Otros componentes de los alimentos. Compuestos Bioactivos. Ingredientes funcionales.

Frida Kahlo. Viva la vida. 1954

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https://www.ucm.es/innovadieta/

Dieta compleja

Nutrientes	No nutrientes	
N ≈ 50 Proteínas Lípidos CHO Fibra Minerales Vitaminas Agua	**Componentes naturales bioactivos** en tejidos animales, hongos, algas, bacterias y vegetales (fitoquímicos) **N = ???** **Bioactivos** Protección enfermedad crónica no transmis. **Dieta mixta: 60.000 – 100.000 ≈ 1,5 g/día (Leiztmann, 2002)**	Aditivos y contaminantes N = ???

(Modificado de Varela y Ruiz-Roso, 1991)

España ≈ 3,5 g/día
(Saura y Goñi, Food Sci Nutr 2009;49(2): 145-152)

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Componentes bioactivos

"Componentes bioactivos de los alimentos que influyen en la actividad celular y en los mecanismos fisiológicos y con efectos beneficiosos para la salud"
(Kris-Etherton y col., Annu Rev Nutr 2004;24:511-538)

What are bioactive compounds?
Consensus:
*Bioactive compounds are essential and **nonessential compounds** (e.g., vitamins or polyphenols) that occur in nature, are part of the food chain, and can be shown to have an effect on human health.*
(Biesalski y col., Nutrition 2009;25/11-12:1202-1205)

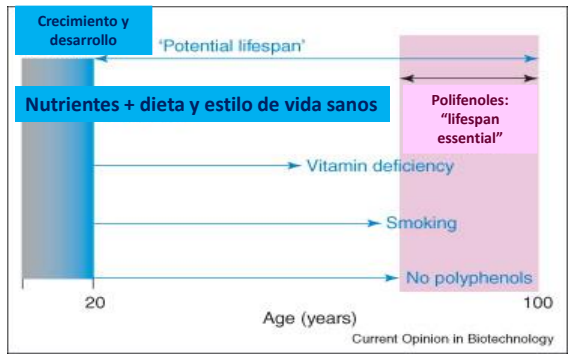
Componentes bioactivos

¿Son nutrientes?
¿Cuánto necesitamos?
¿Cuál es el upper level?
¿Dónde se encuentran?
¿En qué cantidad?
¿Cuál es su biodisponibilidad?
¿Y su mecanismo de acción?
¿…?????

"Condicionalmente esencial"
(Olmedilla, Revista de Nutrición Práctica, nº 12: 64-69; 2008)

El extra!!
"Lifespan essential"
"Adult vitamins"
(Holst, Williamson, Curr Opin Biotechnol. 2008 Apr;19(2):73-82)

Proposed translation of the **benefit of phytochemicals on lifespan** on the basis of effects which **reduce the risks of chronic disease**
(Holst, Williamson, 2008)



"Lifespan essential"
"Adult vitamins"
(Holst, Willimason, 2008)

"Condicionalmente esenciales"
(Olmedilla, 2012)

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Alimentos funcionales

Aquellos que, además de su valor nutritivo, aportan beneficios para la salud o tienen un papel en la prevención de la enfermedad (ECV, cáncer, diabetes, obesidad, ..)
(ADA, J Acad Nutr Diet 2013;113/8:1096-1103; Pennington, J Food Comp Anal 002;15(4):419-434)

Aquellos que demuestran satisfactoriamente que afectan a una o más funciones corporales específicas, más allá de sus efectos nutritivos intrínsecos, de modo que resulten apropiados para mejorar el estado de salud y el bienestar, reducir el riesgo de enfermedad, o ambas cosas (ILSI, Functional Foods from science to health and claims 2008).

- **Frutas** (manzana, cítricos, melocotón, aceitunas, ...)
- **Verduras y hortalizas** (espárragos, coles, cebollas, ajo, pepino, berenjena, puerro, zanahoria, pepino, ...)
- **Legumbres**
- **Frutos secos**
- **Aceites**
- **Cereales** (trigo, ...)
- **Hongos**
- **Algas**

- **Pescados** (AGP n-3; EPA, DHA, ...)
- **Huevos** (luteína, ...)
- **Lácteos** (ác. linoleico conjugado (CLA), péptidos, probióticos, ...)
- **Carnes** (CLA, péptidos, ...)
- ..... 120 alimentos "naturales" consumidos habitualmente con componentes bioactivos → funcionales

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Organization	Definition
Academy of Nutrition and Dietetics	"Foods defined as whole foods along with fortified, enriched, or enhanced foods that have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels."
International Food Information Council	"Foods or dietary components that may provide a health benefit beyond basic nutrition and may play a role in reducing or minimizing the risk of certain diseases and other health conditions."[12]
Institute of Food Technologists	"Foods and food components that provide a health benefit beyond basic nutrition (for the intended population)."[7]
International Life Sciences Institute	"Foods that by virtue of the presence of physiologically active food components provide health benefits beyond basic nutrition."[13]
European Commission	"A food that beneficially affects one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease. It is part of a normal food pattern. It is not a pill, a capsule or any form of dietary supplement."[14]
Health Canada	"A *functional food* is similar in appearance to, or may be, a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions."[15]
Japanese Ministry of Health, Labour, and Welfare	"FOSHU [food for specified health uses] refers to foods containing ingredient with functions for health and officially approved to claim its physiological effects on the human body. FOSHU is intended to be consumed for the maintenance / promotion of health or special health uses by people who wish to control health conditions, including blood pressure or blood cholesterol."[16]

Figure 1. Working definitions of the term *functional foods.*

J Acad Nutr Diet. 2013;113/8:1096-1103.

Alimentos funcionales

Primer alimento funcional: 1988
Refresco japonés con fibra dietética: "Fibe mini"
Certificado como: Food for Specified Health Use (FOSHU)

EEUU: fibra, vitaminas, antioxidantes, ..
Europa: bacterias ácido-lácticas
Asia: extractos naturales de plantas

(Wahlqvist y Wattanapenpaiboon, 2002)
http://whqlibdoc.who.int/publications/9241590416.pdf

Áreas de interés para los alimentos funcionales

- Salud digestiva / pre- y pro-bióticos
- Salud cardiovascular / hipo-colesterolemiantes
- Prevención de cáncer
- Salud ocular / degeneración macular
- Salud ósea
- Salud y bienestar general/ Antioxidantes/ Anti-inflamatorios/ Detoxificación/ Inmunomoduladores/ …
- Etc…

(ADA, J Acad Nutr Diet 2013;113/8:1096-1103)

Componentes bioactivos

- **Alimentos vegetales (fitoquímicos)**
- Hongos
- Alimentos marinos (algas)
- Alimentos de origen animal
- Bacterias (fermentación de alimentos y microflora intestinal)

Componentes bioactivos

Metabolitos secundarios de las plantas. Funciones

- Supervivencia y crecimiento de la planta
- Protección frente al estrés ambiental (calor, luz UV, poca agua, ...)
- Protección frente a predadores (sabor amargo, picante, …)
- Mecanismos de defensa frente a patógenos (pesticidas naturales, …)
- Atrayentes o repelentes de animales
- Pigmentos → color de flores y frutos → Polinización y dispersión de semillas
- Protegerse de animales herbívoros (ej: compuestos fenólicos, ..)
- Inhibición del crecimiento de plantas competidoras
- Estructural (ej. ligninas: soporte mecánico de la planta, ..)

Cuánto más estresada está la planta, más metabolitos sintetiza

Pérez-Urria Carril, Elena y Ávalos García, Adolfo (2009) *Metabolismo secundario de plantas.* REDUCA, 2 (3). pp. 119-145. ISSN 1989-3620 - http://eprints.ucm.es/9603/

Vitamin Nature of Flavones

Bentsáth, A.; Rusznyák, St.; Szent-Györgyi, A.

Nature, Volume 138, Issue 3497, pp. 798 (1936).

1936

IN a previous note[1] we reported on the favourable effect of flavones upon the resistance and permeability of the capillary wall in certain pathological conditions. The substances responsible for this activity were tentatively termed 'vitamin P'. The acceptance, however, of the vitamin nature of these dyes depended on the experimental demonstration of the symptoms of deficiency.

Wld Rev. Nutr. Diet., vol. 24, pp. 117–191
(Karger, Basel 1976)

1976

The Flavonoids.
A Class of Semi-Essential Food Components:
Their Role in Human Nutrition

Joachim Kühnau

Contents

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1970s

Efectos

Primeros estudios glucosinolatos-brécol-cáncer en animales en 1970s: Graham et al. (1978); Haenszel et al. (1980):

- Anticancerígeno (inhiben proliferación celular e inducen apoptosis)
- Antimicrobiano
- Antioxidante
- Antiinflamatorio
- Activan el sistema inmune
- Autismo??
- ...

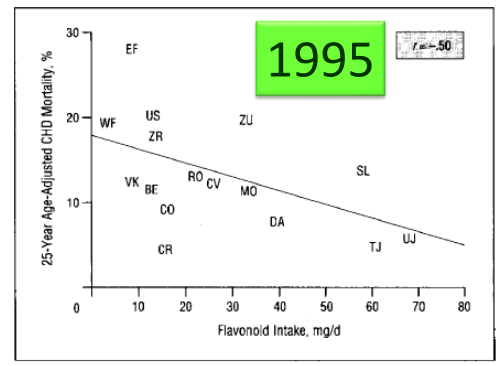
Correlación entre ingesta de flavonoides y mortalidad coronaria
The seven countries study

"Current smoking, intake of saturated fat and ***Intake of the polyphenolic flavonoids*** *accounted for the great difference in CHD mortality rate".*

The main sources of flavonoids in the diet are vegetables, fruits, fruit juices, tea, and wine

Hertog MG, al. Arch Intern Med. 1995;155:381-386.

1995

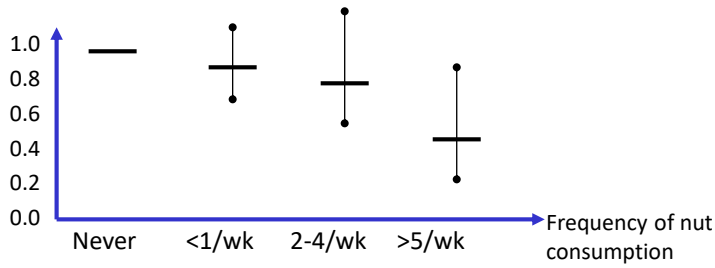


Average flavonoid intake and age-adjusted mortality from coronary heart disease (CHD) after 25 years of follow-up (the Seven Countries Study). BE indicates Belgrade, Serbia; CO, Corfu, Greece; CR, Crete, Greece; CV, Crevalcore, Italy; DA, Dalmatia, Croatia; EF, East Finland; MO, Montegiorgio, Italy; RO, Rome, Italy; SL, Slavonia, Croatia; TJ, Tanushimaru, Japan; US, US railroad; UJ, Ushibuka, Japan; VK, Velika Krsna, Serbia; WF, West Finland; ZR, Zrenjanin, Serbia; and ZU, Zutphen, the Netherlands.

NUTS and cardiovascular health

1997

The Nurses' Health Study
- 86,016 women (orig. 121,700 → 34-59 yrs)
- 14 yrs of follow-up (1980-1994)
- 861 nonfatal MI & 394 fatal CHD



Hu et al. N Engl J Med. 337:1491-1499, 1997

Box 4.2.2 Phytochemicals

Plants contain a wide range of biologically active compounds, some of which are known as phytochemicals. There may be as many as 100 000 different compounds, which determine particular properties in plants, and in the fruits and vegetables they produce, such as flavour and colour. Phytochemicals are classified according to their chemical structure and functional characteristics, and include salicylates, phytosterols, saponins, glucosinolates, polyphenols, protease inhibitors, monoterpenes, phytoestrogens, sulphides, terpenes, and lectins.

It is widely believed that the health benefits of diets high in fruits and vegetables are likely to be due partly to the presence of phytochemicals. For instance, several act as antioxidants, preventing oxidative damage to cells, proteins, and DNA. It is likely that other bioactive phytochemicals have yet to be identified, and those that are known may have additional properties in the body that are not yet understood. But it is thought that nutrients, phytochemicals, and other, as yet unknown, bioactive components act together to influence physiological responses.

Although many phytochemicals are bioactive, they are not essential in the diet and there is no daily requirement, so they are not classed as nutrients. Humans have developed tastes for some phytochemicals, such as the hot flavours of mustard oil, bitter alkaloids, and irritating capsaicins. There is genetically inherited variation in sensitivity to some tastes, for example, the bitter taste of isothiocyanates in cruciferous vegetables such as cabbage.

- Second Expert Report: Food, Nutrition, Physical activity and the Prevention of Cancer: a Global Perspective, WCRF-AICR, 2007

Componentes bioactivos. Papel en la salud

Posibles mecanismos de acción:

- Antioxidantes
- Modulación genética y epigenética.
- Activación / inhibición de sistemas enzimáticos.
- Regulación del ciclo celular.
- Protección del ADN.
- Modificación de la comunicación celular.
- Modificación del perfil hormonal.
- Estimulación del sistema inmunitario.
- Modulación de la respuesta inflamatoria.
- Efectos sobre la hemostasia, antitrombóticos.
- Modulación del perfil lipídico.
- Efecto hipocolesterolémico.
- Efecto hipotensor.
- Efecto hipoglucémico.
- Actividad antimicrobiana, ……

Prevención:

- Cáncer
- ECV
- HTA
- Diabetes
- Obesidad, ..
- Salud digestiva, ocular, ósea, …
- Enf. neurodegenerativas
- Longevidad, ….

Capitulo 2. Otros componentes de la dieta. 2.2. Componentes bioactivos de los alimentos.
www.kelloggs.es/content/dam/newton/media/manual_de_nutricion_new/Manual_Nutricion_Kelloggs_Capitulo_02.2.pdf
http://www.kelloggs.es/es_ES/manual-de-nutricion.html
Liu, R. H. (2013), Dietary Bioactive Compounds and Their Health Implications. Journal of Food Science, 78: A18–A25

Proposed mechanisms by which dietary phytochemicals may prevent cancer (Adapted from Liu and Finely 2005)

- Antioxidant activity
  - Scavenge free radicals and reduce oxidative stress
  - Inhibit nitrosation and nitration
  - Prevent DNA binding and damage
- DNA damage repair
- Inhibition of cell proliferation
- Induction of cell differentiation
- Inhibition of oncogene expression
- Induction of tumor suppress gene expression
- Induction of cell cycle G1 arrest
- Induction of apoptosis
- Regulation of signal transduction pathways
- Enzyme Induction and enhancing detoxification
  - Phase II enzyme
  - Glutathione peroxidase (GPX)
  - Catalase
  - Superoxide dismutase (SOD)
- Enzyme Inhibition
  - Cyclooxygenase-2 (COX-2) and PGE_2 synthesis
  - Inducible nitric oxide synthase (iNOS)
  - Xanthine oxidase
  - Phase I enzyme (block activation of carcinogens)
- Enhancement of immune functions and surveillance
- Anti-angiogenesis
- Inhibition of cell adhesion and invasion
- Regulation of steroid hormone metabolism
- Regulation of estrogen metabolism
- Antibacterial and antiviral effects

Liu, R. H. (2013), Dietary Bioactive Compounds and Their Health Implications. Journal of Food Science, 78: A18–A25. doi: 10.1111/1750-3841.12101

Componentes bioactivos

	Hay evidencia para los siguientes efectos									
	A	B	C	D	E	F	G	H	I	J
Carotenoides (frutas, hortalizas)	X		X		X			X		
Fitosteroles (aceites, soja, cereales, frutos secos, ..)	X							X		
Saponinas (legumbres, soja, ajo, cebolla)	X	X			X			X		
Glucosinolatos (repollo, brecol, coliflor, ajo, cebolla)	X	X						X		
Polifenoles (frutas, hortalizas, vino, té, café, cacao)	X	X	X	X	X	X	X		X	
Inhib. Proteasa (trigo, legumbres, soja, tomate)	X		X							
Terpenoides (hierbas, especias, cítricos, coles, tomate, ajo, cebolla)	X	X								
Fitoestrógenos (soja, legumbres, frutos secos, cereales)	X	X								
Organo-sulfurados (ajo, cebolla, puerros)	X	X	X	X	X	X	X	X		X
Ácido fítico (cereales, frutos secos, legumbres)	X		X		X				X	

A=anticancerígeno / B= antimicrobiano / C=antioxidante / D=antitrombótico / E=inmuno-modulador / F=antiinflamatorio / G=antihipertensivo / H=hipocolesterolemiante / I=hipoglucémico / J=digestivo
Salud ocular, salud ósea, …

(Watzl y Leitzmann, 1999. Tomado de Mann y Truswell, 2002; pp:261)

