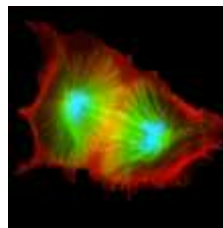




# Berries and Human Health: An Update



**Gordon J. McDougall & Andreas Kolb**



The James  
**Hutton**  
Institute

Soft Fruit Information Day, SSCR Winter Meeting, 16th February 2017

# Wonder berries?



## Fruit juice that can help put off old age

**By Mark Reynolds**

**DRINKING** dark fruit juices could help us enjoy longer, healthier lives, according to new research.

Fitness-conscious Scots are being advised to swap their glasses of red wine for purple grape juice.

Scientists at the University of Glasgow tested a series of juices to measure their levels of antioxidants – natural plant compounds which counter the impact of disease and ageing.

They found that dark fruit juices are the best source of the health-inducing compounds.

A regular intake of such juices boosts the immune system and helps ward off diseases like cancer.

The juice of Concord grapes, a variety native to North America, had the highest content of polyphenols – a particularly potent antioxidant group.

The new study, published in the Journal of Agriculture and Food Chemistry, found that the darker juices tend to contain the higher levels of polyphenols.

Cloudy apple juice and cranberry juice also tested well.

Researchers further discovered that it may not be just the number, but also the variety of antioxidants in a juice that determine its potential benefits.

Antioxidants combat free radicals – “bad” chemicals in the bloodstream.

Professor Alan Crozier, who led the study, said: “Previous research has shown that the antioxidant action of polyphenols contained in drinks like red wine and tea may help to protect against chronic diseases by mopping up free radicals, which can cause damage to cells.

“Yet the research highlights that not all drinks are created equal when it comes to polyphenols.

“It’s therefore important to consider the individual type of the compounds that you are consuming, because each has different benefits.”

US scientists found that mice engineered to produce high levels of an antioxidant enzyme lived 30 per cent longer and had fewer heart conditions and other age-related diseases. If the same is true in humans, people could live for more than 100 years.

Leading nutritionist Nigel Denby said people should get a broad spectrum of antioxidants in their diet.

He added: “Concord purple grape juice is a rich source of a variety of polyphenols whereas other juices are high only in specific polyphenols.”

**‘The research has highlighted the fact that not all drinks are created equal’**



*Anti-Ageing, Blood-pressure-dropping, cancer-stopping, diet-replacing, mood-enhancing, virus-kicking, performance-restoring...berries!!!!*

# Nature's superfoods?



# Berry Research at the Hutton

*We breed market-leading varieties*

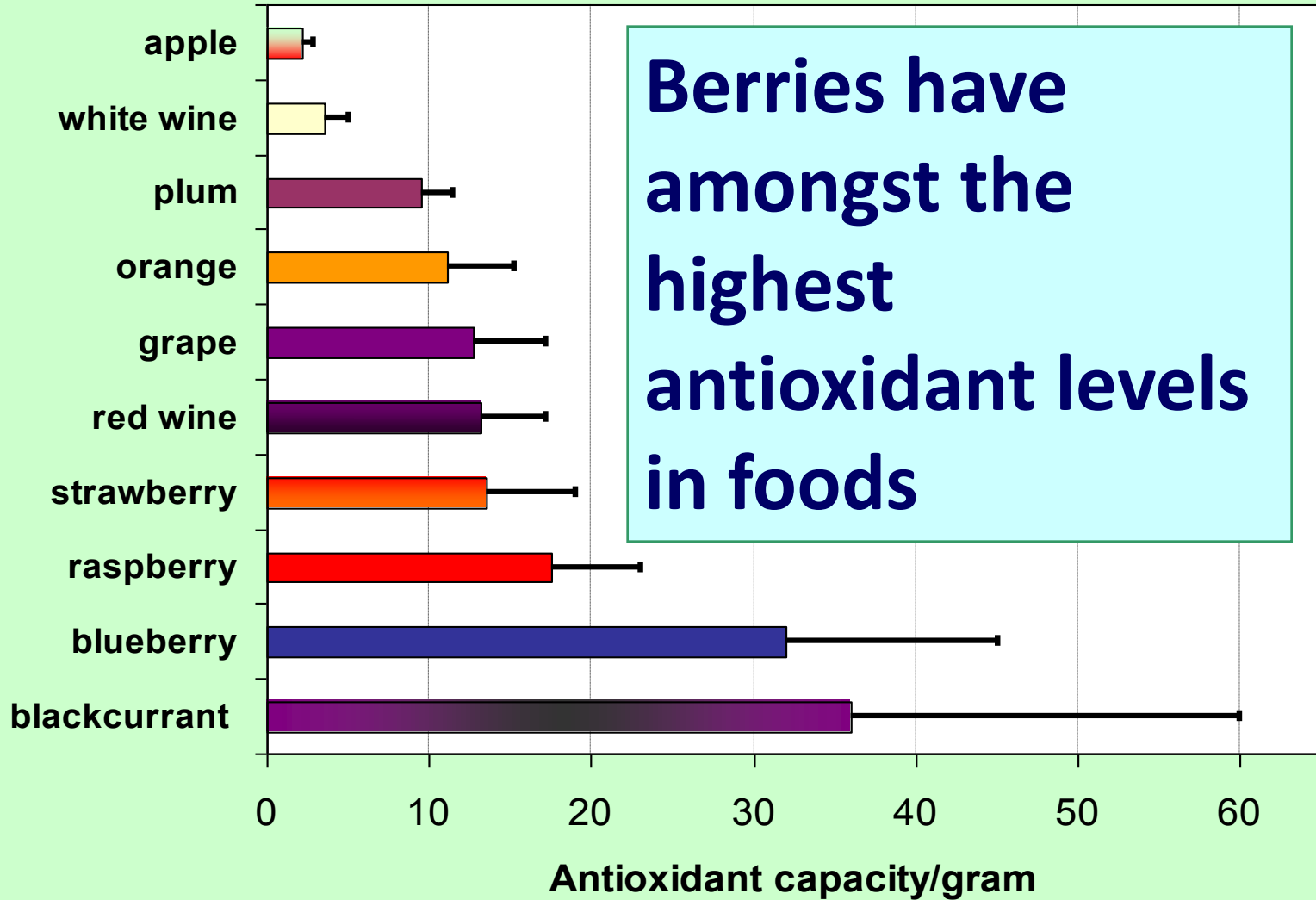
- *Blackcurrants – the “Ben” series*
  - *Raspberries – the “Glen” series*
  - *Blackberries – the “Loch” series*
  - *Strawberries – “Symphony, Rhapsody”*
  - *New blueberry varieties for UK conditions*
- Good flavour, high quality, high performance
  - Higher levels of bioactive components for health



