



PAPER DELS POLIFENOLS EN LA SALUT, ESTUDI DE LA COHORT PREDIMED

Anna Tresserra i Rimbau

24 de març de 2015



Qui som?



IP

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On estem?



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Campus de l'Alimentació de
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Pàgina web



<http://www.polyphenolresearch.com/>

Inici Nuestro grupo Líneas de investigación Noticias Proyectos de I+D+i Galería Publicaciones Servicios Enlaces Contacto

Grup Antioxidants Naturals

POLYPHENOL RESEARCH

INTRODUCCIÓN AL GRUPO ANTIOXIDANTES NATURALES

El Grupo Antioxidantes Naturales fue fundado en 1993 en respuesta a la necesidad de aprender acerca de las características funcionales excepcionales que presentan los polifenoles. Tras los estudios iniciales sobre el vino y el cava, hoy en día nuestros proyectos de investigación cubren una amplia gama de alimentos.

Nuestras líneas de investigación se centran en compuestos bioactivos: biodisponibilidad y efectos en la salud de los seres humanos y también en la de los animales. Cubrimos una amplia gama de alimentos y hacemos uso de las técnicas de análisis más modernas en el campo de la espektrometría de masas para identificar y cuantificar los polifenoles y carotenoides así como sus metabolitos en muestras biológicas de los ensayos clínicos.

Nuestro grupo de investigación de Antioxidantes Naturales ha participado en estudios nacionales e internacionales, tales como el ensayo PREDIMED y el estudio EPIC, respectivamente. Realizamos proyectos de colaboración con algunas universidades de prestigio internacional como Harvard School of Public Health de Boston y UC Davis , en California , entre otros . También vale la pena señalar que el Grupo de Antioxidantes Naturales ha sido calificado como un " Grupo de Investigación Consolidada 2014 SGR 773 " por la Generalitat de Catalunya , pertenece a XARTA (Food Technology Reference Net) y el INSA (Institut d'Investigació de Nutrició y Seguretat Alimentaria) y también al CIBER (Centros de Investigación Biomédica en Salud , CIB2 FIS / D3 / J03).

Todo lo anterior indica que el grupo de investigación capaz de realizar ensayos clínicos y estudios epidemiológicos aspirando al nivel de excelencia en estos campos. Nuestro objetivo es preparar personal autónomo reconocido internacionalmente para el ejercicio de la investigación. Tanto la investigación básica como la aplicada pueden llevarse a cabo con el fin de cumplir con los requerimientos de la industria , mientras que también inciden en nuestra sociedad . El estudiante adquiere las destrezas y habilidades que les permitan encontrar un lugar en el área de trabajo.

LOS PRINCIPALES OBJETIVOS DEL GRUPO ANTIOXIDANTES NATURALES

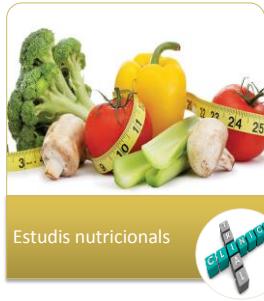
El grupo Antioxidante Naturales trabaja en proyectos relacionados con la investigación de compuestos bioactivos de los alimentos y su actividad biológica en los seres humanos .

Informació actualitzada
sobre:

- Membres del grup
- Línies d'investigació
- Notícies
- Projectes I+D
- Publicacions
- Serveix que oferim
- Informació de contacte
- Galeria d'imatges
- Beques
- ...



Què fem?



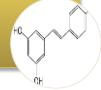
Estudis nutricionals



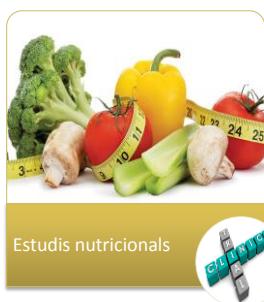
Estudi de
biomarcadors



Estudi de compostos
bioactius en aliments



Què fem?



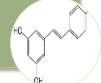
Estudis nutricionals



Estudi de
biomarcadors



Estudi de compostos
bioactius en aliments



Estudis de compostos bioactius en aliments



Beer Polyphenols by LC-LTQ-Orbitrap MS

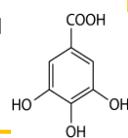


- We analyzed the beer polyphenolic profile by High Resolution Mass Spectrometry (LC-LTQ-Orbitrap)
- 3 types of Beer: Marzen Bier, Pilsen and Lager.
- Full Scan Mode and Tandem MS/MS experiments with accurate mass measurements of the ions and the fragments
- 47 phenolic compounds were detected, 7 of them were reported for the first time**

Malt Polyphenols

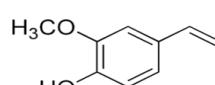
Hydroxybenzoic acids

Gallic acid
Protocatechuic acid-*O*-hexoside
Dihydroxybenzoic acid
Protocatechuic acid
Hydroxybenzoic acid
Vanillic acid



Alkylmethoxyphenols

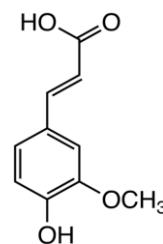
4-vinylguaiacol



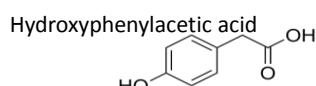
70-80% of the beer polyphenols come from malt

Hydroxycinnamic acids

Caffeic acid *O*-hexoside
Caffeic acid
1-caffeoylequinic acid
3-caffeoylequinic acid
4-caffeoylequinic acid
5-caffeoylequinic acid
Coumaric acid *O*-hexoside
Feruoylquinic acid
Sinapic acid-*O*-hexoside
Sinapic acid
Ferulic acid



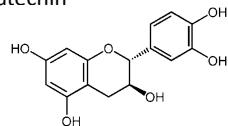
Hydroxyphenylacetic acids



Malt Polyphenols

Flavanols

Catechin
Catechin-*O*-hexoside
Catechin-*O*-dihexoside
Epicatechin

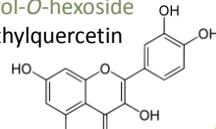


Flavonols

Quercetin-3-*O*-glucoside

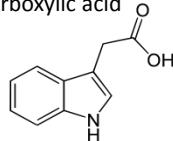
Kaempferol-*O*-hexoside

3,7-dimethylquercetin



Miscellaneous

Indole-3-carboxylic acid

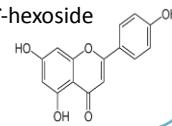


Flavones

Apigenin-*C*-hexoside-*O*-hexoside

Apigenin-*C*-hexoside-pentoside

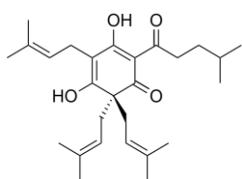
Apigenin-*C*-hexoside



Hop Polyphenols

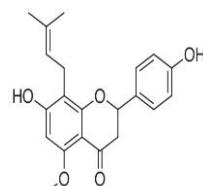
α -acids and β -acids

co-Humulone
ad-Humulone
n-Humulone
Iso- α -cohumulone
Iso- α -adhumulone
Iso- α -nhumulone
Lupulone



Prenylflavanoids

Isoxanthohumol
Xanthohumol
Desmethylxanthohumol
8-prenylnaringenin
6-prenylnaringenin

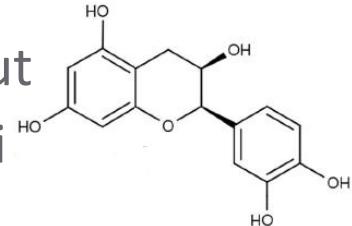


30-20% of the beer polyphenols come from hops



Index

✓ Els polifenols i la salut

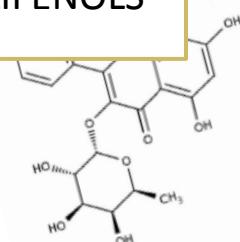


□ Estudis nutricionals i biomarcadors

□ Estudi de la cohort PREDIMED



ELS POLIFENOLS





Polifenols

- Compostos bioactius
- Metabolits secundaris de les plantes
- Es troben principalment en fruites, verdures i cereals
- Principal font d'antioxidants de la nostra dieta

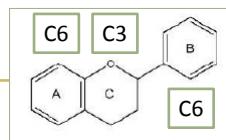


Estructura i classificació

Mínim: Anell aromàtic + grups hidroxil

Flavonoids (C6-C3-C6)

- Flavones
- Flavonols
- Flavan-3-ols o flavanols
 - Proantocianidines
- Flavanones
- Antocianidines
- Isoflavones
- Xalcones
- Cumarins
- ...



No flavonoids

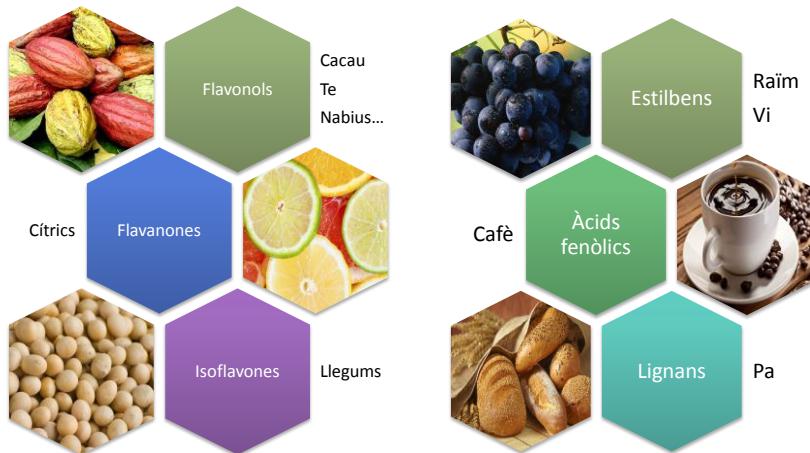
- Àcids fenòlics
- Estilbens
- Lignans
- Fenols simples
- Altres





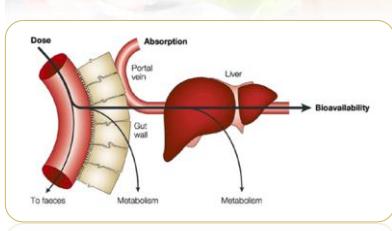
Distribució dels polifenols en els aliments

El contingut fenòlic depèn de múltiples factors: tipus d'aliment, maduresa, clima, manipulació, etc.



