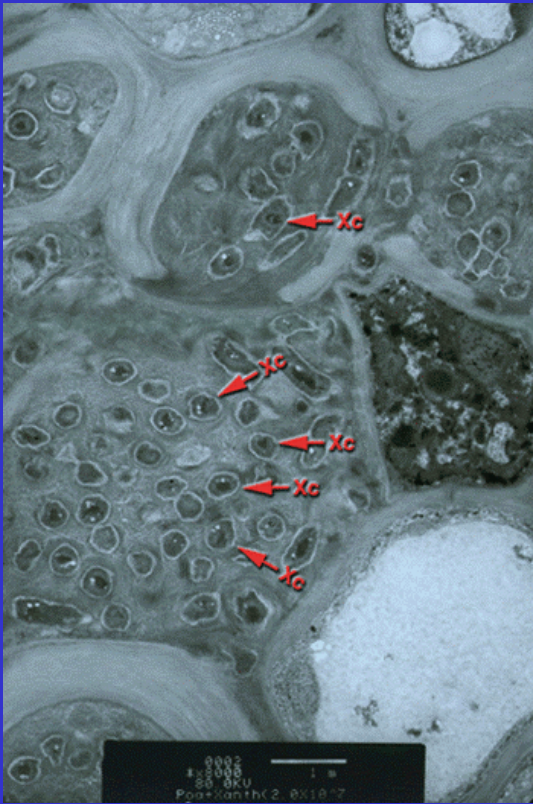


TCJJP - Spring 2008

Citrus Diseases

Citrus Canker



bacterial pathogen
Xanthomonas axonopodis

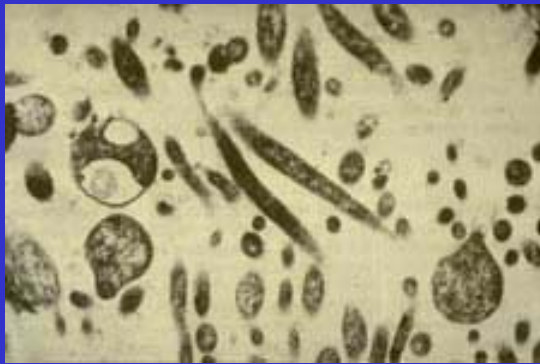


Huanglongbing (HLB)

(citrus greening, or yellow dragon disease)

Asian citrus psyllid,

Diaphorina citri Kuwayama
PSYLLOIDEA, HEMIPTERA



Candidatus Liberibacter

asiaticus (known in Florida since 1998)

- The disease was detected /verified in South Florida in August, 2005
- The pathogen is a phloem-limited fastidious bacterium (able to survive only within the vascular system of a plant).
- It is yet to be readily cultured.
- Citrus greening pathogens are transmitted by insect vectors in the family Psyllidae
- Latency period following infection: 6 mos. to 2+ years
- Disease can be transmitted through grafts

