# Soft Fruit Health Benefits: State of the Art

**Derek Stewart** 









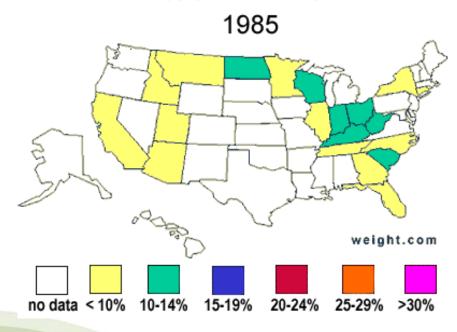


# Soft Fruit Health Benefits:State of the Art Why bother?



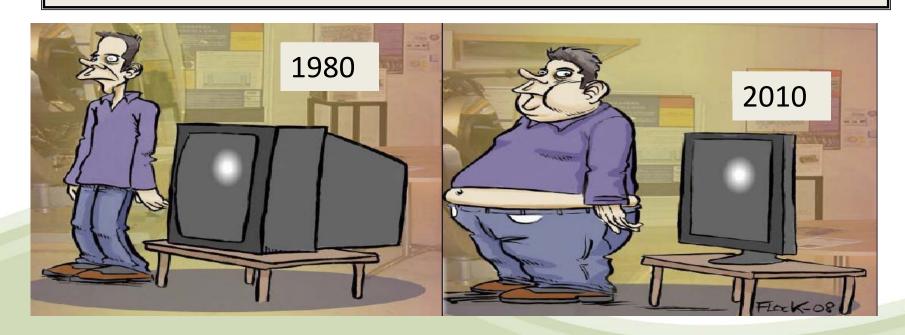
#### Prevalence of Obesity

Behavioral Risk Factor Surveillance System (BRFSS) Data from U.S. Center for Disease Control





- Mortality ↓ : Morbidity ↑
- Western population is living longer but is sicker.
- CVD, Diabetes, (some) cancers, neuro-degeneration and inflammation associated disorders



## **Anthocyanins**



#### **GIT**

Implicated in cancer reduction, bacterial population modulation (prebiotic) either directly or via associated metabolites



## Visual Acuity and Eye strain

- Reduced eye strain. J. Eye, 23, 129-133; 25, 114-118.
- Reduced Asthenopia & Myopia and .
   Blackcurrant >>>Bilberry.
- Saccharide decoration
- Rut > Glc >>> Ara ≈ Gal

#### Cancer

Oral, oesophageal and colon cancer studies in cells, rats and humans. Cancer Prev Res (Phila). 2, 187–194

#### **Brain & Cognitive Function**

Significant effort highlighting short term memory improvement accompanying blueberry intake. Nutrition 27, 338-42; .

#### **Neural**

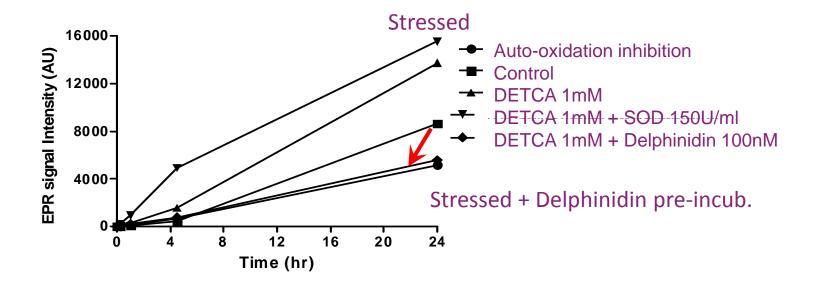
EU Capacities BrainHealthFood:improve neurological traits-neuphobia, avoidance time etc at low doses. See Claudia Santos talk

#### **Inflammation**

Modulation of exercise-induced oxidative stress. complement the ability of exercise to enhance immune responsiveness to potential pathogens

