The pecan: A healthful and nutrient-dense tree nut

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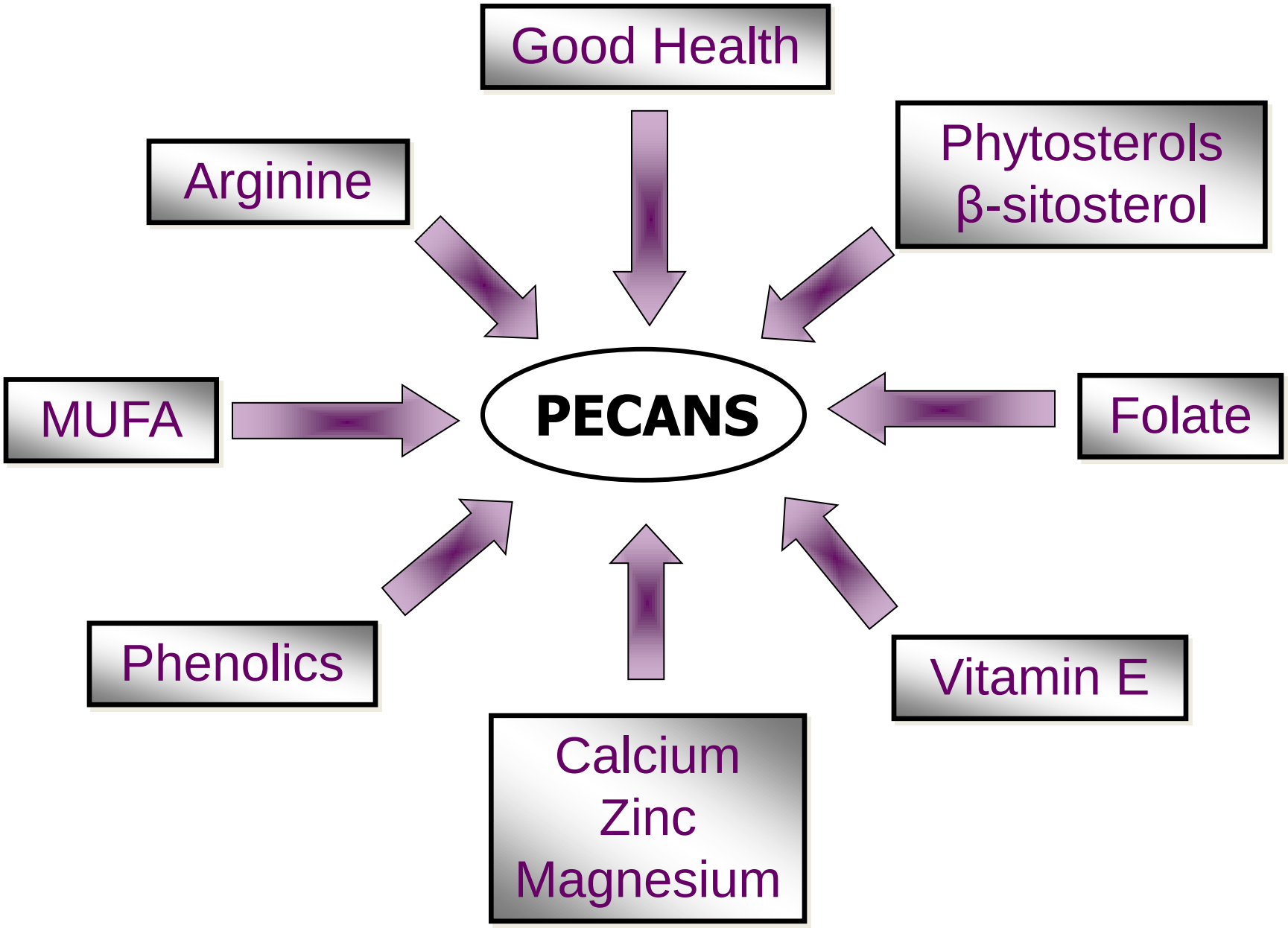
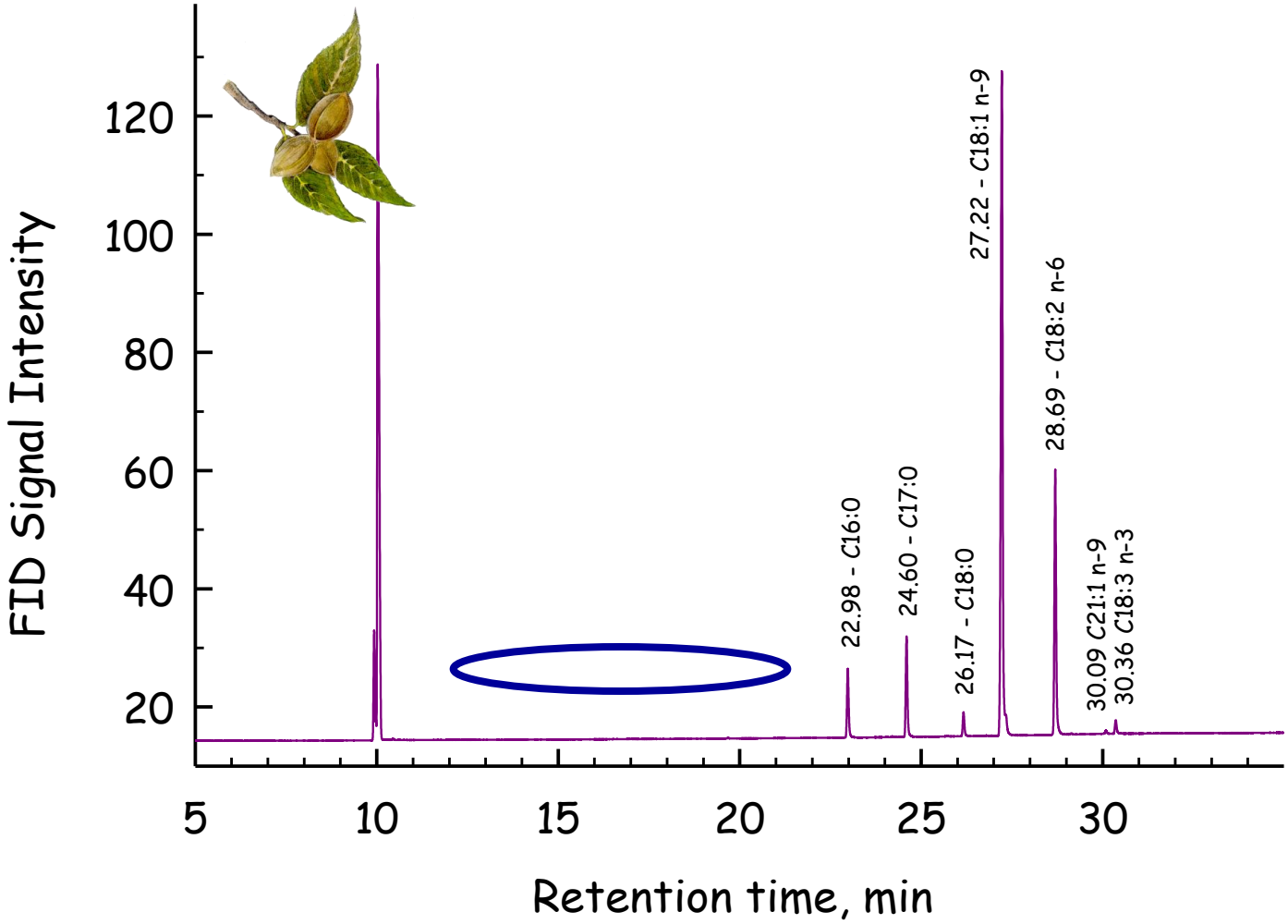
Association of Nut Consumption with Total and Cause-Specific Mortality