Huanglongbing (HLB) / Citrus Greening Disease

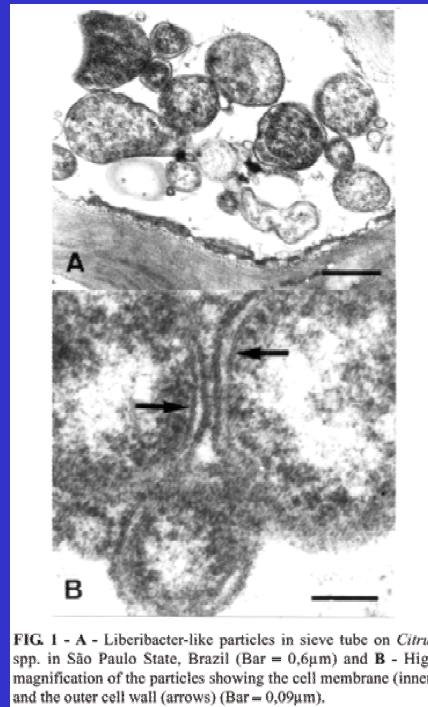
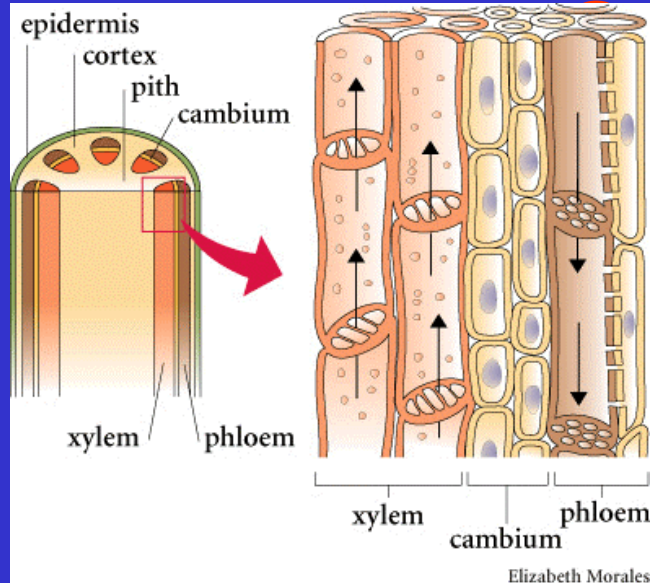


FIG. 1 - A - Liberibacter-like particles in sieve tube on *Citrus* spp. in São Paulo State, Brazil (Bar = 0,6 μ m) and B - High magnification of the particles showing the cell membrane (inner) and the outer cell wall (arrows) (Bar = 0,09 μ m).



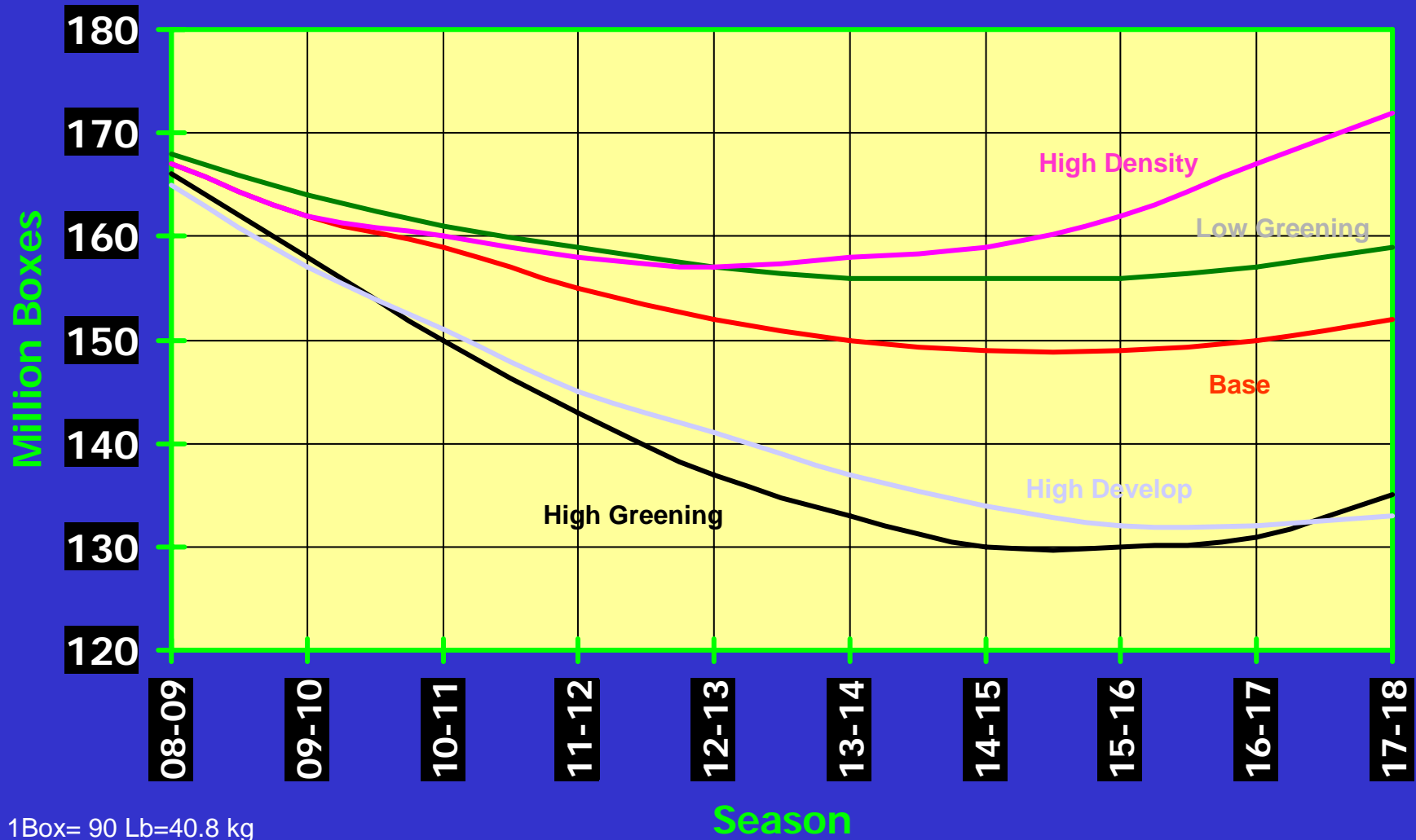
The bacterium inhibits the **phloem** (nutrient-carrying tissues) and blocks the transfer of nutrients. It eventually starves the tree

