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SMOOTHIES and PPO's

Smoothies are a popular and very nutritious way to add polyphenols to your daily food.
Polyphenols are a group of chemicals made up of:
Flavonoids (flavan-3-ols): green tea, cruciferous veggies, apples, berries, soybeans, citrus; and
Non-Flavonoids : sesame seeds, black grapes, peaches, prunes, turmeric, etc.

They are a category of nutrients which have been classed by the NIH as a "bioactive food compound", meaning not essential for life, but highly recommended for their support of cardiovascular and neurological health, and endorsed by The Expert Panel of the NIH.

Until recently, many nutritionists have recommended preparing polyphenol-rich fruit smoothies made with plant milk and bananas, which make them into a delicious and nutritious drink.

However, in April, 2023, a comprehensive study, first published in the British Journal of the Royal Society of Chemistry, reported the effect of a substance called polyphenol oxidase (PPO) present in certain fruits and vegetables, which, when consumed with polyphenol-rich foods, destroy the polyphenols and rob the smoothie of most of it's nutritional attributes.

PPO's are found in abundance in banana, beet greens and apples.
Research into reducing to the PPO content of bananas found that sulfites worked quite well, but have been forbidden to be added to food since 1997. Onion and heat (200 degrees F) cut the PPO content by about 50%. Pineapple similarly reduced PPO's after marinating the banana in pineapple juice for three days at 60 degrees F.
Freshly squeezed lemon juice somewhat reduced PPO's 25-35% when added to the banana.
The consensus opinion was that the best alternative to bananas was to substitute mangos for the bananas in smoothies.

Bananas consumed within an hour of consuming polyphenol fruits or vegetables will still actively degrade the polyphenols and should be avoided until later to ensure gastric emptying of the polyphenol foods.

moroccan quinoa

TABLE 4 Food sources rich in flavan-3-ols

Food[1]	Amount	Flavan-3-ol content,[2] mg
Tea, green, brewed (92303010)	8 ounces (240 g)[3]	318.74
Tea, black, brewed (92302000)	8 ounces (240 g)[3]	277.32
Blackberries, raw (63201010)	1 cup (150 g)	63.76
Craisins (62109100)	½ cup (88 g)	33.78
Dark chocolate, 70–85% cacao solids (91705030)	3 squares (28 g)	19.49
Red wine (93401010)	5 ounces (150 g)	16.62
Apple (63101000)	1 small (165 g)	15.33
Cocoa powder (11830150)	1 tablespoon (5 g)	13.06
Blueberries, raw (63203010)	1 cup (150 g)	10.04
Raspberries, raw (63219000)	1 cup (150 g)	8.74
Strawberries, raw (63223020)	1 cup (150 g)	6.90
Grapes, red or green, raw (63123000)	1 cup (150 g)	5.82

[1] Code in the Food Nutrition Database for Dietary Studies (FNDDS).
[2] Flavan-3-ol content using the What's in the Foods You Eat Search Tool (63) and the USDA Database for the Flavonoid Content of Selected Foods, Release 3.3 (64).
[3] Amount in grams specific to tea leaves by dry weight.

Table 4 Polyphenol oxidase (PPO) activity and (–)-epicatechin content of selected fruits and vegetables with relevance for smoothie preparation. PPO activity expressed as mean ± SEM (n = 3). Epicatechin content was obtained from the USDA database for the flavonoid content of selected foods, release 3.2 (2015) and data are expressed as means values (minimum and maximum)[a]

Products	PPO activity (KU/100 g of edible portion)
Banana	3258 ± 71
Beet greens	1594 ± 24
Apple (red delicious)	570 ± 27
Pear	147 ± 4
Beets	94 ± 5
Peach	41 ± 2
Avocado	24 ± 5
Strawberry	18 ± 1
Wheatgrass	15 ± 1
Blueberry, highbush	12 ± 1
Cucumber	10 ± 1
Parsley	6 ± 1
Mango	6 ± 1
Cocoa powder, unsweetened	b.l.d.
Orange	b.l.d.
Pineapple	b.l.d.
Kale	b.l.d.
Spirulina (powder)	b.l.d.