### Porcine Artery model – Arterial relaxation

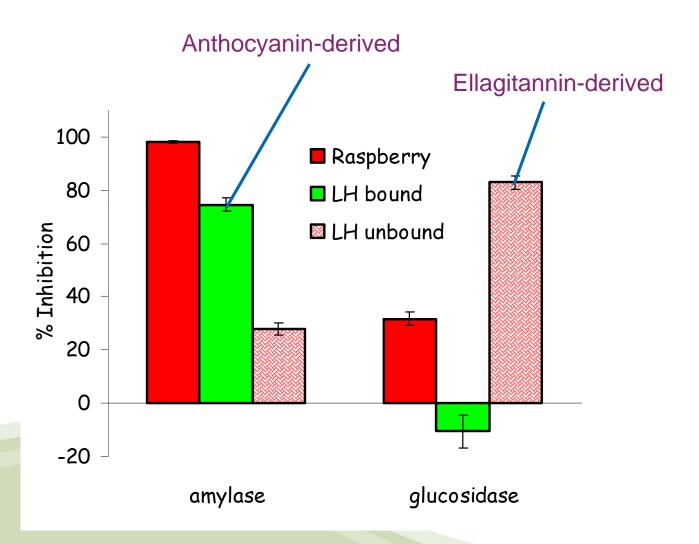




- DETCA induces oxidative stress in porcine artery model
- Delphinidin (acute phase) highly effective antioxidant in this model

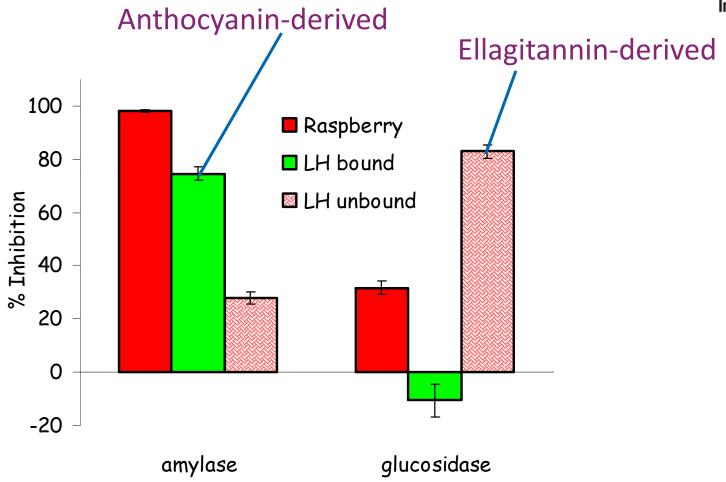
## Impact of soft fruit consumption on type II diabetes Inhibition of starch digestion





#### Impact of soft fruit consumption on diabetes; Inhibition of starch digestion

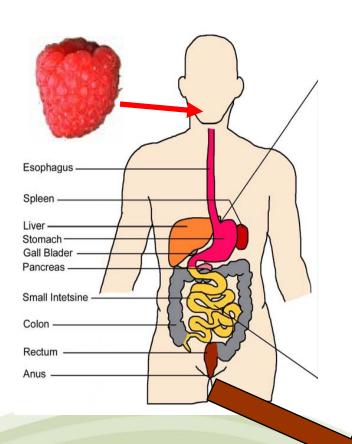




S07.021 (Wed. 1:30) Modulation of Digestive Enzymes by Berry Polyphenols: Potential Health Benefits Mcdougall *et al.* 

#### Faecal metabolism of berry polyphenols





- Metabolomic Profiling of faecal water metabolites in 10 free-living students after intake of raspberry puree (200 g/d for 14 d) by gas-chromatography mass spectrometry (GC-MS [and LC-MS]): Metabolomics
- Substantial ingestion of anthocyanins, ellagitannins etc.
- Focus on major phenolic metabolites.
- Some common metabolic patterns noted.





