blood)



- Modulation of cytokine, signalling mol. generation – various cells
- Nuclear factor (NFkB) gene activation/inhibition
- Induction of cytokine gene expression
- Natural killer cell activity – whole blood and cell lines
- Phagocytosis
- Neutrophil oxidative burst
- T cell subset activation – flow cytometry
- Glucose uptake, lipid accumulation – adipocytes, muscle cells
- Lymphocyte Oxidative stress protection

A platform for cell-based immunity and inflammation 'evaluation'

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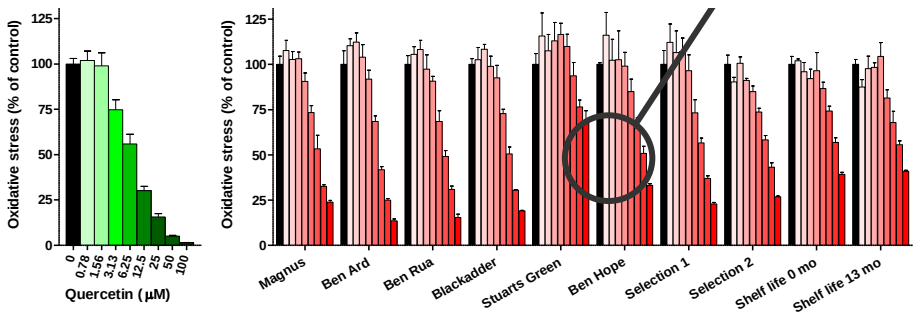
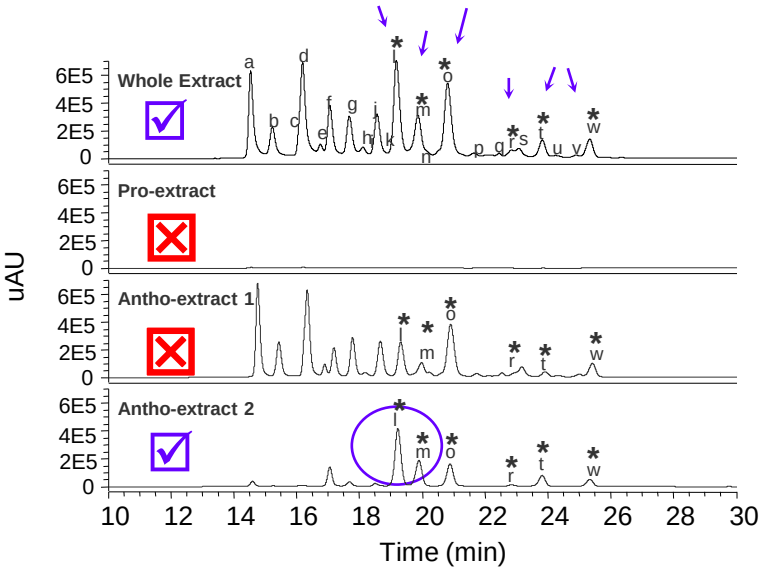
Cell-based assays





Guidance on best genotypes and actives

R.D. Hurst, R.W. Wells, S.M. Hurst, T.K. McGhie, J.M. Cooney and D.J. Jensen (2009) Blueberry fruit polphenolics suppress oxidative stress-induced skeletal muscle cell damage in vitro, *Mol. Nutr. Food Res*. 53, 1-11.