Els polifenols i la salut

Biodisponibilitat



L'absorció depèn de:

- Matriu alimentària
- Dosi
- Trànsit intestinal
- Tipus de polifenols
- Edat i sexe



Alguns necessiten ser metabolitzats

- Hidrolització
- Reactions de conjugació:
 - Metilació
 - Sulfatació
 - Glucurunidació

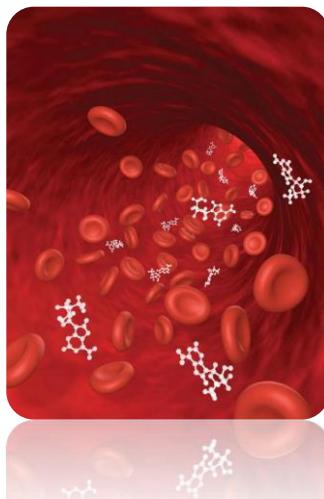
Fetge
Intestí prim

Viatgen per la sang units a proteïnes transportadores (albúmina)



Polyphenols and health

Biodisponibilitat



Concentracions plasmàtiques:

- De 0 a 4 $\mu\text{mol/L}$ amb una ingestió de 50 mg

C_{max}:

- De 1-6 h després de la ingestió

Excreció:

- Vía biliar (els més pesats i conjugats)
- Orina (els més lleugers)



Polifenols i salut

Malalties cardiovasculars
 Síndrome metabòlic
 Malalties neurodegeneratives
 Càncer
 Resistència a la insulina
 Obesitat
 Estrès oxidatiu
 Enveliment





Polifenols i salut

Malalties cardiovasculars

Principal causa de mortalitat i morbilitat en els països desenvolupats



Aterosclerosis



Infart agut de miocardi



Embòlia

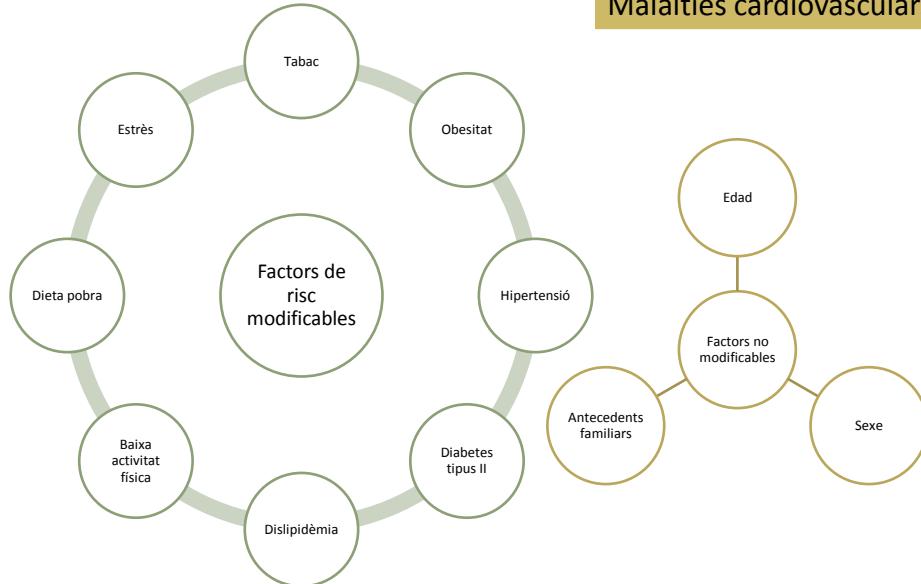


Hipertensió



Polifenols i salut

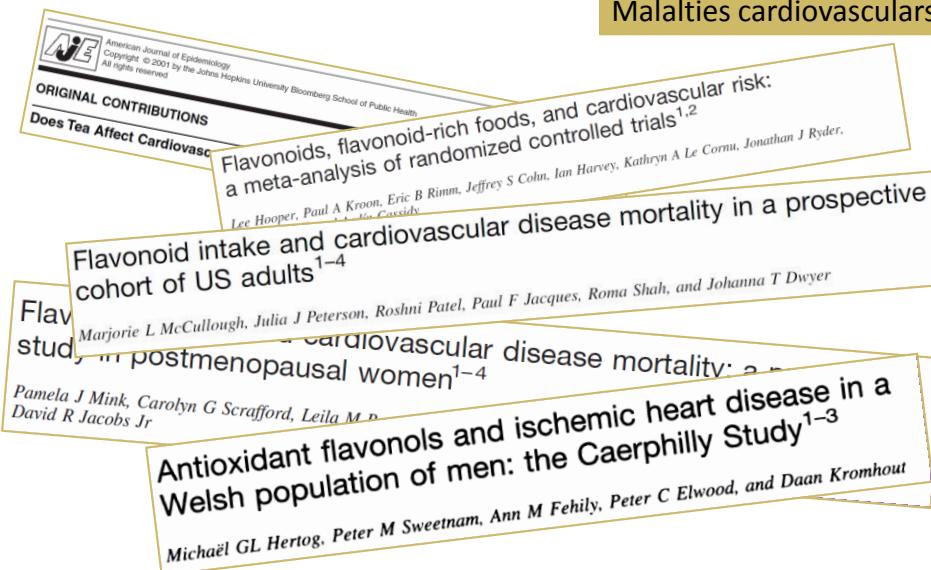
Malalties cardiovasculars





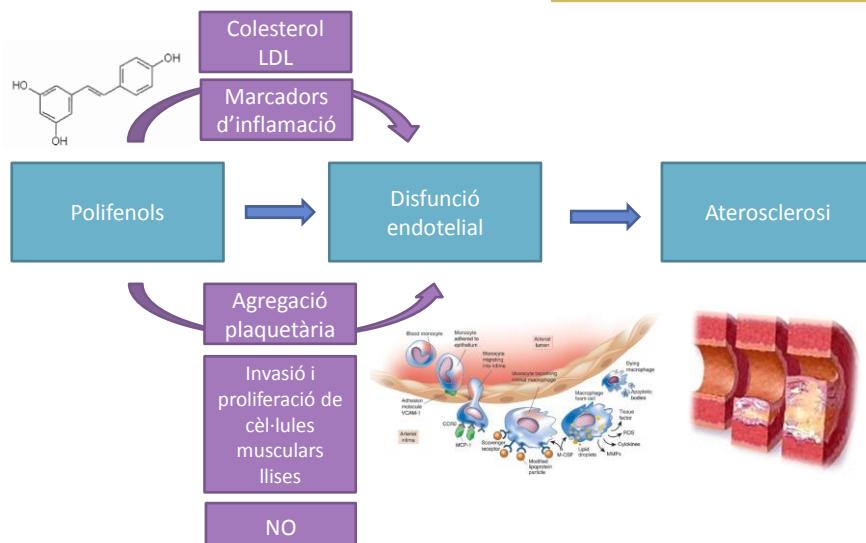
Polifenols i salut

Malalties cardiovasculars



Polifenols i salut

Malalties cardiovasculars



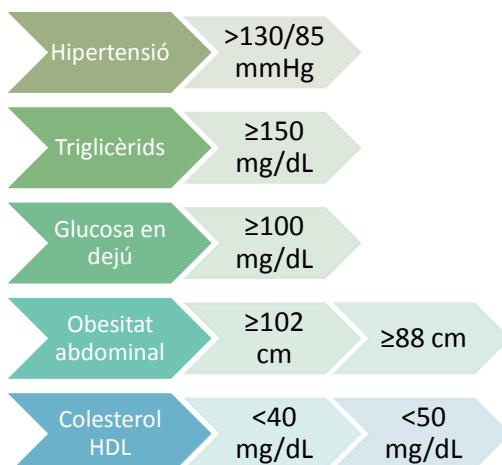


Polifenols i salut

Malalties cardiovasculars
Síndrome metabòlic
Malalties neurodegeneratives
Càncer
Resistència a la insulina
Obesitat
Estrès oxidatiu
Enveliment



Polifenols i salut



Síndrome metabòlic

According to the International Diabetes Federation (IDF) and the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) criteria





Polifenols i salut

Síndrome metabòlic



REVIEW

Modulation of metabolic syndrome-related inflammation by cocoa

Yeyi Gu and Joshua D. Lambert

Laboratory Studies on Weight Control and Prevention of Metabolic Syndrome by Green Tea[†]

Sae-tan Sudathip, Kimberly A. Grove, and Joshua D. Lambert

Department of Food Science, The Pennsylvania State University, University Park, PA 16802



Review

Nutritional support in the pharmacological treatment of metabolic syndrome

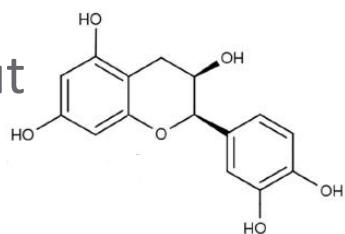
*Francesco Visioli**

Laboratory of Functional Foods, IMDEA-Food, Madrid, Spain

Index

- ✓ Els polifenols i la salut
- ✓ Estudis nutricionals i biomarcadors

- Estudi de la cohort PREDIMED

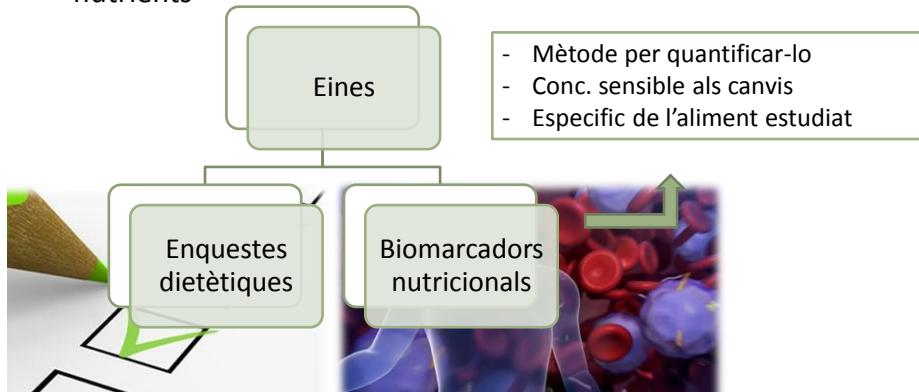




Epidemiologia nutricional

Objectiu: avaluar els efectes de la dieta sobre la salut de la població i el risc de patir alguna malaltia.