[a] Below level of detection, b.l.d;

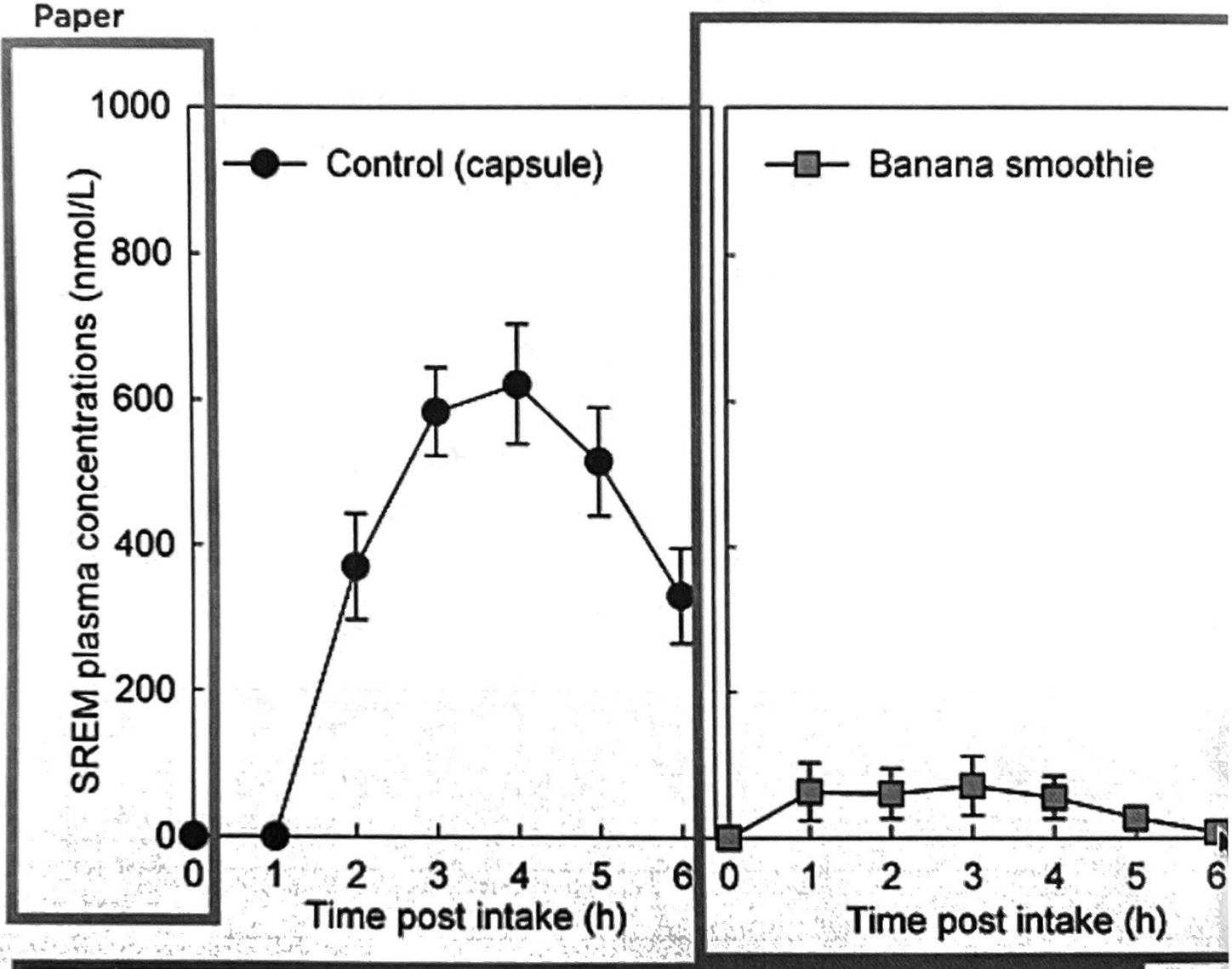

Fig. 1 Concentration of structurally related (–)-epicatechin metabolites (SREMs) in plasma after th and flavan-3-ols mixed in different fruit smoothies (n = 6). Data are expressed as means ± SEM.

