

Impact case study (REF3b)

Institution:	University of Northumbria at Newcastle
Unit of Assessment:	26 - Sport and Exercise Sciences, Leisure and Tourism
Title of case study: Facilitation of athlete recovery: applications of tart cherries and the influence on the sustainability of a functional food	
<p>1. Summary of the impact</p> <p>Tart cherries are rich in phytochemicals that include compounds that contain anthocyanins and melatonin, which possess antioxidant and anti-inflammatory properties and consequently have the potential to enhance recovery following strenuous physical activity. Our research has examined novel applications of tart Montmorency cherry juice, specifically in recovery from exercise and managing exercise-induced inflammation, oxidative stress and sleep; this has led to extensive reach to the scientific and wider community and has seen significant increases in the sales and its routine use by athletic (Olympic and professional sports) and general populations who report positive effects on the global effects of recovery following training, competitions and injury.</p>	
<p>2. Underpinning research</p> <p>Strenuous physical activity can result in both metabolic and mechanical stresses that lead to significant but temporary muscle damage, muscle pain, sleep disturbance and elevations in inflammation and oxidative stress. Interestingly, many clinical pathologies (rheumatoid arthritis and gout, for example) display similar characteristics of inflammation and oxidative stress to those seen following strenuous exercise. These exercise models of physiological stress, therefore, present useful paradigms to examine the efficacy of numerous interventions that may be of benefit in managing these factors.</p> <p>Following an extensive review of the literature examining potential interventions to manage the consequences of strenuous exercise (Dr Glyn Howatson and Professor Ken van Someren, 2008), tart Montmorency cherries were identified to contain high quantities of phytochemicals that display anti-inflammatory and anti-oxidative effects. Consequently, it makes the expectation tenable that this could be applied as a functional food to reduce the negative effects of strenuous exercise by managing both inflammation and oxidative stress and consequently accelerate recovery. Until now, little or no research had addressed this question.</p> <p>Howatson (Reader at Northumbria from September 2009) et al. (2010), examined the extent to which muscle function could recover and oxidative stress and inflammation could be managed by consumption of a tart Montmorency cherry juice following the London Marathon. In a blinded, placebo-controlled trial, the research showed that following a marathon race muscle function recovery was significantly enhanced, which was accompanied by a 10% increase in antioxidant capacity and a concomitant decrease in inflammation and oxidative stress suggesting that cherry juice ingestion accelerated recovery by managing negative effects associated with strenuous exercise.</p> <p>This was an important first step in demonstrating the efficacy of tart cherry juice as a functional food to aid recovery by managing oxidative stress and inflammation. In a further adjunct investigation (Howatson et al., 2011a) the team examined the hypothesis that exercise-induced cardiac troponin release was caused by oxidative stress following marathon running. Despite there being changes in anti-oxidative capacity there was no change in cardiac damage indices between cherry juice supplementation and a placebo, thereby providing evidence that cardiac troponin release is unlikely to be mediated by oxidative stress.</p> <p>An often forgotten element of the recovery process is sleep. Athletes and indeed members of the wider populations can suffer from disturbed sleep, which may be due to travelling time zones, high training loads, shift work, over-reaching and unexplained underperformance syndrome or some other underlying pathology such as insomnia. Based on an independent laboratory analysis that reported naturally high melatonin levels in a tart Montmorency cherry concentrate, the team examined the efficacy of cherry juice on melatonin levels and sleep quality and quantity (Howatson</p>	

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et al., 2011b; with Dr Jason Ellis, Reader at Northumbria). Research showed that cherry juice consumption showed a significant rise in total melatonin and increased overall sleep quality by 5-6%. Finally, the team have been awarded research funds (~£200,000) from competitive internal and industry sources to continue investigations into the applications of tart Montmorency cherry juice in exercise and health paradigms.

