



Can an apple a day keep the Doctor away?

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Outline

- Introduction to flavanols
 - What are flavanols?
 - What do flavanols do?
- Flavanols
 - In the diet
 - In apples and apple juice
- My work
 - Current project
 - Future studies

What are flavanols?

- Flavanols are a sub-group of polyphenols
- Can be further sub-divided into epicatechin and catechin
- They occur naturally in plants
- Can be sourced through the diet



Benefits and effects of flavanols

Flavanols have been described to have the following beneficial effects on the cardiovascular system:

- Increased bioavailability of nitric oxide (vasodilator)
- Anti-inflammatory effects
- Reduced blood pressure
- Increased number of blood vessel-forming cells
- Antioxidant effects

Sources of flavanols in the diet

Foods which contain the most amount of flavanols include:

- Red wine
- Cocoa
- Tea (including green tea)
- Fruits such as apples, grapes, berries and cherries

The amount of flavanols present in usual portion sizes of the standard foods/drinks is small

Flavanol-rich foods on the market

Many products are currently being marketed as containing high levels of **polyphenols** and **flavanols** such as:



Nescafe Green
Blend Coffee



Welch's Purple Grape Juice



Dark chocolate



Red Wine



Tetley
RedBush Tea

Traditional high-flavanol foods and drinks have negative factors if consumed in large quantities:

- Processed cocoa/chocolate – Fat and sugars
- Red wine – Alcohol

There is the need for high-flavanol foods/drinks which can be considered 'healthy'

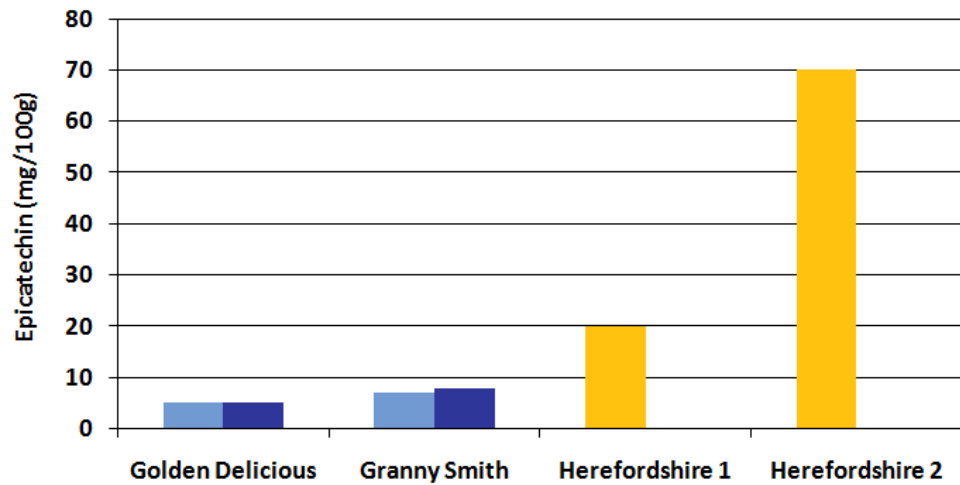
- Development of fruit juices/drinks



Flavanol-rich apple juice

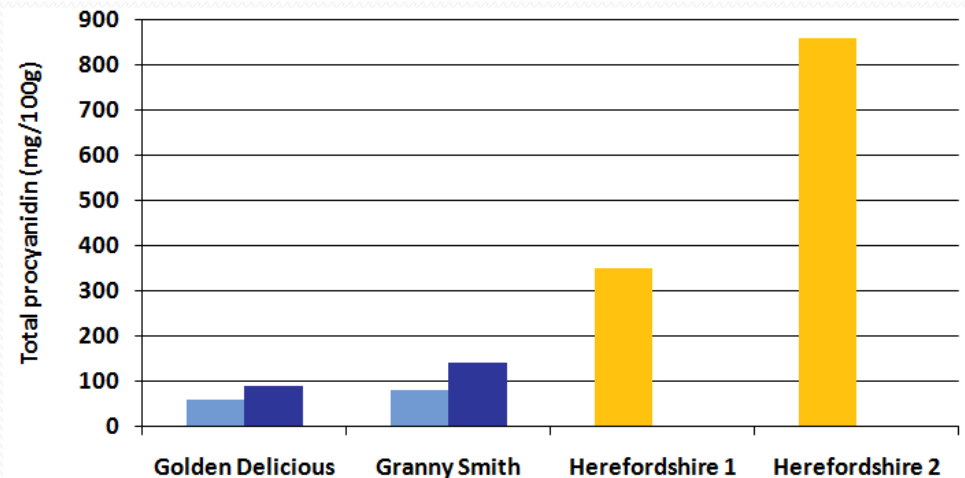
- Made using a specific variety of British apple from Herefordshire which has a naturally-high epicatechin content
- Use a water-based extraction procedure permitting separation from the apple sugars
- Produces a 'health drink' which is low in sugars and fat but high in epicatechin

