New Challenges in Food Science and Technology

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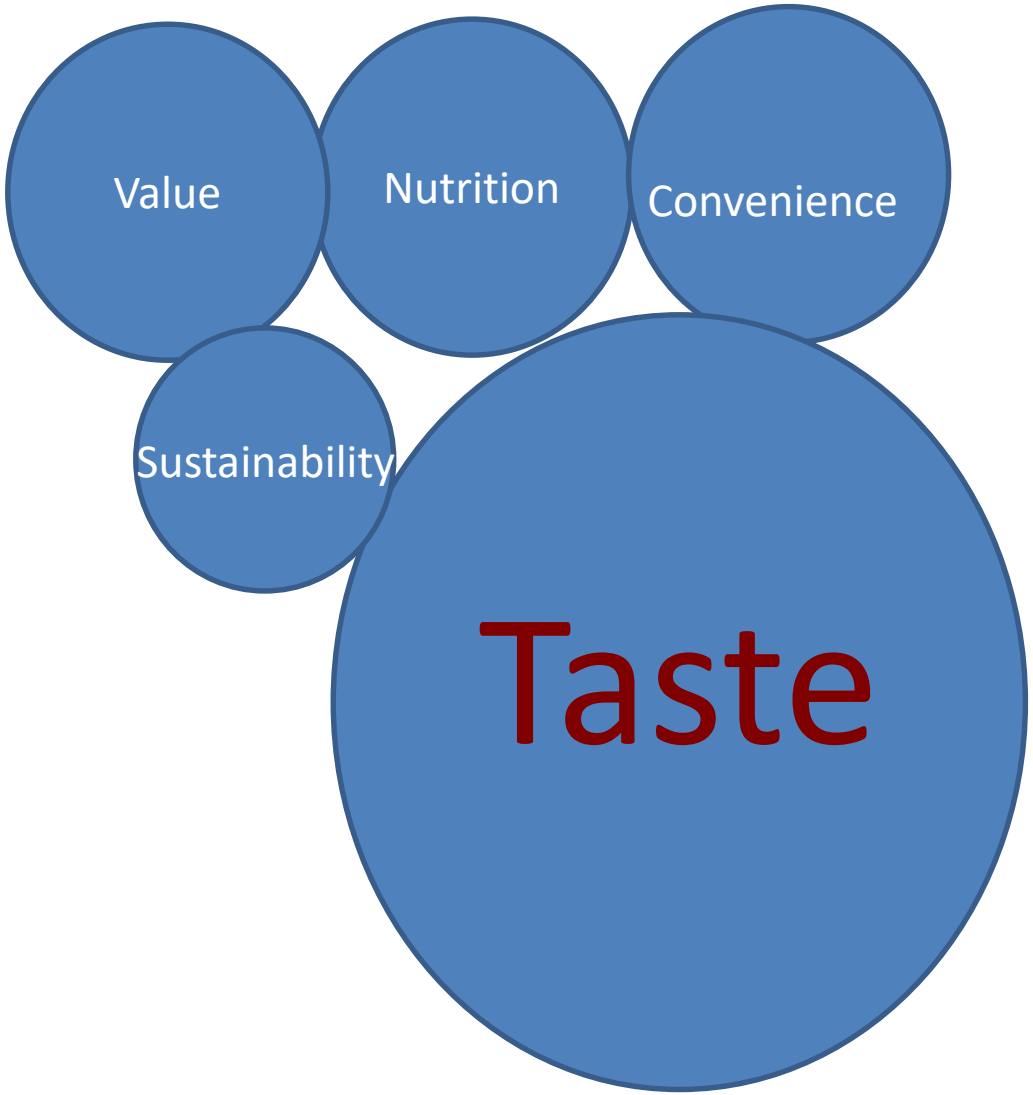
Drivers of Food Purchases