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Summary of the strength of evidence on the association between the consumption of vegetables and fruit and the risk of chronic diseases

	Evidence judgement (strength of the evidence)			
	Convincing	Probable	Possible	Insufficient
Obesity		o[a]	↓[b]	
Type 2 diabetes mellitus		o		
Hypertension	↓			
Coronary heart disease (CHD)	↓			
Stroke	↓			
Cancer		↓		
Chronic inflammatory bowel diseases				~
Rheumatoid arthritis (RA)			↓	
Chronic obstructive pulmonary disease (COPD)			↓	
Asthma			↓	
Osteoporosis			↓	
Eye diseases				
Macular degeneration			↓	
Cataract			↓	
Glaucoma				~
Diabetic retinopathy				~
Dementia			↓	

↓ Risk reduction by increased vegetable and fruit consumption,
o no association,
~ insufficient evidence
[a]Weight loss -- [b]Weight increase

Steinberg, Department of Nutrition, University of California, 2012
Slavin & Lloyd 2012 Adv Nutr 3:506-516. http://advances.nutrition.org/content/3/4/506.long
Boeing et al 2012 Eur J Nutr Sep;51(6):637-63. http://link.springer.com/article/10.1007/s00394-012-0380-y/fulltext.html

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La prevención/retraso de la EC es posible

4 FR modificables:

- Cambios en la dieta
- Peso corporal adecuado
- Incremento actividad física
- Dejar de fumar

Mensaje muy sencillo:
"Consuma más alimentos de origen vegetal"
>400-600 g/día (adultos)
480 g/d (5-14 años)
330 g/d (0-4 años)
(Lock et al., WHO, 2004)

Prevención:
≈ 80% CHD/ECV
90% DM2
33-60% Cáncer

EC: Enfermedad crónica
WHO, 2003; Strong y col. Lancet 2005;366:1758, Epping-Jordan y col. Lancet 2005;366:1667; Murphy y col., 2014

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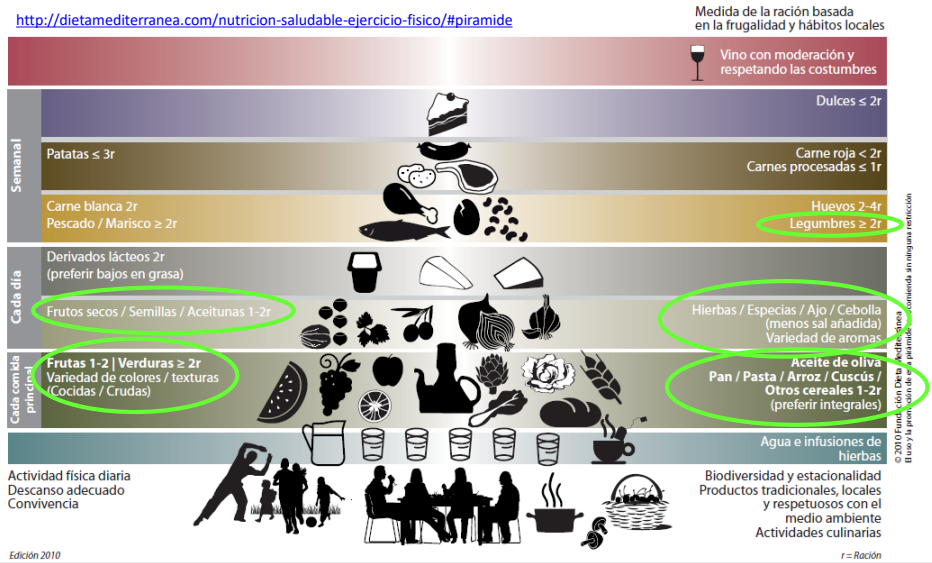
Pirámide de la Dieta Mediterránea: un estilo de vida actual

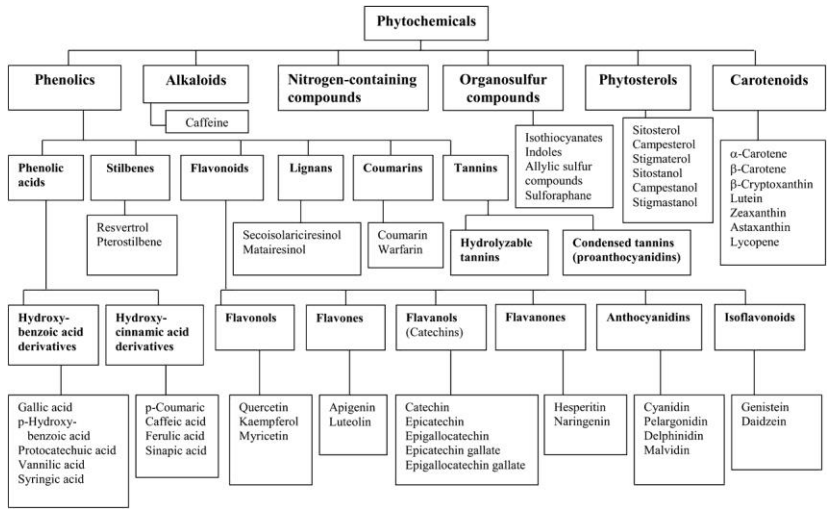
Guía para la población adulta

http://dietamediterranea.com/nutricion-saludable-ejercicio-fisico/#piramide



Classification of dietary phytochemicals.

http://advances.nutrition.org/content/4/3/384S.long



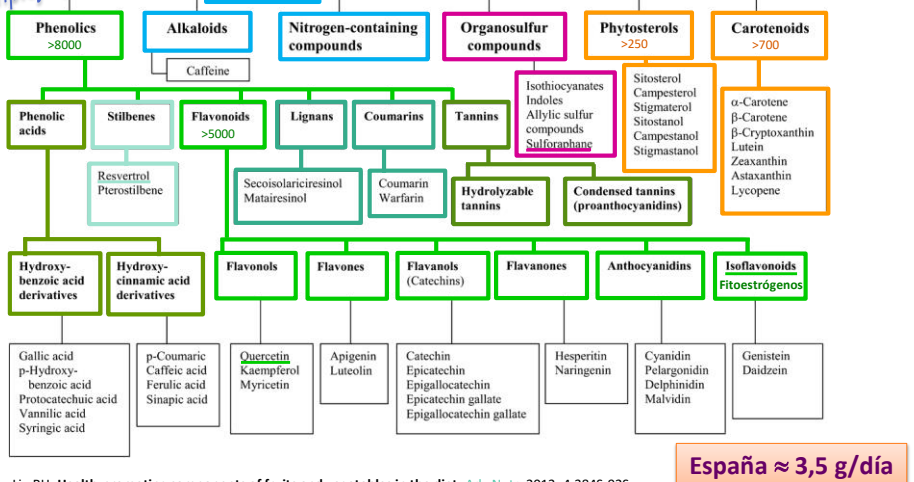
Rui Hai Liu Adv Nutr 2013;4:384S-392S

Advances in Nutrition

Componentes bioactivos. Clasificación

Mezcla compleja y heterogénea

Nitrogenados | **Fitoquímicos** | Terpenoides | Clorofila



Liu RH. **Health-promoting components of fruits and vegetables in the diet.** Adv Nutr. 2013 ;4:384S-92S.
http://advances.nutrition.org/content/4/3/384S.long

España ≈ 3,5 g/día
(Saura y Goñi, 2009)

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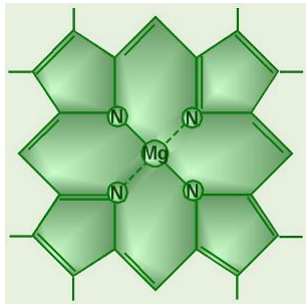
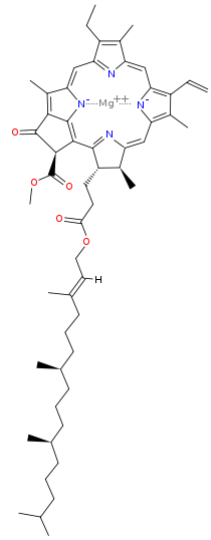
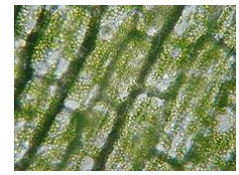
Clorofila y Mg



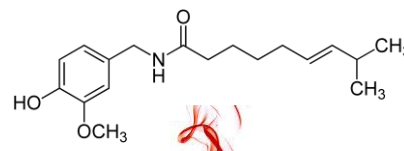




http://lpi.oregonstate.edu/mic/dietary-factors/phytochemicals/chlorophyll-chlorophyllin

Alcaloides (≈12.000)
Compuestos nitrogenados

- Capsaicina
- Cafeína
- ….



Terpenoides (25.000-40.000)

Carotenoides:
- Carotenos:
  - α-caroteno
  - ß-caroteno
  - Licopeno
- Xantofilas:
  - ß-criptoxantina
  - Luteína
  - Zeaxantina

Esteroles vegetales:
- Esteroles y estanoles

(β-sitosterol, estigmasterol, campesterol, …)

Terpenoides (25.000-40.000)

Carotenoides:
- Carotenos:
  - α-caroteno
  - ß-caroteno
  - Licopeno
- Xantofilas:
  - ß-criptoxantina
  - Luteína
  - Zeaxantina

Ingesta media en España:
Carotenoides: 9,5 mg/día
(O`Neil y col., 2001; tomado de Saura y Goñi, 2005)

Ingesta media en España:
Carotenoides: 3,5 mg/día (3 - 4,3 mg/día)
0,5 mg/d luteína
0,1 mg/d zeaxantina
Mayoritarios: β-caroteno (1 mg/día) y licopeno (1,3 mg/día)
(Olmedilla, 2007)

Aprox. la mitad de los ingeridos corresponde a carotenoides con actividad provitamínica-A

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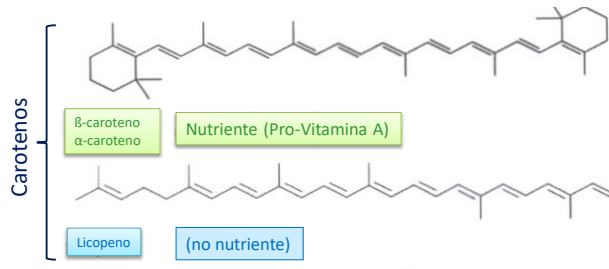
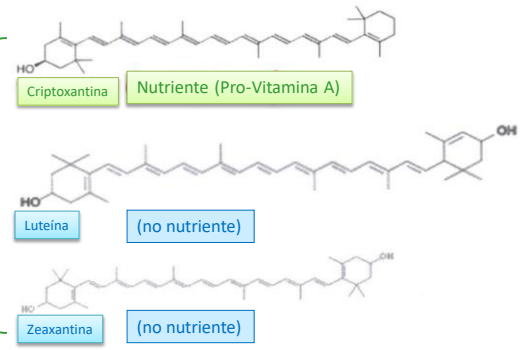
Carotenoides mayoritarios en suero



Carotenos

- ß-caroteno / α-caroteno — Nutriente (Pro-Vitamina A)
- Licopeno — (no nutriente)



Xantofilas

- Criptoxantina — Nutriente (Pro-Vitamina A)
- Luteína — (no nutriente)
- Zeaxantina — (no nutriente)

100 g de acelgas cocidas:
- 1.960 mcg de luteína
- 0 mcg de zeaxantina

100 g de espinacas cocidas:
- 6.422 mcg de luteína
- 0,564 mcg de zeaxantina

100 g de yema:
- 1.723 mcg de luteína
- 1.257 mcg de zeaxantina

(mayor biodisponibilidad)

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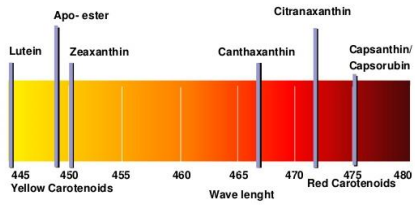
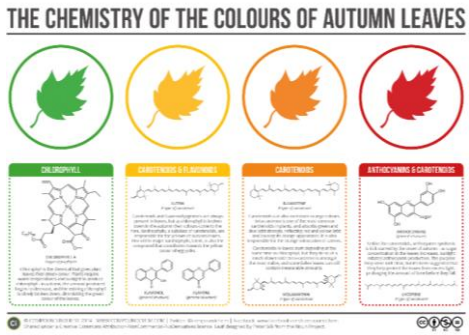


Schlatterer and Breithaupt, 2006



Contenido en Carotenoides sin actividad provitamínica A (µg / 100 g)

Licopeno — tomate (1.000 – 62.000)
Sandía (2.500)
Cerezas (10)

Luteína — verduras y frutas (-)
- Espinacas (4.000 - 6.000)
- Acelgas · Brócoli (≥ 1000)
- resto (< 1000)

- Aguacate (314)
- resto (< 100)

Zeaxantina — Espinacas (crudas (377) cocidas (564))
Pimiento rojo (289 - 390)
Naranja (66)

Olmedilla y col., 1996

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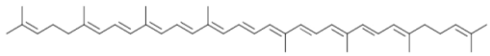
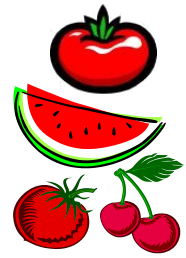
Licopeno (mg/100g)

(Olmedilla y col., 1996)



Tomate tipo pera	62,273
Tomate de ensalada	2,116
Tomate tipo canario	1,604
Sandía	2,454
Cerezas	10
Zumo de tomate	25,000 / 1 vaso
Salsa de tomate casera	8,900 /1/4 taza



s, lunes 22 de febrero de 1999

Un componente del tomate reduce las posibilidades de sufrir cáncer

EL PAÍS, **Barcelona**

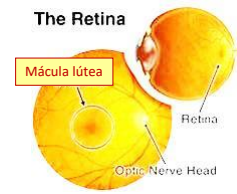
Los tomates y sus derivados, especialmente la salsa de tomate, disminuyen el riesgo de desarrollar algunos tipos de cáncer, según un estudio publicado por el Instituto Nacional del Cáncer de Estados Unidos. Tras revisar 72 trabajos de investigación respecto a los efectos del tomate sobre la salud, concluye que "las personas que consumen más productos a base de este fruto (...) corren menos riesgos de padecer varios tipos de cáncer".

El coordinador del estudio, Edward Giovanucci, de la Facultad de Medicina de Harvard, indica que los tumores en los que ejerce mayor nivel de protección son los de próstata, páncreas, pulmón o colon rectal. El efecto protector se atribuye principalmente a los pigmentos carotenoides, que son los que dan el color rojo a los tomates. Estas sustancias tienen un efeto antioxidante muy beneficioso para la salud.

La relación entre estos pigmentos y el cáncer de próstata ya fueron demostrados en 1995 por el equipo de Giovanucci, tras comprobar que los hombres que consumen productos a base de tomate, más de diez veces por semana, reducen su riesgo de cáncer en un tercio respecto a los que lo comen menos de dos veces por semana. Ahora, se ha comprobado que reduce un 60% el ries-
cer de colon y de recto.

Luteína

Carotenoide del grupo de las xantofilas
Pigmento amarillo



"Condicionalmente esencial"
(Harper, 1999; Semba y col., 2003; Olmedilla, 2012)

"Lifespan essential"
"Adult vitamins"
(Holst, Willimason, 2008)

Menor riesgo de:
- Cataratas y DMAE
- Cáncer, ECV, …

Mecanismos de protección de carotenoides ante la luz:
1. Filtros de luz azul
2. Antioxidante

Relacionado con la prevención de la enfermedad crónica

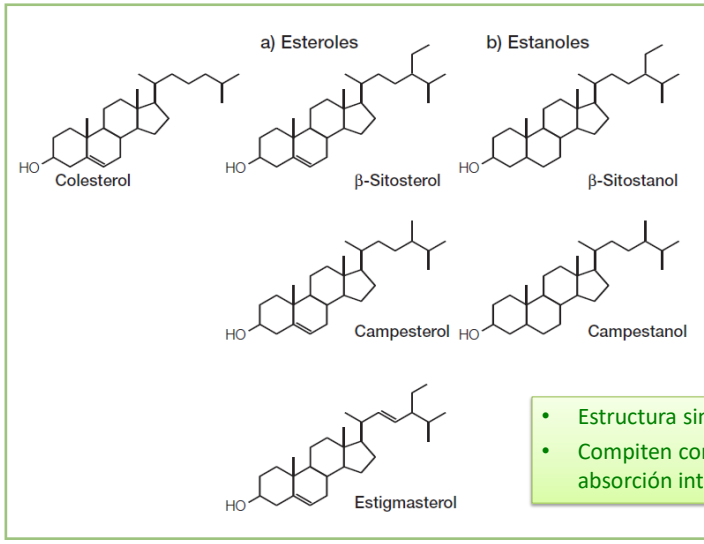
Terpenoides (25.000-40.000)

Carotenoides:
- Carotenos:
  - α-caroteno
  - ß-caroteno
  - Licopeno
- Xantofilas:
  - ß-criptoxantina
  - Luteína
  - Zeaxantina

Esteroles vegetales:
- Esteroles y estanoles

(β-sitosterol, estigmasterol, campesterol, …)

Fitosteroles



- Estructura similar a la del colesterol.
- Compiten con el colesterol en la absorción intestinal.

