La vitamina C

La vitamina C, o acido ascorbico, appartiene al gruppo delle **vitamine cosiddette idrosolubili**, quelle cioè che non possono essere accumulate nell'organismo, ma devono essere regolarmente assunte attraverso l'alimentazione.
Oltre a sciogliersi nell'acqua, la vitamina C e sensibile alle alte temperature, per cui si perde del tutto in caso di cottura in acqua.

- La vitamina C **partecipa a molte reazioni metaboliche e alla biosintesi di aminoacidi, ormoni e collagene.**
- Ha forti poteri antiossidanti
- E' contenuta soprattutto negli alimenti freschi: in alcuni tipi di frutta e verdura come le arance, le fragole, i mandarini, i kiwi, i limoni, gli spinaci, i broccoli, i pomodori e i peperoni. Per godere appieno dei benefici della vitamina C, questi alimenti devono essere conservati non più di 3-4 giorni e consumati crudi o comunque poco cotti.

SCIENTIFIC OPINION

Scientific Opinion on the substantiation of health claims related to vitamin C and reduction of tiredness and fatigue (ID 139, 2622), contribution to normal psychological functions (ID 140), regeneration of the reduced form of vitamin E (ID 202), contribution to normal energy-yielding metabolism (ID 2334, 3196), maintenance of the normal function of the immune system (ID 4321) and protection of DNA, proteins and lipids from oxidative damage (ID 3331) pursuant to Article 13(1) of Regulation (EC) No 1924/2006[1]

EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)[2, 3]
European Food Safety Authority (EFSA), Parma, Italy

CONCLUSIONS

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

- The food constituent, vitamin C, which is the subject of the health claims, is sufficiently characterised.

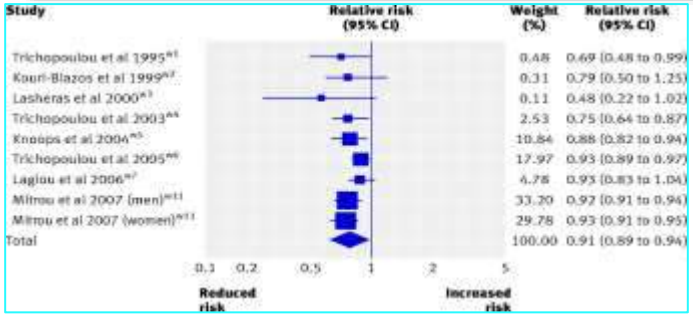
Reduction of tiredness and fatigue (ID 139, 2622)

- The claimed effect is "vitamin/mineral supplementation to reduce fatigue and tiredness in situations of inadequate micronutrient status". The target population is assumed to be the general population. Reduction of tiredness and fatigue is a beneficial physiological effect.

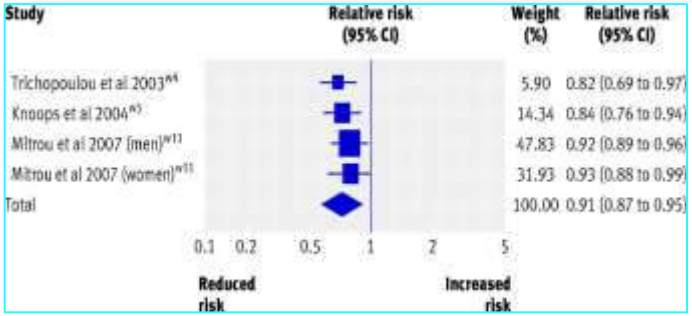
- A cause and effect relationship has been established between the dietary intake of vitamin C and protection of DNA, proteins and lipids from oxidative damage.
- The following wording reflects the scientific evidence: 'Vitamin C contributes to the protection of cell constituents from oxidative damage'.

- A cause and effect relationship has been established between the dietary intake of vitamin C and contribution to normal psychological functions.
- A claim on vitamin C and energy-yielding metabolism has already been assessed with a favourable outcome.
- A claim on vitamin C and the normal function of the immune system has already been assessed with a favourable outcome.

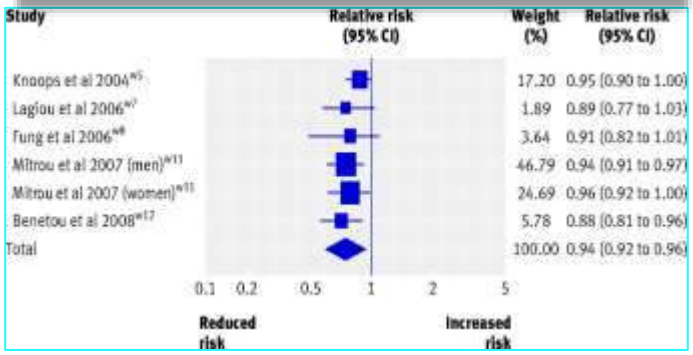
Adherence to Mediterranean diet
All cause mortality



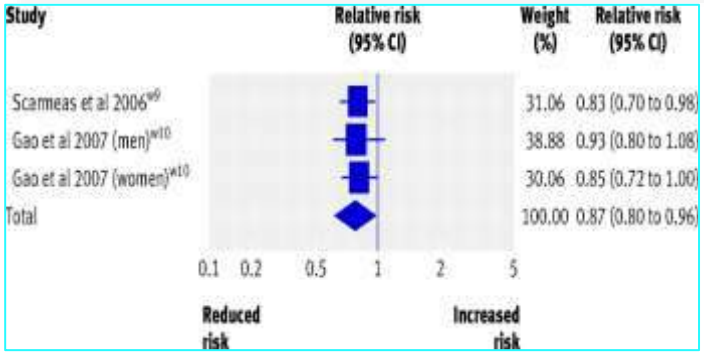
Adherence to Mediterranean diet
Cardiovascular mortality



Adherence to Mediterranean diet
Cancer mortality



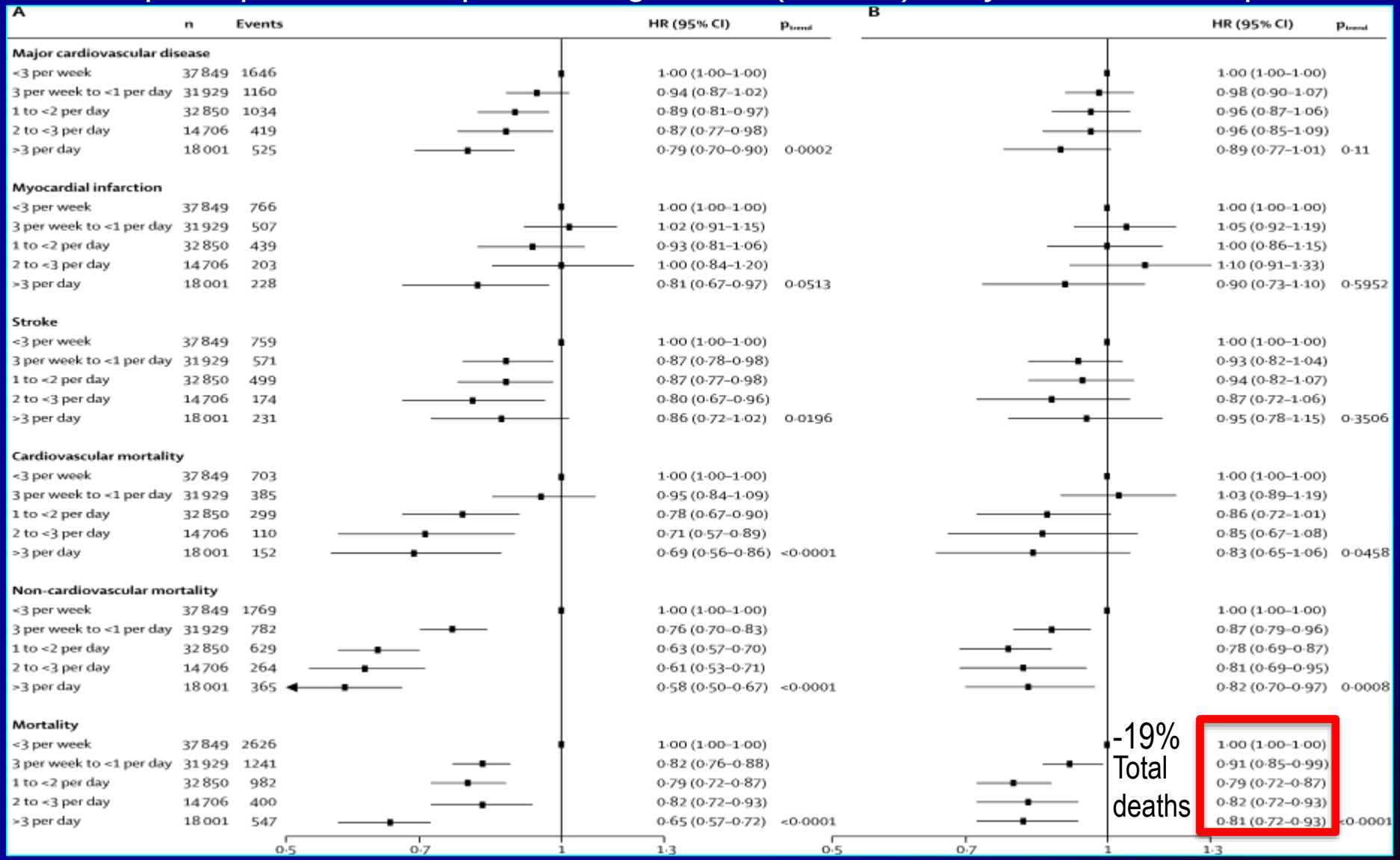
Adherence to Mediterranean diet
Alzheimer/Parkinson diseases



Sofi F et al. BMJ 2008;337:bmj.a1344

Fruit, vegetable and legume intake: CV disease and deaths in 18 countries (PURE)

135.335 participants without pre-existing CVD – (median) 7.4 years of follow-up

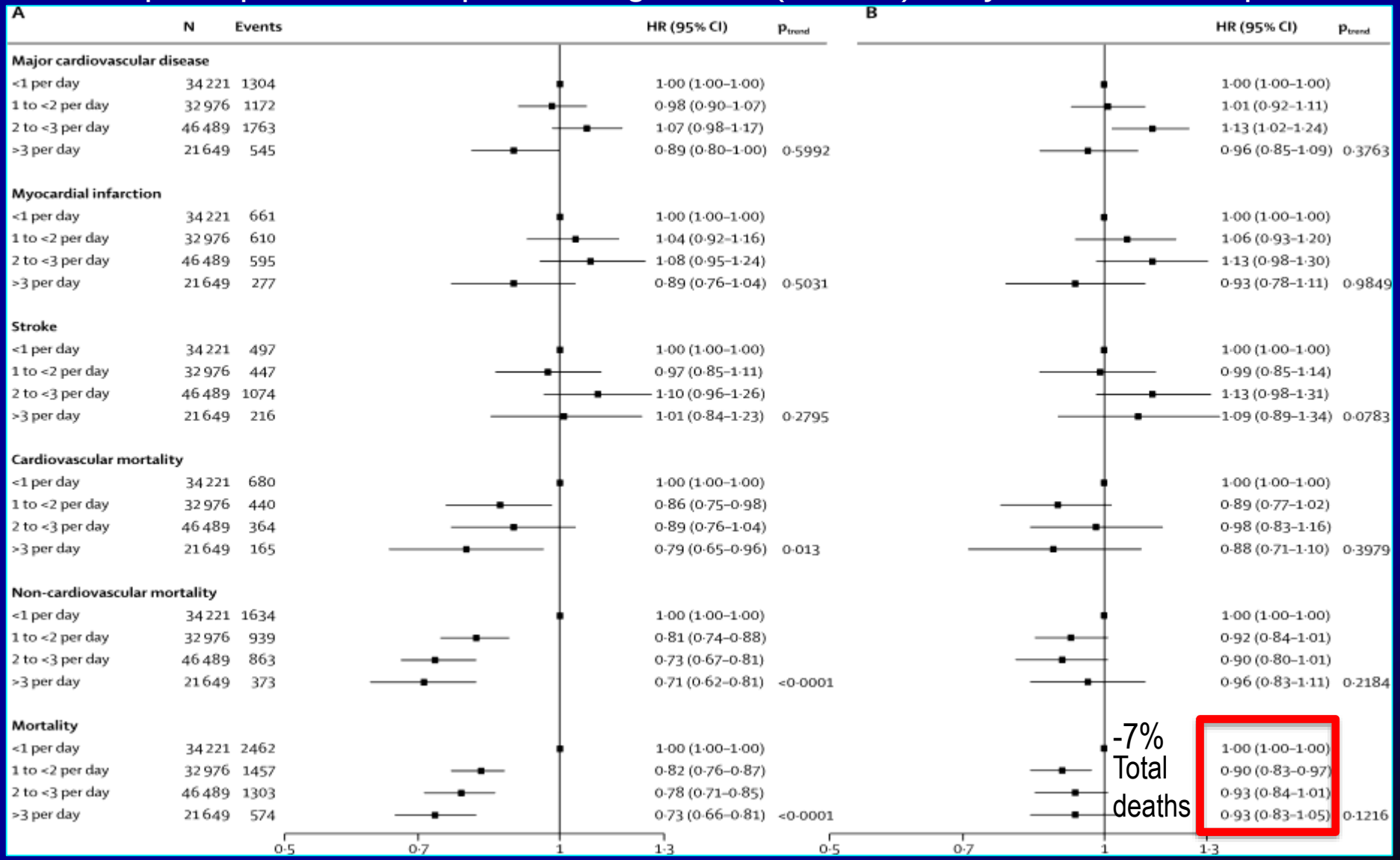


(A) Adjusted for age, sex, and centre (random effect). (B) Adjusted for age, sex, centre (random effect), energy intake, current smoker, diabetes, urban or rural location, physical activity, education level, and tertiles of white meat, red meat, and intake of breads, cereals, and vegetables

Miller V et al The Lancet 2017 DOI: (10.1016/S0140-6736(17)32253-5)

Vegetable intake: CV disease and deaths in 18 countries (PURE)