Florida Orange Production Projections

Season	Base	Low Greening	High Greening	High Develop.	Hurricane Yields	High Density	No Plantings
----- million boxes -----							
03-04	242	242	242	242	242	242	242
04-05	150	150	150	150	150	150	150
05-06	148	148	148	148	148	148	148
06-07	129	129	129	129	129	129	129
07-08	168	168	168	168	168	168	168
08-09	167	168	166	165	117	167	167
09-10	162	164	158	157	113	162	162
10-11	159	161	150	151	110	160	159
11-12	155	159	143	145	108	158	153
12-13	152	157	137	141	106	157	147
13-14	150	156	133	137	106	158	141
14-15	149	156	130	134	106	159	134
15-16	149	156	130	132	108	162	126
16-17	150	157	131	132	111	167	119
17-18	152	159	135	133	115	172	112

1Box= 90 Lb=40.8 kg

Florida Orange Production Projections



1Box= 90 Lb=40.8 kg

SOURCE: FDOC projections using FASS historical figures and future assumptions.

Present Funding

Current Research Funding in Florida

- Sources of current available funding - \$7.5 MM
 - State of Florida (FL Legislature) - \$3.75 MM
 - Florida Department of Citrus (FDOC) - \$2MM portion 'matching' of state funding (grower advertising and marketing 'tax' \$\$)
 - Florida Citrus Production Research Advisory Council (FCPRAC) -- \$1.75 MM (grower research 'tax' \$\$)
- Previous year -- << \$1 MM in HLB/canker research
- As of this year the National Academy of Sciences will be reviewing the scientific value of proposals requesting funding.

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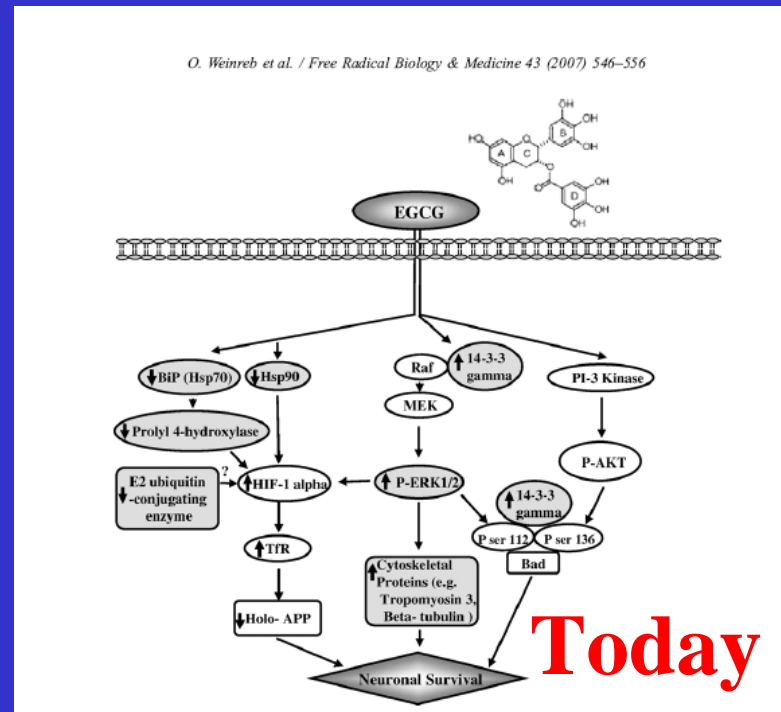
Health and Wellness Effects of Fruit
Juices