Figura 1. Estructura del colesterol y esteroles vegetales comunes.

El Libro Blanco de los Esteroles Vegetales, 2005

Fitosteroles

Scientific Opinion on the substantiation of a health claim related to 3 g/day plant stanols as plant stanol esters and lowering blood LDL-cholesterol and reduced risk of (coronary) heart disease.
EFSA Journal 2012;10(5):2692 [17 pp] http://www.efsa.europa.eu/en/efsajournal/pub/2692

CONCLUSIONS
On the basis of the data presented, the Panel concludes that:

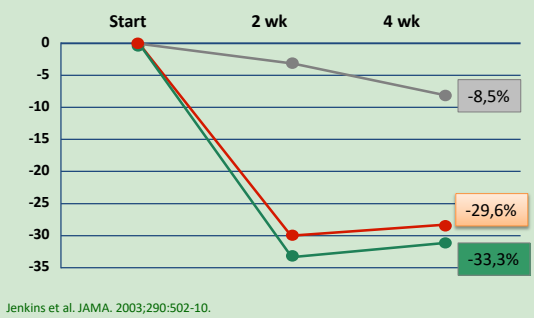
- plant stanol esters at a daily intake of 3 g plant stanols (range 2.7 g to 3.3 g) in matrices approved by Regulation (EC) No 376/2010 (yellow fat spreads, dairy products, mayonnaise and salad dressings) lowers LDL-cholesterol by 11.4 % (95% CI: 9.8 – 13.0).
- the minimum duration required to achieve the maximum effect of plant stanol esters on LDL-cholesterol lowering is two to three weeks.
- while plant stanol esters added to foods such as margarine-type spreads, mayonnaise, salad dressings, and dairy products such as milk, yoghurts including low-fat yoghurts, and cheese have been shown consistently to lower blood LDL-cholesterol levels, the size of the cholesterol-lowering effect of plant sterols/stanols added to other food formats is less well established.

http://aesan.msssi.gob.es/AESAN/web/cadena_alimentaria/detalle/registro_comunitario_declaraciones.shtml
Declaraciones de propiedades saludables bajo el artículo 13 autorizadas posteriormente a las del Reglamento (UE) Nº 432/2012

Jenkins y col. Am J Clin Nutr 2005;81:380-7
The portfolio diet: cholesterol lowering foods compared with a statin in hypercholesterolemic participants

Dietary Portfolio vs Statin

LDL reduction (%)



Jenkins et al. JAMA. 2003;290:502-10.

Randomised controlled trial

- Control: a diet very low in saturated fat
- Statin: the same diet plus lovastatin, 20 mg/d
- Dietary portfolio:
  - plant sterols (1.0 g/1000 kcal)
  - soy protein (21.4 g/1000 kcal)
  - viscous fibers (9.8 g/1000 kcal)
  - almonds (14 g/1000 kcal)

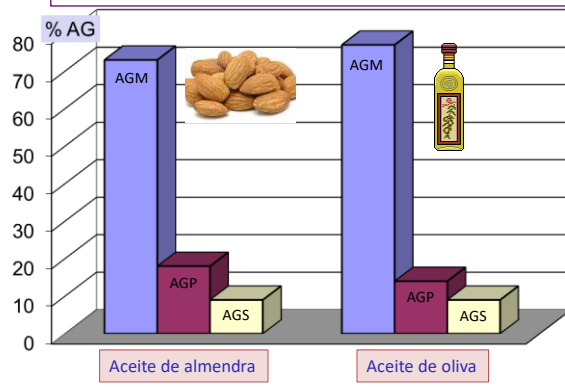
"It is possible to achieve as great an effect (↓25-30%) with food components as with low dose statin treatment"

La composición de la grasa de las almendras es como la del aceite de oliva

Van Gohg. Almendro en flor
73.5 x 92.0 cm. Saint-Rémy: February, 1890
Amsterdam: Van Gogh Museum

Fitoesteroles
Flavonoides
Otros polifenoles
Fibra
Minerales
Vitaminas
CHO, …

Ácidos grasos (%) de almendras y aceite de oliva



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Fitosteroles

ß-sitosterol (60% del total)
Campesterol (30% del total)
Estigmasterol

Ingesta habitual:
Dietas occidentales:
150 – 555 mg/d
(≈ ingesta de colesterol)
Oriental y vegetariana:
300 mg – 1 g/d

España:
374 mg/d
(Jiménez y col., 2006. tomado de Saura y Goñi, 2009)

Table 4 Phytosterols intake in the Spanish diet (Jimenez-Escrig et al., 2006)

Source	mg/person/day
Cereals	87.9
Fruits	38.4
Vegetables	24.0
Legumes	27.1
Nuts	8.3
Vegetable oils	188.5
Total	374.2

(Saura y Goñi, 2009)

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Fitosteroles

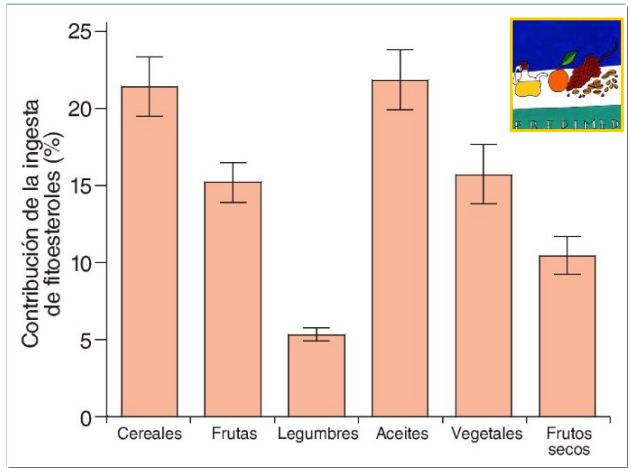
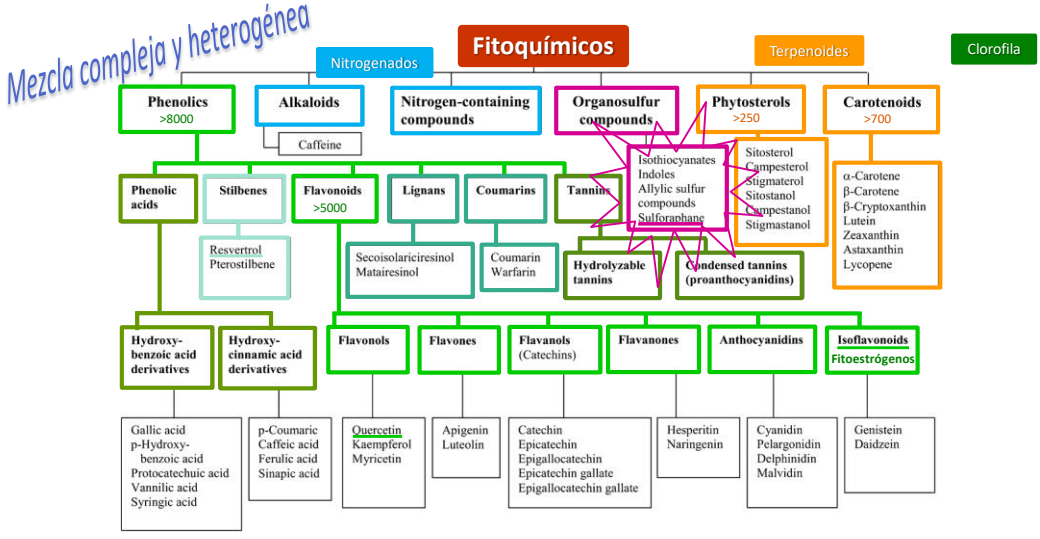


Figura 2. Contribución de los grupos de alimentos vegetales a la ingesta diaria estimada de fitoesteroles a los 12 meses de intervención en los participantes del **estudio PREDIMED**. Escurriol y col., Dietética.2010; 14 :3-9 - vol.14 núm 01

http://www.elsevier.es/es/revistas/revista-espa%C3%B1ola-nutricion-humana-dietetica-283/fitoesteroles-circulantes-biomarcadores-absorcion-los-esteroles-dieta-13149397-originales-2010

Componentes bioactivos. Clasificación

Mezcla compleja y heterogénea



Liu RH. **Health-promoting components of fruits and vegetables in the diet.** Adv Nutr. 2013 ;4:384S-92S. http://advances.nutrition.org/content/4/3/384S.long

Compuestos azufrados:

- Aliáceas (Alicina, Aliína, Ajoeno, Sulfuro de dialilo, Tiosulfinatos, Saponina, ..)
- Crucíferas (Glucosinolatos (>120) (isotiocianato, sulforafano, I3C)

EPIC – España 1992-96 (Hª Dietética – R24h)

Ingesta de crucíferas: 11.3 g/día:
Coliflor> repollo>coles de Bruselas>
brécol (2,6g/d)>lombarda>nabo
(5% de vegetales ≈225 g/d)
Glucosinolatos: 6.5 mg/día
Mujeres>hombres
Norte *vs* Sur: 7.3 vs 5.4 mg/d

Agudo y col. Consumption of cruciferous vegetables and glucosinolates in a Spanish adult population. Eur J Clin Nutr. 2008;62(3):324-31.

http://www.thegutsygourmet.net/post-brassica.jpg

Familia Brassicaceae o Cruciferae (crucíferas)

350 géneros
3200 especies

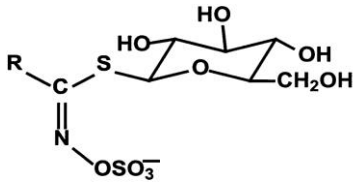
España es el mayor exportador de coles (brócoli, coliflor y coles) de la Unión Europea Y el 2º mayor productor después de EEUU

Asociación de Productores-Exportadores de Frutas y Hortalizas de la Región de Murcia - http://www.masbrocoli.com/aldia/ficha_aldia.aspx?frmId=75#sthash.1GP2UY7I.dpuf

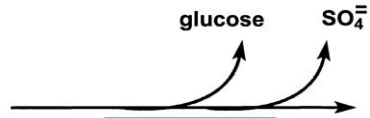
- *Brassica*
  - Col, col-i-flor, brócoli, repollo, lombarda, coles de Bruselas, col china, col rizada (Berza, kale)
  - Nabo o colinabo, nabiza, grelos
  - Colza, aceite de colza
  - Mostaza negra
- *Raphanus*
  - Rábano, rabanitos
  - Wasabi (rábano picante)
- *Sinapis*
  - Mostaza blanca
- *Nasturtium*
  - Rúcula, berro

Hojas
Inflorescencias
Tallos
Raíces
Semillas

Conversión de glucosinolatos en isotiocianatos por la enzima mirosinasa de la planta o de la flora intestinal



Glucosinolatos >120



Mirosinasa

Crucíferas masticadas , trituradas o troceadas

R–N=C=S

Isotiocianatos
- Fenetil isotiocianato
- Alil isotiocianato
- **Sulforafano**

Indoles
- **Indol-3-carbinol**

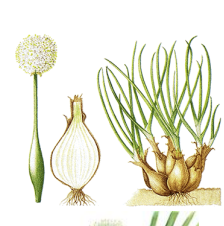
Responsables del típico sabor y olor de estos alimentos y de su papel en la salud

Talalay, Fahey. J. Nutr. 2001;131:3027S-3033S
Keum y col., 2004

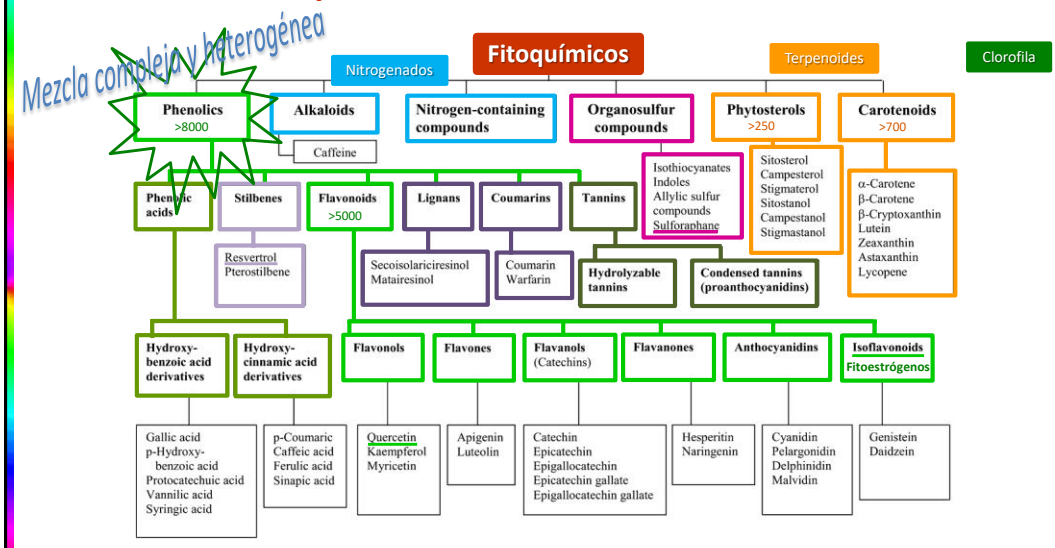
Cebolla (*Allium cepa* L.)
Chalota (*Allium ascalonicum*)

- Compuestos fenólicos:
  - Mejor fuente del flavonoide quercetina
  - Antocianinas (color morado)
- Compuestos azufrados (alíina, alicina)
- Fibra: fructanos, FOS (efecto prebiótico)

Efecto antioxidante, antiinflamatorio, antimicrobiano, anticancerígeno



Componentes bioactivos. Clasificación



Liu RH. **Health-promoting components of fruits and vegetables in the diet.** Adv Nutr. 2013 ;4:384S-92S. http://advances.nutrition.org/content/4/3/384S.long

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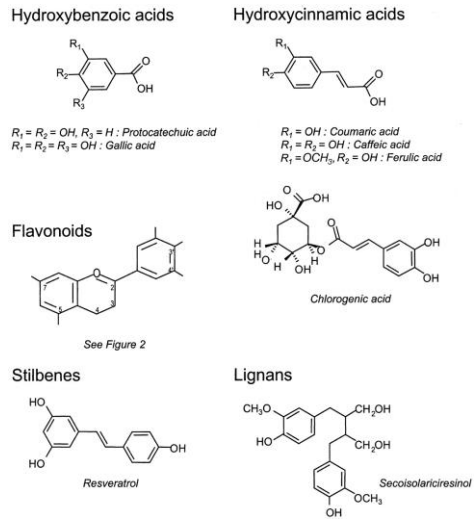
Chemical structures of polyphenols



Claudine Manach et al. Am J Clin Nutr 2004;79:727-747

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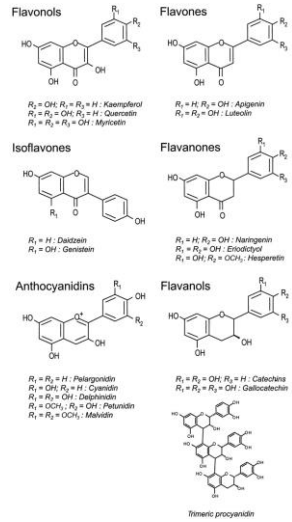
Chemical structures of flavonoids



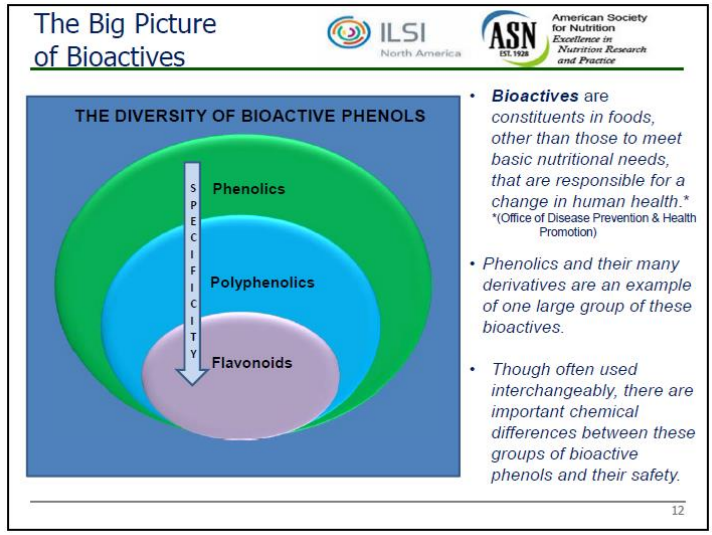
Claudine Manach et al. Am J Clin Nutr 2004;79:727-747

Table 1. Content of polyphenols in foods and beverages

Chemical class	Most common examples	Rich sources	Mean UK intake (mg/day)[a]	Comments on possible variations from the mean in individual diets
Flavanols	Catechins, gallocatechins (monomeric and oligomeric)	Tea (epicatechins, gallocatechins, theaflavins), cocoa (epicatechin, procyanidins), apples, broad beans (epicatechin)	590 (600)	Much higher in heavy tea drinkers
Flavanones	Hesperidin	Citrus fruit	25 (32)	Orange juice up to 500 mg/l
Flavonols	Quercetin, rutin	Tea, apples, onions	61 (40)	
Hydoxycinnamic acids	Chlorogenic acids (caffeoylquinic acids)	Coffee, chicory, artichoke, plum, pears	478 (517)	Up to 2000 mg/day in heavy coffee drinkers
Anthocyanins	Cyanidin	Berry fruits	20 (24)	A 100 g portion of blackberries contains ~170 mg anthocyanins

[a] Data from Yahya *et al.* (2016) (Leeds Wellbeing study) but intakes are dependent on individual diets and highly variable. Value in parentheses shows standard deviation.