És necessari determinar amb exactitud la ingestió d'aliments i nutrients



Epidemiologia nutricional

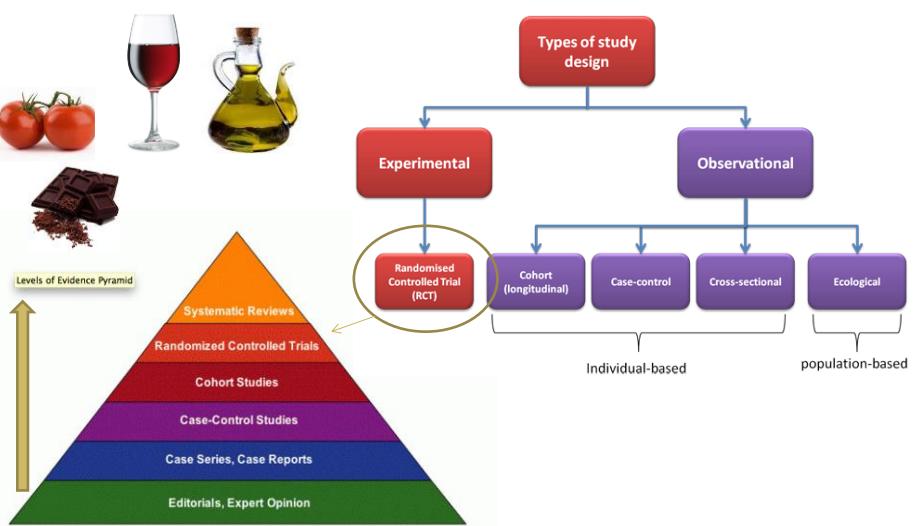
	Food frequency questionnaires	Nutritional biomarkers
Advantages	Cheaper Fast and easy to use Ability to classify individuals into consumption categories	Objective Accurate Bioavailability and metabolism are considered Able to track a nutritional intervention
Disadvantages	Depends on interviewee memory and reliability. Bioavailability and metabolism are not considered Food composition tables not always available Low accuracy in estimating and quantifying food portions Long time required by the interviewee.	Expensive Biomarkers are not always available Complex interpretation of the result as it depends on bioavailability and metabolism. Interindividual differences Require extracting, preserving and working with biological samples.



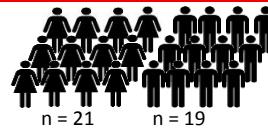
Què fem?



Alguns dels nostres estudis



DISEÑO ESTUDIO SALSAS



Sanos, 29 ± 11 años;
IMC = 23.3 ± 3.8 kg/m²

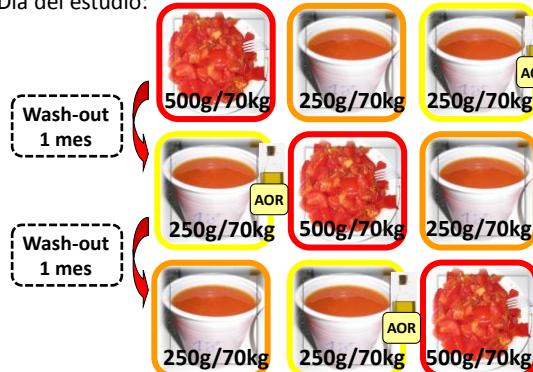
AGUDO

3 Días previos:



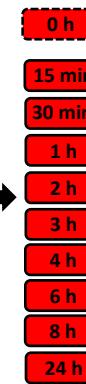
Tomate
Polifenoles

Día del estudio:



Plasma

Orina



DISEÑO ESTUDIO ZUMOS



Sanos, 27 ± 5 años;
IMC = 23.2 ± 2.3 kg/m²



Plasma

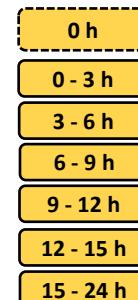
Orina

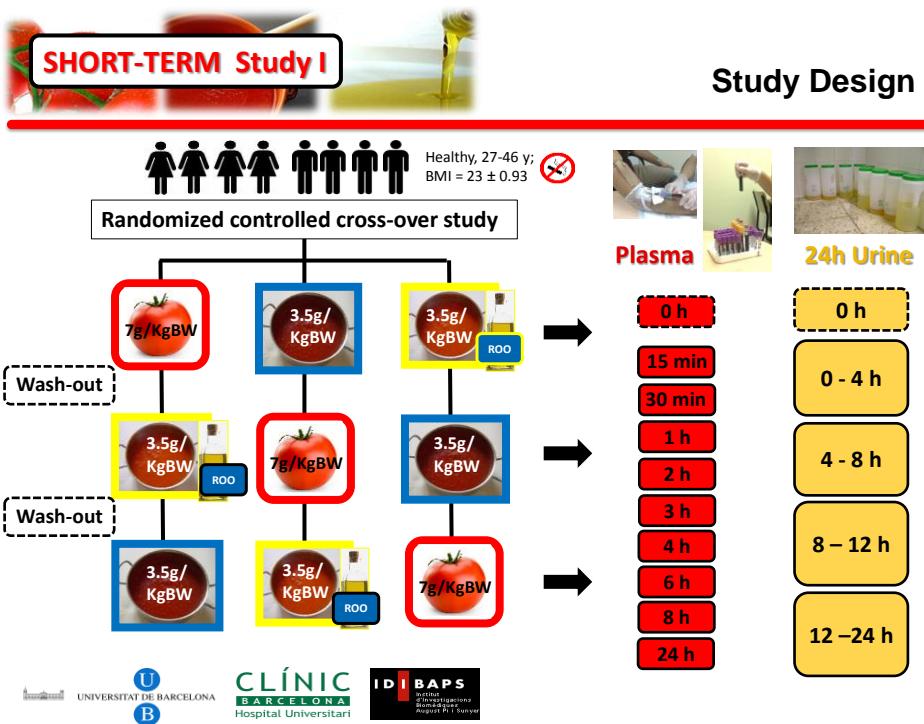
3 Días previos:



Tomate
Polifenoles
Carotenos

Día del estudio:







Biomarcador de consum de cervesa



The Journal of Nutrition
Nutritional Epidemiology

J. Nutr. 144: 484–488, 2014.

Urinary Isoxanthohumol Is a Specific and Accurate Biomarker of Beer Consumption^{1–3}

Paola Quífer-Rada,^{4,5} Miriam Martínez-Huélamo,^{4,5} Gemma Chiva-Blanch,^{5,6} Olga Jáuregui,⁷ Ramón Estruch,^{5,6} and Rosa M. Lamuela-Raventós^{4,5*}

⁴Department of Nutrition and Food Science-XARTA-INSA, School of Pharmacy, University of Barcelona, Barcelona, Spain; ⁵CIBER Physiopathology of Obesity and Nutrition, Institute of Health Carlos III, Madrid, Spain; and ⁶Department of Internal Medicine, Hospital Clinic, Institute of Biomedical Investigation August Pi i Sunyer, and ⁷Scientific and Technological Center, University of Barcelona, Barcelona, Spain



Biomarcador de consum de cervesa

Dose-response,
randomized, cross-
over clinical trial

20 male
volunteers

20 female
volunteers



0 mL
330 mL
660 mL
990 mL



0mL
330 mL
495 mL
660 mL



8 hours after

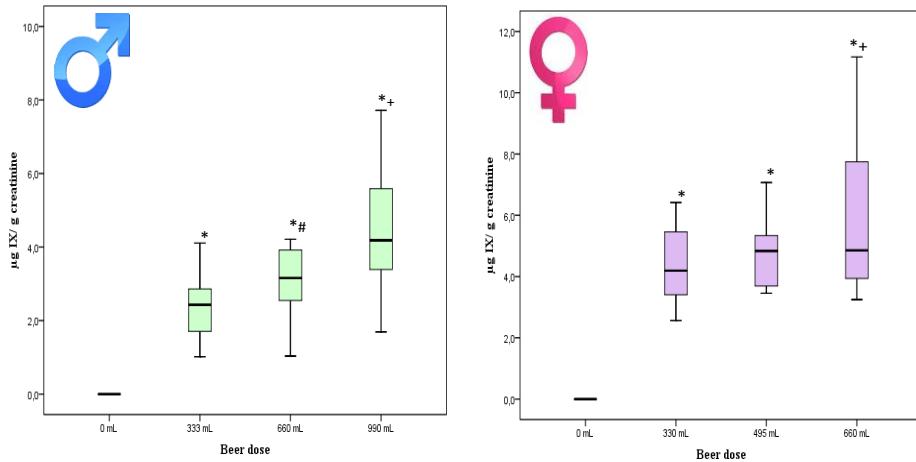


5 days washout period
before each intervention



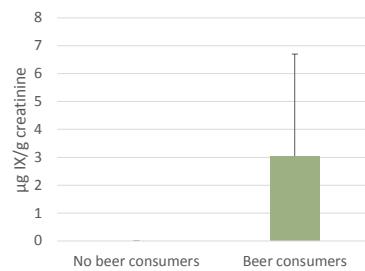
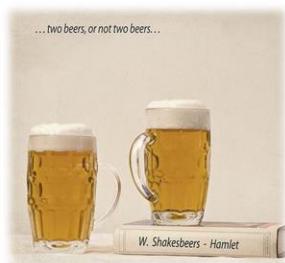
Biomarcador de consum de cervesa

Urinary excretion of Isoxanthohumol in male and female volunteers 8 hours after the intake of different volumes of beer



Biomarcador de consum de cervesa

In Free Living Population in PREDIMED



IX is really a good biomarker that can be used in epidemiological studies to evaluate beer health outcomes.