Table 3 Pharmacokinetic parameters determined for the sum of structurally related (–)-epicatec capsule format and mixed in fruit smoothies. Data presented as mean values ± SEM and analyze (test material) as fixed effect and subject and sequence as random effects. P-Values correspon (control)[a]

	C_{max}	T_{max}	A

e to Banana Smoothies for Polyphenol Absorption

Antioxidants (Ba

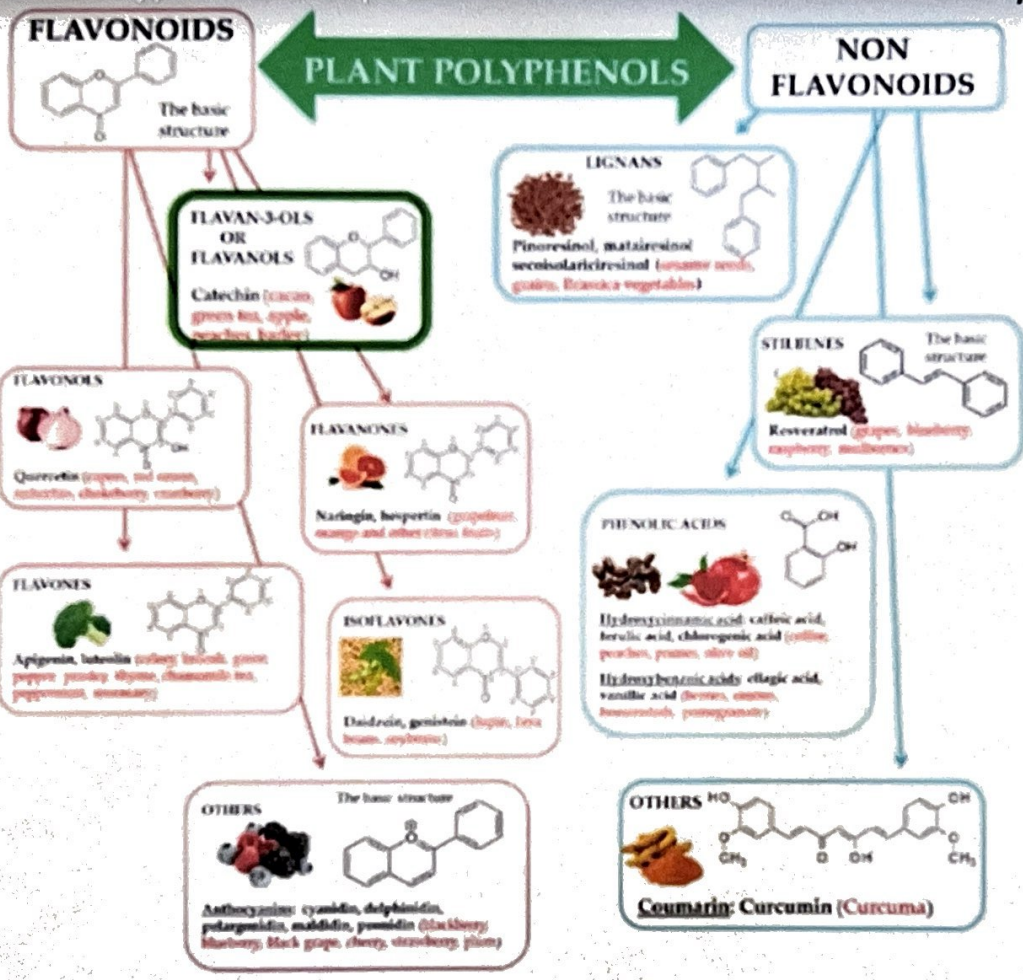

Figure 1. Polyphenols, subclasses, basic chemical structures, and representative polypher sources (in red).

Downside to Banana Smoothies for
phenol Absorption

Food & Function

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Impact of polyphenol oxidase on the bioavailability of flavan-3-ols in fruit smoothies: a controlled, single blinded, cross-over study†