# What's healthy about Berries?



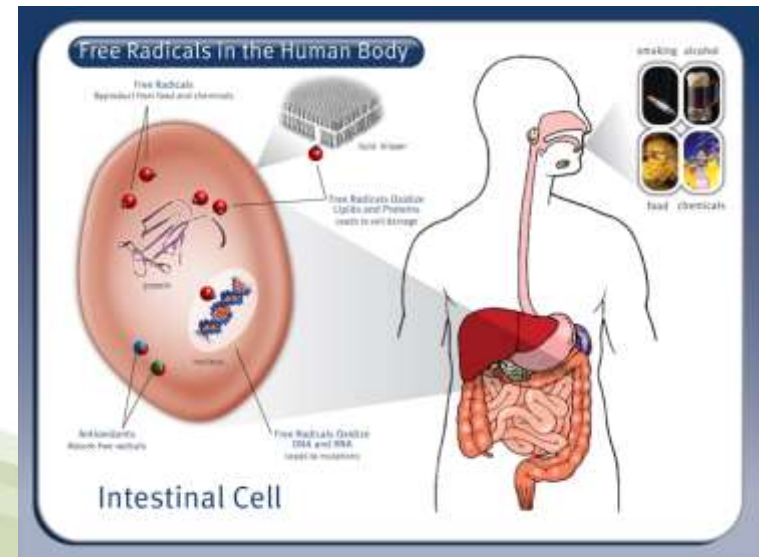
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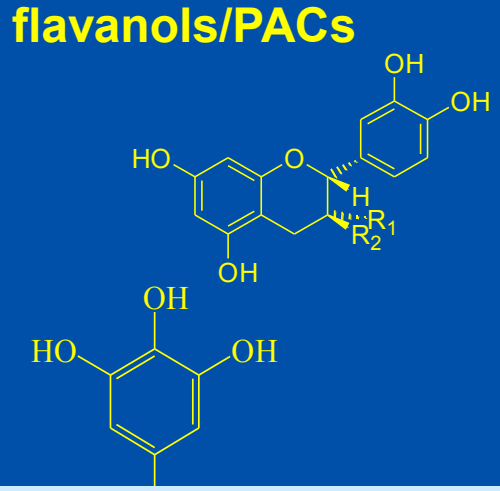
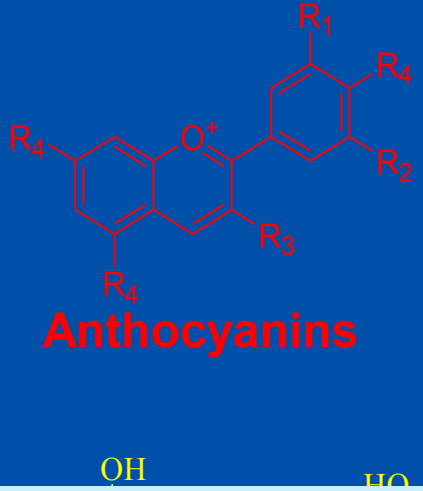
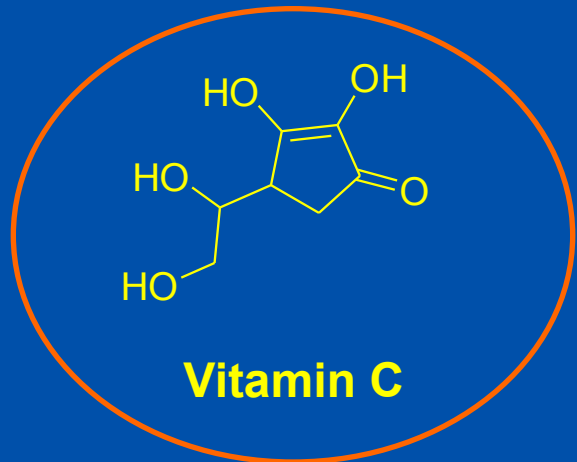


# Oxygen, antioxidants & free radicals

- We “burn” our food with Oxygen to release energy
- By-products include free radicals which are **VERY** reactive. They can damage the body and cause disease.
- Our bodies work hard to remove these radicals and prevent damage
- **Dietary antioxidants** are proposed to “top-up” protection

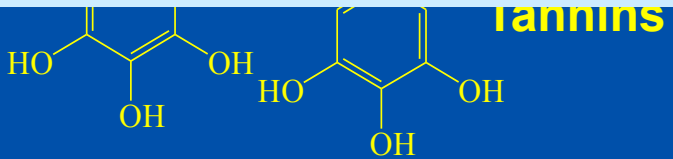


Berries contain very high levels of **antioxidants** – the two main types are Polyphenols and **Vitamin C**



**Antioxidant theory has lost favour**  
Polyphenols are good antioxidants in the test-tube and can have simple antioxidant properties in food and drinks  
They achieve their benefits through many potential mechanisms

- **Promoting cellular antioxidant responses**
- **Mimicking the action of drugs**