Post “ORAC et al.” Era.



Yesterday

ORAC: The higher the merrier



Translation: Tea has a positive effect on the nervous system

Phytochemicals Mode of Action

- Bioavailability is limited and only a small fraction is absorbed.
- The amount cannot account for a “one to one” molecular reaction needed for electron exchange.
- Almost all of the polyphenols are modified (metabolized) as soon as absorbed.
- The metabolites (sulfates, glucuronates) are often poorer electron donors than the parent molecule.
- They are present in the body at a total concentration of 1 to 2% of the endogenous antioxidants.

Phytochemicals Mode of Action

- “The in vitro antioxidant properties of polyphenols (electron donors) cannot account for their health related activity”(Waterhouse).
- **Values derived from in vitro ORAC type analyses have no physiological significance and do not reflect in any way the health values of a food.**

In Vivo Antioxidant Distribution

Blood antioxidants expressed in microMoles/liter

ENDOGENOUS Antioxidants

Glutathione 1.5

Uric acid 300

Protein (-SH group) 500

EXOGENOUS Antioxidants

Ascorbic acid 40

A tocopherol 25

B carotene 0.4

More than 90% of the blood antioxidant potential comes from the endogenous proteins. (From M. Serafini, 2005)

Polyphenol concentrations in plasma are low (usually 1 mM or less) and much lower than those of uric acid, an endogenous antioxidant (150–450 mM). Manach et al. (2005)

FLAVONOIDS: ANTIOXIDANTS OR SIGNALLING MOLECULES?

ROBERT J. WILLIAMS, JEREMY P. E. SPENCER, and CATHERINE RICE-EVANS

Wolfson Centre for Age-Related Diseases, GKT School of Biomedical Sciences, King's College London, Guy's Campus,
London SE1 9RT, UK

there is an emerging view

that flavonoids, and their in vivo metabolites,

do not act as

conventional hydrogen-donating antioxidants

but may exert

modulatory actions in cells through

signalling pathways.