Biomarcadors d'ingesta de polifenols

To review recent evidences on biomarkers of polyphenol intake

Nutritional biomarkers are metabolites from external components such as foods, assessed in biological samples, that are used to determine the ingestion of a particular food or food group, or nutrient or non-nutrient constituent.

Alexander Medina-Remón^{1,2,3}, Anna Tresserra-Rimbau^{1,2,3}, Sara Arranz^{1,4}, Ramón Estruch^{1,3,4} & Rosa M Lamuela-Raventos^{1,2,3}

¹Nutrition & Food Science Department, Xarxa IAT, Instituto de Investigaciones Nutrición y Seguridad Alimentaria, Pharmacy School, University of Barcelona, Barcelona, Spain
²CIBER CB06/03, Fisiopatología de la Obesidad y la Nutrición, Instituto de Salud Carlos III, Spain
³IRIBA, IREC, CSIC-UAB, Instituto de Salud Carlos III, Spain
⁴Department of Internal Medicine, Institut d'Investigacions Biomèdiques August Pi Sunyer, Hospital Clínic, Barcelona, Spain
*Author for correspondence:
Tel.: +34 934034843
Fax: +34 934035931
E-mail: iamela@ub.edu

- The Folin-Ciocalteu method
- Analyses of total polyphenols in urine samples

Bioanalysis (2012) 4(22), 2705–2713

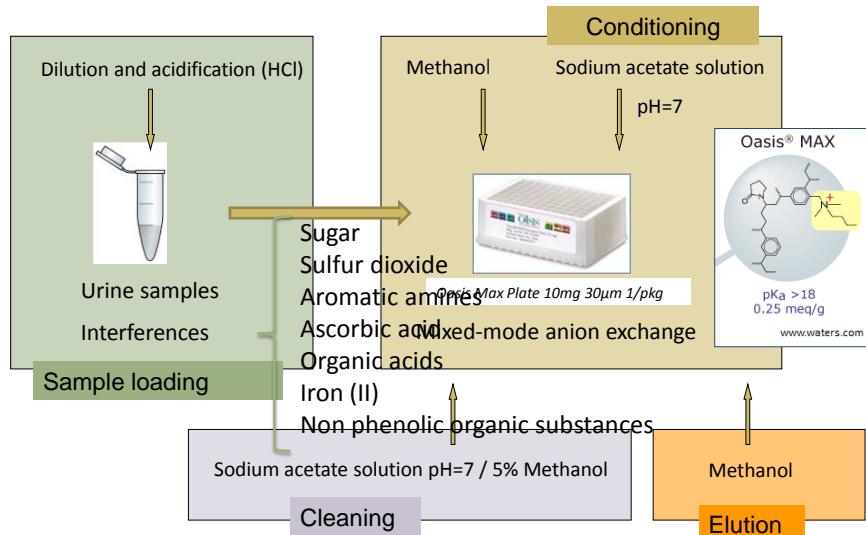
RESEARCH ARTICLE

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Polyphenols excreted in urine as biomarkers of total polyphenol intake



Biomarcadors d'ingesta de polifenols





Biomarcadors d'ingesta de polifenols

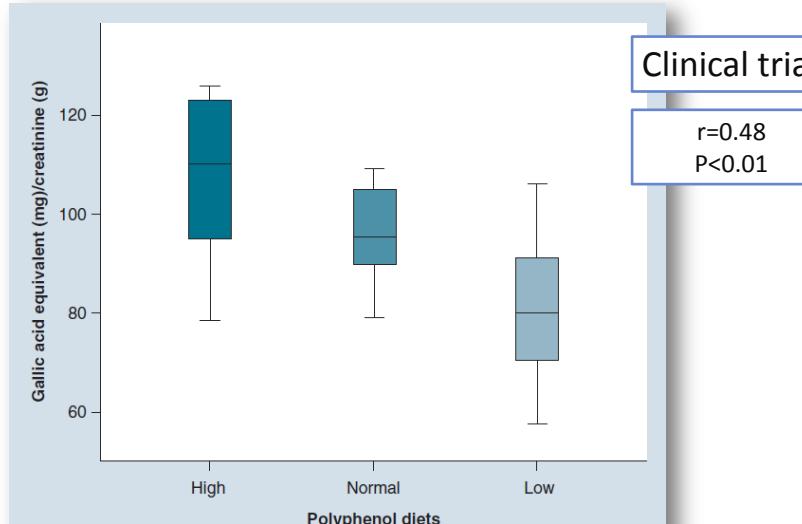


The colorimetric reaction takes place in 96-well plates.

- 170 µL MilliQ water
 - 15 µL samples
 - 12 µL Folin-Ciocalteu reactive
 - 30 µL Na₂CO₃ solution
- ↓ 1 hour
- 73 µL MilliQ water



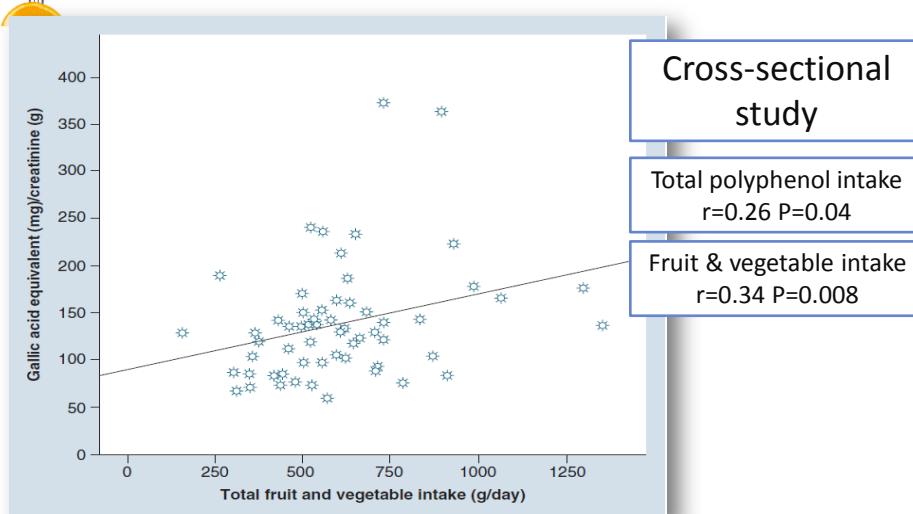
Biomarcadors d'ingesta de polifenols



Excreció de polifenols



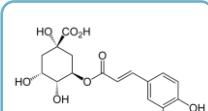
Biomarcadors d'ingesta de polifenols



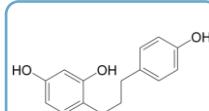
Correlació entre la ingestà de polifenols i el consum de F&V



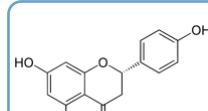
Biomarcadors d'ingesta de polifenols



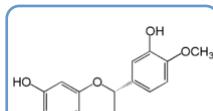
Chlorogenic acid



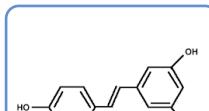
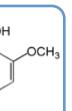
Phloretin



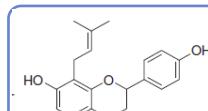
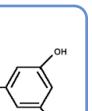
Naringenin



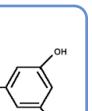
Hesperitin



Resveratrol



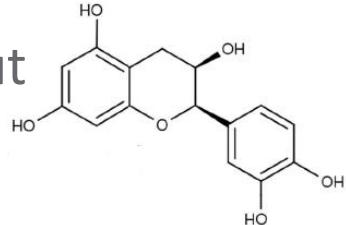
Isoxanthohumol



ALTRES EXEMPLES

Index

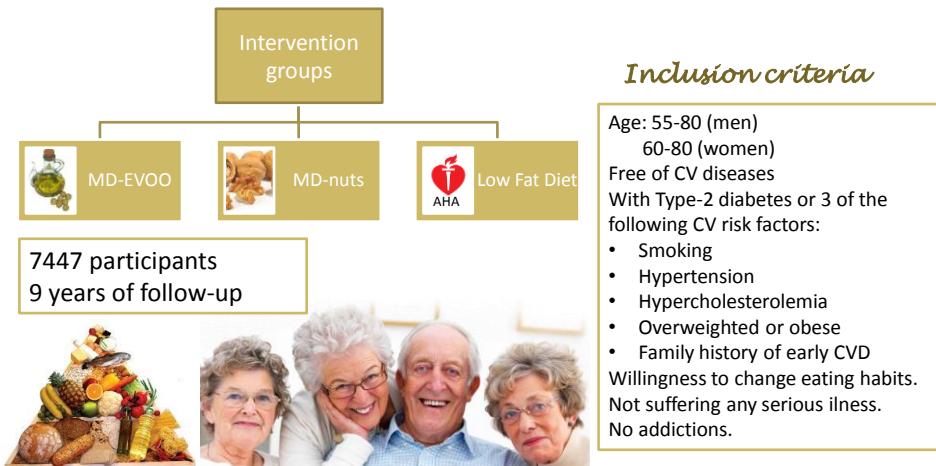
- ✓ Els polifenols i la salut
- ✓ Estudis nutricionals i biomarcadors
- ✓ Estudi de la cohort PREDIMED



The PREDIMED study

Prospective, randomized, multicentric and controlled trial

Aim: to determine the health benefits of the traditional Mediterranean Diet in the primary prevention of CV diseases.