Taste = Successful Dietary Intervention

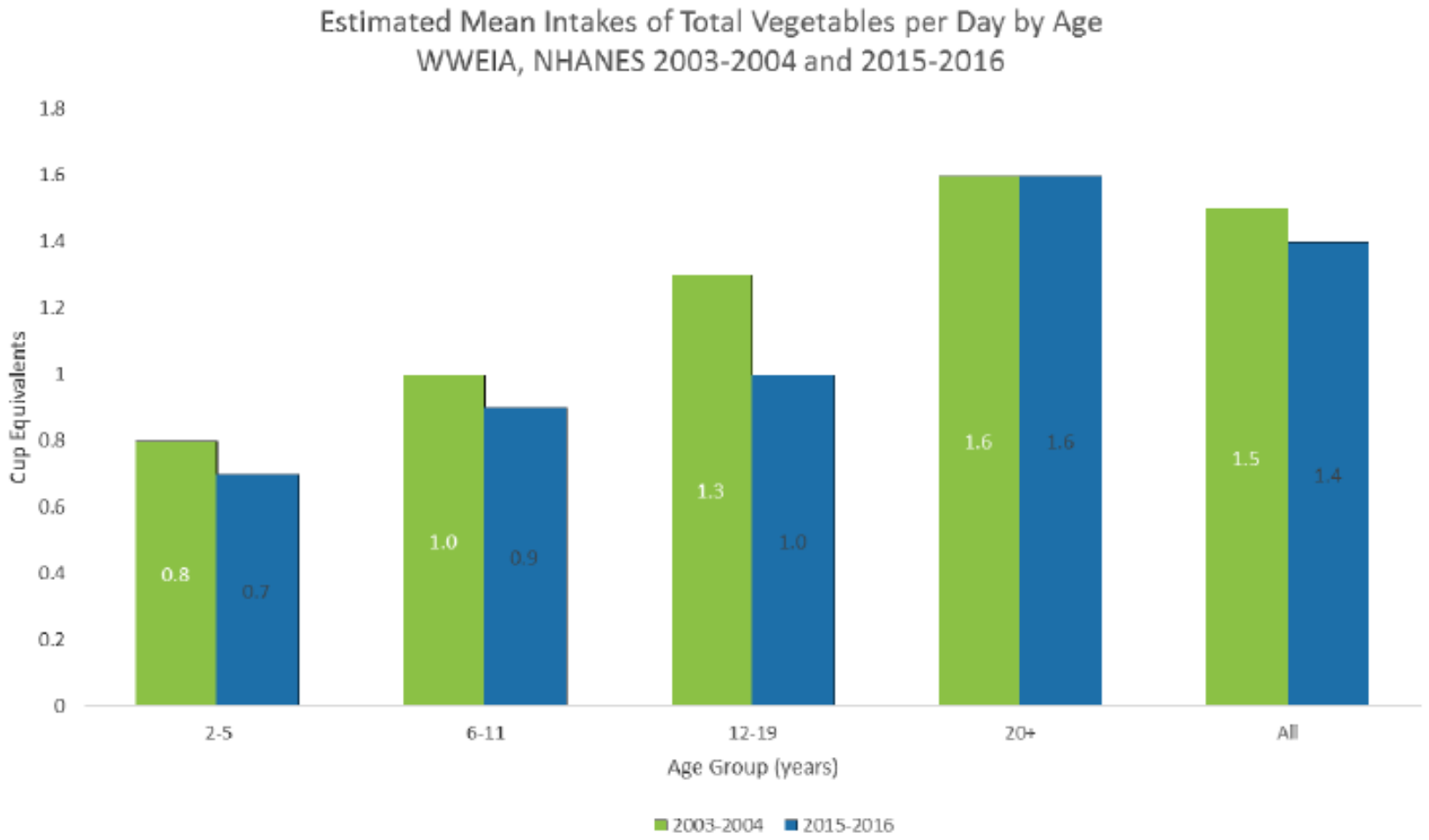
- Obvious fact for successful food
  - If your food doesn't taste good, people won't buy it regardless of its health benefits.
  - If people don't buy the food, there is no chance to improve health

http://www.veganise.me/eat-more-kale

Eat More Fruits and Veggies

- Can have:
  - Low caloric density
  - High nutrient density
  - Better links to health outcomes
    - Obesity, Heart Disease, Diabetes and Cancer
  - Bioactive food components
  - More sustainable
- Five a Day Program (launched early 2000's)