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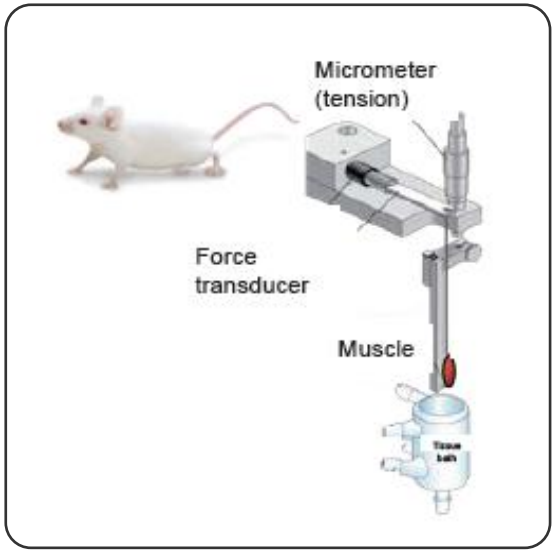
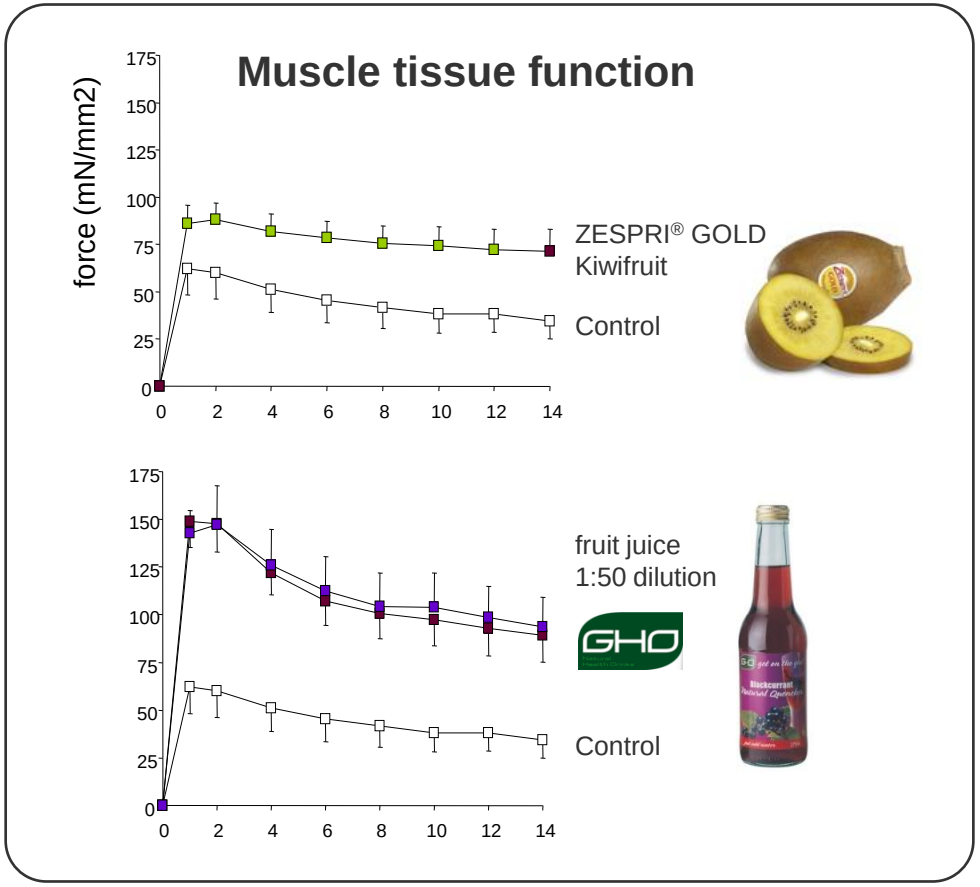
Muscle function – ex vivo modelling





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Skinner, M.A., Hunter, D.C., Denis, M., Parlane, N., Zhang, J., Stevenson, L.M., & Hurst, R.D. (2007) Health benefits of ZESPRI GOLD Kiwifruit: effects on muscle performance, muscle fatigue and immune responses. *Proc. Nutr Soc of NZ*, vol 31, 49-59.

Schrage,B., Stevenson, D., Wells, R., Lyall, K., Holmes, S., Deng, D., & Hurst, R. (2010) Evaluating the health benefits of fruits for physica fitness: A research platform. *J. Berry Res*. 1, 35-45.