135.335 participants without pre-existing CVD – (median) 7.4 years of follow-up

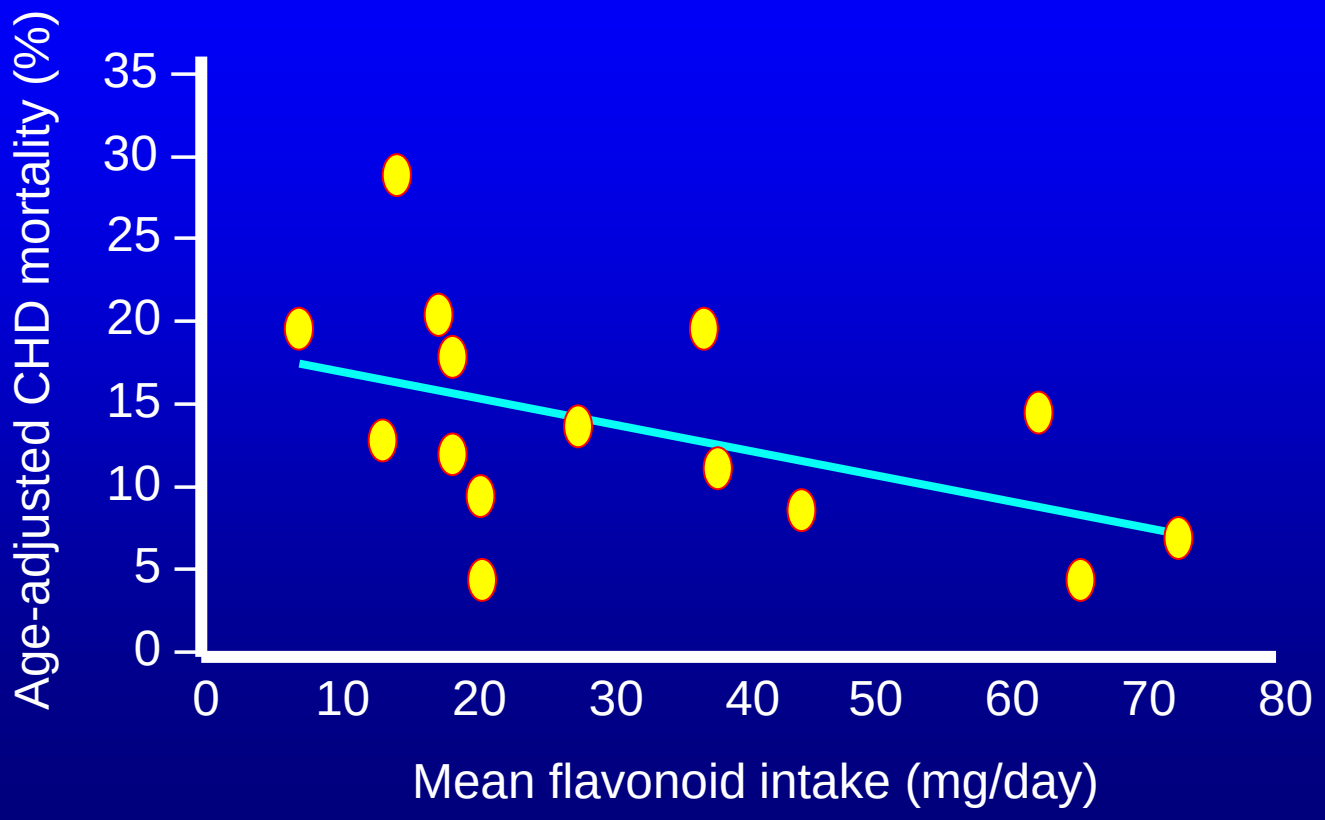


(A) Adjusted for age, sex, and centre (random effect). (B) Adjusted for age, sex, centre (random effect), energy intake, current smoker, diabetes, urban or rural location, physical activity, education level, and tertiles of white meat, red meat, and intake of breads, cereals, and fruit

Miller V et al The Lancet 2017 DOI: (10.1016/S0140-6736(17)32253-5)

Flavonoid intake and long-term risk of coronary heart disease (CHD) in the seven countries study

Average intake of flavonoids was inversely associated with mortality from CHD and explained about 25% of the variance in CHD rates in the 16 cohorts



Hertog et al Arch Intern Med 1995, 155:381-386

Budapest Marzo 2023

Albert Szent-Györgyi

In origine, ha dato ai flavonoidi il nome di "vitamina P" per la loro efficacia nel ridurre la permeabilità dei vasi sanguigni .
Questo nome fu abbandonato quando ci si rese conto che queste sostanze non soddisfacevano la definizione ufficiale di vitamine , in quanto non erano considerate essenziali per la vita.

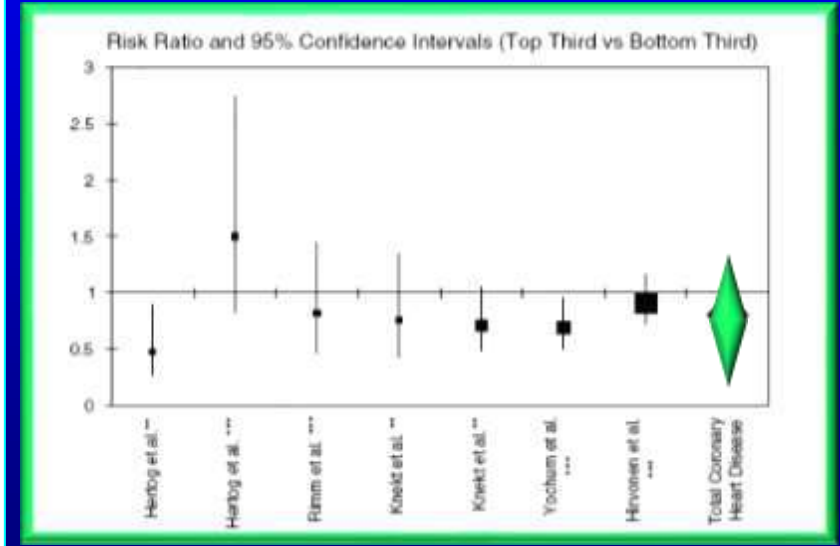
Intake flavonoids associated with lower cardiovascular risk

Epidemiological evidence on flavonoids

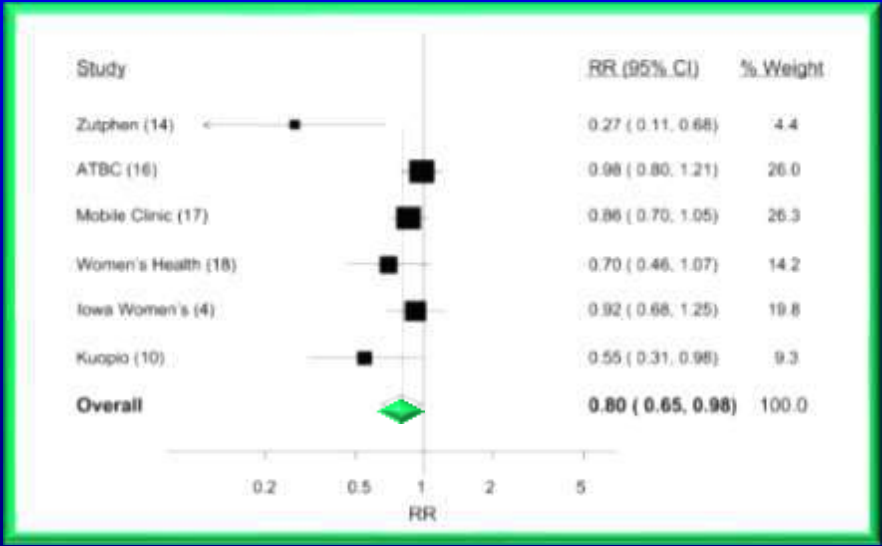
- Meta-analyses show that a higher flavonoid intake is associated with:

- 20% lower risk of CHD mortality (Huxley and Neil, 2003)

- 20% lower risk of stroke (Hollman et al, 2010)



(Huxley and Neil, 2003)



(Hollman et al, 2010)

J Am Coll Nutr. 2015;34 Suppl 1:14-21. doi: 10.1080/07315724.2015.1080105.

Anti-inflammatory Diets.

Sears B[1].

Author information

Abstract

Chronic disease is driven by inflammation. This article will provide an overview on how the balance of macronutrients and omega-6 and omega-3 fatty acids in the diet can alter the expression of inflammatory genes. In particular, how the balance of the protein to glycemic load of a meal can alter the generation of insulin and glucagon and the how the balance of omega-6 and omega-3 fatty acids can effect eicosanoid formation. Clinical results on the reduction of inflammation following anti-inflammatory diets are discussed as well as the molecular targets of anti-inflammatory nutrition. To overcome silent inflammation requires an anti-inflammatory diet (with omega-3s and polyphenols, in particular those of Maqui). The most important aspect of such an anti-inflammatory diet is the stabilization of insulin and reduced intake of omega-6 fatty acids. The ultimate treatment lies in reestablishing hormonal and genetic balance to generate satiety instead of constant hunger. Anti-inflammatory nutrition, balanced 40:30:30 with caloric restriction, should be considered as a form of gene silencing technology, in particular the silencing of the genes involved in the generation of silent inflammation. To this anti-inflammatory diet foundation supplemental omega-3 fatty acids at the level of 2-3 g of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) per day should be added. Finally, a diet rich in colorful, nonstarchy vegetables would contribute adequate amounts of polyphenols to help not only to inhibit nuclear factor (NF)-κB (primary molecular target of inflammation) but also activate AMP kinase. Understanding the impact of an anti-inflammatory diet on silent inflammation can elevate the diet from simply a source of calories to being on the cutting edge of gene-silencing technology.

cells

MDPI

Review

Dietary Flavonoids and Insulin Signaling in Diabetes and Obesity

María Ángeles Martín [1,2] and Sonia Ramos [1,*]

Cell/Animal Model	Treatment	Effect on Insulin Signaling	Main Metabolic Outcomes	Reference
		Liver		
(db/db) diabetic mice	Tangeretin (50 mg/kg bw), 30 days	↑IR, ↑AKT, ↑GSK3	↓Blood glucose ↑Glucose tolerance ↓HOMA-IR	[37]
HFD-fed and STZ-induced type 2 diabetic rats	Myricetin (20 mg/kg bw), 4 weeks	↑p-IR, ↑p-IRS1, ↑p-AKT, ↓PTP1B enzyme activity	↓Blood glucose, ↓HbA1c ↓HOMA-IR ↓TG, ↓LDL, ↑HDL	[38]
STZ-induced diabetic rats	Isoquercetin (40 mg/kg bw), 45 days	↑IR, ↑IRS-1, ↑IRS-2, ↑AKT ↑GLUT-2, ↑GK, ↓G6Pase, ↓PEPCK	↓Blood glucose ↑Glucose tolerance ↑Glycogen levels	[39]
Zucker diabetic fatty rats [ZDF/crl-lepr (fa/fa)]	10% cocoa rich diet, 9 weeks	↓p-(Ser)-IRS-1, ↑p-GSK3, ↓p-GS, ↑GLUT-2 ↓PEPCK, ↑GK	↓Blood glucose, ↓HbA1c ↑Glucose tolerance ↓HOMA-IR ↓ Glycogen levels	[40]
(db/db) diabetic mice	Mulberry anthocyanin extract (50 and 125 mg/kg bw), 8 weeks	↑AKT, =p-GSK3, ↑FOXO1	↓Blood glucose ↑Glucose tolerance, ↓HOMA-IR, ↓TG, ↓LDL ↓Glycogen levels	[41]

cells

MDPI

Review

Dietary Flavonoids and Insulin Signaling in Diabetes and Obesity

María Ángeles Martín [1,2] and Sonia Ramos [1,*]

STZ-induced diabetic rats	Catechin (50 mg/kg bw), 3 weeks	↑PI3K in endothelium	↓Blood glucose ↑Aortic nitrite/nitrate concentration. ↑Endothelium-dependent relaxation	[51]
Rat NRK-52E renal cells	Epicatechin (10 μM) or DHPAA (10 μM) during 2 h and glucose (30 mM) for additional 22 h	↑IR, ↑p-IR, ↑p-GSK3, ↓GS, ↓PEPCK in renal cells	↑Glucose uptake ↓Glucose production	[52]
STZ-induced diabetic mice	Luteolin (10 mg/kg bw), 4 weeks	↑IR, ↑PI3K, ↑AKT in kidney	↓Blood glucose, ↓TG, ↓LDL ↑Glucose tolerance ↓serum and urine levels of creatinine and uric acid	[53]
STZ-induced diabetic rats	Quercetin (0.1%) or Naringenin (0.05%), 2 months	↑IRS-1, ↑PI3K, ↑AKT ↑GLUT-1, ↑GLUT-3 in brain	↓Blood glucose	[54]

cells

MDPI

Review

Dietary Flavonoids and Insulin Signaling in Diabetes and Obesity

María Ángeles Martín [1,2] and Sonia Ramos [1,*]

Human interventional trials of the effects of flavonoid and flavonoid-rich food intake on insulin resistance in diabetes

Type of Study	Number of Participants	Treatment	Effect on Metabolism	Reference
RCDB, parallel	93♀(post-menopausal (type 2 diabetic patients)	850 mg flavanols and 100 mg isoflavones/day, 1 year	=Glycemia, =HbA1c, ↓Insulinemia, ↓HOMA-IR, ↓LDL, =HDL	[62]
RCDB, parallel	68 (35♂+ 33♀) (type 2 diabetic patients)	1500 mg of green tea extract (856 mg of ECGC)/day, 16 weeks	=Glycemia, ↓Insulinemia, ↓HOMA-IR, ↑HDL, =LDL, =TG	[63]
RCDB, crossover	12 (3♂+ 9♀) (hypertensive type 2 diabetic patients)	83.6 mg of cocoa flavanols, acute	=Glycemia, =Insulinemia, =HOMA-IR, =LDL, =HDL, =TG	[67]
RCDB, crossover	18 (4♂+ 14♀) (type 2 diabetic patients)	Cocoa beverage (960 mg polyphenols), acute	=Glycemia, ↑Insulinemia, =HOMA-IR, ↑HDL, =LDL, =TG	[64]
RCDB, parallel	35 (18♂+ 17♀) (hypertensive type 2 diabetic patients)	83.6 mg of cocoa flavanols/day, 12 weeks	=Glycemia, =HbA1c, =Insulinemia, =HOMA-IR, =LDL, =HDL, =TG	[65]
RCDB, crossover	12 (7♂+ 5♀) (hypertensive type 2 diabetic patients)	Dark chocolate (450 mg flavanols)/day, 8 weeks	=Glycemia, =HbA1c, =Insulinemia, =HOMA-IR, ↑HDL, =LDL	[66]
RCDB, parallel	42 (20♂+ 22♀) (type 2 diabetic patients)	135 mg silybin/day, 6 months	↓Glycemia, =Insulinemia, =HOMA-IR, =HDL, ↓TG	[68]
RCDB, crossover	32 (16♂+ 16♀) (type 2 diabetic patients)	Grape seed extract (600 mg of flavonoids)/day, 4 weeks	=HOMA-IR, =HDL, =TG, ↓TC	[69]

cells

MDPI

Review

Dietary Flavonoids and Insulin Signaling in Diabetes and Obesity

María Ángeles Martín [1,2] and Sonia Ramos [1,*]

Human interventional trials of the effects of flavonoid and flavonoid-rich food intake on insulin resistance during obesity

Type of Study	Number of Participants	Treatment	Effect on Metabolism	Reference
RC, crossover	27 ♂(BMI > 25 kg/m^2, 53–63 years)	600 g blackberries (1500 mg flavonoids), acute (12 h)	=Glycemia, =Insulinemia, HOMA-IR, ↓HOMA-B, ↓AUC in GTT for insulin ↓respiratory quotient, ↓AUC for NEFA, ↓TG	[96]
Prospective	6 (4♂+ 2♀), (BMI = 25–35 kg/m^2, ≥45 years)	Kosen-cha (1 L/day, 14,300 mg polyphenols), 12 weeks	=Glycemia, ↓HOMA-IR ↓BW, ↓BMI, ↓WC, ↓TG	[97]
RCB, crossover	26 (21♂+ 5♀), (BMI > 25 kg/m^2, 38–58 years)	Pecan-rich diet (15% of total calories), 12 weeks	↓Glycemia, ↓Insulinemia, ↓HOMA-IR, ↓HOMA-B ↓VLDL, ↓LDL, ↓HDL, ↓TG	[98]
RC, crossover	28 (12♂+ 16♀), (BMI = 25–35 kg/m^2, 40–65 years)	Pomegranate juice (500 mL, 1685 mg polyphenols/L), 4 weeks	↓Insulinemia, ↓HOMA-IR =BW, =BMI	[99]
RCSB, crossover	42 adult women (25 overweight [BMI ≥ 25 kg/m^2] + 21 controls, [BMI = 18–24.9 kg/m^2])	Dark chocolate (20 g, 500 mg polyphenols), 4 weeks	=Insulinemia, =HOMA-IR, ↓QUICKI ↓BW, =WC	[100]
RCDB, parallel	46 adult women (13 overweight + 8 obese, [BMI ≥ 25 kg/m^2] + 21 controls, [BMI = 25 kg/m^2])	Orange juice (750 mL/day, 135 mg flavonoids/L), 8 weeks	=Glycemia, =Insulinemia, =HOMA-IR. ↓Total Cho, ↓LDL, =HDL. =BMI, =body fat mass, =body mass, =WC	[101]
RCDB, parallel	54 breast cancer survivors (BMI = 25–40 kg/m^2, 18–80 years)	Green decaffeinated tea (960 mL/day, 235.64 mg catechin and 128.84 mg EGCG), 6 months	=Glycemia, =Insulinemia, =HOMA-IR. ↓LDL, ↑HDL, =TG ↓BW, ↓BMI, ↓fat mass, ↓lean mass, ↓WC, ↓hip circumference	[102]