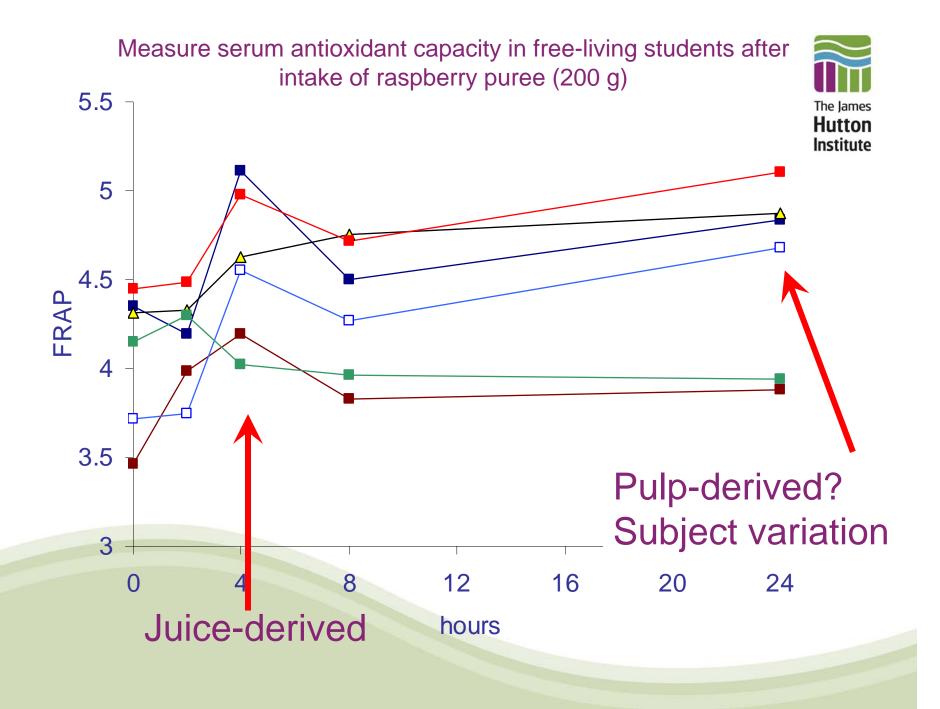
#### Faecal metabolism of berry polyphenols



Phenylacetic acid increased in 7/10 subjects

- 4-Hydroxy phenylacetic acid increased in 6/10 subjects
- 3-Hydroxy phenylacetic acid increased in 5/10 subjects
- 3-Phenylpropionic acid increased in 6/10 subjects
- 3-(4-Hydroxy)-phenylpropionic acid increased in 5/10 subjects
- 3,4-Dihydroxy benzoic acid increased in 7/10 subjects
- 4-Hydroxy benzoic acid increased in 2/10 subjects

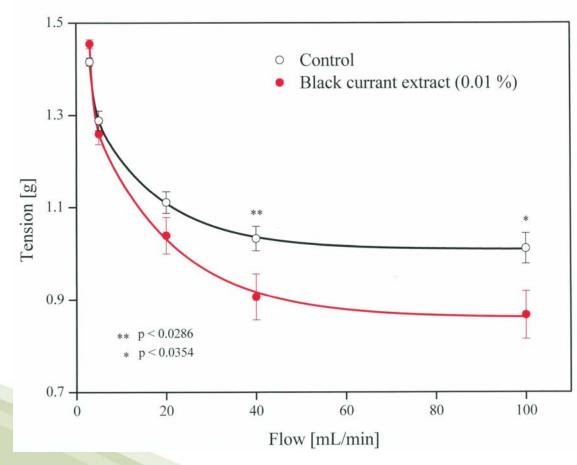
- Predominantly anthocyanin derived
- Fits evidence from model studies with faecal inocula but shows large inter-individual variation.
- Due to differences in diet or microflora?
- A proper confined study is required: defined diet, labelled fruit/anthos?