Total Antioxidant Capacity: Appraisal of a Concept^{1,2}

Helmut Sies*

J. Nutr. 137: 1493–1495, 2007.

. Although using TAC may be helpful in comparing different food items,

the extrapolation to their contribution of antioxidant defense in vivo

and, further, to health issues, should be discouraged,

This is of particular importance because dietary phytochemicals

and other small molecules

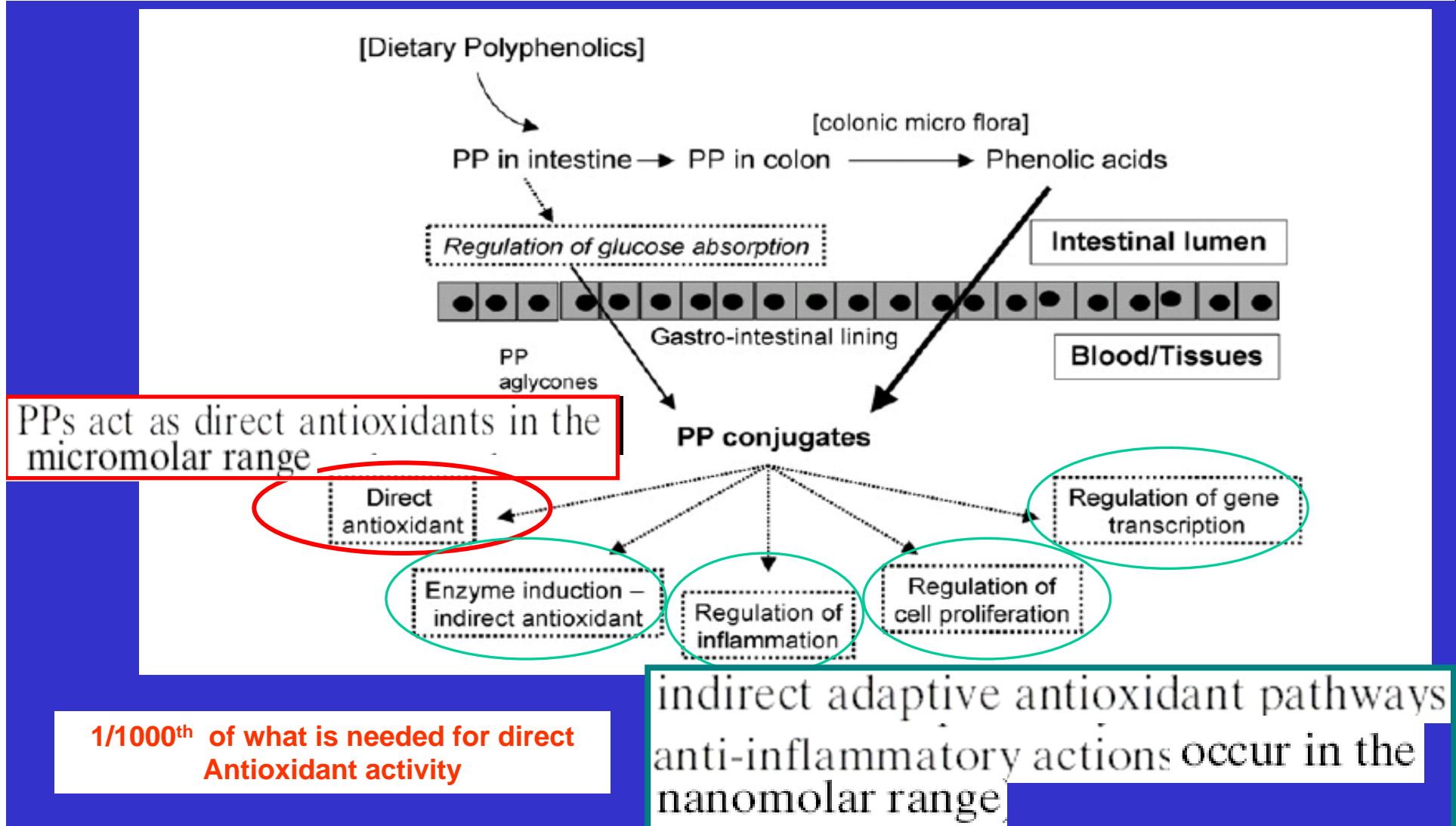
have nonantioxidant activities.

Polyphenolic phytochemicals – just antioxidants or much more?

D. E. Stevenson* and R. D. Hurst

Cell. Mol. Life Sci. 64 (2007) 2900–2916

The Horticulture and Food Research Institute of New Zealand, Private Bag 3123, Waikato Mail Centre,



Comparison of the health potentials of juices requires:

The development of new physiological methods to quantify the health properties of juices using :

