



Anthocyanin-Rich New Zealand Blackcurrant: Applications for Exercise and Health

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CHICHESTER

United Kingdom



November 4, 2023



Anthocyanin-Rich New Zealand Blackcurrant: Applications for Exercise and Health

anthocyanins

antioxidant activity



Google search results for "anthocyanins".

Search results include:

- color
- structure
- food
- red
- chemical formula
- purple
- pigment
- blue
- leaf

Results shown:

- Wikipedia: Anthocyanin - Wikipedia
- Science Notes: Anthocyanins - Definition, Benefits ...
- Cleveland Clinic Health Essentials: Health Benefits - Cleveland Clinic
- BYJU'S: ANTHOCYANIN STRUCTURE
- MDPI: Food Sources Richest in Anthocyanins
- MDPI: Derivatives through Clay Minerals ...
- ScienceDirect.com: Anthocyanin - an overview ...

Antioxidant Activity ...

phenol rings

Polyphenols (>8000)

Phenolic acids

Hydrobenzoic acids
e.g. protocatechuic acid
gallic acid

Hydroxycinnamic acids
e.g. ferulic acid
curcumin

>4000

Flavonoids

Stilbenes
e.g. resveratrol

Lignans

>600

Anthocyanidins
e.g. cyanidin

Flavonols
e.g. quercetin

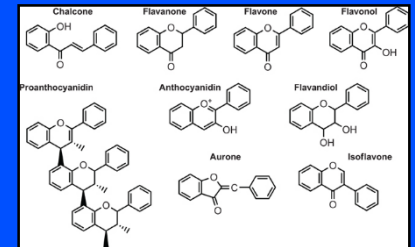
Flavones

Isoflavones

Flavanones

Flavanols
e.g. catechins

anthocyanins are glycosides of anthocyanidins
e.g. cyanidin-3-glucoside



Polyphenol composition



black
elderberry



strawberry



black
chokeberry



blackcurrant



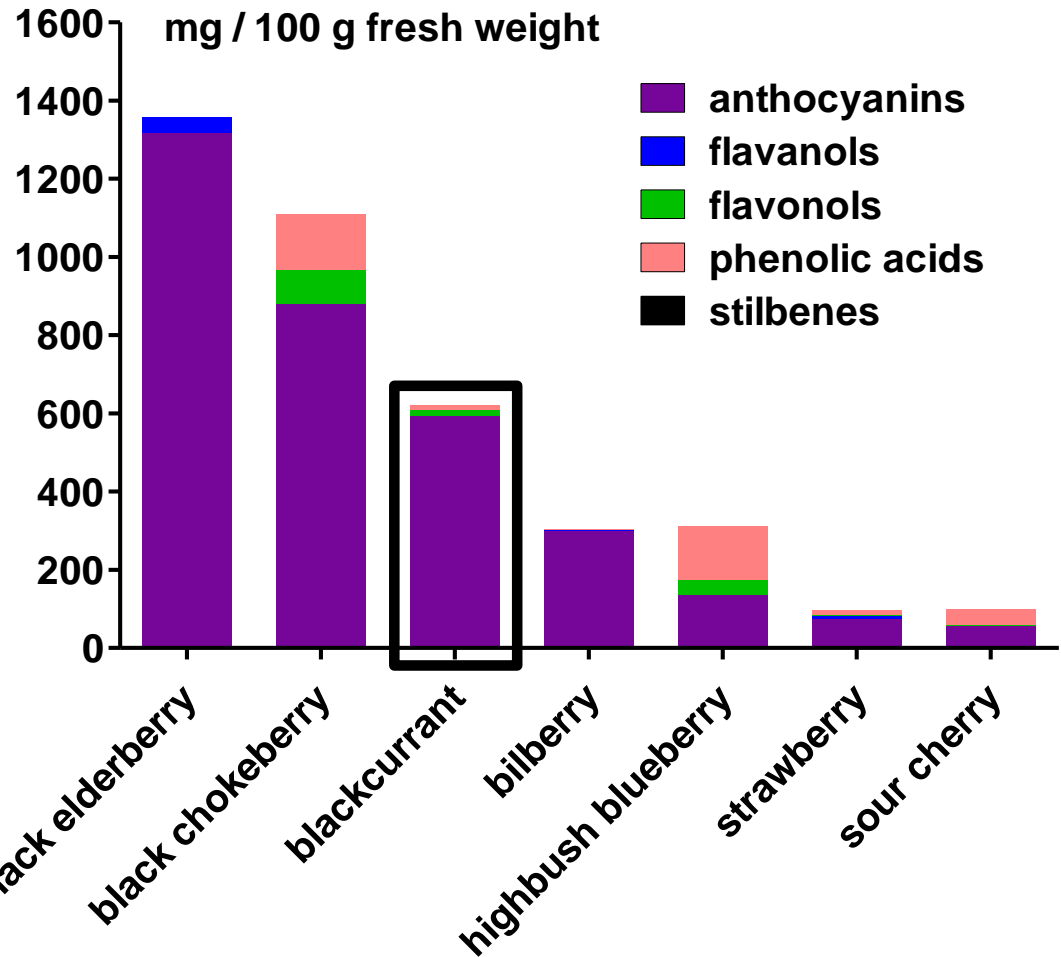
bilberry



sour cherry



highbush
blueberry



Anthocyanin composition



black