No Significant Change in Vegetable Intakes Between 2003-2004 and 2015-2016



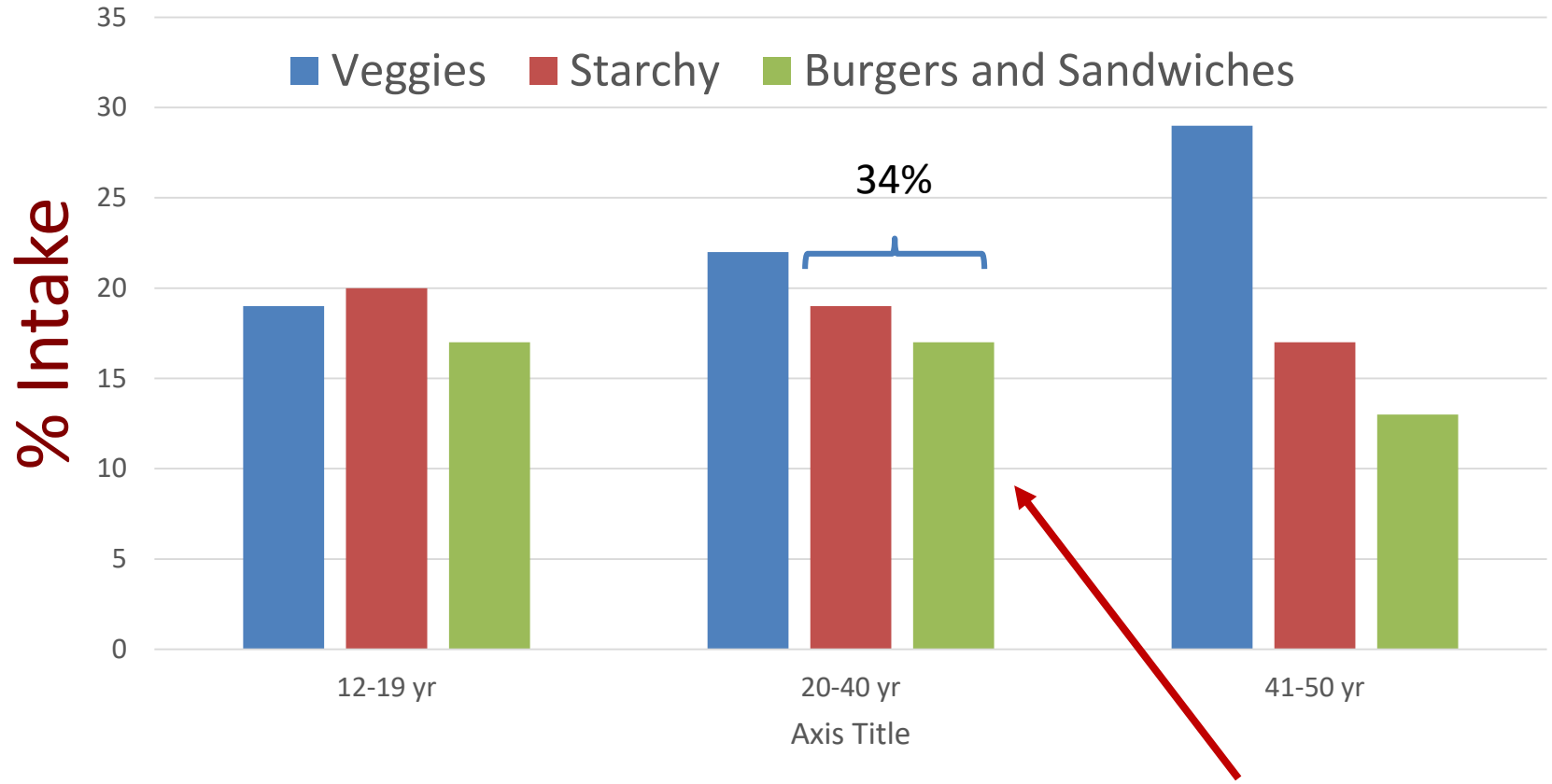
Dietary Guidelines for Americans

DATA SOURCE: What We Eat in America, NHANES 2003-2004 and 2015-2016, day 1, individuals 2+ years
Bowman SA, et al. Food Surveys Research Group. Dietary Data Brief No. 20, November 2018.

No increase at any age group

Why?

What Vegetables are being Eaten



Wambogo, E, Reedy, J, Shams-White, M. Sources of Food Group Intake, NHANES 2013-2016. HHS, NCI, 2019.