Comparison of flavanol content in different apple varieties



Variation of epicatechin levels in different types of apples

Variation of total procyanidin levels in different types of apples



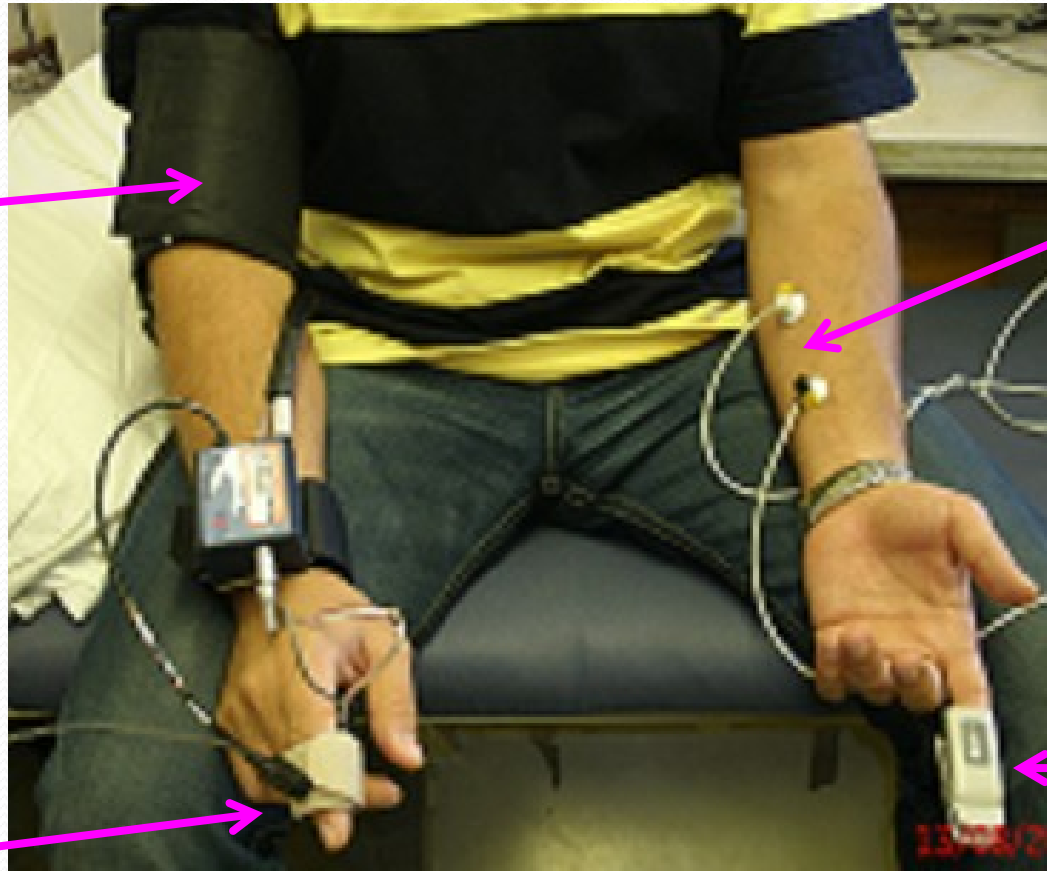
My current project

- Acute haemodynamic effects of an epicatechin-rich apple juice on healthy male volunteers, aged either 18-25 years or 50-70 years
- Compare these effects with two well-known vasoactive substances, salbutamol and glyceryl trinitrate (GTN)
- Use non-invasive measurements
 - Finometry, Pulse Wave Analysis and laser Doppler flowmetry
- Duration: Feb-Oct 2010 (9 months)

Non-invasive equipment

Finometer -
Blood pressure
cuff for initial
calibration

Finometer -
Finger cuff for
continuous
monitoring



Laser Doppler
- Two probes
are attached to
the surface of
the skin

**Pulse wave
analysis
finger probe**



The Finometer

Measures: Blood pressure, heart rate, cardiac output, stroke volume and other derived variables

Pulse Wave Analysis

Measures: Indices of arterial stiffness and endothelial function



Evening before

Avoid flavanol-rich and caffeine-rich foods and drinks and strenuous exercise
Evening meal carbohydrate-based