chokeberry



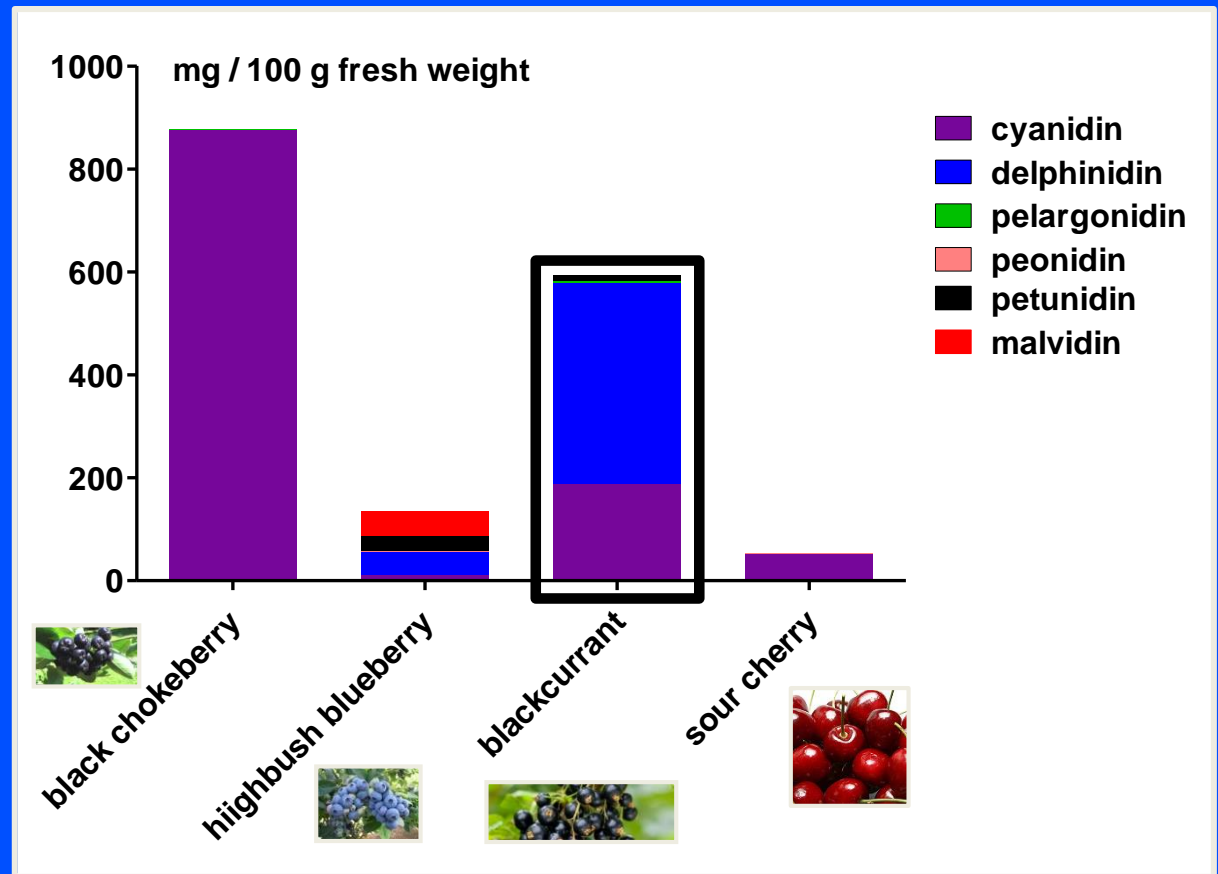
blackcurrant



highbush
blueberry



sour cherry



Berries differ in total anthocyanin content and composition

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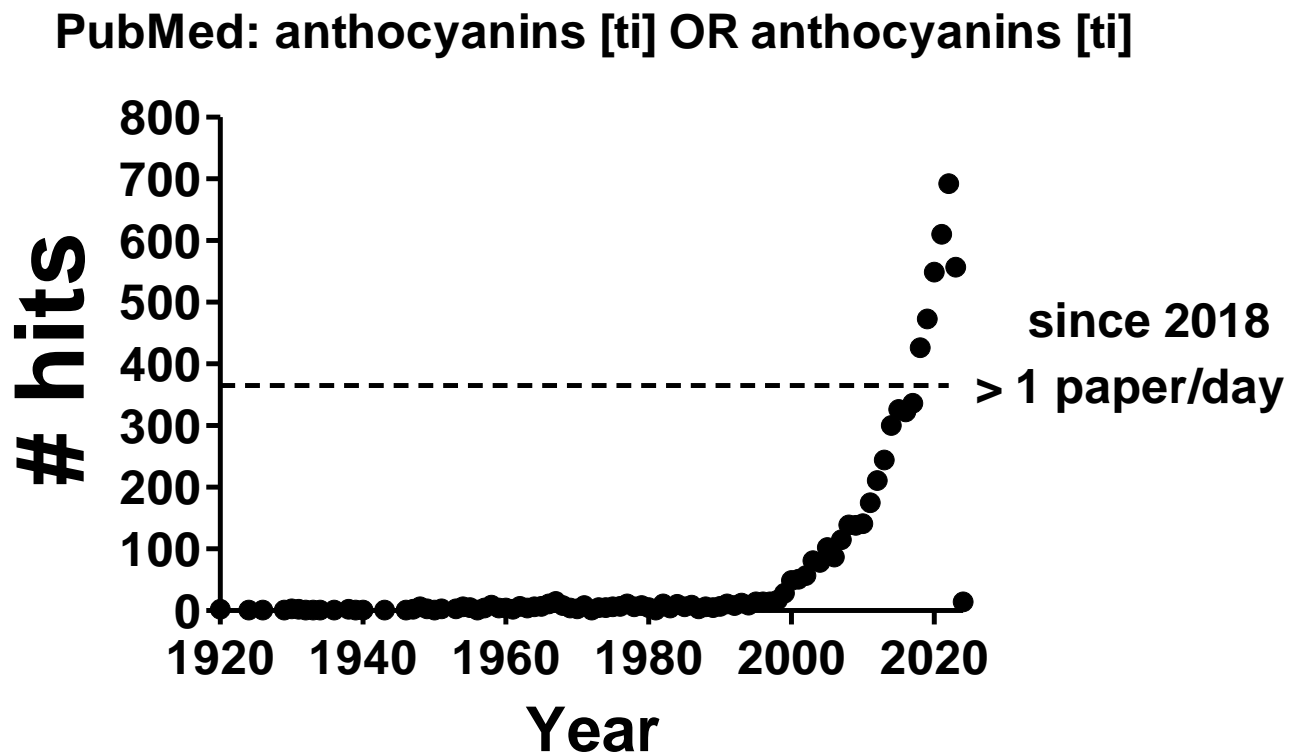
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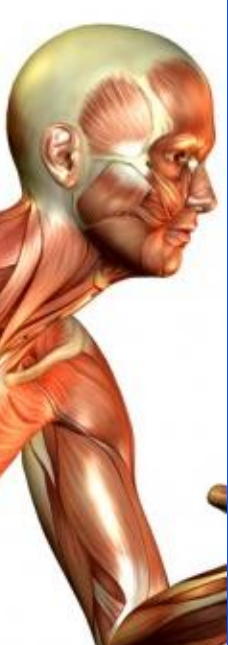
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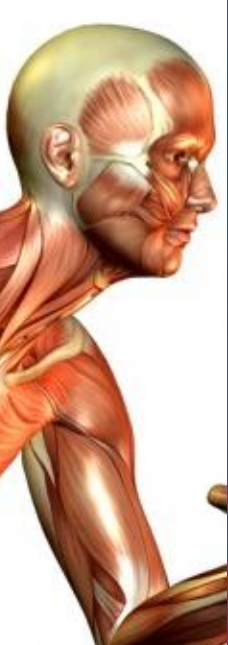


Anthocyanin-Rich New Zealand Blackcurrant: Applications for Exercise and Health

Outline

- Why interest in anthocyanin-rich blackcurrant?
- Metabolic and exercise performance effects
- Health-related effects
- Are we there yet?: The unknowns





Anthocyanin-Rich New Zealand Blackcurrant: Applications for Exercise and Health

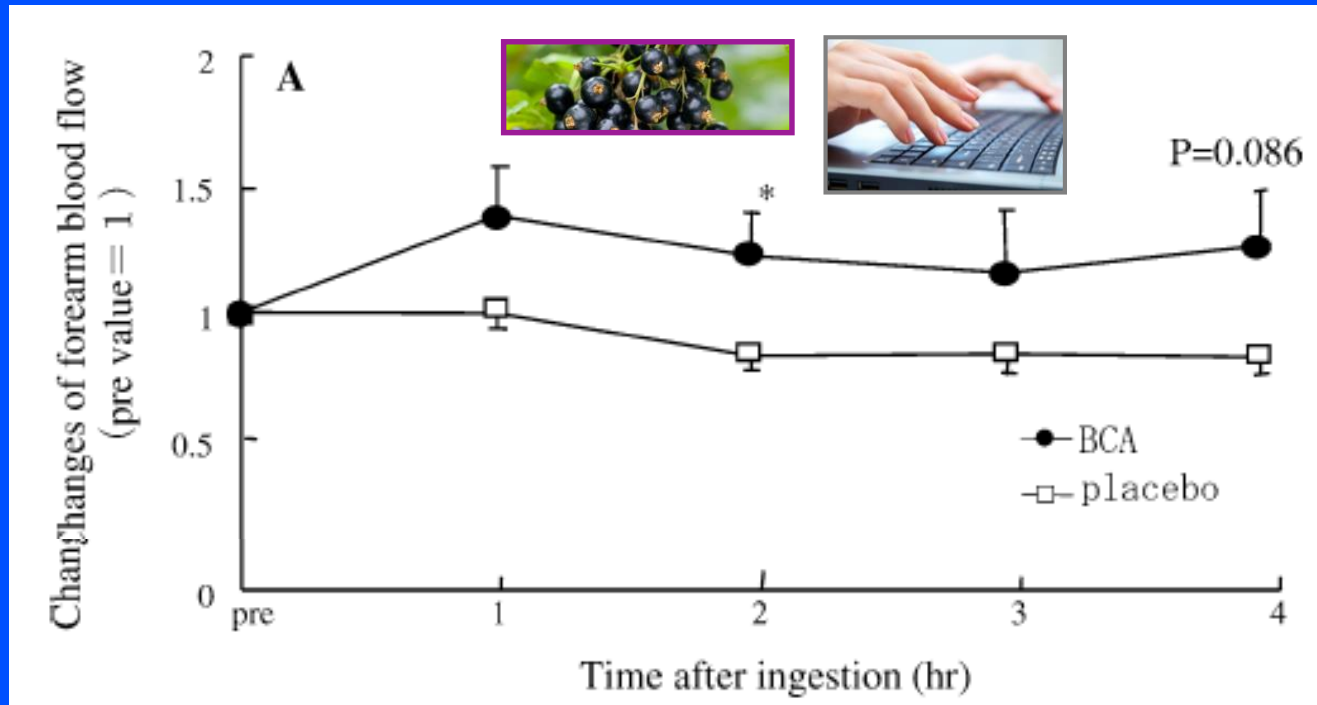
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Effects of blackcurrant anthocyanin intake on peripheral muscle circulation during typing work in humans

blackcurrant anthocyanin concentrate $17 \text{ mg (kg BW)}^{-1}$ 10.83% anthocyanins



2005

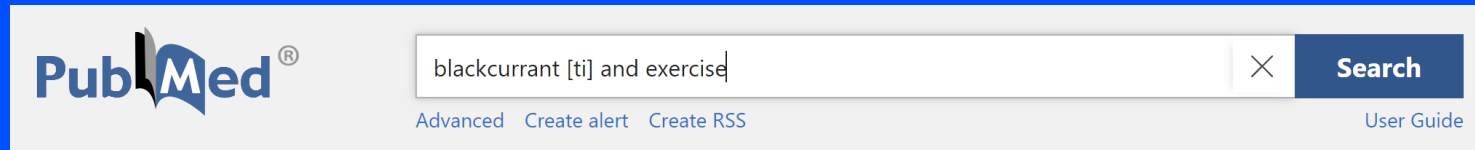
8 males, 3 females
age: 39 ± 12 yr

forearm blood flow
(supine position)

near infrared
spectroscopy

blackcurrant increased blood flow by **22%** (2 hr)

peer-reviewed < 2013: Only one paper!



2009

Post-exercise observations

30-min indoor rowing

5 males, 5 females

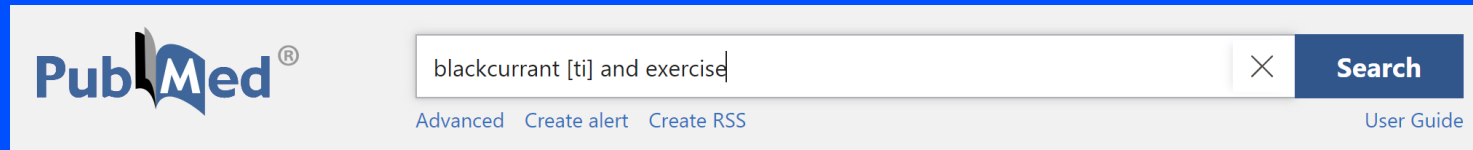
age: 48 ± 3 yr



120 mg anthocyanins before exercise



peer-reviewed < 2013: Only one paper!