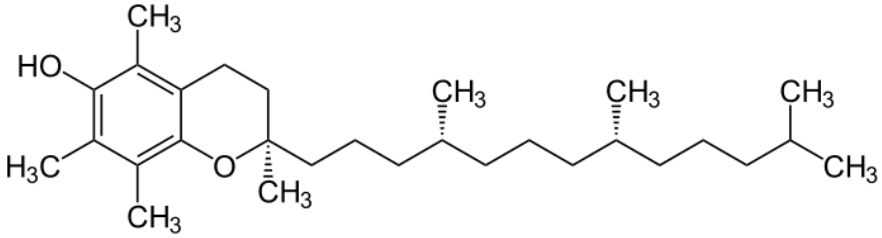
November 2013 … Increased nut consumption has been associated with a reduced risk of major chronic diseases, including cardiovascular disease and type-2 diabetes mellitus.

Bao *et al.* 2013. *New England Journal of Medicine. 369*:2001-2011.


Good Health
Arginine
Phytosterols
β-sitosterol
MUFA
PECANS
Folate
Phenolics
Calcium
Zinc
Magnesium
Vitamin E



C16:0	C18:0	C18:1 (n-9)	C18:2 (n-6)	C18:3 (n-3)	C21:1 (n-9)
6.10	2.36	65.09	23.76	1.15	0.37



Tocopherol (T) content of 18 different pecan cultivars (mg/100 g nutmeat, *n*=3).

Cultivar	α-T[a]	β-T	γ-T	δ-T
'Stuart' Clarke Co. (GA)	0.90 b	0.33 ab	21.22 ab	0.08 abc
Cordele 'Stuart' Crisp Co. (GA)	1.47 ab	0.55 ab	25.16 ab	0.11 abc
'Desirable' Lowndes Co. (GA)	0.72 b	0.74 a	25.93 ab	0.17 a
'Stuart' Tift Co. (GA)	1.10 ab	0.26 ab	21.68 ab	0.10 abc
'Wichita' Tift Co. (GA)	0.86 b	0.02 b	22.53 ab	0.06 abc
'Desirable' Crisp Co. (GA)	1.09 ab	0.31 ab	19.37 ab	0.11 abc
'Desirable' Tift Co. (GA)	1.43 ab	0.45 ab	20.74 ab	0.11 abc
'Sumner' Tift Co. (GA)	0.68 b	0.20 ab	16.74 b	0.07 abc
'Pawnee' Tift Co. (GA)	0.59 b	0.19 ab	20.44 ab	0.09 abc
McWilliams 'Stuart' Crisp Co. (GA)	1.89 a	0.37 ab	23.80 ab	0.13 bc
'Elliott' Tift Co. (GA)	0.85 b	0.26 ab	22.57 ab	0.13 b
'Wichita' Pinal Co. (NM)	1.03 ab	0.11 ab	25.83 ab	0.02 c
'Western' Doña Ana Co. (NM)	1.00 ab	0.10 ab	27.73 a	0.02 bc
'Desirable' (TX)	0.85 b	0.29 ab	18.75 ab	0.14 a
'Cheyenne' (TX)	0.82 b	0.06 b	26.48 ab	0.04 abc
'Choctaw' (TX)	0.74 b	0.28 ab	15.98 b	0.03 bc
'Kiowa' (TX)	1.15 ab	0.35 ab	23.06 ab	0.07 abc
'Gracross' (TX)	0.96 b	0.21 ab	22.19 ab	0.03 bc

[a] Means in the same column with the same letter are not significantly different by Tukey's multiple range test (P > 0.05).

A Qualified Health Claim

- Heart disease remains the number one killer in the USA. According to the AHA, CVD was responsible for 32.3% of all deaths nationwide in 2009.

- In July 2003, the US Food & Drug Administration approved the 1st qualified health claim for tree nuts.