Morning before

Fasting period

STUDY 1

STUDY 2

Baseline measurements of Pulse
Contour, Finometer and Laser Doppler
for 15 min

Consumption of apple juice

Measurements of Pulse Contour,
Finometer and Laser Doppler every 2
min for 2 hours

Baseline measurements of Pulse
Contour, Finometer and Laser Doppler
for 15 min

Salbutamol inhalation

Measurements of Pulse Contour,
Finometer and Laser Doppler every 2
min for 30 min

Sublingual glyceryl trinitrate

Measurements of Pulse Contour,
Finometer and Laser Doppler every 2
min for 30 min

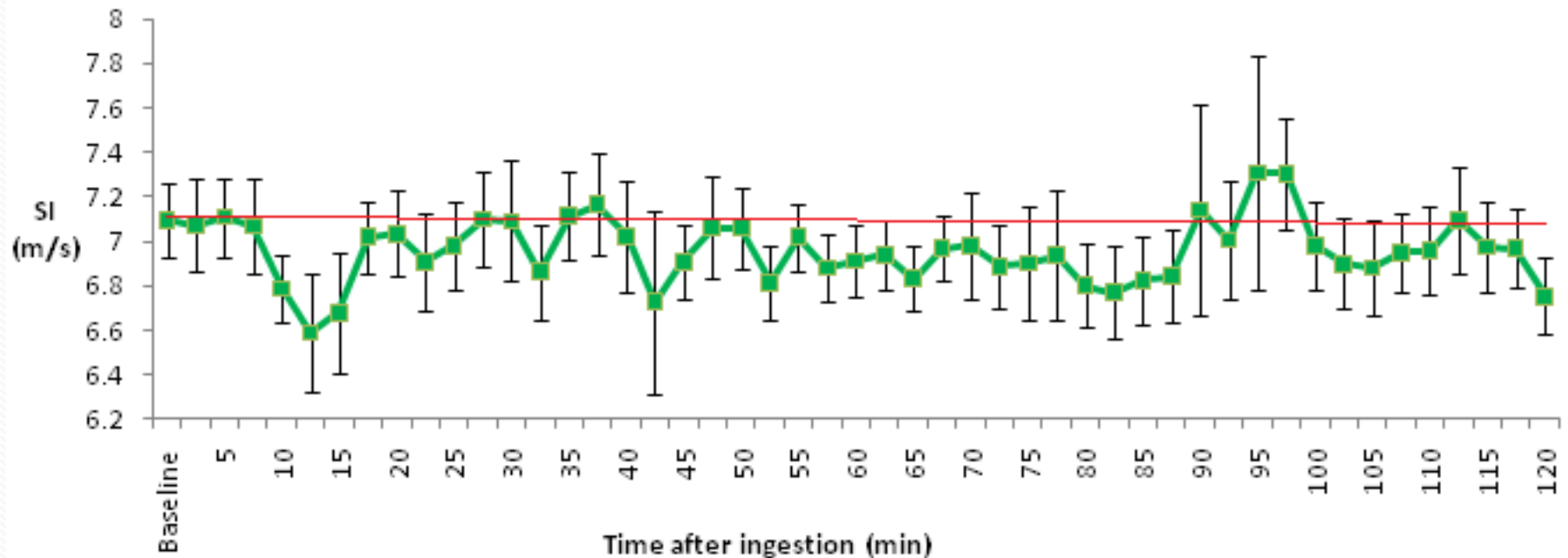
Study period 2.5 h
approx

Study period 2 h
approx

Results so far

Only data from the younger group of volunteers has been analysed so far.

Stiffness index (which measures stiffness of the arteries) is reduced for the majority of the two hour study period after consumption of the apple juice (data shown for n=14).



Future studies

- Comparing different doses of epicatechin in the juice to a negative control drink (without any epicatechin)
e.g. 1/2/3 mg/kg bodyweight
- Observing potential differences in types of flavanols within the apple juice
e.g. Comparing monomers and oligomers
- Studies can then be extended to a more 'at risk' population sample

So... Does an apple a day keep the Doctor away?