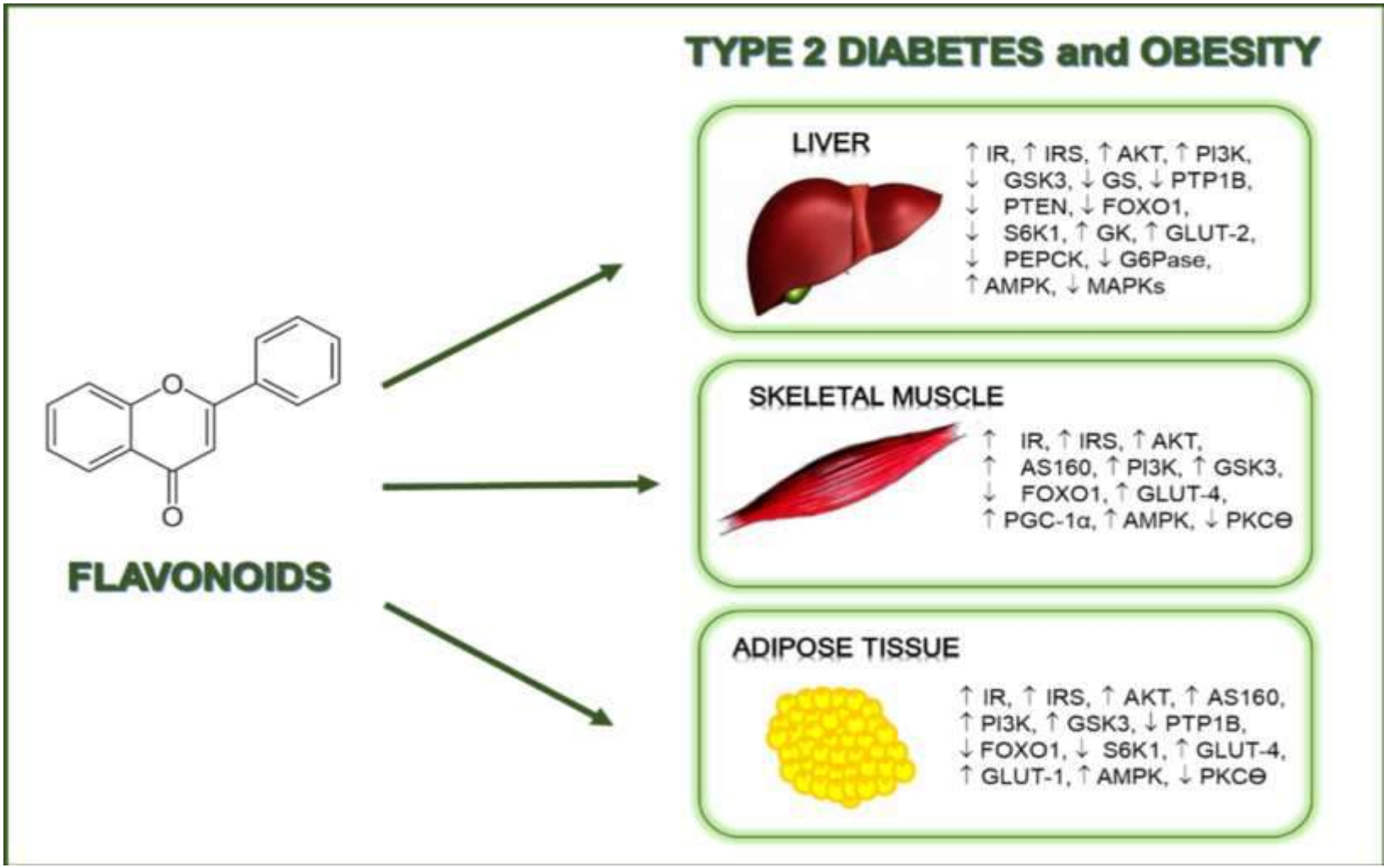
cells

MDPI

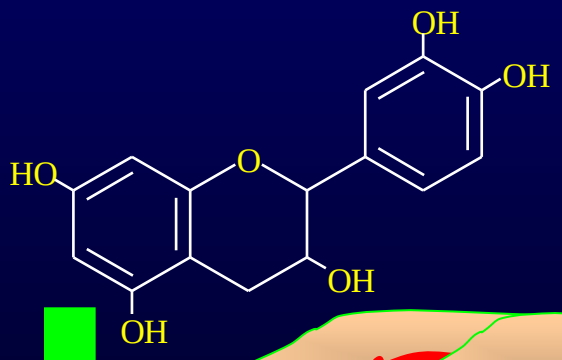
Review

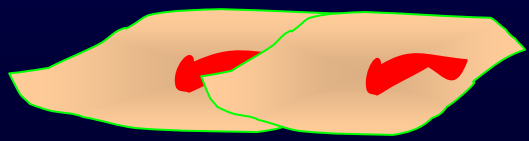
Dietary Flavonoids and Insulin Signaling in Diabetes and Obesity

María Ángeles Martín [1,2] and Sonia Ramos [1,*]



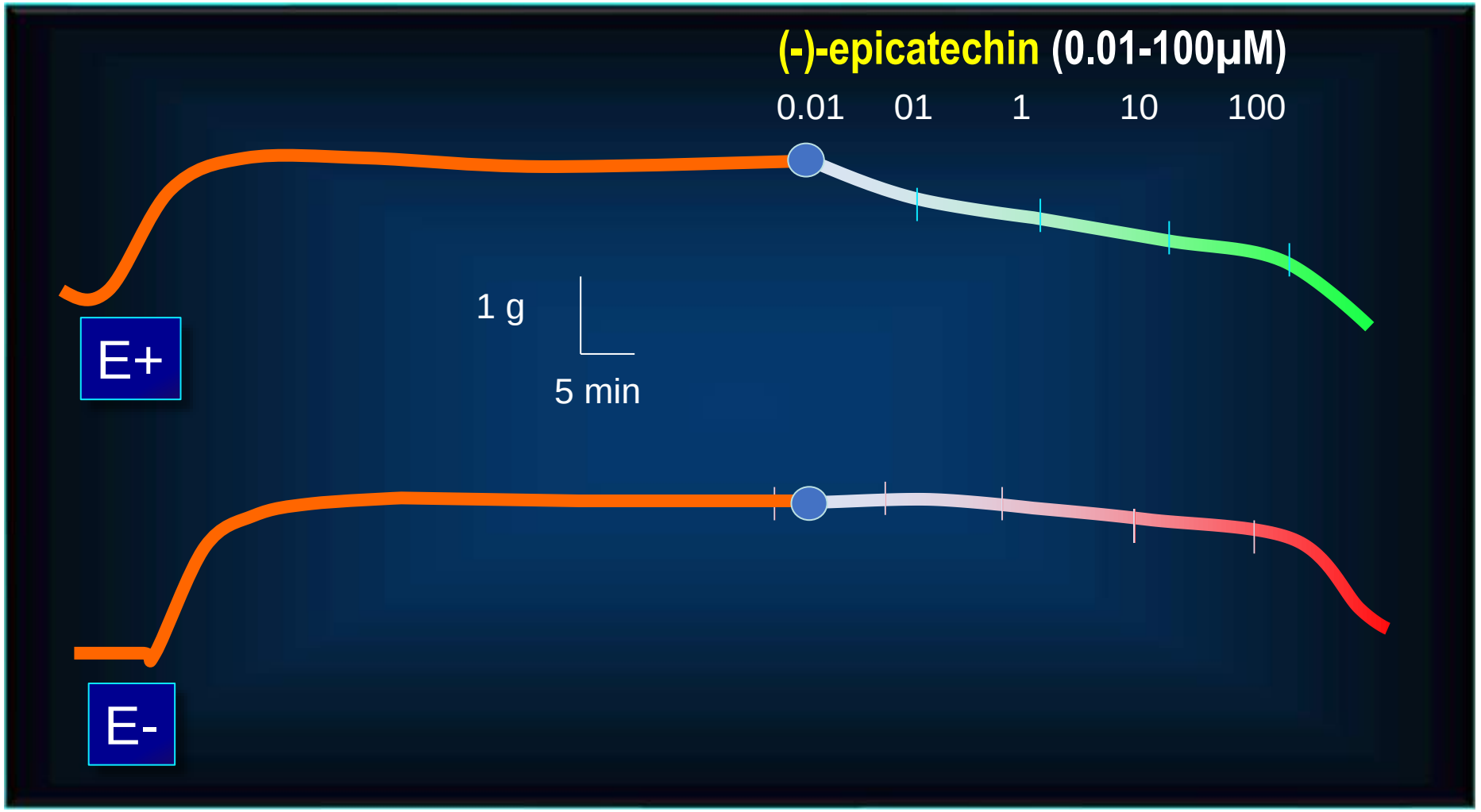
Polifenoli





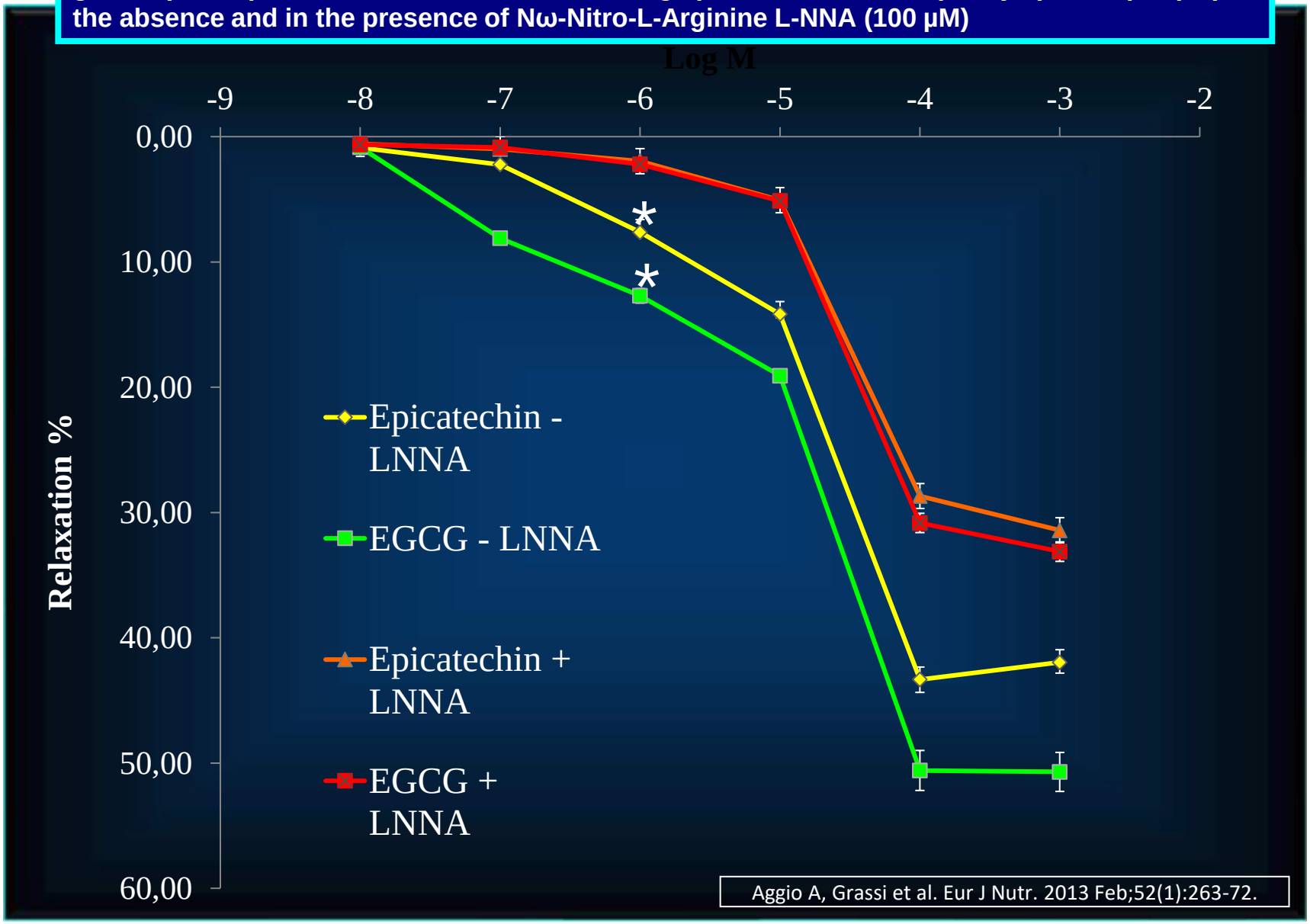
Endothelial “protection”?

Concentration-dependent relaxant effect of (-)-epicatechin (0.01-100µM) on phenylephrine-precontracted rat aortic rings with (E+) or without (E-) endothelium



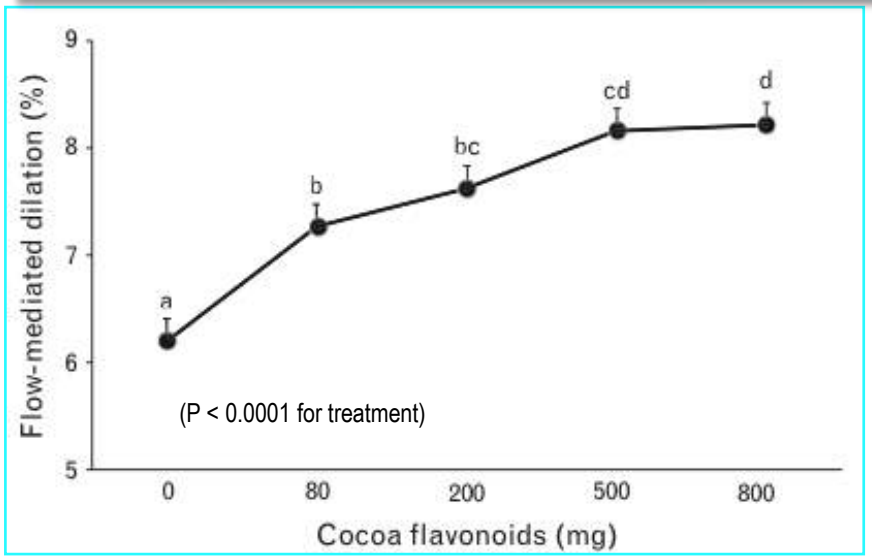
Grassi D et al. Eur J Nutr 2012

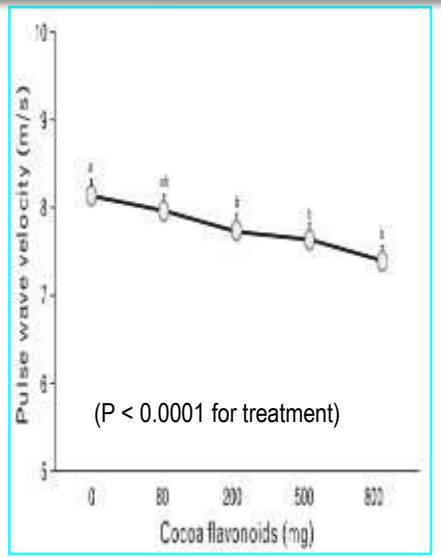
Concentration dependent vasorelaxant effect of (-)-epicatechin (EC) and (-)- epigallocatechin gallate (EGCG) on endothelium-intact aortic rings precontracted with phenylephrine (0.3 μM) in the absence and in the presence of Nω-Nitro-L-Arginine L-NNA (100 μM)