Found 1 result for *blackcurrant [ti] AND exercise*

Filters applied: From 1900 to 2013/12/31. [Clear all](#)

Clinical Trial > Am J Physiol Regul Integr Comp Physiol. 2009 Jul;297(1):R70-81.
doi: 10.1152/ajpregu.90740.2008. Epub 2009 Apr 29.

Short-term blackcurrant extract consumption modulates exercise-induced oxidative stress and lipopolysaccharide-stimulated inflammatory responses

K A Lyall ¹, S M Hurst, J Cooney, D Jensen, K Lo, R D Hurst, L M Stevenson

2009



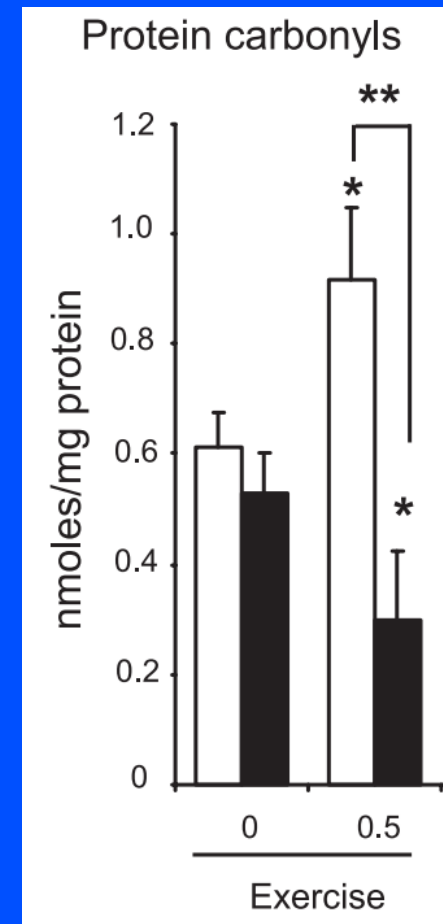
**exercise-induced
oxidative stress**

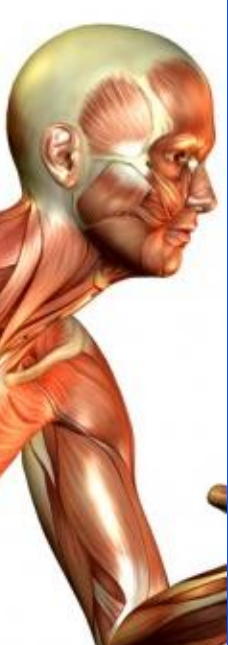


protein carbonyls



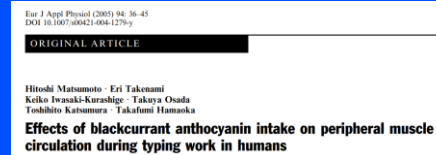
blackcurrant





Anthocyanin-rich Blackcurrant

↑ blood flow

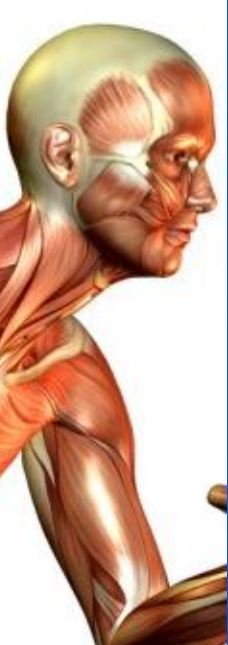


2005

↓ exercise-induced oxidative stress



2009



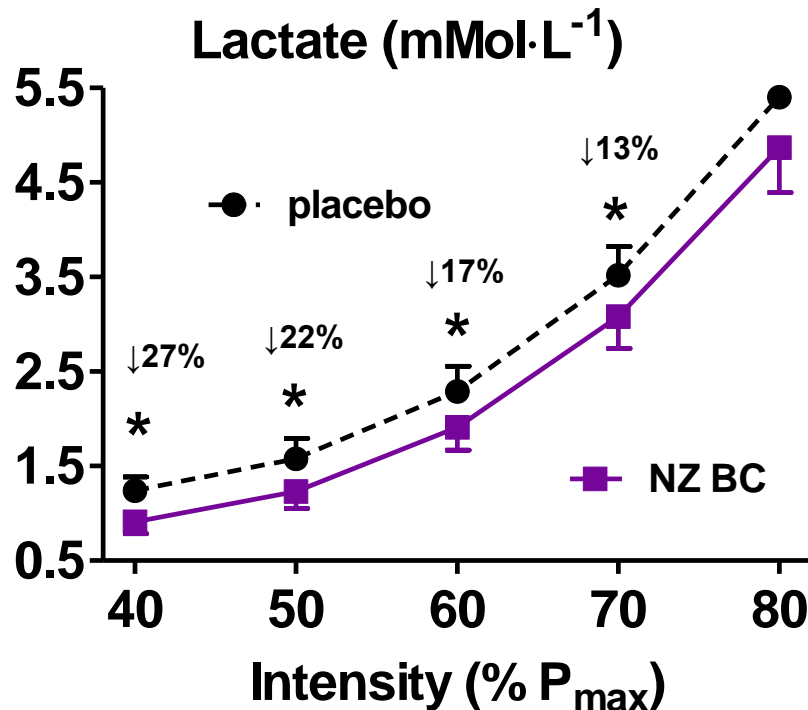
Anthocyanin-Rich New Zealand Blackcurrant: Applications for Exercise and Health

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Lactate: intermittent incremental cycling (4 min stages, 2 min rest)



***n* = 13 (triathletes)**



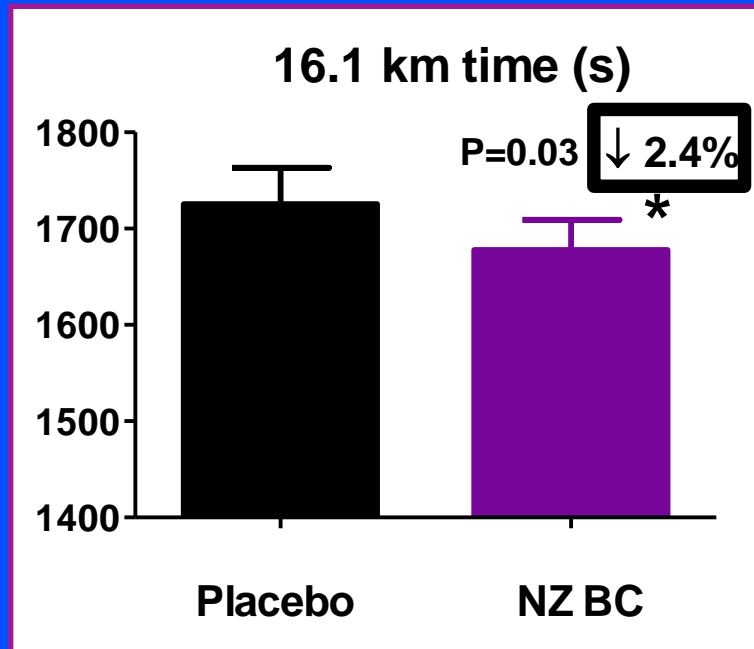
**6 gram New Zealand
blackcurrant powder for 7 days**

~139 mg anthocyanins/day for 7 days

NZBC – New Zealand blackcurrant

**New Zealand blackcurrant resulted in a shift of
the cycling intensity-lactate curve**

16.1 km cycling time-trial performance



NZBC – New Zealand blackcurrant



1 per day for 7 days



n = 14 (cyclists)

11 did go faster

~105 mg blackcurrant anthocyanins



double-blind placebo controlled cross-over design

two full 16.1 km familiarizations

Acute Dietary Nitrate Supplementation Improves Cycling Time Trial Performance

Lansley et al., *Med. Sci. Sports Exerc.* 43, 1125-1131, 2011

↓ 2.7%



beetroot



- 16.1 km cycling time trial

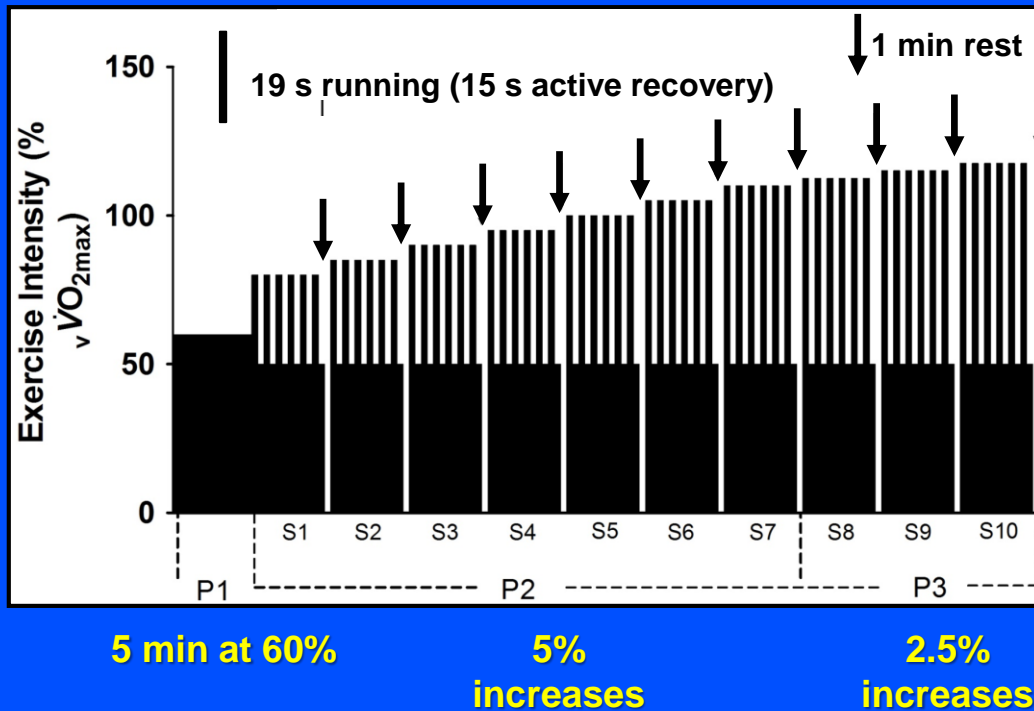
Endurance (aerobic) exercise



What about high intensity (more anaerobic) intermittent exercise?