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Human exercise models

Rowing	Repeat quadriceps squats
	
30 mins, 80 % max heart rate **Oxidative stress**	4 sets of 10 repeats, 3 min rest between repeats – to failure - **Muscle damage**

New Zealand blackcurrant powdered extracts evaluated

A platform for human-intervention ‘evaluation’

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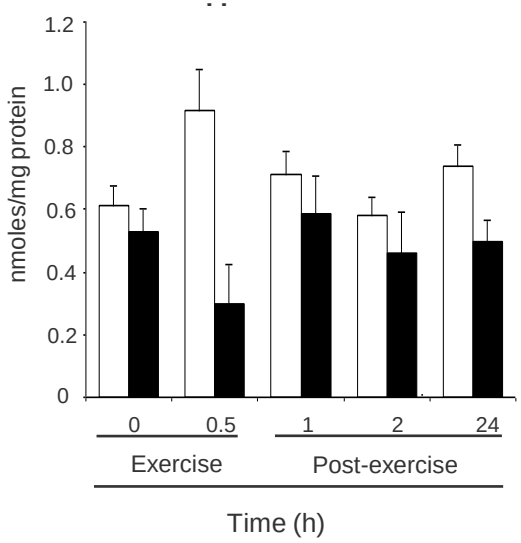
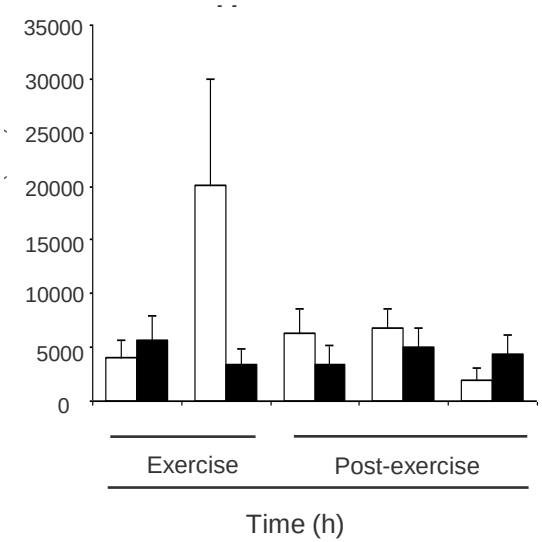
Human exercise – blackcurrant
Oxidative stress model

- N=8 volunteers
- Double-blind, cross-over
- 30 min rowing exercise at 80% max ♥ rate
- 240 mg total anthocyanin

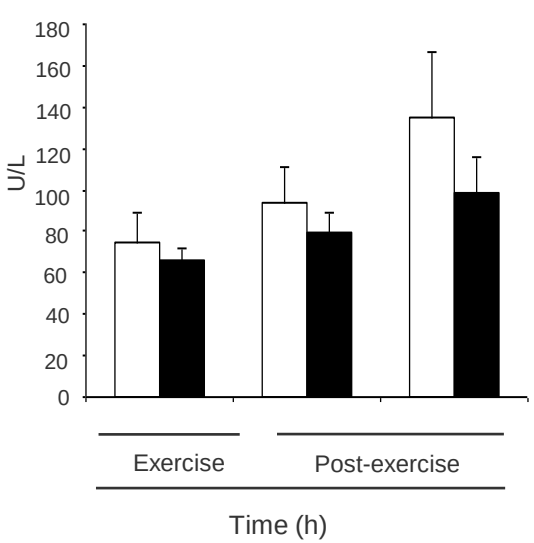
Protein carbonyls



Oxidative Capacity



CK activity



Blackcurrant modulated exercise-induced oxidative stress and muscle damage

K.A. Lyall, et al., (2009) Short-term blackcurrant extract consumption modulates exercise-induced oxidative stress and lipopolysaccharide-stimulated inflammatory responses, *Am. J. Physiol. Regul. Integr. Comp. Physiol*. 297, R70-81.