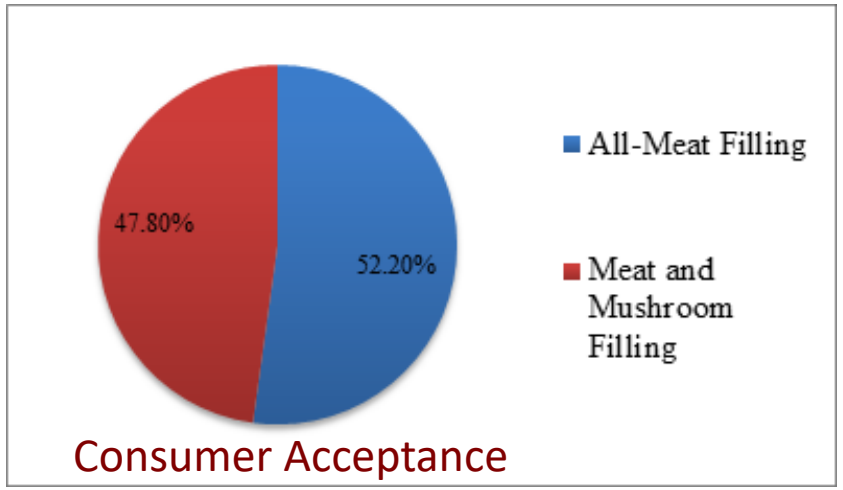
How important is cost vs taste

Most purchased vegetables	Value- Cost/serving
1. Potato	$0.06/serving
2. Tomato	$0.21/serving
3. Onion	$0.12/serving
4. Corn	$0.21/serving
5. Green beans	$0.13/serving
18 Asparagus	$0.66/serving
30. Kale	$0.19/serving

Suggests that value and taste are large drivers of vegetable choices

Vegetable Blends - Stealth Nutrition

- Mushroom: Beef Taco filling
  - 45% button mushrooms



  - Umami favor decreases need for salt
  - Moisture binding decreases fat content

Amanda Kinchla

Robert Bankert, UMass Dining

Plant Based Animal Food Substitutes

Suggested Benefits

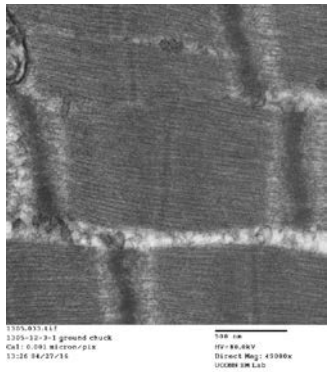
- More Sustainable
- Lower Energy Density
- High in Fiber
- Bioactive Compounds
- Ethical and Moral Issues
- Healthier

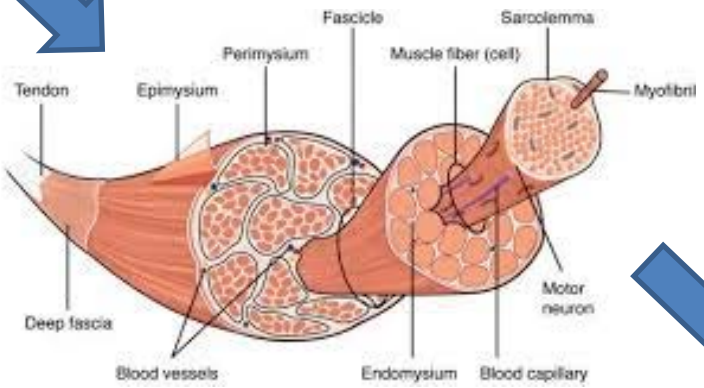
Plant-Based Milks

https://www.youtube.com/watch?v=JJCTIPWPNtw

- Grind seeds→ blend with hot or cold water→ filter out pomace
- No cholesterol or lactose, some fiber
- Fortified with calcium at a similar level as milk
- Lower calories
  - Cow's milk > Unsweetened Soy milk (less fat and sugar) > Unsweetened Almond Milk (less fat, sugar and protein)
- Sustainability- Species Dependent