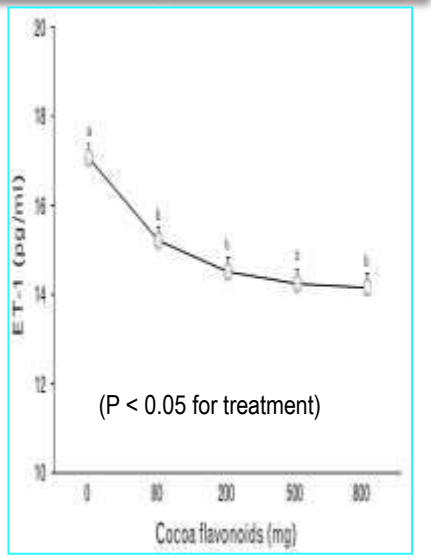


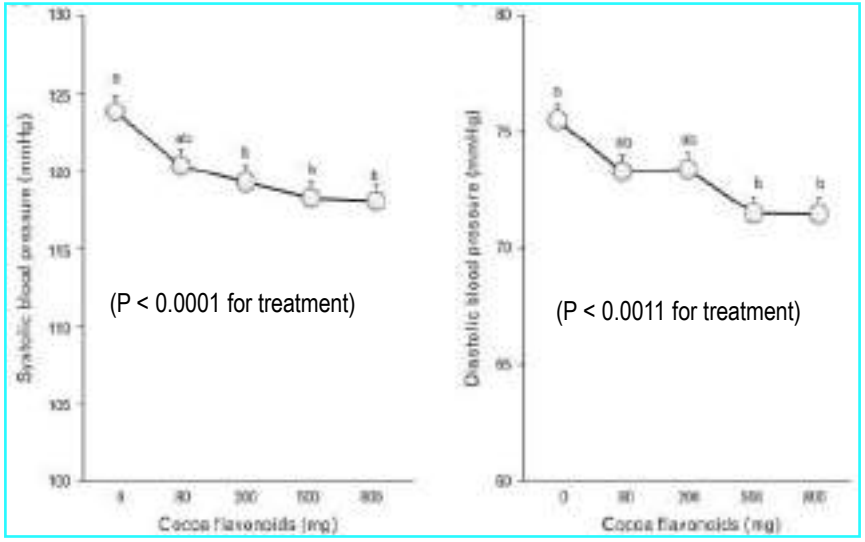
Aggio A, Grassi et al. Eur J Nutr. 2013 Feb;52(1):263-72.

Flavonoids effects on FMD, PWV, office systolic/diastolic BP and day/night BP values







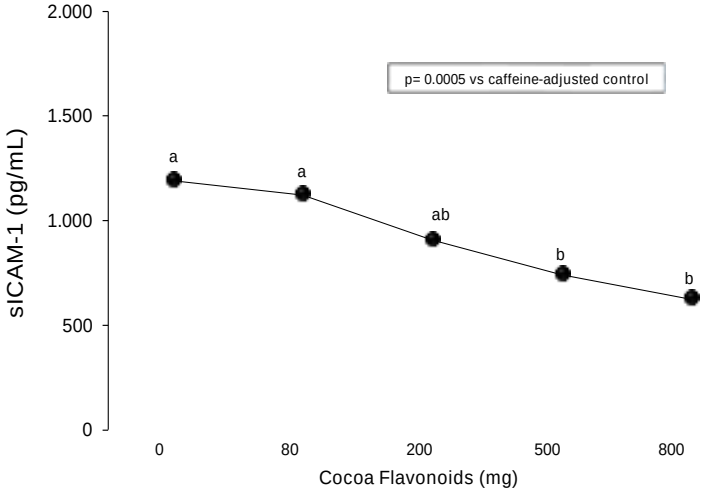


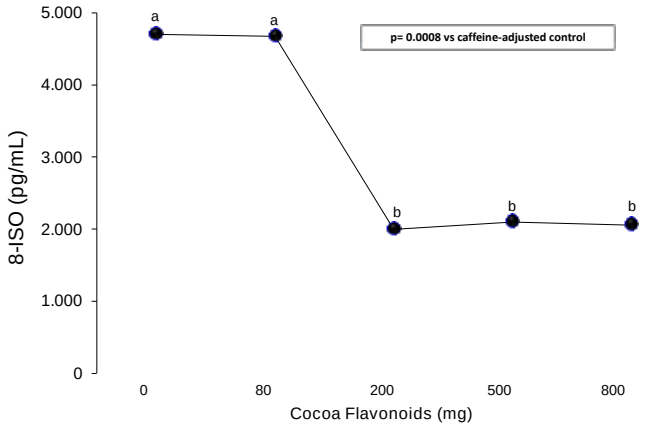
ABPM	0 mg control	80 mg	200 mg	500 mg	800 mg	SEM	P
SBP 24 h	117.7	118.3	114.7	115.5	114.3	1.60	0.05
SBP day	122.4	122.5	119.1	119.4	119.1	1.56	0.038
SBP night	108.7	110.1	106.6	107.8	106.3	1.33	NS
DBP 24 h	70.8	70.9	70.7	71.2	71.3	1.07	NS
DBP day	75.5	75.3	75.1	75.3	75.7	1.91	NS
DBP night	62.0	62.7	61.7	63.1	63.5	1.34	NS
HR 24 h	76.4	73.8	77.2	76.2	75.9	1.58	NS
HR day	79.2	77.5	81.5	80.3	80.2	1.94	NS
HR night	70.9	66.6*	68.7	68.5	67.5*	1.33	0.024
PP 24 h	47.0	47.5	43.8	44.6	43.1*	1.87	0.0064
PP day	47.2	47.5	43.4*	44.2	43.6*	1.81	0.0088
PP night	46.7	47.4	44.3	44.9	43.0	2.10	0.0352

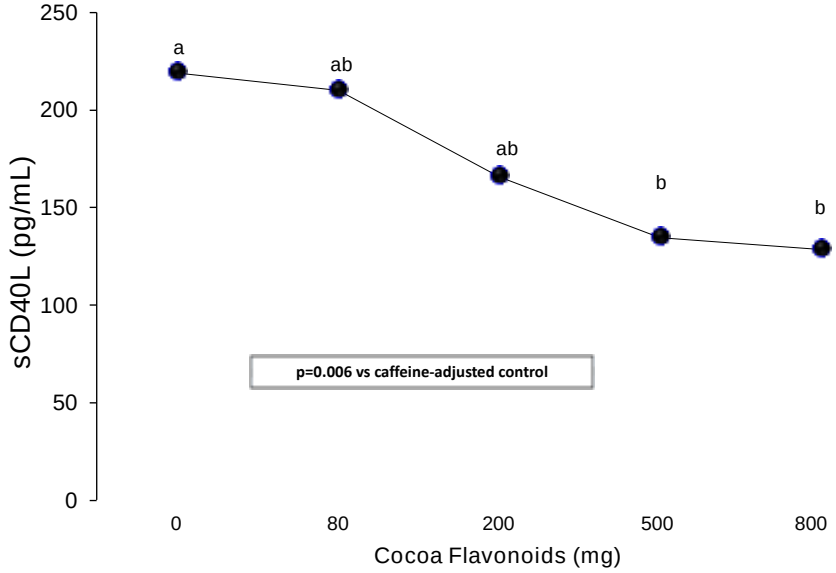
Grassi D et al J Hypertens 2015, 33:294–303

Cocoa consumption decreases oxidative stress, proinflammatory mediators and lipid peroxidation in healthy subjects: a randomized placebo-controlled dose-response clinical trial.

Grassi D et al. BPCP-D-23-00018R1 .







European Food Safety Authority EFSA Journal 2012;10(7):2809

SCIENTIFIC OPINION

Scientific Opinion on the substantiation of a health claim related to cocoa flavanols and maintenance of normal endothelium-dependent vasodilation pursuant to Article 13(5) of Regulation (EC) No 1924/2006[1]

EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

The Panel concludes that a cause and effect relationship has been established between the consumption of cocoa flavanols and maintenance of normal endothelium-dependent vasodilation.

The Panel could not have reached its conclusions without the human intervention study claimed as proprietary by the applicant (Grassi et al., 2011, unpublished).

4. Panel's comments on the proposed wording

The Panel considers that the following wording reflects the scientific evidence: "Cocoa flavanols help maintain endothelium-dependent vasodilation, which contributes to normal blood flow".

5. Conditions and restrictions of use

In order to obtain the claimed effect, 200 mg of cocoa flavanols should be consumed daily. This amount could be provided by 2.5 g of high-flavanol cocoa powder or 10 g of high-flavanol dark chocolate. These amounts of cocoa powder or dark chocolate can be consumed in the context of a balanced diet. The target population is the general population.

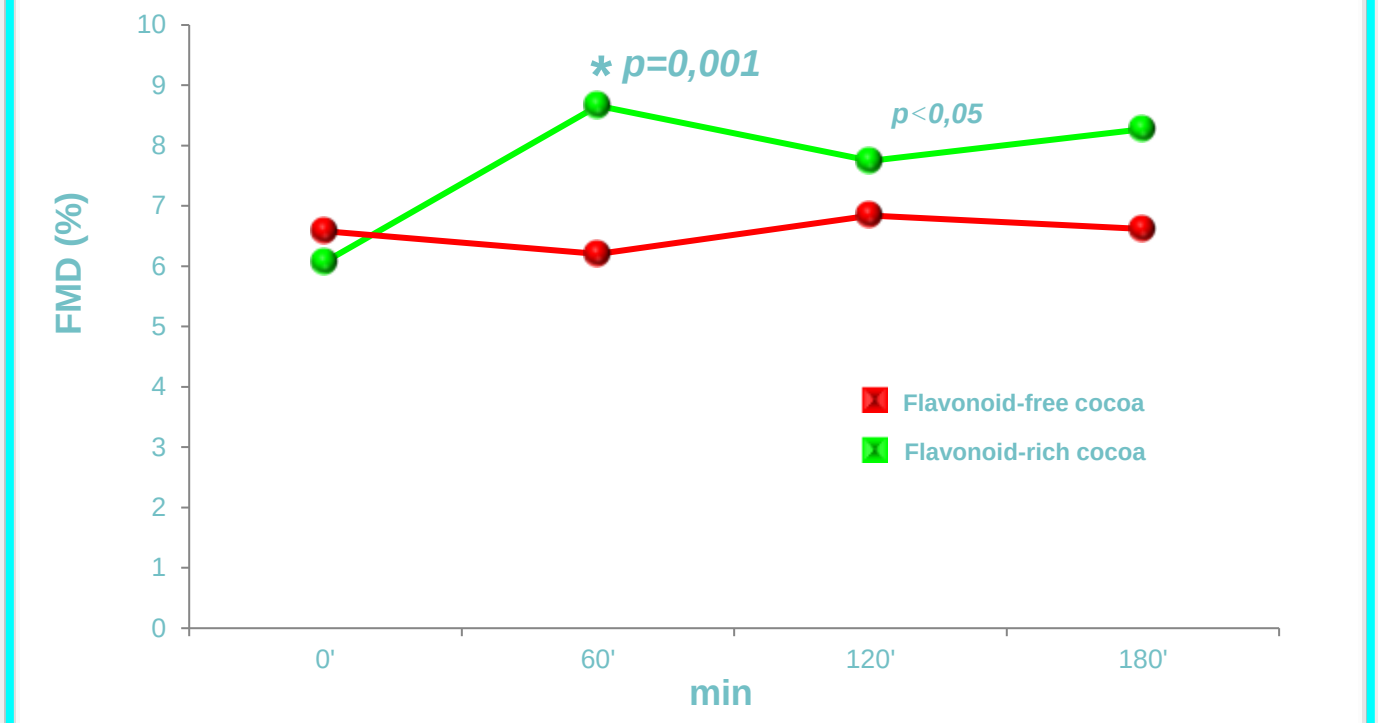
Correlations between blood pressure, endothelial function and insulin resistance changing variables by Spearman nonparametric correlation in IGT EH patients.

Parameters	r	P
Δ clinical SBP - Δ FMD	-0.547	0.0004
Δ clinical DBP - Δ FMD	-0.488	0.001
Δ 24-h SBP - Δ FMD	-0.460	0.003
Δ daytime SBP - Δ FMD	-0.446	0.005
Δ nighttime SBP - Δ FMD	-0.431	0.006
Δ 24-h DBP - Δ FMD	-0.457	0.003
Δ daytime DBP - Δ FMD	-0.516	0.0009
Δ nighttime DBP - Δ FMD	-0.368	0.022

Parameters	r	P
Δ HOMA-IR - Δ clinical SBP	0.376	0.019
Δ HOMA-IR - Δ clinical DBP	0.442	0.005
Δ HOMA-IR - Δ 24-h SBP	0.388	0.016
Δ HOMA-IR - Δ nighttime SBP	0.451	0.004
Δ HOMA-IR - Δ 24-h DBP	0.334	0.040
Δ HOMA-IR - Δ daytime DBP	0.425	0.007
Δ ISI - Δ clinical DBP	-0.501	0.001
Δ ISI - Δ 24-h SBP	-0.368	0.022
Δ ISI - Δ 24-h DBP	-0.384	0.017
Δ QuickI - Δ clinical SBP	-0.386	0.016
Δ QuickI - Δ clinical DBP	-0.445	0.005
Δ QuickI - Δ 24-h SBP	-0.392	0.014
Δ QuickI - Δ 24-h DBP	-0.341	0.036
Δ CIR_{120} - Δ clinical SBP	-0.401	0.012
Δ CIR_{120} - Δ daytime SBP	-0.3542	0.029
Δ CIR_{120} - Δ 24-h DBP	-0.333	0.041
Δ CIR_{120} - Δ daytime DBP	-0.335	0.039
Δ CIR_{120} - Δ nighttime DBP	-0.374	0.020

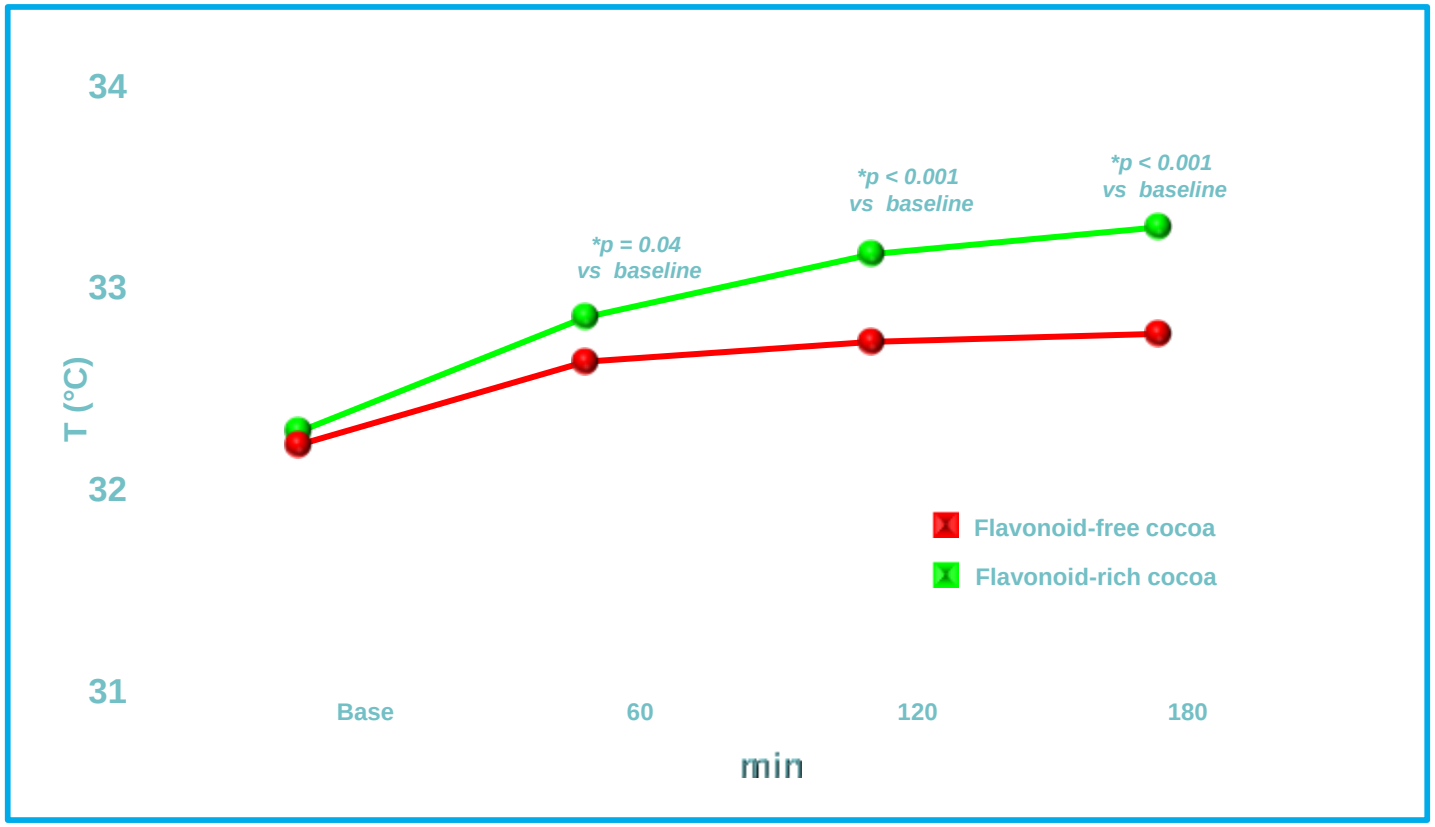
Grassi D et al. J Nutr. 2008;138:1671-76.