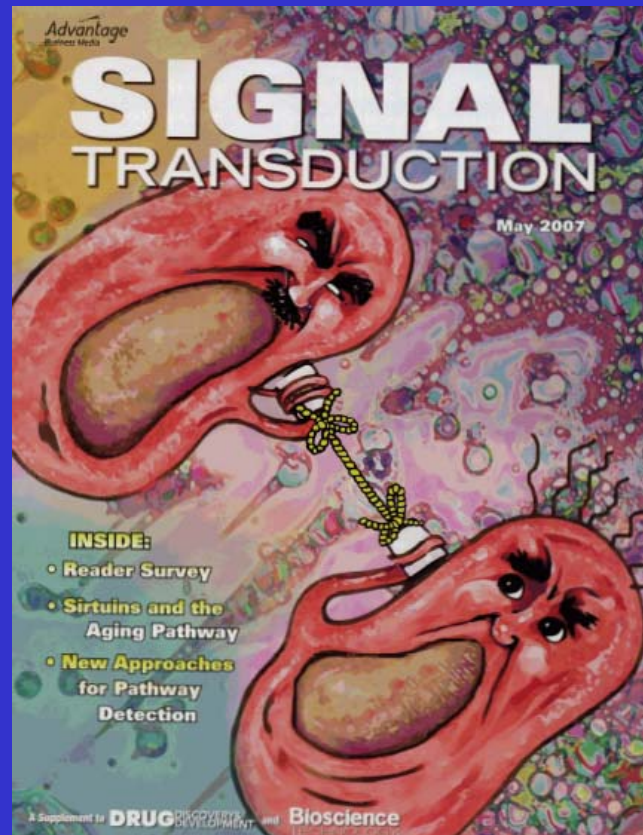
Transcriptomics (Effect on gene expression)

Study of the expression level of mRNAs in a given cell population, using techniques based on DNA micro-array technology.

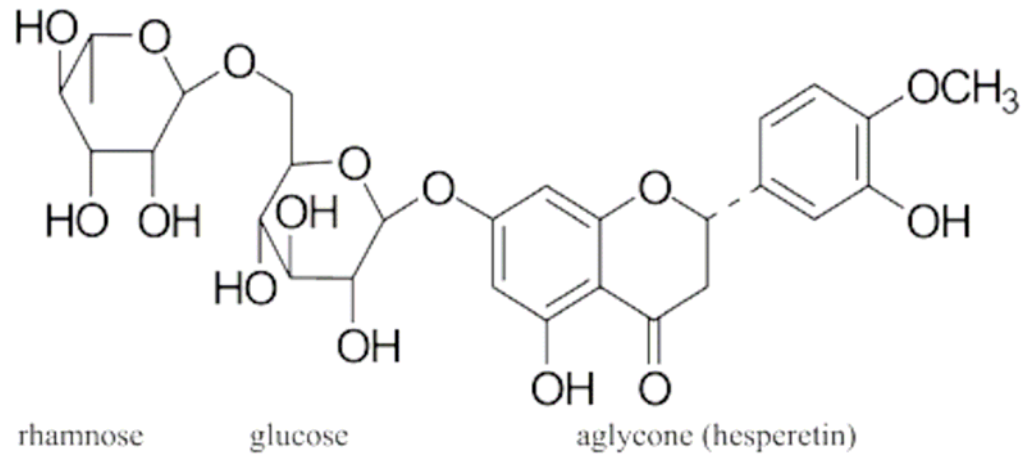
Proteomics (Effect on proteins)

Study of the expression, localization, functions, and interactions of the proteins produced by the genes.

How to explain to consumers the health benefits of juices ?

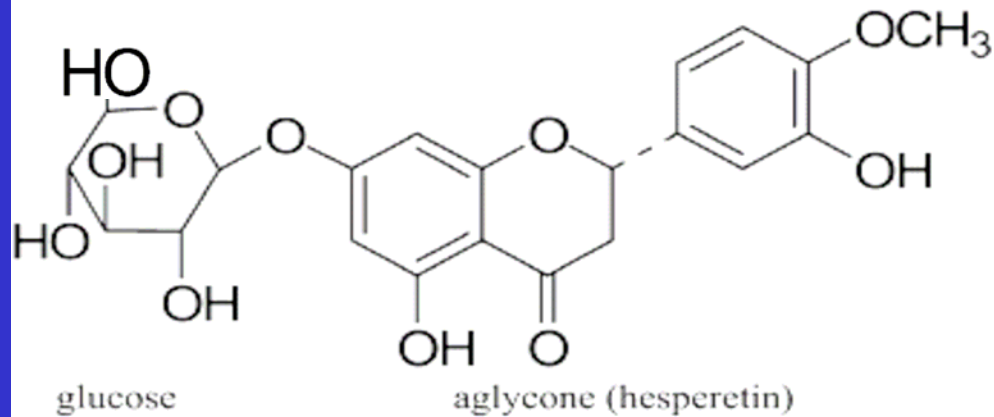


Juice Modification



Hesperetin 7-rhamnoglucoside

α -L-Rhamnosidase



hesperetin-7-glucoside

J Nutr. 2006,136 :404-408.