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Flavan-3-ols are bioactive compounds found in a variety of fruits and vegetables (F&V) that have been linked to positive health benefits. Increasing habitual flavan-3-ol intake is challenged by the generally low consumption of F&V. While smoothies are a commonly endorsed, consumer-accepted means to increase the daily intake of these important foods, fruits used for smoothie preparation can have a high polyphenol oxidase (PPO) activity and thus potentially affect the content and bioavailability of flavan-3-ols. To assess whether or not consuming freshly prepared smoothies made with different PPO-containing fruit impacts the bioavailability of the flavan-3-ols, a controlled, single blinded and cross-over study was conducted in healthy men (n = 8) who consumed a flavan-3-ol-containing banana-based smoothie (high-PPO drink), a flavan-3-ol-containing mixed berry smoothie (low-PPO drink) and flavan-3-ols in a capsule format (control). The peak plasma concentration (C_{max}) of flavan-3-ol metabolites after capsule intake was 680 ± 78 nmol L^{-1}, which was similar to the levels detected after the intake of the low PPO drink. In contrast, the intake of the high PPO drink resulted in a C_{max} of 96 ± 47 nmol L^{-1}, 84% lower than that obtained after capsule intake. In a subsequent study (n = 11), flavan-3-ols were co-ingested with a high-PPO banana drink but contact prior to intake was prevented. In this context, plasma flavan-3-ol levels were still reduced, suggesting an effect possibly related to post-ingestion PPO activity degrading flavan-3-ols in the stomach. There was a substantial range in the PPO activity detected in 18 different fruits, vegetables and plant-derived dietary products. In conclusion, bioavailability of flavan-3-ols, and most likely other dietary polyphenol bioactives, can be reduced substantially by the co-ingestion of high PPO-containing products, the implications of which are of importance for dietary advice and food preparation both at home and in industrial settings.

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1. Introduction

Flavan-3-ols, including the monomers (−)-epicatechin and (+)-catechin, and their related oligomeric derivatives, the procyanidins, are a group of plant-derived, dietary bioactives within the wider group of polyphenols. A growing body of evidence supports the notion that increasing habitual flavan-3-ol intake results in improvements in health, notably for cardiovascular health and cognitive function,[1–3] with the Academy of Nutrition and Dietetics recently issuing a recommendation of a 400–600 mg daily consumption of flavan-3-ols for cardiometabolic protection.[3] Dietary sources of flavan-3-ols include teas, cocoa-based products and a variety of fruits including apple, pear, berries, peaches and grapes.[4–6] In this context, eating more flavan-3-ol-containing fruits would represent a valid means to increase intake while observing current dietary guidelines.[7] However, the overall consumption of fruit and vegetables is below recommended levels despite a continuing effort to promote their intake.[7,8] Smoothies are often promoted by various nutrition and health-focused organizations[7,9,10] and are popular among consumers as a convenient approach to consuming the recommended daily servings of fruit and vegetables and their derived nutrients.[9,11,12]

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† Supplementary supplementary information (ESI) available. See DOI: https://doi.org/10.1039/d3fo01599h

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MUSHROOMS

- Contains ertgothionine
- Considered to be "The Longevity Vitamin" not considered essential for life but required for long-term health.
- The serum compound among hundreds followed found to be associated with the lowest rate of disease and death.
- Functions as a very potent intramitochondrial antioxidant.
- Found only in mushrooms and tempeh (fungi-fermented soybean cake)
- -Porcini mushrooms have the most ergothionine
  - 3X more than shiitake and oyster mushrooms
    -9X more than button Champignons de Paris, crimini, & portobello mushrooms
- May explain why mushroom consumption is associated with a lower risk of dying prematurely from all causes put together.
- Ergothionine levels in the brain decline after age 60 and the reduction is tied to both frailty and cognitive decline, apparently due to a drop in ergothionine transporter at the blood-brain barrier despite stable mushroom consumption
- So, this augers for making mushroom consumption all the more important as one ages.
-

COOKING

- All Agaricus mushrooms (white, shiitake, cremini, portobello should be cooked before eating because of a heat-unstable toxin called agaratine, which is a potential carcinogen. Microwave for 1 minute is probably best option. 65% reduction.
- Risk is thought to be at most 1 new cancer in 10,000 with daily consumption.
- Shiitake mushrooms contain a toxin called lentinin which, in 1 out of every 50 people, causes a severe dermatitis called shiitake mushroom flagellate dermatitis, for which there is no treatment but goes away in a few weeks.
- Chanterelle mushrooms should always be cooked and not eaten raw (hydramine toxicity - GI symptoms)
- Maitake and enoki are probably best cooked, based on mushroom industry recommendations.

RAW MUSHROOMS

- oyster mushrooms are safe to eat raw.
- Lion's mane oysters are also safe to consume without cooking.