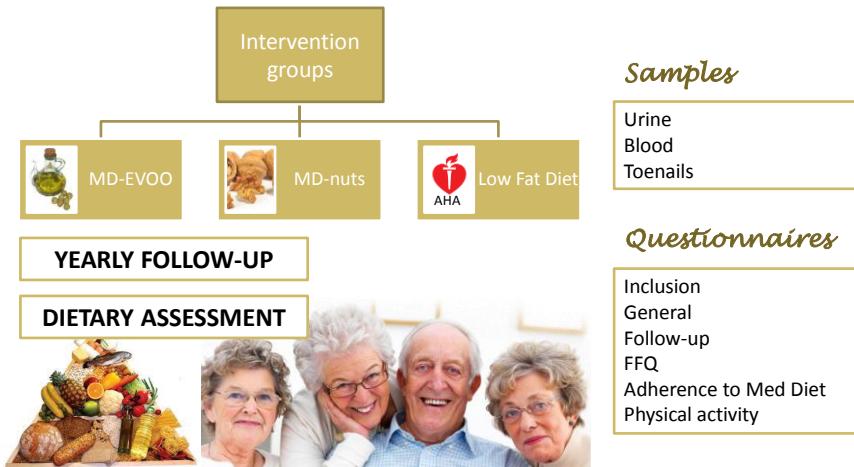




The PREDIMED study

Prospective, randomized, multicentric and controlled trial

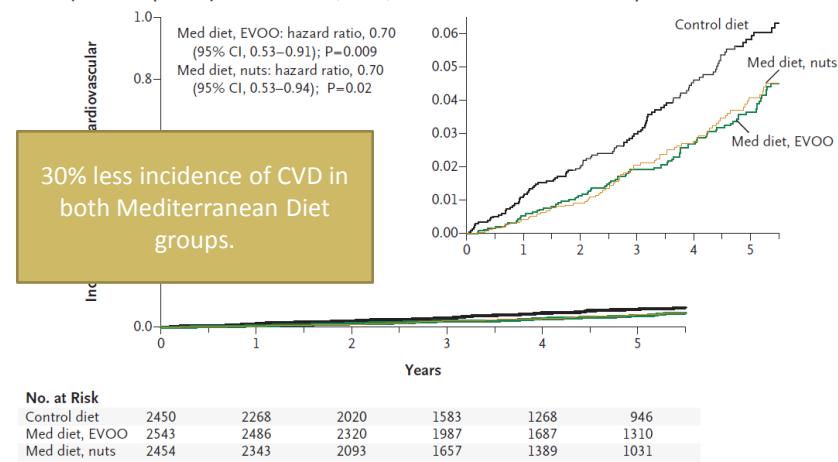
Aim: to determine the health benefits of the traditional Mediterranean Diet in the primary prevention of CV diseases.



The PREDIMED study

The NEW ENGLAND JOURNAL of MEDICINE

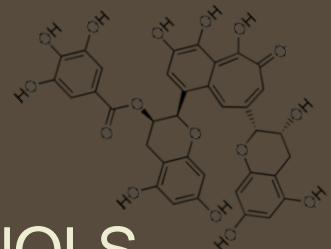
A Primary End Point (acute myocardial infarction, stroke, or death from cardiovascular causes)





ESTUDI DE LA COHORT PREDIMED

El paper de la ingestà de polifenols en la cohort PREDIMED

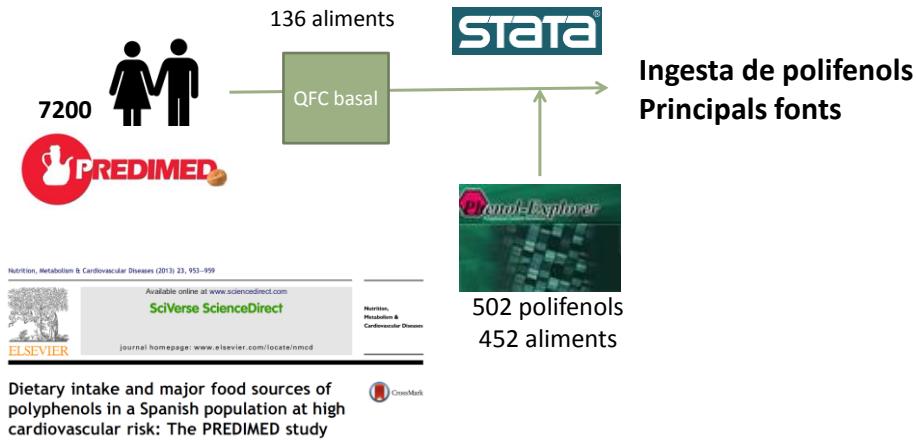


QUANTS POLIFENOLS PRENEN? D'ON VENEN?

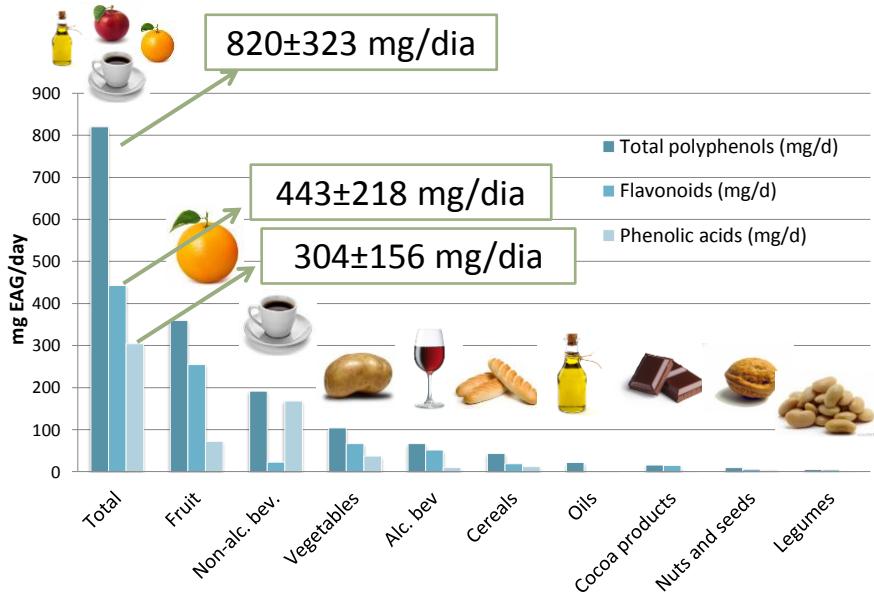
Càlcul de la ingestà de polifenols i de les fonts principals



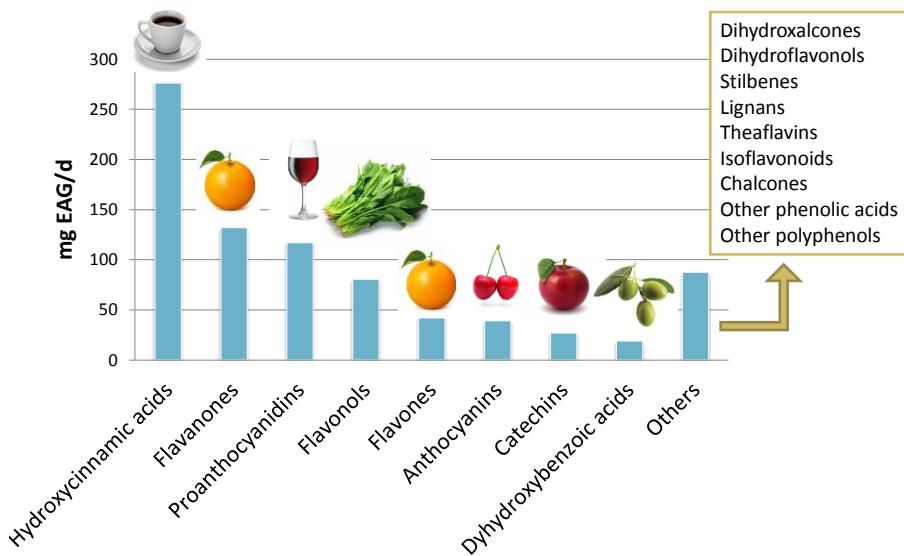
Metodologia



Resultats



Resultats



Resultats



Of the 290 polyphenols, 86 were consumed in amounts >1mg/day

Polyphenol	Subclass	Intake (mg/day)	Main contributor
5-caffeoquinic acid	Hydroxycinnamic acids	112	Coffee
Hesperidin	Flavanones	90	Oranges
3-caffeoquinic acid	Hydroxycinnamic acids	50	Coffee
4-caffeoquinic acid	Hydroxycinnamic acids	43	Coffee
Quercetin 3,4'-O-diglucoside	Flavonols	21	Onions



Results

Polyphenols from olives and olive oil: the Mediterranean difference

Polyphenol group			Full diet	% Intake derived from olives and olive oil	Individual polyphenols ingested only from olives and olive oil
Anthocyanidins	0.00	4.49 ± 6.81	38.5 ± 37.4	11.7	—
Flavones	0.36 ± 0.33	1.51 ± 2.30	41.6 ± 26.1	4.50	Iisorhoifolin Luteolin 6-C-glucoside
Flavonols	0.00	2.67 ± 4.06	80.4 ± 32.7	3.32	—
Hydroxybenzoic acids	0.06 ± 0.03	7.62 ± 11.6	19.1 ± 16.8	40.2	2,4-Dihydroxybenzoic acid
Hydroxycinnamic acids	0.04 ± 0.03	19.0 ± 28.8	276 ± 146	7.03	Hydroxycaffeic acid [2] Verbascoside <i>m</i> -coumaric acid
Other phenolic acids	0.02 ± 0.01	7.43 ± 11.3	7.56 ± 11.3	98.5	3,4-Dihydroxyphenylacetic acid Dihydro- <i>p</i> -coumaric acid ^{a,c} Homoveratric acid ^{a,b}
Other polyphenols	20.9 ± 10.5	25.8 ± 39.2	71.2 ± 46.7	65.6	Oleuropein, ligstroside ^b , 3,4-DHPEA-EDA ^b and other tyrosols 3,4-Dihydroxyphenylglycol ^{b,c} 1-Acetoxypinoresinol ^c
Lignans	0.53 ± 0.30	0.01 ± 0.01	0.85 ± 0.36	63.5	—
Total polyphenols	21.9 ± 10.9	68.5 ± 104.0	820 ± 323	11%	—

^a Only described in black olives.
^b Only described in virgin olive oil.
^c Only described in green olives.