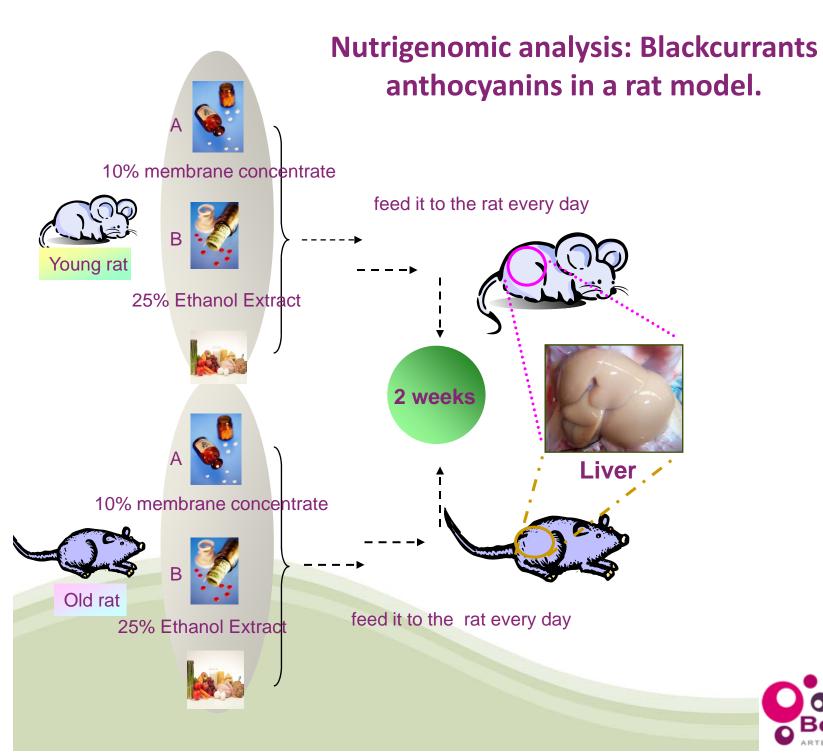


## Blackcurrant anthocyanins cause a flow-dependent increase in blood perfusion in isolated human intracerebral arteries



- •Flow-dependent isometric tension was measured in segments of isolated human intracerebral arteries from consciousness areas: derived from brain surgery.
- The anthocyanin driven
   vasodilatation may have a
   beneficial effect on the cognitive
   functions in dementia of the
   Alzheimer type, in the prevention
   of TIA and stroke
- Flow-dependent relaxation is almost identical to fluvistatin.



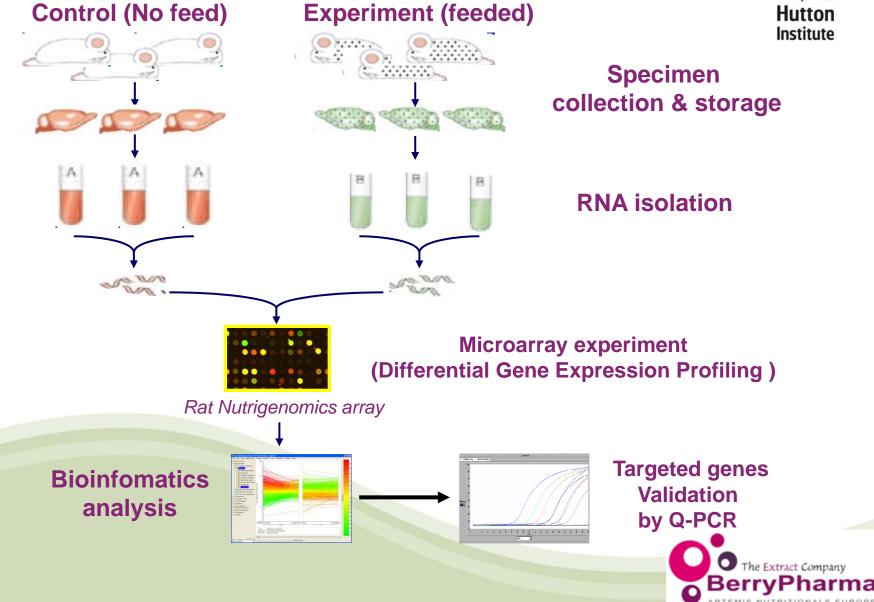






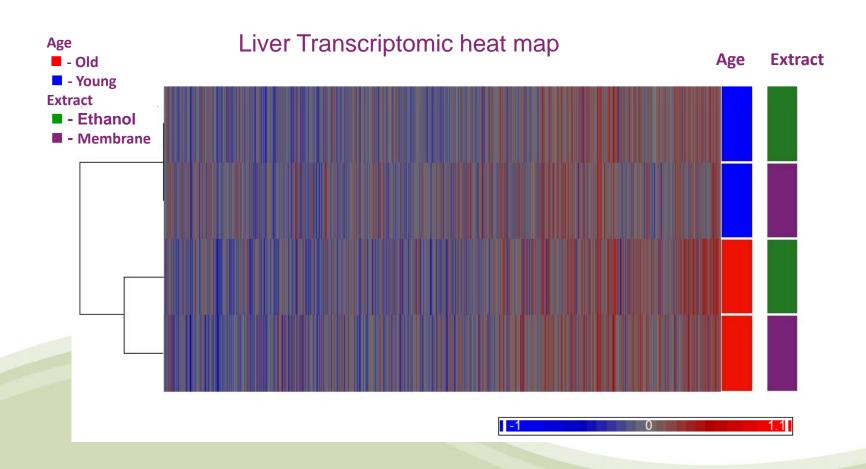
#### Nutrigenomic analysis: Blackcurrants anthocyanins in a rat.