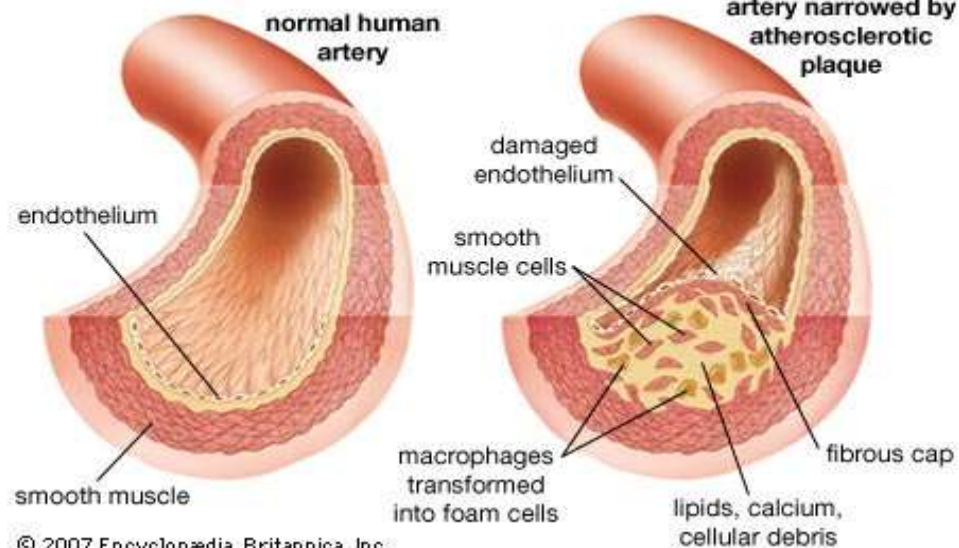
# Free radicals are implicated in cardiovascular disease



## Oxidative stress



## Atherosclerosis



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Oxidative stress



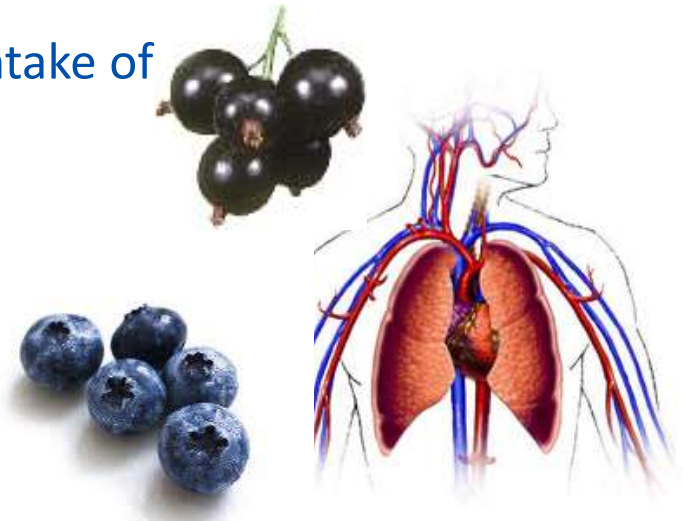
Stroke, Atherosclerosis,  
High Blood Pressure, Heart  
attack

- Free radicals can cause protein damage and lipid peroxidation - leads to loss of membrane integrity, cell damage and cell death

# Cardiovascular function and intake of soft fruit: Effects of qualitative and quantitative variation in berry antioxidant status

**Human Intervention trial** – effect of six week intake of

- blackcurrant berries with low vitamin C content
- blackcurrant berries with high vitamin C content
- blueberries (No vitamin C)
- coloured flavoured water (control)



## Effects on cardiovascular function

Positive effects on blood vessel flexibility and markers for endothelial cell function and oxidative stress

**OUTCOMES:** Better vessel flexibility and reduced oxidative stress





# Free radicals and Alzheimer's?

## Oxidative stress, Alzheimer's and the Brain

Brain = 2 % adult body mass but uses 20 % oxygen inhaled

Poor antioxidant mechanisms

Brain cells don't renew by cell division - accumulate FR-induced damage with age & free radical damage implicated in Alzheimer's

■ *EU project*

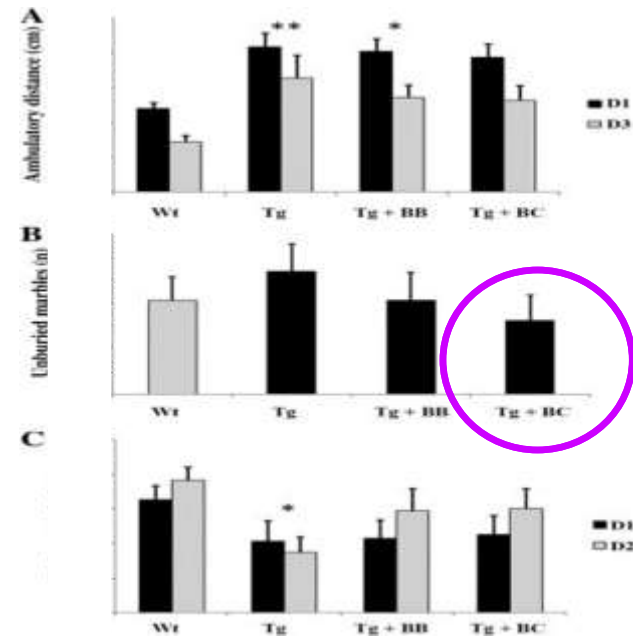
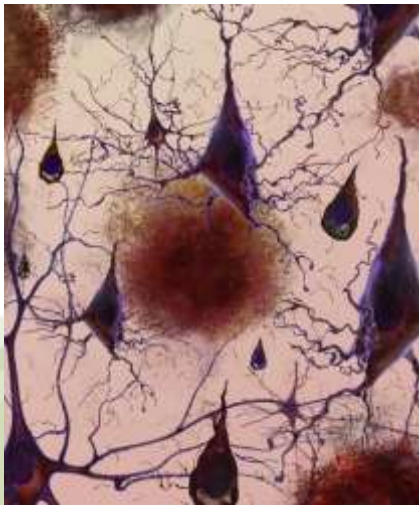