MEDICINAL MUSHROOMS (FYI only)

- Seishi Japanese mushrooms (called mushroom of immortality) or lingzhi in China, a bitter woody species prepared as a tea, is apparently able to double the lifespan of mice and earthworms. No studies of controlled use in humans.
- Psilocybin (Magic Mushroom) mushrooms consist of over 500 species of hallucinogenic mushrooms, currently under investigation for treatment of severe depression and PTSD and several other psychological conditions. None FDA approved at this time.

grilled mushroom - ↑

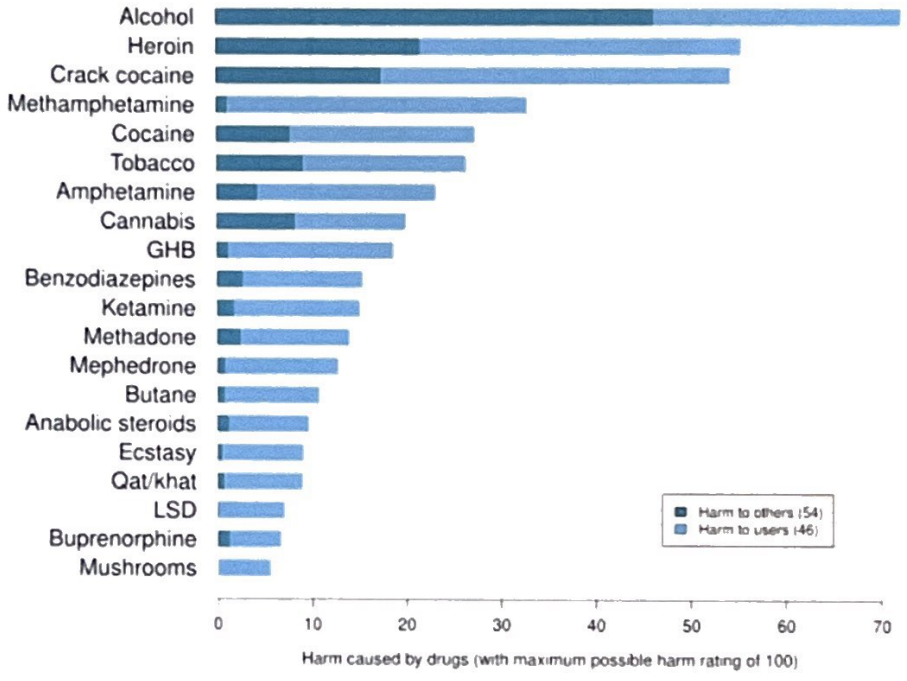

Table from the 2010 DrugScience study ranking various drugs (legal and illegal) based on statements by drug-harm experts. This study rated "mushroom" the least harmful drug overall and for users, and the only drug that did not get any scores for harm on others.[39]

Figure 1. Linear wheallike lesions over the trunk in a flagellate pattern.

Figure 2. More extensive flagellate eruption over the back.

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Table 5. Influence of storage and household processing on the agaritine content of Agaricus *mushrooms.*

Process	Conditions (°C)	Time	Amount of agaritine remaining in the mushroom (%)*
Storage:			
Refrigerator	5	6 days	75
Refrigerator	5	14 days	50
Drying	25	24 hours	82
Drying	50	7.5 hours	76
Drying	40–60	7 hours	81
Freezing without thawing	−18	7 days	75
Freezing with thawing	−18	7 days	52
Freezing without thawing	−18	30 days	41
Freezing with thawing	−18	30 days	23
Household processing:			
Cooking	boiling water	5 min	44
Cooking	boiling water	60 min	12
Dry baking	200	10 min	77
Deep frying	150	10 min	50
Deep frying	170	5 min	52
Frying	150	10 min	43
Microwave heating	1000 W, 2450 MHz**	1 min	35

* 100% = agaritine content in fresh mushrooms before processing; ** 20 g sliced mushrooms.

Is It Safe to Eat Raw Mushrooms?

Michael Greger M.D. FACLM · July 14, 2021 · Volume 54

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BROCCOLI & OTHER CRUCIFEROUS VEGETABLES

These vegetables provide powerful anti-inflammatory, anti-cancer, neuroprotective, anti-oxidant, benefits through their ability to create sulforaphane when the raw plant is consumed. When the plant is damaged or eaten, an enzyme called myrosinate is activated, which in turn converts the precursor, glucoraphanin, into sulforaphane. However, this benefit to humans only occurs when the raw vegetable is consumed.

If the vegetable is cooked, the myrosinate enzyme is destroyed and the glucoraphanin is never converted to sulforafphane.