"*Scientific evidence suggests, but does not prove, that eating 1.5 ounces per day of most nuts, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.*"

Clinical Studies

Lipid Biomarkers in Men & Women Who Consumed Step I and Pecan-enriched Diets

	Baseline values	Step I Diet	Pecan Diet	% Change
Total cholesterol, *mmol/L*	5.04 ± 0.84	4.78 ± 0.75	4.47 ± 0.70	**-6.7**
LDL cholesterol, *mmol/L*	3.27 ± 0.65	3.05 ± 0.56	2.73 ± 0.51	**-10.4**
HDL cholesterol, *mmol/L*	1.14 ± 0.26	1.20 ± 0.23	1.21 ± 0.25	**+5.6**
LDL:HDL cholesterol	2.86 ± 0.90	2.81 ± 0.90	2.37 ± 0.70	**-15.7**
TAG, *mmol/L*	1.23 ± 0.67	1.29 ± 0.77	1.16 ± 0.69	**-11.1**
Apo A1, *g/L*	1.33 ± 0.20	1.30 ± 0.20	1.36 ± 0.21	**+2.2**
Apo B, *g/L*	0.87 ± 0.20	0.85 ± 0.21	0.75 ± 0.19	**-11.6**
Lipoprotein (a), *g/L*	0.21 ± 0.19	0.25 ± 0.22	0.20 ± 0.18	**-15.1**

Rajaram *et al.* (2001). Values are means ± SD, $n = 23$.

2011 Loma Linda Study

- Pecan consumption increased plasma postprandial antioxidant capacity & phenolics (catechin) levels, and decreased LDL oxidation in humans.
- A randomized, placebo-controlled, crossover trial with a 1-wk washout period between treatments (whole pecans, blended pecans, or control) showed that γ-tocopherol levels 2x at 8 h, and H-$ORAC_{FL}$ and L-$ORAC_{FL}$ values increased by 12 and 10%, respectively, at 2 h.
- After pecan consumption, oxidized LDL decreased 30, 33, and 26% at 2, 3, and 8 h, respectively, while epigallo-catechin-3-gallate levels at 1 and 2 h were higher than at baseline (0 h) and after the control test meal.

2011 Loma Linda Study

- Conclusion … these results show that bioactive constituents of pecans are absorbable and contribute to postprandial antioxidant defenses in the human body.

- The phenolics composition of pecans is complex and largely unknown. When pecans are consumed, their catechin monomers (*i.e.*, the flavan-3-ols; building blocks of the proanthocyanidins [PACs]) are absorbed, **but more knowledge on the antioxidants in pecans is warranted.**

Hudthagonsol *et al.* 2011. Pecans acutely increase plasma postprandial antioxidant capacity and catechins and decrease LDL oxidation in humans. *The Journal of Nutrition 141: 56-62.*

Phytochemicals

Pecans: Top Nut for Antioxidants

A USDA study finds that pecans lead the pack for antioxidants!

TOTAL ANTIOXIDANTS
(micromoles TE per serving)

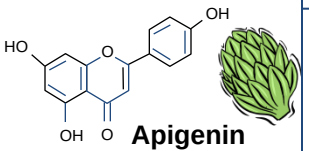
www. georgiapecansfit.org

Source: Ronald L. Prior, Ph.D., J. Agric. Food Chem. 2004, 52, 4026-4037

Classification of Dietary Phenolics

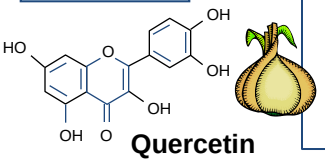
Flavonoids

Flavones



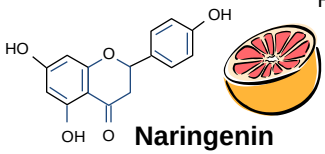
Apigenin

Flavonols



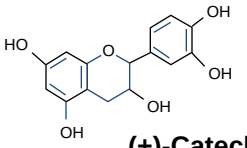
Quercetin

Flavanones



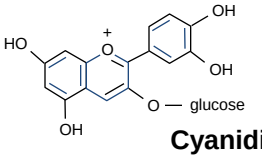
Naringenin

Flavanols (catechins)