**BrainHealthFood**

■ *Bioactive compounds from blackcurrant processing waste for brain health*

Involving Pan - European Universities and small businesses

# Intake of blackcurrants improves outcomes in mouse models of Alzheimer's disease

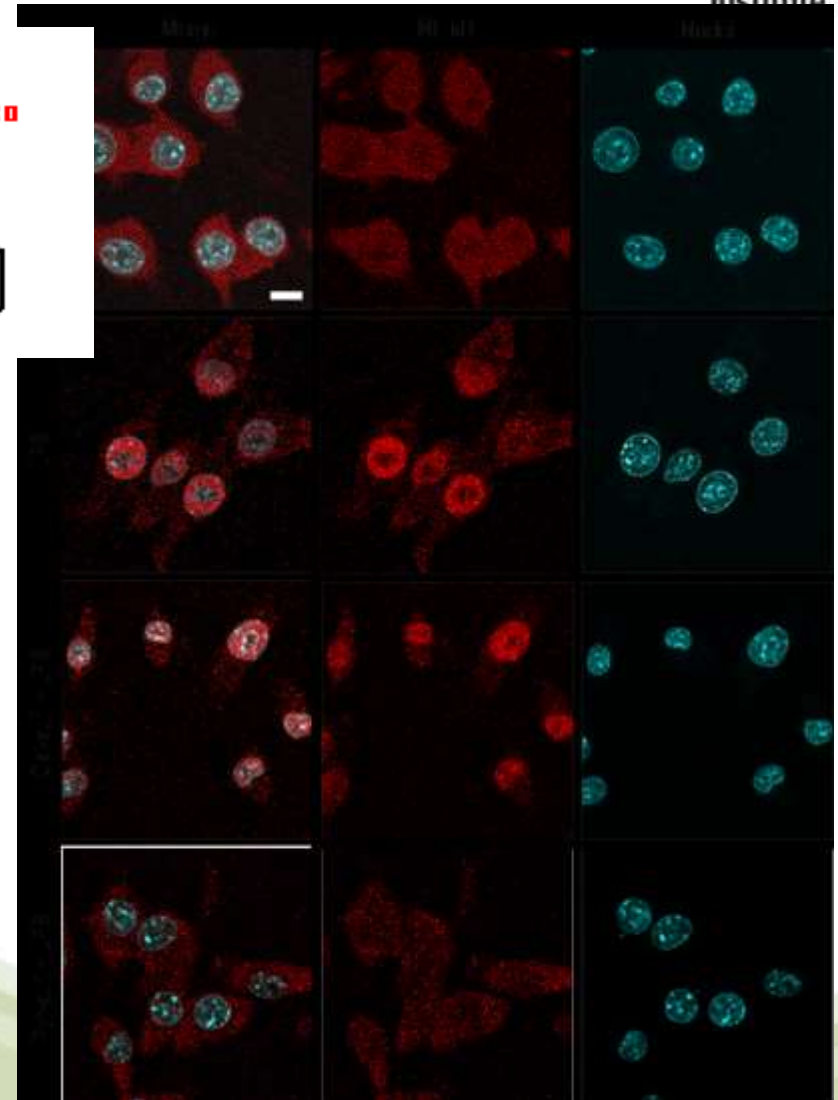
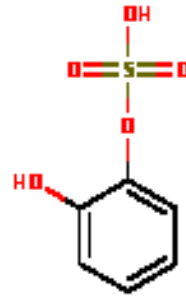


Berries improve cognitive function through improving inherent neuroprotective systems

Work to examine neuroprotective effects of raspberries has recently been funded with University of Ulster

# Polyphenol metabolites cross blood-brain barrier and influence neuro-inflammation

- Polyphenol metabolites detected in blood after juice intake (Pir et al, MNFR 2014)
- Found to be able to pass across blood-brain-barrier models
- Cause neuroprotective effects in brain cells via reduction of inflammatory agents



# Polyphenol benefits occur in gut?



**Studies suggest low bioavailability!**

**Majority of polyphenols remain in gut**

Are these components inactive?