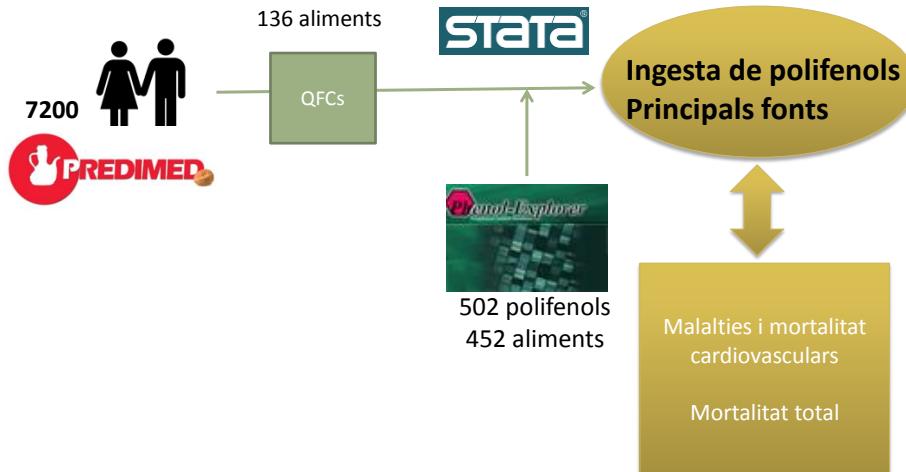


LA INGESTA DE POLIFENOLS ESTÀ ASSOCIADA A LA REDUCCIÓ DE MALALTIES?

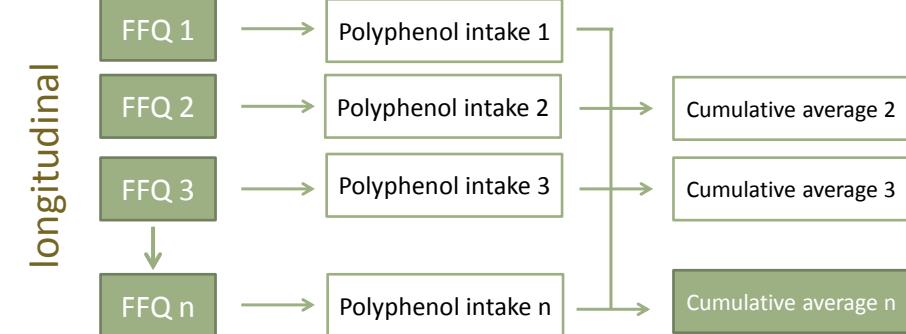
Estudi observacional i longitudinal del PREDIMED



Metodologia

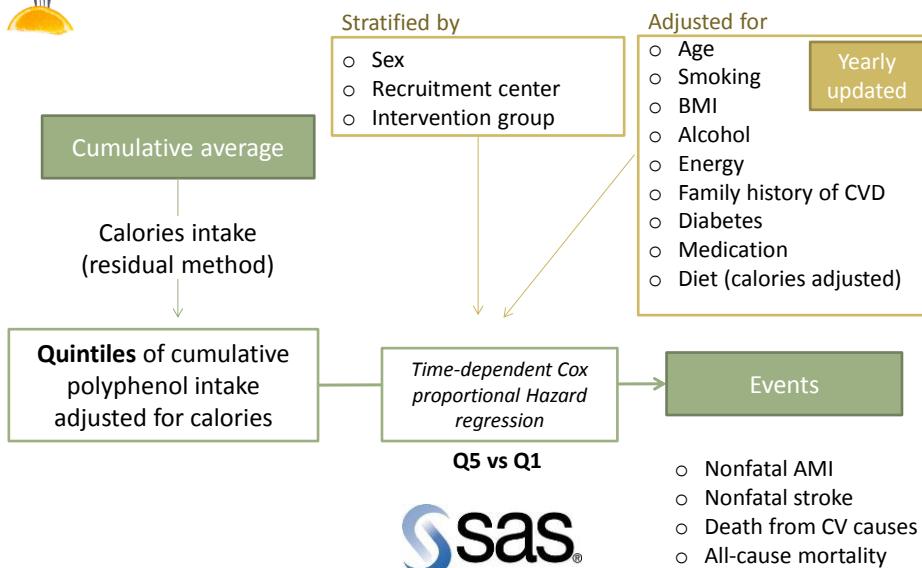


Methodology

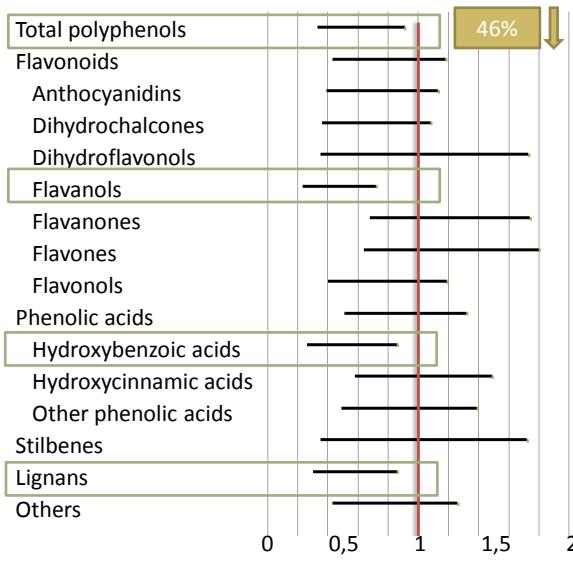




Metodología



Resultats



Total polyphenols
HR 0.54; CI 0.33 to 0.91; P-trend=0.04

Flavanols
HR 0.40; CI 0.23 to 0.72; P-trend=0.003

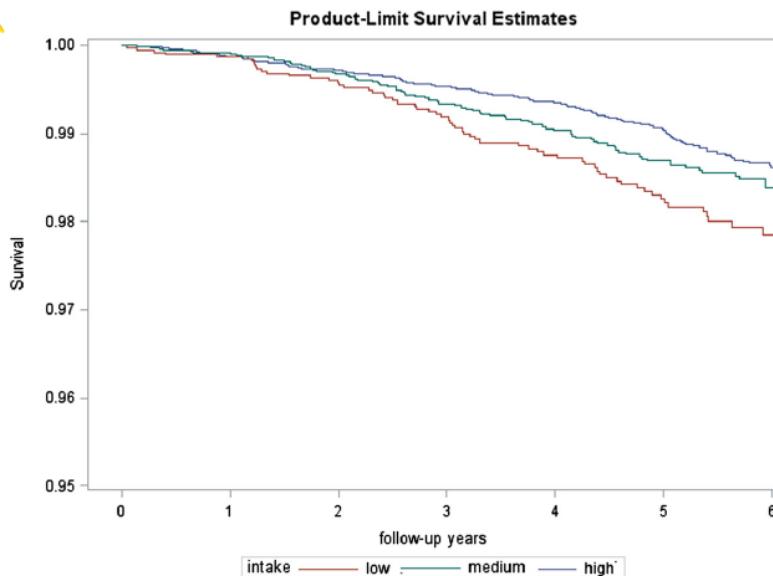
Hydroxybenzoic acids
HR 0.47; CI 0.26 to 0.86; P-trend=0.02

Lignans
HR 0.51; CI 0.30 to 0.86; P-trend=0.007





Ingesta de polifenols i mortalitat



Nelson Aalen estimates of the incidence of death by groups of polyphenol intake.



Ingesta de polifenols i mortalitat

Total polyphenol intake was significantly associated with all-cause mortality after adjusting for all confounders.

The dose-response trend suggested an L-shaped relationship.

Table 2 Cox proportional hazard ratios for total mortality according to quintiles of cumulative total polyphenol intake

	Quintiles of cumulative intake of total polyphenols, mg/d					<i>P</i> -trend
	Q1 (535)	Q2 (700)	Q3 (800)	Q4 (917)	Q5 (1170)	
No. of deaths	88	62	52	63	62	
No. of person-years	5,505	6,599	6,767	6,559	5,638	
Age- and sex-adjusted HR (95% CI)*	1.00	0.65 (0.44 to 0.95)	0.55 (0.37 to 0.82)	0.73 (0.50 to 1.06)	0.66 (0.44 to 0.98)	0.12
Multivariable-adjusted HR (95% CI)†	1.00	0.68 (0.46 to 1.01)	0.60 (0.39 to 0.90)	0.75 (0.51 to 1.12)	0.60 (0.39 to 0.91)	0.07
Additionally adjusted HR (95% CI)‡	1.00	0.71 (0.48 to 1.05)	0.62 (0.41 to 0.95)	0.79 (0.53 to 1.17)	0.63 (0.41 to 0.97)	0.12

HR, Hazard ratio; CI, Confidence interval.

*Analyses were stratified by sex, recruitment center and intervention group.

†The multivariable HR has been additionally adjusted for age (<60, 60 to 64.9, 65 to 69.9, 70 to 74.9, >/=75 years), smoking (never, (<5, 5 to 19, >20 per day) or cigars and pipes (<3, 3 to 6, >6 per day)), BMI (<25, 25 to 29.9, or >/=30 Kg/m²), baseline diabetes, alcohol (<10, 10 to 14, 15 to 29.9, >/=30 g/day), total energy intake (continuous variable), physical activity (continuous variable), family history of CVD or cancer, aspirin use, antihypertensive drug use, use of cardiovascular medication, use of oral hypoglycaemic agents, insulin, other medication.

‡This model has been additionally adjusted for intake of protein, saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids and cholesterol (all as continuous variables).