Willianson, The role of polyphenols in modern nutrition 2017;42/3: 226–235.
http://onlinelibrary.wiley.com/doi/10.1111/nbu.12278/full



- ILSI, Flavonoids | Más

http://ilsina.org/event/understanding-flavonoids-their-role-in-health/
Http://asn-cdn-remembers.s3.amazonaws.com/f389088d94b90d94dce8a69512c9159c.pdf

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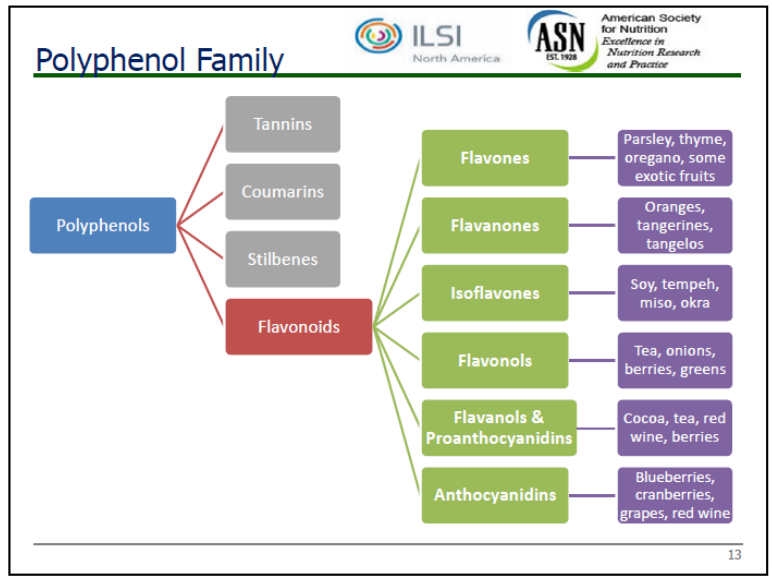

- ILSI, Flavonoids | Más

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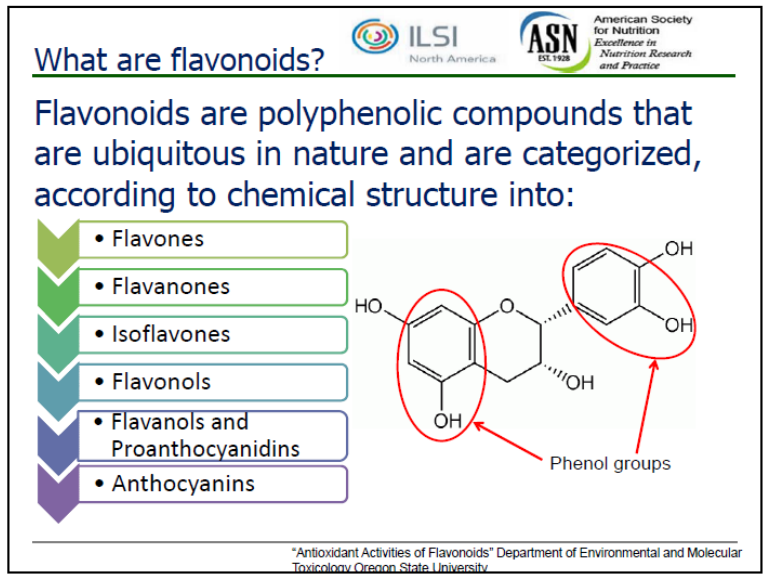

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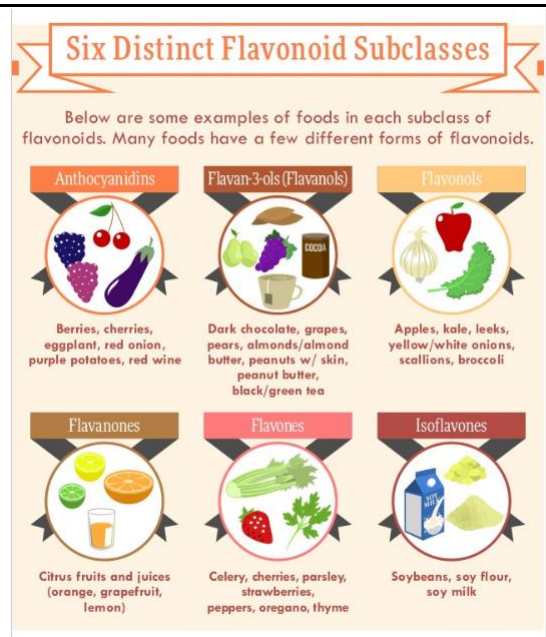
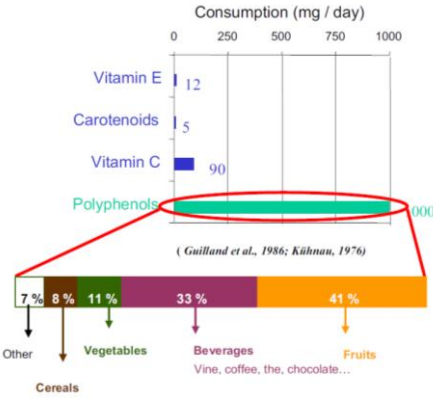


http://www.foodinsight.org/infographic-flavanoids-antioxidants-chocolate-health

Compuestos fenólicos, polifenoles (>8.000)



Dark Chocolate	951 mg/40 g
Milk Chocolate	394 mg/40 g
Hot Chocolate	45 mg/240 mL

Catequina, epicatequina, proantocianidina

Dragan Milenkovic, Sylvain Auclair, Augustin Scalbert. Unité de nutrition Humaine, Centre d'INRA de Clermont-Ferrand/Theix, France

Ingesta total ≈ 1 g/d en personas que comen varias porciones de frutas y vegetales al día
(Guilland *et al.* 1986; Kühnau, 1976; Manach et al. 2004)
- 1/3 son no flavonoides y 2/3 son flavonoides
(Urquiaga, 2007)

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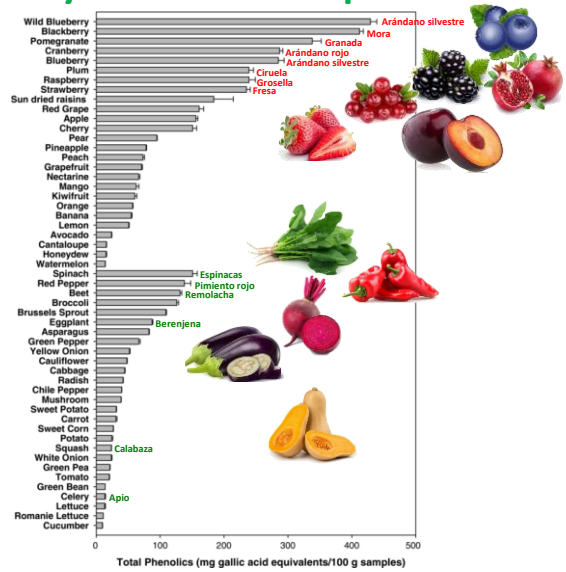
Dietary Bioactive Compounds



Journal of Food Science, Volume 78, Issue s1, pages A18-A25, 21 JUN 2013
http://onlinelibrary.wiley.com/doi/10.1111/1750-3841.12101/full#jfds12101-fig-0001

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España: Ingesta de polifenoles

(extractable + non-extractable) (mg/g original dry sample) (Saura y Goñi, 2007)

Food group	Group intake[a] g/d	Total polyphenols intake range mg/d
Cereals	221.7 ± 4.43	793–1.087
Vegetables	280.2 ± 5.61	230–283
Legumes	22.2 ± 0.44	238–275
Fruits	200.6 ± 4.01	470–763
Nuts	5.9 ± 0.12	102–121
Beverages	**505 (ml)[b] ± 10.10**	**580–647** (19-25% del total)
Oils	52 (ml)[b] ± 1.04	5–11
Total		**2.591–3.016 mg/día**

[a] g Edible portion/person yday; [b] From Saura-Calixto and Goñi (2006).
http://www.sciencedirect.com/science/article/pii/S0308814606001130#tbl3

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Ingesta total de flavonoides en Europa

(Zamora-Ros y col., 2012)

EPIC study	MED countries	Non-MED countries
Flavonoid intake (mg/d)	310.2 ± 3.0	373.7 ± 3.0 (ns)
Proantocianidinas/ Antocianidinas (% total)	59% Frutas, vino, té, hortalizas	48,2% Té, frutas

- **Flavonoles (miricetina, quercetina)**
- **Flavonas (apigenina)**
- Flavanoles (catequina)
- Favanonas (naringenina)
- Antocianidinas (cianidina)
- Isoflavonoides (fitoestrógenos: genisteína, daidzeína)

Mayoritarios en la dieta
- Quercetina: 70%
- Kanferol: 17%
- Miricetina: 6%
- Luteolina: 4%
- Apigenina: 3%

MANZANAS
UVAS
CEBOLLAS
CÍTRICOS
SOJA
FRUTAS Y HORTALIZAS

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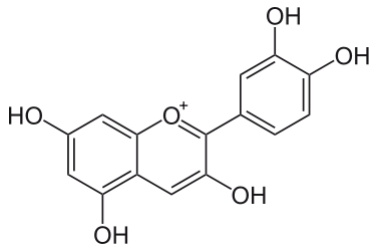
Cianidina



En medio ácido (pH < 3) = rojo
pH neutro = púrpura
En medio básico = azúl

http://cienciadesdeotropunto.blogspot.com.es/2012/03/disoluciones-de-colores-lombarda-como.html
http://www.ehu.eus/biomoleculas/hc/sugar33c4.htm#a
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-20612004000400036

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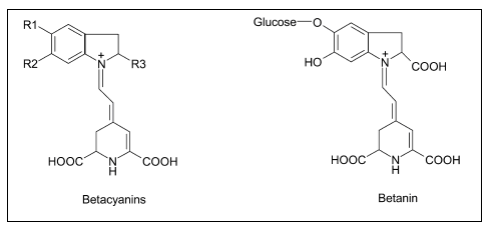
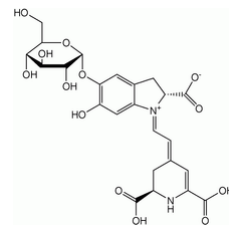
Betalaínas:

- Betacianinas (Betanina) (E-162): color púrpura
- Betaxantinas: amarillas





Al contrario de lo que sucede con las antocianinas, el color de las betalaínas no depende del pH. Las betacianinas mantienen su color púrpura sin ningún cambio entre pH 4 y 7 y los cambios que se producen a pH tan extremos como 2 ó 9 son pequeños.

http://milksci.unizar.es/bioquimica/temas/pigmentos/otroscolores.html
www.investigacionyciencia.es/files/2981.pdf
http://www.consumer.es/seguridad-alimentaria/ciencia-y-tecnologia/2002/10/29/3885.php

Betalains and anthocyanins are two different families of pigments that are never found together in the same plant (Gandía-Herrero et al. Trends Plant Sci. 2013 Jun;18(6):334-43).

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Table 2 Total polyphenol, flavonoid and phenolic acid intake from the different food groups in the PREDIMED cohort, relative contribution of each food group and main food sources.

Food group	Total polyphenols (mg/d)	Flavonoids (mg/d)	Phenolic acids (mg/d)	Main food sources (% contribution to polyphenol intake in the food group)
Fruit	360 ± 217	255 ± 167	72 ± 61	Oranges (33), apples (28), olives (15), cherries (8)
Non-alcoholic beverages	192 ± 140	23 ± 39	168 ± 133	Coffee (88), orange juice (7), tea (3), other juices (1)
Vegetables	104 ± 40	67 ± 31	37 ± 18	Potatoes (35), spinach (20), onions (12), lettuce (8)
Alcoholic beverages	67 ± 126	52 ± 101	10 ± 18	Red wine (95), beer (3), rosé wine (0.8), white wine (0.7)
Cereals	43 ± 48	19 ± 18	12 ± 14	Refined wheat-flour bread (44), whole-grain wheat-flour bread (31), whole-grain flour biscuits (10), breakfast cereals (5)
Oils	22 ± 11	0.36 ± 0.33	0.12 ± 0.05	Virgin olive oil (62), olive oil (38)
Cocoa products	16 ± 41	15 ± 40	0.3 ± 0.7	Chocolate (73), cocoa powder (27)
Nuts and seeds	10 ± 14	6.4 ± 9.3	3.8 ± 6.0	Walnuts (66), other nuts (34)
Legumes	5.6 ± 4.8	4.8 ± 4.2	0.8 ± 0.7	Beans (97), lentils (2), peas (1)
Total	820 ± 323	443 ± 218	304 ± 156	Coffee (18), oranges (16), apples (12), olives and olive oil (11), red wine (6)

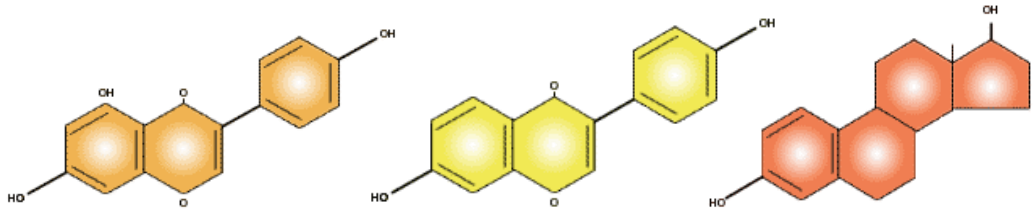
Tresserra-Rimbau y col., Nutr Metab Cardiovasc Dis. 2013 Oct;23(10):953-9.

Table 3 Polyphenol intakes according to main polyphenol subclasses in the 7200 participants of the PREDIMED cohort and main food sources.

Polyphenol subclass	Total polyphenols (mg/d)	Main food contributors (% contribution to intake of the polyphenol subclass)
Hydroxycinnamic acids	276 ± 146	Coffee (62), potatoes (9), apples (7), olives (5)
Flavanones	132 ± 125	Oranges (91), orange juice (8), red wine (0.5), tomatoes (0.1)
Proanthocyanidins	117 ± 81	Red wine (35), apples (33), peaches (12), plums (7)
Flavonols	80.4 ± 32.7	Spinach (24), beans (17), onions (14), lettuce (6)
Flavones	41.6 ± 26.1	Oranges (39), whole-grain wheat-flour bread (23), refined-grain wheat-flour bread (19), whole-grain wheat-flour biscuits (5)
Anthocyanins	38.5 ± 37.4	Cherries (30), red wine (29), olives (12), strawberries (10)
Catechins	26.7 ± 19.6	Apples (24), red wine (21), tea (11), peaches (10)
Hydroxybenzoic acids	19.1 ± 16.8	Olives (46), red wine (21), walnuts (10), beer (5)
Dihydroxychalcones	2.95 ± 2.57	Apples (100)
Dihydroflavonols	2.82 ± 5.39	Red wine (98), rosé wine (1), white wine (1)
Stilbenes	1.84 ± 3.39	Red wine (94), white wine (2), grapes (1), strawberries (1)
Lignans	0.85 ± 0.36	Olive oil (47), virgin olive oil (25), whole-grain wheat-flour bread (6), refined-grain wheat-flour bread (5)
Theaflavins	0.33 ± 1.36	Tea (100)
Isoflavonoids	0.003 ± 0.003	Beans (97), beer (3)
Chalcones	0.0006 ± 0.0019	Beer (100)
Other phenolic acids	7.56 ± 11.3	Olives (90), red wine (6), beer (2), virgin olive oil (1)
Other polyphenols	71.2 ± 46.7	Olives (37), virgin olive oil (18), olive oil (11), whole-grain wheat-flour bread (9)

Tresserra-Rimbau y col., Nutr Metab Cardiovasc Dis. 2013 Oct;23(10):953-9.