Bioavailability Is Improved by Enzymatic Modification of the Citrus Flavonoid Hesperidin in Humans: A Randomized, Double-Blind, Crossover Trial¹

Inge Lise F. Nielsen,* Winnie S. S. Chee,* Lea Poulsen,† Elizabeth Offord-Cavin,* Salka E. Rasmussen,† Hanne Frederiksen,† Marc Enslin,* Denis Barron,* Marie-Noelle Horcajada,** and Gary Williamson*²

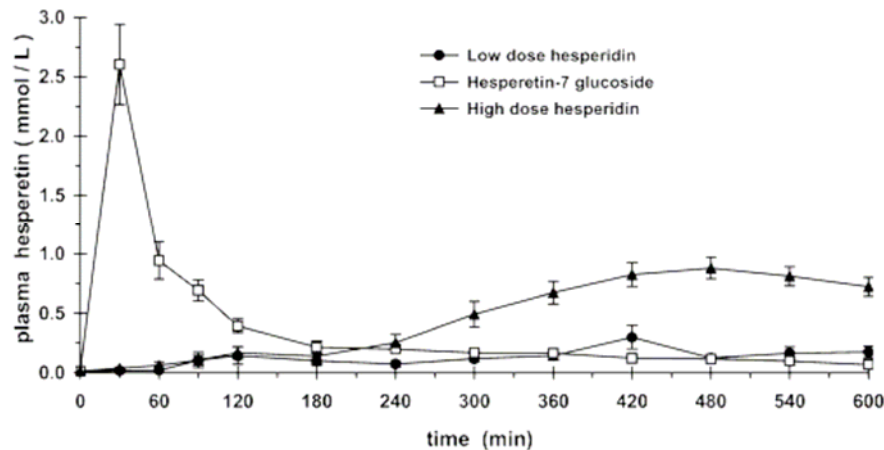


FIGURE 2 Plasma concentration vs. time curve of total hesperetin in healthy humans after consumption of 3 orange juice treatments. Values are means \pm SEM, $n = 16$.

- **Williamson examined the absorption of hesperidin and hesperitin 7 glusose .**
- **The peak plasma concentrations of hesperetin were 4-fold higher**
- **after subjects consumed hesperetin-7-glucoside juice compared**
- **with those consuming hesperidin juice.**

**Hesperetin-7-glucoside is more efficient than hesperidin in improving bone metabolism
in adult rats**

HORCAJADA Marie-Noëlle¹, GIL-IZQUIERDO Angel¹, NIELSEN Inge-Lise², MORAND Christine¹,
HABAUZIT Véronique¹, WILLIAMSON Gary², BARRON Denis², LEBECQUE Patrice¹, DAVICCO Marie-
Jeanne¹, COXAM Véronique¹ & OFFORD Elizabeth².

The metabolite hesperetin-7-glucoside appeared more efficient than the native molecule since 0.25% hesperetin-7-glucoside induced the same effect than 0.5% of hesperidin in preventing bone loss.

**FLAVONoids in Fruits & Vegetables: their Impact on Food Quality,
Nutrition and Human Health**

A European Union 6th Framework Project / Priority 5: Food Quality and Safety



Provide the necessary knowledge, tools and validated methods to enable development of high quality, consumer-acceptable Fruits & Vegetables and derived foods / beverages containing flavonoids at levels that are optimal for human health



Juice Enhancement

- Hesperetin 7-glucoside appears to be twice as effective as hesperidin.
- **As we learn the mode of action of phytochemical metabolites, the possibility of modifying juice to enhance health benefits will be raised.**