Flavanol-rich cocoa acutely increases endothelium-dependent, flow-mediated dilation



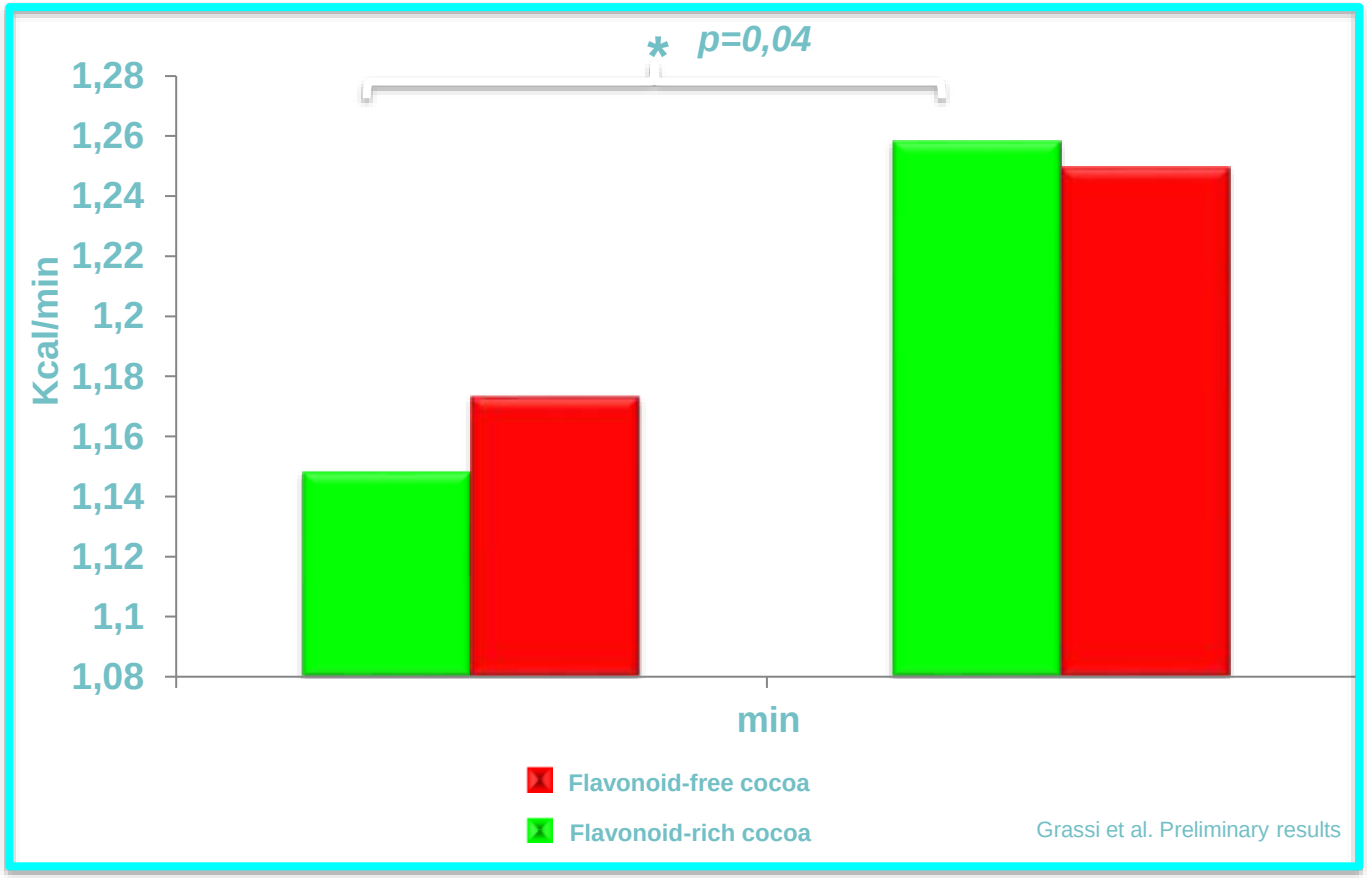
Grassi et al. Preliminary results

Flavanol-rich cocoa acutely increases *Thermogenesis*



Grassi et al. Preliminary results

Flavanol-rich cocoa acutely increases caloric consumption



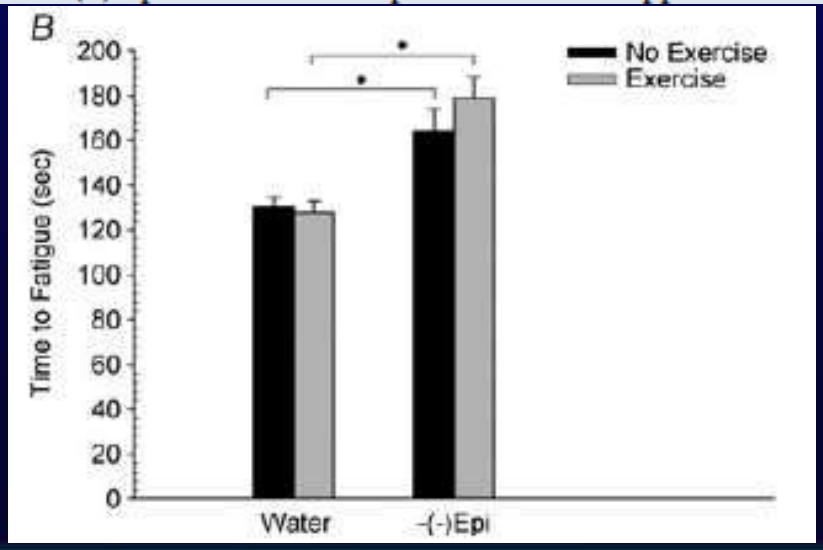
(–)-Epicatechin enhances fatigue resistance and oxidative capacity in mouse muscle

J Physiol. 2011;589(Pt 18):4615-31.

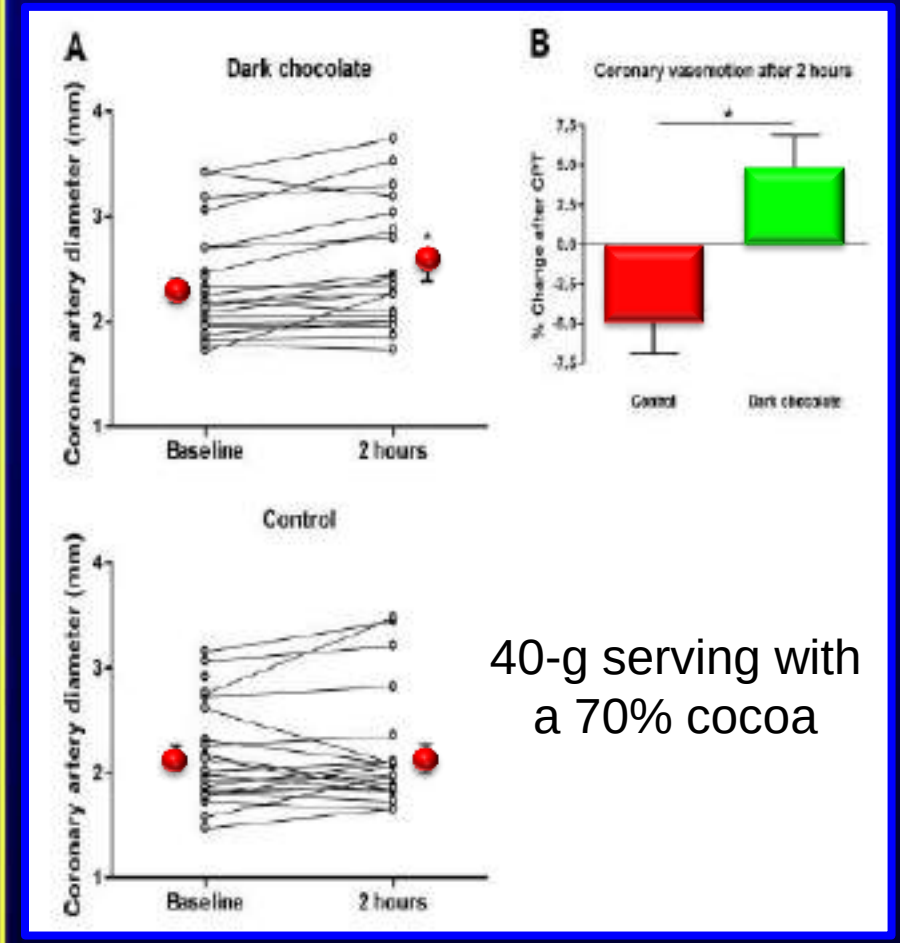
Leonardo Nogueira[1], Israel Ramirez-Sanchez[1,4], Guy A. Perkins[2], Anne Murphy[3], Pam R. Taub[1], Guillermo Ceballos[4], Francisco J. Villarreal[1], Michael C. Hogan[1] and Moh H. Malek[5]

[1]*Department of Medicine, School of Medicine, University of California, San Diego, CA, USA*
[2]*National Centre for Microscopy & Imageing Research, and* [3]*Department of Pharmacology, La Jolla, CA 92093, USA*
[4]*Escuela Superior de Medicina del Instituto Politécnico Nacional, Seccion de Posgrado, Mexico City, Mexico*
[5]*Integrative Physiology of Exercise Laboratory, Wayne State University, Eugene Applebaum College of Pharmacy & Health Sciences, Detroit, MI 48201, USA*

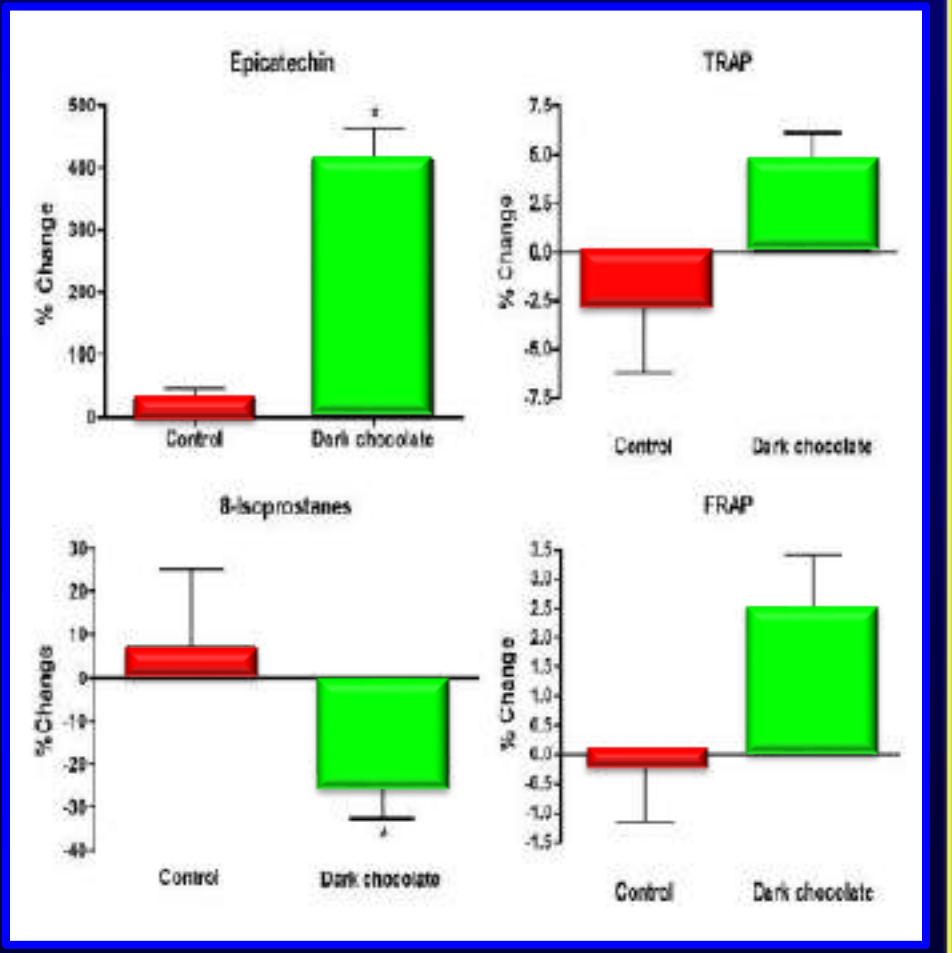
proteins, mitofilin, porin and capillarity than (–)-epicatechin alone. These findings indicate that (–)-epicatechin alone or in combination with exercise induces an integrated response that includes structural and metabolic changes in skeletal and cardiac muscles resulting in greater endurance capacity. These results, therefore, warrant the further evaluation of the underlying mechanism of action of (–)-epicatechin and its potential clinical application as an exercise mimetic.