Therefore, in order to benefit from the full health potential of the vegetable, it is necessary to perform one of three possible options:

1) Eat the vegetable raw. The act of chewing releases the myrosinate.
2) Add myrosinate to the cooked vegetable before consuming it. This may be accomplished by sprinkling a small amount of ground mustard seed onto the vegetable. Alternatively, consuming the cooked vegetable with another myrosinate-rich vegetable like arugula, water kress, raw kale or raw cabbage is another option, although the simplest and best results are probably to go with the mustard.
3) Simply chop the cruciferous vegetable (kale, radish, Swiss chard, broccoli, cabbage) and leave it to stand for a minimum of 40 minutes and then cook it. This is unquestionably the best and also the easiest option.

freezing doubles the glucoraphan content – cell wall disruption
steaming is best cooking modality

—

Frying verbotin is an abomination
- broccoli + kale – 2x lectin loses steamed

lectins – eye protection
broccoli 1676 lect : boiling ↑ antiox ; microwave detrimental
cauliflower to
spinach – mince. Heat ↓ lectin to ↓ BCAA
yams/ sw pot – sens. to hi heat.

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RANDOM COOKING SUGGESTIONS

- 1849 Geriatric Medicine textbook: "Frying is an abomination"
  Carbohydrates exposed to high heat generate acrylamide which are associated with early death due to suppression of autophagy.

- When protein and sugar are exposed to high heat, a browning effect is produced called the Maillard Reaction, so-named in 1912 for discovery by a French chemist and chef. If can even happen in the body at normal temperatures, but is slow. The outcome is the production of AGE (advanced glycation end-products) which are a major contributor to the aging process. HbA1c is a measure of glycation of red blood cells. AGE's cause proteins to cross-link resulting is stiffening of collagen in vertebral discs and artery walls (hypertension) and heart muscle (congestive heart failure). Reaction is irreversible. Turnover of collagen is 95 years, and 15 years in skin.
- This is not the same thing as caramelization, which involves only the bonding between carbohydrates and does not lead to AGE production.
- However, when carbs are exposed to very high heat (deep-frying) acrylamide is formed, which suppresses cellular autophagy (cancer, cell mutations, dysfunctional protein production, misfolded protein potentially causing Parkinson's Disease, ALS, myeloma)

-In general Microwave cooking and steaming vegetables is best for preservation of nutrients. Boiling reduces water-soluble vitamins like Vitamin C and folate but not fat-soluble ones like A, D, E, and K. Broccoli looses leutein if microwaved - ø same for spinach. Both should be steamed / pressure cooked.
-Cruciferous vegetables benefit from boiling/steaming since their cell-walls are disturbed releasing their nutrients such as glucoraphanin. Freezing also works for broccoli. ~~But not broccoli~~.
-Root vegetables can be either microwaved or baked the oven
Sweet potatoes are considered a super-food since they contain a protease inhibitor called sporamin/ They are one of the healthiest and cheapest foods available. NASA uses them for space missions, and have been shown to reduce cancer growth and metastases in human trials targeting leukemia, oral cancers, colon cancer and breast cancer.

sheldon cooper (jim parsons) "fun with flags" → Fun w/ Factoids

ADEQUATE FOOD IN

↓

cellular ↓ AMPK enzyme

↓

mitochondria produce energy and stimulate IGF-1 and mTOR activation

↓

more cells / larger cells

some good → growth

some botched → misfolded proteins, DNA errors, zombie (dysfunctional) cells
- ↳ Parkinson's Dis
- ↳ cancer
- ↳ inflammation
- ↳ toxic by products
- ↳ immune supression ±

IGF 1993 insulin-like GF
Cynthia Kenyon

- By adulthood, new growth should slow down and maintain an equilibrium between new and retired cells
- But, by maintaing caloric XS of need + XS protein

↓

AMPK supressed + IGF-1 / mTOR ↑

INSUFFICIENT FOOD INTAKE

↓

↑ AMPK

↓ IGF-1
↓ mTOR

↑ AUTOPHAGY
↳ ↓ misfolded protein; defective DNA
↓ inflammation, etc

- Calorie reduction treatment is effective but problematic — sometimes lethal -
- protein ↓ works like caloric reduction (0.8 g/kg/day)
  - certain proteins are 1° responsible for ~~Ex~~ suppression of IGF-1 and mTOR
- amino acid XS intake is primary inducer of IGF-1 + TOR
  - Methionine
    - ↑ lifespan ~40% = avg age human 110yrs
  - BCAA (leucine, isoleucine, valine)
    ↳ v. potent mTOR activator (conc in dairy) - exc yogurt?