(+)-Catechin

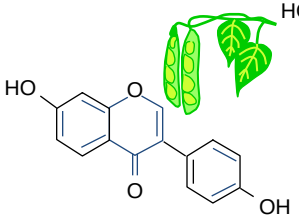
Anthocyanins



Cyanidin 3-glucoside

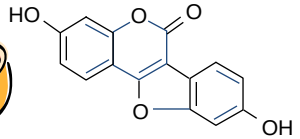
Isoflavonoids

Isoflavones

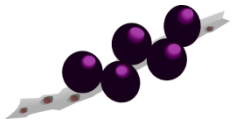


Daidzein

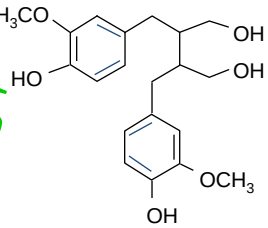
Coumestans



Coumestrol

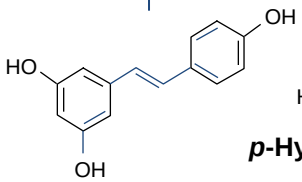


Lignans



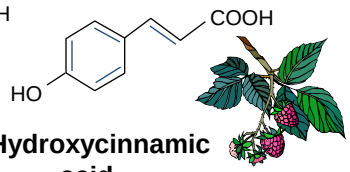
Secoisolariciresinol

Stilbenes

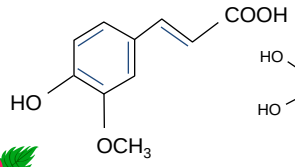


Resveratrol

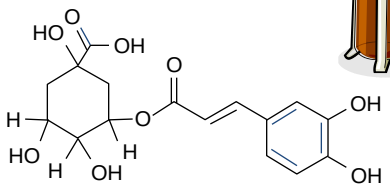
Phenolic acids



p-Hydroxycinnamic acid



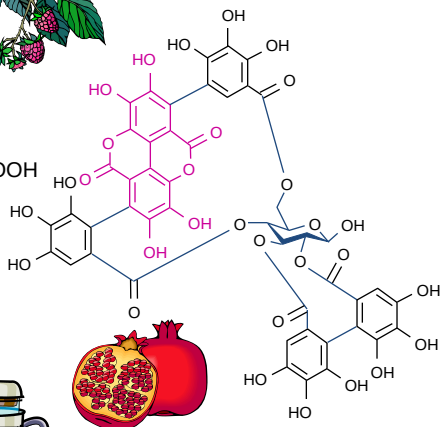
Ferulic acid



Chlorogenic acid

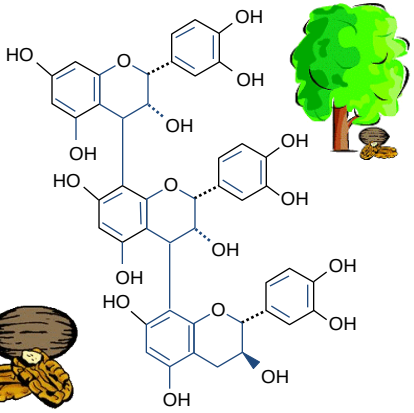
Phenolic polymers

Ellagitannins

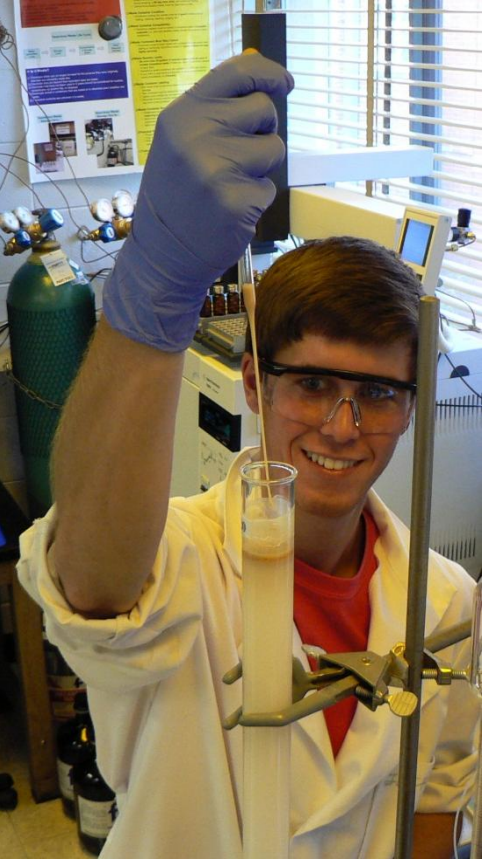


Punicalagin

Proanthocyanidins



Procyanidin trimer (flavan-3-ol)