Dark Chocolate Improves Coronary Vasomotion and Reduces Platelet Reactivity



40-g serving with a 70% cocoa



Flammer et al. Circulation. 2007;116:2376-2382

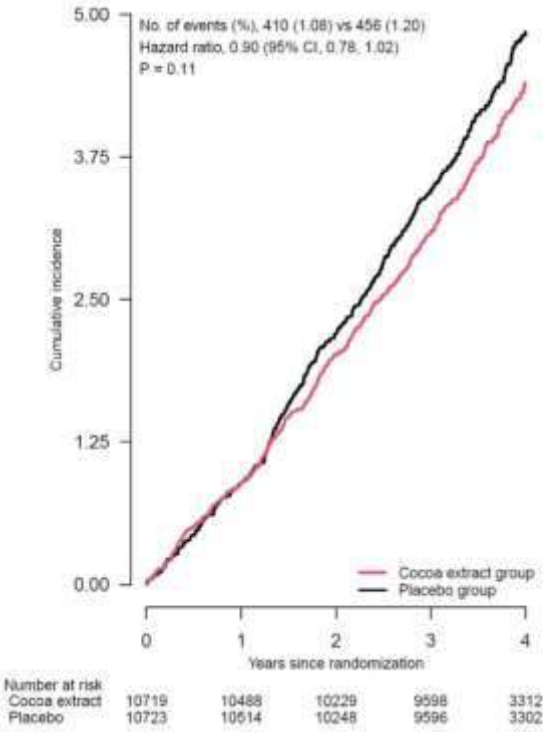
Effect of cocoa flavanol supplementation for the prevention of cardiovascular disease events: the COcoa Supplement and Multivitamin Outcomes Study (COSMOS) randomized clinical trial

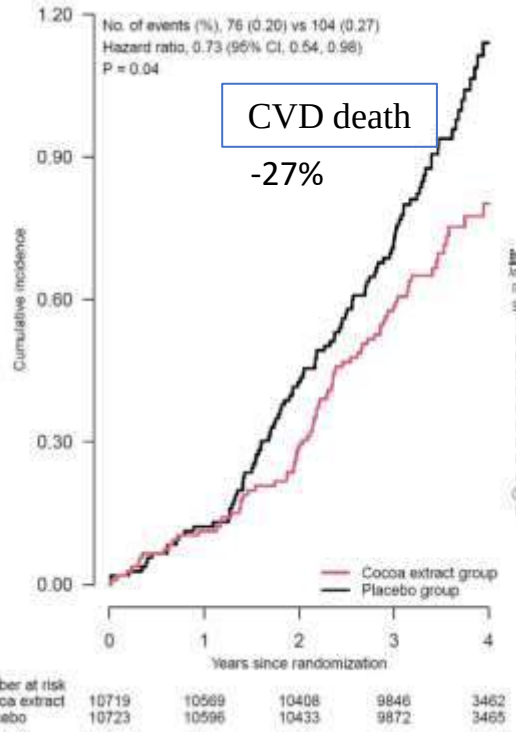
Howard D Sesso,[1,2] JoAnn E Manson,[1,2] Aaron K Aragaki,[3] Pamela M Rist,[1,2] Lisa G Johnson,[3] Georgina Friedenberg,[1] Trisha Copeland,[1] Allison Clar,[1] Samia Mora,[1,4] M Vinayaga Moorthy,[1] Ara Sarkissian,[1] William R Carrick,[3] and Garnet L Anderson,[3] for the COSMOS Research Group

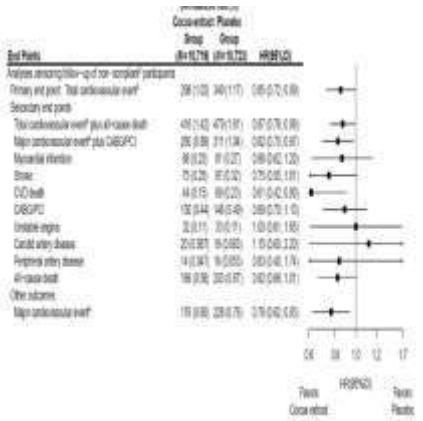
follow-up of 3.6 y

Am J Clin Nutr 2022;00:1–11

a composite of myocardial infarction, stroke, CVD death, CABG/PCI, unstable angina including hospitalizatio n, carotid artery surgery, and peripheral artery surgery

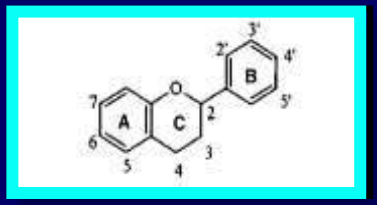






Tea is rich in Flavonoids

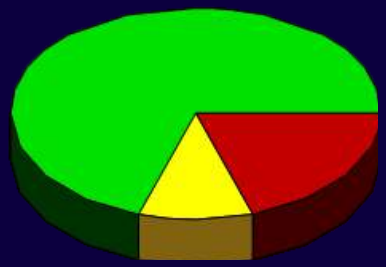
- Polyphenolic compounds (6 subclasses: flavonols, flavones, flavanones, flavan-3-ols, anthocyanidins, isoflavones)
- Tea is a rich dietary source of flavonoids in the diet, contributing between 50% and 80% of intake
- Other sources of flavonoids include cocoa, apples, grapes, wine
- Health benefits of tea may be attributed to flavonoids



Tea and Vascular Health - Evidence Emerging From Epidemiological And FMD Studies

Green tea

Catechins (70%)



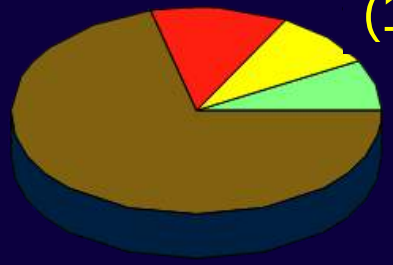
Polymeric flavonoids (20%)

Flavonols (10%)

Black tea

Teaflavins (12%)

Flavonols (10%)

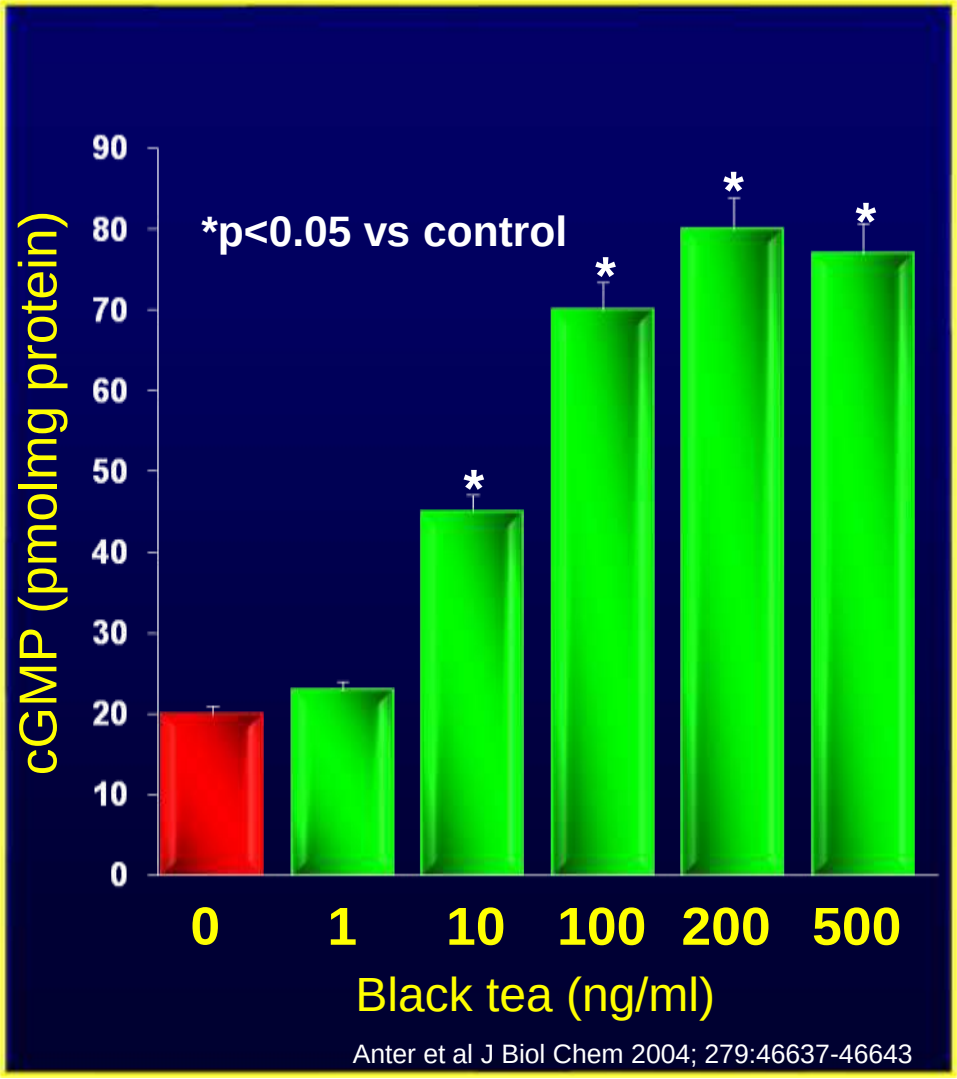


Catechins (8%)

Tearubigins (70%)

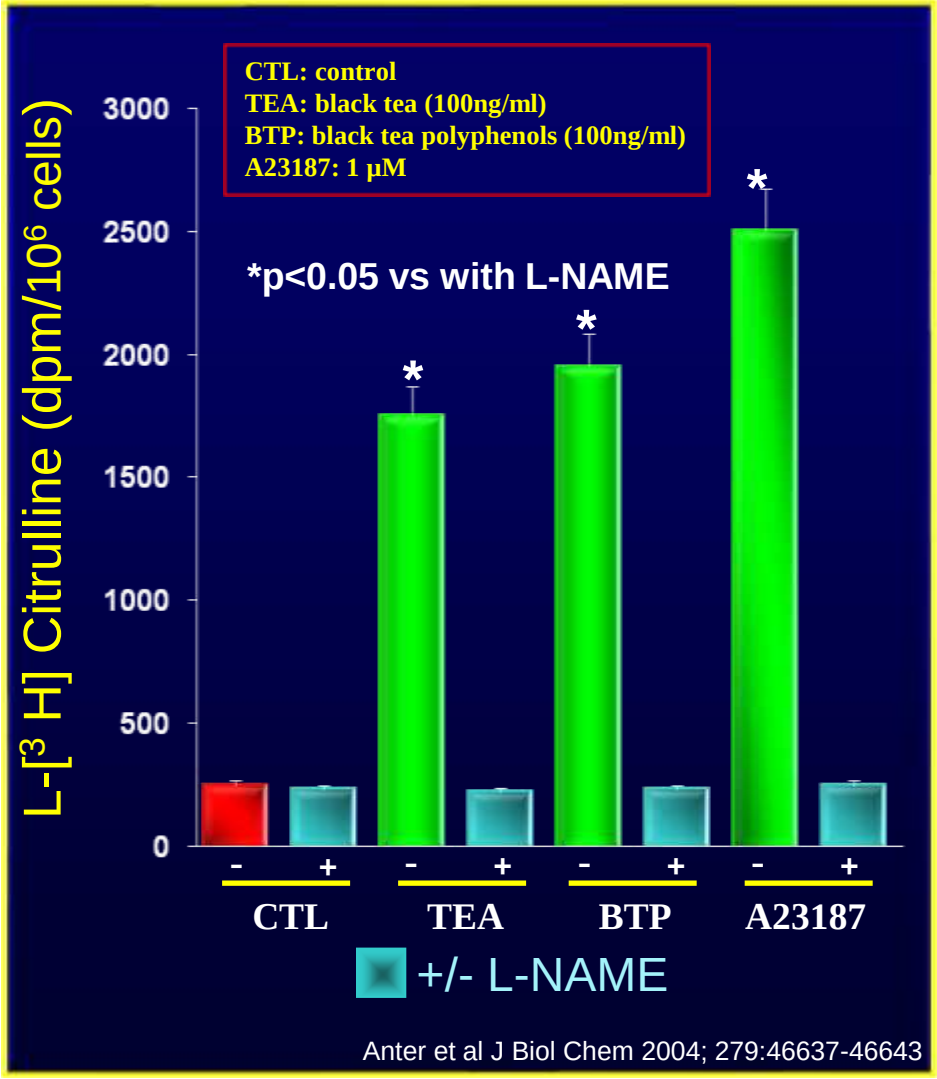
Black tea polyphenols improve NO availability in vitro

Dose effect on endothelial NO production



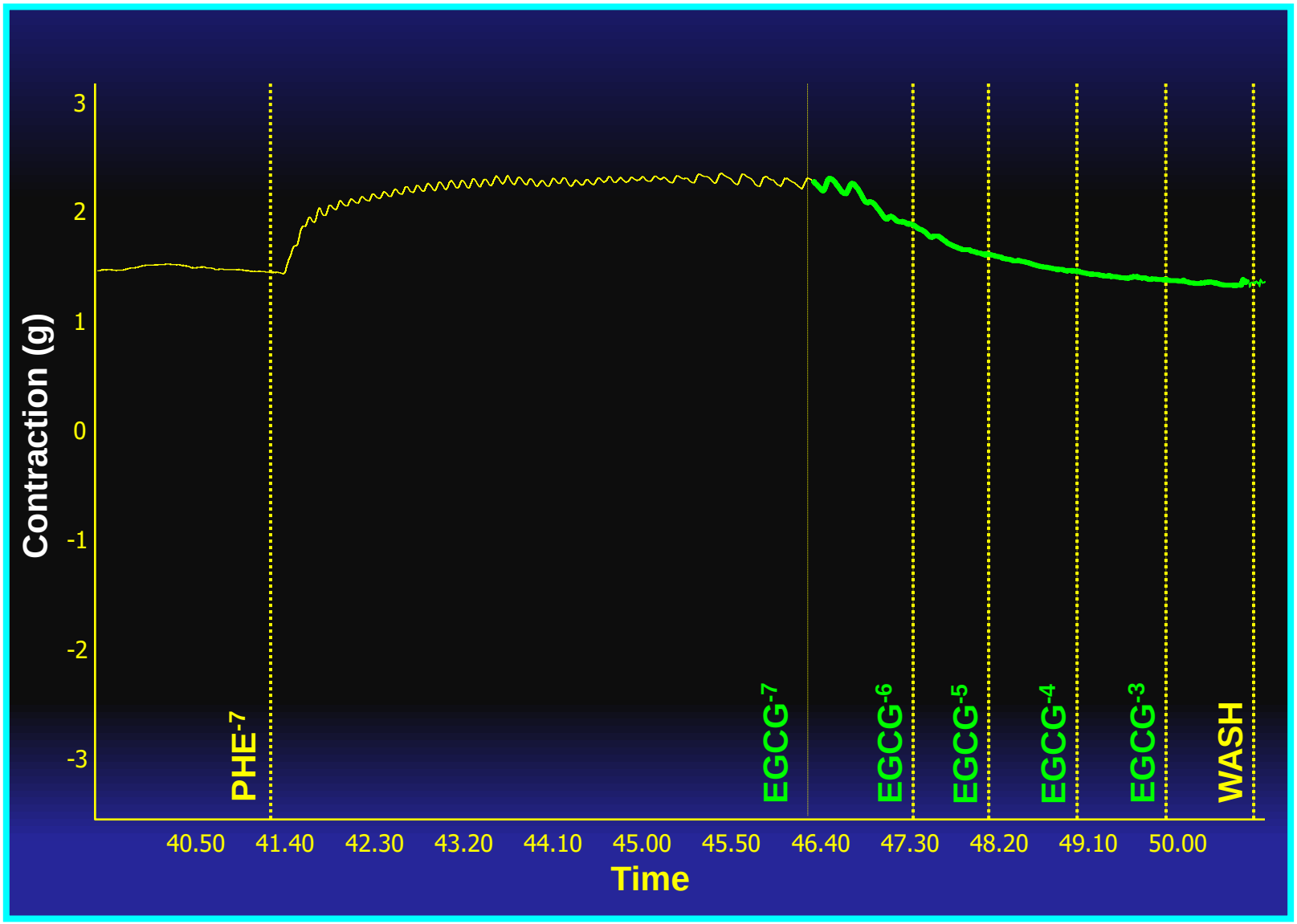
Anter et al J Biol Chem 2004; 279:46637-46643