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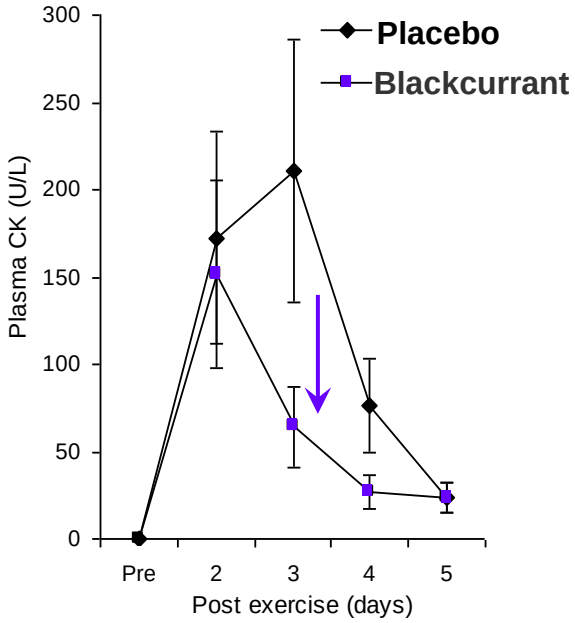
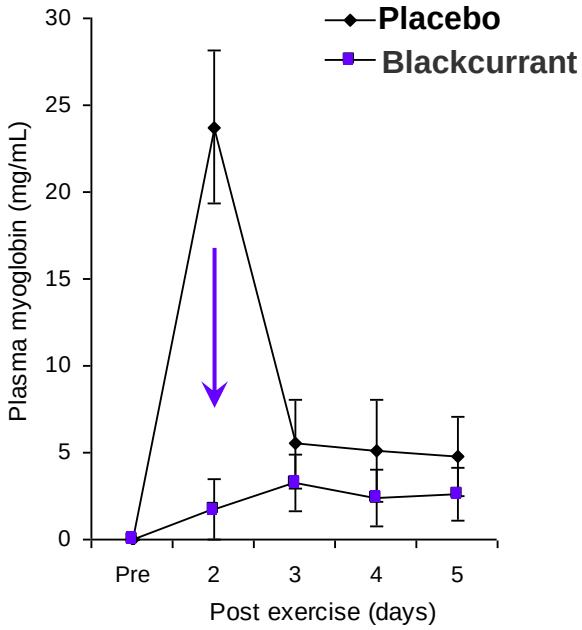
Human exercise – blackcurrant
Muscle damage model