Pecan Nutmeat

Soxhlet / Hexanes

Defatted Nutmeat

70:29.5:0.5% (*v/v/v*) AWAc

Crude Pecan Extract

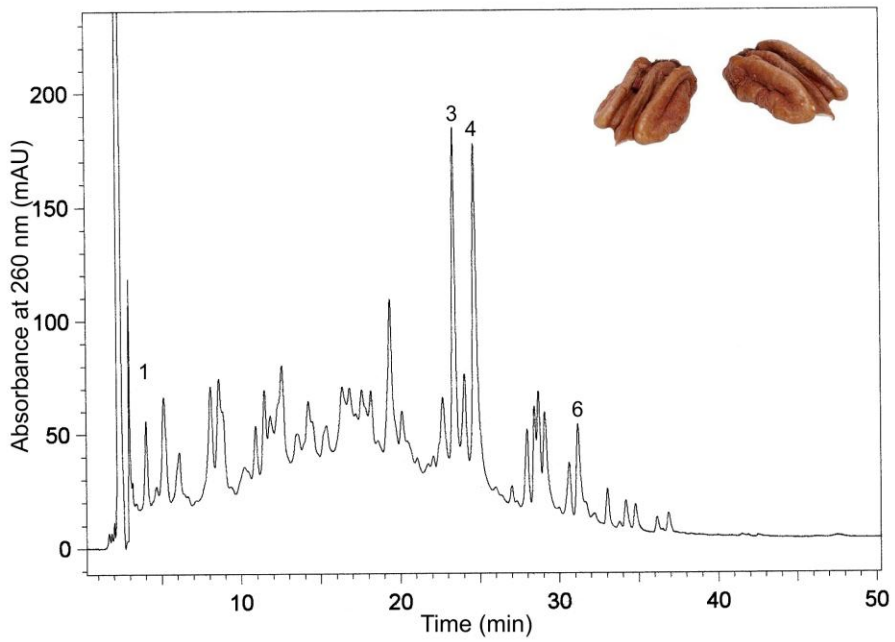
Yield
18.6±0.9%

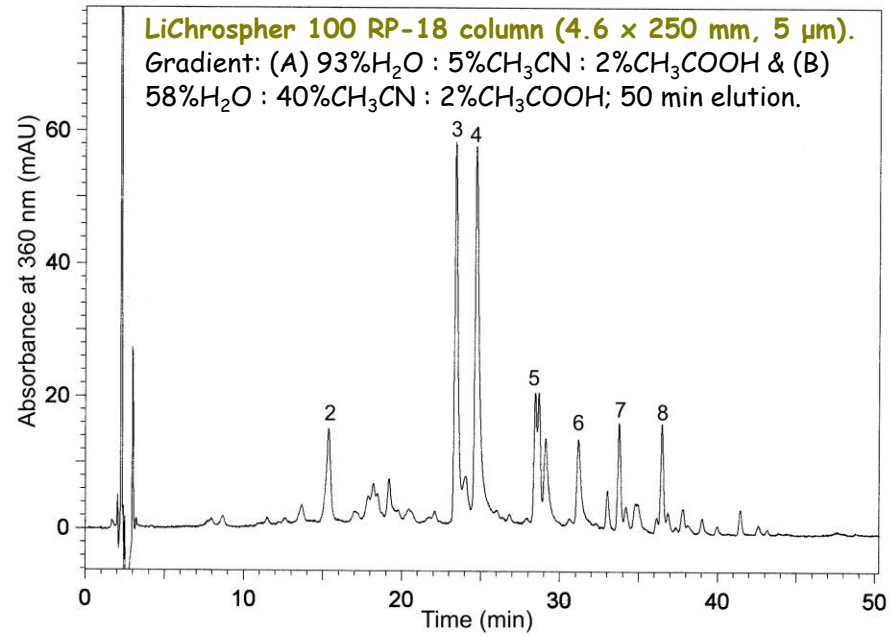
Lipophilic Sephadex LH-20 Column
95% (*v/v*) EtOH / 50% (*v/v*) Acetone

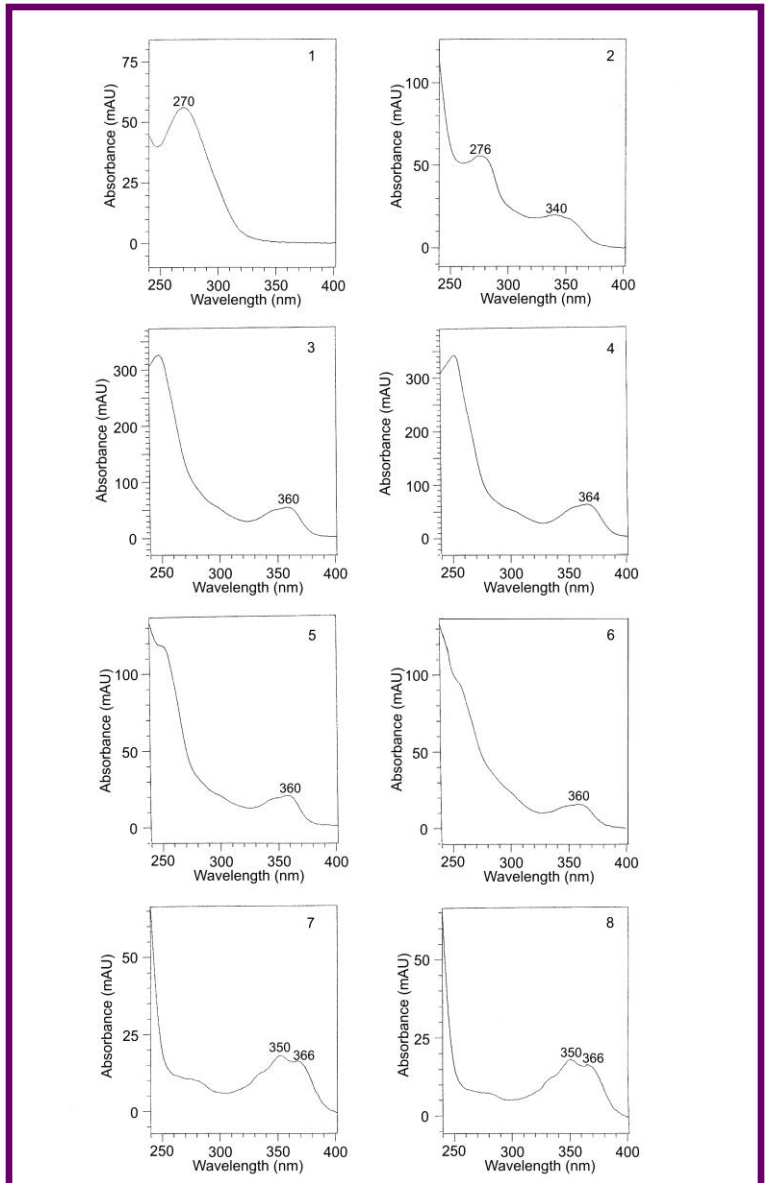
4 Low-Molecular-Weight Fractions (LMW)