Plant Based Meat Substitutes



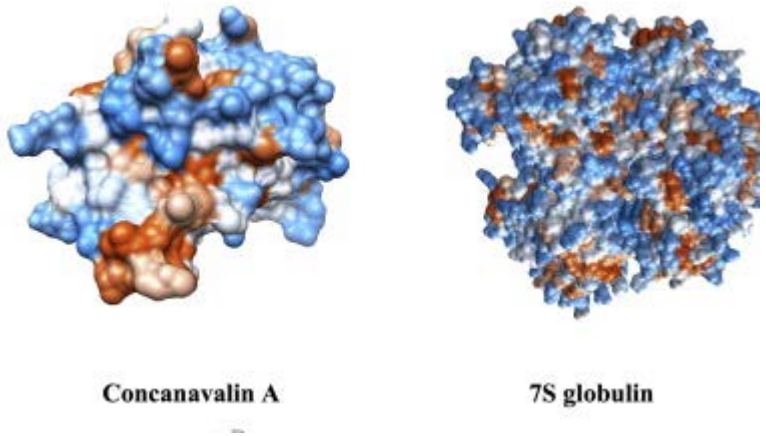


Meat Striation

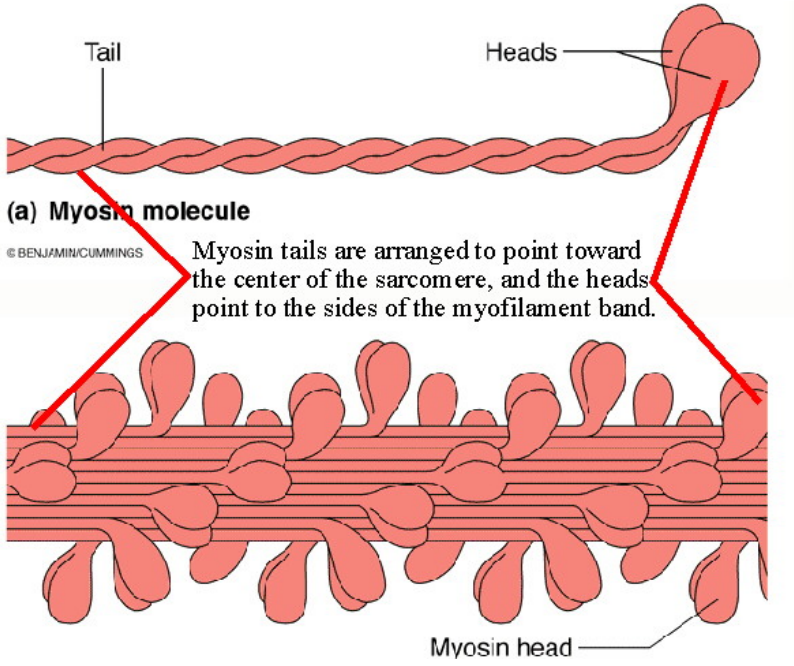
Most plant proteins function as a reservoir of amino acids for the germinating seed, not as structural proteins.