Isoflavonas y estradiol



Genisteína Diadzeina Estradiol

Ingesta de Fitoestrógenos

España = < 1 mg/día
Japoneses = 18,3 - 31,4 mg/día
Coreanos = 23,3 mg/día

Hernandez-elizondo, J. et al. Estimación de la ingesta de fitoestrógenos en población femenina. *Nutr. Hosp.* 2009, vol.24, n.4, pp. 445-451. http://scielo.isciii.es/pdf/nh/v24n4/original2.pdf

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Fitoestrógenos derivados de lignanos y otros bioactivos

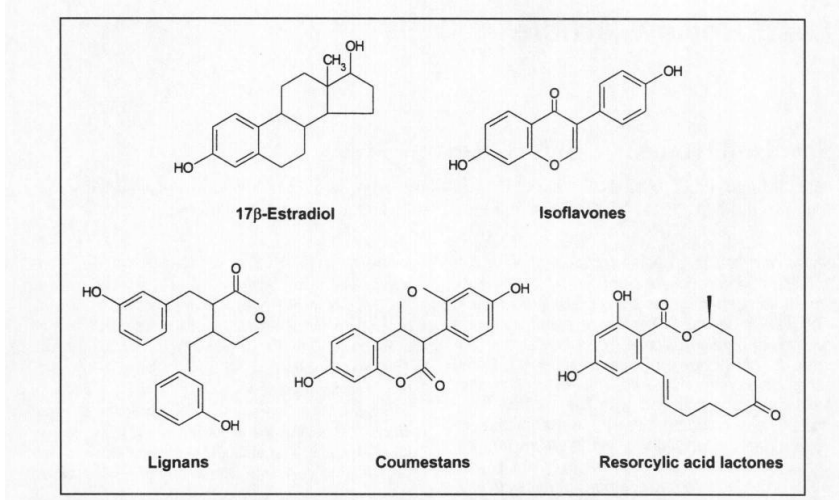

Figure 1. Chemical structure of the human estrogen, 17β-estradiol, and the classes of phytoestrogens compounds, isoflavones, lignans, coumestans, and resorcylic acid lactones.

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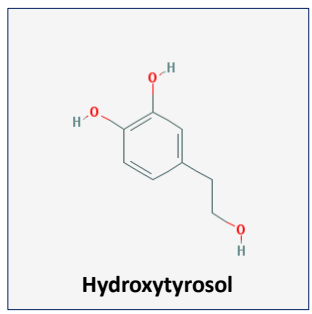
Aceite de oliva (az-zait)

- AGM (80% oleico) (AGP)
- Vitamina E
- Otros bioactivos minoritarios:
  - Polifenoles, flavonoides (36 identifi. , ↑Biodisponibilidad; 500 mg/L aceite virgen extra)
  - Carotenos, fitosteroles, ..
  - >200; 2% del peso

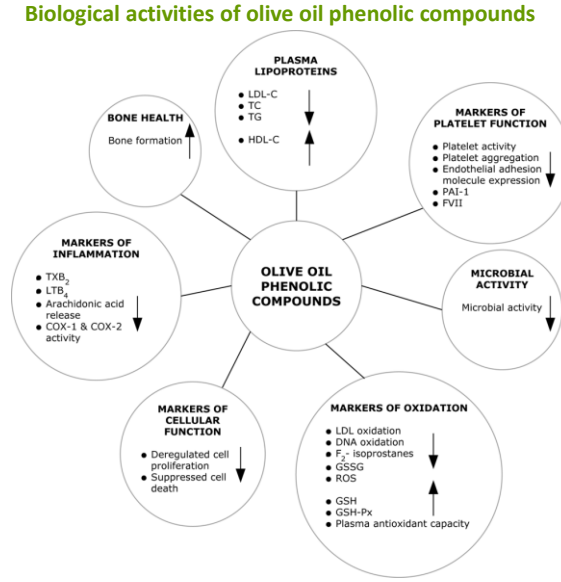


Hydroxytyrosol

The three phenolic compounds in highest concentration in olive oil are:
- Oleuropein
- **Hydroxytyrosol** (3,4-dihydroxyphenyl ethanol)
- Tyrosol.

Sabor amargo y picante

Biological activities of olive oil phenolic compounds



Cicerale S, Lucas L, Keast R. Biological Activities of Phenolic Compounds Present in Virgin Olive Oil. *International Journal of Molecular Sciences* **2010**, *11*(2), 458-479. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2852848/

Scientific Opinion on the substantiation of health claims related to polyphenols in olive and protection of LDL particles from oxidative damage. EFSA Journal 2011;9(4):2033.

CONCLUSIONS

On the basis of the data presented, the Panel concludes that: The food constituent, polyphenols in olive (olive fruit, olive mill waste waters or olive oil, *Olea europaea* L. extract and leaf) standardised by their content of hydroxytyrosol and its derivatives (e.g. oleuropein complex), which is the subject of the health claims, is sufficiently characterised in relation to the claimed effects.

Protection of LDL particles from oxidative damage

The claimed effects are "reduces oxidative stress", "antioxidant properties", "lipid metabolism", "antioxidant activity, they protect body cells and LDL from oxidative damages", and "antioxidant properties". The target population is assumed to be the general population. In the context of the proposed wordings, the Panel assumes that the claimed effects refer to the protection of low-density lipoprotein (LDL) particles from oxidative damage. Protection of LDL particles from oxidative damage may be a beneficial physiological effect.

A cause and effect relationship has been established between the consumption of olive oil polyphenols (standardised by the content of hydroxytyrosol and its derivatives) and protection of LDL particles from oxidative damage.
The following wording reflects the scientific evidence: "Consumption of olive oil polyphenols contributes to the protection of blood lipids from oxidative damage."

In order to bear the claim, **5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) in olive oil should be consumed daily**. These amounts, if provided by moderate amounts of olive oil, can be easily consumed in the context of a balanced diet. The concentrations in some olive oils may be too low to allow the consumption of this amount of polyphenols in the context of a balanced diet. The target population is the general population.

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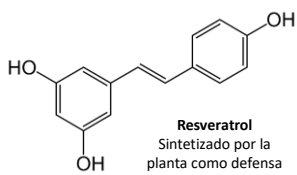
Vino tinto: >500 componentes ≠

- Polifenoles (Hidroxitirosol, Resveratrol, etc.)
  (1,8 g/L de polifenoles)



Resveratrol
Sintetizado por la planta como defensa frente a infección y estrés oxidativo.

- Uvas (sólo en la piel)
- Vino
- zumo de uva
- Cacahuetes
- Arándanos
- Arándanos rojos

Table 3 Potentially active polyphenols in wine[125]

Polyphenols have multiple aromatic rings possessing hydroxyl groups

A. **Flavonoids**
   Anthocyanins: cyanidin, delphindin (both as glycosides)
   Flavonols: quercetin, as glycoside
   Flavan-3-ols (not found as glycosides):
      Monomers: *catechins*
      Oligomers: *procyanidins*,[111]
      Polymers: proanthocyanidins (oligomers and polymers contain catechins and epicatechin)

B. **Non-flavonoids**
   Resveratrol
   Peceid, conjugated resveratrol glycoside
   Gallic acid
   Others

The italicized polyphenols are those most clearly linked to beneficial changes in cardiovascular experiments.

Lionel H. Opie and Sandrine Lecour The red wine hypothesis: from concepts to protective signalling molecules. Eur Heart J 2007, 28: 1683-1693.

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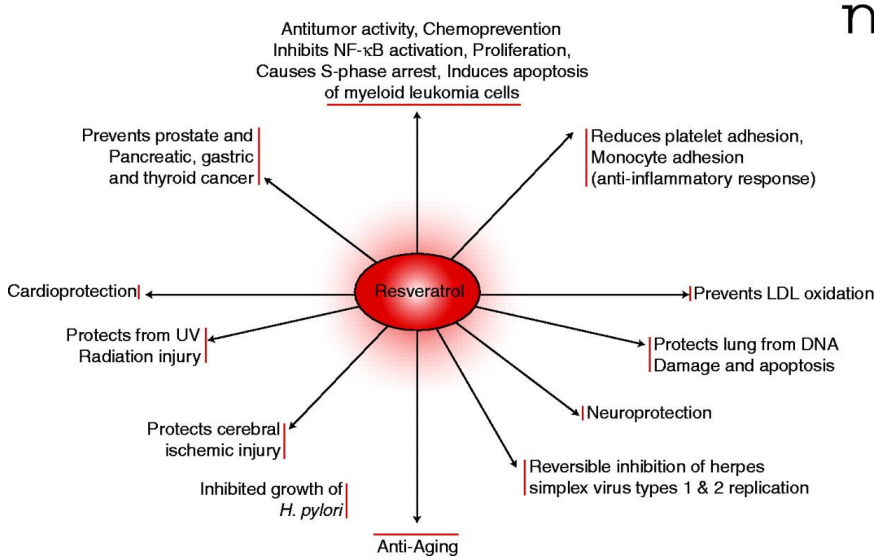
Health benefits of Resveratrol



Mol. Interv. 2006;6:36-47. **Resveratrol in Cardioprotection: A Therapeutic Promise of Alternative Medicine** Dipak K. Das and Nilanjana Maulik

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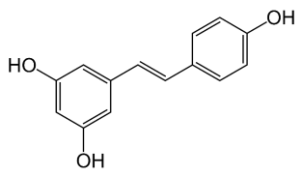
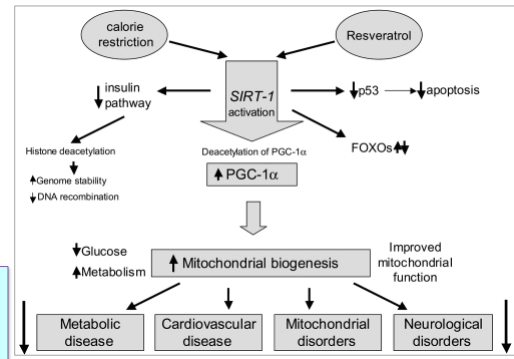
Resveratrol



"Muchos factores endógenos y exógenos, entre ellos la dieta hipocalórica, las sirtuinas y el resveratrol, regulan la biogénesis mitocondrial, al activar el PGC-1α (coactivador 1 alfa del receptor activado por proliferadores de peroxisomas). La actividad de las sirtuinas, productos de los genes de longevidad Sirt, se induce por la dieta hipocalórica y se controla por los cambios en el cociente intracelular NAD/NADH. Las sirtuinas son desacetilasas dependientes del NAD que establecen conexión entre la función mitocondrial, el metabolismo y la longevidad. El resveratrol, un mimético de la dieta hipocalórica, activa las sirtuinas e inhibe algunos de los efectos indeseables del envejecimiento"
(Cascales An. R. Acad. Nac. Farm., 2009, 75 (2): 273-301).
http://www.analesranf.com/index.php/aranf/article/viewFile/938/943



Curró y col. Resveratrol protects against homocysteine-induced cell damage via cell stress response in neuroblastoma cells. J Neurosci Res. 2015 Jan;93(1):149-56.
Bastianetto y col. Neuroprotective action of resveratrol. Biochim Biophys Acta. 2015 Jun;1852(6):1195-201.

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Hierbas y especias, ajo, cebolla, vinagre, limón, …

Encabezan el ranking de capacidad antioxidante

9 Antioxidant activity of common dried herbs and spices.[42]

>2000 bioactivos

Common name	Botanical name	Antioxidant activity*
Clove	*Syzygium aromaticum*	465.3 mmol/100 g
Oregano	*Origanum vulgare*	137.5 mmol/100 g
Cinnamon	*Cinnamomum zeylanicum*	98.4 mmol/100 g
Peppermint	*Mentha piperita*	78.5 mmol/100 g
Thyme	*Thymus vulgaris L.*	74.6 mmol/100 g
Rosemary	*Rosmarinus officinalis L.*	66.9 mmol/100 g
Marjoram (sweet)	*Origanum majorana*	55.8 mmol/100 g
Basil	*Ocimum basilicum L.*	30.9 mmol/100 g
Ginger	*Zingiber officinale*	22.5 mmol/100 g
Dill	*Anethum graveolens*	15.9 mmol/100 g
Curry	*Murraya koenigii L.*	13.0 mmol/100 g
Chives	*Allium schoenoprasum*	7.1 mmol/100 g
Parsley	*Petroselinum crispum*	3.6 mmol/100 g
Coriander	*Coriandrum sativum L.*	3.3 mmol/100 g
Vanilla seeds	*Vanilla planifolia*	2.6 mmol/100 g
Garlic	*Allium sativum L.*	2.1 mmol/100 g

* Mean total antioxidant activity per 100 g. (Tapsell, 2006)

Biodisponibilidad de bioactivos

- Se absorben principalmente en forma libre (como aglicona), algunos unidos a azúcares (como glucósidos)
- Pico en sangre: entre 1 y 2,5 horas, o hasta 8 h en algunos compuestos
- Concentración plasmática: rango 1-5 µmol/L
- En sangre circulan como metabolitos conjugados (metilados, sulfatados o como glucurónidos)
- Pueden ser parcialmente metabolizados por la flora intestinal
- Vida media de eliminación: 23 a 28 h
- Detoxificación metabólica como xenobióticos para reducir su potencial efecto citotóxico, incrementar su hidrosolubilidad y facilitar su eliminación urinaria o biliar.
- Excreción urinaria/biliar
- Biodisponibilidad: 20% +/-

Steinberg, Department of Nutrition, University of California, 2012
Mariane Lutz. Biodisponibilidad de compuestos bioactivos en alimentos. PERSPECTIVAS EN NUTRICIÓN HUMANA. Vol. 15, N° 2, julio-diciembre de 2013, p. 217-226

Biodisponibilidad

Factores que afectan a los efectos biológicos de los bioactivos

- Factores inter-individuales
  - Transporte a través de la pared intestinal
  - Diferencias genéticas en la biotransformación enzimática (fase I y II) e interacción con otros compuestos endógenos o xenobióticos
  - Microflora intestinal
  - Tránsito intestinal
  - Edad, sexo, estado fisiológico
- Dieta, matriz alimentaria, naturaleza química del bioactivo (lipo/hidrosolubilidad, tamaño molecular, grado de polimerización y si están o no conjugados, …..)

Steinberg, Department of Nutrition, University of California, 2012
Mariane Lutz. Biodisponibilidad de compuestos bioactivos en alimentos. PERSPECTIVAS EN NUTRICIÓN HUMANA. Vol. 15, N° 2, julio-diciembre de 2013, p. 217-226

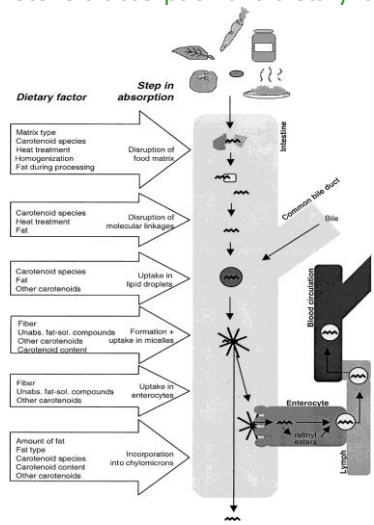
Biodisponibilidad

"Colon: importante en la metabolización de los compuestos bioactivos: La flora microbiana posee una alta actividad hidrolítica y es capaz de desconjugar las moléculas que se encuentren de esta forma y romper las moléculas grandes, liberando otras más pequeñas y simples, muchas de las cuales son biodisponibles. Esto explica, en gran medida, la alta variabilidad observada en los niveles plasmáticos de compuestos bioactivos medidos en sujetos que consumen cantidades estándar de estos compuestos, ya que su metabolismo intestinal es altamente dependiente de su tipo de flora microbiana, generando metabolitos diversos cuya biodisponibilidad (BD) es diferente. En consecuencia, la BD de los compuestos originalmente presentes en el alimento puede ser extremadamente baja, pero la BD de sus productos de fermentación puede ser muy elevada. Un ejemplo es el de compuestos fenólicos presentes en la granada, fruto reconocido por poseer un alto contenido de elagitaninos (taninos hidrolizables) y elevada capacidad antioxidante; sin embargo, los compuestos que son realmente biodisponibles no son los que se encuentran originalmente en la fruta, sino los derivados del ácido elágico y otros que genera la microbiota, como la urolitina B, que ejerce una serie de acciones saludables, y que se puede medir en plasma y orina luego de ingerir la granada. El rol de la microflora intestinal en la BD de algunos compuestos es muy importante: es el caso de la isoflavona daidzeína, que puede dar origen a los metabolitos bioactivos equol y O-desmetilangolensina. Se ha descrito que sólo el 30 a 40% de las personas que consumen soya, el principal aportador de isoflavonas de la dieta, pueden producir equol, debido a que el tipo de flora intestinal que poseen es capaz de realizar esta acción y, en consecuencia, este se absorbe y es biodisponible para actuar en el organismo de estos sujetos".
Mariane Lutz. Biodisponibilidad de compuestos bioactivos en alimentos. PERSPECTIVAS EN NUTRICIÓN HUMANA. Vol. 15, N° 2, julio-diciembre de 2013, p. 217-226

Ejemplo de biodisponibilidad

"Proporción de bioactivo que se digiere, absorbe y metaboliza a través de las rutas metabólicas habituales"

Steps of carotenoid absorption and dietary factors that affect carotenoid absorption



Absorción: 20-60%

"SLAMENGHI":

Species of carotenoids,
Linkages at molecular level,
Amount of carotenoid,
Matrix,
Effectors,
Nutrient status,
Genetics,
Host-related factors
Interactions among these variables

Los carotenoides sin actividad pro-vitamínica A compiten con el B-caroteno en la absorción intestinal y en el metabolismo.

van het Hof K H et al. J. Nutr. 2000;130:503-506

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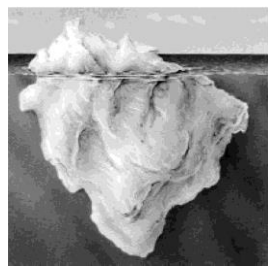
Known and missing dietary polyphenols

Total España	2.591–3.016 mg/día



Extractable Polyphenols (EPP) ⟷ Chemical and Biological studies Nutrition and Health research

1.106 mg/día → **Biodisponibilidad 2-20% (<10%)** (Martin y Appel, 2010)

Non Extractable Polyphenols (NEPP)

1.910 mg/día → **Fermentación colónica**
- **Efectos locales**
- **Efectos sistémicos**

Saura-Calixto; *J. Agric. Food Chem.* **2012,** 60, 11195-11200.