- high-intensity incremental treadmill running



$n = 13$ (recreationally active males)



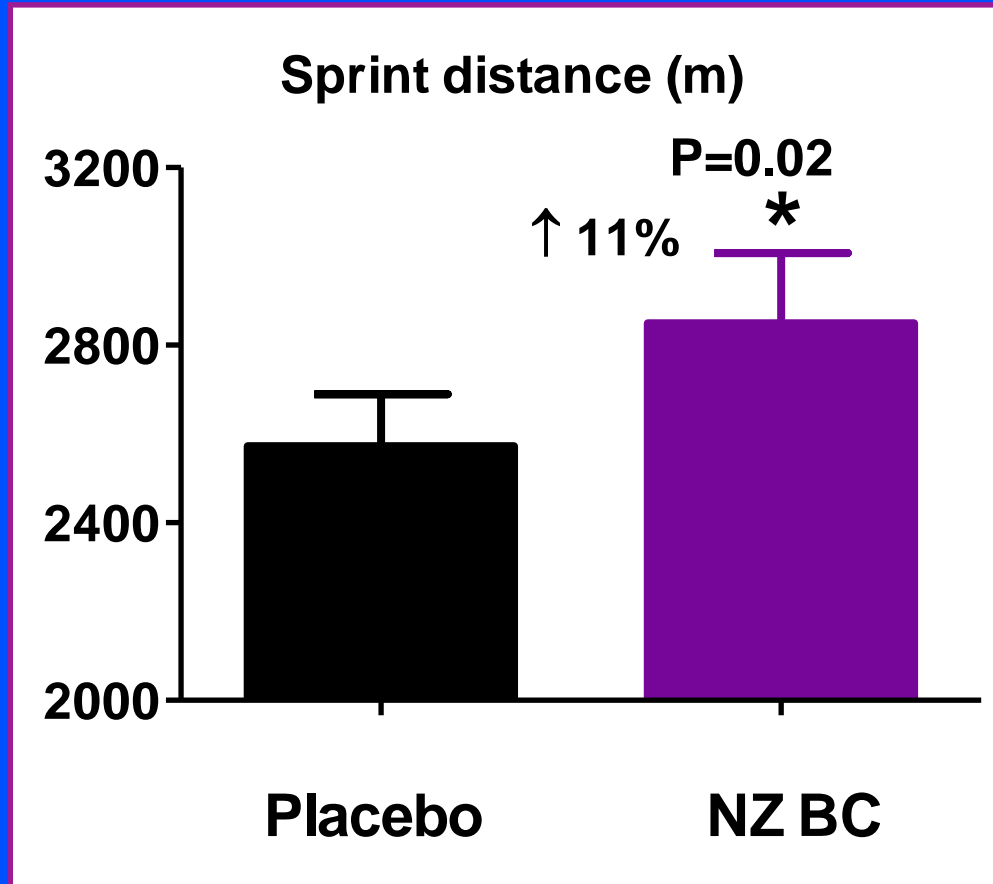
~105 mg anthocyanins/day for 7 days



NZBC – New Zealand blackcurrant



- high-intensity incremental treadmill running



$n = 13$ (recreationally active males)

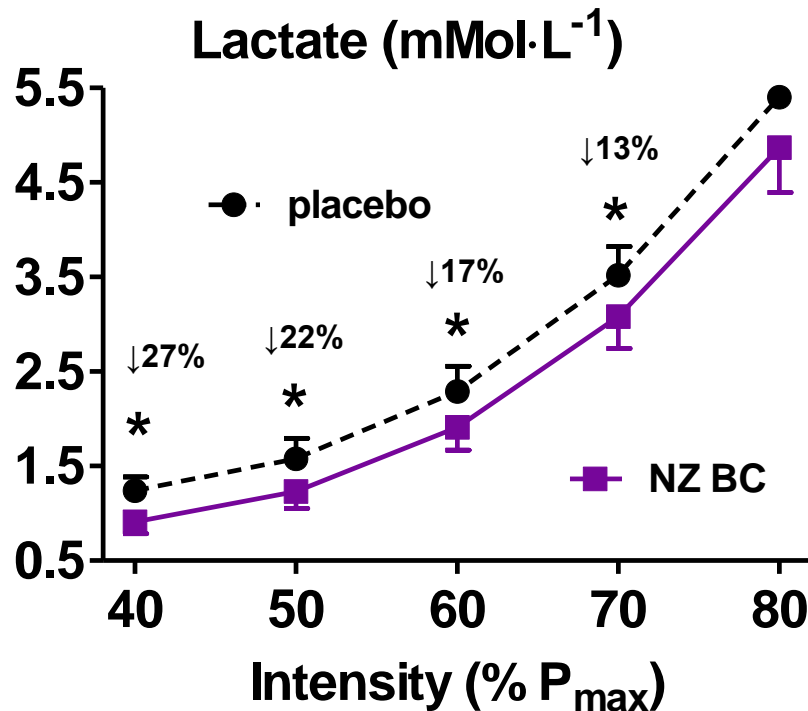
9 improved

~105 mg anthocyanins/day for 7 days



NZBC – New Zealand blackcurrant

Intermittent incremental cycling (4 min stages, 2 min rest)



***n* = 13 (triathletes)**



**6 gram New Zealand
blackcurrant powder for 7 days**

~139 mg anthocyanins/day for 7 days

NZBC – New Zealand blackcurrant

**New Zealand blackcurrant resulted in a shift of
the cycling intensity-lactate curve**

Dose effects of New Zealand blackcurrant on substrate oxidation and physiological responses during prolonged cycling

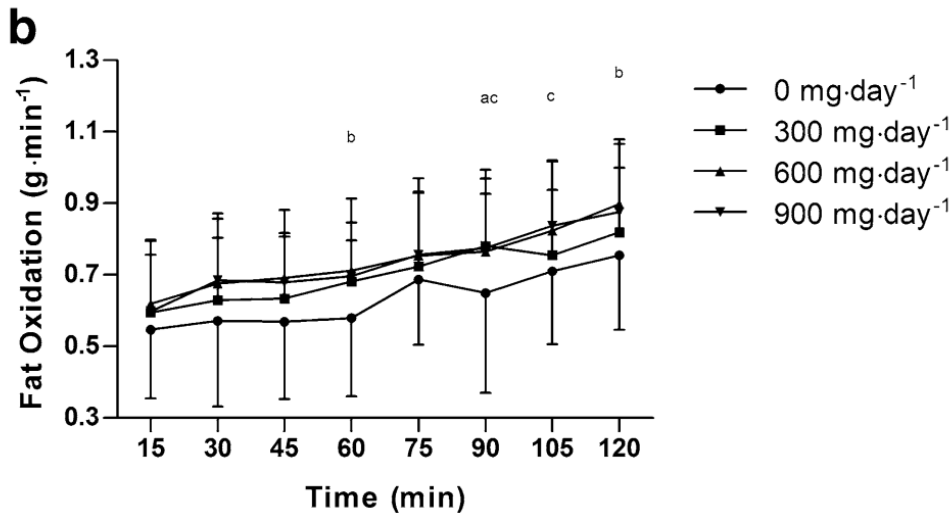
Matthew David Cook^{1,2} · Stephen David Myers¹ · Mandy Lucinda Gault¹ ·
Victoria Charlotte Edwards¹ · Mark Elisabeth Theodorus Willems¹



male cyclists

2 hr cycling at 65% $\dot{V}O_{2\max}$

2 per day for 7 days (~210 mg anthocyanins/day)



fat oxidation
22%

Dose effects of New Zealand blackcurrant on substrate oxidation and physiological responses during prolonged cycling

Matthew David Cook^{1,2} · Stephen David Myers¹ · Mandy Lucinda Gault¹ · Victoria Charlotte Edwards¹ · Mark Elisabeth Theodorus Willems¹