eNOS activation in PAECs

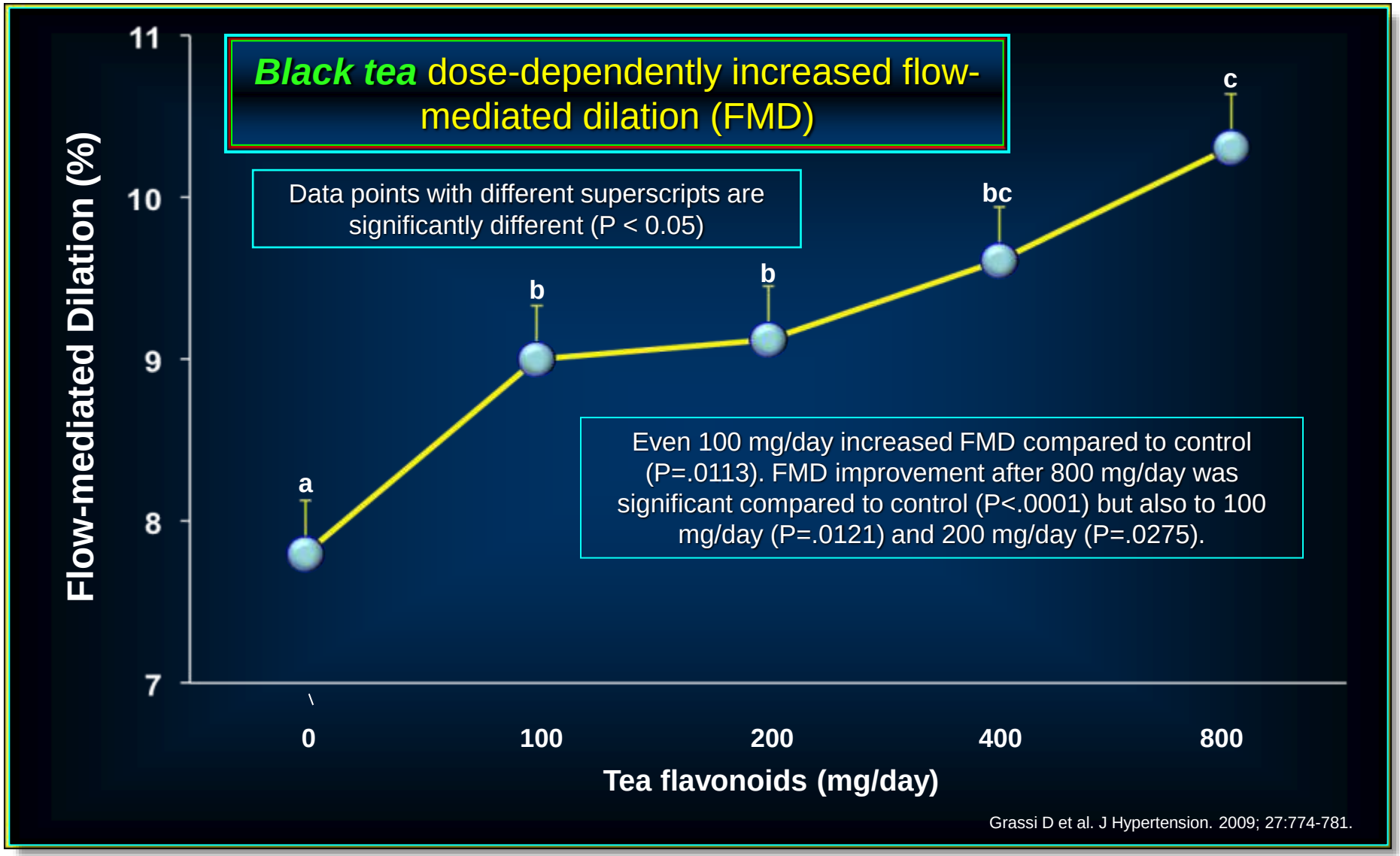


Anter et al J Biol Chem 2004; 279:46637-46643

Endothelium-dependent vasorelaxation: epigallocatechin-3-gallate ($1x10^{-7}$, $1x10^{-6}$, $1x10^{-5}$, $1x10^{-4}$, $1x10^{-3}$ M) in isolated aortic rings



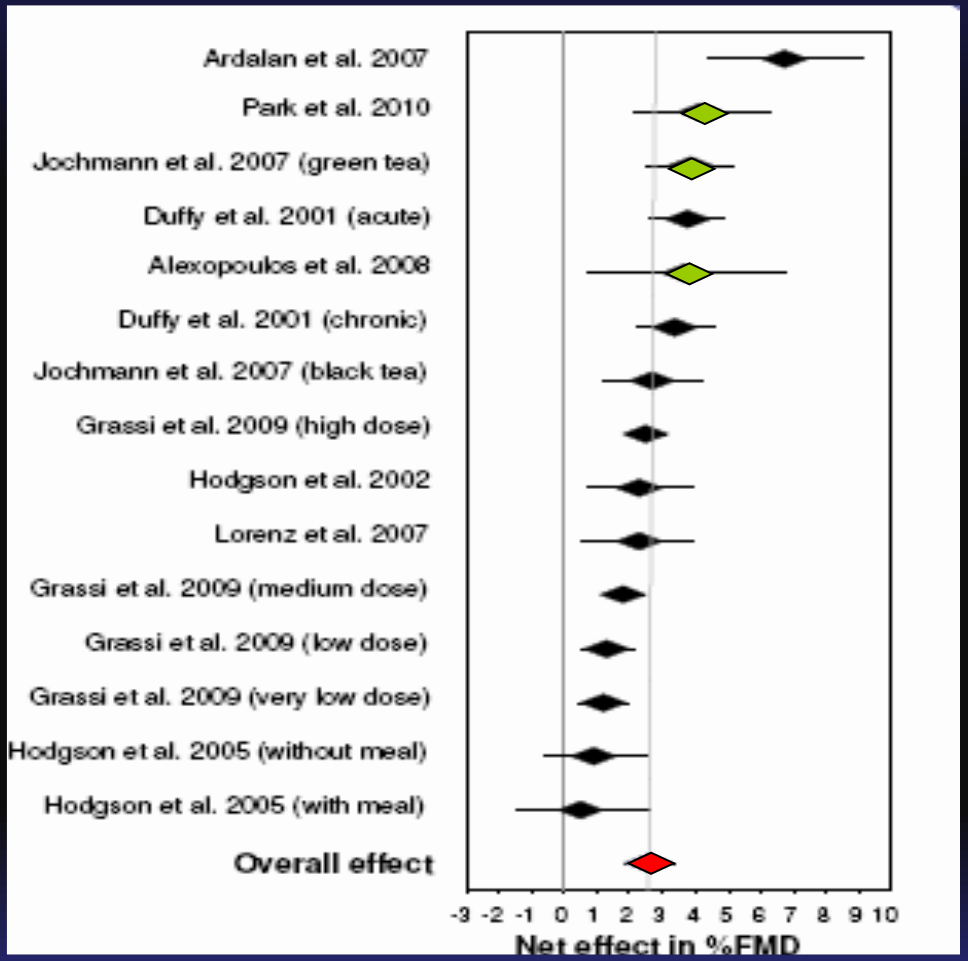
Black tea consumption dose-dependently improves endothelium-dependent vasodilation in healthy subjects



Grassi D et al. J Hypertension. 2009; 27:774-781.

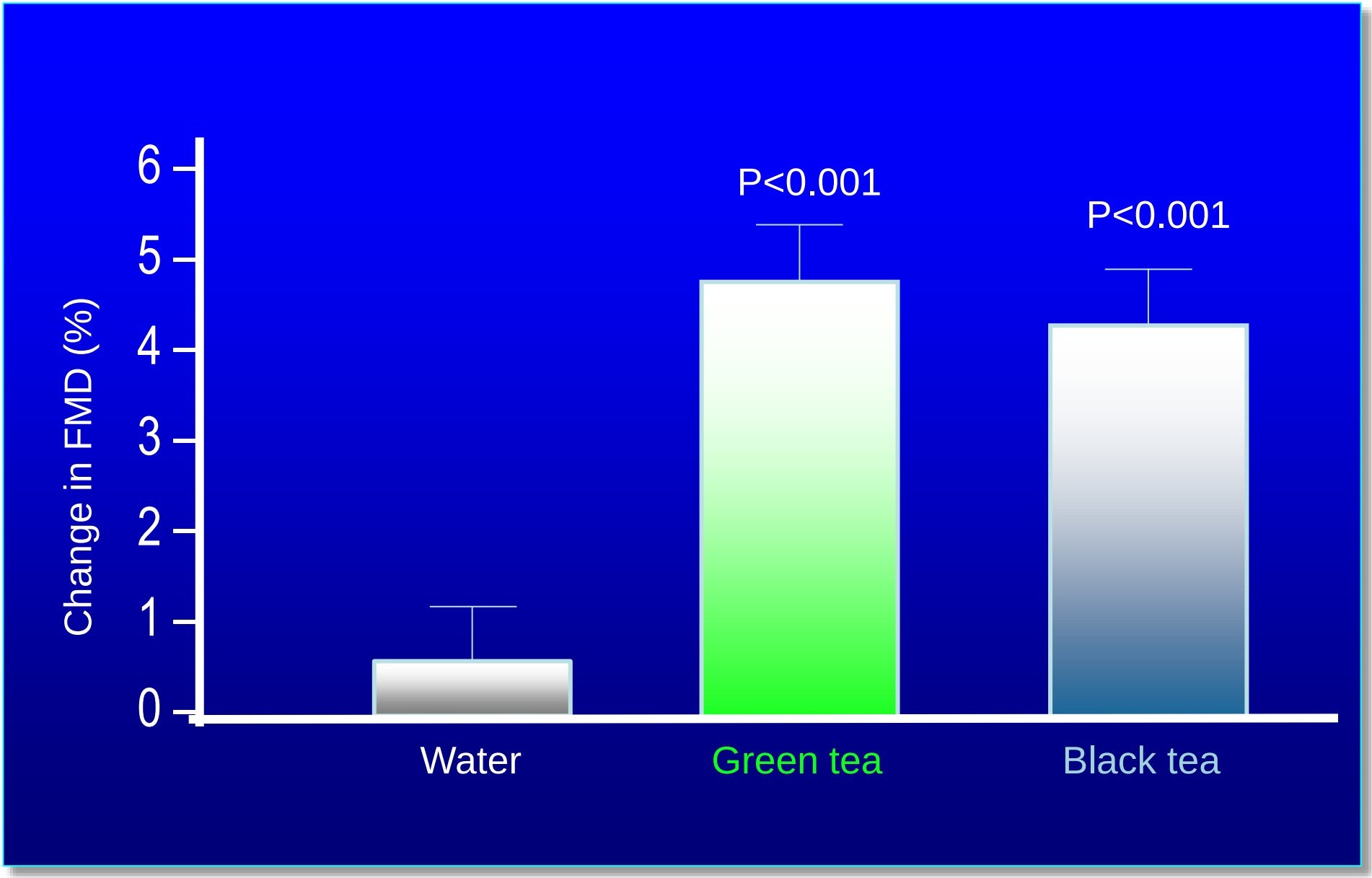
8 out of 9 studies showed an increase in FMD

- **9 studies with 15 study arms**
- **Average effect on FMD of tea vs. placebo = 2.6% (95% CI: 1.8-3.3%; P-value <0.001)**
- **Median daily dose = 500 mL of tea (~2-3 cups).**
- **Significant heterogeneity between studies (Q = 62.1, P-value <0.001; I^2 = 75.8%), which is partly explained by the cuff position**



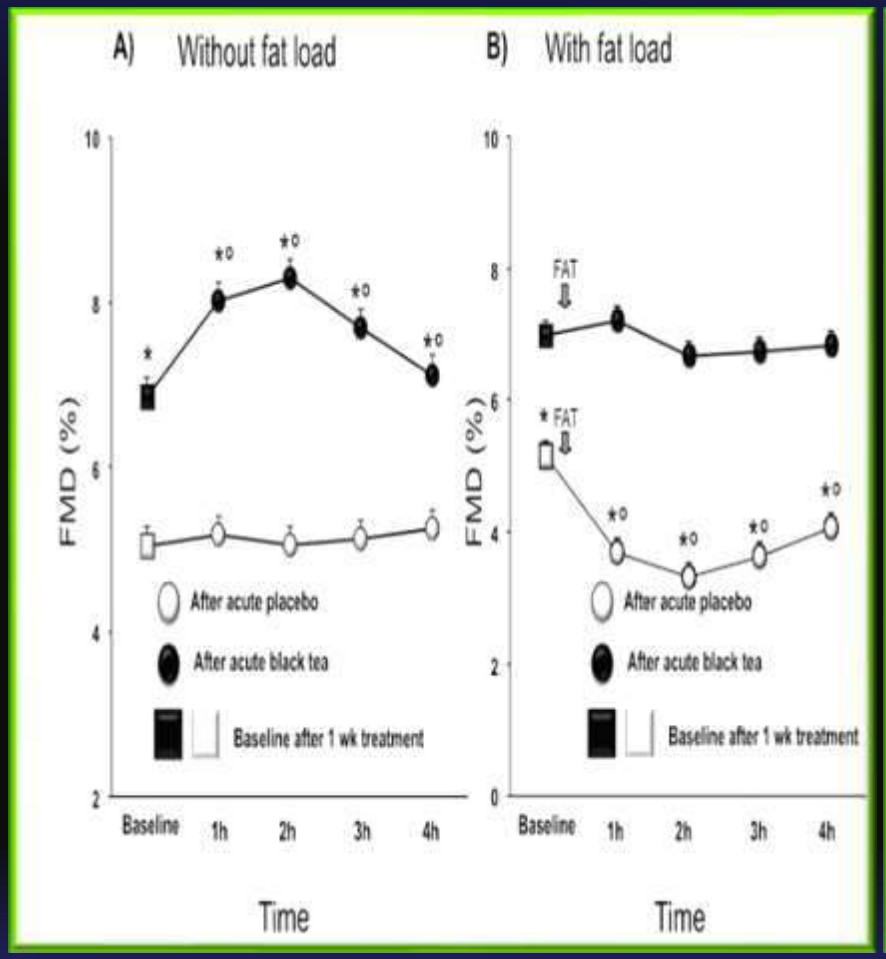
Forrest plot of the net FMD effects in 15 study arms

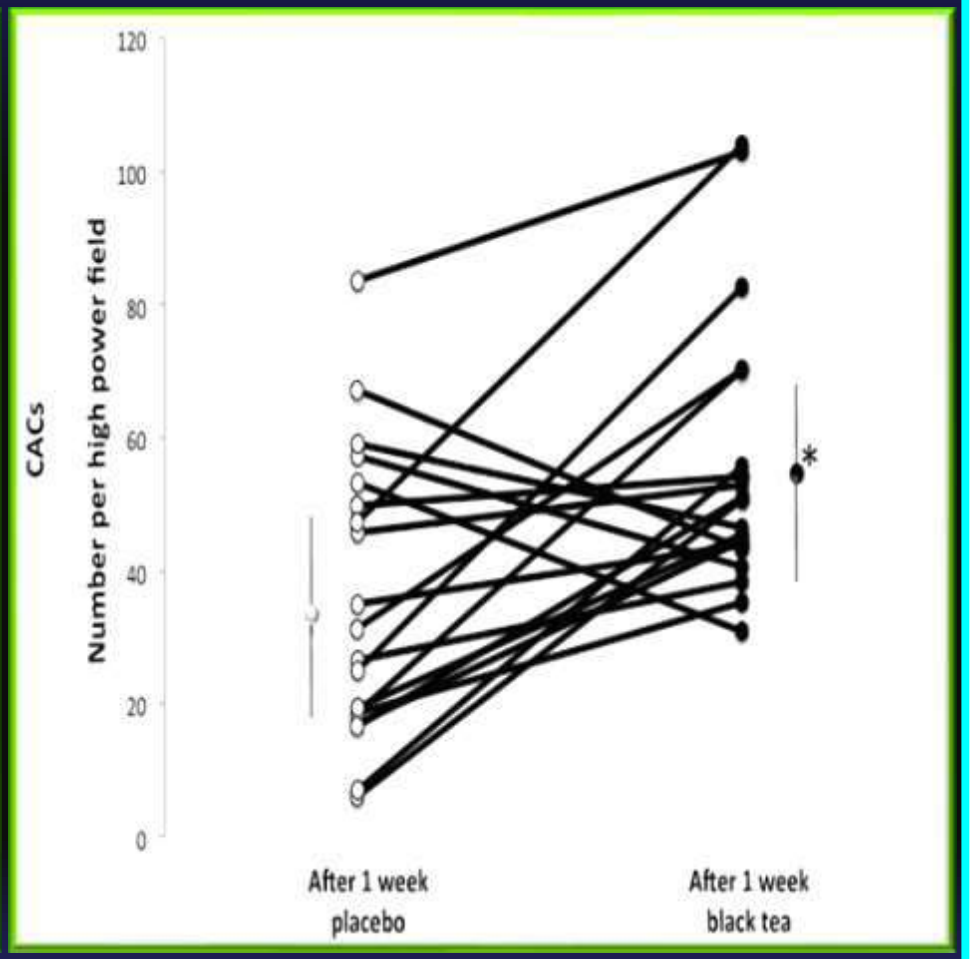
Tea and FMD: Green or Black ?