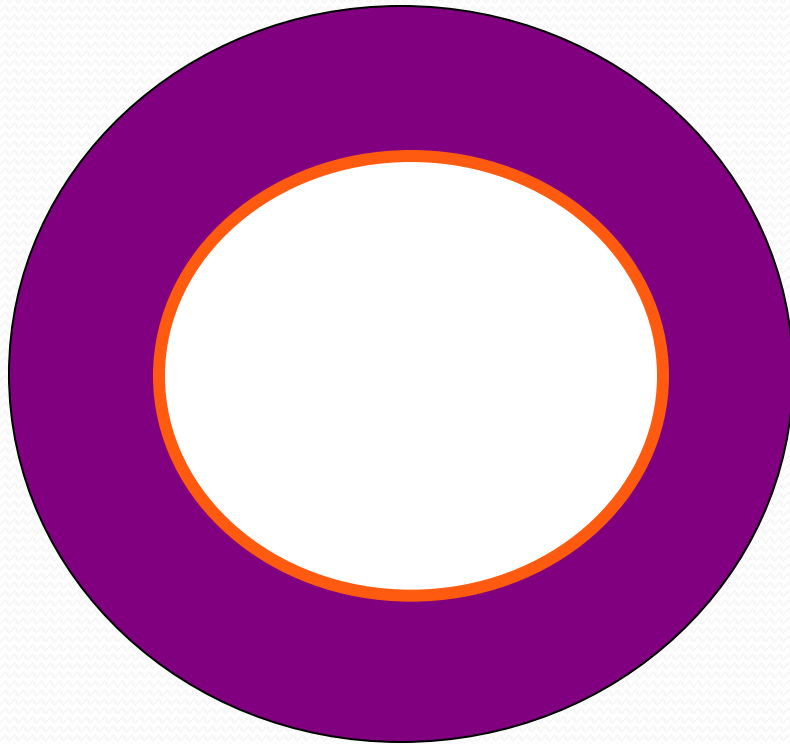
- Flavanols have been shown to exert beneficial effects on cardiovascular health
- An apple juice (made from apples with a higher natural epicatechin content) is a good method of consuming flavanols without unnecessary fats/alcohol
- A glass of such juice may prove to be a valuable in helping to maintain good cardiovascular health

Flavanols and Endothelial Function

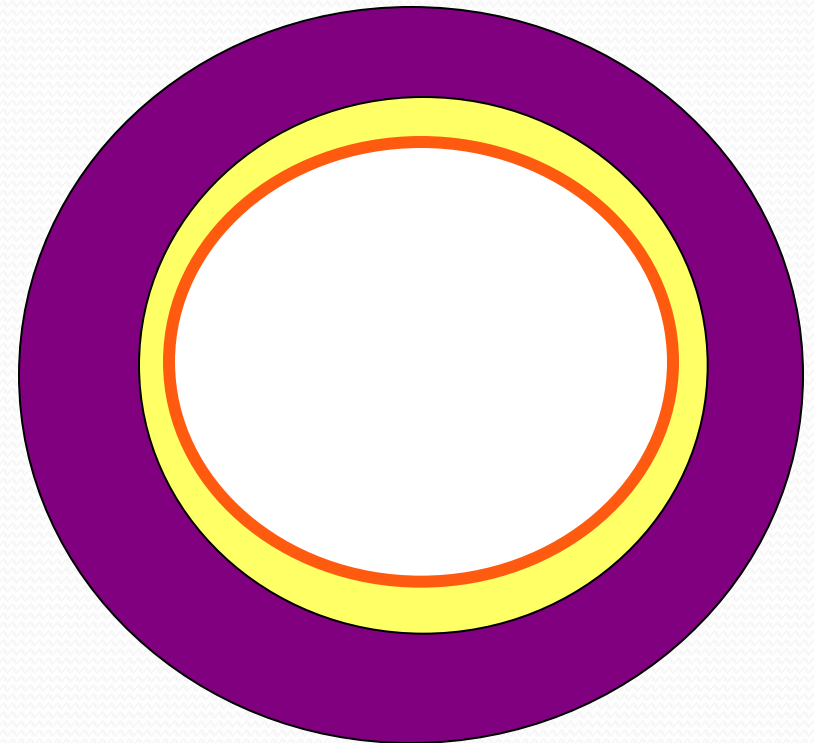
- The lining of the blood vessel is called the endothelium
 - helps to maintain vascular tone
- Nitric oxide is a vasodilator found in the endothelium
- Flavanols have been shown to increase the bioavailability of nitric oxide by:
 - Reducing quantity which reacts with free radicals
 - Increasing local amounts of its precursor compound
- This increases the compliance of the blood vessel and thus improves endothelial function
- Endothelial dysfunction is present in many cardiovascular disease states

Flavanols and Endothelial Function

Normal
artery



Effect of endothelial nitric oxide –
the **compliance** of the vessel is
increased (yellow ring)



 Smooth muscle

 Endothelium