Plant-based Meat Substitutes

- The globular proteins in soy and pea do not behave like muscle proteins



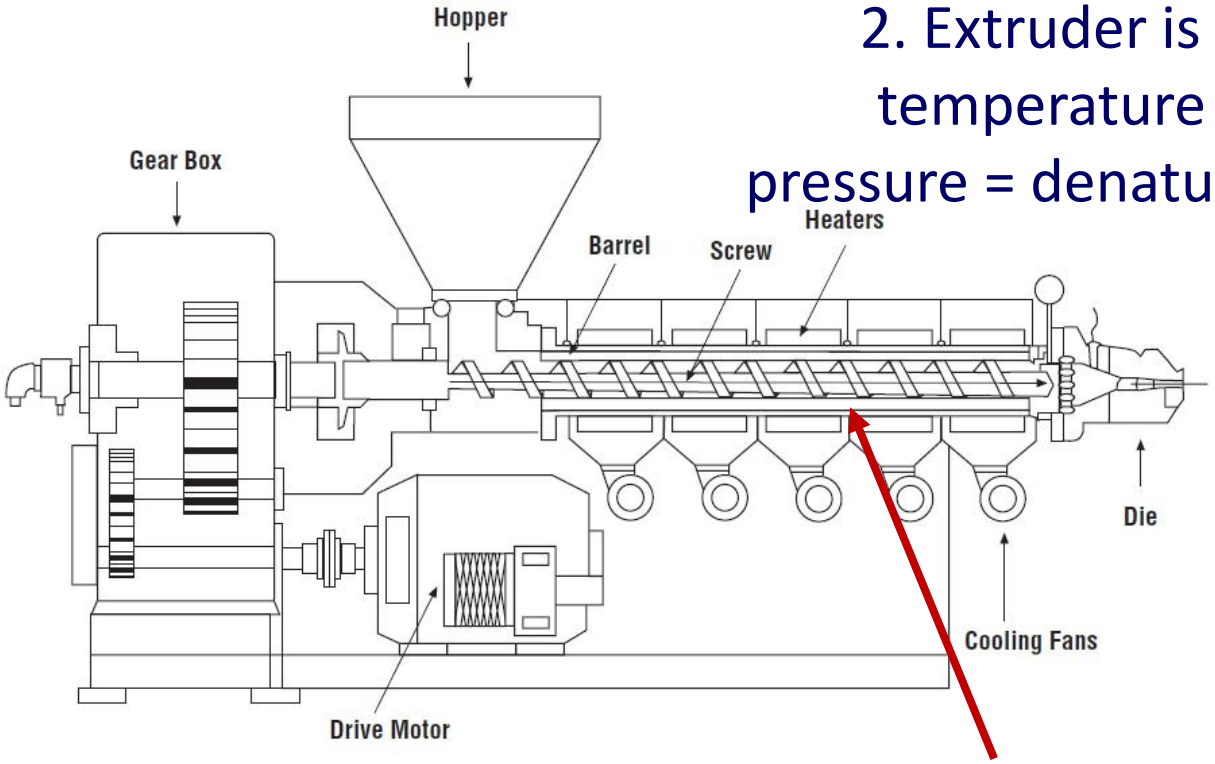
Soy Proteins



Myosin

Production of plant based meat substitutes

1. Protein isolate is mixed water in passed through extruder



2. Extruder is at high temperature under pressure = denatures proteins

- Product exits die
- Water flash evaporates to make fibrous structure
- Fibers are cut

3. Screw aligns denatured protein to make fibrous texture

Extruded Vegetable Protein Taste Like Crap

Flavor/flavor enhancers

Protein = structure

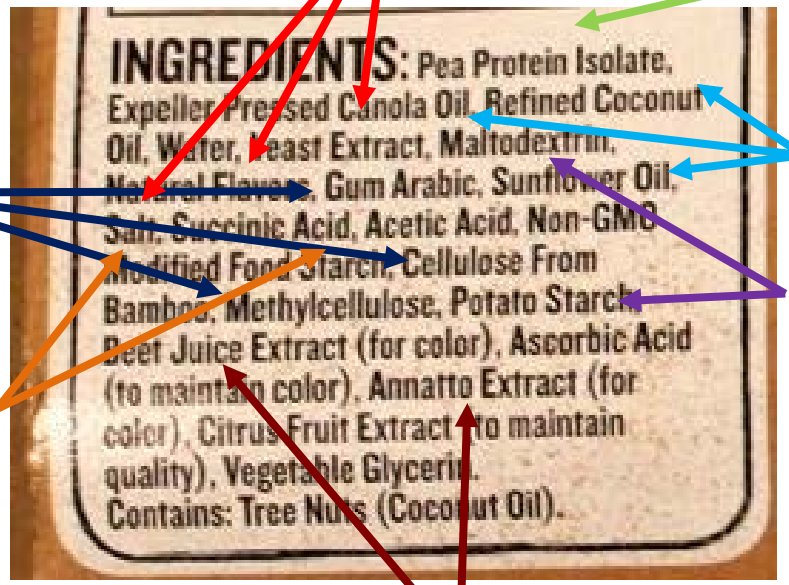
Gums/Cellulose
= structure/binding

Fat = moistness/lubrication

Starches= moisture binding

Acids = protein modification

Color



Is meatless fast food really healthier for you?

MarketWatch compared nutritional value and the cost of meat and meatless menu items at popular fast food chains

BURGER KING	IMPOSSIBLE WHOPPER	WHOPPER
Price	$5.19*	$4.19
Calories	630	660
Fat	34 grams	40 grams
Saturated fat	11 grams	12 grams
Sodium	1,240 milligrams	980 milligrams
Protein	25 grams	28 grams
MCDONALD'S	**MCVEGAN**	**BIG MAC**
Price	$5.80	$3.99
Calories	438	540
Fat	21 grams	28 grams
Saturated fat	1.9 grams	1 gram
Sodium	n/a	940 milligrams
Protein	7.5 grams	25 grams
WHITE CASTLE	**IMPOSSIBLE SLIDER**	**ORIGINAL SLIDER**
Price	$1.99	$0.72
Calories	210	140
Fat	11 grams	7 grams
Saturated fat	4 grams	2.5 grams
Sodium	550 milligrams	380 milligrams
Protein	11 grams	6 grams
DEL TACO	**BEYOND TACO**	**REGULAR DEL TACO**
Price	$2.49	$1.49
Calories	300	300
Fat	19 grams	18 grams
Saturated fat	10 grams	12 grams
Sodium	510 milligrams	410 milligrams
Protein	19 grams	18 grams