Jochmann et al., Br J Nutr 99(4): 863 (2007)

Black Tea Increases Circulating Endothelial Progenitor Cells and Improves Flow Mediated Dilatation Counteracting Deleterious Effects from a Fat Load in Hypertensive Patients: A Randomized Controlled Study



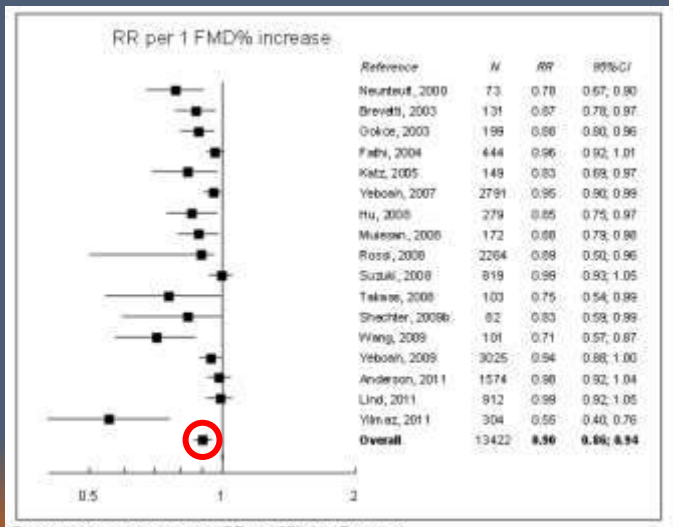


Grassi D et al. Nutrients. 2016 Nov 16;8(11). pii: E727.

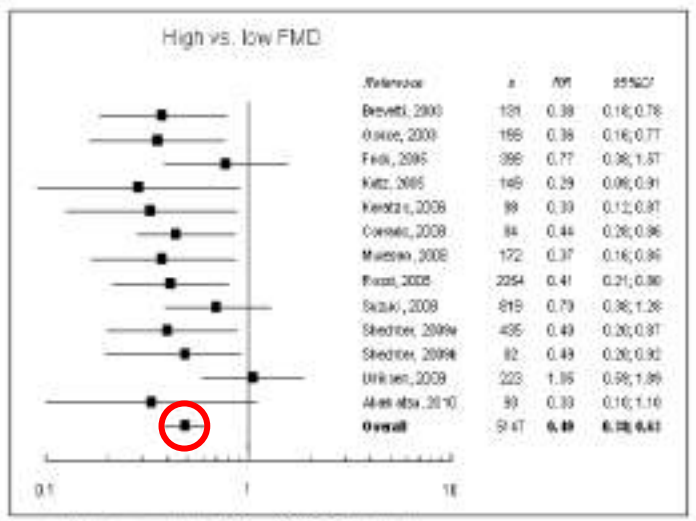
Meta-analysis updated: confirms the value of FMD

Continuous: 1%↑ FMD is associated with 10%↓ CVD risk

Categorical: difference in CVD risk high vs. low FMD: 51%



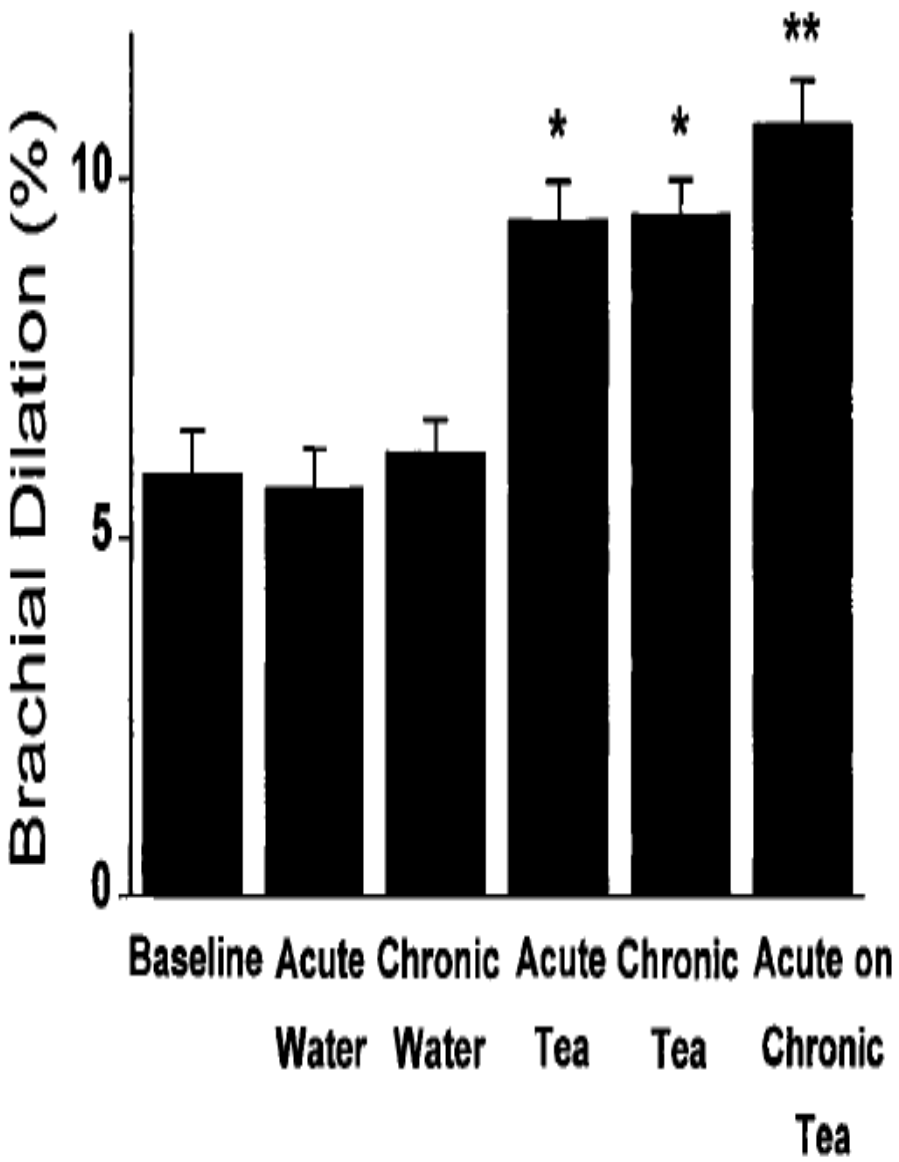
Forest plot for continuous data (RR and 95%CI; 17 studies)



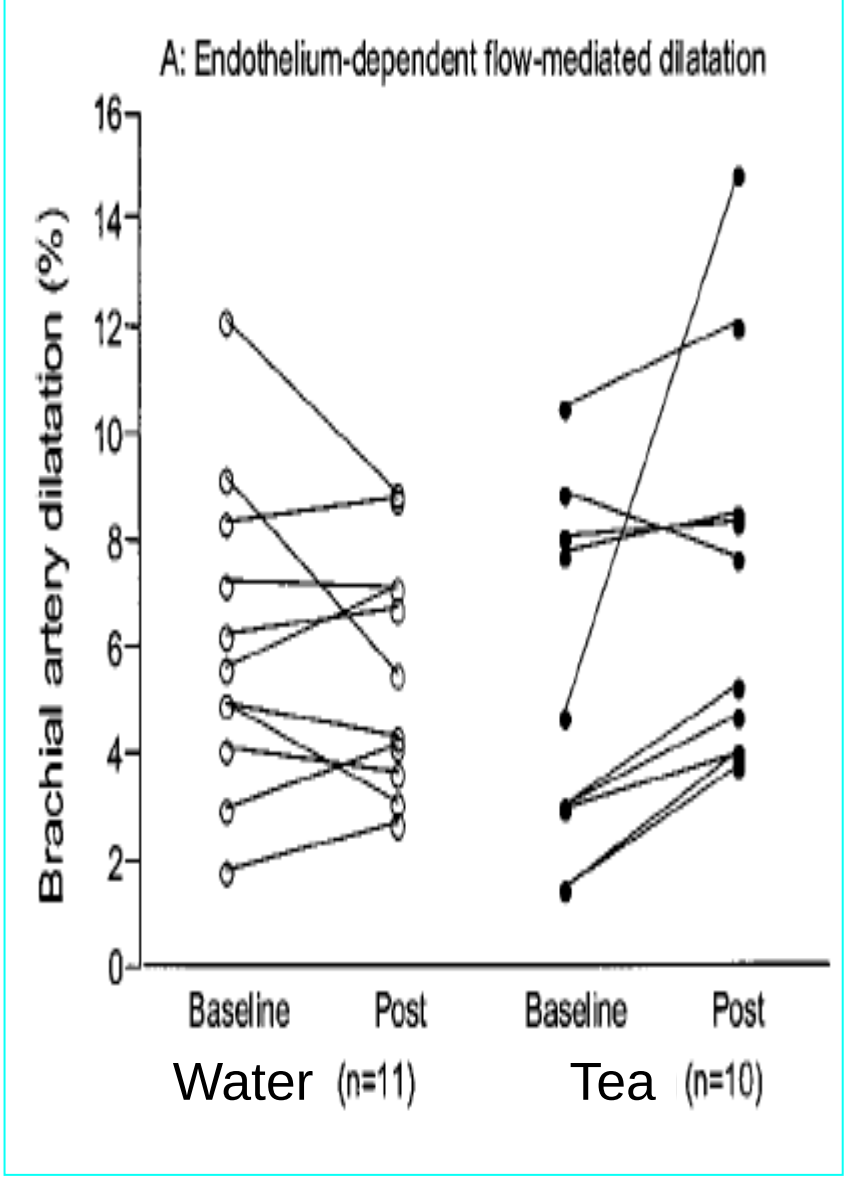
Forest plot for categorical data (RR and 95%CI; 13 studies)

Ras et al. Int J Cardiol. 2013;168(1):344-51.

Tea and FMD: Chronic effects (after 4 weeks) ?



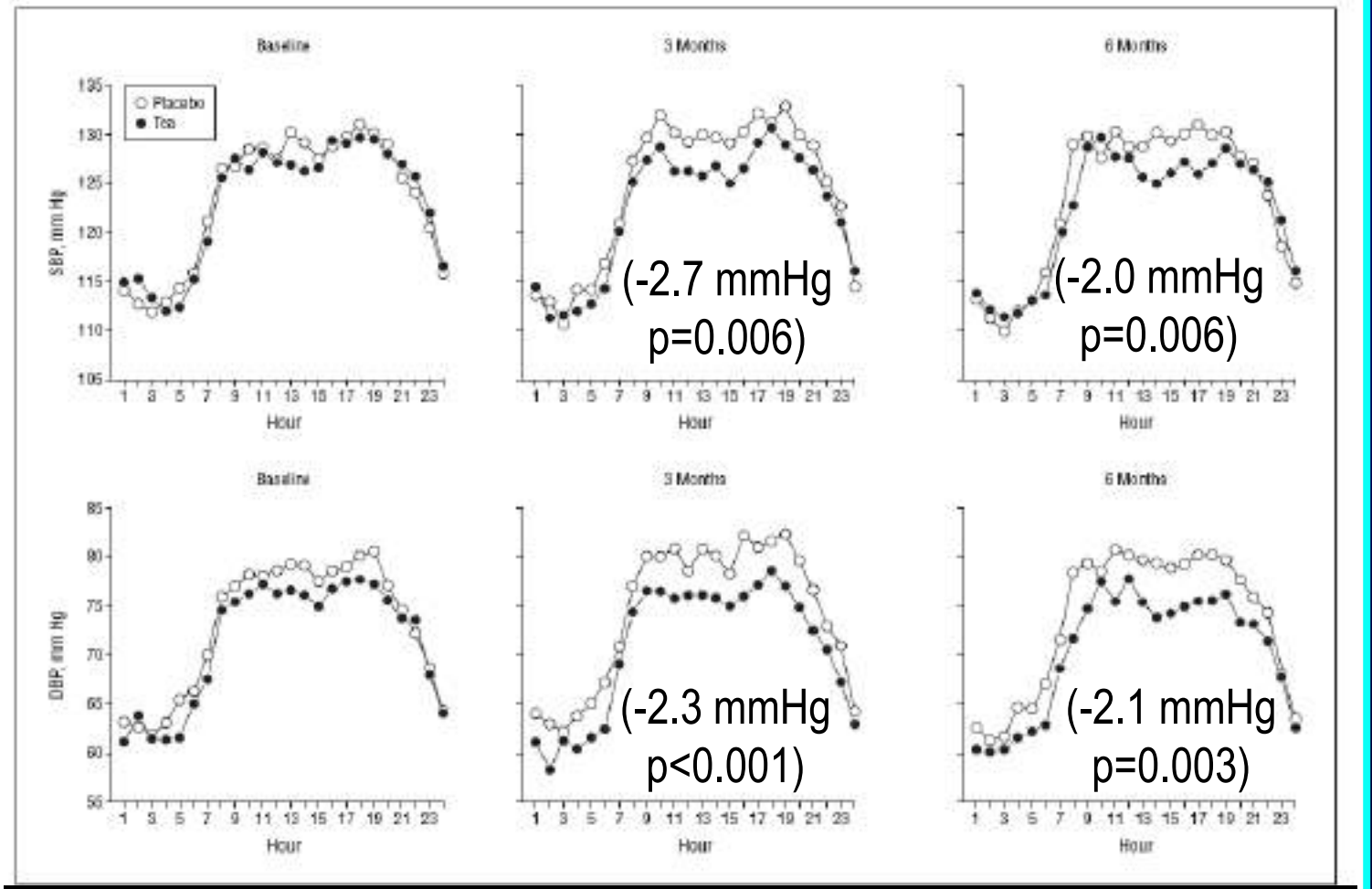
Duffy et al., Circulation 2001



Hodgson et al., Clinical Science 2002

BP lowering effect confirms previous study with long-term tea intervention

6 months tea intervention, 3 cups per day in subjects with normal to high-normal range BPs



Hodgson JM, et al. Arch Intern Med 2012; 172(3): 186-188