## Blackcurrant anthocyanin intervention Rat transcriptomic analysis

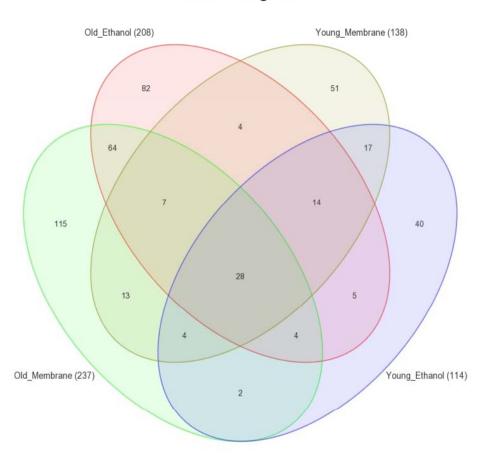




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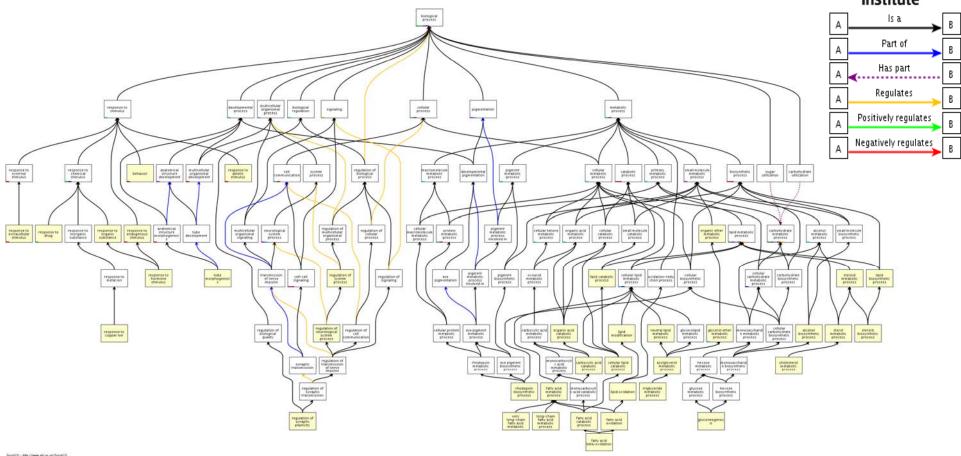