*Price varies per location

Source: MarketWatch reporting

Plant based burgers are nutritionally similar to meats

Better Sustainability

Taste?

“some of these brands (meat substitute) that are extremely popular now that are taking the world by storm, if you look at the ingredients, they are super, highly processed foods.”

John Mackey, CEO, Whole Foods

Ultra-Processed Foods

- Term was coined by Carlos Monteiro and is associated with the Nova Food Classification system which defines 4 food groups
  1. Unprocessed or minimally processed foods
  2. Processed culinary ingredients
     - e.g. Oils, butter, sugar and salt used to make foods in home and restaurant
  3. Processed Foods
     - e.g. Certain canned foods, cheeses, “freshly” made bread
  4. Ultraprocessed Foods
     - Soft drinks, sweet or savory packaged snacks, reconstituted meat product, pre-prepared frozen dishes, foods with additives

Ultra-Processed Foods

- Further definitions of ultraprocessed foods include:
  - Modified foods made from formulations of substances derived from foods and additives (not “whole” foods)
  - Foods made to be:
    - Energy dense
    - Poor sources of protein, dietary fiber and micronutrients
    - Convenient • Hyperpalatable, attractive and quasi-addictive
    - Low cost • Falsely seen as healthy
    - Highly marketed to encourage over consumption
  - Related to “Big Food”

Monteiro et al., 2018, Public Health Nutrition, v 21, pp 5-17

Food Processing Unit Operations

- Carbonated soft drinks; sweet or savory packaged snacks; chocolate, candies (confectionery); ice cream; mass-produced packaged breads; margarines; breakfast ‘cereals’; pre-prepared meals and pizza; poultry and fish ‘nuggets’ and ‘sticks’, sausages, burgers, hot dogs and other reconstituted meat products; ‘instant’ soups, noodles

Misleading - not related to processing as the foods in red are produced by very different unit operations

More related to formulation issues – Ultraformulated?

Evidence of Health Impact of Ultraprocessed Foods

- Most evidence is from epidemiological studies
- Clinical

  "Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake, Hall et al., 2019, Cell Metabolism, vol. 30, pp 67-77"

  - 20 inpatient adults received ultra-processed and unprocessed diets for 14 days each at the NIH Clinical Center
  - Diets were matched for calories, sugar, fat, fiber, and macronutrients

Clinical Results

- *Ad libitum* intake was ~500 kcal/day more in the ultra-processed versus unprocessed diet
- Body weight changes were highly correlated with diet differences in energy intake
- Unclear why but has been suggested to be due to food volume, preference and/or satiety