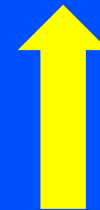
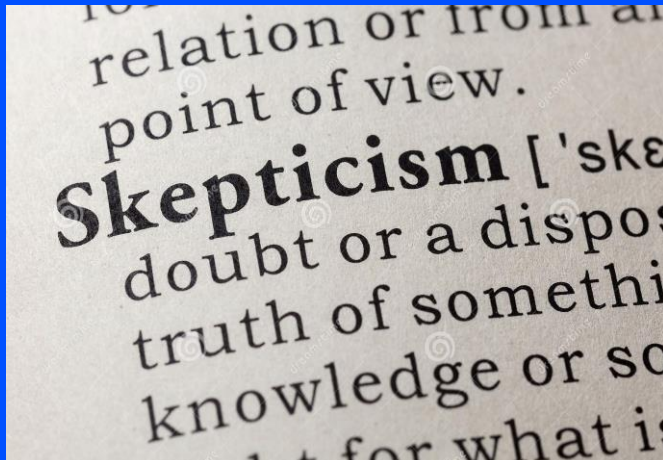
male cyclists

2 hr cycling at 65% $\dot{V}O_{2\max}$

2 per day for 7 days (~210 mg anthocyanins/day)



Chichester-based studies



fat oxidation

22%



New Zealand blackcurrant extract enhances fat oxidation during prolonged cycling in endurance-trained females

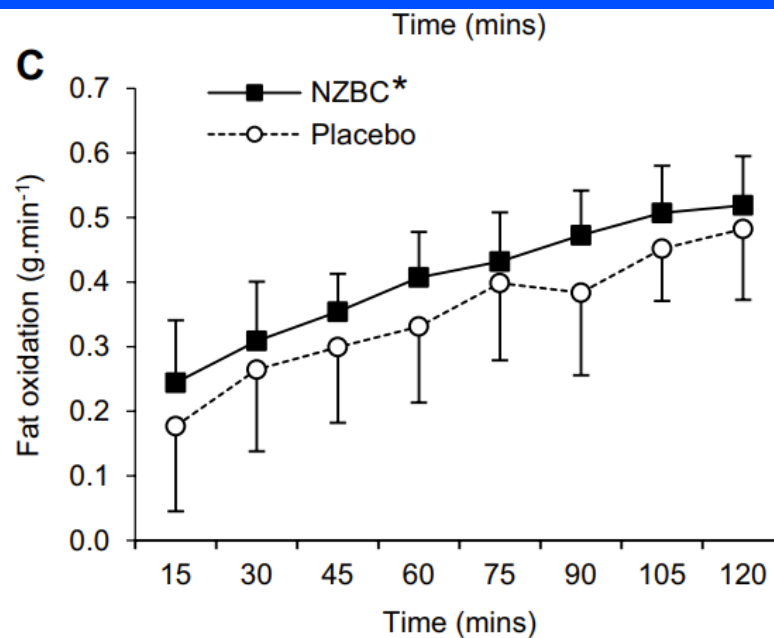
Juliette A. Strauss¹ · Mark E. T. Willems² · Sam O. Shepherd¹



female cyclists

2 hr cycling at 65% $\dot{V}O_{2max}$

2 per day for 7 days (~210 mg anthocyanins/day)

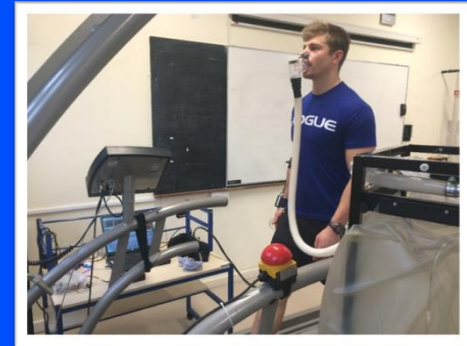


fat oxidation 27%





Do you need to supplement every day to enhance exercise-induced fat oxidation?



16 males, walking at 5-MET
for 30 min





2 per day for 14 days
(~210 mg anthocyanins/day)

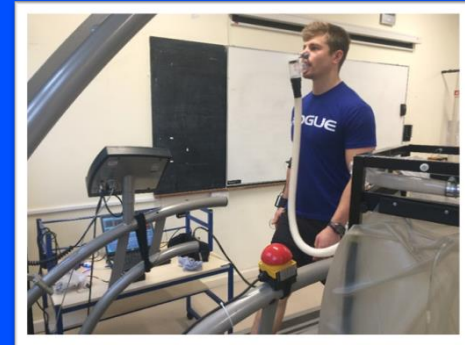
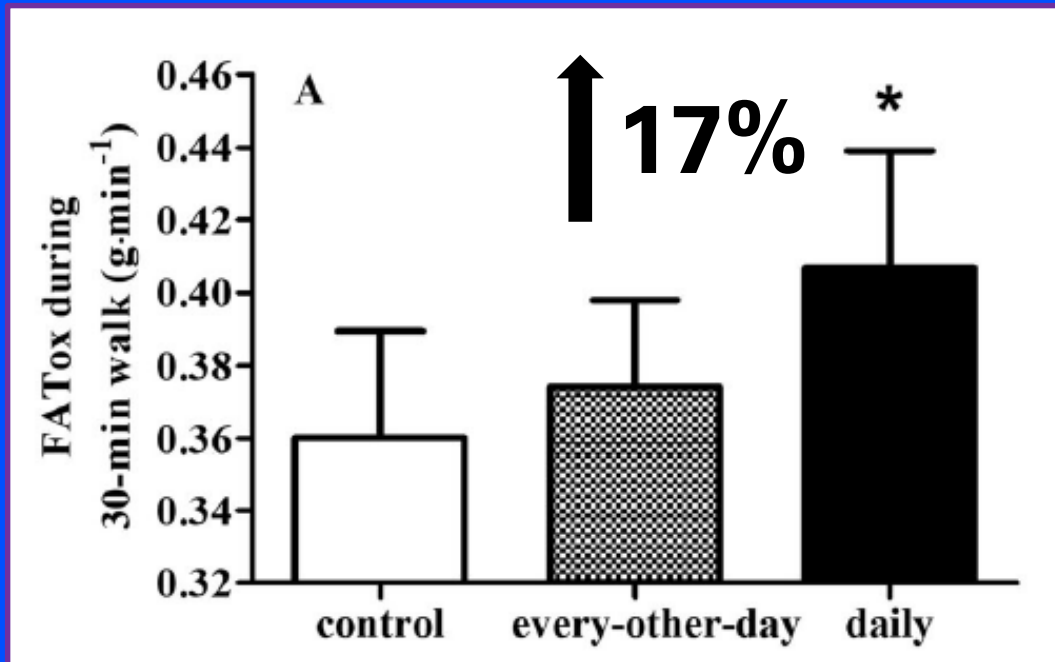
2 every-other-day for 14 days
(~210 mg anthocyanins/day)



Daily and Not Every-Other-Day Intake of Anthocyanin-Rich New Zealand Blackcurrant Extract Alters Substrate Oxidation during Moderate-Intensity Walking in Adult Males

Mehmet Akif Şahin, PhD^{a,b}, Pelin Bilgiç, PhD^b , Stefano Montanari, MSc^a, and Mark Elisabeth Theodorus Willems, PhD^a 

^aInstitute of Sport, University of Chichester, Chichester, UK; ^bDepartment of Nutrition and Dietetics, Hacettepe University, Ankara, Turkey



16 males, walking at 5-MET
for 30 min



2 per day for 14 days
(~210 mg anthocyanins/day)

2 every-other-day for 14 days
(~210 mg anthocyanins/day)





peer-reviewed < 2013



blackcurrant [ti] exercise



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[> Am J Physiol Regul Integr Comp Physiol. 2009 Jul;297\(1\):R70-81.](#)

doi: 10.1152/ajpregu.90740.2008. Epub 2009 Apr 29.

FULL TEXT LINKS



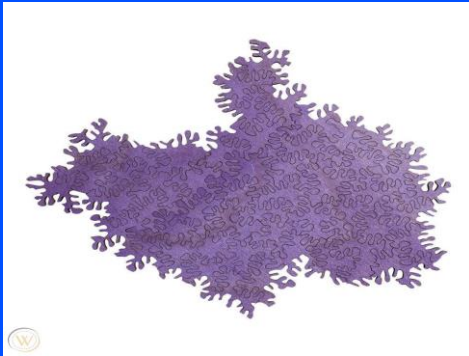
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Short-term blackcurrant extract consumption modulates exercise-induced oxidative stress and lipopolysaccharide-stimulated inflammatory responses

peer-reviewed - present



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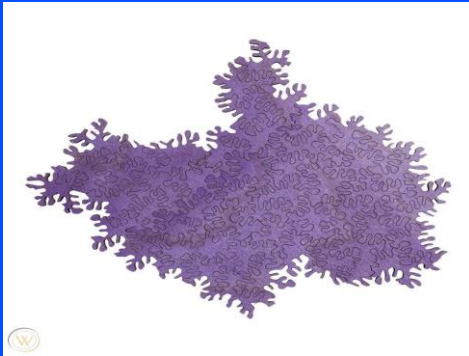
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44 sources