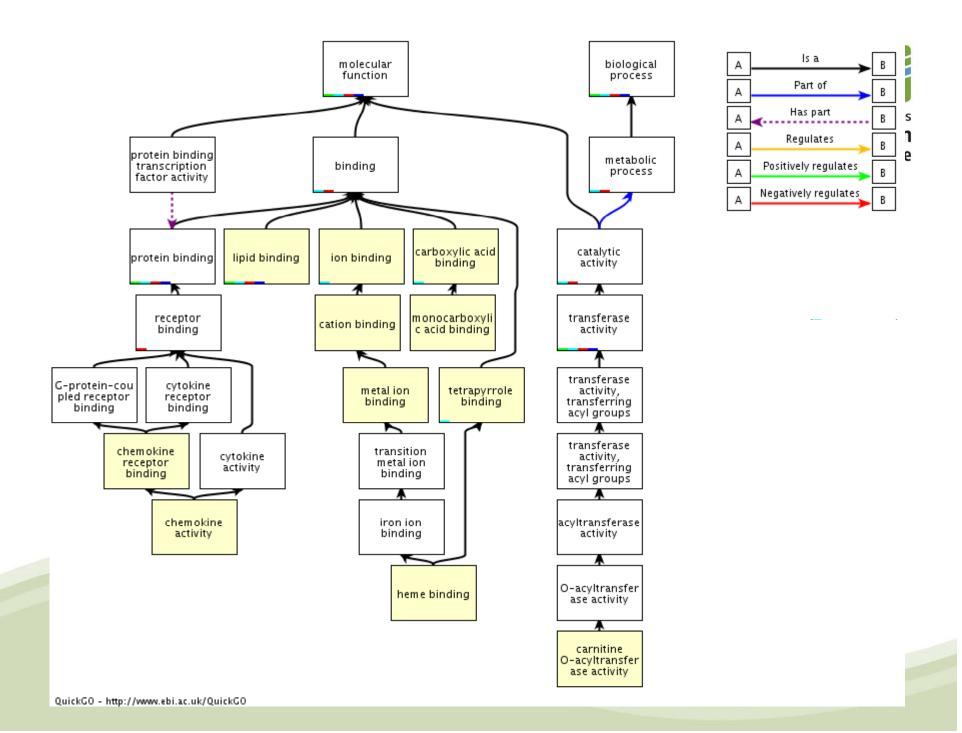
#### Venn Diagram



## Pathway enrichment/regulation and ontology as a consequence of blackcurrant anthocyanin intervention









### Case Study 1

#### Cardiovascular function and intake of soft fruit



#### Intervention trial – assess effects of six week ingestion 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

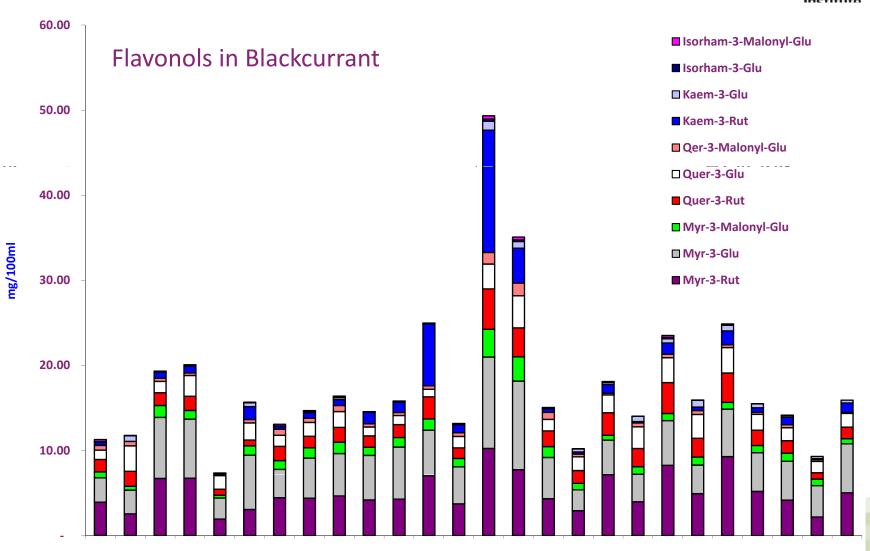
Assess Micro-circulation & macro-circulation, arterial stiffness, (SphygmoCor Pulsewave Analysis System) and carotid intima media thickness (Accuson Sequoia).

Relate to *In vivo* markers for endothelial cell function and oxidative stress. Assess bioavailability of fruit derived antioxidants.

- Blueberry group showed a modest reduction in carotid intima-media thickness
- Both blackcurrant groups showed reductions in isoprostanes.

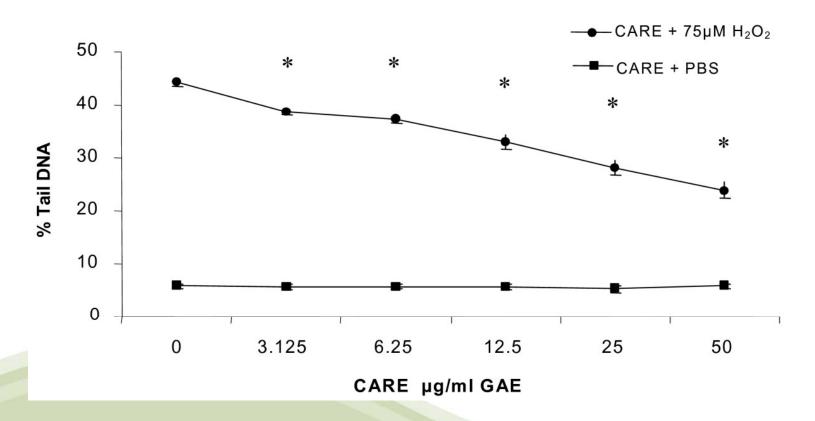


#### Polyphenolic Diversity



Genotoxic and anti-genotoxic effects of CARE (24 hr incubation) at different concent on DNA damage in HT29 cells