3. References to the research

1. **Howatson, G.**, McHugh, M.P., Hill, J.A., Brouner, J., Jewell, A., van Someren, K.A., and Shave, R. (2010) 'Efficacy of tart cherry juice in reducing muscle damage, inflammation and oxidative stress following marathon running. ACSM Annual Conference, Seattle, Washington, 26-30 May 2010.' *Medicine and Science in Sports and Exercise*, **41**, S507-8. DOI: 10.1249/01.MSS.0000356097.06975.07
2. **Howatson, G.**, McHugh, M.P., Hill, J., Brouner, J., Jewell, A., van Someren, K.A., and Shave, R. Howatson, S.A. (2010) 'The effects of a tart cherry juice supplement on muscle damage, inflammation, oxidative stress and recovery following marathon running.' *Scandinavian Journal of Medicine and Science in Sports*, **20**, 843-52. DOI: 0.1111/j.1600-0838.2009.01005.x
3. **Howatson, G.**, Goodall, S., Hill, J., Brouner, J., Gaze, D., McHugh, M. P., Shave, R. (2011) 'The influence of dietary antioxidant supplementation on exercise-induced cardiac troponin release.' *International Journal of Cardiology*, **152**, 100-102. DOI: 10.1016/j.ijcard.2011.07.006
4. **Howatson, G.**, Hill, J.A., McHugh, M.P., Gaze, D., Shave, R. (2011) 'Antioxidant supplementation and exercise-induced cardiac troponin release. ACSM Annual Conference, Denver, CO 31 May – 4 June, 2011.' *Medicine and Science in Sports and Exercise*, **43**, S435. DOI: 10.1249/01.MSS.0000401197.06972.3d
5. **Howatson, G.**, Bell, P.G., Tallent, J., Middleton, B., McHugh, M.P., Ellis, J. (2012) 'Effect of tart cherry juice (*Prunus cerasus*) on melatonin levels and enhanced sleep quality.' *European Journal of Nutrition*, **51**, 909-916. DOI: 10.1007/s00394-011-0263-7

Funding for further research from external sources

- Grant holder: **G Howatson**; Title: Novel applications of tart cherry juice; Sponsor: CherryActive and Cherry Marketing Institute; Period and value: 2010-2013, **£57,773**.
- Grant holder: **G Howatson**; Title: Influence of tart cherry juice on blood flow, cognition and exercise efficiency; Sponsor: Cherry Marketing Institute; Period and value: 2013-2016, **£75,000**.
- Grant holder: **G Howatson**; Title: Influence of tart cherry juice on recovery from strenuous metabolic exercise Sponsor: Cherry Marketing Institute; Period and value: 2013-2014, **£14,723**.

In all cases the research was conceived, managed and implemented by the lead author, with contributions from other Northumbria University academics, and to a lesser extent, collaborators within the EIS, NISMAT in NY, USA and other UK HEIs.

4. Details of the impact

The initial conference communications and press releases following the formal publication of the research in 2012 has generated huge interest in the popular press and most notably been reported on the front page of the Daily Telegraph (Source 1), Daily Mail, featured on Breakfast TV and BBC Radio 2 and 4, Dr Oz Show (Source 9). In addition, the information from the relevant research outputs has been directly disseminated to:

- Previous and present National Director of Science at English Institute of Sport (EIS);
- Previous and present National Lead Performance Nutritionist at EIS;
- GB Cycling physiologist, Regional Lead Physiologist and Lead Practitioner for recovery at the EIS;
- Performance nutritionists from GB Sailing, GB Modern Pentathlon, and GB Triathlon at EIS;
- GB Cycling and Team SKY professional Road Racing Team.

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As a result, these sports have used these products and have found a positive benefit in recovering from strenuous exercise and injury. Of particular note:

- GB cycling routinely use tart Montmorency cherry juice as part of their recovery strategy on a daily basis during high training loads and competition;
- GB sailing, GB Triathlon and the GB Modern Pentathlon team use it when travelling time zones and in heavy competition;
- Used as an adjunct treatment of injured Olympic athletes in the rehabilitation;
- The EIS have now included cherry juice as an evidenced based intervention in their resource guide for GB athletes.

The use of this intervention has been directly driven by the research at Northumbria and has been an integral part of the operations that has resulted in recent Olympic and international sporting success. Testimonial evidence from GB cycling confirms this: “...we are utilising the findings of your research and applying cherry juice as an intervention to improve recovery and ultimately athlete performance here at GB Cycling and Team SKY...” (Source 3). Furthermore, many other sports with high volume competition schedules have learned of the potential benefits through dissemination of the research by the University and popular press and ~50% of Premiership Football Clubs and ~80% of Premiership Rugby Union teams now routinely use it and report a positive effect on the recovery (Source 4). Also, numerous professional teams in the USA routinely use cherry juice to enhance recovery and performance that is based on evidence from our research. These include NFL - New York Giants, Seattle Seahawks; NBA – Miami Heat, Cleveland Cavaliers; NHL – New York Rangers, Chicago Blackhawks; MLB – NY Mets, Seattle Mariners (source Nicholas Institute of Sports Medicine and Athletic Trauma, NY, USA) (Source 10).