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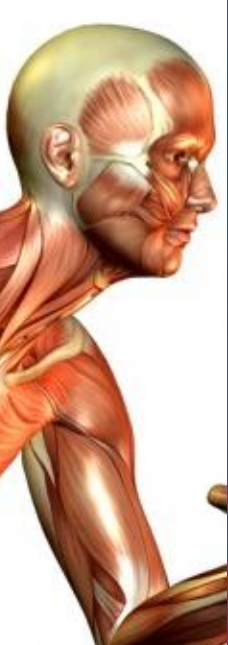
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33 sources





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RESULTS BY YEAR

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The health benefits of anthocyanins: an umbrella review of systematic reviews and meta-analyses of observational studies and controlled clinical trials

Berner-Andrée Sandoval-Ramírez, Úrsula Catalán , Elisabet Llauradó , Rosa-María Valls, Patricia Salamanca, Laura Rubió, Silvia Yuste, and Rosa Solà

Nutrition Reviews 80(6):1515–1530, 2022

the diabetes epidemic

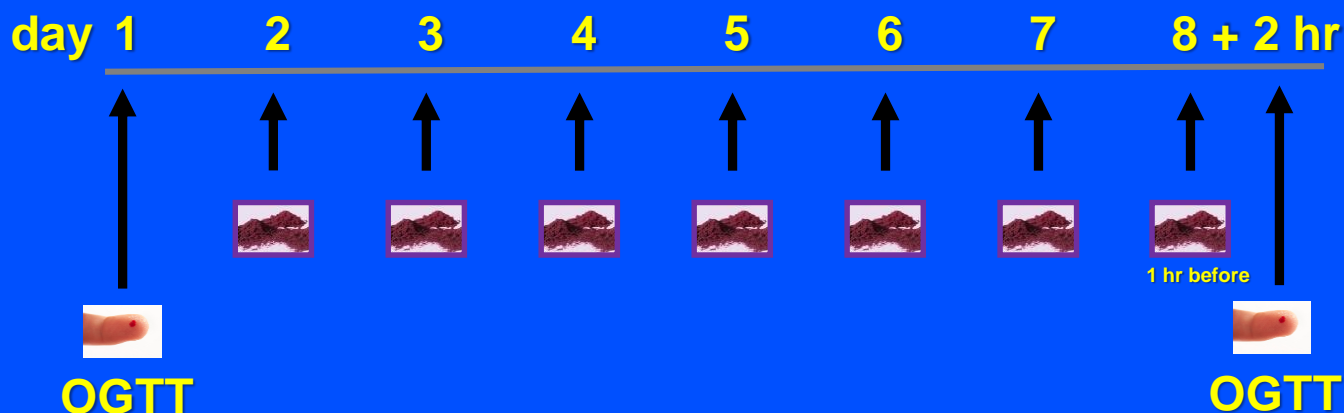


reduced insulin sensitivity



Beneficial effects on fasting insulin and postprandial responses through 7-day intake of New Zealand blackcurrant powder

Mark Elisabeth Theodorus Willems¹, Jose Dos Santos Silva¹, Matthew David Cook^{1,2}, and Sam David Blacker¹

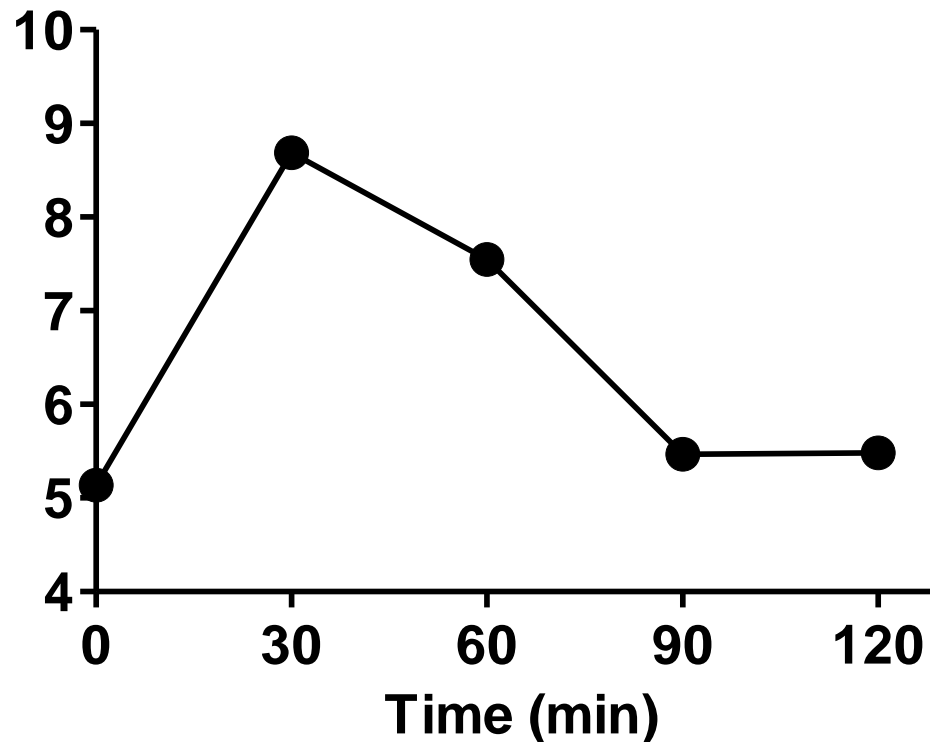


- 17 participants (9 females, 20-53 years)
- 7-days of 6 gram New Zealand blackcurrant powder (6 gram: 138.6 mg anthocyanins, 49 mg vitamin C and 5.2 g of carbohydrates)
- 2 hr OGTT (75 gram glucose) after overnight fast
- glucose-insulin analysis at 0, 30, 60, 90 and 120 min samples

Oral Glucose Tolerance Test

75 gram glucose dissolved in water

Postprandial blood glucose ($\text{mmol} \cdot \text{L}^{-1}$)



- area under the curve



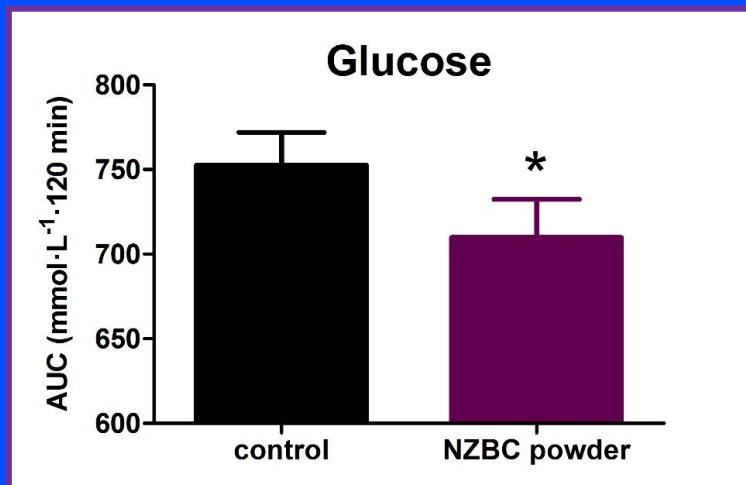
glucose
insulin



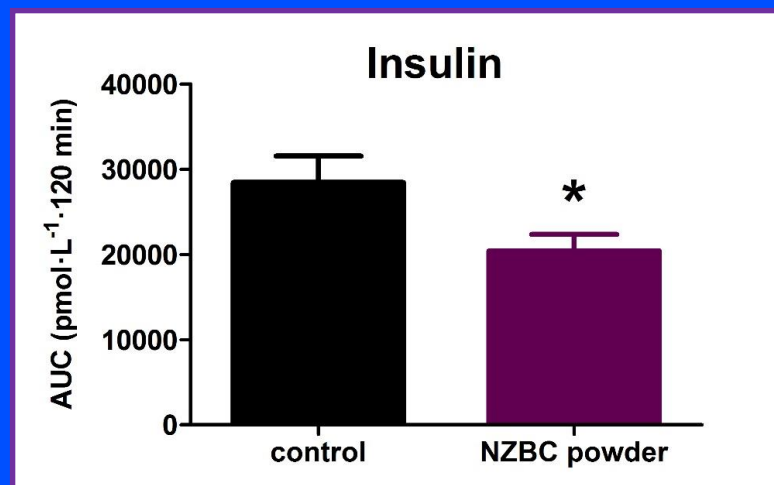
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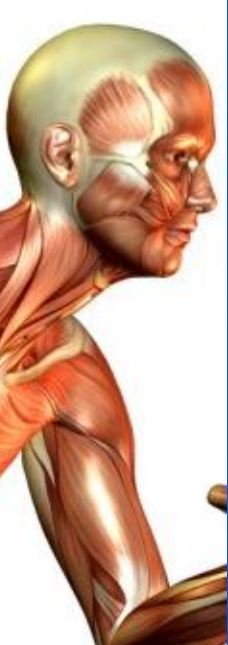
Increased insulin sensitivity



area under the curve ↓ 5.7% (P<0.05)



area under the curve ↓ 31.1% (P<0.05)