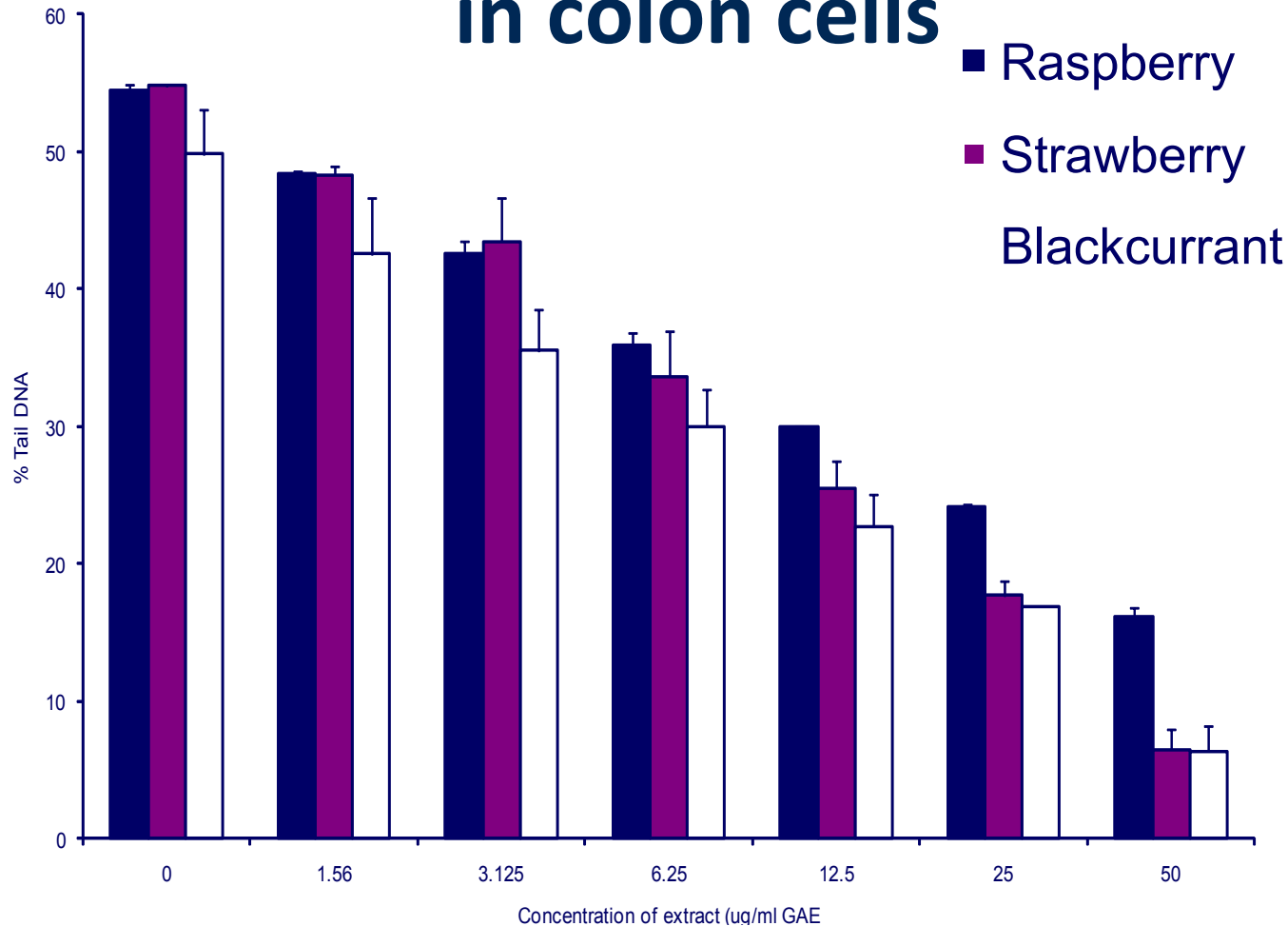
**Possible roles**

**Influence gut cells**

*Colon cancer*

**Modulate digestive processes**

# Berry polyphenols reduce DNA damage in colon cells



Berry extracts protect against DNA damage in colon cancer cells

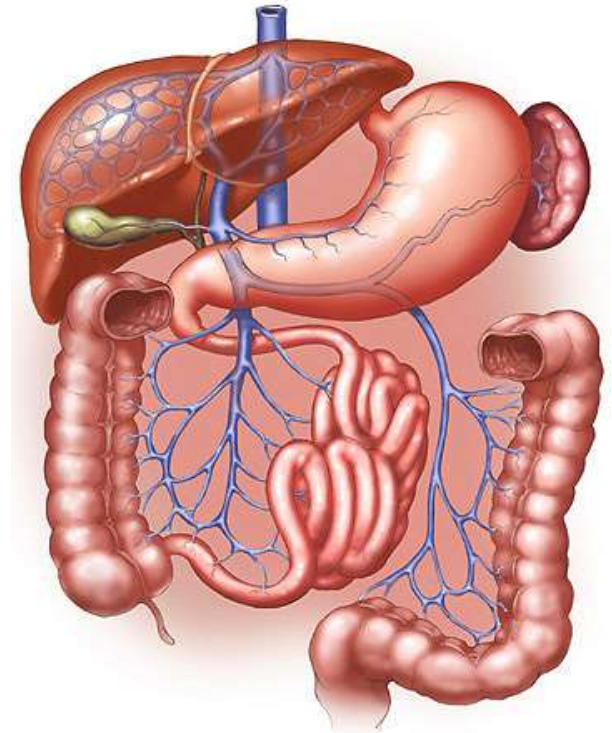
**Strawberry = Black currant > Raspberry**