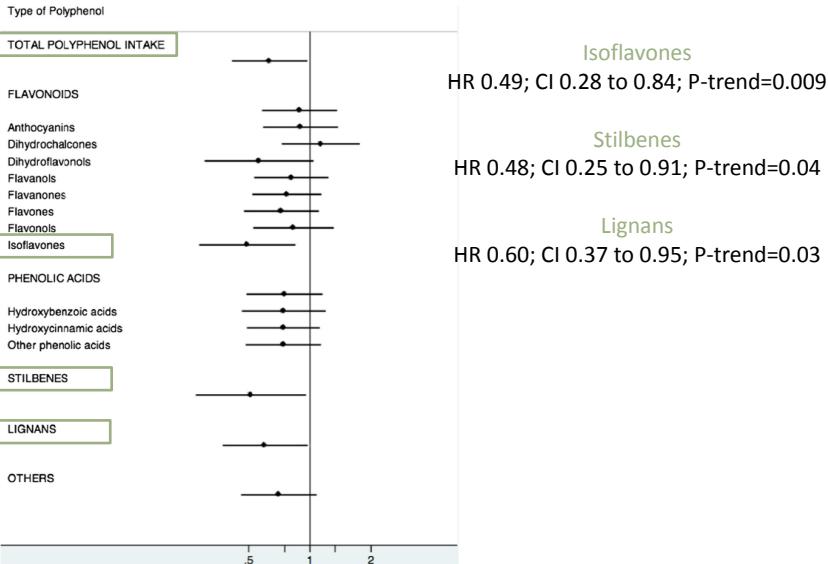
37%

cigarettes



Ingesta de polifenols i mortalitat

POLYPHENOL SUBGROUPS



Resum

Polyphenols	Cardiovascular risk	All-cause mortality risk	Food sources (examples)
Total polyphenols	✓	✓	
Flavanols	✓		Cocoa, red wine, apples
Hydroxybenzoic acids	✓		Pomegranate, berries, olives, red wine
Lignans	✓	✓	Virgin olive oil, whole-grain rye flour
Stilbenes		✓	Red wine, lingonberry
Isoflavones	✓	✓	Soy, beans



Consum moderat de vi i SM

Evaluat l'associació entre el consum moderat de vi i la SM

Estudi transversal basal

British Journal of Nutrition, page 1 of 11
© The Authors 2014

Moderate red wine consumption is associated with a lower prevalence of the metabolic syndrome in the PREDIMED population

Anna Tresserra-Rimbau^{1,2}, Alexander Medina-Remón^{2,3}, Rosa M. Lamuela-Raventos^{1,2}, Monika Ballo^{2,4}, Jordi Salas-Salvadó^{2,4}, Dolores Corella^{2,5}, Montserrat Fitó^{2,6}, Alfredo Gómez^{2,8}, Enrique Gómez-Gracia^{2,8}, José Lapeira^{2,9}, Fernando Arós^{2,10}, Miquel Fitó^{2,11}, Emili Ros^{2,12}, Luis Serra-Majem¹³, Xavier Piñol^{2,14}, Miguel A. Muñoz¹⁵, Ramon Estruch^{2,3*}, on behalf of the PREDIMED Study Investigators

*Correspondence: ramon.estruch@ub.edu

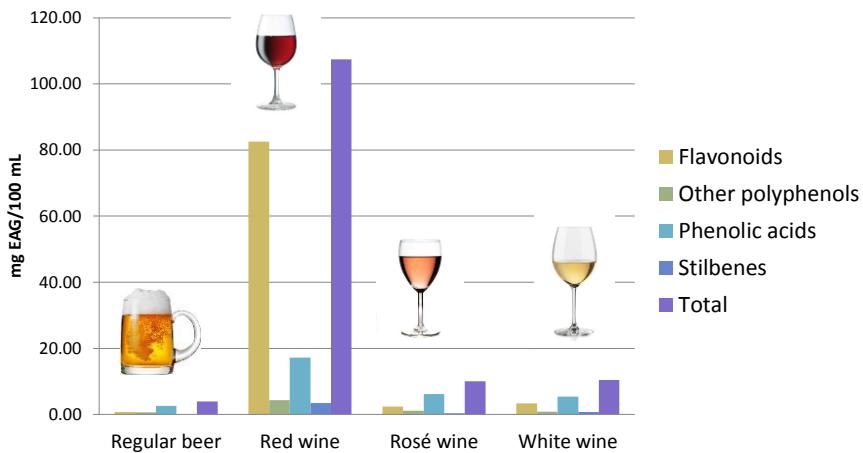




Consum moderat de vi i SM

Per què el vi?

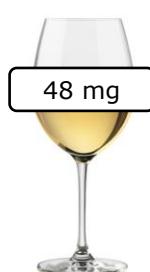
Phenolic content of beer and wines



Consum moderat de vi i SM



330 mL



150 mL



150 mL

Phenolic acids 9 mg
Flavonoids 3 mg

Phenolic acids 8 mg
Flavonoids 5 mg
Stilbenes 1 mg

Flavonoids 124 mg
Phenolic acids 26 mg
Stilbenes 5 mg



Consum moderat de vi i SM

What is a standard drink (SD)?

10 g of pure alcohol



100 mL of wine



What is a moderate?

<3 SD/day <2 SD/day



Flavonoids	124 mg
Phenolic acids	26 mg
Stilbenes	5 mg



Consum moderat de vi i SM



5801 participants
baseline



Red wine

0 drinks/d



0.51 drinks/d



2.9 drinks/d

N. subjects

0-1 drink/d

3037 (52%)

>1 drink/d

2086 (36%)

678 (12%)

MS

75%

61%

53%



Consum moderat de vi i SM



Non-drinkers



0.1-1 drink/d



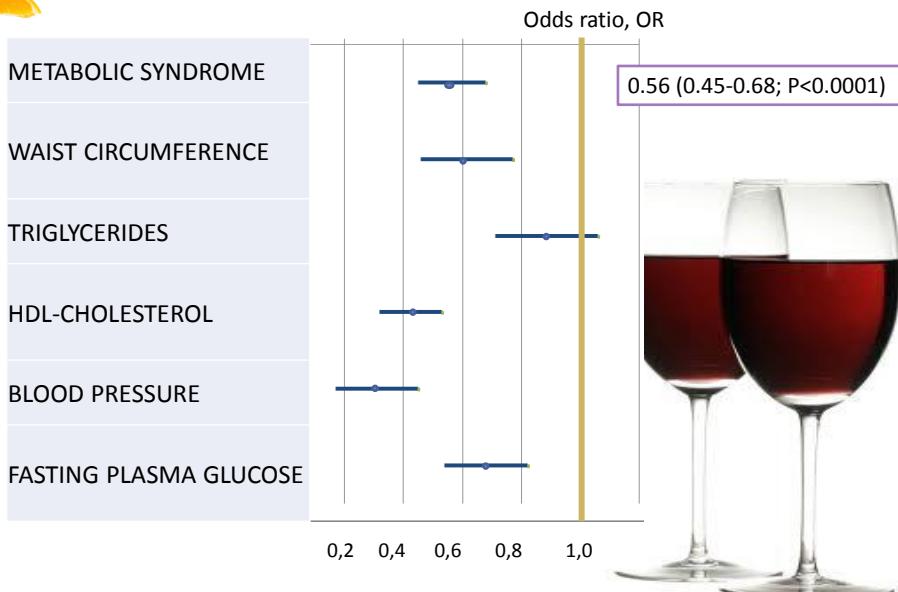
>1 drink/d

Multiple logistic regression analysis

↓
Odds ratio
(OR)



Consum moderat de vi i SM

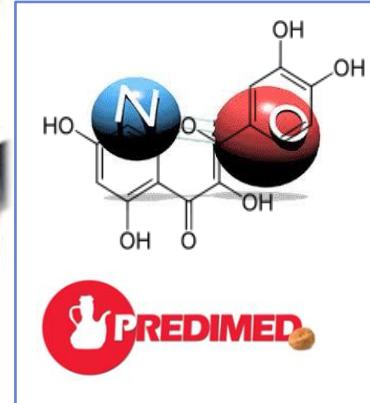




Els polifenols i la PA

Mecanismes d'acció: disminució de la PA a causa de l'augment de la producció de NO plasmàtic

Estudi de la població PREDIMED al cap d'un any



Els polifenols i la PA

Mini-Reviews in Medicinal Chemistry, 2013, 13, 1137-1149

The Effect of Polyphenol Consumption on Blood Pressure

Alexander Medina-Remón^{a,b}, Ramón Estruch^{b,c}, Anna Tresserra-Rimbau^{a,b}, Anna Vallverdú-Queralt^{a,b} and Rosa María Lamuela-Raventos^{a,b,*}

Nutrition, Metabolism & Cardiovascular Diseases (2014) xx, 1–8

Available online at www.sciencedirect.com



Nutrition, Metabolism & Cardiovascular Diseases

journal homepage: www.elsevier.com/locate/nmcd

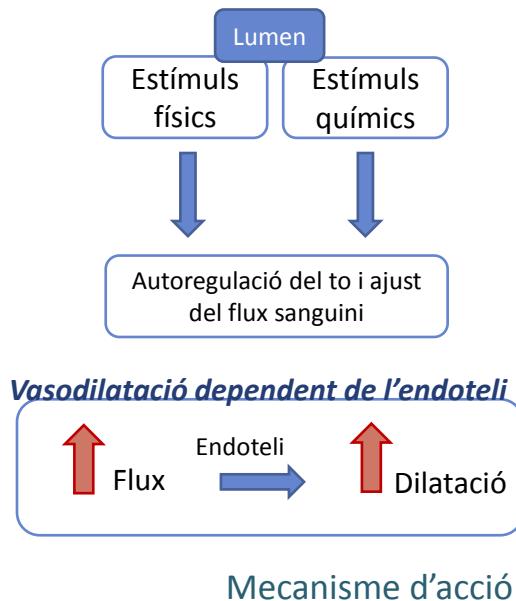
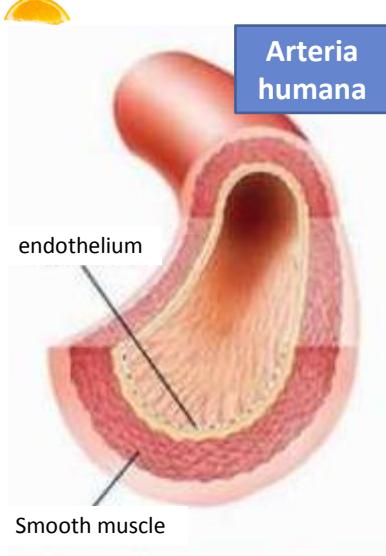