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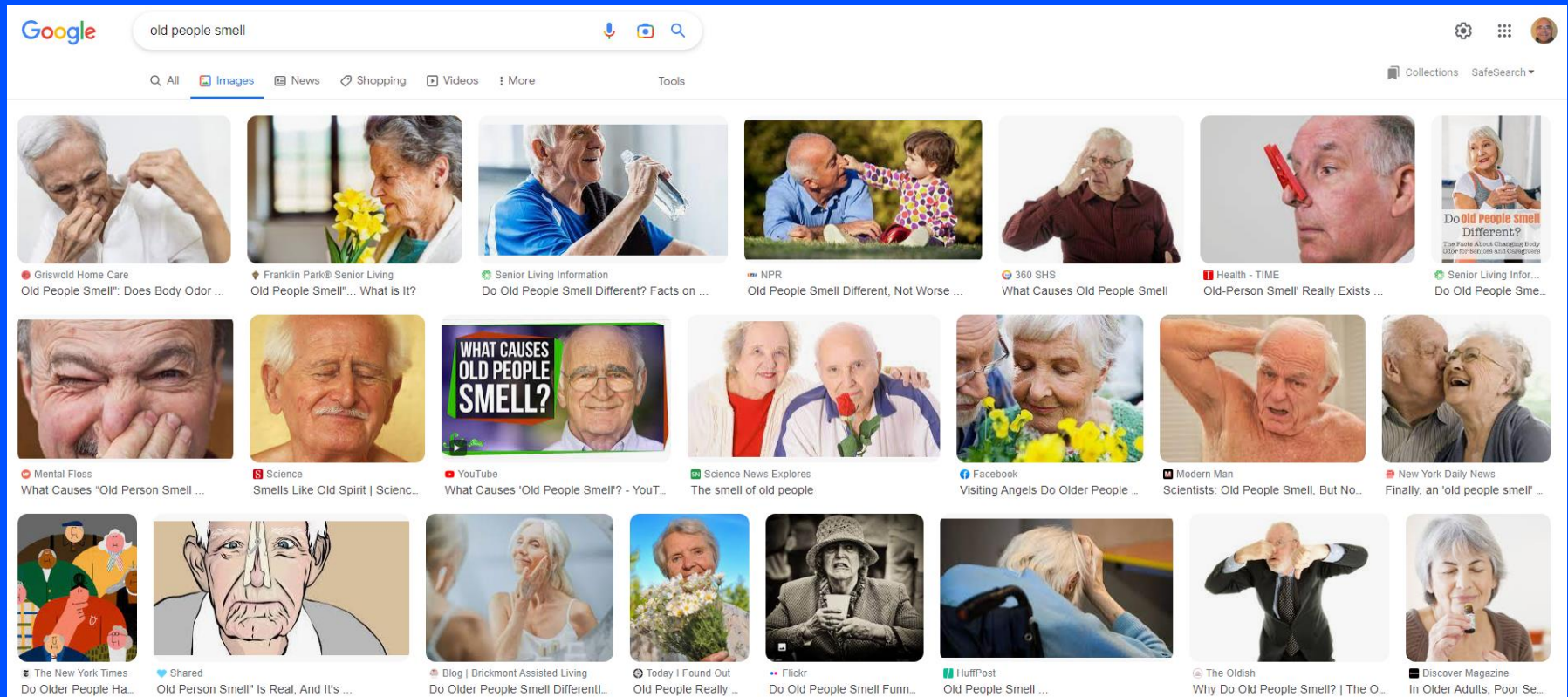
Body odor: Old people smell?

Google

old people smell

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Collections SafeSearch



Grid of search results for "old people smell":

- 1. Griswold Home Care: Old People Smell: Does Body Odor ...
- 2. Franklin Park® Senior Living: Old People Smell"... What is It?
- 3. Senior Living Information: Do Old People Smell Different? Facts on ...
- 4. NPR: Old People Smell Different, Not Worse ...
- 5. 360 SHS: What Causes Old People Smell
- 6. Health - TIME: Old-Person Smell' Really Exists ...
- 7. Senior Living Infor...: Do Old People Sme...
- 8. Mental Floss: What Causes "Old Person Smell" ...
- 9. Science: Smells Like Old Spirit | Scienc...
- 10. YouTube: What Causes 'Old People Smell'? - YouT...
- 11. Science News Explores: The smell of old people
- 12. Facebook: Visiting Angels Do Older People ...
- 13. Modern Man: Scientists: Old People Smell, But No...
- 14. New York Daily News: Finally, an 'old people smell' ...
- 15. The New York Times: Do Older People Ha...
- 16. Shared: Old Person Smell" Is Real, And It's ...
- 17. Blog | Brickmont Assisted Living: Do Older People Smell Different...
- 18. Today I Found Out: Old People Really ...
- 19. Flickr: Do Old People Smell Funn...
- 20. HuffPost: Old People Smell ...
- 21. The Oldish: Why Do Old People Smell? | The O...
- 22. Discover Magazine: In Older Adults, Poor Se...



Contents lists available at ScienceDirect

Journal of Chromatography B

journal homepage: www.elsevier.com/locate/chromb



Measurement of 2-nonenal and diacetyl emanating from human skin surface employing passive flux sampler–GCMS system

Keita Kimura^a, Yoshika Sekine^{a,*}, Shota Furukawa^a, Minami Takahashi^a, Daisuke Oikawa^b

^a Graduate School of Science, Tokai University, 4-1-1 Kitakaname, Hiratsuka, Kanagawa 259-1292, Japan

^b AIREX Inc., 2-17-6 Myojincho, Hachioji, Tokyo 192-0046, Japan

2016

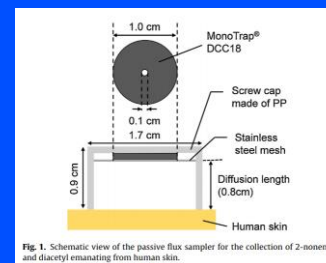
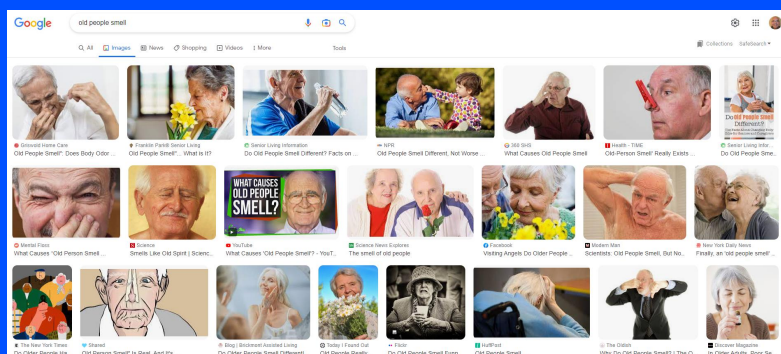
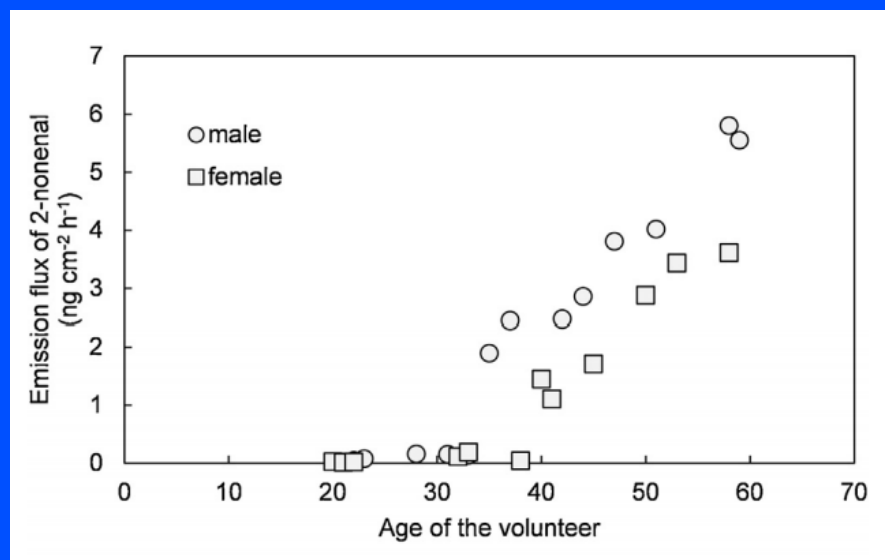


Fig. 1. Schematic view of the passive flux sampler for the collection of 2-nonenal and diacetyl emanating from human skin.



Fig. 2. Sampling of 2-nonenal and diacetyl at the nape of the neck. The PFS was fixed to a piece of medical tape.



That "old person smell" is actually caused by a chemical, called 2-nonenal, that old people secrete through their skin.