via induction of cellular antioxidant responses

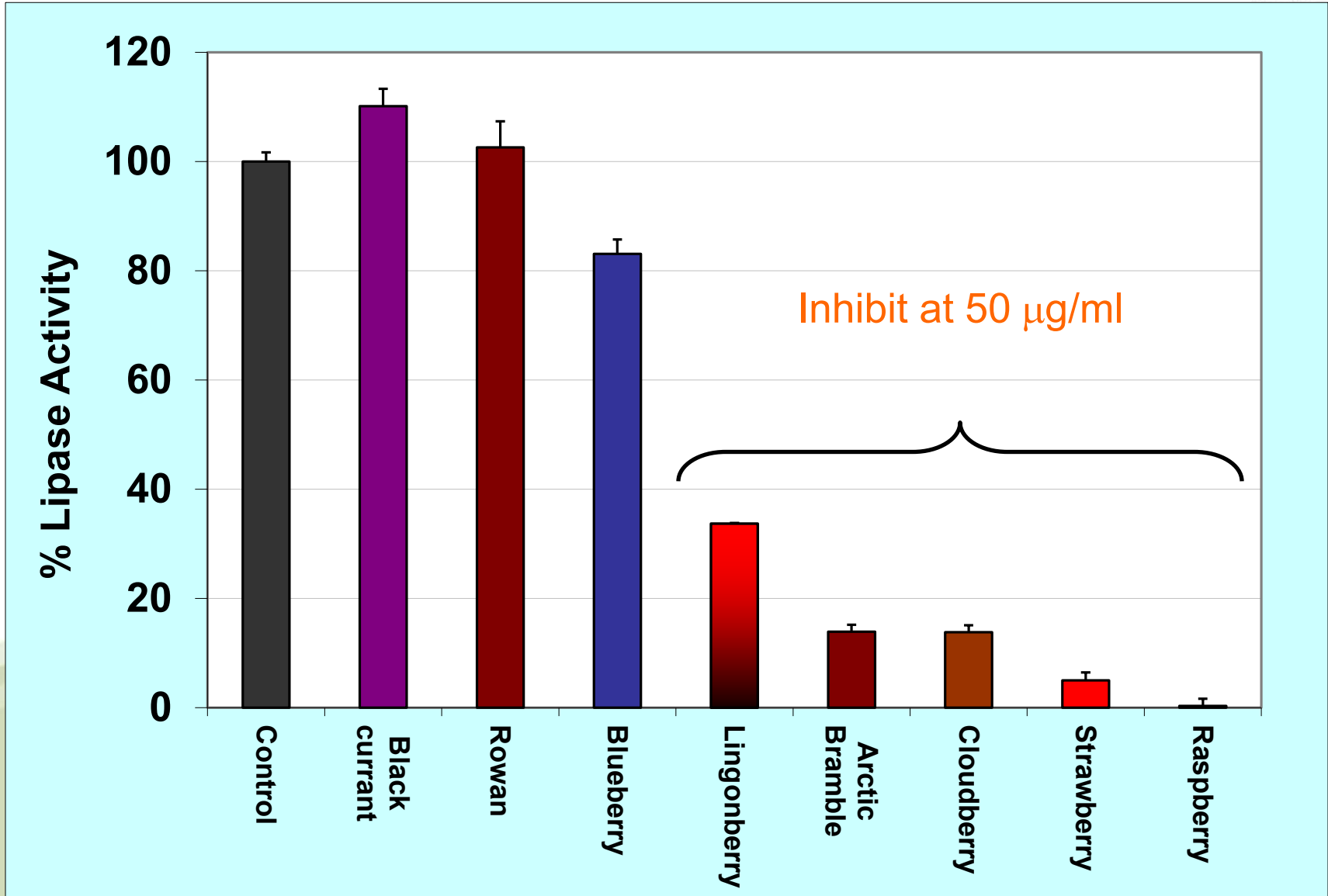


# Control of food digestion?

- Polyphenols can inhibit digestive processes and slow or modulate nutrient release from food
- **Inhibition of fat digestion – influence blood lipid levels, CVD, diabetes and obesity**
- **Inhibition of starch digestion – influence blood glucose control and type 2 diabetes**

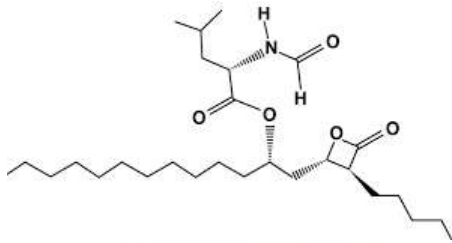
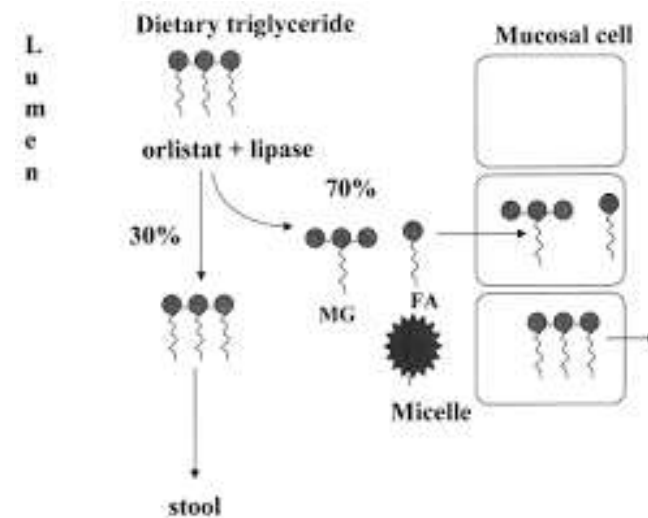


# Fat digestion depends on lipase: Berries inhibit lipase activity

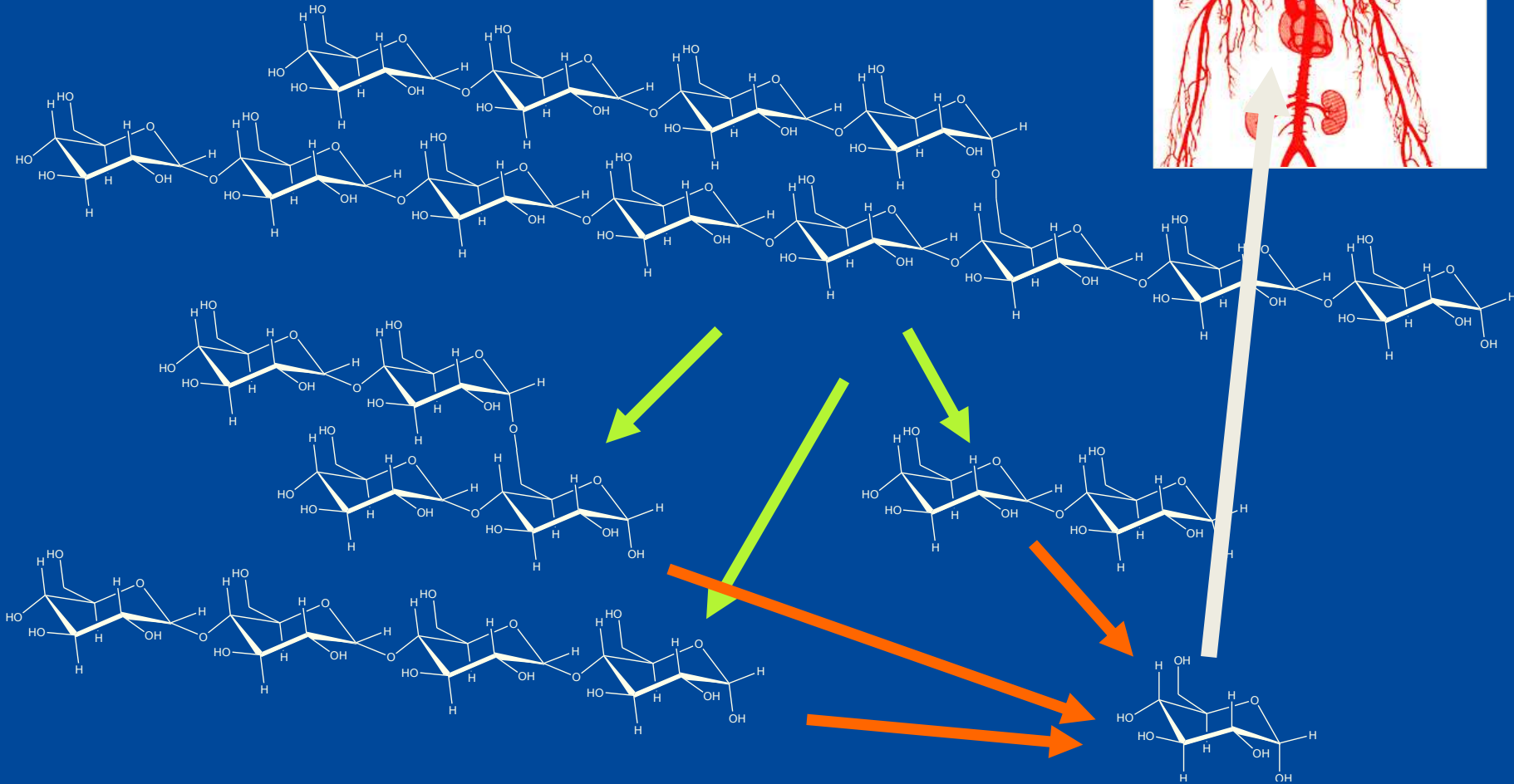
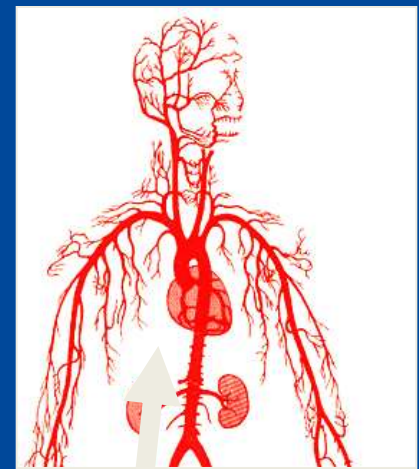