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Efecto prebiótico de los polifenoles no extraibles

Saura. J. Agric. Food Chem. 2012, 60, 11195−11200

Main Features
nonsoluble in aqueous organic solvents
main classes: high molecular weight proanthocyanidins, hydrolyzable phenolics (including phenolic acids and hydrolyzable tannins)
nonbioaccesible neither bioavailable in the small intestine
bioaccessible and bioavailable in the large intestine
time to reach maximum concentration in plasma ≥8 h
Health-Related Properties
enhancement of lipid excretion
increase of intestinal antioxidant activity
modulation of *Lactobacillus* growth in rat cecum
chemopreventive effect: reduction of the number and size of colonic crypts
modulation of gene expression: down-regulation of genes associated with tumor development and proto-oncogenes, up-regulation of tumor suppressor genes
production of phenolic metabolite with potential systemic effects

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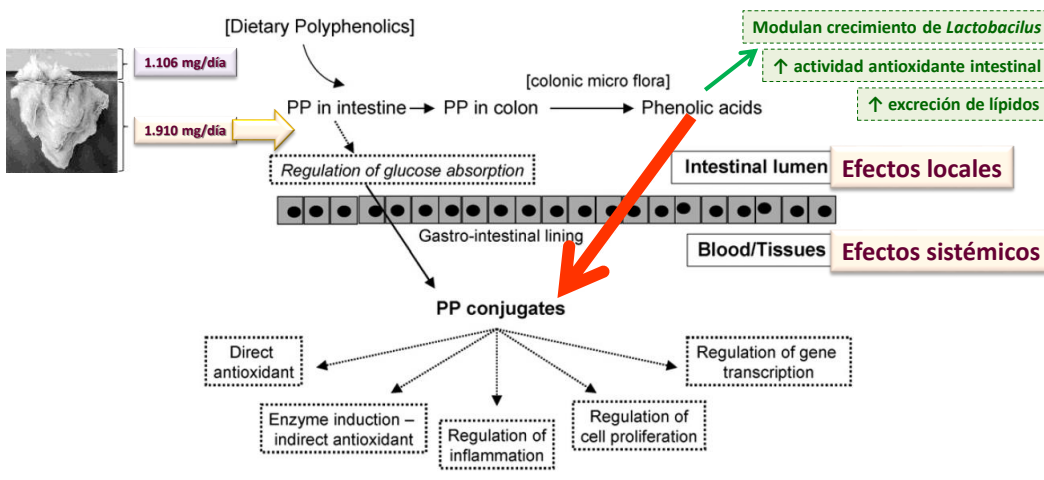
Potencial efecto "prebiótico" de los polifenoles no extraíbles

(Goñi y col., 2005; Stevenson y col., 2007; Hevert y col., 2009; López-Oliva y col., 2012; Pozuelo y col., 2012; Saura, 2012)



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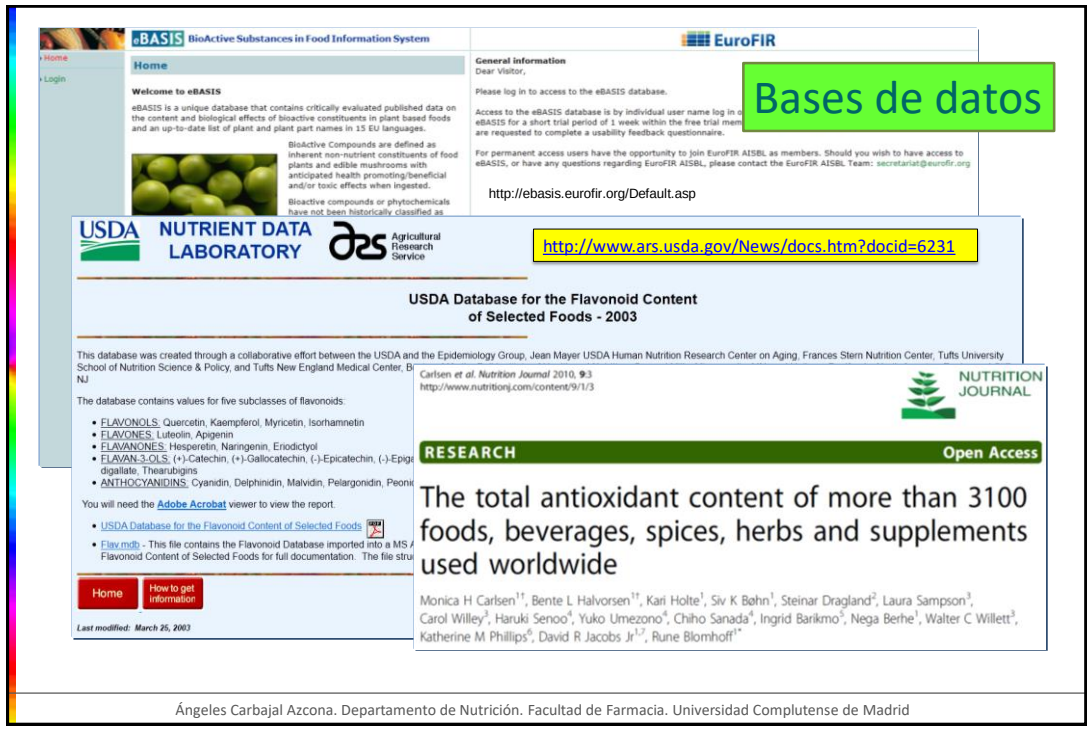

Phytonutrient intakes in European Union countries in relation to fruit and vegetable (F&V) consumption from the European Food Safety Authority (EFSA) Comprehensive Food Consumption Database. F&V consumption taken from the EFSA data [19]. Phytonutrient intake (mg/d) is the product of F&V consumption and phytonutrient levels from online supplementary Table S1. **The values above the double line represent the countries that consume an average amount of < 400 g of F&V**. Dark, light and no shading indicate upper 25th, middle 50th and lower 25th percentiles, respectively, for consumption of each phytonutrient. http://www.journals.cambridge.org/bjn

Country	F&V (g/d)	α-Carotene	β-Carotene	β-Cryptoxanthin	Lycopene	Lutein/ zeaxanthin	Anthocyanidin	Flavanone	Flavonol	Flavanol	Ellagic aci
Sweden	285	1·3	2·4	1·02	4·9	2·6	13	18	7	10	1·3
The Netherlands	292	1·1	3·1	0·54	3·6	3·2	3	13	12	7	0·2
Latvia	293	1·7	3·2	1·70	4·6	4·1	32	3	11	8	4·9
Ireland	330	2·6	5·3	1·28	3·0	4·6	6	9	18	8	0·5
UK	333	1·9	4·3	1·16	5·0	4·2	14	7	16	9	1·3
Belgium	336	1·8	4·1	1·28	4·1	3·9	20	11	14	12	2·0
Czech Republic	338	1·5	2·9	1·02	1·1	3·3	14	11	17	12	1·2
Germany	392	1·4	4·2	1·07	4·8	3·4	23	8	13	16	2·4
France	397	2·2	5·4	1·41	2·0	4·0	29	9	16	14	2·4
Finland	417	2·2	4·8	1·56	1·6	4·2	32	33	17	9	5·5
Denmark	429	3·2	6·6	2·03	2·1	5·4	22	11	18	19	1·7
Hungary	434	1·6	3·3	0·85	0·9	3·8	9	12	19	20	1·0
Spain	468	2·8	7·2	2·45	2·9	6·3	25	20	25	15	1·5
Italy	509	3·5	8·7	3·11	3·3	7·5	24	30	22	18	0·6
Average <400 g/d	333	1·7	3·9	1·2	3·7	3·7	17·1	9·9	13·8	10·7	1·8
Average >400 g/d	451	2·7	6·1	2·0	2·2	5·4	22·4	21·2	20·2	16·2	2·1
P	<0·01	0·01	0·02	0·02	0·05	0·01	0·33	0·01	0·01	0·02	0·78

Notes: NA, not available; FBS, food balance sheets; EFSA, European Food Safety Authority; NDNS, National Diet and Nutrition Survey.

Phytonutrient intakes in relation to European fruit and vegetable consumption patterns observed in different food surveys
David R. Tennant, Julia Davidson and Andrea J. Day,
British Journal of Nutrition
Volume 112, Issue 07, pp 1214-1225
doi:10.1017/S0007114514001950, Published online by Cambridge University Press August 2014;

Ángeles Carbajal Azcona. Departamento de Nutrición. Facultad de Farmacia. Universidad Complutense de Madrid

Tabla 1. Algunos componentes bioactivos de los alimentos de origen vegetal, principales fuentes dietéticas e ingesta en España

Componente	Fuente dietética	Ingesta en España[a]
Terpenoides (varios miles)		
– **Carotenoides** (de los más de 700 identificados, solo unos 50 están en la dieta y de estos los siguientes representan el 95% de los carotenoides en sangre): • Carotenos: – α-caroteno, β-caroteno (precursores de vitamina A). – Licopeno. • Xantofilas: – β-criptoxantina (provitamina A). – Luteína, zeaxantina	**β-caroteno:** hortalizas y frutas de color naranja (por ejemplo, zanahoria, mango, albaricoque, melón, melocotón, fruta de la pasión, ciruela); verduras de hoja verde oscuro (por ejemplo, espinacas); tomate y derivados. **Licopeno:** tomates, sandía, pimiento rojo, pomelo rosado. **β-criptoxantina:** naranjas, papaya. **Luteína y zeaxantina:** verduras de hoja verde (por ejemplo, acelgas, espinacas, lechuga, apio), naranjas, patatas, tomates, pimientos rojos, maíz, aguacate, melón.	**Carotenoides, total:** 3-4,3 mg/día. Licopeno: 1,3 mg/día. β-caroteno: 1 mg/día. Luteína: 0,5 mg/día. Zeaxantina: 0,1 mg/día. Europa: = 12 mg/día.
– **Fitoesteroles** (> 250): • Esteroles y estanoles (2 g/día para reducir LDL-c)[b]: β-sitosterol, estigmasterol, campesterol, sitostanol, campestanol.	Aceites vegetales (maíz, girasol, soja, oliva), cereales, legumbres, frutos secos, hortalizas. Alimentos enriquecidos.	**Dietas occidentales:** 150-555 mg/día. **Oriental y vegetariana:** 300 mg-1 g/día.
Compuestos fenólicos (> 8.000)		
– **Alcoholes y ácidos fenólicos simples** (tirosol, hidroxitirosol, ácidos hidroxibenzoicos e hidroxicinámicos [elágico, gálico, vanílico, capsaicina, cumárico, cafeico, ferúlico, clorogénico, etc.]).	Cítricos, aceitunas, aceite de oliva virgen, otras frutas, hortalizas, avena, soja, frutos secos, vino, cerveza, té, etc.	
– **Polifenoles:** • Flavonoides (> 5.000): – Flavonoles (quercetina, kamferol, miricetina, rutina, etc.). – Flavanoles (flaván-3-oles): – Catequinas (catequina, epicatequina, etc.). – Pro(anto)cianidinas o taninos condensados. – Flavanonas (naringenina, hesperitina, naringina, hesperidina, etc.). – Antocianinas (con azúcar en posición 3) y antocianidinas (antocianinas sin azúcar) (cianidina, etc.). – Flavonas (apigenina, luteolina, etc.). – Isoflavonas (genisteína, daidzeína, etc. [fitoestrógenos]). • Estilbenos (resveratrol). • Curcuminoides (curcumina). • Lignanos (principal fuente de fitoestrógenos en occidente).	**Quercetina, kamferol, miricetina y antocianidinas:** cebollas (30-40 mg/100 g), puerros, lechuga, brécol, tomates, uvas, naranjas (pulpa), manzanas, cerezas, moras, frambuesas, arándanos, aceitunas, vino tinto, té, orégano y otras hierbas aromáticas. **Catequinas y proantocianidinas:** manzanas, peras, cerezas, uvas, albaricoque, melocotón, frutos secos, legumbres, cacao, chocolate negro, vino, sidra, cerveza, té. **Hesperidina, naringenina:** cítricos, zumo de uva. **Apigenina, luteolina:** perejil, apio, pimiento, tomillo, aceitunas. **Resveratrol:** piel de la uva, vino, zumo de uva, arándanos. **Fitoestrógenos:** isoflavonas (genisteína, daidzeína) y lignanos: soja y derivados, otras legumbres, cereales integrales, frutos secos, frutos del bosque, brécol, ajo, zanahorias, etc.	**Polifenoles, total:** 2.500-3.000 mg/día. **Flavonoides:** Unos 25 mg/día. **Quercetina:** Unos 23 mg/día. **Fitoestrógenos:** España: < 1 mg/día. Asiáticos: 20-50 mg/día.
Compuestos azufrados		
– De aliáceas (alina, alicina, ajoeno, dialilsulfuro, etc.). – Glucosinolatos (> 120) (isotiocinato, sulforafano, Indol-3-carbinol).	**Alina, dialilsulfuro:** cebolla, cebollino, cebolleta, puerro, ajo. **Isotiocinato, sulforafano, I3C:** repollo, coliflor, brécol, berza, coles de Bruselas, lombarda, ajo, cebollas, nabo, mostaza.	**Glucosinolatos, total:** 6,5 mg/día. Norte/Sur: 7,3/5,4 mg/día.

Meléndez: Bodegón (pepinos, tomates y recipientes) - 1774
Museo del Prado. Madrid

Capitulo 2. Otros componentes de la dieta. 2.2. Componentes bioactivos de los alimentos.
www.kelloggs.es/content/dam/newton/media/manual_de_nutricion_new/Manual_Nutricion_Kelloggs_Capitulo_02.2.pdf
http://www.kelloggs.es/es_ES/manual-de-nutricion.html

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Food synergy: the key to a healthy diet

Jacobs Jr, D. R. & Tapsell, L. C. 2013, 'Food synergy: the key to a healthy diet', Proceeding of the Nutrition Society, vol. 72, no. 2, pp.200-206.

Concepto de dieta total

Proceso por el que componentes de los alimentos, nutrientes y no nutrientes, identificados o no, trabajan conjuntamente.