Blackcurrant prevents muscle damage – long term action

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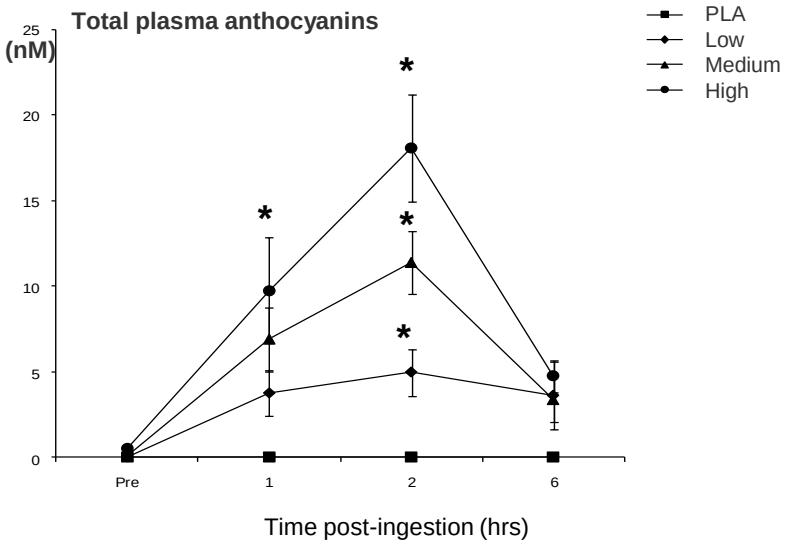
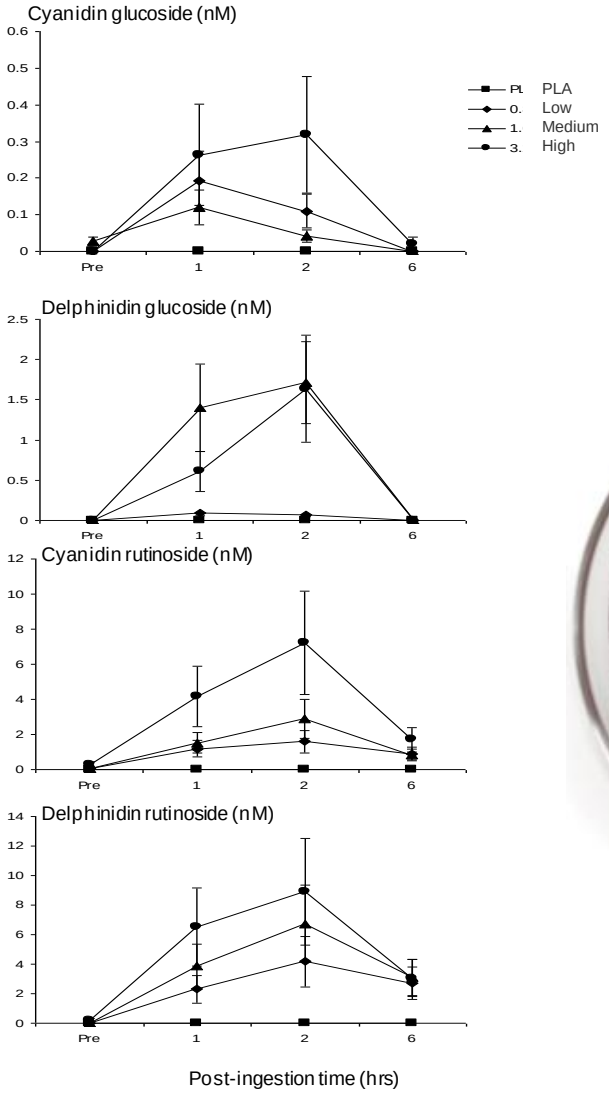
Blackcurrant anthocyanin bioavailability – which dose ?