# Reduced Lipid Digestion = ↓ obesity?

- Inhibiting lipase and lipid digestion is known to influence calorie intake and therefore weight management in humans
- The drug, Orlistat, has been proven to influence weight management by the **same mechanism**



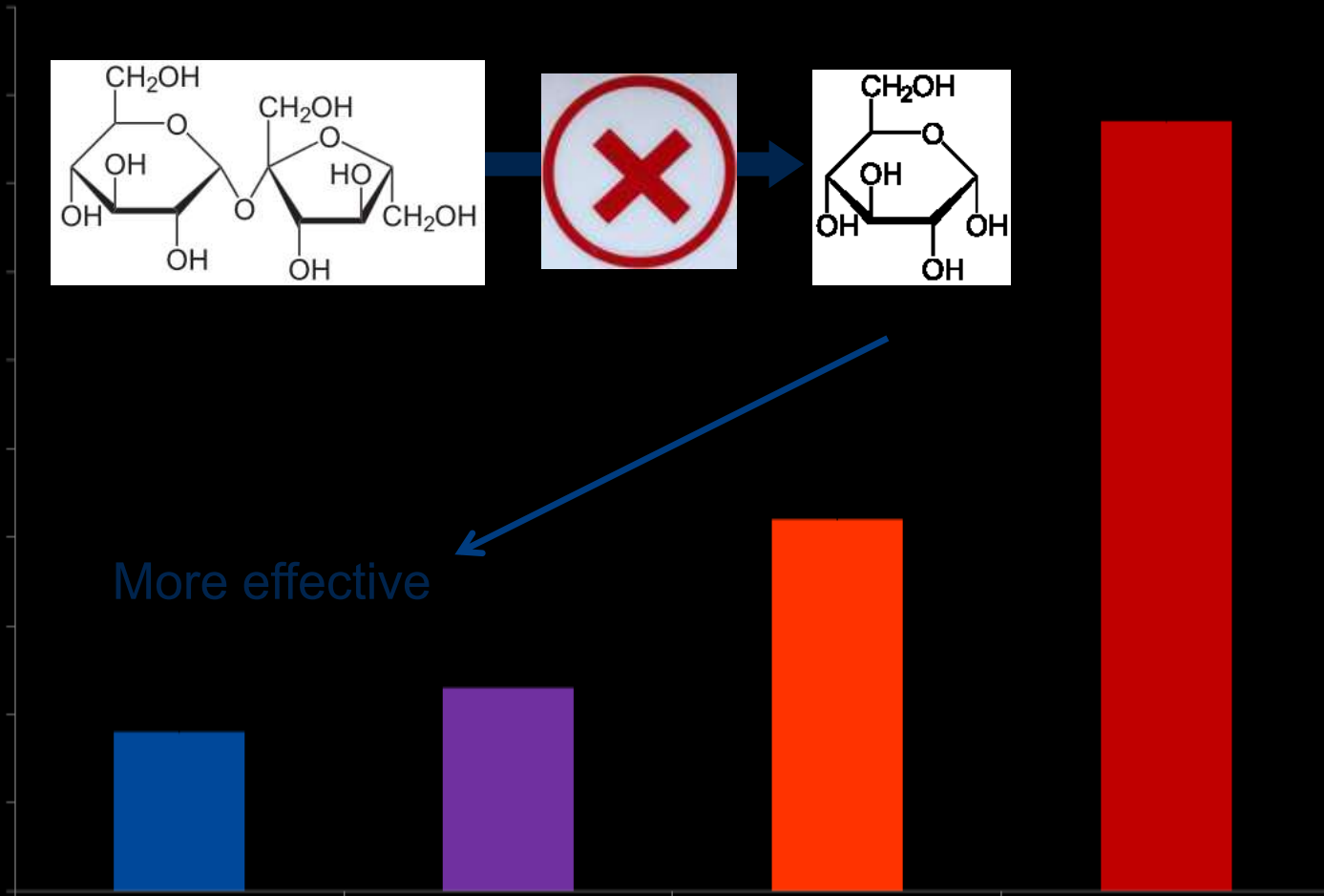
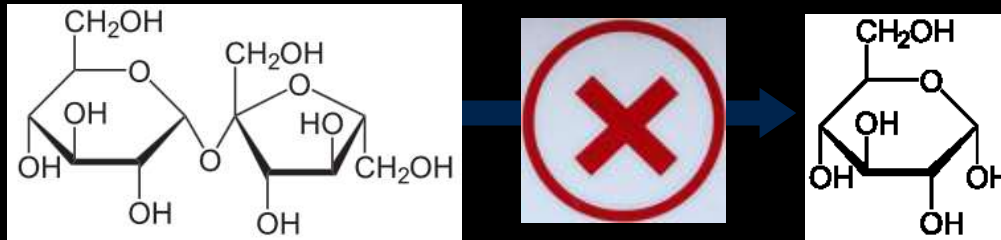
# Inhibition of starch digestion