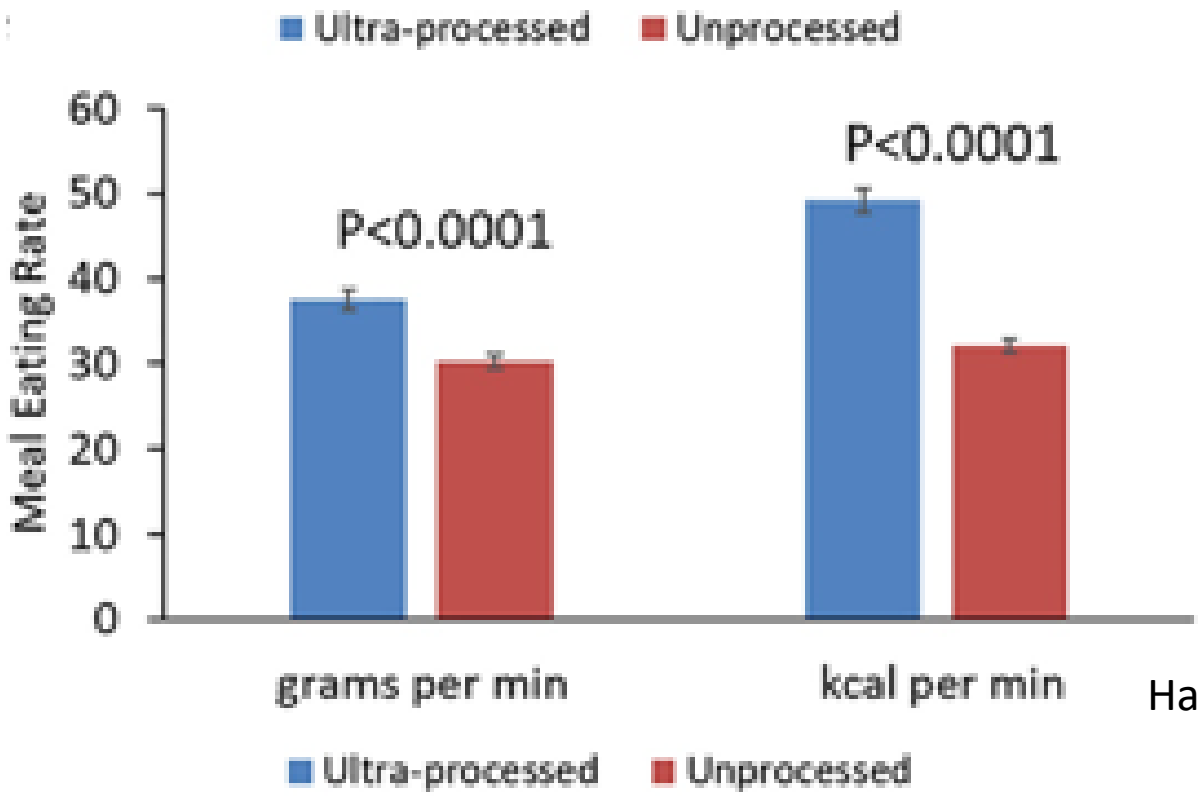
Examples of breakfast meals

Ultraprocessed

Unprocessed

Hall et al., 2019

Food/Energy Consumption Rates in Clinical Trial



Hall et al., 2019

Could higher energy density foods allow for faster consumption before satiety triggers engage?

Implications of an unprocessed diet

- Higher food costs ($106/week for ultraprocessed vs $151/week for unprocessed in clinical trial)
- Preparation needs more time and skill
  - Difficult in current social setting with commuting times and family responsibilities
- Increased food waste
  - Removal of processing and food preservatives will increase food spoilage
- Decreased sustainability
  - Food preparation at an industrial scale is more sustainable than home cooking
    - Low energy utilization (3.8 cents/food dollar, USDA, Economic Research Service)
    - Increased yields/decreased food waste
    - By-product utilization
- Higher Food Safety Risk

Challenges of Non-Processed Foods in a Modern Diet

- Approximately 50% of men and 66% of women cook (Tallie, 2018, Nutrition Journal)
  - 92% of women cooked in 1965
  - Total cooking time per day is approximately 20 and 50 minutes for men and women respectively
  - % individuals that cook and time cooking decrease with decreasing education level
- Percent disposable household income spent on food (USDA, ARS, 2018)
  - Lowest 20% of income = 35.4% = $79/week
  - Middle 20% of income = 13% = $144/week
  - Highest 20% of income = 8.2% = $257/week

Lower income diets are lower in protein and higher in added sugar and fat and higher rates of obesity

Challenge

- To have a healthy diet you need a food supply
- Processed foods are an important part the modern food supply because industrial food production can provide convenient, affordable, nourishing, sustainable and great tasting foods that are accessible to all
- The is not doubt that improvements in the food supply are needed
  - What are the targets and incentives that can make the food supply healthier?
    - There are many of the food industry responding to nutritional recommendations
  - What is a simple nutrition message that can drive these changes?
  - How do we make sure that the healthy food supply is accessible to all?

Unintended Consequences of Dietary Fat Recommendations

Before 1920's most fats were animal derived

- Decrease Dietary Cholesterol (late 50s, early 60s)
  - Replace animal fats with tropical oils

- Decrease Dietary Saturated Fatty Acids (early 80s)
  - Replace tropical oils with hydrogenated fats

- Decrease *trans* Fatty Acids (late 90s, early 2000s)
  - High Oleic Vegetable Oils