Effects of total dietary polyphenols on plasma nitric oxide and blood pressure in a high cardiovascular risk cohort. The PREDIMED randomized trial

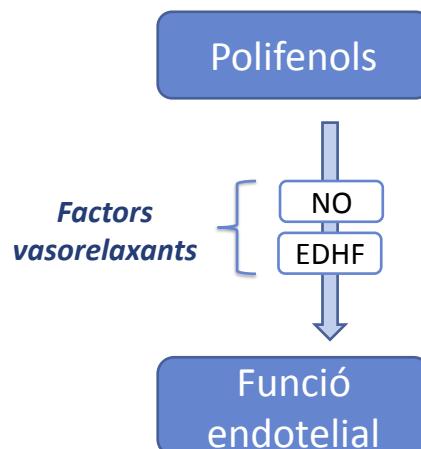
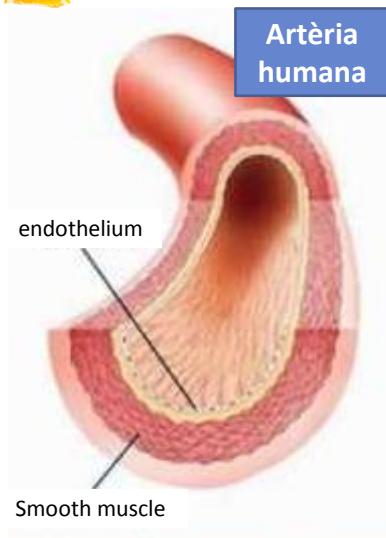
A. Medina-Remón^{a,b}, A. Tresserra-Rimbau^{b,c}, A. Pons^{b,d}, J.A. Tur^{b,d}, M. Martorell^{b,d}, E. Ros^{b,e}, P. Buil-Cosiales^{b,f}, E. Sacanella^{a,b}, M.I. Covas^{b,g}, D. Corella^{b,h}, J. Salas-Salvadó^{b,i}, E. Gómez-Gracia^{b,j}, V. Ruiz-Gutiérrez^{b,k}, M. Ortega-Calvo^{b,l}, M. García-Valdueza^{b,m}, F. Arós^{b,n}, G.T. Saez^{b,o}, L. Serra-Majem^{b,p}, X. Pinto^{b,q}, E. Vinyoles^{b,r}, R. Estruch^{a,b}, R.M. Lamuela-Raventos^{b,s,t}, on behalf of the PREDIMED Study Investigators



Els polifenols i la PA



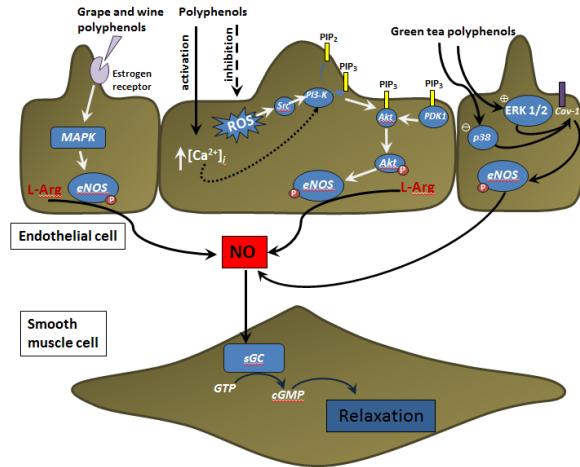
Els polifenols i la PA



Mecanisme d'accio



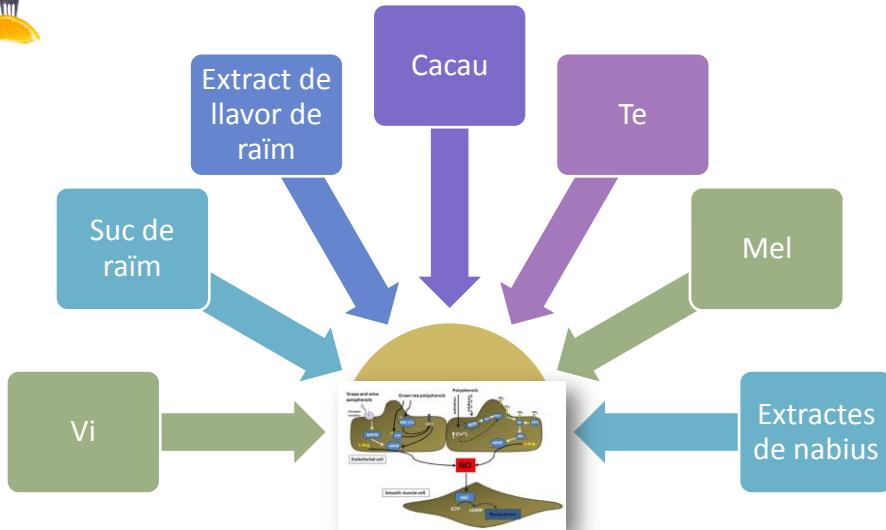
Els polifenols i la PA



Mecanisme d'acció

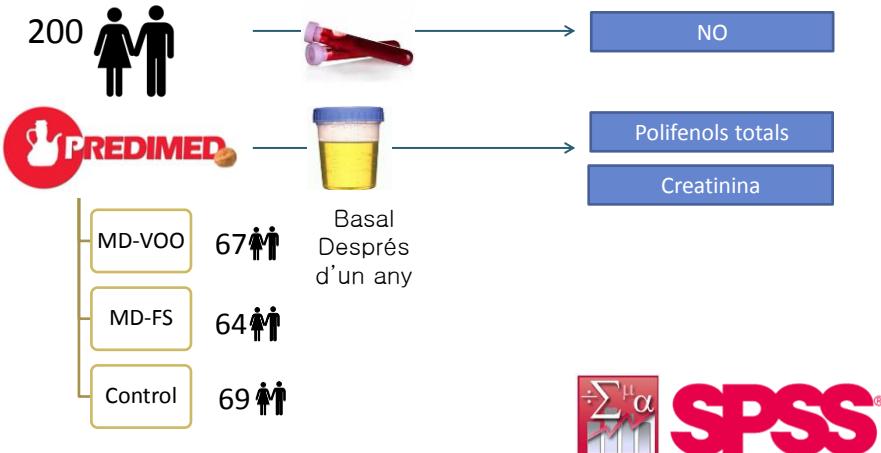


Els polifenols i la PA

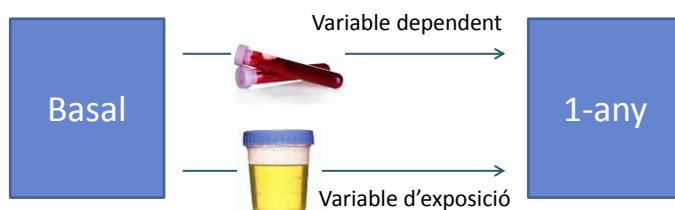




Els polifenols i la PA



Els polifenols i la PA

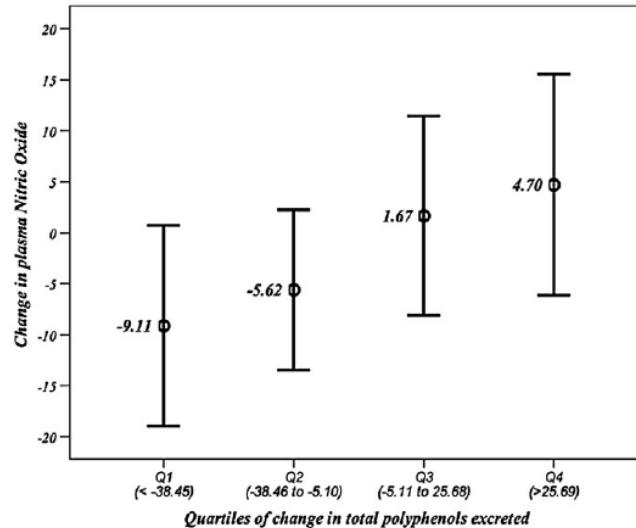


Regressió lineal
multivariable





Els polifenols i la PA



Els polifenols i la PA

MD-EVOO
MD-FS

Variables fixes

ANCOVA

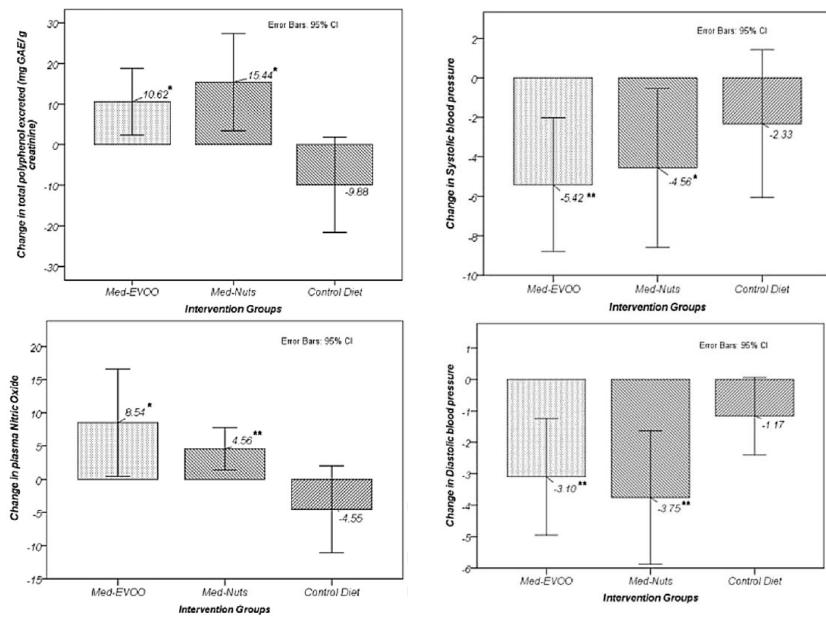


Dependent variables





Els polifenols i la PA



Moltes gràcies!!!