Efectos aditivos, sinérgicos y acumulativos

"El todo es mucho más que la suma de las partes"

Ángeles Carbajal Azcona. Departamento de Nutrición. Facultad de Farmacia. Universidad Complutense de Madrid

Antioxidant capacity of vegetables, spices and dressings relevant to nutrition

Br J Nutr 2005; 93: 257-266

Paolino Ninfali[1,2]*, Gloria Mea[2], Samantha Giorgini[2], Marco Rocchi[3] and Mara Bacchiocca[1]

Vegetables are the most important sources of phenolics in the Mediterranean diet. Phenolics, especially flavonoids, are suggested as being essential bioactive compounds providing health benefits. In this study, twenty-seven vegetables, fifteen aromatic herbs and some spices consumed in Central Italy (the Marches region) were studied to reveal total phenolic, flavonoid and flavanol content as well as their antioxidant capacity measured by the oxygen radical absorbance capacity (ORAC) method. A comparison in terms of antioxidant capacity was made between different salads, as well as between salads to which aromatic herbs had been added. Lemon balm and marjoram at a concentration of 1·5 % w/w increased by 150 % and 200 % respectively the antioxidant capacity of a salad portion. A 200 g portion of a salad enriched with marjoram corresponded to an intake of 200 (SD 10) mg phenolics and 4000 (SD 300) ORAC units (μmol Trolox equivalents). Olive oils and wine or apple vinegars were the salad dressings that provided the highest increase in antioxidant capacity. Among the spices tested, cumin and fresh ginger made the most significant contribution to the antioxidant capacity. The results are useful in surveying the antioxidant parameters of vegetables, herbs and spices produced and consumed in our geographical area as well as in quantifying the daily intake of phenolics and ORAC units. The results can be used in public health campaigns to stimulate the consumption of vegetables able to provide significant health protection in order to prevent chronic diseases.

- Marjoram, for example, has been shown to increase the antioxidant capacity by 200%
  (Ninfali y col., Br J Nutr 2005, 93, 257–266)
- Tomate entero: mayor protección en el cáncer de próstata (CP) que el suplemento de licopeno.
- **Brecol + tomate**: mayor protección en CP que cada alimento por separado.
  Tomatoes or lycopene versus prostate cancer: is evolution anti-reductionist? J Natl Cancer Inst. 2003 Nov 5;95(21):1563-5

Very low doses (more similar to dietary doses) of **selenium and docosahexaenoic acid** in combination were more effective against cancer than either of these components individually at high doses (Narayanan y col., 2004; Hardman y col. Nutrition and Cancer 2011;63:6, 960-970)

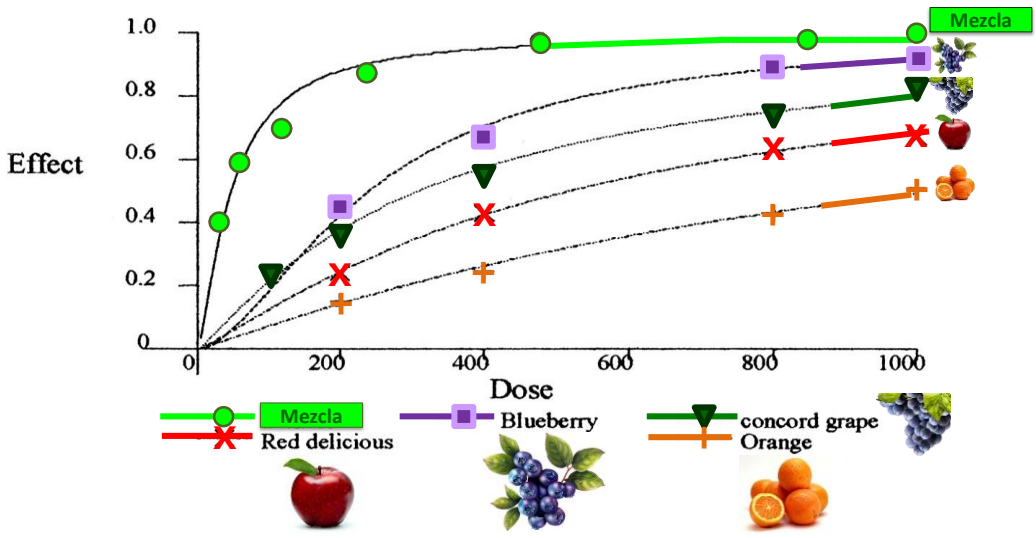
Synergy: resveratrol with: caffeic acid, catechin, quercetin, ellagic acid, etanol, vitamin E, tyrosol, ... (Norata et al., 2007; Pignatelli et al., 2006; Li et al., 2006, Fernández-Mar y col., 2012).

Resveratrol, hydroxytyrosol and melatonin are three compounds naturally present in wine. They could act **synergically** to ensure a higher cytoprotective effect against oxidative stress, thus further supporting the hypothesis that health benefits of Mediterranean diet are partly due to wine (200 ml of wine = 0.38 mg of resveratrol, 0.45 mg of hydroxytyrosol and 61.4 mcg of melatonin, apart from other important bioactive compounds) (Fernández-Mar y col., 2012)

The total antioxidant activity of phytochemicals in 1 g of apples with skin is equivalent to 83.3 μmol vitamin C equivalents—that is, the antioxidant value of 100 g apples is equivalent to 1500 mg of vitamin C. This is much higher than the total antioxidant activity of 0.057 mg of vitamin C (the amount of vitamin C in 1 g of apples with skin). In other words, vitamin C in apples contributed only < 0.4% of total antioxidant activity. Thus, most of the antioxidant activity comes from phytochemicals, not vitamin C. The natural combination of phytochemicals in fruit and vegetables is responsible for their potent antioxidant activity (Liu, 2003).

Dose–response of antioxidant activity of orange, apple, grape, blueberry and 4-way combination

Liu RHJ. Nutr. 2004;134:3479S-3485S



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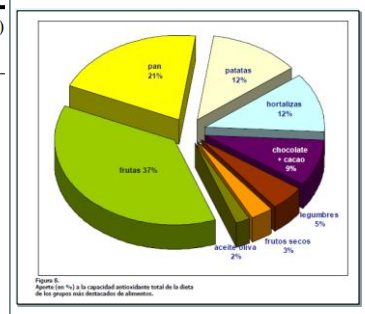
Capacidad antioxidante total de la dieta

Suma de los potenciales antioxidantes de vitaminas, polifenoles, carotenoides y otros compuestos minoritarios ('equivalentes trolox')

Table 3 Total dietary antioxidant capacity (TDAC) in the Spanish diet (Saura-Calixto and Goñi, 2006) (Saura y Goñi, 2009)

Source	Antioxidant capacity (ABTS method) (μmol trolox equivalent)
Nuts	176.0
Fruits	342.0
Vegetables	272.0
Legumes	134.7
Cereals	33.4
Beverages	
Coffee	1581.7
Wine	616.6
Others	377.7
Vegetable oils	
Olive	12.8
Others	2.4
TDAC	3549.3



http://www.nutricion.org/recursos_y_utilidades/PDF/Instrucciones_Rueda_Antiox.pdf

Definition of the Mediterranean Diet Based on Bioactive Compounds

FULGENCIO SAURA-CALIXTO and ISABEL GOÑI
Nutrition and Gastrointestinal Unit, UCM (Department of Nutrition I) - C
Ciudad Universitaria, Madrid, Spain

Saura-Calixto F, Goñi I. Definition of the Mediterranean Diet Based on Bioactive Compounds. Crit Rev Food Sci Nutr. 2009; 49: 145-152

Table 6 Essential dietary indicators in the Mediterranean diet

Indicator	Range	Major contributors
Monounsaturated fatty acids /saturated fatty acids	1.6–2.0	Olive oil
Dietary fiber intake as indigestible fraction intake (g/person/day)	41–62	Cereals: white bread; pasta; rice Fruits: orange; apple; grape Nuts: walnut Vegetables: tomato; potato Legumes: dry beans; chickpeas
Antioxidant activity intake (μmol trolox equivalent/person/day)	3500–5300	Coffee; wine Fruits: Orange; apple; grape Vegetables: tomatoes; onions; capsicum; garlic Legumes
Phytosterols intake (mg/person/day)	370–555	Vegetables oils: Sunflower; olive Cereals: white bread Fruits: orange Legumes: chickpeas Vegetables: tomatoes

Adherence to the Mediterranean diet is associated with total antioxidant capacity in healthy adults: the ATTICA study[1–3]

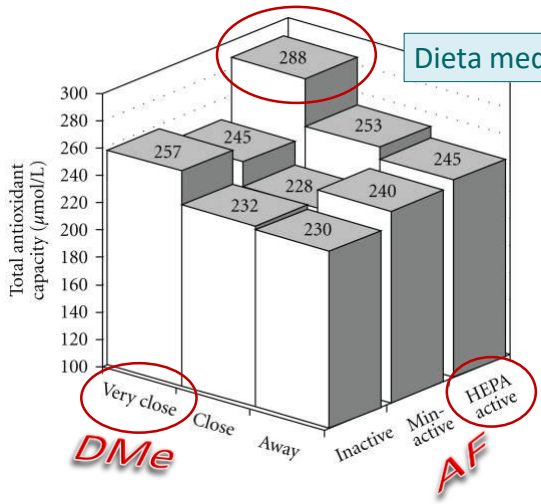
Christos Pitsavos, Demosthenes B Panagiotakos, Natalia Tzima, Christina Chrysohoou, Manolis Economou, Antonis Zampelas, and Christodoulos Stefanadis

Conclusion:

Greater adherence to the Mediterranean diet is associated with elevated Total Antioxidant Capacity (TAC) levels and low oxidized LDL-cholesterol concentrations, which may explain the beneficial role of this diet on the cardiovascular system.

Pitsavos y col., Am J Clin Nutr 2005;82:694 –9.

J Am Coll Nutr. 2009 Dec;28(6):648-56.
Dietary total antioxidant capacity: a novel indicator of diet quality in healthy young adults.
Puchau B, Zulet MA, de Echávarri AG, Hermsdorff HH, Martínez JA.



Dieta mediterránea + actividad física

Increased physical activity and greater adherence to the Mediterranean diet were associated with **increased total antioxidant capacity.**

Physical Activity and Adherence to Mediterranean Diet Increase Total Antioxidant Capacity: The ATTICA Study. TAC levels and physical activity status (inactive, min-active, and HEPA active (health enhancing physical activity, a high active category)) by MedDietScore that assessed adherence to the Mediterranean diet (away, close, and very close). Kavouras y col., Cardiol Res Pract. 2011.

¿Hay suficiente evidencia científica?

Are Cranberries an effective functional food?

Is protection from urinary infection an old wives tale?

***Ericaceae* Family:**

- ***cranberries, blueberries, huckleberries, bilberries***

(Coppola et. al. *Methods to Detect Adulteration of Fruit-Juice Beverages.* 1995; (1) 287-308)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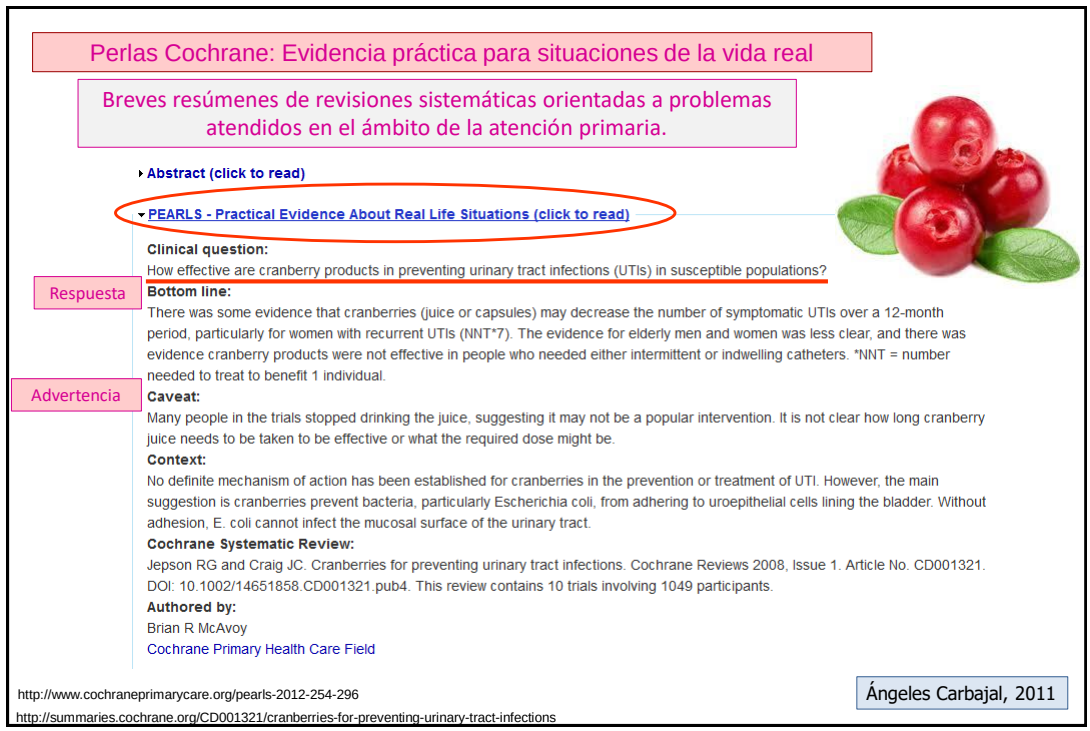
Cranberries for preventing urinary tract infections
Jepson RG, Williams G, Craig JC
Published Online: October 17, 2012
Cranberries (usually as cranberry juice) have been used to prevent urinary tract infections (UTIs). Cranberries contain a substance that can prevent bacteria from sticking on the walls of the bladder. This may help prevent bladder and other UTIs. This review identified 24 studies (4473 participants) comparing cranberry products with control or alternative treatments. There was a small trend towards fewer UTIs in people taking cranberry product compared to placebo or no treatment but this was not a significant finding. Many people in the studies stopped drinking the juice, suggesting it may not be a acceptable intervention. Cranberry juice does not appear to have a significant benefit in preventing UTIs and may be unacceptable to consume in the long term. Cranberry products (such as tablets or capsules) were also ineffective (although had the same effect as taking antibiotics), possibly due to lack of potency of the 'active ingredient'.
Abstract (click to read)
Background:
Cranberries have been used widely for several decades for the prevention and treatment of urinary tract infections (UTIs). This is the third update of our review first published in 1998 and updated in 2004 and 2008.
Objectives:
To assess the effectiveness of cranberry products in preventing UTIs in susceptible populations.
Cochrane Collaboration.
Find the resea
Get full text in The Cochr
this Review titled:
Cranberries for preventin
infections
Primary Review Group:
Ángeles Carbajal, 2011


Perlas Cochrane: Evidencia práctica para situaciones de la vida real
Breves resúmenes de revisiones sistemáticas orientadas a problemas atendidos en el ámbito de la atención primaria.
Abstract (click to read)
PEARLS - Practical Evidence About Real Life Situations (click to read)
Clinical question:
How effective are cranberry products in preventing urinary tract infections (UTIs) in susceptible populations?
Respuesta
Bottom line:
There was some evidence that cranberries (juice or capsules) may decrease the number of symptomatic UTIs over a 12-month period, particularly for women with recurrent UTIs (NNT*7). The evidence for elderly men and women was less clear, and there was evidence cranberry products were not effective in people who needed either intermittent or indwelling catheters. *NNT = number needed to treat to benefit 1 individual.
Advertencia
Caveat:
Many people in the trials stopped drinking the juice, suggesting it may not be a popular intervention. It is not clear how long cranberry juice needs to be taken to be effective or what the required dose might be.
Context:
No definite mechanism of action has been established for cranberries in the prevention or treatment of UTI. However, the main suggestion is cranberries prevent bacteria, particularly Escherichia coli, from adhering to uroepithelial cells lining the bladder. Without adhesion, E. coli cannot infect the mucosal surface of the urinary tract.
Cochrane Systematic Review:
Jepson RG and Craig JC. Cranberries for preventing urinary tract infections. Cochrane Reviews 2008, Issue 1. Article No. CD001321. DOI: 10.1002/14651858.CD001321.pub4. This review contains 10 trials involving 1049 participants.
Authored by:
Brian R McAvoy
Cochrane Primary Health Care Field
http://www.cochraneprimarycare.org/pearls-2012-254-296
http://summaries.cochrane.org/CD001321/cranberries-for-preventing-urinary-tract-infections
Ángeles Carbajal, 2011

Dieta Mediterránea

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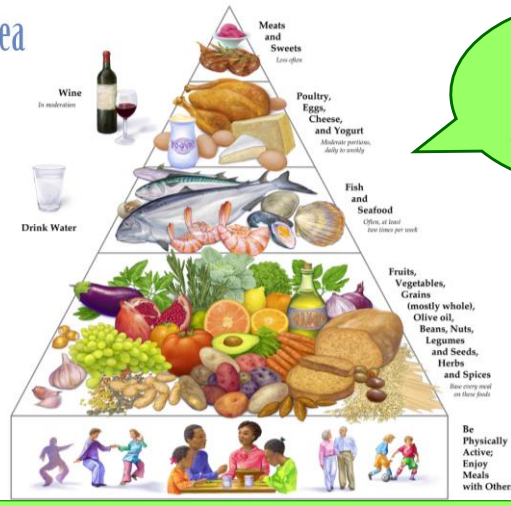
16-nov-2010



Modelo de dieta prudente y saludable. "Dieta funcional"

La dieta mediterránea puede ser una referencia muy útil para definir cuantitativa y cualitativamente una mezcla de componentes bioactivos naturales de origen dietético, consumidos durante décadas y potencialmente efectivos para reducir el riesgo

(Carbajal y col., Rev Chil Nutr 2001;28/2).