Tannin Fraction

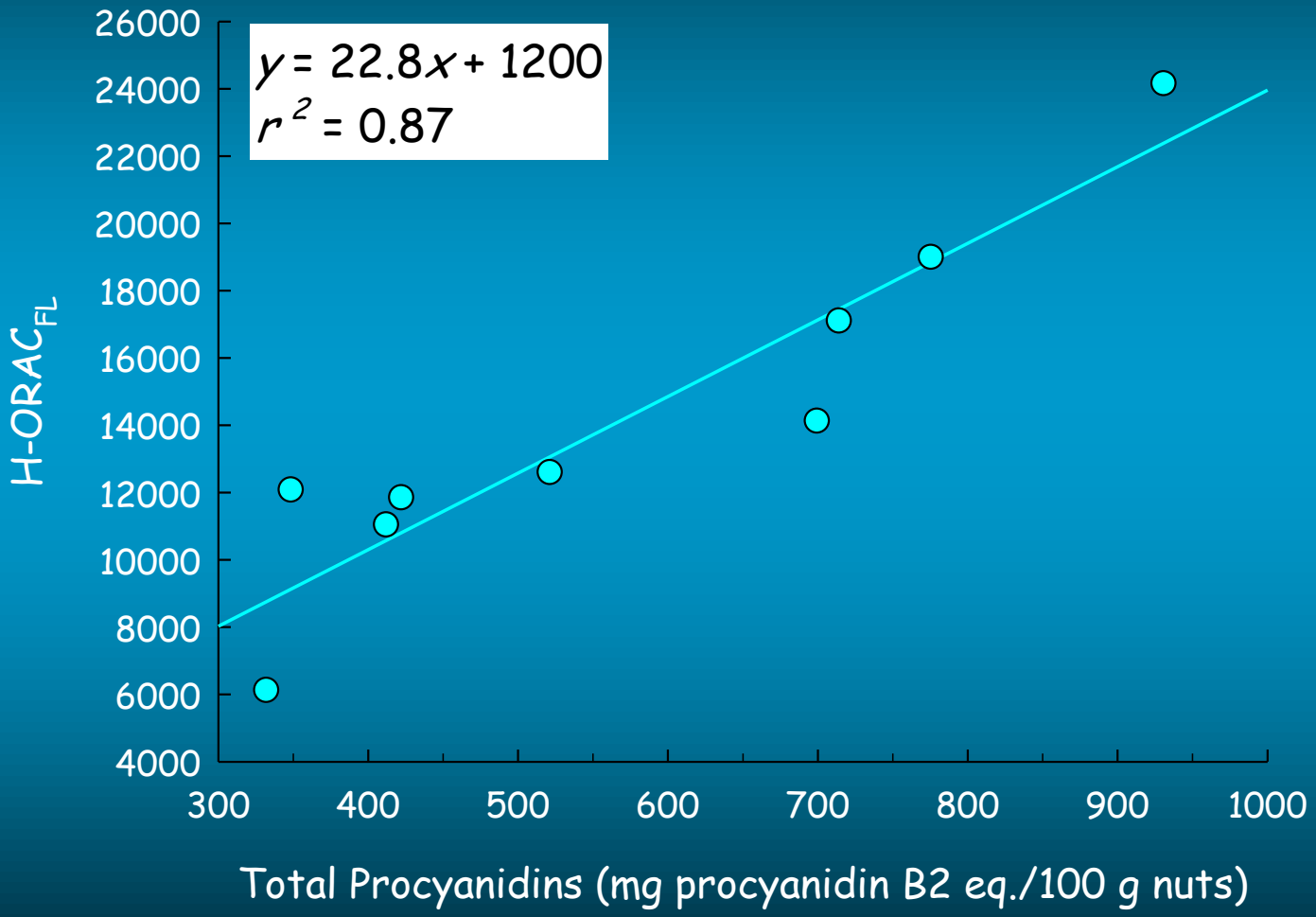
Crude Extract Fingerprint

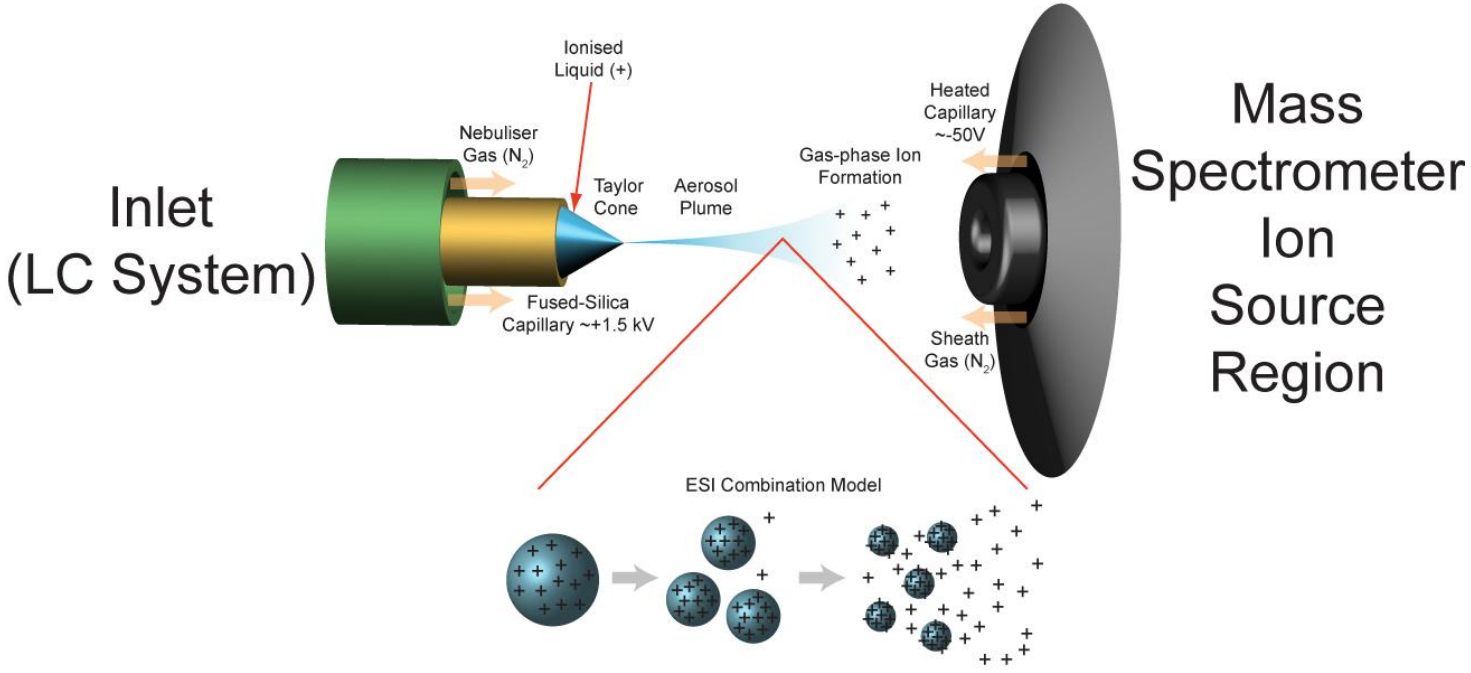




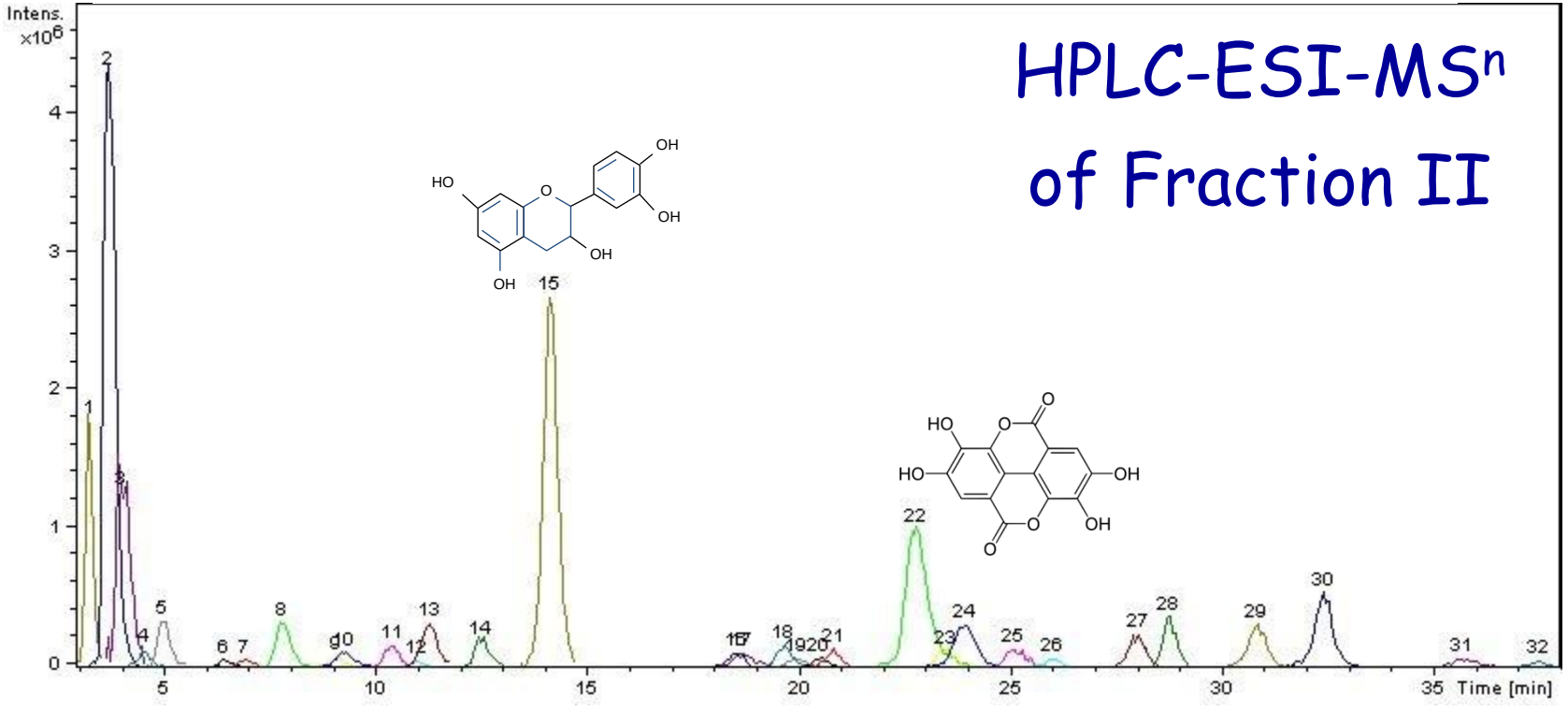


H-ORAC$_{FL}$ vs TPr Correlation





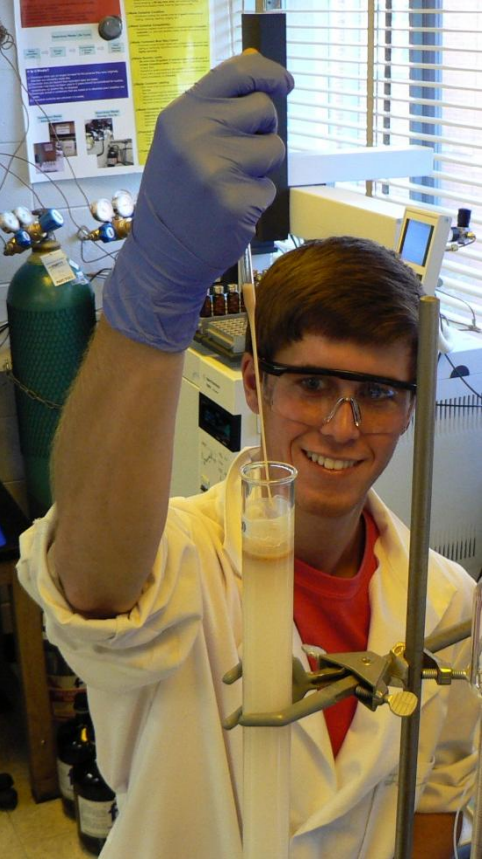
HPLC-ESI-MS^n of Fraction II



HPLC/ESI-MS^n of Fraction II

Cmp#	Tentative Identification[a]	[M-H]$^-$	MS-MS
2	caffeoylhexose	341.2	178.7
5	HHDP glucose	481.1	300.8
6	gallic acid	168.8	152.7, 124.7
7	*p*-hydroxybenzoic acid	136.9	121.7, 111, 106.8
8	gallic acid hexoside	331	168.7, 124.8
13	catechin hexoside	451	288.8
15	catechin	289	244.8, 204.7, 178.7
22	ellagic acid pentose	433	300.7
24	methyl ellagic acid glucoside	477.1	314.8, 299.8
25	ellagic acid	300.9	216.7
28	methyl ellagic acid pentose	447	314.8
30	dimethyl ellagic acid pentose	475.1	459.8, 328.9, 298.8
31	methyl ellagic acid galloyl pentose	599	446.9, 314.5

[a]Characterized by RP-HPLC/ESI-MS^n with quantification completed using commercial standards (Robbins, Ma, Wells, Greenspan & Pegg. 2014. *J. Agric. Food Chem. submitted*).