- » Optimum dose determined
- » Peak post consumption determined

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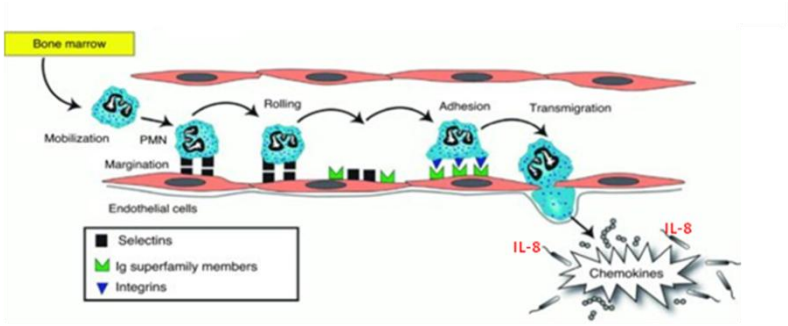
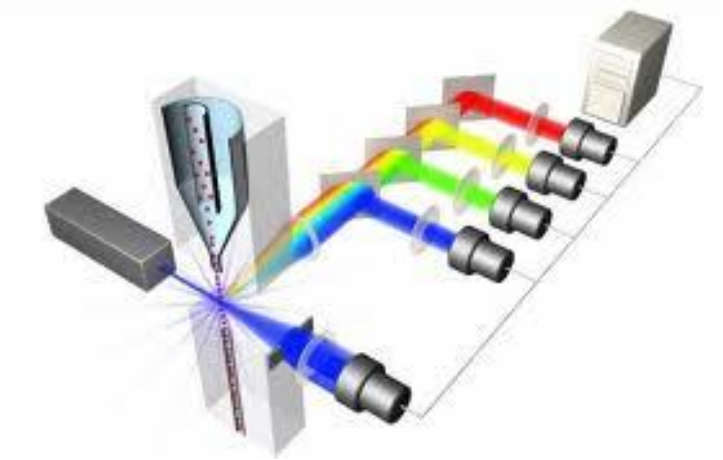
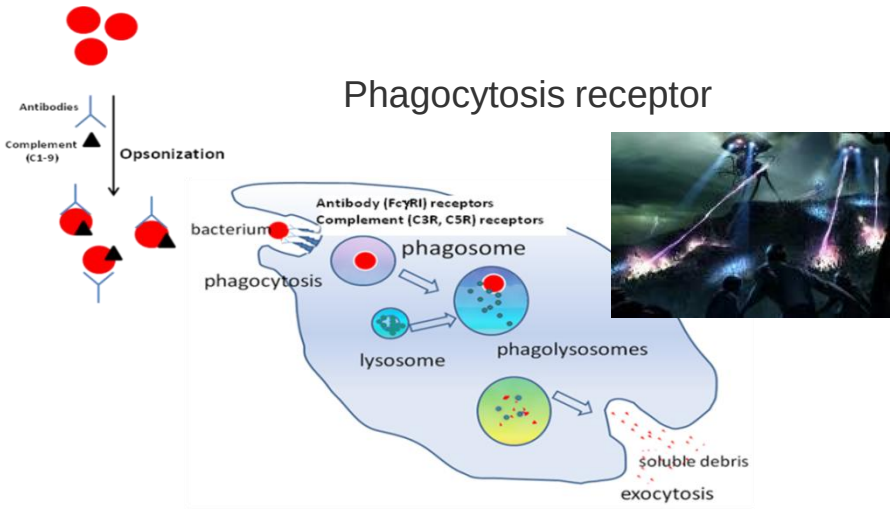
Immunity – neutrophils – first line of defence



Recruitment receptors





Phagocytosis receptor

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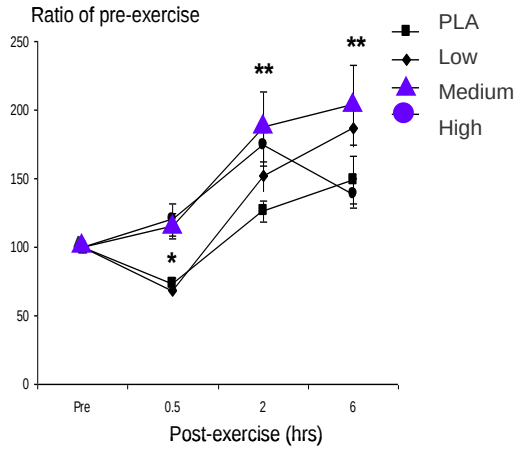
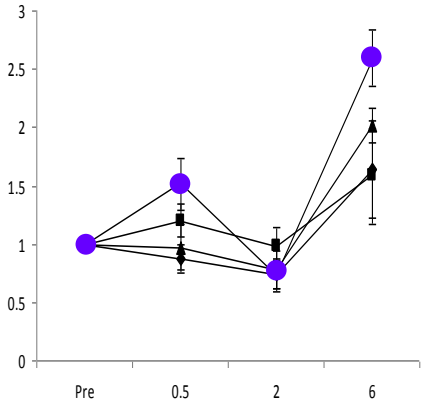
Neutrophil receptors & function – effect of blackcurrant (WITH EXERCISE)