A more recent application of the cherry juice in the management of disordered sleep has also been extremely successful (Pigeon et al., 2009; Howatson et al., 2012). In addition to using this intervention to assist recovery, athletes have also implemented it as an adjunct treatment in managing disturbed sleep from heavy training, return from injury, improving general sleep quality and when travelling time zones – statements in testimonials from National Lead Performance Nutritionists include: “... spontaneous self reports, from an athlete using cherry juice daily after the IRU physio, training and strength sessions, highlighted the impact on reduced DOMS, better sleep patterns and a greater sense (feeling) of tolerance towards the following training sessions over a two week time frame. This athlete believed this was a contributor to his return to play, Olympic selection at trials and participation in the London Olympic Games.” (Source 2).

Interest in this functional food, globally, has grown enormously to the point where sales have increased by two-fold for tart Montmorency cherry juice concentrate (CherryActive) in the week of the research being released. CherryActive, with over 1,000 retailers, is now the largest supplier of Montmorency cherry concentrate and capsules in the UK. The Managing Director has said the research has directly contributed to an increase in sales (approximately 12 per cent increase from 2010 to 2011) which was unexpected during a time of austerity and when the price of cherries had increased enormously due to crop failures influenced by inclement weather. This has resulted in a more sustainable future for the business.

Many of thousands of people routinely use tart cherry concentrate to manage joint pain, improve exercise recovery and sleep quality and also to increase antioxidant intake; while it is not possible to completely attribute our research with all these users, UK distributors have attributed the increase in sales to the publication of the research and the substantial expansion of their market (source from CherryActive). A recent example of where the research has impacted on the wider community is provided by Mark Allison who raised over £100,000 for charity by running across America in 100 days: he said tart cherry juice was essential in aiding his recovery from day to day and he will routinely use it to facilitate recovery from training and events for the future (Source 8)

The results from the research have also had a meaningful impact on the wider community, where the application has been realised for numerous people with disordered sleep, are time zone travellers or shift workers. There was an increase (~two-fold worldwide) in the sales of Montmorency cherry juice (Source 7) following the publication (Howatson et al., 2012) of the

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research. The research was also recently featured on a Channel 4 series Food Hospital (December, 2011; Source 5) where a simplified on-line public trial was conducted over a two-week period to examine the efficacy of cherries in aiding sleep (<http://www.channel4.com/programmes/the-food-hospital/>). Finally, a recent medical TV programme in the United States (The Dr Oz Show, 30 October 2012) (Source 9) also highlighted the research conducted at Northumbria and how the findings are being implemented by practitioners and impacting on patients globally (<http://www.doctoroz.com/videos/tart-cherry-all-natural-sleep-aid-pt-1> and <http://www.doctoroz.com/videos/tart-cherry-all-natural-sleep-aid-pt-2>) – Source 10).

5. Sources to corroborate the impact

1. The Telegraph front page on 2 November 2012 and online blog: (<http://www.telegraph.co.uk/foodanddrink/8863309/Cherry-juice-can-help-get-a-good-nights-sleep.html>) - over 700 members of the public have recommended its use.
2. Personal communications with past and present National Lead Performance Nutritionist (EIS), and Senior Performance Nutritionist GB sailing, Modern Pentathlon – March and September 2012.
3. Personal communications - Performance Nutritionist for GB cycling and Team SKY - testimonial March 2012.
4. Professional sport – Premiership football and rugby – CherryActive.
5. Channel 4 Food Hospital - <http://www.channel4.com/programmes/the-food-hospital/> - Series 1 – Episode 6 - December 2011
6. The Montmorency Cherry Health and Nutrition Report on the benefits of 'superfruits' http://www.thefooddoctor.com/images/pdfs/CherryActive_Report.pdf.
7. Funding sources (Cherry Marketing Institute, CherryActive), PhD studentship – 2010-2016 plus Northumbria fully-funded studentship and email confirming increase in Cherry Juice sales from Managing Director of CherryActive.
8. Charity fund raiser - (<http://markallisonjogtole.blogspot.com/2011/09/cherry-active-secret-weapon.html>; <http://markallisonjogtole.blogspot.com/2011/03/cherry-active.html>) – May to August 2011.
9. Dr Oz Show - 30 October 2012 <http://www.doctoroz.com/videos/tart-cherry-all-natural-sleep-aid-pt-1> – details of how the findings are being implemented by practitioners and impacting on patient.
10. The findings are being implemented by practitioners and impacting on patients globally: Director of Research at the Nicholas Institute of Sports Medicine and Athletic Trauma, Lenox Hill Hospital, NY, NY, USA.