überfacts





Contents lists available at ScienceDirect

Journal of Chromatography B

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Measurement of 2-nonenal and diacetyl emanating from human skin surface employing passive flux sampler—GCMS system

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^a Graduate School of Science, Tokai University, 4-1-1 Kitakaname, Hiratsuka, Kanagawa 259-1292, Japan

^b AIREX Inc., 2-17-6 Myojincho, Hachioji, Tokyo 192-0046, Japan

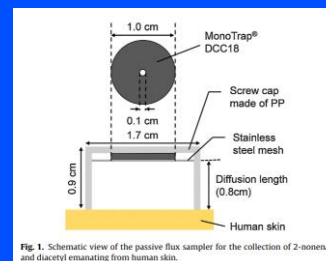


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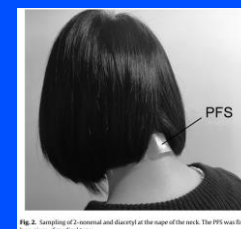
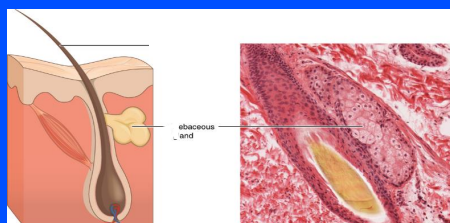


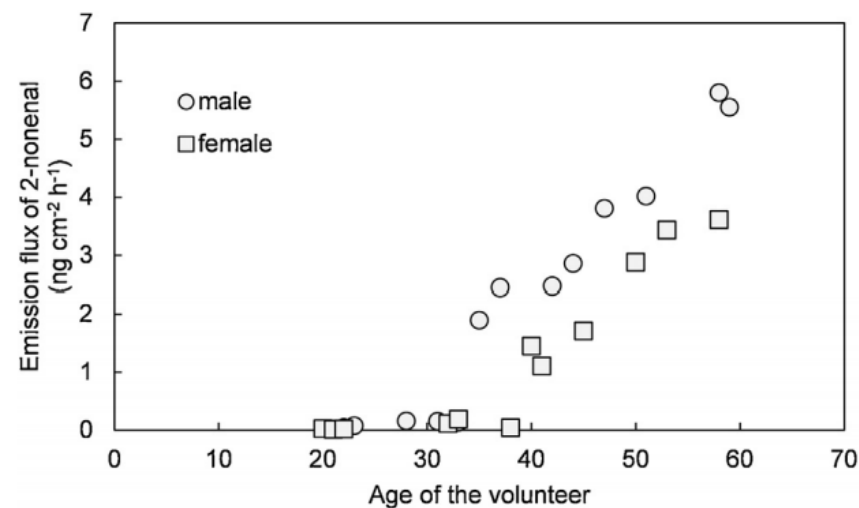
Fig. 2. Sampling of 2-nonenal and diacetyl at the nape of the neck. The PFS was fixed to a piece of medical tape.

2016

2-nonenal is a lipid peroxidation product and the consequence of a decrease in antioxidant defense



sebaceous gland

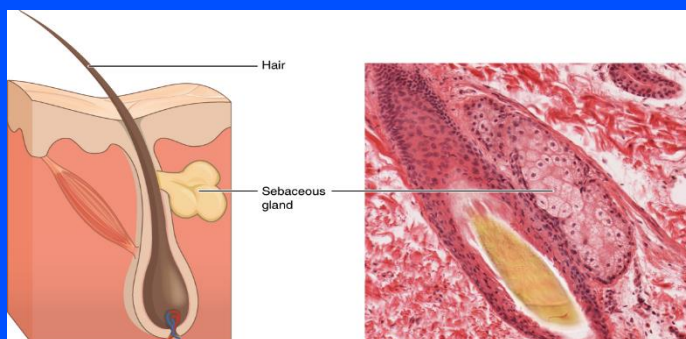


TOKAI UNIVERSITY



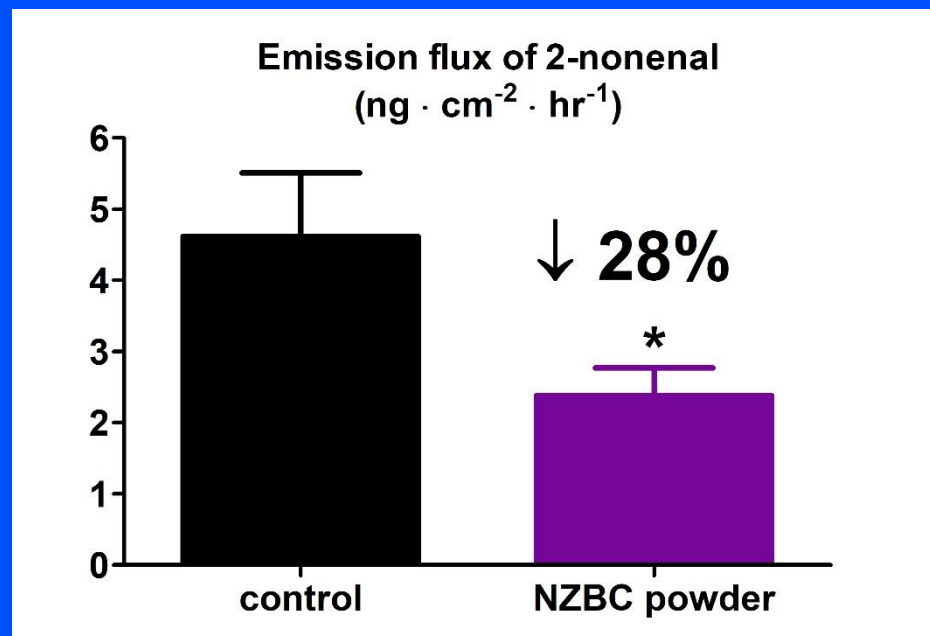
- 6 gram NZBC powder per day for 7 days
- 48 no washing of nape of the neck
- 1 hr skin gas collection
- gas chromatography–mass spectrometry

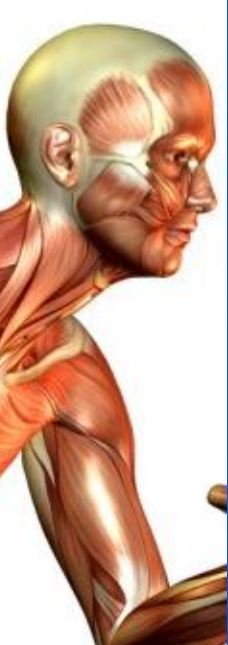
J Diet Suppl. 19(5):603-620, 2022.



sebaceous gland

2-nonenal is a lipid peroxidation product



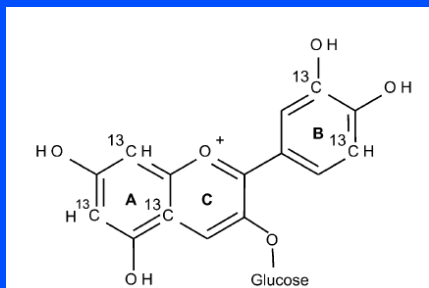


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Cyanidin-3-glucoside



one dose



BJP British Journal of
Pharmacology

RESEARCH PAPER

The pharmacokinetics of anthocyanins and their metabolites in humans

R M de Ferrars^{1*}, C Czank^{1*†}, Q Zhang², N P Botting^{2‡}, P A Kroon³,
A Cassidy¹ and C D Kay¹

2014

Parent anthocyanins

Cyanidin-3-glucoside

Degradants

Protocatechuic acid (PCA)

Phloroglucinaldehyde

Protocatechuic acid derived

Benzoic acid-4-glucuronide

Methyl-3,4-dihydroxybenzoate

PCA-3-glucuronide

PCA-4-glucuronide

PCA-sulfates^c

Vanillic acid (VA)

IsoVA

VA-4-glucuronide

IsoVA-3-glucuronide

VA-sulfates^c

4-Hydroxybenzaldehyde

Ferulic acid

Hippuric acid

Phloroglucinaldehyde derived

Ferulic acid^d

**16 metabolites
in blood**

Delphinidin-3-glucoside
Delphinidin-3-rutinoside
Cyanidin-3-rutinoside
Cyanidin-3-glucoside



**New Zealand
blackcurrant
extract**



**chronic
dosing**



gut microbiota?

responders / non-responders?

Parent anthocyanins
Cyanidin-3-glucoside
Degradants
Phloroglucinaldehyde
catechuic acid derived
Benzoic acid-4-glucuronide
Methyl-3,4-dihydroxybenzoic acid
PCA-3-glucuronide
PCA-4-glucuronide
PCA-sulfates ^c
Vanillic acid
IsoVA
VA-4-glucuronide
IsoVA-3-glucuronide
VA-sulfates ^c
4-Hydroxybenzoic acid
Ferulic acid
Hippuric acid
Phloroglucinaldehyde derived
Ferulic acid ^d



**cell/tissue
function?**

Future directions



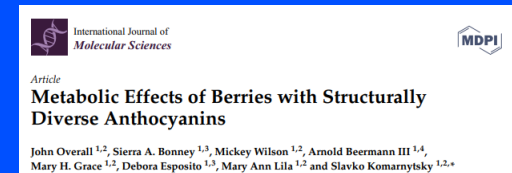
still quite a journey!



- **The anthocyanin composition:
Does it matter in humans?**



exercise



C57BL/6 mouse model of polygenic obesity

- **Optimal anthocyanin dosing strategies in
different cohorts: Dose and intake duration**
- **Synergistic effects of anthocyanin and
other supplements**

In the future!

A competition of berries?





The future is still bright!



<https://www.databridgemarketresearch.com/report/global-anthocyanins-market> (16/01/2023)

Global anthocyanin market: Growth at a rate of 4.35% in the forecast period of 2021 to 2028

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Take home message

Intake of anthocyanin-rich New Zealand blackcurrant has enriched the world of sport and exercise nutrition and shown the potential for anthocyanin supplementation



Out last year

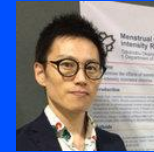


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Thank you

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