Pecan Nutmeat

Soxhlet / Hexanes

Defatted Nutmeat

70:29.5:0.5% (*v/v/v*) AWAc

Crude Pecan Extract

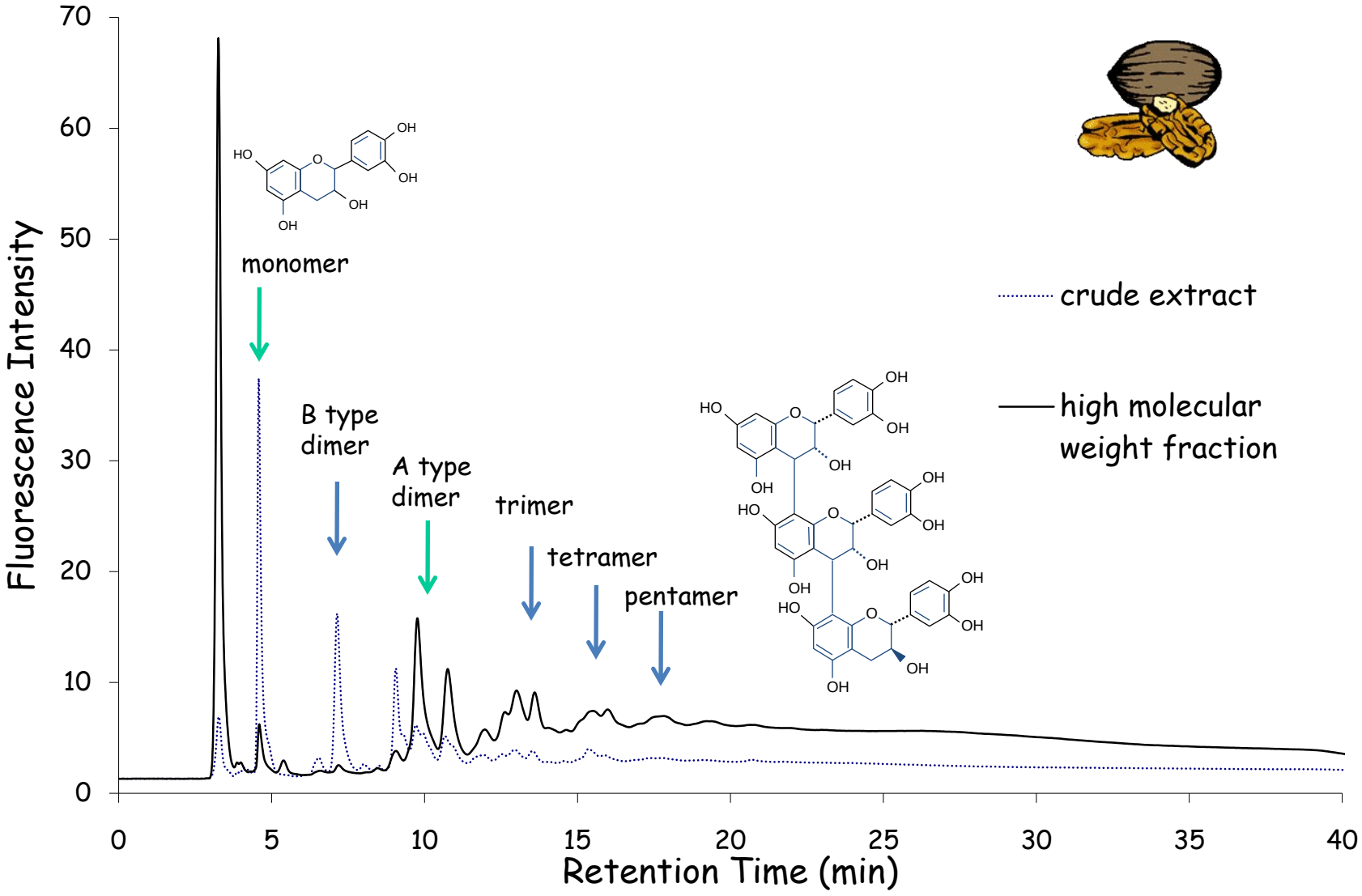
Yield
18.6±0.9%

Lipophilic Sephadex LH-20 Column
95% (*v/v*) EtOH / 50% (*v/v*) Acetone

4 Low-Molecular-Weight Fractions (LMW)

Tannin Fraction

Separation of Pecan PACs



Proanthocyanidin (PAC) Distribution in Pecans

Degrees of Polymerization (DP)	Content within each DP (mg/g fraction)[a]	% Distribution of the PACs
1	0.3	0.4
2	47.3	56.7
3	21.1	25.3
4 thru 6	14.8	17.7
> 6	tr	0
Total	83.5	

[a]Characterized by diol-phase HPLC with quantification completed using commercial standards with varying degrees of polymerization (Robbins, Ma, Wells, Greenspan & Pegg. 2014. *J. Agric. Food Chem. submitted*).

Proven Nutritional Properties of Pecans

Good source of fiber

Trans-fat free

Cholesterol free

Sodium free

Protein (2.8 g)

Heart healthy

MUFA

Arginine

Phenolics

Vitamin E

8 Essential minerals

8 Essential water-soluble vitamins

Phytosterols

American Heart Association CERTIFIED Meets Criteria For Heart-Healthy Food

Packed with antioxidants

Thanks are extended to …

- Georgia Agricultural Commodity Commission for Pecans and USDA-NIFA-SCRI for funding

- Graduate students
  - Katie Robbins
  - Yi Gong
  - Yuanyuan Ma
  - Taylor Bellamy
- Hilton Segler
- Randy Hudson
- John Robison
- Ron Eitenmiller
- SCRI Pecan Team of Researchers


Questions?