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Importancia del color

Color	Compuesto fitoquímico	Frutas y hortalizas
Verde	Glucosinolatos	Brócoli, col
Naranja	Alfa y beta- caroteno	Zanahoria, mango, calabaza
Rojo	Licopeno	Tomate
Rojo oscuro –morado – púrpura	Antocianinas y otros polifenoles	Uvas, moras, frambuesas, arándanos
Naranja-amarillo	Criptoxantina Flavonoides	Melón francés, melocotón, papaya, naranja, mandarina
Amarillo-verde	Luteína y zeaxantina	Espinaca, maíz, aguacate, melón
Verde	Clorofila (fuente de Mg)	Vegetales

Heber, D., Bowerman, S. (2001). Applying Science to Changing Dietary Patterns. American Institute for Cancer Research 11th Annual Research Conference on Diet, Nutrition and Cancer

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OPEN ACCESS Freely available online PLoS one

You Are What You Eat: Within-Subject Increases in Fruit and Vegetable Consumption Confer Beneficial Skin-Color Changes

Ross D. Whitehead[1]*, Daniel Re[1], Dengke Xiao[1], Gozde Ozakinci[2], David I. Perrett[1]*

1 School of Psychology, Perception Lab, University of St Andrews, St Andrews, Fife, Scotland, **2** School of Medicine, University of St Andrews, St Andrews, Fife, Scotland

Abstract

Background: Fruit and vegetable consumption and ingestion of carotenoids have been found to be associated with human skin-color (yellowness) in a recent cross-sectional study. This carotenoid-based coloration contributes beneficially to the appearance of health in humans and is held to be a sexually selected cue of condition in other species.

Methodology and Principal Findings: Here we investigate the effects of fruit and vegetable consumption on skin-color longitudinally to determine the magnitude and duration of diet change required to change skin-color perceptibly. Diet and skin-color were recorded at baseline and after three and six weeks, in a group of 35 individuals who were without makeup, self-tanning agents and/or recent intensive UV exposure. Six-week changes in fruit and vegetable consumption were significantly correlated with changes in skin redness and yellowness over this period, and diet-linked skin reflectance changes were significantly associated with the spectral absorption of carotenoids and not melanin. We also used psychophysical methods to investigate the minimum color change required to confer perceptibly healthier and more attractive skin-coloration. Modest dietary changes are required to enhance apparent health (2.91 portions per day) and attractiveness (3.30 portions).

Conclusions: Increased fruit and vegetable consumption confers measurable and perceptibly beneficial effects on Caucasian skin appearance within six weeks. This effect could potentially be used as a motivational tool in dietary intervention.

Citation: Whitehead RD, Re D, Xiao D, Ozakinci G, Perrett DI (2012) You Are What You Eat: Within-Subject Increases in Fruit and Vegetable Consumption Confer Beneficial Skin-Color Changes. PLoS ONE 7(3): e32988. doi:10.1371/journal.pone.0032988

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You Are What You Eat: Within-Subject Increases in Fruit and Vegetable Consumption Confer Beneficial Skin-Color Changes (Whitehead y col., 2012)

Conclusions: Increased fruit and vegetable consumption confers measurable and perceptibly beneficial effects on Caucasian skin appearance within six weeks. This effect could potentially be used as a motivational tool in dietary intervention.

Examples of face stimuli to be used in an appearance-based intervention, with face color manipulated to represent (a) an increase of 6.5 and (b) a decrease of 6.5 fruit and vegetable portions relative to starting appearance (not shown); the color difference between these 2 images thus represents a difference in daily consumption of 13 portions of fruit and vegetables. (Whitehead y col., 2012)

What is Xenohormesis?

"Polyphenols such as resveratrol and quercetin, which are produced by stressed plants, activate sirtuin enzymes and extend the lifespan of fungi and animals, ostensibly by mimicking the beneficial effects of caloric restriction. This observation raises an interesting question: Why should foreign molecules that are non-nutritive and seemingly unrelated to any endogenous molecule modulate the same biochemical pathways that mediate the response to an energy deficit? A possible explanation is that the sirtuin enzymes have evolved to respond to plant stress molecules as indicators of an impending deterioration of the environment. This idea has become known as the Xenohormesis Hypothesis, the name stemming from a combination of the prefix xeno-(for stranger) with hormesis (a protective response induced by mild stress). Here we review the evidence for xenohormesis in a broader context, taking into account the diverse spectrum of phytochemicals to which animals are exposed. We also consider alternative hypotheses that may explain some of the beneficial effects of plant-based foods. We suggest that xenohormesis, defined as an adaptive response in the physiology of an organism to molecular cues that are neither nutritive nor direct stressors, most likely occurs at some level. Whether this can fully or partially account for the beneficial effects of resveratrol and other phytochemicals remains to be seen. However, there is already sufficient cause to re-evaluate the relationship between complex organisms, including humans, and their food."

Baur, J.A., and D.A. Sinclair, 2008. What is Xenohormesis?. Am. J. Pharmacol. Toxicol., 3: 152-159.

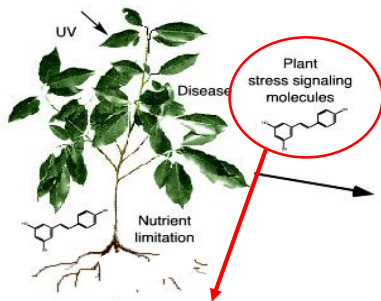
La hipótesis de la xenohormesis propone que las xenohormetinas (fitoquímicos producidos por plantas estresadas) son señales de cambios ambientales que desencadenan una respuesta adaptativa beneficiosa en las personas que los consumen (Medina et al., Med Hypotheses. 2017 Nov;109:126-130).

Xeno (griego *ξένος*): extraño

Hormesis (griego *hormáein*): estimular

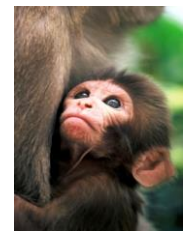
The Xenohormesis Hypothesis

Organisms have evolved to pick up on chemical signals that other species produce to turn on their own defenses against adversity. In this way, animals can prepare in advance of a deteriorating environment.



Stressed plants communicate to the animal

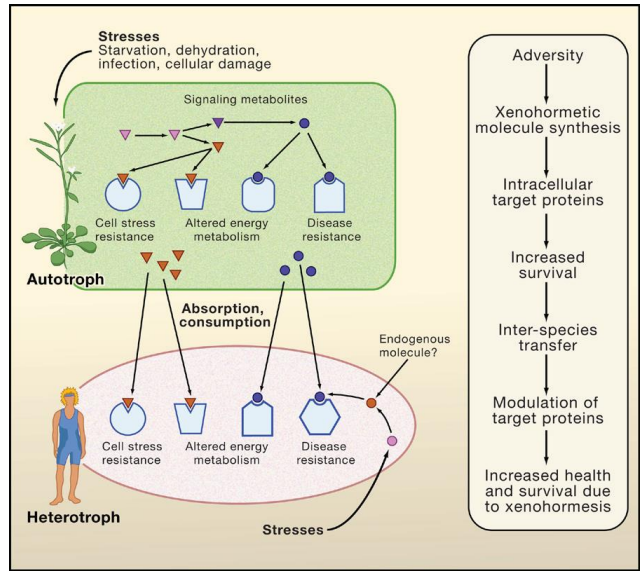
Animal Eats the Stressed Plants



Activation of Animal genes called Sirtuins

Imparts stress resistance, longer life

Howitz y Sinclair, Cell *133*, May 2, 2008
http://thescipub.com/html/10.3844/ajptsp.2008.152.159



Howitz y Sinclair, Cell *133*, May 2, 2008

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Parece que tenemos la !píldora mágica!, pero, ……

Los polifenoles purificados, ¿tienen el mismo efecto que consumidos con los alimentos?

Posiblemente NO
Un comprimido no puede "mimetizar" esta mezcla natural y equilibrada de fitoquímicos que comemos con los alimentos.
Además, los alimentos, tienen otras muchos bioactivos nutrientes.

Incluso puede tener el efecto contrario! (Hormesis)
Muchas veces, de lo bueno, ¡cuánto más … peor!

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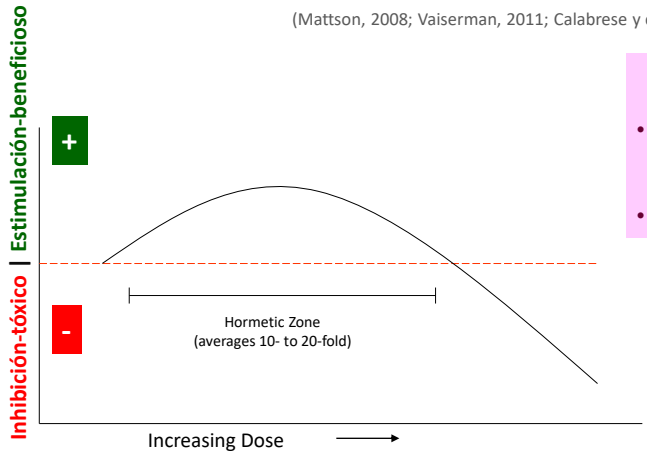
Hormesis Curve

Hormesis: del griego ὁρμάω "estimular"

(Mattson, 2008; Vaiserman, 2011; Calabrese y col., 2012)



Hormesis → respuesta bifásica:

- A dosis bajas (o intermitente) → respuesta adaptativa beneficiosa
- A dosis altas: efecto tóxico

Paracelso (1493-1541): "Todo depende de la dosis"

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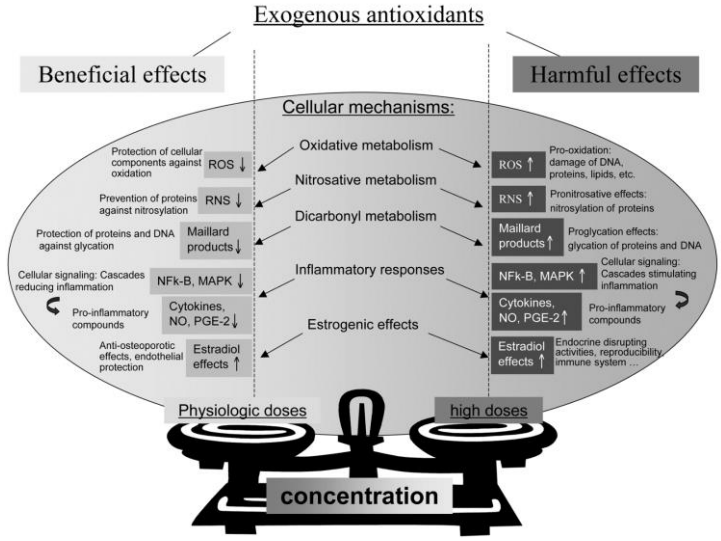
Double-edged effects of exogenous antioxidants on cellular responses including oxidative, nitrosative and dicarbonyl metabolisms and other pathways such as inflammatory processes depending potentially on their concentrations: physiologic doses leading to beneficial effects whereas high doses may result in harmful effects.



Oxid Med Cell Longev. 2010 Jul-Aug; 3(4): 228–237.

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Protective and adverse components of fruits and vegetables linked to health outcomes

Protective	Adverse
Dietary fiber	Aflatoxin
Vitamin C	Pesticides
Vitamin E	Herbicides
Carotenoids	Nitrates
Flavonoids	Alar
Folic acid	Goitrogens
Selenium	Enzyme inhibitors
Dithiolthiones	Phenolic compounds
Glucosinolates	Saponins
Indoles	Inositol hexapyhosphate
Isothiocyanates	
Coumarins	
Phenols	
Protease inhibitors	
Plant sterols	
Isoflavones/lignans	
Saponins	
Inositol hexaphosphate	
Allium compounds	
Limonene	

Slavin & Lloyd 2012 Adv Nutr 3:506-516.
http://advances.nutrition.org/content/3/4/506.long

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Componentes bioactivos

¿Son nutrientes?
¿Cuánto necesitamos?
¿Cuál es el upper level?
¿Dónde se encuentran?
¿En qué cantidad?
¿Cuál es su biodisponibilidad?
¿Y su mecanismo de acción?
¿…?????

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TABLE C2-3 A Sampling of Phytochemicals—Possible Effects and Food Sources

This table is meant not for memorization of chemical names, but to demonstrate the wide variety of phytochemicals and food sources under study in regard to human health.

NAME	POSSIBLE EFFECTS	FOOD SOURCES
Capsaicin	May modulate blood clotting, may reduce the risk of fatal clots in heart and artery disease.	Hot peppers
Carotenoids (including beta-carotene, lutein, lycopene, and hundreds of related compounds)[a]	Act as antioxidants; possibly reduce risks of heart disease, age-related eye disease,[b] cancer, and other diseases.	Deeply pigmented fruits and vegetables (apricots, broccoli, cantaloupe, carrots, pumpkin, spinach, sweet potatoes, tomatoes)
Curcumin	May inhibit enzymes that activate carcinogens.	Turmeric, a yellow-colored spice
Flavonoids (including flavones, flavonols, isoflavones, catechins, and others)[c,d]	Act as antioxidants; may scavenge carcinogens; bind to nitrates in the stomach, preventing conversion to nitrosamines; inhibit cell growth; flavonoids of blueberries may improve memory; flavonoids of cranberries may flush bacteria from the urinary tract.	Berries, black tea, celery, chocolate, citrus fruits, green tea, olives, onions, oregano, purple grapes, purple grape juice, soybeans and soy products, vegetables, whole wheat, red and white wine
Indoles	May trigger production of enzymes that block DNA damage from carcinogens; may inhibit estrogen action.	Broccoli and other cruciferous vegetables (brussels sprouts, cabbage, cauliflower), horseradish, mustard greens
Isothiocyanates (including sulforaphane)	May inhibit enzymes that activate carcinogens; trigger production of enzymes that detoxify carcinogens.	Broccoli and other cruciferous vegetables (brussels sprouts, cabbage, cauliflower), horseradish, mustard greens
Monoterpenes (including limonene)	May trigger enzyme production to detoxify carcinogens; may inhibit cancer promotion and cell proliferation.	Citrus fruit peels and oils
Organosulfur compounds (including allicin)	May speed production of carcinogen-destroying enzymes or slow production of carcinogen-activating enzymes	Chives, garlic, leeks, onion

Sizer/Whitney, Nutrition: Concepts & Controversies, 2010

Phenolic acids[d] (including ellagic acid)	May trigger enzyme production to make carcinogens water soluble, facilitating excretion.	Coffee beans, fruits (apples, blueberries, cherries, grapes, oranges, pears, pomegranates prunes, strawberries), oats, potatoes, soybeans
Phytic acid	Binds to minerals, preventing free-radical formation, possibly reducing cancer risk.	Whole grains
Phytoestrogens (members of the flavonoid family, genistein and diadzein)	May inhibit estrogen and produce these actions: inhibit cell replication in GI tract; reduce risk of breast, colon, ovarian, prostate, and other estrogen-sensitive cancers; reduce cancer cell survival; may reduce risk of osteoporosis. May also alter blood lipids favorably and reduce heart disease risk when consumed in soy foods.	Soybeans, soy flour, soy milk, tofu, textured vegetable protein, other legume products
Phytoestrogens (lignans)	Block estrogen activity in cells, possibly reducing the risk of cancer of the breast, colon, ovaries, and prostate.	Flaxseed, whole grains
Protease inhibitors	May suppress enzyme production in cancer cells, slowing tumor growth; inhibit hormone binding; inhibit malignant changes in cells.	Broccoli sprouts, potatoes, soybeans and other legumes, soy products
Resveratrol[e]	May offset artery-damaging effects of high-fat diets.	Red wine, peanuts
Saponins	May interfere with DNA replication, preventing cancer cells from multiplying; stimulate immune response.	Alfalfa sprouts, other sprouts, green vegetables, potatoes, tomatoes
Tannins[d]	May inhibit carcinogen activation and cancer promotion; act as antioxidants.	Black-eyed peas, grapes, lentils, red and white wine, tea

[a]Other carotenoids include alpha-carotene, beta-cryptoxanthin, and zeaxanthin. [b]The age-related eye disease is macular degeneration.
[c]Other flavonoids of interest include ellagic acid and ferulic acid. [d]A subset of the larger group *polyphenolic phytochemicals*.
[e]A member of the chemical group stilbene, which is a subset of the larger group *polyphenolic phytochemicals*.

Sizer/Whitney, Nutrition: Concepts & Controversies, 2010

Botero, Naturaleza muerta con sandía – 1991. Óleo sobre lienzo. 95 x 116 cm.