**Amylase** chops into fragments

**Glucosidase** nibbles off glucose

# $\alpha$ -glucosidase in gut converts sucrose to glucose - inhibited by berry polyphenols



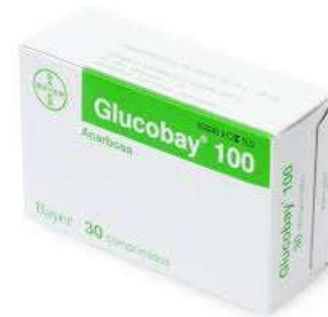
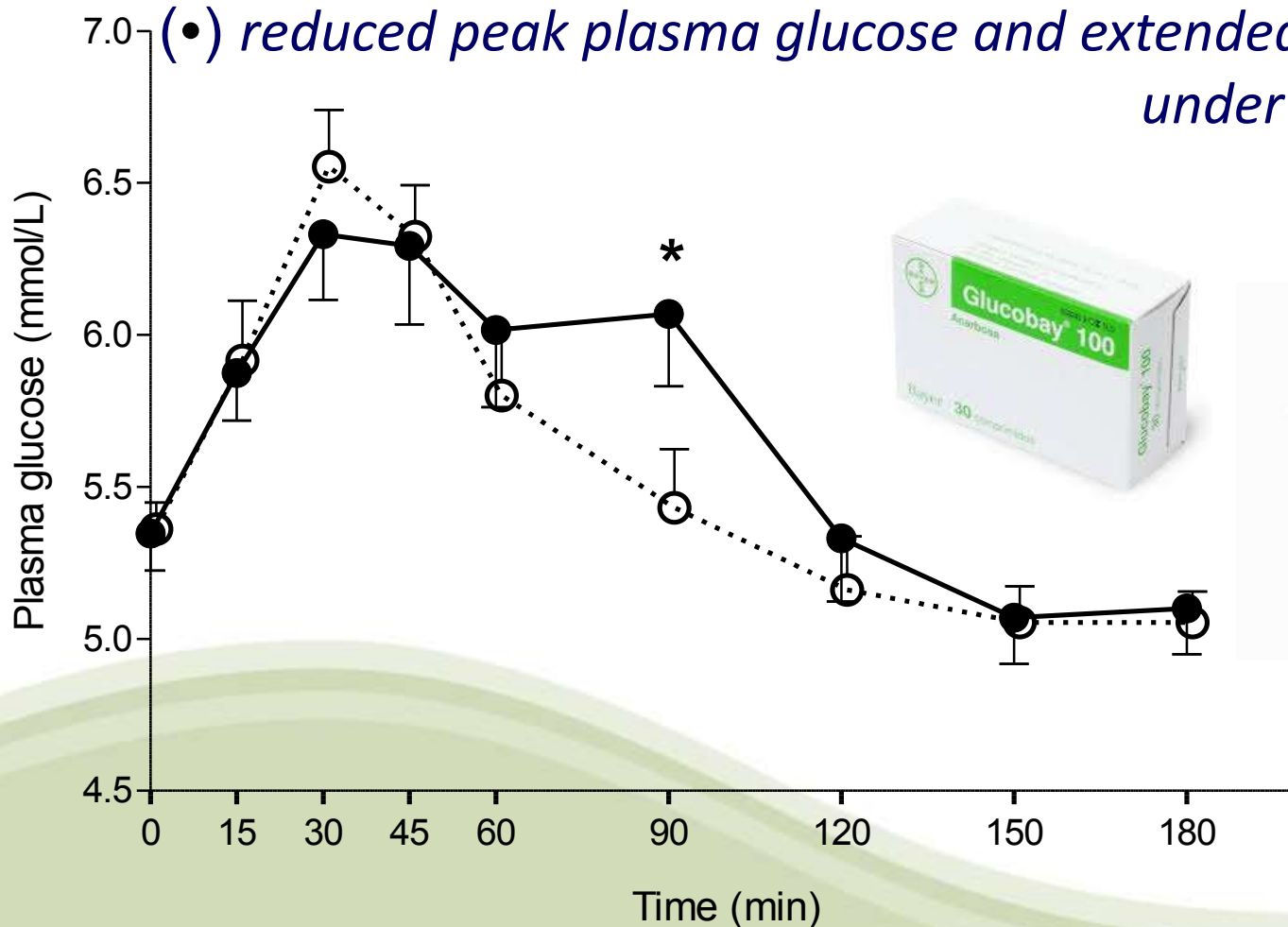
Can we influence type II diabetes using these berry components?



# Human trial – blunted glycaemic response

People drank sucrose-sweetened black currant (BC) juices with low and high **polyphenol** content. The high PP juice

(●) reduced peak plasma glucose and extended the area under the curve



# Hand over to Andreas!

# Acknowledgements



RESAS  
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Science & Analytical  
Services



The James  
Hutton  
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SCOTTISH GOVERNMENT



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# Questions?



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