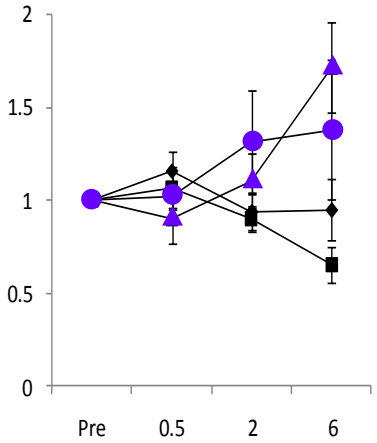
Neutrophil recruitment



Phagocytosis receptor



Bacteria being eaten



- » Neutrophil cell receptors enhanced by blackcurrant
- » Neutrophil killing bacteria function increased

Immune assistance – fight infection/tissue repair
Assists the natural benefits of exercise

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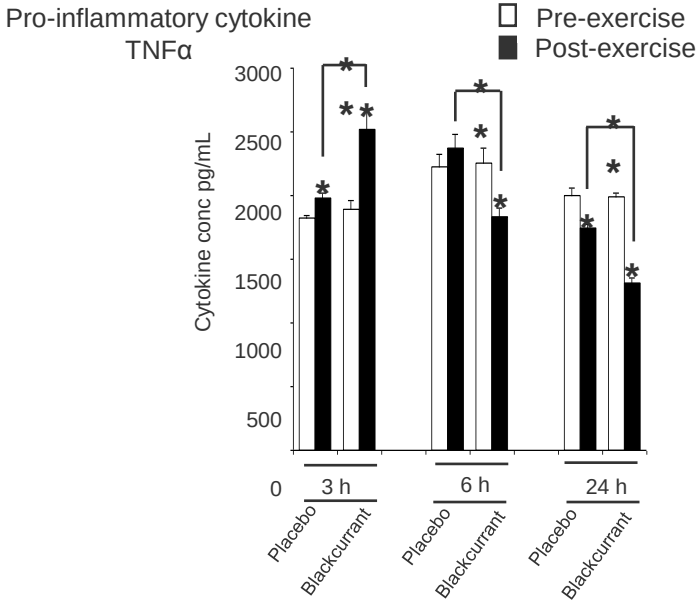
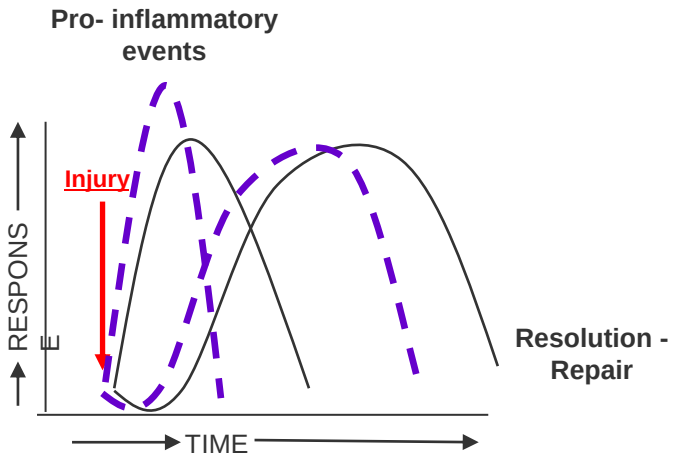
Human exercise – blackcurrant – immunity

Plasma applied to monocytic cell line, challenged with bacterial toxin (LPS)





Augmented acute inflammatory response

Increased ability to respond to pathogens

Earlier resolution - quicker repair
Assists the natural benefits of exercise

K.A. Lyall, et al., Short-term blackcurrant extract consumption modulates exercise-induced oxidative stress ….. *Am. J. Physiol. Regul. Integr. Comp. Physiol*. 297 (2009), R70-81.