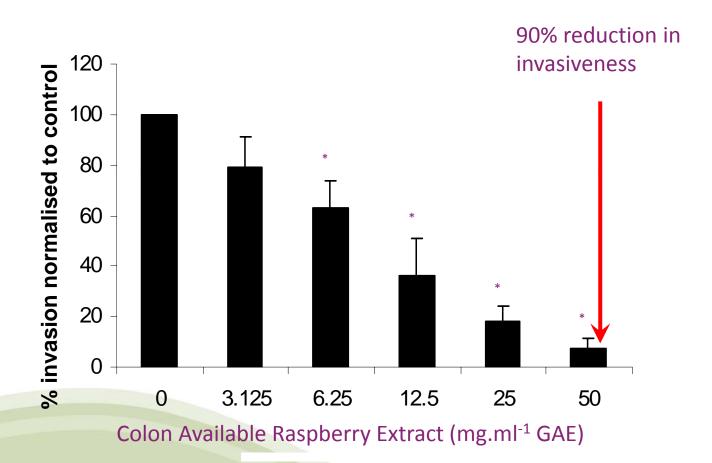




CARE- Colon Available Raspberry Extract

Impact of fruit polyphenolics of invasiveness of HT115 colon cancer cells *in vitro*: Cancer spread



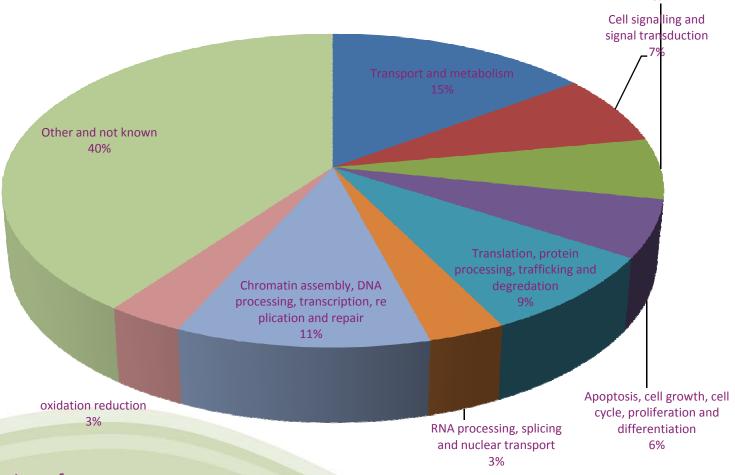


Gene modulation in HT29 cell following exposure to Rubus extract

Cell cytoskeleton, motility and extracellular matrix associated

6%



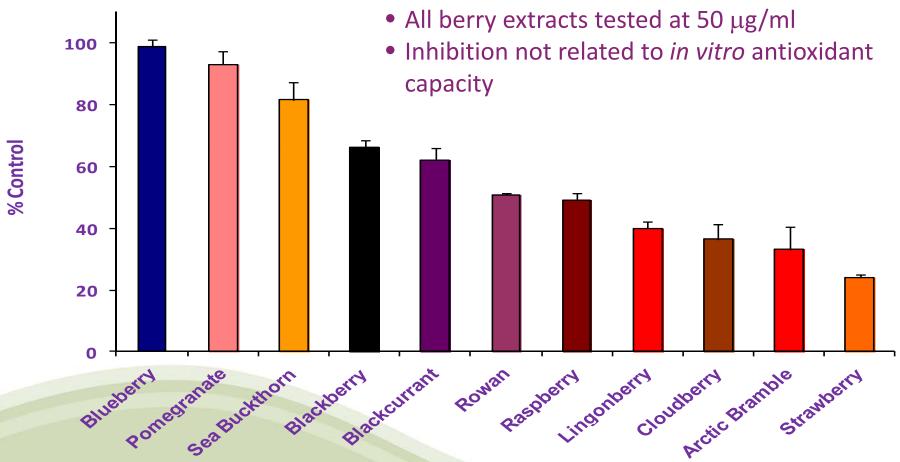


#### Modulation of:

- Tumour protein p53 Transcription factor regulating cell cycle and thus functions as a tumor suppressor.
- G0/G1 switch gene 2 control of cell growth phase shift.

### Colon cancer cells efficacy





#### **Conclusions**

- The James
  Hutton
  Institute
- Soft fruit are a viable source of nutrients and (proto) beneficial components.
- Regular intake may well reduce the risk/incidence of major degenerative disease.
- Many of the active components survive processing and hence intake can be multiple format.
- 'Omics per se will be key to accelerating breeding and can lead to tailored fruit for fresh and processed markers.
- We must not lose sight of the fact that food also need to taste good so a detailed understanding of the crosstalk between biosynthetic pathways is crucial and will be exploited by metabolomics and genomic developments.