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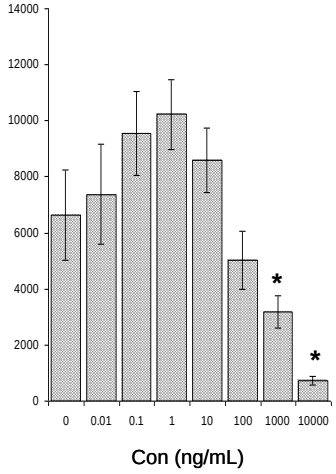
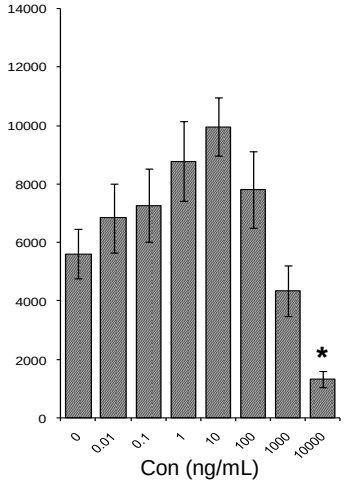
Mechanism of action?

Lab antioxidant test

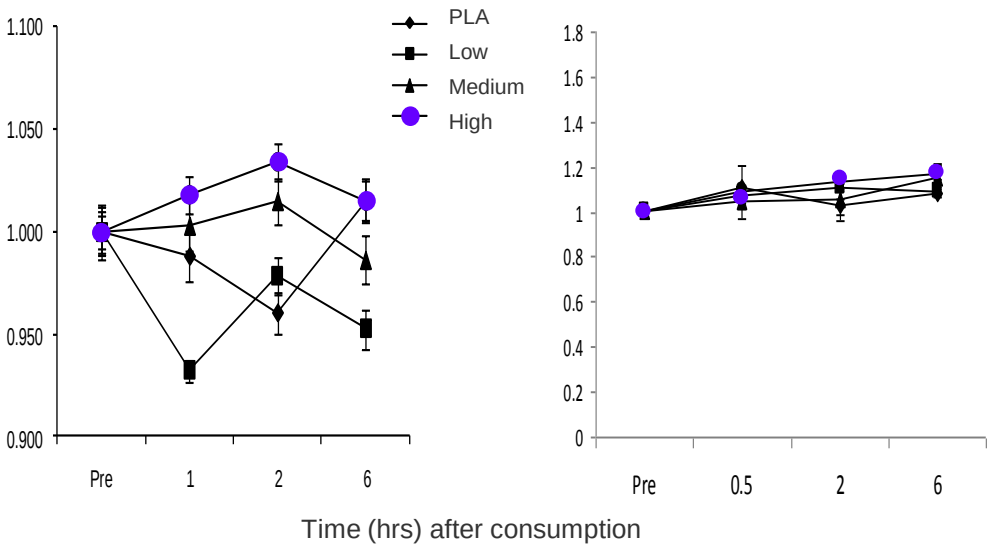
Product 1



Product 2



Plasma antioxidant status



- Products are similar – strong antioxidants
- Action very unlikely to be ‘antioxidant’
- Good insights on action & actives (not shown)

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Why is this important?

- Good evidence for ‘assisting the natural benefits of exercise & sports’ for New Zealand blackcurrant
- Good evidence of functionality, dose, timing, actives, likely mode of action

Commercial benefit

Soft marketing claims backed by science (not anecdotal):

- Controlled oxidative stress and inflammation
- Controlled muscle damage and soreness
- Assisted immune protection - enhanced immunity
- Speedier tissue repair, recovery and performance in exercise
- Train/work harder …….and for longer

People with ‘involvement’ in the specific work shown

Kieran Elborough – General Manager Science

Roger Hurst – Programme Leader

Deborah Tod/Carl Massoratto – Business Managers

Suzanne Hurst
Jeff Greenwood
Shanthi Parkar
Harry Martin
Jing Yuan
Kirsty Lyall
Robyn Wells
Selena Holmes

David Stevenson
Dwayne Jensen
Geoff Langford
Cath Snelling

Other support
Industry support

Janine Cooney

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